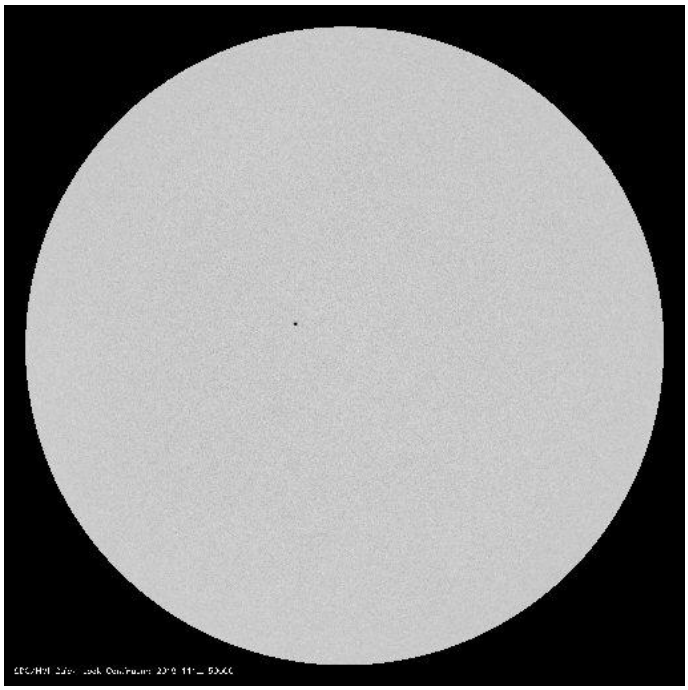
NEWBURY ASTRONOMICAL SOCIETY
MONTHLY MAGAZINE – DECEMBER 2019

MERCURY TRANSIT 11TH NOVEMBER 2019

As predicted on the afternoon of Monday 11th November there was a Transit of the planet Mercury. Transits occur when the inner planets (Mercury or Venus) pass directly between the Sun and Earth. Mercury appeared as a small dot on the edge of the Sun at about 12:40 GMT.



Mercury imaged by SOHO at 15:00 GMT

The Newbury Astronomical Society visited Francis Baily School in Thatcham, Berkshire, UK to provide an observation opportunity for the 400+ year 2 to year 6 children (5 to 11 years old). The society provided six telescopes specially equipped for observing the transit safely using a number of different techniques.

1. An image of the Sun was projected on to a small white screen attached to a telescope to give a similar view to the SOHO image shown above.
2. The transit was also videoed live using a special webcam developed for astro-imaging and attached to a telescope fitted with a Solar Filter. The magnified image was then displayed on the screen of a laptop.
3. The transit was also imaged using a DSLR camera attached to a telescope fitted with a Solar Filter and the images displayed on a laptop monitor.
4. Three other different types of telescope were fitted with special Solar Filters so the children could observe the transit directly as it was happening.

Transit began:	Monday 11th November 2019	12:35
Midpoint:	Monday 11th November 2019	15:19
School finished:	Monday 11th November 2019	15:30

Duration from the UK: ~3 hours

The very end of the transit was not visible from the UK as the Sun set over the western horizon at 16:15.

NASA's image of Mercury approaching the Sun

Transits of Mercury usually occur every 10 years then 3 years and then another 10 years and 3 years. The 10th year always occurs in May and the 3rd year transit is always in November. The last transit of Mercury was on the 9th May 2016 three years ago so this coming transit will be on Monday 11th November 2019. The next transit will be an odd one occurring on 13th November 2032 (13 years) then 7th November 2039 (7 years) It then reverts back to 7th May 2049 (10 years) and 8th November 2052 (3 years).

Equipment used to project an image of the Sun

The children were able to observe the transit live and as it happened using telescopes fitted with special solar filters. These filters are designed to greatly reduce the amount of light passing through the telescope to a safe level and into the eye of the observer.

NEWBURY ASTRONOMICAL SOCIETY MEETING

6th December OJ287 a Mysterious Binary Black Hole
Website: **www.newburyastro.org.uk**

NEXT NEWBURY BEGINNERS MEETING

18th December Heroic failures in Astrophotography
Website: **www.naasbeginners.co.uk**

MERCURY TRANSIT AT FRANCIS BAILY SCHOOL

Six members of the Newbury Astronomical Society arrived at the Francis Baily School in Thatcham at 11:15 on the morning of 11th November 2019. Six telescopes were set up for the children to observe the start of the transit at 12:35.

We were very lucky with the weather as the forecasts on the previous days had predicted cloud and rain. However the day was bright with partial cloud and some clear sky. The first sighting of Mercury as the transit began was during the children's lunch break so the telescopes were swamped with children excitedly queuing at the telescopes for their first look.

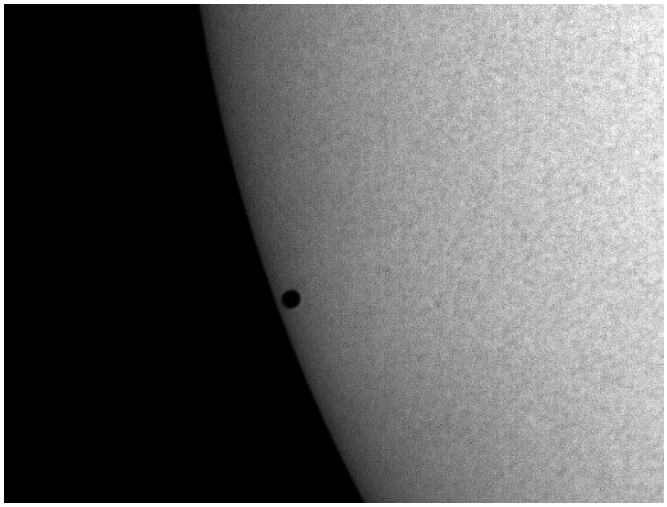
First glimpse of Mercury 12:39 – photo Mark Gray

Mark Gray took digital photographs of the transit using his Digital Single Lens Reflex (DSLR) camera to take pictures as Mercury moved in front of the Sun. His image above shows the silhouette of Mercury as it first appeared in front of the Sun at 12:39. The image below was taken at about 14:58.

