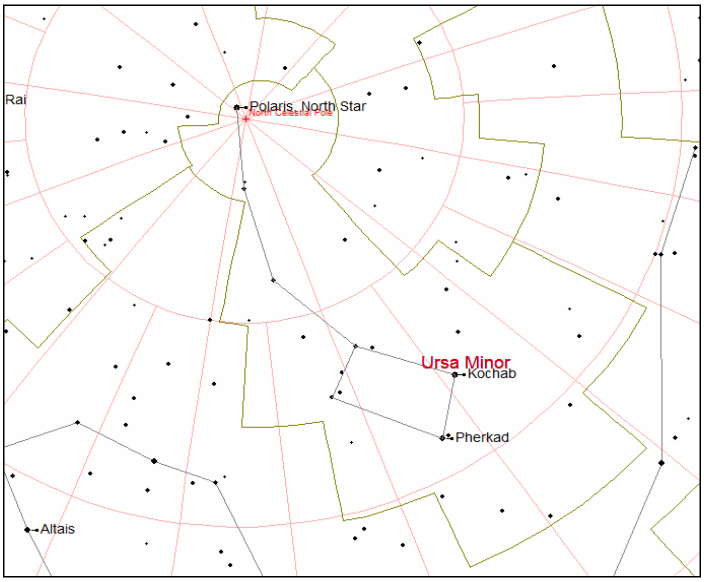
NEWBURY ASTRONOMICAL SOCIETY
BEGINNERS SECTION MAGAZINE – MARCH 2010

THE CONSTELLATION URSA MINOR



Using the 'pointer' stars in the constellation of Ursa Major (The Great Bear) it is easy to find the brightest star 'Polaris' in the constellation of Ursa Minor (The little Bear). See the text following the chart on Page 6. Polaris is the only comparatively bright star in Ursa Minor, in fact it is the only bright (a better term might be: 'less faint') star in this rather barren area of the night sky.

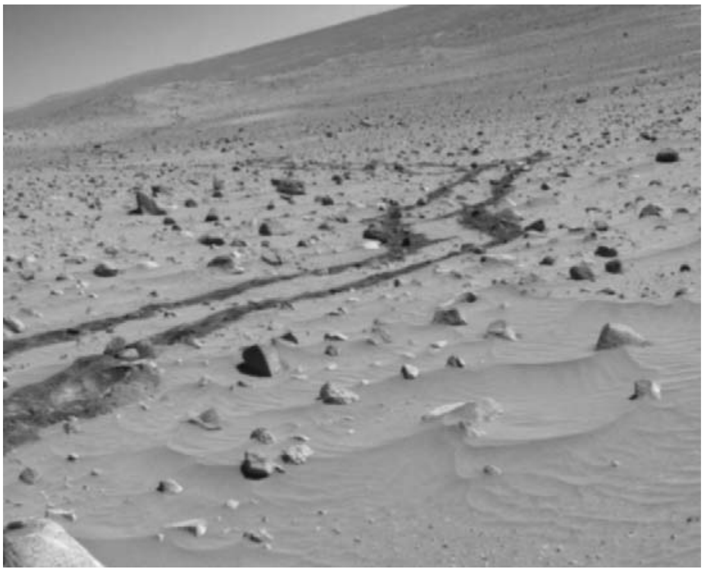
Polaris is an important star because it is located very close to the north celestial pole. The celestial pole is the point in the sky where the rotational axis of Earth points (as shown by the red grid lines on the chart above). There is no star close to the south celestial pole so we are lucky in the northern hemisphere to have a star to help us find this point in the sky. Polaris is not exactly on the north celestial pole it is actually just 44 arc minutes away (1 degree is 60 arc minutes). All the stars appear to rotate around the sky every 24 hours as the Earth rotates on its axis. Because Polaris is so close to the pole it describes a small circle 88 arc minutes in diameter. This is not detectable by eye but a long exposure camera image will show it.

