# NEWBURY ASTRONOMICAL SOCIETY
# MONTHLY MAGAZINE – NOVEMBER 2017

## TELESCOPE WORKSHOP – OPEN EVENING


Street map showing directions to the Scout Hut

To compliment this month's articles, that provide guidance about astronomical telescopes, the Newbury Astronomical Society will be holding a Telescope Workshop on Monday 20th November. This will be an informal evening event, open to anyone, to provide a display of the various telescopes available for the newcomer to the hobby of astronomy. Experienced local astronomers will be available to give advice and guidance on all aspects of astronomy and the equipment available.

The evening will be an opportunity for anyone who has a telescope but may be experiencing problems in setting it up or using it to seek advice. There will be advice available for those who may be thinking about buying a telescope for their own use or perhaps for a Christmas present for somebody else. It may also be an opportunity to take part in a 'live' guide around the night sky outside provided by members of the Newbury Astronomical Society.

If the sky is clear the Workshop will provide the opportunity to try out the telescopes outside with expert advice and help with using them. The telescopes on view can be used outside or help can be provided for using telescopes that have been brought along for the evening, by those who already have a telescope but are in need of a little help.

Light refreshments will be provided in the Scout Hut which can also be used as a 'warming up' retreat for those venturing outside to use the telescopes and anyone who would like an informal chat about anything astronomical.

The Telescope Workshop will start at 7:30pm on Monday 20th November at the Scout Hut, Remembrance Road, Newbury and will finish at some time after 9:00pm.

Directions to the Telescope Workshop venue:

Post Code for satnav: RG14 6BA

From Endborne Road turn into Enborne Grove that has 'The Lamb' pub on the corner, see the map above.

Continue along Enborne Grove, past Enborne Place into Remembrance Road and look for the 'ASTRONOMY SIGNS' on your left. There is a narrow entrance between two houses. Indicated by the arrow on the map above.

There will be people in 'hi-vis' safety jackets waiting at the entrance to guide visitors into the car park.

There is no charge for the evening but a small donation to the scouts for the use of their Hut would be appreciated.

Full details available at: www.naasbeginners.co.uk

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**NEWBURY ASTRONOMICAL SOCIETY MEETINGS**

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|---|---|
| 1st December | Our Galactic Neighbourhood |
| Website: | www.newburyastro.org.uk |

**NEXT NEWBURY BEGINNERS MEETING**

| | |
|---|---|
| 20th December | UFO's Fact or Fiction? |
| Website: | www.naasbeginners.co.uk |

# BEGINNERS GUIDE TO ASTRONOMICAL TELESCOPES

The author with his Skywatcher Evostar 90 'Beginners Telescope'

There are many questions asked about telescopes for the beginner so this article aims to answer some of those questions and give some guidance about telescopes and other equipment that might be needed for astronomy.

The first question is really "Do I need any special equipment to start out in astronomy as a new hobby?" The answer is no! All we need to get started is a little interest in space and the night sky.

Books can be borrowed from the local library and programmes like the 'Sky At Night' can be watched on TV or we can look up almost anything about astronomy on the internet these days. So we can find out about astronomy without actually doing and practical astronomy. However the most enjoyable part of astronomy is the looking up into a clear night sky and enjoying the wonder of this 'free' show of the beauty and vastness of the universe around us.

The first step is to actually go outside on a dark, clear night and have a look. It is not necessary to buy anything to do this but a reclining garden chair will make it more comfortable and reduce the risk of getting a stiff neck due to looking up into the sky. There are a few things to remember when doing any practical astronomy at any level so a quick mention of some of these points.

It is very important to dress up to keep warm. The enjoyment can rapidly reduce when the cold starts to set in. The best nights are usually the cold winter nights so it is very important not to get cold. Secondly we need to shield ourselves from any lights. We can tolerate some light around but not if it shines on to us and especially directly into our eyes. Reduce the lights by turning off as many as possible, draw curtains. If necessary erect temporary light shields perhaps using a garden umbrella. It is usually best to look in a southerly direction if possible.

Initially it is not necessary to do any more than just look around the night sky and just take in its beauty and contemplate what all these points of lights that we call stars really are.

The first thing we need is a chart that will identify the stars and also the apparent groups and patterns of stars that we can see. The brighter stars do have real names and patterns they form we call constellations. We use the constellations to identify areas of sky to which we give names to help find our way around the sky. Constellations mainly have names taken from ancient mythology like: Hercules, Perseus, Orion and Pegasus.

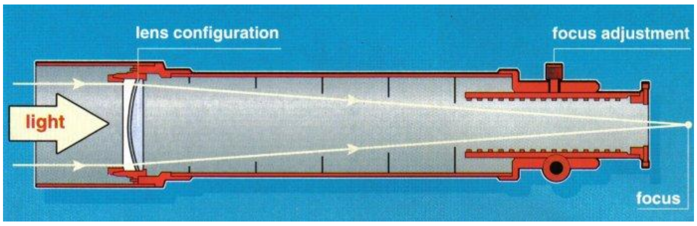
A pair of binoculars will help to identify some of the fainter stars to complete the view of the asterism (recognisable pattern) formed by the stars. However the binoculars will make the stars look brighter but they will also magnify the area of sky. The stars will not appear any bigger but they will appear brighter. However the magnification may result in the asterism appearing too large to fit into the field of view. So this may take some time to get used to.

Binoculars may also reveal some fuzzy looking objects that are not star-like and are in fact not stars at all. These may be clusters of stars or Nebulae (singular Nebula). Nebulae are clouds of gas and dust out in the distant 'deep' sky. The brighter planets Venus, Mars, Jupiter and Saturn will be revealed too, looking different using binoculars. They look like a rather 'fuzzy' looking star that is starting to appear to have size unlike a star which is always just a point of light.

The planets or nebulae do need a telescope to see any detail on them. A telescope will collect more light and focus that light into an image that can then be magnified. It will reveal some of the detail that cannot be seen with the 'naked eye' or using standard type binoculars.

## REFRACTING TELESCOPES

All refracting telescopes use a glass lens as their primary focusing unit (Primary Optic). This lens is normally made up from two or more lens elements to produce a clearer image and reduce colour distortions caused by refraction as explained below.




The construction of a refracting telescope

Lenses use the property called REFRACTION to change the direction of rays of light and direct them towards a desired Focal Point. Refraction occurs when light passes between two different transparent materials such as glass, air and water.

When light passes, at an angle, through the surface of a block of glass the angle is changed. As the light re-emerges through the opposite side of this material its angle will be changed again, back to its original angle.

To utilise this phenomena lenses are produced with a curved surface so when parallel rays of light meet the surface it will present a varying angled surface to the rays. The paths of all the rays hitting the lens will be bent differently towards common focal point. (The more the surface of the lens is curved the more the light rays are bent). As the light emerges from the back face of the lens it is again bent. The increasing curvature of the lens bends the light more at the edge of the lens than at the middle so all rays converge on to the same (focal) point.

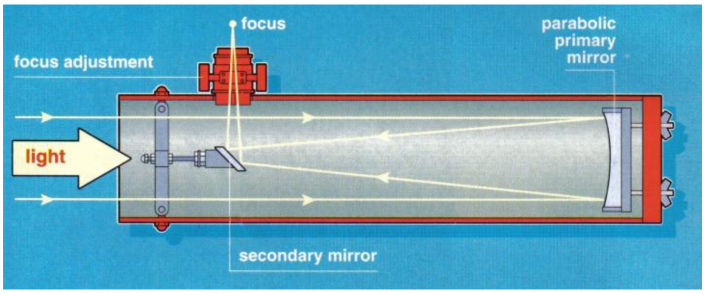
The job of the lens is to gather a large area of light and concentrate it into a smaller area where the image that the light is carrying is focused. Because the light has been concentrated into a smaller area it will appear brighter. A bigger lens will gather more light and will produce a brighter image or put another (more important) way, a larger lens will allow fainter objects to be seen.