Mercury in transit at 14:58 – photo Mark Gray

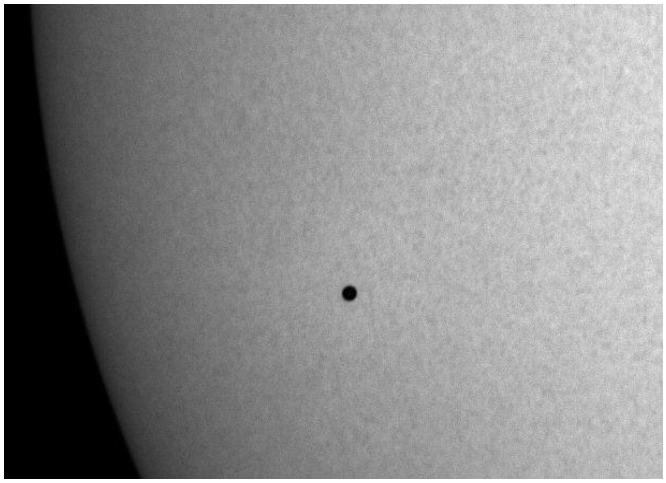
During the afternoon the children came out on to the playground in the classes for a short visit to the telescopes. However some of the viewing sessions took longer than expected while we waited for the clouds to pass. Consequently the queues at the telescopes became quite long due to the backing up but we managed.

The images below were obtained by creating a short video using a modified webcam type of camera. The separate frames of the video were then processed using a computer application. This application selects the best frames and aligns them to one selected frame. Once this process is complete the separate frames are combined (stacked) to create a single image.



Webcam image 12:40 – Image Chris Hooker

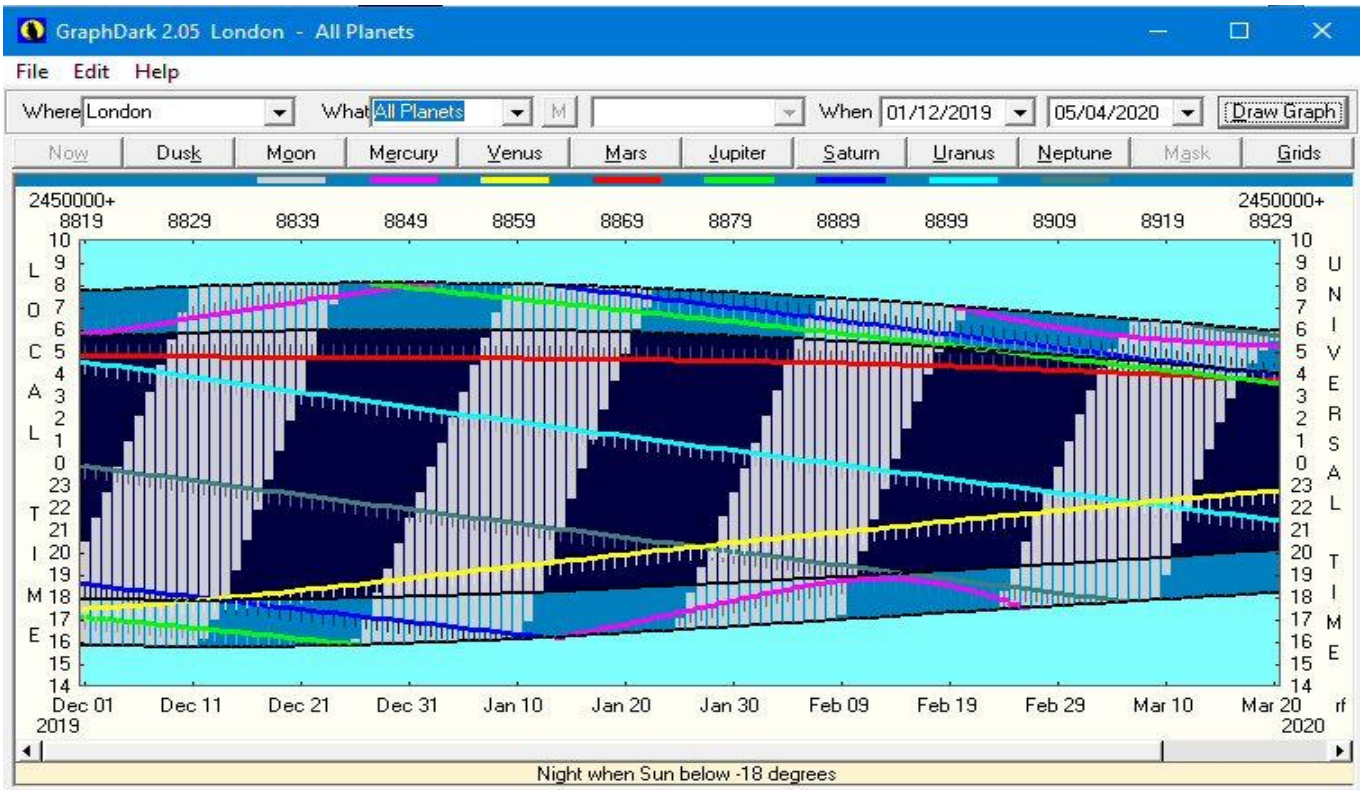
The single image contains all the data from the thousand or more individual frames that are effectively averaged out to produce one very clear image. This is a technique used by astronomers to produce very good images of the Planets, Moon and in this case the Sun using a special Solar Filter.



Webcam image 13:08 – Image Chris Hooker

We were very lucky to be able to see this transit as the weather forecast given a few days before the event were predicting cloud and rain for 11th November. The weather forecast on the previous day (Sunday) appeared to have improved with the forecast of cloud with possible occasional breaks. However we were blessed with clear sky for about half of the time.

INTRODUCING RICHARD FLEET'S GRAPHDARK

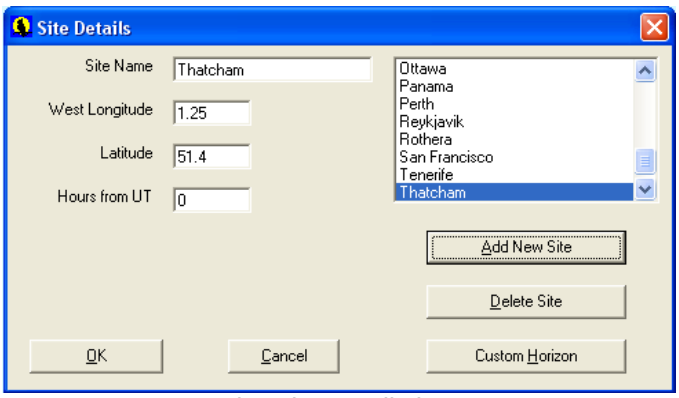


Graphdark is an astronomical application developed by Richard Fleet who is the current vice chairman of the Newbury Astronomical Society. The application can be downloaded free from the front page of this website (ignore trial period warning).

