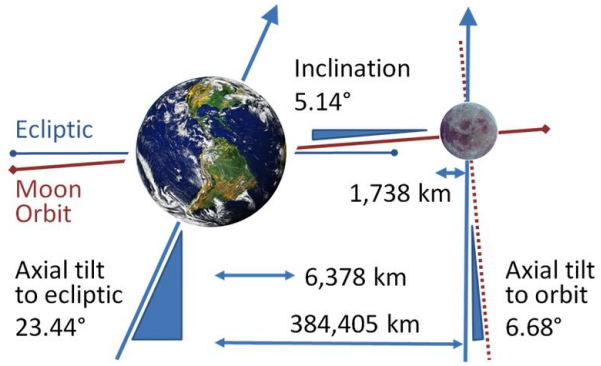
NEWBURY ASTRONOMICAL SOCIETY
BEGINNERS MAGAZINE - MAY 2011

IS THE MOON ALWAYS THE SAME SIZE?

During March this year there were stories in the media suggesting that the Moon would be much closer to Earth and appear exceptionally large in the sky. It was further suggested that recent earthquakes could have been triggered by the combined gravity of the Sun and the extra gravity of the closer Moon. This is very unlikely to be true as the Moon regularly approaches and moves away from Earth with only minor effects such as slightly higher tides.

Astronomically speaking the Moon appears large in the sky with an apparent diameter of about ½ degree. By pure coincidence this is virtually the same apparent diameter as the Sun as seen from Earth. For this reason we are able to enjoy the spectacle of the total eclipse. Due to the slightly elliptical orbit of the Moon around Earth and Earth around the Sun, the apparent sizes do vary causing a difference in the comparative sizes. Sometimes the Moon appears too small to completely cover the Sun and an 'annular' eclipse is seen. Sometimes when the Moon appears significantly larger than the Sun, a longer lasting eclipse occurs.

Due to the axial tilt of our planet the Sun, Moon and planets all appear to move along an imaginary line tracing an arc across the sky, we call this line the Ecliptic. The Moon moves around Earth on an orbital plane that is tilted at 5.14°. This tilt means the Moon can appear up to about 3° above or below the ecliptic (see the position of the Moon on the chart on Page 6).



The average Earth / Moon centre distance is 384,405km but because the orbital path of the Moon is elliptical the Moon can be as far away as 405,500km or as close as 363,300km. This can make a difference in distance of 42,200km which can make a change of nearly 10% in the apparent size of the Moon.

The comparative size of the Moon closest and most distant

There is also another factor that can affect the apparent size of the Moon. This is the illusion that makes the Moon look much larger when it is close to the horizon. Although this happens every month it is especially noticeable when the Moon is full and is enhanced when the Moon is at its closest approach to Earth on its orbit as happened in March.

It is obvious that the Moon cannot change size over the couple of hours that it takes to rise well above the horizon. Yet the Moon definitely appears very big when it is just above the horizon but appears much smaller when directly overhead. The effect is wholly due to the illusion created in our brain when it tries to compare the size of the Moon to familiar objects on the horizon such as trees or buildings. Our brain cannot relate the extreme distance of the Moon when it is close to those familiar objects so it tries to estimate the size and the illusion is created. A simple test is to hold the un-sharpened end of a pencil up at arm's length to cover the Moon when it is low. Repeat the test when the Moon is high and with no surprise we find it is the same size.

Visually the Moon is the second brightest object in the sky, only exceeded by the Sun. From our vantage point, on Earth, we see the Moon illuminated by the Sun at different angles as the Moon moves around its orbit. These changes are known as the Moon phases. When the Moon is positioned between the Sun and us, the far side is illuminated and the side facing us is dark so we can't see it. As the Moon moves around us the bright side gradually appears and we are presented with a 'New Moon'. When the Moon has moved a quarter of the way around the Earth we see half the Moon illuminated. At the point where the Moon is on the opposite side of Earth to the Sun the whole of the Moon facing Earth is illuminated, giving us a 'Full Moon'.