The image produced by a lens is a raw image and cannot be observed directly by the eye. A special eyepiece is used to magnify the image and focus it into the eye. A simple eyepiece will have two lenses that refine the image so that it can be received by the eye. The eyepiece will have a specific focal length that will determine the magnification [of the image] that it will produce. A shorter focal length on the eyepiece will produce a higher magnification than a longer focal length.

A telescope of a specific focal length will produce an image of a specific size, the longer the telescope the larger the image produced will be. The telescope lens simply produces a concentrated image (the larger the lens, the more light it can capture and the brighter the image will be). The longer the focal length of the lens the larger the image will be. The magnification of the telescope system is determined by the focal length of the Primary Optic divided by the focal length of the eyepiece. For example a 1000mm focal length telescope using a 10mm focal length eyepiece will produce a magnification of 1000 ÷ 10 = 100x. A 100 times magnification of the image.

## REFLECTING TELESCOPES

A reflecting telescope uses a curved mirror instead of a lens to collect and concentrate the light into an image. A Newtonian telescope (invented by Sir Isaac Newton) is the simplest type of reflecting telescope. Below is the layout of the optics of a Newtonian tube assembly. The Newtonian configuration is the simplest layout and therefore generally the cheapest of all the reflecting type telescopes. Used with the simple Dobsonian mounting this type of telescope can make a very useful and cheap option for a first telescope at around £200 for a 150mm (6″) instrument.




The construction of a reflecting telescope

Light from a distant object enters the open tube and is reflected back up the tube by a parabolic (concave) mirror. Because the mirror is curved the light is focused into a point where an image is formed. A mirror has a number of important optical advantages over a lens.

The mirror only requires one surface to be polished

Light does not pass through glass so no colour distortion

Glass can be a lower grade, light does not pass through it

Mirrors can be made much bigger and cheaper

To enable the observer to study the image without blocking the light entering the tube, a second small 'flat' mirror is mounted at an angle of 45° at the top of the tube to direct the light out through a hole in the tube. A focusing unit is fitted to the hole to support and adjust the eyepiece.

The eyepiece is a simple microscope used to magnify the image formed by the mirror. Using a variety of eyepieces with different focal lengths (as explained in the previous column), higher or lower magnifications can be obtained.

The central secondary mirror cannot be seen when using the telescope but it does have an effect on the performance of the telescope. A larger reflecting telescope will be required to equal the performance of a refracting telescope. The approximate ratio for equal performance is 150mm aperture (diameter) for a reflector mirror to equal a 120mm refractor lens aperture (diameter). Until about 10 years ago a reflecting telescope was significantly cheaper (aperture for aperture) than a refracting telescope but with modern lens mass production techniques the difference in cost compared to mirrors has been significantly reduced.

There are other variations of the reflecting telescope layout such as the Cassegrain. This design replaces the flat angled secondary with a small convex mirror. This redirects the light back down the tube and through a hole in the centre of the Primary Mirror where the eyepiece is mounted. This configuration can be used to produce a telescope with a very long focal length mounted in a short tube. With its large image this type of telescope is well suited to the observation of planets where a stable high magnification is needed to study surface features.

# TELESCOPE MOUNTINGS

There are two main types of telescope mounting known as Alt/Azimuth and Equatorial. Reflecting and Refracting telescopes can be fitted to either type of mounting. The mounting is the piece of equipment used to support the telescope tube and allow it to be moved and pointed towards the object to be observed.

**Alt/Azimuth Mountings**

This is the simplest of the main types of telescope mounting. A telescope mounting has three functions first it supports the telescope tube assembly. Secondly it provides an interface with the stand. This can be a tripod (as shown below) or some kind of more permanent pedestal. Thirdly it provides a means of raising and rotating the telescope tube assembly.

A refracting telescope on an Alt/Azimuth mounting

A simple Alt/Az mounting will have some kind of interface for securing the telescope tube assembly and some means of securing the mounting to a tripod. It will also have a mechanism for raising and lowering the tube assembly in altitude (Alt) and a means of rotating it horizontally, left or right (Azimuth).

A simple Al/Azimuth telescope mounting

In the image above the Alt/Az mounting is secured to a tripod and has a plate and screw to secure the telescope tube. It has two flexible extended knobs, one for raising the telescope tube in altitude and the other for rotating the mounting horizontally to the left or right (Azimuth).

**Equatorial Mountings**

Alt/Az mountings have a major disadvantage over Equatorial Mountings when using a telescope for astronomy. This is due to our Earth's axis of rotation being tilted 23.4° compared to the axis of Earth's orbit around the Sun. This causes the objects in the sky to appear to move across the sky in an arc as Earth rotates on its axis. To keep tracking an object using an Alt/Az mounting, both drives have to be adjusted to keep the object in view. This becomes a problem if we want to fit an electric tracking drive to the telescope.

The Equatorial Mounting has been developed to solve this problem. The Azimuth axis has the ability to be tilted to compensate for the tilt of Earth's axis. This means only the Azimuth needs to be adjusted to track objects as they appear to move across the sky in an arc. The same telescope tube assembly shown in the previous column is shown below mounted on an Equatorial Mounting.


A refracting telescope on an Equatorial Mounting

The telescope shown above is fitted to an EQ2 mounting and has manual adjustment in both (Altitude) known as Declination (Dec) on an EQ Mount and (Azimuth) known as Right Ascension (RA) on an EQ Mount. The nomenclature 'EQ2' defines the robustness and quality of the EQ mount. The mounts are generally classed from EQ1 (cheapest) to EQ6 (most expensive).

The tilt of the RA axis is dependant of the latitude of the observer so the angle of tilt is adjustable. A dial on the RA adjuster is marked with a scale determined by the latitude where the telescope is going to be used. Newbury in the UK is at latitude 51.4°N so the RA must be set to this number on the scale. For normal observing an approximate setting will do but a more accurate setting must be made if photography, using the telescope, is to be attempted. Once set the RA can be locked and only changed if the telescope is to be used at significantly different latitudes.

On the EQ Mounting shown above there is a gearwheel attached to the RA manual adjustment knob. This is for the attachment of a battery powered electric drive motor. The motor can be mounted on the spindle adjacent to the gearwheel and engaged on the gearwheel. The motor can be disengaged for manually pointing the telescope then re-engaged to automatically track the object.

# THINKING ABOUT BUYING A FIRST TELESCOPE

Before looking at the range of telescopes that is available, consideration should be given as to what the telescope is to be used for. This is the most important consideration of all. The worst possible choice is the one that never gets used. A telescope that is too complicated or too cumbersome to set up will spend its time at the back of a shed or garage and never be used. A first telescope should be easy to set up, easy to use yet give impressive views of the sky.

First we must consider some of the physical characteristics of a telescope and how they affect our requirements.

The main specifications for a really useful first telescope should be: a minimum aperture of at least 80mm for a refractor or 125mm for a reflector. A 750mm to 1000mm focal length is good for both. This combination will provide enough light grasp and permit a high enough magnification to see detail on the brighter planets.