Graphdark displays graphically the location of the planets for observing and information about the viewing conditions for any specified period. The screen-shot above shows the opening screen when the application is first started. There are many functions included in Graphdark that make it an extremely useful tool for any astronomer. This article will be an introduction to some of the basic features of the application to enable the new user to get started. Once the basics are mastered the many other features can be explored and the full application used to explore the night sky and plan an observing session.

YOUR OBSERVING SITE

To use Graphdark you need to tell the application where you are going to observe from. For local sites around the Newbury area it will generally be good enough to select 'London' from the drop down box at the top left of the window by clicking on the down arrow. A selection of worldwide sites is preloaded into the drop down box. Your exact location or any other can be added to the location database by selecting 'Site Details' from 'Edit' in the menu bar at the top of the window. An input box will be displayed. Click on 'Add new site' and enter the name of your site. For example: 'Thatcham' and click on 'ok'. The latitude and longitude boxes will be cleared. Enter your position in degrees and decimal parts of a degree for example West Longitude '1.25' and Latitude '51.4'. In the 'Hours from UT' box enter '0' (zero). Click on 'ok' to close the box. If the new site name is not displayed in the 'where' box, click to pull down the list and select it.



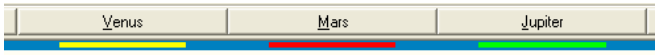
The Site Details box

SETTING THE DISPLAYED DATES

The dates and time span of the graph are shown along the bottom of the graph in Month and year format. The start and finish date can be changed by clicking on the small arrows on the two drop down boxes at the upper right corner of the screen. Clicking the arrow displays a drop down small calendar month window. The month can be change by clicking on the right / left arrows at the top of the box and the day of the month selected by clicking on the date. With the start and finish date selected a click on the box labelled 'Draw Graph' will display the graph for the time between the selected dates.

The graph will be redrawn with the new date span along the bottom of the graph in the conventional 'Dec 01' (Month / day) date display marking the beginning each week. Julian day numbers are the full 7 digit astronomical dates. For example December 31st 2019 will be displayed at the top of the graph as 2450000+8849 = 2458849.
Graphdark can be used to display a number of different graphical representations of the sky selected from the second box marked 'What' at the top of the window. The window shown above is the 'All Planets' display.

In this display the planets are represented by coloured trace lines drawn across the graph. The colour key is shown as the coloured boxes across the top of the graph with the name of each planet above it.



Part of the planet colour key

Each planet trace line has a series of bars either above or below the line.

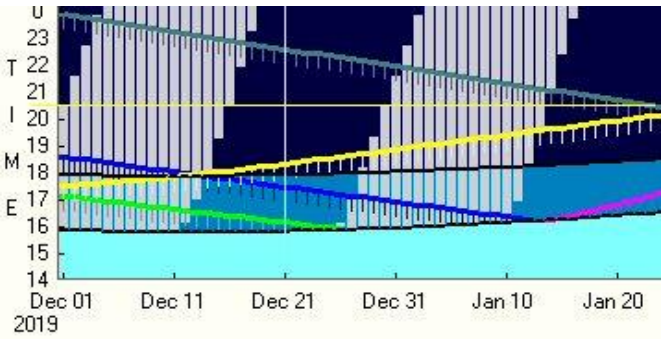
Part of the 'Venus trace' line

These bars on the trace line indicate when during the night the planet will be observable. Bars below the line indicate that the planet is in view from sunset up to the time determined by the line. Bars above the line indicate that the planet is observable from the time determined by the line until sunrise.

The time of the day or night at the observing site is shown on the left vertical axis with 12:00 (midday) at the bottom 24:00 / 0:00 (midnight) half way up and back to 12:00 (midday) at the top. The vertical axis on the right shows Universal Time (UT) which is in effect Greenwich Mean Time (GMT). In the UK UT and Local Time will be the same (+1 hour in summer). If New York was selected as the observing site then the local time at midnight will be shown as 24:00 / 0:0 but UT will be shown as 05:00 because New York time is 5 hours behind GMT (UT).

USING GRAPHDARK

It is now time to use the Graphdark chart for the first time. We must first select the date of the night that we wish to observe. We could select Dec 21st on the bottom date axis, this is indicated by the vertical yellow line but accuracy does not matter too much. It might be that observing is planned to start at 20:30. The yellow lines have been drawn on the chart below to demonstrate the time and date coordinates. Time horizontally from 20:30 and date vertically from Dec 21st (approximately is good enough).



Extract from the Graphdark chart shown on Page 3

The yellow line depicting Venus has bars below the line thus indicating that Venus is observable before and until 18:00 when it sets over the western horizon.

To determine when Venus will start to become visible, look down the graph. There are changes in colour on the graph indicating when darkness falls. The light blue area indicates daylight and the darker blue indicates dusk (the darkening of the sky). Venus will be visible in the twilight just above the western horizon earlier in the evening. See the Zenith chart on the next page.