NEWBURY ASTRONOMICAL SOCIETY MEETING

6th May — The most distance objects in the Universe

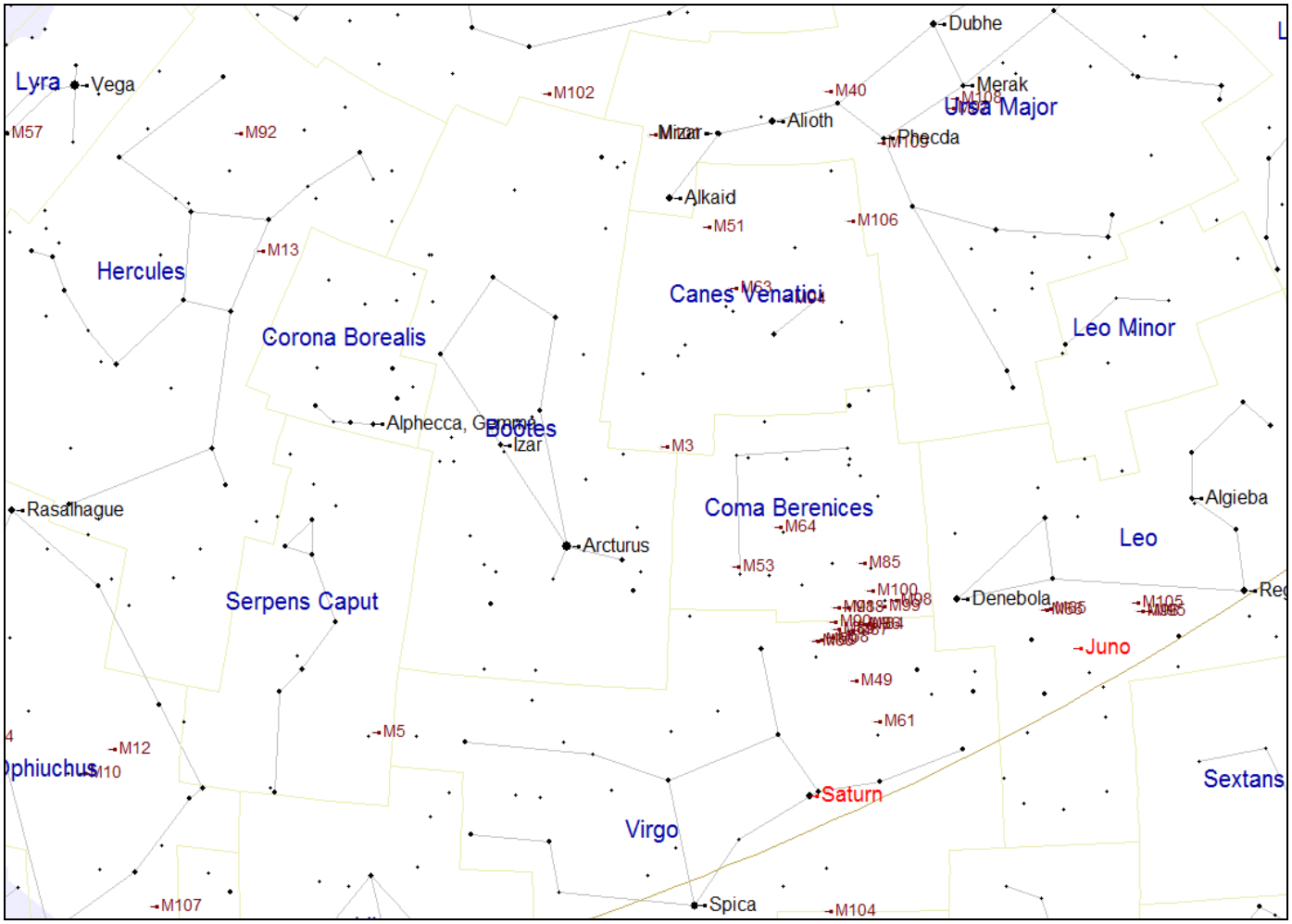
Website: **www.newburyas.org.uk**

THE NEXT NEWBURY BEGINNERS MEETING

18th May — Meteors, Meteorites and Meteoroids

Website: **www.naasbeginners.co.uk**

THE SPRING CONSTELLATIONS



The chart above shows the night sky looking south at about 22:00 British Summer Time (BST). The bright star Spica in the constellation of Virgo is almost directly south and about 20° above the horizon. To the north (above) and to the west (right) of Spica is the planet Saturn also in the constellation of Virgo.

Passing through Virgo is the ecliptic shown as an orange coloured line. This is the imaginary line along which the Sun, Moon and planets appear to move across the sky. The constellations that the ecliptic passes through are known as the constellations of the Zodiac. Along the ecliptic towards the west is the constellation of Leo the Lion. Along the ecliptic towards the east is the constellation of Libra (out of view).