One of the most important attributes for an astronomical telescope is the 'light grasp'. This is an expression used by astronomers to describe the process of the main optic directing light from a distant object into the eye. The pupil of a young human eye can open to 8mm in diameter when fully adapted to the dark. This is about 40 square millimetres ($40mm^2$). A 100mm diameter telescope has an aperture area of $7{,}854mm^2$. It is therefore capable of directing up to approximately 200 times as much light into the eye of the observer. Put another way it will enable the observer to see objects about 200 times fainter than could be seen with the unaided eye. So a larger aperture will allow even fainter objects to be seen.

The focal length is also important. The FOCAL LENGTH is effectively the length of the telescope. It is measured as the distance from the main optic to the point where the image is formed. A short focal length will give a wide field of view but the objects in the field of view will appear small. A long focal length will give a narrow field of view (small area of sky) but the objects in view will appear larger. Short focal lengths are best for looking at star fields and larger objects. Long focal lengths are most suitable for small objects and studying fine detail, for example on the Moon and the planets.

Magnification, strictly speaking is not an attribute of the telescope, it mainly depends on the eyepiece being used. A telescope of a specific focal length will produce an image of a fixed size and this cannot be changed. For example a telescope of a certain focal length may produce an image of the full moon 10mm in diameter. A longer focal length will produce a larger image and a shorter focal length will produce a smaller image. The eyepiece is then used, much like a microscope, to magnify that image. A larger image to start with will allow the eyepiece to produce a higher magnification.

A long focal length 25mm (low power) eyepiece used on a 1000mm telescope will produce a magnification of $1000 \div 25 = 40x$. A short focal length 10mm (high power) eyepiece used on the same 1000mm telescope will produce a magnification of $1000 \div 10 = 100x$. However the same eyepieces used on a 1500mm focal length telescope (that naturally produces a larger image) will have magnifications of: $1500 \div 25 = 60x$ and $1500 \div 10 = 150x$.

To summarise, if the craters on the Moon or the cloud bands on Jupiter are to be studied then a telescope with an effectively long focal length should be sought. A shorter focal length telescope will be more suited to wide field views of the stars. A good all round first telescope should have a focal length of around 750mm to 1000mm.

A first telescope must be easy to use, portable enough to move around and set up and be within a modest budget. The budget available is important but if possible at least £150 should be spent on a new telescope or the pro-rata amount for a second hand instrument (say £100 for a telescope that costs £200 new).

Main manufacturers are MEADE, CELESTRON, ORION, SKY WATCHER, TAL, KONUS and BRESSER. Suppliers of telescopes can be found in the adverts in popular astronomy magazines such as 'Astronomy Now' and 'Sky at Night'.

There now follows a few examples for consideration.

The Skwatcher Evostar 90 EQ2 (see next page)

This telescope represents the ultimate first refracting scope for the beginner. It has an aperture of 102mm and a focal length (FL) of 1000mm. It is supplied with the tripod, two eyepieces, even a camera adaptor. The MRP is about £269.

The telescopes in this range are:

| | | | | |
|---|---|---|---|---|
| Evostar – 90 | 90mm | FL 900 | £152 | Very good |
| Evostar – 102 | 102mm | FL 1000 | £269 | Perfect |
| Evostar – 120 | 120mm | FL 1000 | £349 | A bit expensive |
| Evostar – 150 | 150mm | FL 1220 | £549 | Big & expensive |

Most manufacturers listed above have a similar range. The telescopes in these ranges are typically supplied on a tripod and with an equatorial mounting. They usually have two eyepieces (25mm and 10mm) and sometimes include a Barlow Lens. All are supplied with a 90° Star Diagonal. This is a mirror set at 45° to direct the image into a comfortable position for viewing through the eyepiece.

The smaller examples are usually supplied with a 30mm aperture finder whereas a 50mm would have been better but this can be upgraded later. There are other telescopes at 60mm to 80mm aperture that are not bad if only a small budget is available (£60 to £100). Their capability is really limited to observing the Moon and the moons of Jupiter. The latest details can be checked out on the websites.

## REFLECTING TELESCOPES

Reflecting telescopes are generally cheaper than the equivalent sized refracting telescope. This is because they use a mirror as the main optic and not a more expensive lens. A mirror only has one surface to be ground and polished but the typical refractor, that has two or sometimes three lens elements, has four or six surfaces to be ground and polished.

The cheapest and simplest reflecting telescope is a Newtonian tube assembly fitted to a Dobsonian mount (see below). The mount is a simple Alt/Azimuth with a turntable for rotation and a trunnion for up and down movement. These are very easy to set up and simple to use but the 'turntable' can be a little 'sticky' to turn.

Because the Newtonian has a secondary mirror at the top of the tube there is a small loss of light so a 150mm will give a just slightly brighter image than a 120mm refractor.


The150mm FL 1200mm Skywatcher Skyliner £207

Models in this range:

| | | | |
|---|---|---|---|
| Skyliner | 150mm (6″) | FL 1200mm | £207 |
| Skyliner | 200mm (8″) | FL 1200mm | £275 |

Some manufacturers listed previously have a similar range but Celestron and Meade appear to have stopped selling some models from this range of telescope.

A major advantage, beside the cheapness, of the Dobsonian is its simplicity of use. It just needs to be placed down on a flat surface and it is ready to use. A finder scope is attached to the main tube to help find a desired object. Once the object is located in the main telescope it can be tracked by moving the tube gently, up or down and around while looking through the eyepiece to keep the object central.

The Newtonian tube assembly can also be fitted to an equatorial mounting. This does make the telescope more expensive but can make it easier to track objects across the sky. This combination gives the advantage of a large aperture telescope on a mount that can easily be driven to track objects. Most Dobsonian telescopes use a fairly long focal length tube assembly whereas a shorter focal length is generally favoured for the equatorially mounted Newtonian.

Newtonian reflecting telescope tube assemblies, like most refracting telescopes, can be mounted on an Equatorial Mounting. These mountings are designated by a prefix EQ. A range of EQ mountings are available from EQ1 to EQ6. The higher the EQ number the robustness, weight and cost is increased. The EQ1 is the bottom of the range and can be used for smaller and lighter telescope tubes. It is restricted to visual work and not astro-photography. If more accurate and steadier mounting is required the minimum class of EQ mounting should be an EQ2 or EQ3. The telescope assembly shown below uses an EQ1 mounting.


Celestron Astromaster 114mm Equatorial Newtonian

Models in this range:

| | | | | |
|---|---|---|---|---|
| AstroMaster EQ | 114mm | (4½") | FL 1000mm | £169 |
| AstroMaster EQ | 130mm | (6") | FL 650mm | £199 |
| Celestron C8N | 200mm | (8″) | FL 1000mm | £299 |
| Celestron C10-N | 254mm | (10″) | FL 1200mm | £639 |

Most manufacturers listed previously have a similar range.

Most telescopes bought from the main suppliers are of a similar good quality so much of the selection process is down to personal choice. All the various types and models have their own relatively small advantages and disadvantages but generally they are all good.

Cost is a main factor to be considered. To obtain a good performing telescope will require a minimum outlay of about £150 to £200 but reasonable telescopes can be obtained for a little less, perhaps £100. The key points are: the telescope should be good enough to give impressive views of the night sky, should be easy to set up for observing and easy to use. If these criteria are not met, interest may be lost and the telescope will be condemned to the back of the shed.

A first buyer should not spend too much on a first telescope because the beginner to astronomy may not like the cold, dark nights of winter. So it is probably best to start with a relatively modest first telescope. If the interest blossoms then a larger more expensive telescope can be purchased. When the hobby is established, a feel for what branch of observing would have developed and a better knowledge of what telescope is required to advance the hobby.

Money spent on the first telescope will not be lost because most advanced astronomers will have bought a larger and more expensive telescope but the seldom get rid of their earlier purchases. Sometimes it is easier to take the smaller and more portable telescope out especially if it is to be used at a location away from home.