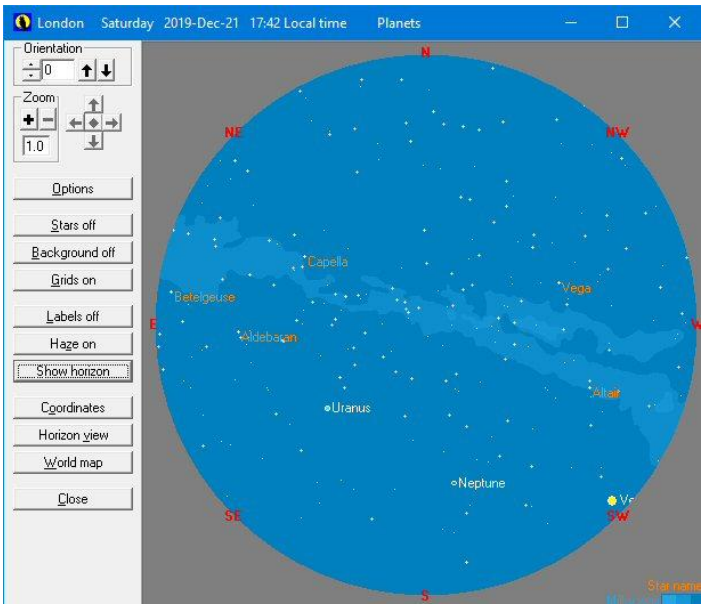
The black area shows that the sky has become dark and it is night. Therefore as Venus is a very bright object it will become visible soon after it rises at 16:00. The yellow line is in the black area so it rises in darkness.

The vertical black and white bands on the graph show if the Moon will be in the sky. The 21st December is in a black band so this shows that the Moon will not be in the sky on this night. White bands show the Moon will be in the sky on those nights.

On the extract from Graphdark shown in the previous column five other planet lines cross the 21st December vertical column. These represent Mars (red), Saturn (dark blue), Uranus (light blue), Neptune (Grey/blue) and Mercury (purple). Some lines of these planets are in the twilight zone therefore will not be visible when they rise. The lines of Mars and Mercury have the bars above the line. This means that on 21st December they would, in theory, be visible from 05:00 until the Sunrise. The lines of Saturn, Venus, Neptune and Uranus have bars below the line. This means they should be visible from Sunset and evening until the time indicated by their trace line.

Looking back to the chart on page 3, when the line representing Mercury appears in the dark blue area at the top of the chart that shows it is in the dawn sky. With the exception of Venus and Jupiter the other planets would not be bright enough to be observable. Jupiter and Venus are bright so can be seen but would be very badly affected by the dirty and turbulent air close to the eastern horizon.

A new user of Graphdark may initially find it difficult to visualise the relative positions of the planets in the sky from the 'All Planets' graph. However there is a very simple way to get a visual representation of the sky showing the positions of the planets. By simply left clicking with the mouse pointer positioned at the desired date and time the Zenith All Sky window is displayed.



The Zenith All Sky display chart

The Zenith All Sky chart is extremely useful in that it shows objects in their correct positions in the sky. By clicking on the centre button of the three at the top right of the window  the window can be expanded to fill the full screen. The cardinal points of the compass are marked on the chart to help with orientation to the night sky. North is at the top, south at the bottom, east to the left and west to the right.

The centre of the chart is the position of the sky directly over your observing location; this point is known as the 'Zenith'. On the Zenith Chart the observing location, time and date of the chart is shown in the title bar at the top of the window viz. London on Saturday December 21st 2019 at 17:42 local time. Venus can be found very low and just above the south west horizon. The planets Uranus and Neptune are also shown. The Milky Way crosses the sky from south west to north east and a number of bright reference stars are labelled.

On the left of the window is panel with a number of buttons that allow different viewing options to be selected. At the top, the up and down arrows rotate the view of the sky to suit your viewing orientation. If your garden faces north then the chart can be rotated 180° so when you look north the chart (when held above your eyes) will align with the sky with the northern horizon in front of you.

Below the orientation arrows are the zoom buttons. To zoom in click on the '+' and to zoom out click on the '–' button. The zoom level is displayed in the small window as a magnification ratio eg 1.0, 1.5 or 2.0.

The buttons from the top are:

Options switches on/off such things as the magnitude of stars to be displayed, constellations and the Milky Way.

Stars button switches the background stars on or off.

Background allows the selected options to be switched on or off.

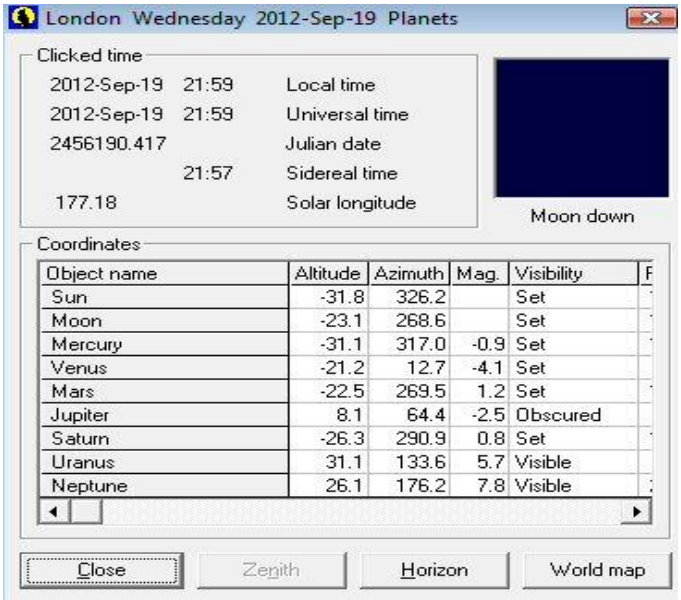
Grids allow the grid options selected in 'Options' to be displayed or switched off.

Labels turns the names attached to displayed objects on or off.

Haze inserts a coloured band around the horizon to represent the area where observation is difficult due to turbulent and dirty air conditions close to the horizon.

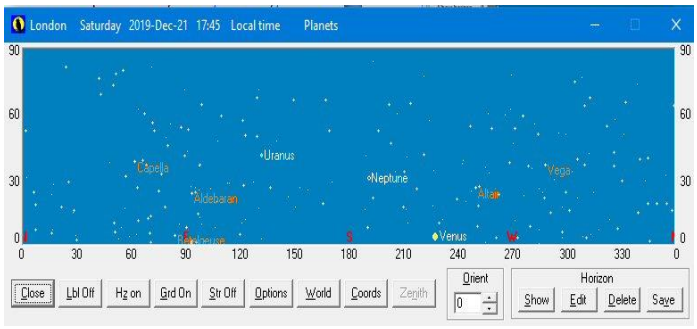
Horizon displays a simulated horizon to show how some objects may be obscured from view.

Coordinates opens another small window that displays details about the time that has been selected and about the planets.