We may ask; why Polaris is important to astronomers? One of the main reasons is that it can be used to align an equatorial mounted telescope before starting to observe. For visual observing simple alignment by eye is often enough to enable the telescope to track a star and keep it in the field of view for 20 minutes or more. If the telescope is to be used for long exposure imaging then a small polar alignment scope can be used to take into account the 44 arc minute displacement of Polaris from the north celestial pole. This will allow the telescope to track an object almost indefinitely.

Polaris has not always been so close to the north celestial pole and will not be there for the longer future. This is due to what is known as precession and is related to a wobble as the Earth spins on its axis. As with a child's Spinning Top, as it spins it also wobbles by an ever increasing amount until it eventually falls over. Earth has a wobble that causes the axis to move in a 47 degree circle every 25,800 years. In a few thousand years Polaris will have moved away from the north celestial pole and our descendants will have no star close to help them find it.

SPIRIT IS TRAPPED FOR EVER

After spending four years limping across .the surface of Mars the Mars Rover named 'Spirit' has finally come to the end of its journey of exploration. In March 2006 Spirit became crippled when its right front wheel became jammed. The jammed wheel did not stop the intrepid explorer and it continued its mission dragging it useless wheel through the sands.



Tracks left by Spirit as it moved across Mars

Unfortunately on 23rd April 2009 Spirit became trapped in a sand pit in the Scamander Crater. NASA scientists and engineers have tried for the last ten months to extradite the explorer from its sand trap but to no avail. Finally NASA has accepted defeat and the sand pit is to be Spirit's final resting place.

Despite being immobile Spirit should be able to continue contributing valuable science for some time into the future. If the stricken rover can survive yet another harsh Martian winter it will be given a new range of tasks to perform. From its now fixed location it will monitor the weather, study the landscape around it in great detail and monitor seismic events (Mars Quakes) and analyse the surface composition around it.

Perhaps the most important task that Spirit will be given is to continuously measure its position very accurately using radio signals. With this information scientists will be able to monitor the wobble in the rotational axis of Mars. From this it is hoped to establish whether the core of Mars is solid or if it is liquid like the core of Earth. If the core has cooled and is now solid it will not flow around causing electrical fields. This could be the reason why Mars does not have a magnetic field like Earth.

Spirit mat be down but it is certainly not out yet.

NEWBURY ASTRONOMICAL SOCIETY BEGINNERS

17th March — All about Dobsonian Telescopes

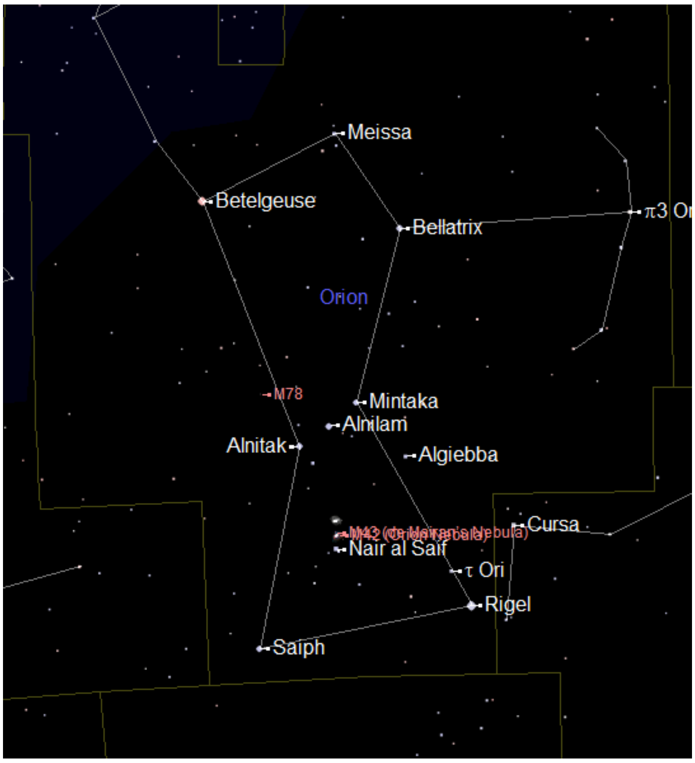
NEWBURY ASTRONOMICAL SOCIETY MEETING

26th March — The Universe is trying to kill us

For all the latest news, don't forget to visit the website on: **www.naasbeginners.co.uk**

WHY ARE SOME STARS BRIGHTER THAN OTHERS?