Leo is one of the few constellation that does look (with some imagination) like what it is supposed to represent. The shape of the backward question mark (?) looks a bit like a lions head with its mane. The other stars from Regulus at the bottom of the '?' to Denebola could be the body of the lion as it rests on the ground. In the space between Leo, Virgo and Coma Berenices is the Virgo Galaxy Cluster. This is, as the name suggests, a cluster of near-by galaxies. A modest sized telescope would be able to reveal a number of these galaxies on a good clear night from a dark location.

To the east of Coma Berenices is the 'kite shaped' constellation of Boötes. The glory of Boötes is the bright orange star Arcturus which is the 4th brightest star in our night sky. Seen with the naked eye Arcturus looks faintly orange but using a pair of binoculars or a telescope it is seen as a stunning bright orange star. Arcturus is an old red giant about 20 times the size of our Sun that is approaching the end of its life.

Almost directly overhead and at the top right of the chart is the very familiar shape of Ursa Major – The Great Bear (sometimes called the Plough). More than anything else it has the shape of a saucepan. The two stars Debhe and Merek are of course the 'pointers to Polaris the Pole Star. The star Mizar in the centre of the handle is a naked eye double star, a small pair of binoculars will show it very clearly. The smaller companion star is called Alcor. A telescope will show that Mizar is also a closer double star in its own right.

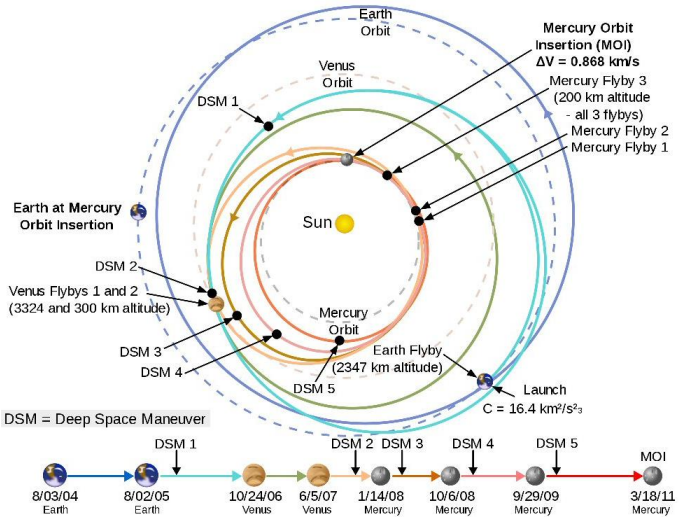
Off the end of the saucepan handle is the faint and indistinctive constellation of Canes Venatici. It has no bright stars but it does host the famous M51 Whirlpool Galaxy. From a dark location and using a larger telescope the spiral arms can be made out. M51 is actually a pair of colliding spiral galaxies that have had a close encounter. Over the next few hundred million years they will collide and pass through each other a number of times and eventually merge into one.

To the east of Boötes is the constellation of Hercules which has a distinctive distorted square at its centre. This shape is known as the 'Keystone' due to its resemblance to the central stone in a stone arch. Two thirds of the way up the western vertical side of the 'keystone' is the beautiful globular cluster known as M13. This stunning ball of about a million stars is visible in a pair of 10 x 50 binoculars as a small fuzzy patch of light. A small telescope will show it as a ball of stars but a larger telescope will reveal its true glory and even show individual stars on the edge of the cluster. Globular Clusters are satellite systems of our galaxy and can also be seen around other spiral galaxies.

MERCURY THE ELUSIVE PLANET

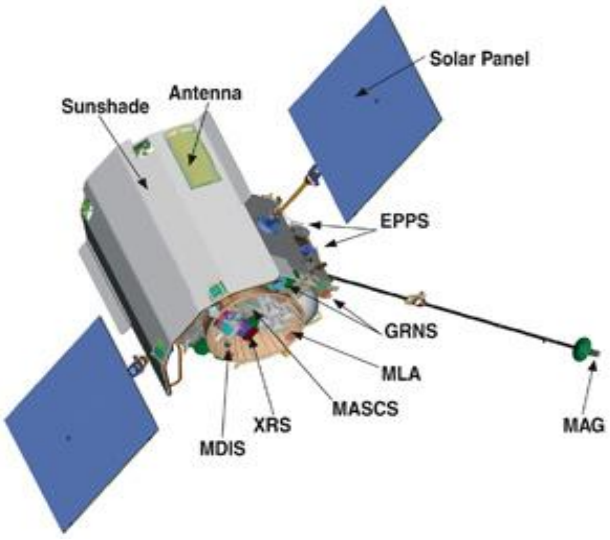
On the 17th March the NASA Mercury exploratory probe MESSENGER fired its engines to enter orbit around the solar system's smallest planet. The craft had spent the last six and a half years looping around the inner solar system during its complicated trajectory from Earth to Mercury.