The Coordinates window

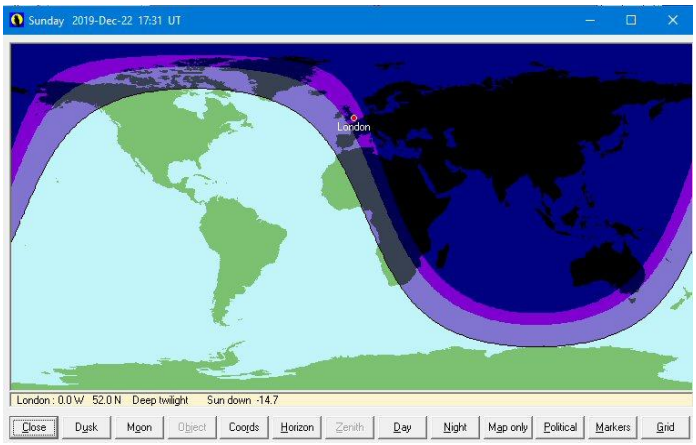
Horizon View button on the left panel is also very useful. Pressing this button shows the view of the sky looking towards the horizon. This window shows the whole sky with planets and some bright reference stars in their true positions. The bottom of the chart shows the horizon with divisions marked 0 (north), 90 (east), 180 (south) and 270 (west). Vertically on the sides of the chart the altitude angle of the objects is marked in degrees from 0 at the horizon up to 90 directly overhead (the Zenith).



The horizon visualisation chart for 17:45 on 21st Dec

The chart above shows the view of the sky looking towards the southern horizon. Venus at this time is setting over the south western horizon. The blue sky indicates the sky is still in twilight at 17:45. The main Graphdark chart and the extract in the previous column show Venus actually sets over the horizon at about 18:00. Uranus and Neptune are positioned in the south. It can be seen on this useful little chart that there are three planets visible and available for observation at about 17:45 0n 21st December. By clicking on the Zenith Chart at a time just before dawn, the planets on view in the early morning will be displayed on the Horizon Chart.

World Map shows graphically the areas on Earth that are in day or night. In the chart below the dark blue area represents the area of the planet that is in total darkness. The purple area around the dark area represents the regions that are in dusk or dawn and the outer light purple area represents twilight.

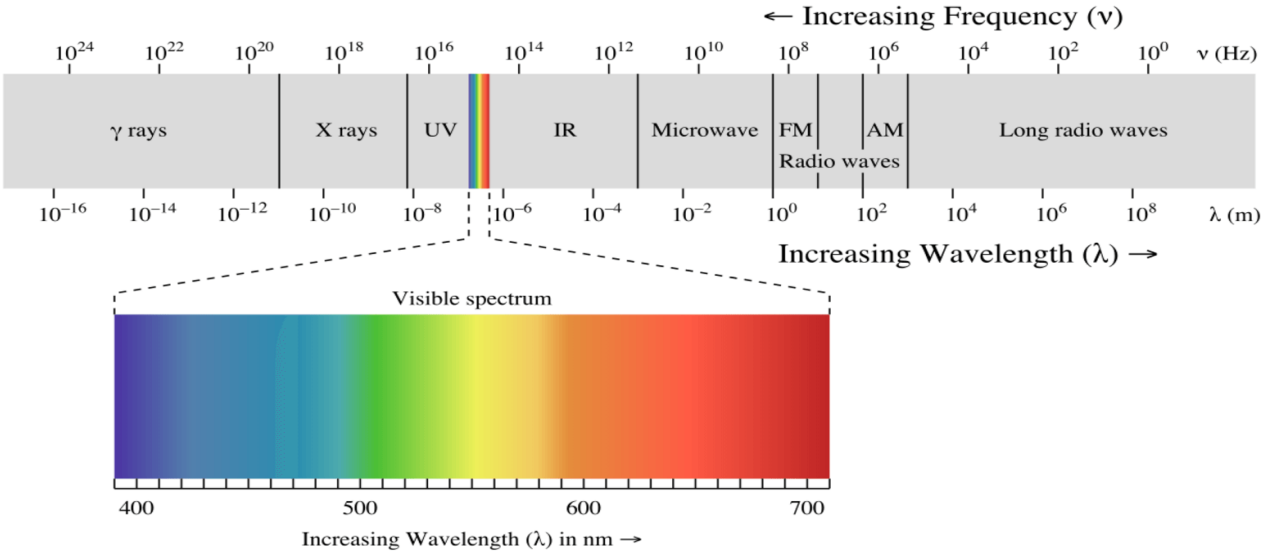


The World Map chart

The buttons along the bottom of this window allows different information to be displayed on the map of the world. For example clicking on 'Moon' displays the areas where the moon can be seen in the sky. 'Political' shows the borders of the countries of the world. 'Grid' superimposes the longitude and latitude lines.

There are many other features in Graphdark so download the application from the front page of the Beginners website and explore.

SPECTROSCOPY (Messages in starlight)

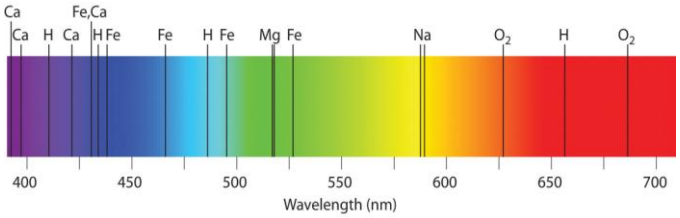


The Electromagnetic Spectrum

Last month this magazine included an article about Spectroscopy. This month we will see how we can produce our own Spectroscope and examine the spectra of light for ourselves.

When any element is heated until it burns it will produce a unique colour. For instance Sodium will always produce an orange glow as we see from Sodium street lights. Hydrogen will produce red light and Copper green. If we examine this light by separating the light into its specific wavelengths using a prism or fine grating we will see a pattern of discrete coloured bands. These patterns of discrete colour bands are unique to that particular element.

If a continuum (all wavelengths) of light from a star passes through a cloud of atoms or molecules of atoms those same discrete colour patterns will be absorbed by the same atoms in the cloud. The absorption of these patterns will appear in spectrum of the continuum of the starlight as dark lines where the colour pattern is missing. Every different elementary atom will produce its unique pattern of absorption lines on the spectrum.