When we look up into a good clear dark night sky we can see a total of about 6000 stars with our unaided eye (what astronomers call ‘naked eye’). The faintest stars that can be seen with near perfect eyesight and the darkest of night skies away from light pollution are about Magnitude 5 to Magnitude 6. The lower the magnitude number the brighter the star will appear.



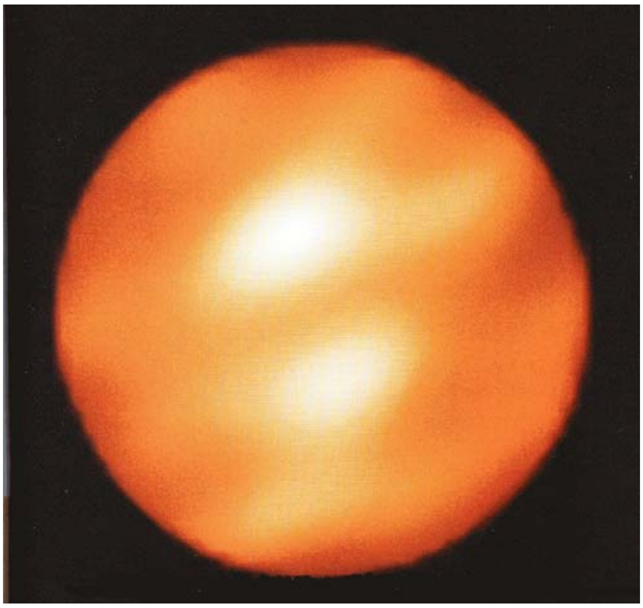
The main stars on Orion

The bright star Betelgeuse in the constellation of Orion is about Magnitude 1 although it varies between 0.4 and 1.2. Rigel which is located at the bottom right of Orion is brighter at 0.14. The stars of Orion’s belt are around magnitude 2. The brightest of the three stars that form Orion’s head Meissa is magnitude 3.3 and noticeably fainter. Imbedded within the Great Nebula is the Trapezium. The brightest of the four stars in the Trapezium is called C and is magnitude 5.4. So why are these stars that are located in the same area of sky so different in brightness?

There a three reasons why stars appear to have different brightness to our eyes. These are the intrinsic brightness of the star, its size and its distance.

Some stars are very bright because they are large. We must be careful when we say a star is large because there are two kinds of large star. There is a massive star which has a very large amount of what stars are made of and that is Hydrogen Gas. A convenient measure of stellar size used by astronomers is to compare other stars to the size of our Sun. So we can say our Sun is 1 Solar Mass is size. The very bright twinkling star to lower left of Orion is called Sirius and it has a mass twice that of the Sun (2 Solar Masses). Being twice the mass of the Sun it consumes its Hydrogen much faster and is significantly brighter and hotter than the Sun. Rigel in Orion is one of the most massive stars in our sky with some estimates up to 50 Solar Masses. It is classed as a Blue Super Giant and produces millions of times the energy output of our Sun. It is one of the brightest stars in our part of the galaxy.

Another measure of size is the diameter of a star which may not be related to its mass. Betelgeuse is a super giant star if we consider its physical size in fact it is one of the largest stars measured by it diameter that we know of. It is in the region of 1600 times the diameter of our Sun. If Betelgeuse was to replace our Sun its outer layers would extend to half way between the orbits of Mars and Jupiter. It is so big that it is the only star that can be seen as a disc using giant telescopes. However the surface temperature is cool at 3100°K when compared with the brighter surface of our Sun at 6400°K and the blistering hot, bright surface of Rigel at 12,000°K.