# SOME TERMS USED FOR TELESCOPES

**ALT AZIMUTH MOUNT (Alt/Az)** A type of telescope mount that has a vertical axis (Altitude) and a horizontal axis (Azimuth). Both axes need to be moved to track an object through its apparent arc across the sky.

**APERTURE** The diameter/area of the main objective. This is normally used to describe the size of the telescope in millimetres.

**BARLOW** A lens unit inserted into the focuser before inserting the eyepiece that effectively doubles or trebles the magnification of the eyepiece.

**DECLINATION (DEC)** The up / down movement on an equatorial mounting.

**DEWSHIELD** A tube fitted to the open end of the telescope to help reduce dew forming on the lens.

**DIAGONAL** this is a device inserted into the focuser on a refracting telescope and some more specialised reflecting telescopes before fitting the eyepiece into the Diagonal. The Diagonal has a flat mirror set a 45° inside to divert the image through 90° into a more comfortable viewing position for the observer.

**DOBSONIAN** A very simple and cheap telescope mounting usually used with a Newtonian reflecting telescope tube. The mount is a simplified Alt Azimuth designed by American astronomer John Dobson. It uses a turntable for rotation and a 'box shaped' trunnion (like an old cannon) mounting to provide up and down movement. These are very easy to set up and simple to use.

**DRIVE** This is a term used to describe an electric motor and gearing to drive the RA axis on an equatorial mounting. It is designed to drive the RA at one revolution per day to compensate for the rotation of Earth. This enables the telescope to easily track a selected object.

**ECLIPTIC or ZODIAC** This is another name for the plane of the Solar System projected out into space and on to the visible sky. As Earth's axis of rotation is tilted 23.4° from the axis of rotation of the Solar System, objects in the sky appear to move across the sky in an arc from east to west. The Sun, Moon and planets appear to move along this imaginary line (the Ecliptic or Zodiac) in the sky.

**EQUATORIAL MOUNT** A type of telescope mount that has one axis tilted to point at the celestial pole. By using this design of mount an object being observed can be tracked by moving just one axis. This is a must for astro - photography.

**EYEPIECE** A small microscope fitted to the telescope to magnify the image formed by the main optic and direct it into the eye.

**FINDER** A small telescope fitted to the main telescope to help find the object. A finder has a wide field of view and low magnification and is normally fitted with cross hairs. Some telescopes are fitted with a Red Dot Finder.

**FOCAL LENGTH** The distance from the main optic to the point where the image is formed.

**FOCAL RATIO** The ratio obtained by dividing the focal length of the objective by its diameter, usually written as $f$ (number) for example $f8$ .

**FOCUSER** Is the holder for the eyepiece. It carries adjusting knobs to enable minor adjustments to the position of the eyepiece to give correct focusing.

**GOTO** This is a computerised drive system fitted to some modern telescopes. It enables the telescope to automatically find and track thousands of objects in its database.

**LIGHT GRASP** The amount of light that a telescope can direct into the observers eye (the bigger the better).

**LATITUDE** is the position of an observer on the surface of Earth measured from Earth's Equator. A position on the equator is Latitude zero. Latitude is measured in degrees north and degrees south of the equator with the poles being 90 degrees north or south.

**MAGNIFICATION** The ability to increase the apparent size of the object using different eyepieces. A short focus eyepiece produces higher magnification. This is calculated by dividing the focal length of the main optic by the focal length of the eyepiece: 1000mm ÷ 10mm = 100x magnification.

**MAKSUTOV** This is a complex design of telescope that, through an optical trick, produces a very long effective focal length in a short tube. These are very good for planetary observation.

**MOUNTING OR MOUNT** This is a term to describe the component of the telescope assembly that supports the Tube Assembly. It also provides an interface for attaching the Telescope Tube Assembly to a stand. It is also fitted with the mechanism for pointing the telescope tube higher and lower and for rotating the telescope right and left.

**NEWTONIAN** A simple reflecting telescope designed by Sir Isaac Newton. It has a concave mirror at the bottom of a tube and a secondary mirror at the top of the tube.

**OBJECTIVE** The main light gathering optical unit of a telescope, the large lens or mirror. Also known as the Main Optic.

**RED DOT FINDER** This is a simple Finder that uses a small red LED to project a red dot on to a transparent glass screen to help locate an object in the sky.

**REFLECTOR** The type of telescope that uses a concaved mirror as its main optic, usually called a 'Reflecting Telescope' or 'Reflector'.

**REFRACTOR** A type of telescope that uses a lens as its main optic, usually called a 'Refracting Telescope' or 'Refractor'.

**RIGHT ASCENSION (RA)** The rotational movement on an equatorial mounting. The axis that is tilted to align with the Earth's polar axis of rotation.

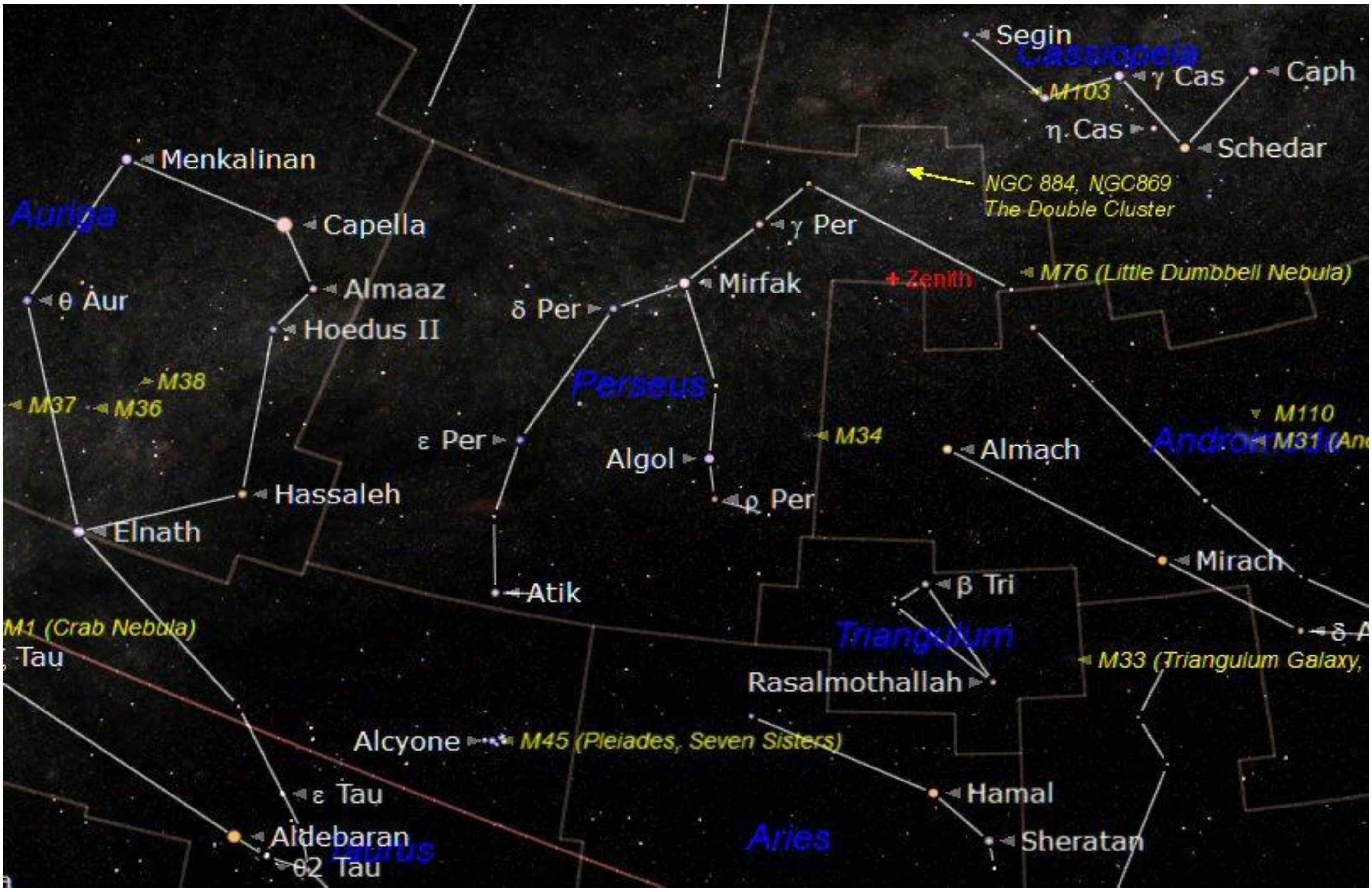
**SCT (SCHMIDT CASSEGRAIN TELESCOPE)** A more complex design of telescope that, through an optical trick, produces a long effective focal length in a short tube.