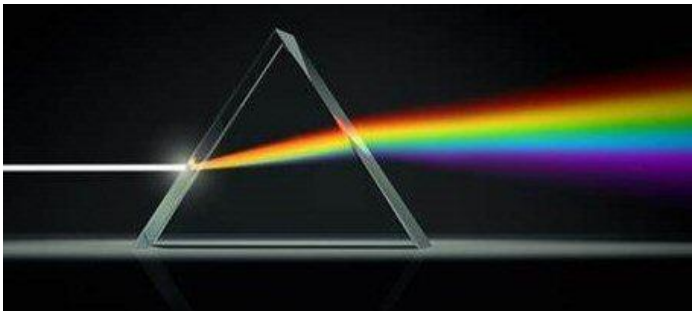


Spectral lines obtained using a Spectroscope

The visible spectrum shown in the diagram above shows the continuum of light that is produced by our Sun. The spectrum and the absorption lines can be studied using a Spectroscope. The Spectroscope separates the light into its constituent colours.

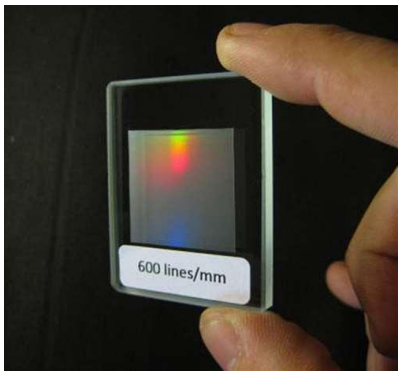
The spectrum above has bands of missing wavelengths of light that have been absorbed by the gas in and surrounding the Sun. If these discrete patterns can be identified then we can identify all the elements present in and around the Sun. Now we have a method of identifying the elements present in other stars by examining the spectrum of light from that star. The science of this process is called 'Spectroscopy'.

Most of us will have done experiments with a prism at school but a little refresher may be useful. A prism is an angled piece of glass, normally triangular in section, through which light is shone. The glass will refract (bend) the light rays as they enter the glass and again when they exit. The different wavelengths that constitute white light are refracted at different angles into what our eyes perceive as colours.



A prism refracting white light into its colours

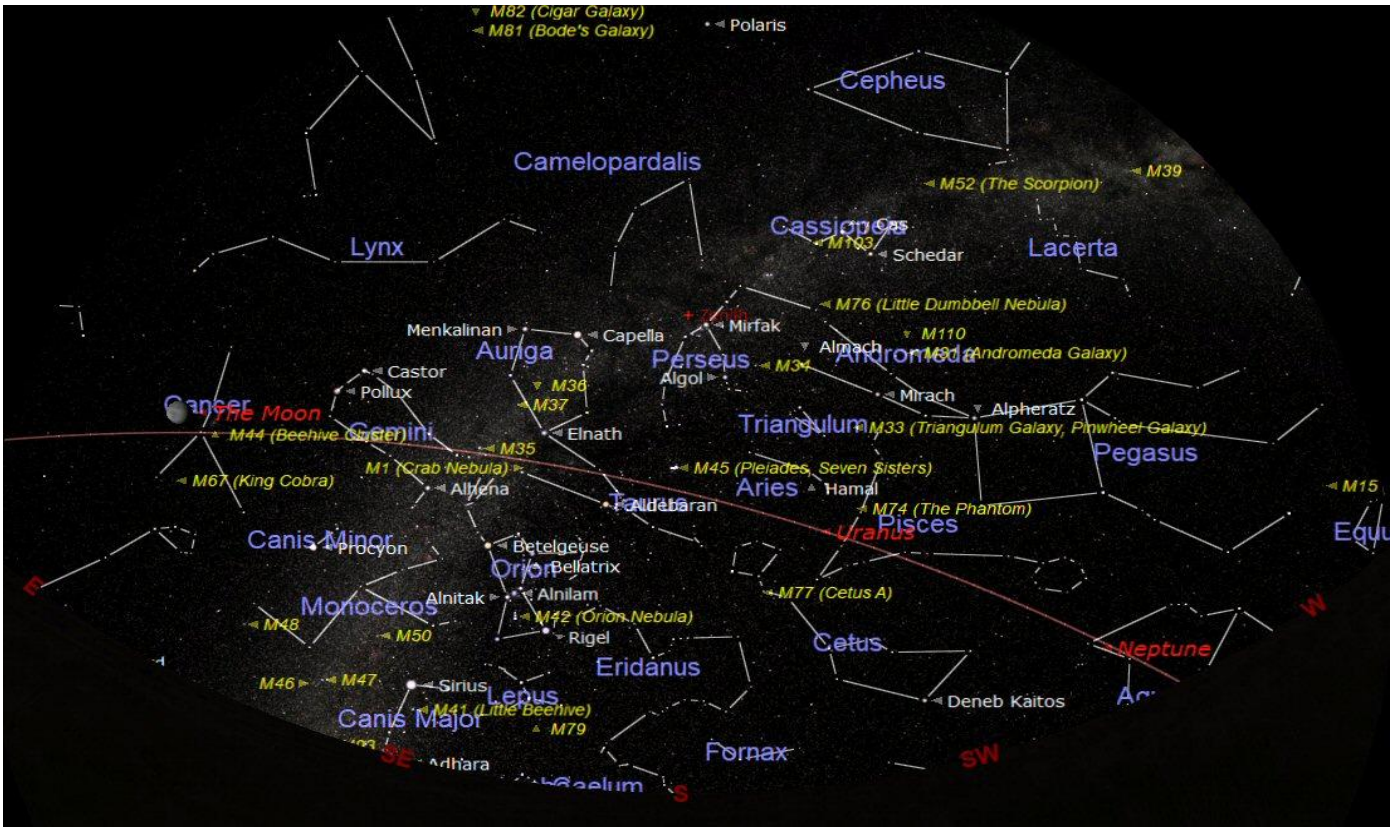
Most modern Spectroscopes use a diffraction grating to separate the colour in a light continuum. This is a piece of glass or other material with a series of very fine lines on its surface, similar to a music CD.



A scientific diffraction Grating

On our Beginners website Chris Hooker has provided some instructions on how to build a simple spectroscope using an old CD as the diffraction grating. Please use the instructions to build your own spectroscope and if you do build one, bring it to the next beginners meeting. The website address can be found on page 1.