Betelgeuse can be seen as a disc

The third factor that governs the apparent brightness of a star is its distance. If two stars are the same absolute brightness but one is twice as far away, the nearer one will appear four times brighter. If we then consider a third star of the same intrinsic brightness but four times as far away it will be sixteen times fainter. This effect is known at the ‘inverse square rule’. This states that if an object is twice as far away it will appear 2^2 (2 x 2) = 4 times as faint. If it is twice as far again (4 times as far) then it will be 4^2 (4 x 4) = 16 times as faint. This means that distance has a major effect on the perceived brightness of a star.

If we now compare the two stars in Orion: Betelgeuse and Rigel we can see how complicated it can be. Betelgeuse has a larger diameter but Rigel has a much brighter surface. Betelgeuse is 420 light years away from us whereas Rigel is over twice as far at 900 light years away. This means that its light will have be reduced to a quarter of what it would have been if it was at the same distance as Betelgeuse. The result is that Betelgeuse appears to us as between magnitude 0.4 and 1.2 (because it is variable) and Rigel appears a little brighter at magnitude 0.14.

Just a quick word about magnitudes. A star one magnitude brighter than another star will actually be 2.512 times brighter. So if two stars have a difference in brightness of 2 magnitudes then the difference in their actual brightness will be 2.5 x 2.5 = 6.3 times brighter. A three magnitude difference will be 2.5 x 2.5 x 2.5 = 15.8 times brighter.

THE DOBSONIAN TELESCOPE

There are may different designs of telescopes and many different types all built to serve a particular requirement. The requirement may be to observe planets or perhaps to specialise in astro-imaging but there is always a defining requirement for the amateur astronomer and that is cost. This requirement is usually: what is the best instrument that I can get for what I can afford.

Back in the 1970's the cost of a decent sized good quality telescope would have been out of reach for most potential new astronomers. The answer in the 1970's was much the same as it had been in the previous 70 years and that was to make your own telescope. Up until the 1990's this was still an option and a challenge taken up by many people who even joined clubs of other enthusiastic budding astronomers to grind their own mirrors and make their own telescope.

Mountings designed and built by the enthusiastic amateurs tended to follow the traditional heavily built equatorial design. This design requires a certain amount of engineering input and a good deal of skill in making things. This remained the case until American amateur astronomer John Dobson started a revolution in telescope mounting design.

John Dobson the designer of the Dobsonian Mount

Dobson began to realise that people could make mirrors and mount their mirror in a tube to produce a good telescope but many struggled to build the mounting to support the tube. So he set about the task of designing a simple mounting that most people could make in their shed or garage using simple tools.

The first thing Dobson did was to study the basic requirements of a telescope mount. He then worked out the simplest design to meet each requirement. Amongst the things he soon discovered were things like: most people just wanted to look through the telescope and not take long exposure photographs. This meant that an equatorial type mounting was not essential. This also meant that a mechanical drive was not necessary to accurately track an object as it appeared to move across the sky due to the rotation of Earth. The telescope could be moved by the observers as they were looking through the eyepiece.

As the axis of Earth is tilted by about 23° objects appear to move across the sky in an arc form the east to the west as night progressed. This meant that the mounting needed to have two directions of movement up and down and side to side.

John Dobson then set about designing a mounting that had these four main requirements:

1. To support the tube and allow it to move up and down 90° (from Horizon to Zenith).
2. Provide movement for the tube horizontally through 360° (to swing around in all directions).
3. To be smooth and easy to move by hand.
4. Be a simple and cheap as possible to make.

He achieved all these requirements in a revolutionary design that was to become known as the 'Dobsonian Mounting'.

One of John Dobson's early mountings

His design was one of those ideas that always make people say "why didn't anyone think of this before". It was simple but brilliant. The basis was a three sided box structure mounted on a 'turntable' to provide horizontal rotation. On top of the box was a 'Trunnion' bearing, much like that used to support an old cannon on its carriage. This bearing allowed the tube to swing up and down.