**TRIPOD** This is a three legged support stand used for mounting and supporting telescopes. The legs are usually adjustable to compensate for uneven ground and to position the telescope at a comfortable height for observing.

**TUBE ASSEMBLY** This is the tube that holds and supports the Main Optic (main lens or mirror). It also has the Focusing Unit attached and usually a Finder.

**ZENITH** and imaginary spot directly overhead in the sky. (The point projected beneath our feet is called the Nadir.)

# CONSTELLATION OF THE MONTH - PERSEUS




The constellation of Perseus is directly overhead this month. The point in the sky directly overhead is called the Zenith and can be seen marked on the chart above in red.

The recognised asterism (shape) of the dot-to-dot figure of Perseus is ‘stirrup’ or ‘tuning fork’ shaped. It is surrounded by the constellations of Andromeda and Triangulum (to the west), Aries and Taurus (to the south) Auriga (to the east) with Camelopardalis and Cassiopeia (to the north). There is a rather distinct line of stars aligned between the ‘W’ of Cassiopeia down to Taurus.

The bright star Algol, designated Beta Persei (β Persei, abbreviated to β Per) and is known colloquially as the Demon Star. It is a bright multiple star in the constellation of Perseus and the most famous star in the constellation. It was the first identified and best known eclipsing binary. This type of star is not an intrinsically variable star but an eclipsing binary star where one star passes in front of another. Algol is actually a three-star system, consisting of Beta Persei Aa1, Aa2, and Ab.

The large and bright primary β Persei Aa1 is regularly eclipsed by the smaller β Persei Aa2. Algol's combined magnitude is usually a constant +2.1 but regularly dips to +3.4 every 2.86 days (2 days, 20 hours and 49 minutes). It remains at +3.4 for about 10 hours while Aa2 is in front of Aa1. There is also a secondary eclipse (the ‘second minimum’) when Aa2 is occulted (passes behind) the brighter Aa1. This secondary eclipse cannot be detected visually.

Magnitude is a measure of the brightness of a star. The lower the number the brighter the star appears. Some very bright stars may have a minus magnitude (eg. -1.2).

There are two Messier objects in Perseus these are M34 an Open Cluster and M76 a Planetary Nebula.

Messier 34 (M34)

Messier 76 (M76)

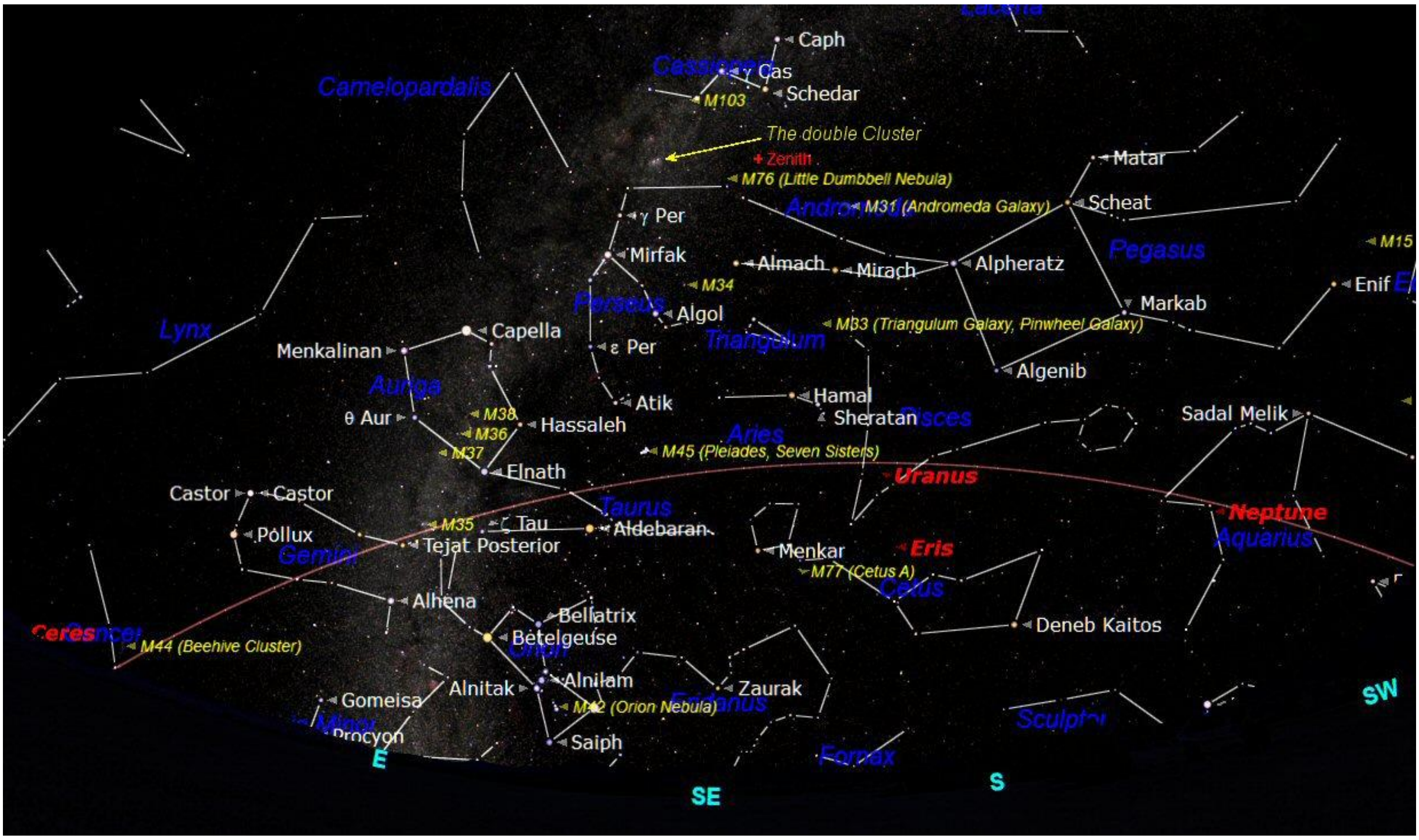
Messier 34 is a group of about 80 stars that formed together from a cloud of gas and dust called a nebula.

M76 is the remains of a star that was about the same size as our Sun but more advanced. It has used up all its Hydrogen fuel and advanced through its Red Giant phase to become a tiny White Dwarf star.