A TOUR OF THE NIGHT SKY - DECEMBER 2019



The chart above shows the night sky looking south at about 20:00 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 (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 Sagittarius (the Archer) just moving over the western horizon, Aquarius (the Water Carrier), Pisces (the Fishes), Aries (the Ram), Taurus (the Bull), Gemini (the Twins), Cancer (the Crab) and Leo (the Lion).

Just disappearing over the south western horizon is the constellation of Sagittarius (the Archer). It is really a southern constellation but we can see the upper part creep along the horizon during the summer. The central bulge of our galaxy is located in Sagittarius so the richest star fields can be found in the constellation along with many of the beautiful and interesting deep sky objects that we seek out. Saturn is currently in Sagittarius but has moved over the western horizon.

The summer constellations are still prominent in the early evening sky in the west. Only just visible is Hercules (the Hunter). Following Hercules is the Summer Triangle with its three corners marked by the bright stars: Deneb in the constellation of Cygnus, Vega in Lyra, and Altair in Aquila. The Summer Triangle is very prominent and can be used as the starting point to find our way around the night sky. The Milky Way (our Galaxy) flows through the Summer Triangle passing through Cygnus, down to the horizon through Altair in the lower part of the Summer Triangle.

The Milky Way flows north from the Summer Triangle through the rather indistinct constellation of Lacerta (the Lizard), past the pentagon shape of Cepheus and on through the 'W' shape of Cassiopeia and down through Auriga and Orion to the south eastern horizon.

Prominent in the south 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.

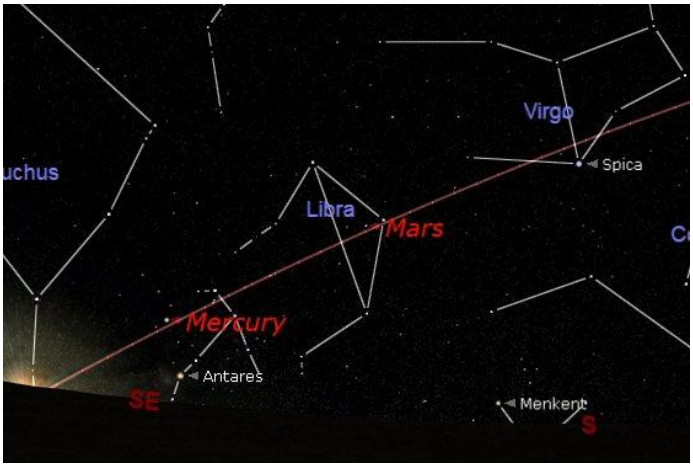
Coming into view in the south east is the constellation of Taurus (the Bull). The most obvious star in Taurus is the lovely Red Giant Star called Aldebaran. It appears slightly orange to the 'naked eye' but it is very obviously orange when seen using binoculars or a telescope. Aldebaran is located at 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.

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 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 January issue of this magazine.

THE SOLAR SYSTEM THIS MONTH

MERCURY will not be observable this month as it will be too close to the Sun as it rises in the East. It was in 'transit' with the Sun (passing in front of the Sun) on 11th November. See pages 1 and 2.

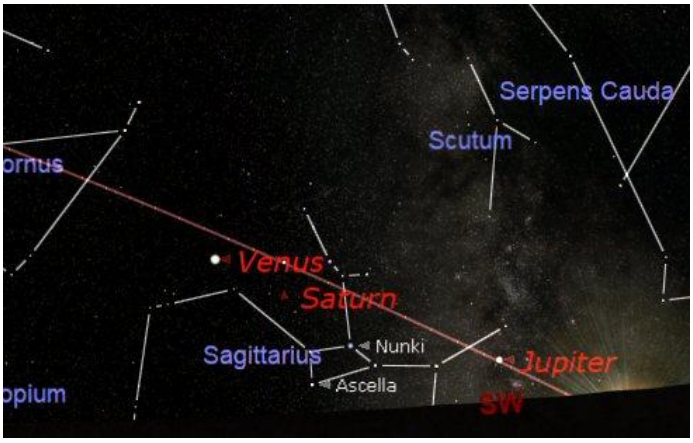


Mercury and Mars at sunrise on 15th December

VENUS is difficult to observe this month as it will be too close to the Sun and very low on the south western horizon at sunset. It is moving out from its conjunction with the Sun (passed above the Sun) on 14th August and is now moving away from the Sun. See the chart below.

MARS will be observable (with difficulty) this month low in the east before sunrise. Mars is still a long way from us on the other side of the Solar System so it looks rather small at just 4.1" (arc seconds) see the chart above.

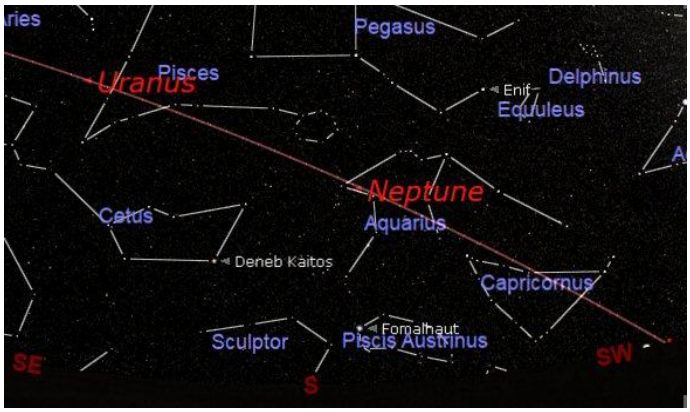
JUPITER is now out of view and moving ever closer to the Sun. It has been very low in the sky this year and looked rather disappointing in the dirty and turbulent air close to the horizon. Jupiter will be in conjunction with the Sun on 27th December. See the chart below.



Venus, Saturn and Jupiter at Sunset on 15th December

SATURN will be low in the south west as the sky darkens and is about to move below the western horizon. Saturn is very low and in the murky and turbulent air close to the southern horizon. It may still just be possible to see the ring system although it will appear unstable due to the air movement close to the horizon. It will require at least a small telescope 75mm to 100mm and a magnification of about 100x to see the rings at all. Saturn's largest moon Titan may also be visible in a telescope but the fainter moons will be very difficult to see even using a larger telescope. See the chart above.