MESSENGER (the acronym for: MErcury Surface, Space ENvironment, GEochemistry and Ranging) arrived in orbit to start taking pictures of Mercury from its orbit around the planet. This the first imaging opportunity from orbit, the only other 'close-up' images were taken during a fly-by of Mercury by Mariner 10 in 1974 and 1975. Messenger used a fly-by of Earth, two close encounters with Venus and three passes of Mercury to obtain the correct orbital speed and position.



The route taken by MESSENGER to reach Mercury

After obtaining its final orbit in March it began imaging and probing the whole surface with its suite of on-board instruments.

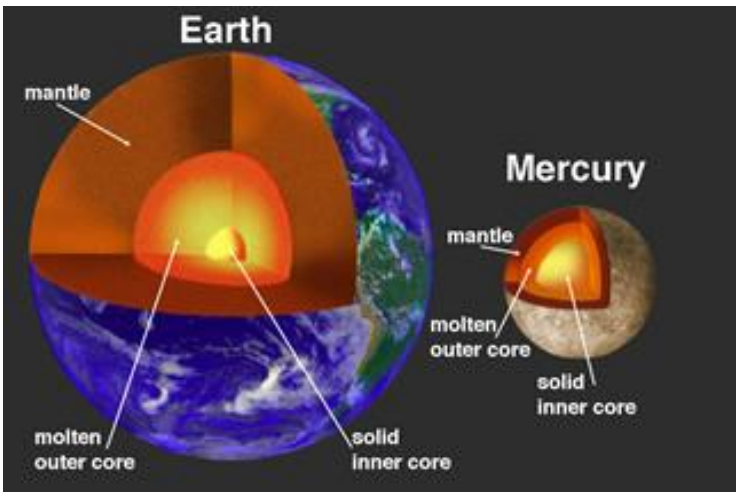


The science instruments on MESSENGER are:

EPPS	Energetic Particle and Plasma Spectrometer
MAG	Magnetometer
GRNS	Gamma-Ray and Neutron Spectrometer
MLA	Mercury Laser Altimeter
XRS	X-Ray Spectrometer
MDIS	Mercury Dual Imaging System
MASCS	Mercury Atmospheric and Surface Composition Spectrometer

Mercury, Venus, Earth, and Mars are terrestrial (rocky) planets. In a number of ways Mercury is an extreme member, for example it is: the smallest, the densest planet and it has the oldest surface. Being closest to the Sun it has the most extreme daily variations in surface temperature and is currently the least explored planet.

Understanding this 'odd ball' among the terrestrial planets is crucial to developing a better understanding of how the planets in our Solar System formed and evolved. To develop this understanding, the MESSENGER mission spacecraft and science instruments are focused on answering the outstanding questions that will allow us to understand Mercury as a planet.