The most beautiful object in Perseus is the Double Cluster which is best seen using binoculars

A binocular object; the Double Cluster, in Perseus

# THE NIGHT SKY - NOVEMBER 2017




The night Sky November 2017 at 21:00 (09:00 pm)

The chart above shows the night sky looking south at about 21:00 GMT on 15th November. 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: Capricornus (the Goat), Aquarius (the Water Carrier), Pisces (the Fishes), Aries (the Ram), Taurus (the Bull), Gemini (the Twins), Cancer (the Crab) and just off the chart to the east and soon to rise is Leo (the Lion).

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, Perseus and into Cassiopeia at the top of the chart. Perseus is the constellation of the month, see page 8.

The outermost planet Neptune is in the constellation of Aquarius but looks small and faint and will need a telescope to see. A *beginner's* telescope will show Neptune as a rather fuzzy looking star with a blue tinge but a larger telescope will show it as a small blue disc. Uranus is located in the constellation of Pisces and is slightly easier to see than Neptune as is only half as far away as Neptune. It appears twice the diameter of Neptune and four times as bright so it can be seen as a small disc using a *beginner's* telescope with a magnification of 100x or more.

The planets Venus, Mars and Jupiter rise just before the Sun in the early morning in the east with Mercury and Saturn setting just after the Sun in the west in the evening. None of these planets are well positioned for observing.

Sitting astride the ecliptic in the south 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 large, faint 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.

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

Following Taurus along the ecliptic is Gemini (the Twins). The twin stars Pollux and Castor are easy to find. There is a lovely Messier Open Cluster M35 in Gemini just off the end of the line of stars emanating from the bright star Castor. Castor is a double star when seen in a telescope.

Close behind Taurus is the faint and elusive stars of Cancer (the Crab). Although Cancer itself is quite difficult to identify it is worth seeking out because at its centre is the lovely open cluster Messier 44 (M44) also known as Pleiades. It is faint but lovely to see using binoculars.

The last constellation worth mentioning is Leo (the Lion). Leo is one of the few constellations that do (with a little imagination) look like what they are supposed to depict. Leo resembles a sitting lion or the Sphinx in Egypt. It has a 'hook' shape or backward '?' for the head and long pentagon lying on its side for the body. Leo is of interest this month because the radiant point for a meteor shower is located in the '?'. The peak of the shower will be on 17th and 18th of November and as the radiant of the shower is located in Leo, it is called the Leonid shower. Every 33 years we expect a very active shower but not this year.

# THE SOLAR SYSTEM NOVEMBER 2017

The next two pages give guidance for finding and observing the Sun, Moon and planets this month. For more details visit the monthly 'What's Up' on the Newbury Astronomical Society's Beginners website at: www.naasbeginners.co.uk.

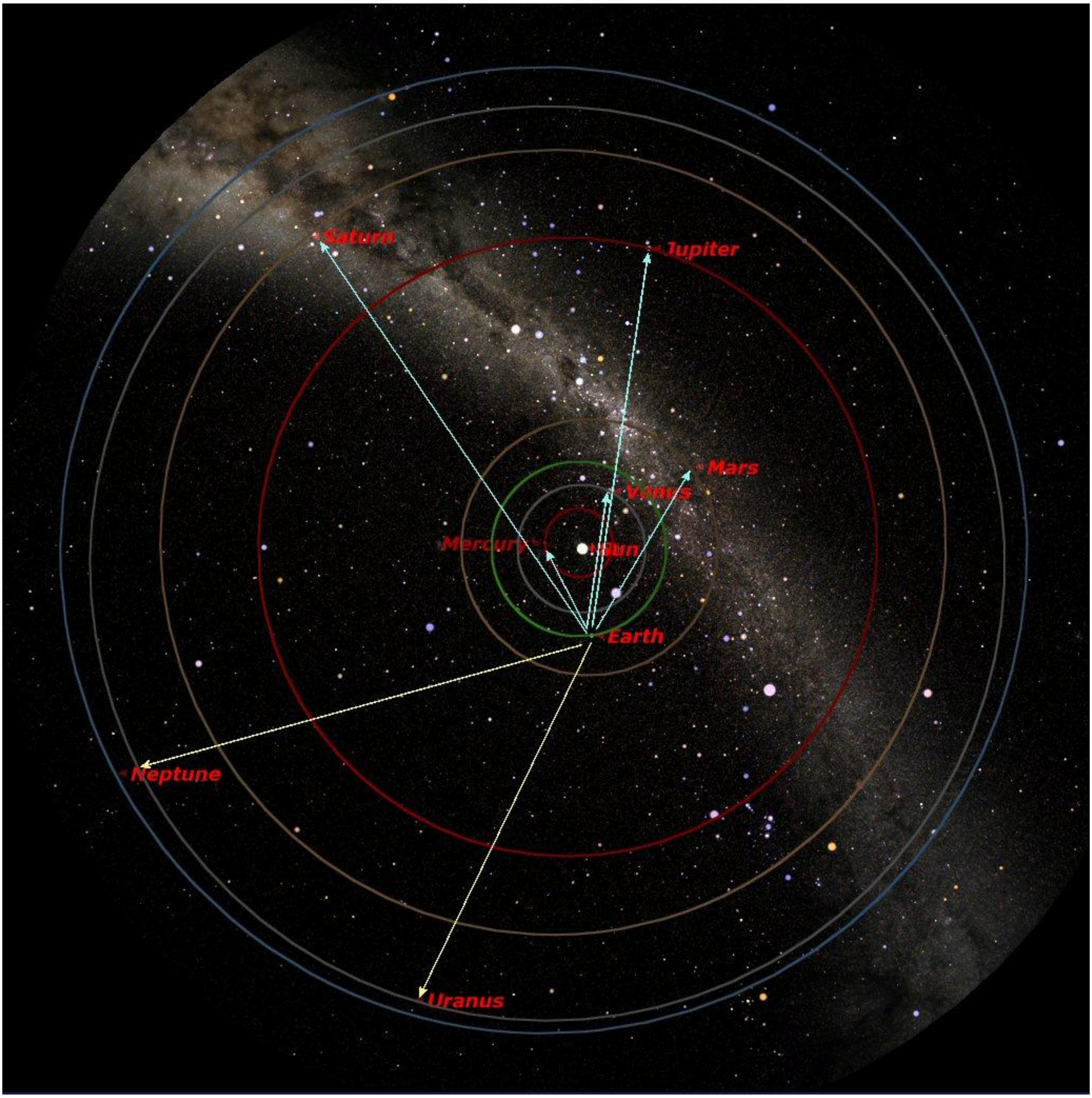
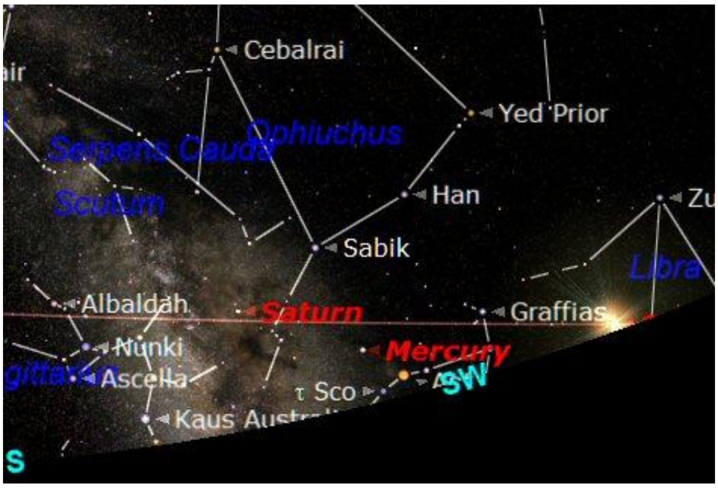



Chart showing the relative positions of planets on the evening of 15th November 2017

The chart above shows the relative positions of the planets this month. Uranus and Neptune are in the direction shown by the yellow arrows and can be seen from the dark of Earth and therefore appear in the night sky. The planets in the direction shown by the blue arrows are in the same direction as the Sun when viewed from Earth. We would be looking from the daytime side of Earth so or may just about see some planets just before sunrise or sunset. As these planets are in the same direction as the Sun it is difficult or impossible to see them.