URANUS the Ice Giant Planet was at opposition to the Sun (due south at midnight – 24:00 GMT) on 28th October it was at its best position for observation this year. It will be visible during in the evening using a small telescope as a slightly fuzzy blue, star like, object. A larger telescope with a magnification of 100x or more will show it as a small blue/green disc. See the chart below.



Uranus and Neptune at 18:00 mid-month

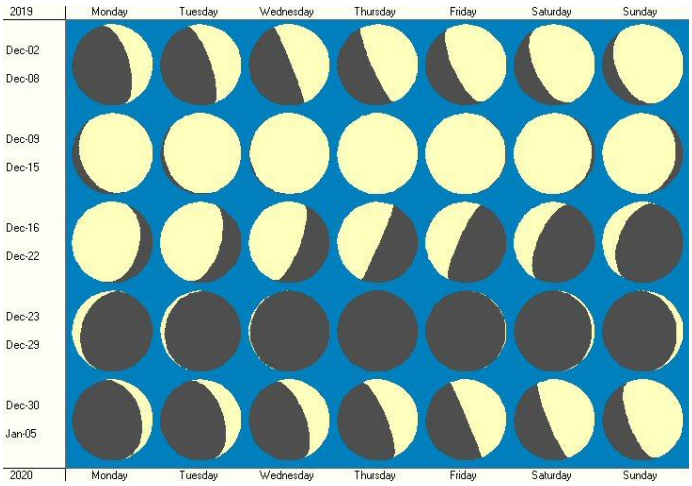
NEPTUNE was at opposition on 10th September and at its best position for observation this year but it is now moving towards the western horizon. A medium sized telescope (100mm to 150mm) will be needed to show Neptune as a small blue/green disc using a magnification of 150x but it is small and difficult to find. See the chart above.

THE SUN

There may still be some occasional sunspots to see even though the active phase of the Solar Cycle is now over.

The Sun rises at 07:45 GMT at the beginning of the month and at 08:00 GMT by the end of the month. It will be setting at 15:53 GMT at the beginning and 16:00 GMT 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 4th December

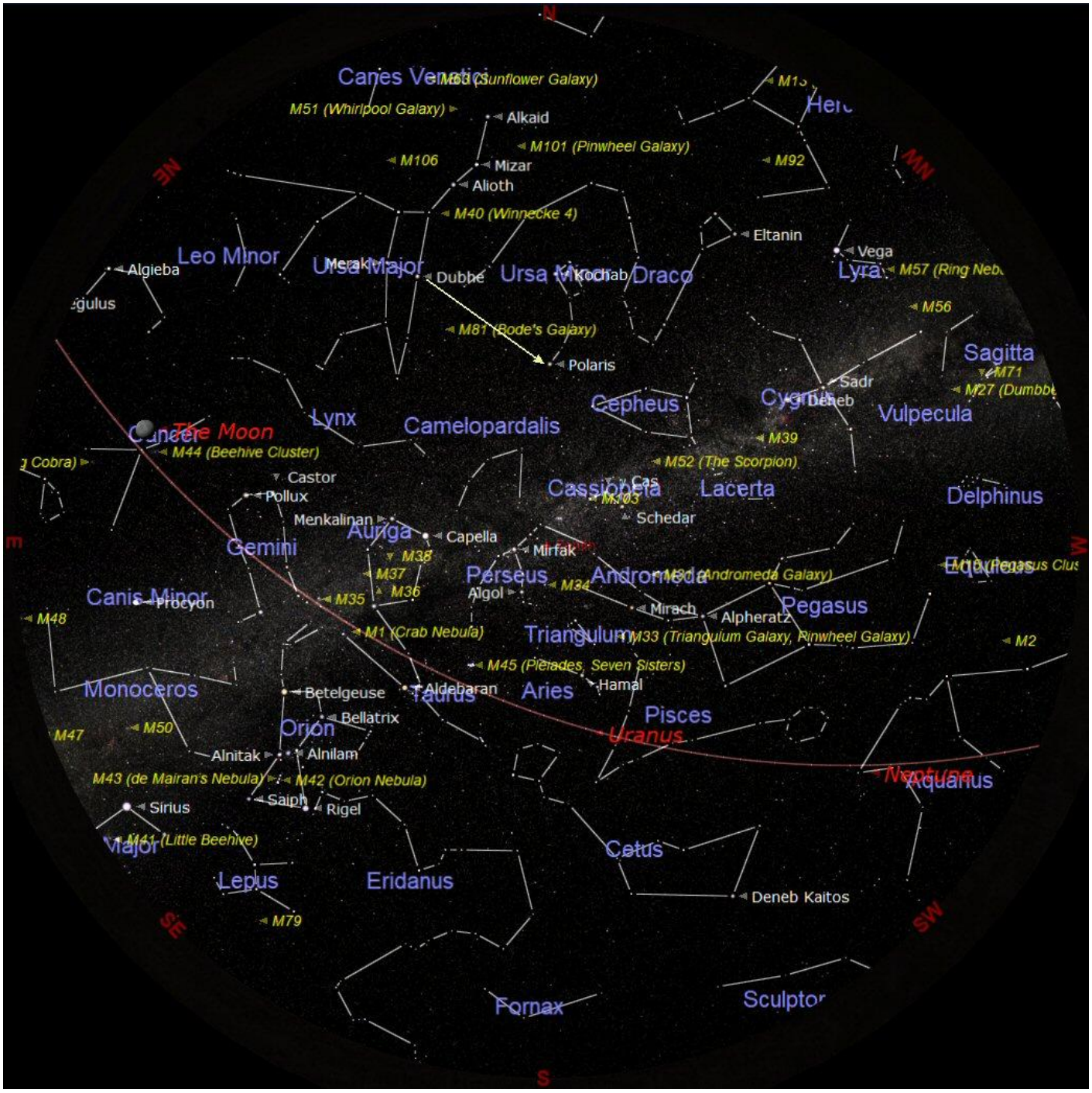
Full Moon will be on 12th December

Last Quarter will be on 19th December

New Moon will be on the 26th December

The Winter Solstice will be on 22nd December

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 Meantime 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: Uranus and Neptune. Venus and Saturn are just observable in the very early evening.