Steve Harris' 6″ home made Dobsonian telescope

In combination with the very simple Newtonian reflecting telescope design, the Dobsonian became the instrument for the amateur telescope maker to build. Because of its simplicity even a large telescope could be manufacture at a very modest cost. The design created a light and very portable telescope that could be taken to a dark viewing site in the boot of most family cars. On arrival at the observing site the telescope could be set up and operational in minutes. The manual movement technique is very simple and with a little practice becomes automatic. The Dobsonian is still a very popular design and can now even be bought in shops.

USING A DOBSONIAN TELESCOPE

Simplicity is the driver behind the Dobsonian telescope design from the simple Newtonian telescope tube to simplified Alt-Azimuth mounting it is easiest telescope to make and to use.

Often the telescope is transported in two sections, the tube assembly and the mounting but this depends on the size of the instrument. Very large instruments may need to be disassembled further to permit manual handling.

To set up a small Dobsonian it is a simple matter of carrying the base unit to the observing site and putting it down in the desired position. A word of caution is required here and it is to position the mount on a reasonable level piece of ground. The turntable mechanism may be so light to turn that a slope may cause the telescope to rotate inadvertently.

The next operation is to carry the tube assembly and place it on to the base mount. The bottom of the tube must fit into the open side of the box section or it will not be able to be elevated. The telescope is now ready to use. However as with all telescopes (especially those with an open tube) time must be allowed for the optics to cool and stabilise. This normally will take about 20 minutes. It can still be used in this time but it will take at least 20 minutes before it will start to perform at its best.

As with all telescopes it is first prudent to check that the finder scope has not been accidentally knocked out of alignment during transport or setting up. This is simple and can be done while the telescope is cooling down. Fit a low power eyepiece into the focuser (something like a 25mm eyepiece should be used to start observing anyway). Find the brightest star or planet around and point the telescope at this object. Centralise the object in the finder then look into the main telescope. If the object is in the centre of view then all is fine and as it should be. If it is not central then move the telescope until it is in the centre of the eyepiece. Using the adjusting screws on the finder align the finder on to the object check that the object is still in the centre of the eyepiece. Repeat this until the object is central in the main telescope and the finder.

When using the telescope for the first time spend some time getting used to moving the telescope to keep the object in the field of view. With a little practice this is soon mastered. Find a bright object using the finder and then centralise the object in the main telescope (use a low power eyepiece for this). Watch the object through the eyepiece and notice how quickly it moves across the field of view. When it is approaching the edge of the field of view gently move the tube to bring the object back to the centre. Hold the body of the focuser to move the tube and try not to put your fingers around the lip of the tube. The heat from your hand may cause heat waves to ripple across the tube into your field of view and disrupt the image.

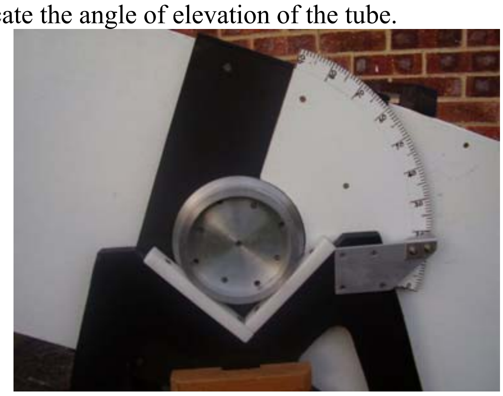
Develop the technique of gently moving the tube so the object is positioned across the field of view to the far side. This will allow more time to study the object as it moves across the whole field of view. Practice this for a few minutes then carefully replace the eyepiece with a 10mm eyepiece without moving the tube. Repeat the alignment technique but this will now be a bit more difficult. The object will appear to move much quicker and less movement and more gentle movement of the tube will be required to reposition the object. With a little practice the technique will soon be mastered.

ADVANCES TO THE DOBSONIAN DESIGN

Large Dobsonian telescopes often use an open truss tube design to produce a lighter and more portable instrument. The tube is split into two parts the eyepiece end and the main mirror end. The two sections of the tube are then joined together using a number of tie rods.