Saturn and Mercury are close to the Sun and low on the south western horizon in the bright sky at sunset. Uranus and Neptune are well positioned all night in the southern sky. Venus, Mars and Jupiter can just be glimpsed in the very early morning sky just before sunrise low on the south eastern horizon in the brightening dawn sky.

**MERCURY** rises at 08:40 in the beginning of the month and 09:50 at the end of the month. It will rise and set after the Sun therefore will be in the daytime sky and not visible.

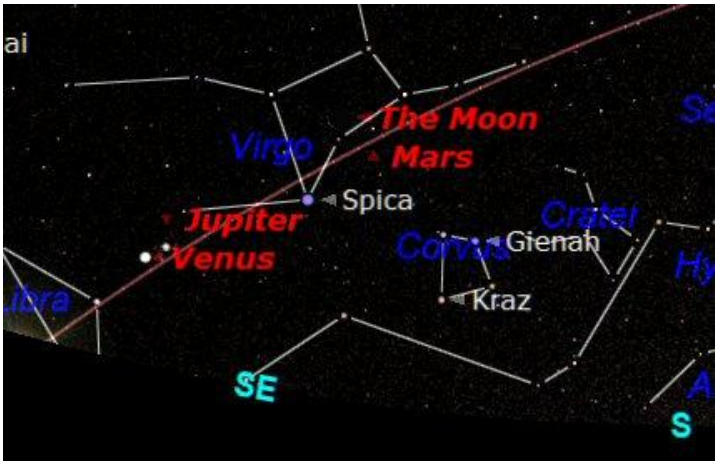



Mercury and Saturn setting in the south west at sunset

**VENUS** rises at about 06:00 this is just an hour before the Sun rises so it will be very difficult to see. See the chart below. With a very clear view to the south eastern horizon Venus may just be visible. It will appear relatively small at 10 arc-seconds and will appear nearly fully illuminated by the Sun. Venus is moving towards the Sun and will be in conjunction (pass behind) the Sun in January.

**MARS** rises at around 03:40 and will be in the south east as the Sun is rising and the sky begins to brighten. The Red Planet appears small at just 4.0 arc-seconds in diameter and is fading to magnitude +1.8. Mars is currently on the opposite side of the Sun to us on Earth and consequently appears very small. See the chart below.

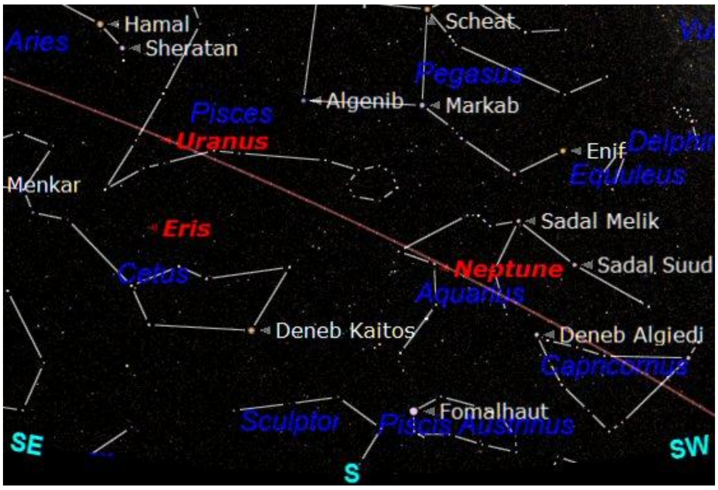
**JUPITER** is just moving out from conjunction with the Sun. It rises at 06:10 at the beginning of the month and 05:25 at the end of the month. It is still close to the Sun and will not be visible. It is very low in the east as the sky is brightening before sunrise at about 07:15. It will not be in a position for observing until the new year and that will be in the early morning before sunrise. The chart below has the sky darkened so the planets can be seen in the south east.




Jupiter, Mars and Venus rising in the east 07:00

**SATURN** will not be visible in the bright dusk sky close to the south western horizon as the Sun sets. The ringed planet rises at about 10:00 this month in daylight so it will not be observable. Saturn sets in the west at about 18:00 a couple of hours after the Sun. See the Mercury Chart.

**URANUS** will be in a very good observable position this month as it was at opposition on 19th October. This means it was due south at midnight (01:00 BST). Uranus may just be visible using a good pair of binoculars but a telescope at a magnification of 100x or higher will be needed to see it as a small blue/green disc. See the chart below.




Uranus and Neptune in the south at 20:00

**NEPTUNE** will be visible in the south as soon as the sky is dark. It was at opposition (due south at midnight – 01:00 BST) on 2nd September. It was then at its best position for observation this year. A telescope will be needed to show Neptune as a small blue/green disc using a magnification of 100x but it is small and difficult to find.

## THE SUN

The Sun rises at 07:00 at the beginning of the month and at 07:40 by the end of the month. It will be setting at 16:30 at the beginning and 15:55 by the end of the month.

## THE MOON PHASES IN NOVEMBER

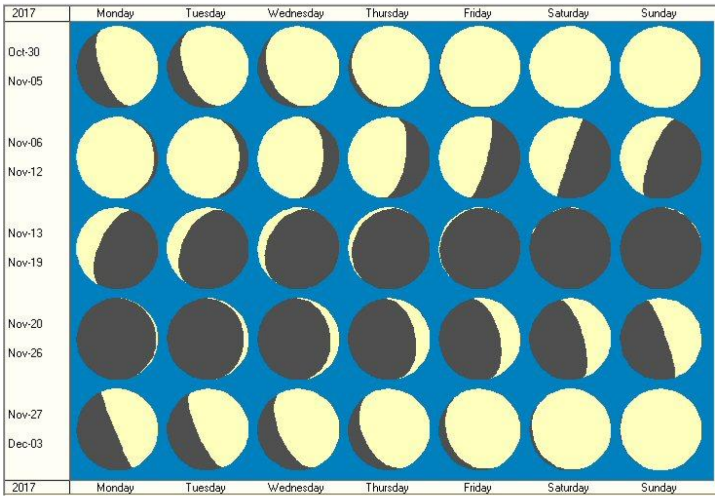
The Moon phases have a monthly cycle.

NEW MOON will always appear in the west at sunset.

FIRST QUARTER is always in the south at sunset.

FULL MOON rises in the east as Sun sets in the west.