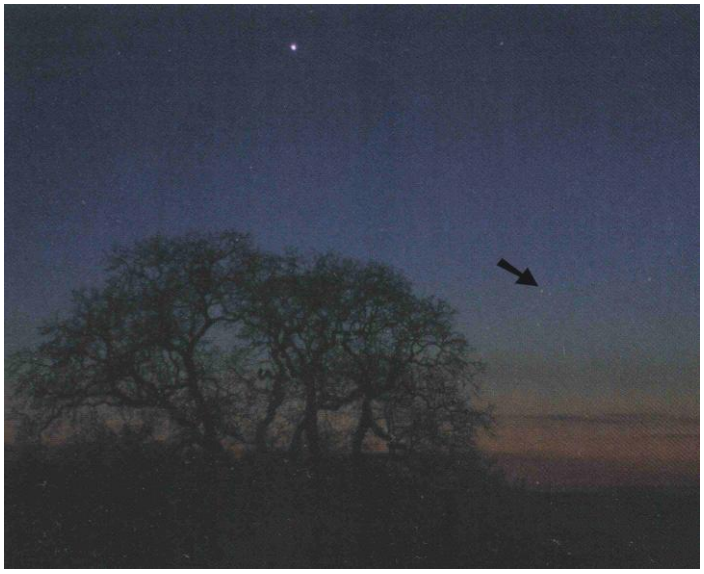
Comparison of Earth and Mercury

Each of the terrestrial planets consists of a dense iron-rich core surrounded by a rocky mantle, composed largely of magnesium and iron silicates. The topmost layer of rock is a crust formed from minerals with lower melting points than those in the underlying mantle. The crust by differentiation early in the planet's history or by later volcanic or magmatic activity. The density of each planet provides information about the relative sizes of the iron-rich core, the rocky mantle and crust, since the metallic core is much denser than the rocky components. Mercury's uncompressed density (what its density would be without compaction of its interior by the planet's own gravity) is about 5.3 grams per cubic centimetre, by far the highest of all the terrestrial planets. In fact, Mercury's density implies that at least 60% of the planet is a metal-rich core this is twice as great as for Earth, Venus, or Mars! To account for about 60% of the planet's mass, the radius of Mercury's metallic core must be approximately 75% of the radius of the entire planet.

Two instruments will help to understand the affect of the unusually large metal core and the magnetic field it may generate. MAG is the instrument that will map Mercury's magnetic field. It will also search for regions of magnetised rocks in the surface crust. Radio Science (RS) will use radio waves to study the Doppler Effect to measure very slight changes in the spacecraft's velocity as it orbits Mercury. This will allow scientists to study Mercury's mass distribution, including variations in the thickness of its crust.

Prior to MESSENGER only 45% of Mercury's surface had been seen by spacecraft during the Mariner 10 mission. Combining the Mariner 10 photos with the images from MESSENGER's three Mercury flybys, about 98% of the surface of Mercury has been seen in detail. Now with MESSENGER in orbit it is possible for the first time to begin to investigate Mercury's geologic history on a global basis. Many interesting things have already caught the eye of the scientists during fly-by visits but there is much more to come.

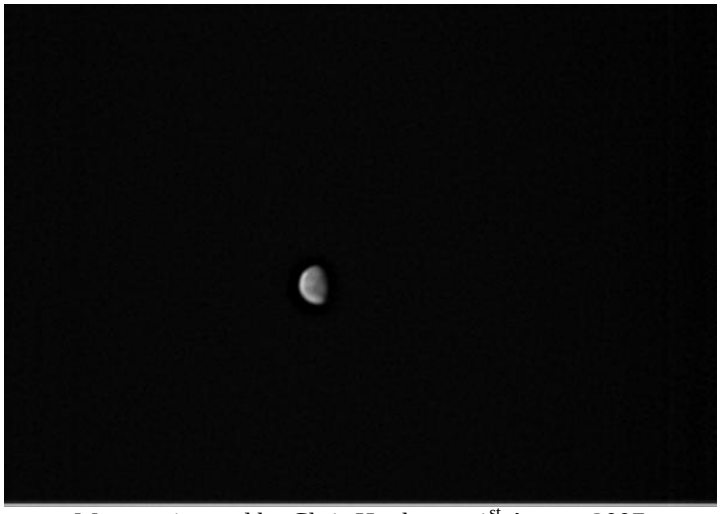
Mercury is the smallest planet in the Solar System at about 4,880km in diameter (Earth is 12,756km and our Moon is 3476km). It is also the closest planet to the Sun orbiting at an average distance of 58 million km (Earth is 150 million km). From our vantage point Mercury is always close to the Sun and can be very difficult to find. It can only be seen when the Sun is below the horizon before sunrise or after sunset. Being close to the Sun, Mercury will always be in the thick, turbulent and dirty layer of the atmosphere close to the eastern or western horizons.



Venus and Mercury (arrowed) at twilight

Despite being small Mercury can be surprisingly bright when positioned at its best but can be easily missed even by experienced astronomers. A search using binoculars should only be carried out when the Sun is below the horizon or hidden by a building or other immovable object. Even so dawn observations must be conducted with great care in case the Sun rises into view un-noticed and its light enters the binoculars.