Richard Fleet's 20″ Open Truss Tube Dobsonian

A useful modification to the Dobsonian mount is the fitting of Setting Circles. These can be used in conjunction with a computer planetarium application to help locate objects in the sky. An 'Alt' scale (up and down) of 90° can fitted to the tube to indicate the angle of elevation of the tube.

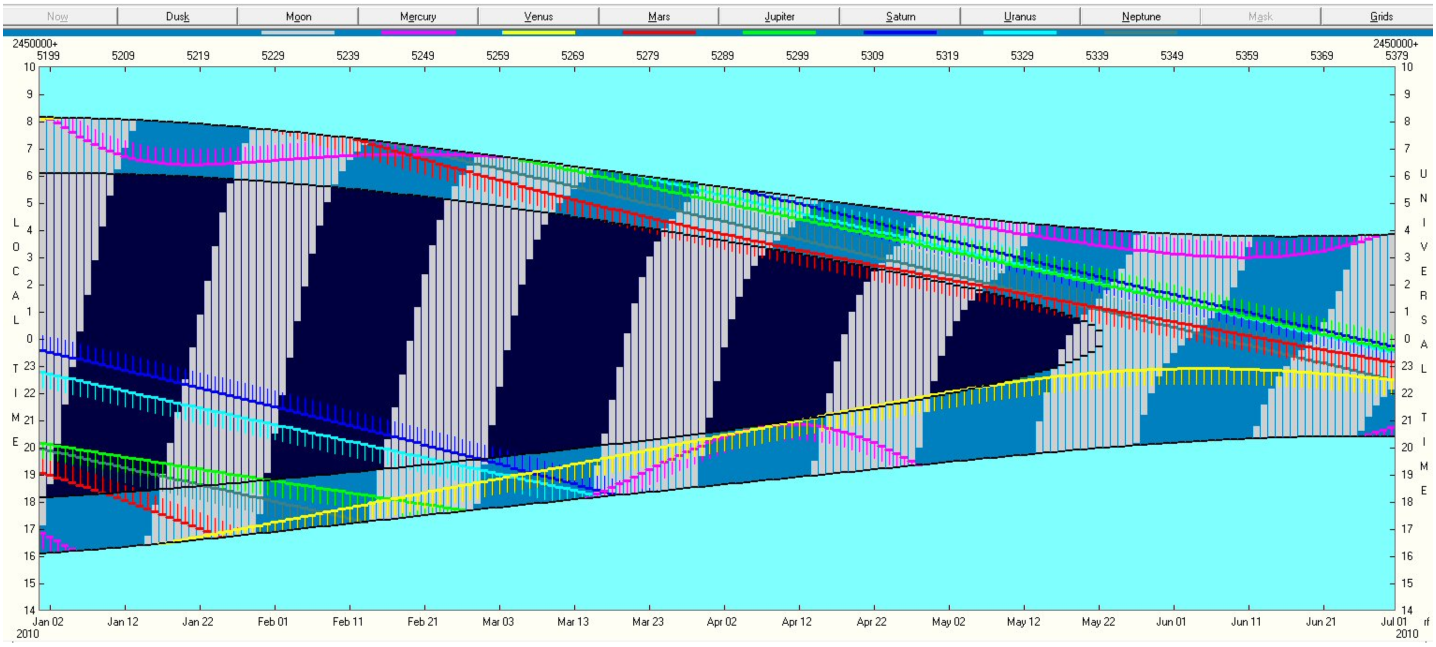


The Alt (up and down) Setting Circle

A 360° Setting Circle can be fitted to the turn table base to indicate the Azimuth (horizontal rotation) position.

The Azimuth (horizontal rotation) Setting Circle

The Alt – Azimuth co-ordinates of the object can be obtained very easily from a computer planetarium programme and used to align the telescope on to that object.



THE SOLAR SYSTEM JANUARY 2010

The chart above is from Richard Fleet's GRAPHDARK application that can be downloaded free from his website at: www.rfleet.clara.net .