LAST QUARTER rises in the east after midnight



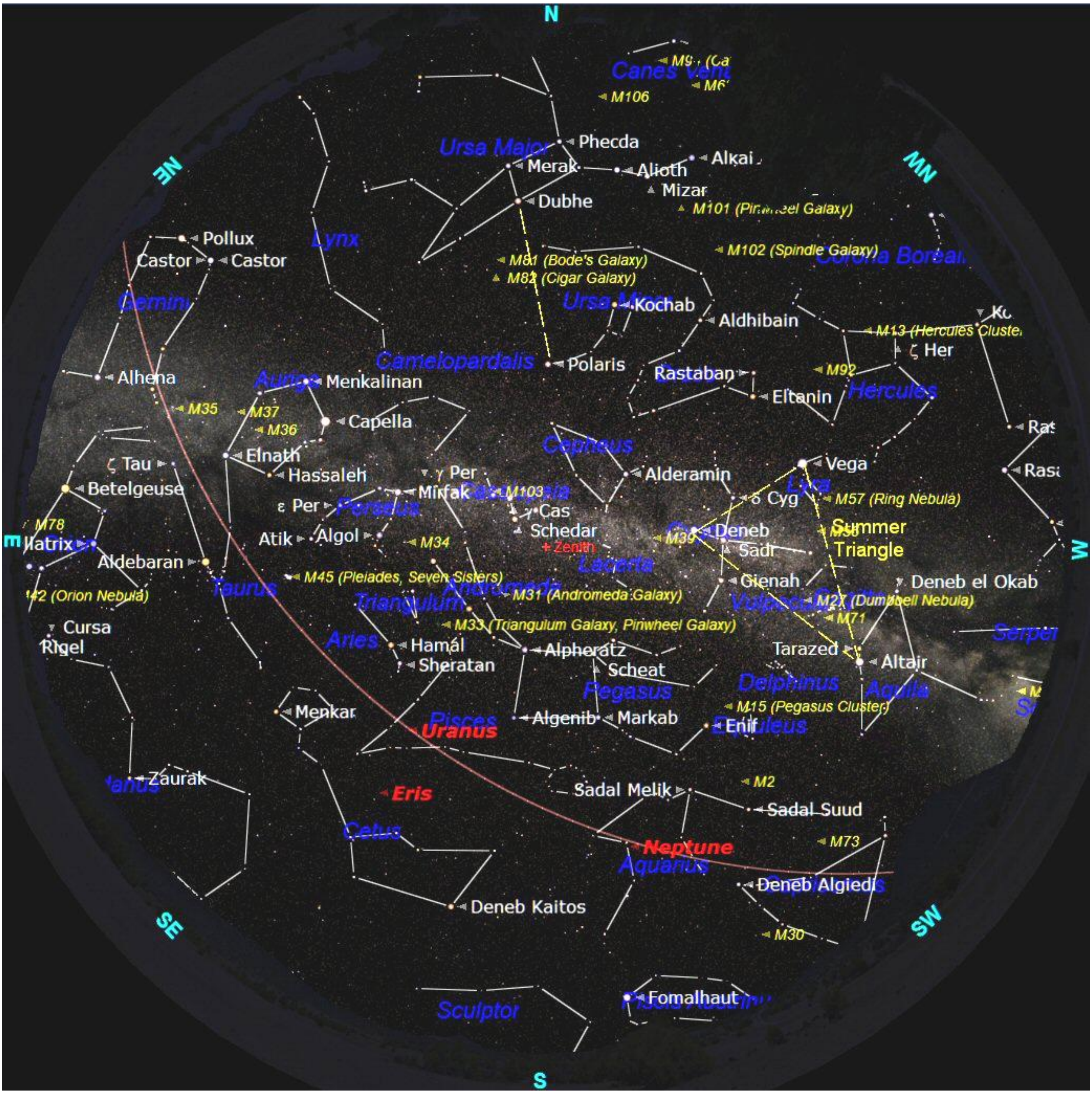

Full Moon will be on 4th November

Last Quarter will be on 10th November

New Moon will be on 18th November

First Quarter will be on 26th November

# THE NIGHT SKY THIS MONTH



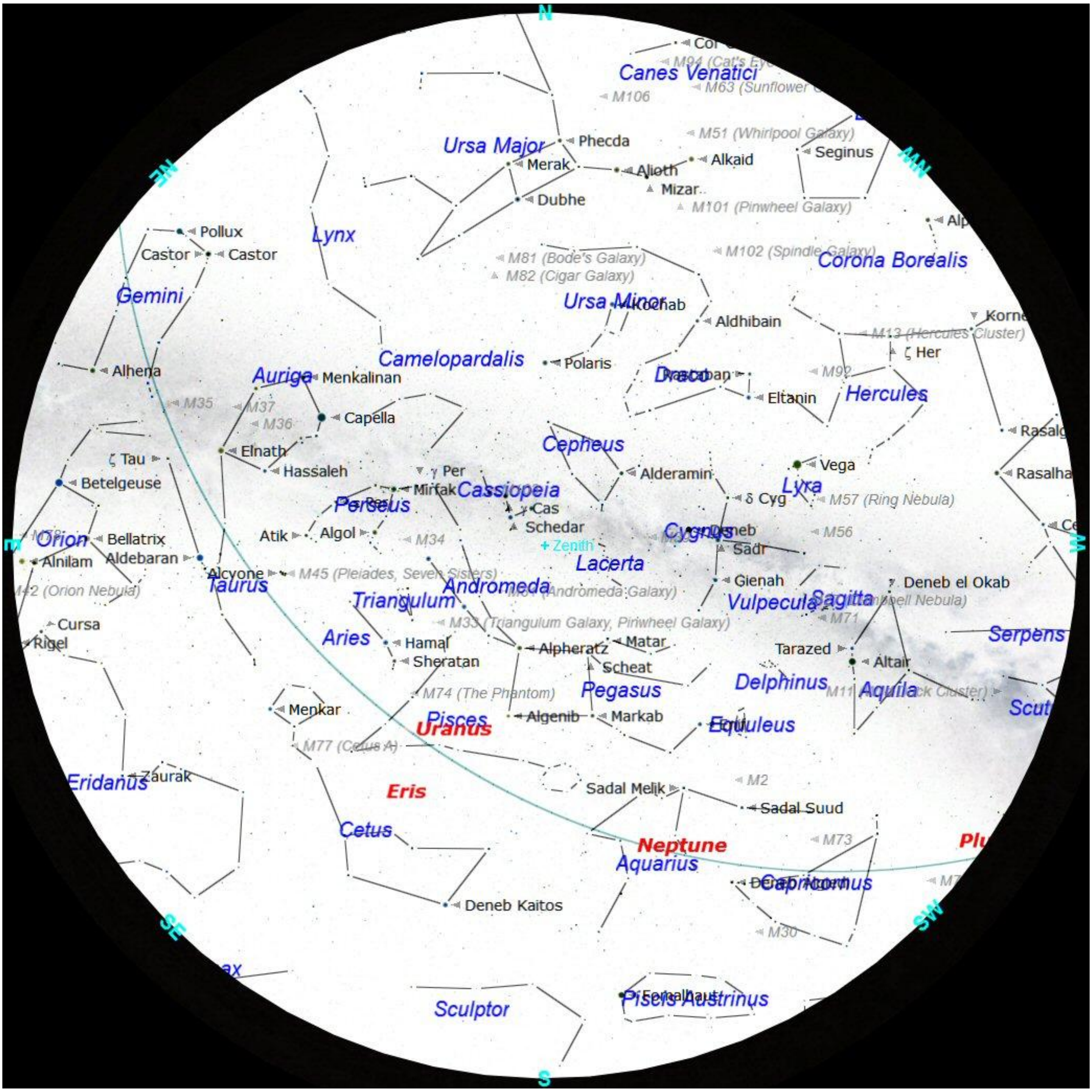

The chart above shows the whole night sky as it appears on 15th November at 21:00 (9 o'clock) in the evening Greenwich Mean Time (GMT). As the Earth orbits the Sun and we look out into space each night the stars will appear to have moved across the sky by a small amount. Every month Earth moves one twelfth 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 quite easy to find. This month it is low over the northern horizon. 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: Uranus and Neptune. Venus is in the east before sunrise.

## THE NIGHT SKY THIS MONTH

This chart below is included for printing off and use outdoors




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

The chart shows the sky at 21:00 on 15th November 2017