The dates for the next 6 months are shown along the bottom of the chart and the time up the sides. The areas shown light blue at the top and bottom indicate daylight. The lower thick curved line shows the start of dusk and the upper shows the end of dawn (full daylight). The conical curved black line shows full darkness. The thinner curved black lines show the legal 'lighting up' times. The curved vertical bands show the Moon phases (white the moon is in the sky, black it is not). The coloured lines show the times when the planets are visible. The vertical bars on the lines indicate when the planet is visible. Bars below the line show the planet is visible from sunset up until the time indicated by the line. Above the line indicates it is visible from the time indicated up until dawn.

MERCURY moves out from conjunction with the Sun during the first half of the month. It will be visible low on the western horizon in the evening setting at 19:25 (a full hour after the Sun) by the end of March.

VENUS can be seen in the west as the Sun sets at 18:22 with Venus following the Sun over the horizon at 19:58.

MARS rises in the east at midday mid month and will be due south at 20:40. It still appears small but will be in a good position for most of the night. By 19:00 it will appear like a bright reddish star high in the south east. A telescope will be required to see its small 12 arc second reddish coloured disc. A larger telescope will shown some of the more distinctive surface markings and the white polar ice cap.

Mars imaged using a webcam on 6th March 2010

JUPITER will be too close to the Sun to be seen this month.

SATURN rises in the east at 18:30 as the Sun sets in the west. It will be high enough for viewing by 20:00 and very well placed in the south by midnight. It reaches opposition towards the end of the month (22nd March). The ring system is just starting to open out again after appearing edge on for most of last year. It is just possible to see the Cassini Division (the gap in the ring system) but it does require a larger telescope.

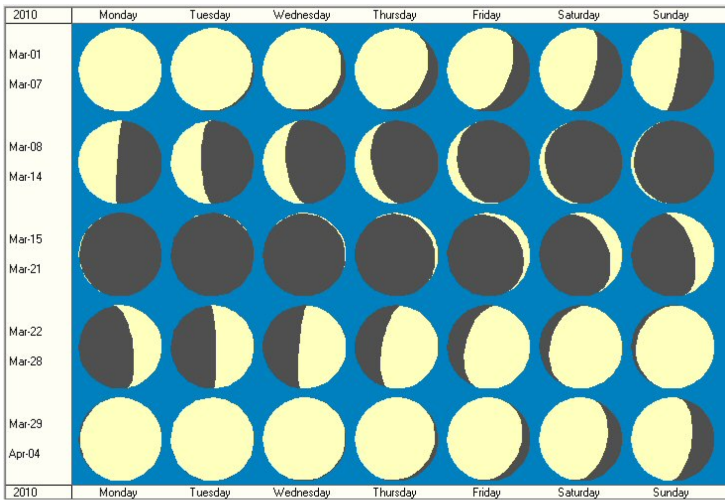
URANUS is behind the Sun and not observable this month.

NEPTUNE is now in conjunction with the Sun and will not be observable this month.

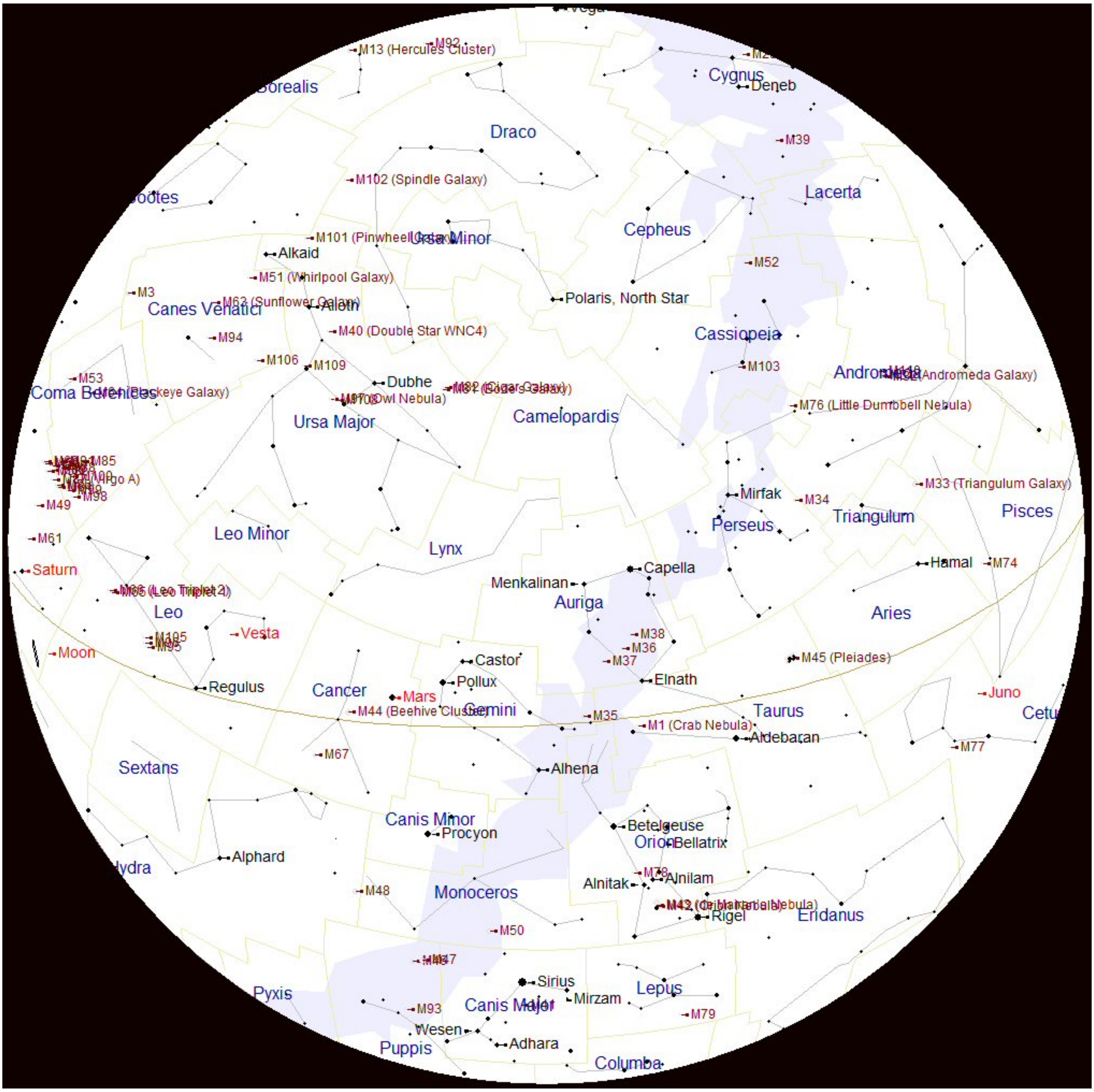
THE SUN There has been some Sunspots recently to enlighten the hitherto bland views of the Sun. The Sun has an eleven year cycle of increasing sunspot activity. We should now be well into the period of maximum activity but the activity has been very sparse until the last few months with almost no activity at all.

A special solar filter must be fitted to a telescope to view sunspots or the image can be projected on to a screen. DO NOT LOOK DIRECTLY AT THE SUN IT WILL CAUSE BLINDNESS.

THE MOON The phases of the Moon this month:



THE SKY THIS MONTH



The chart above shows the night sky as it appears on 1st March at 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 middle of the month and at 7 o'clock GMT at the end of the month. Due to the Earth rotating once every 24 hours, the stars also appear to move 15º (360º divided by 24) each hour from east to west.

The centre of the chart will be the position in the sky directly overhead. 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 high in the north east. Look for the distinctive saucepan shape, four stars forming the bowl and three stars forming the handle. Follow an imaginary line, up from the two stars in the bowl furthest from the handle. These will point the way to Polaris which will be to the north of overhead at about 50º above the northern horizon. Polaris is the only moderately bright star in a fairly empty patch of sky. When you have found Polaris turn completely around and you will be facing south. To use this chart, position yourself looking south and hold the chart above your eyes.