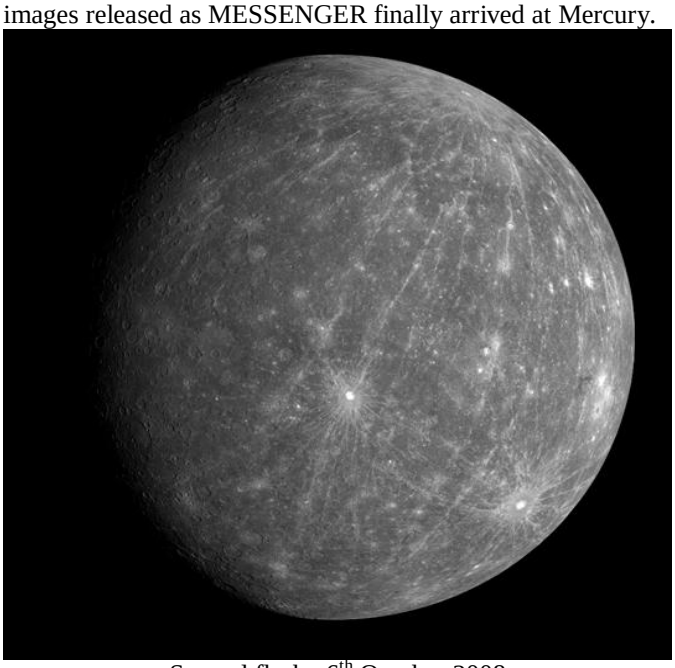
Mercury can be imaged but for the reasons discussed above the task can be very difficult. Our own Chris Hooker spent a lot of time trying to capture this elusive prey and has been very successful. The image below was taken by Chris in 2007.



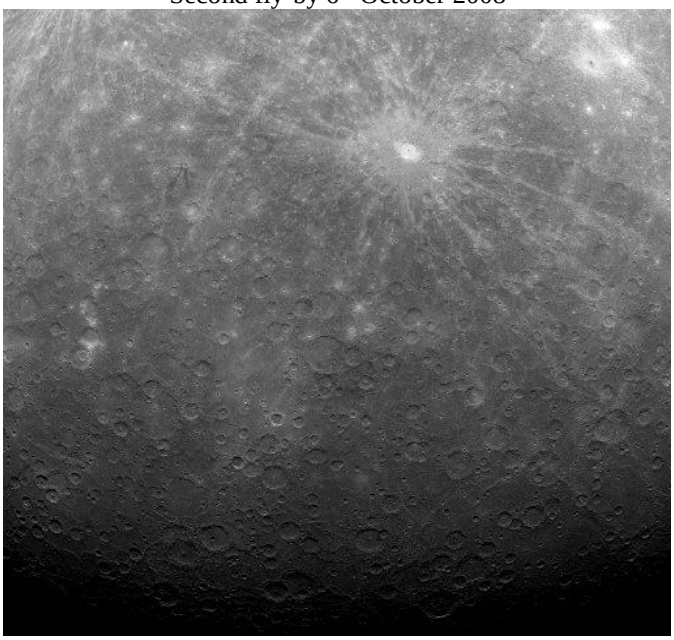
Mercury imaged by Chris Hooker on 1st August 2007

The best observational opportunity this year was on 23rd March which was also a clear evening. Even so the 'half Moon' crescent was difficult to make out even using a telescope. The next opportunity to see Mercury will be around 26th April but the elusive planet will be very close to the eastern horizon at sunrise.

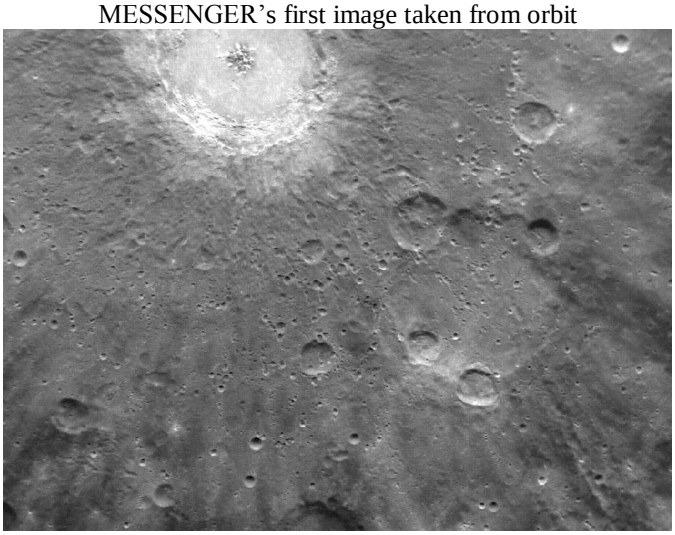
To overcome the disappointment of not being able to see the surface detail on Mercury we can now at least admire the first images from MESSENGER. Below is a selection of the first images released as MESSENGER finally arrived at Mercury.



Second fly-by 6th October 2008

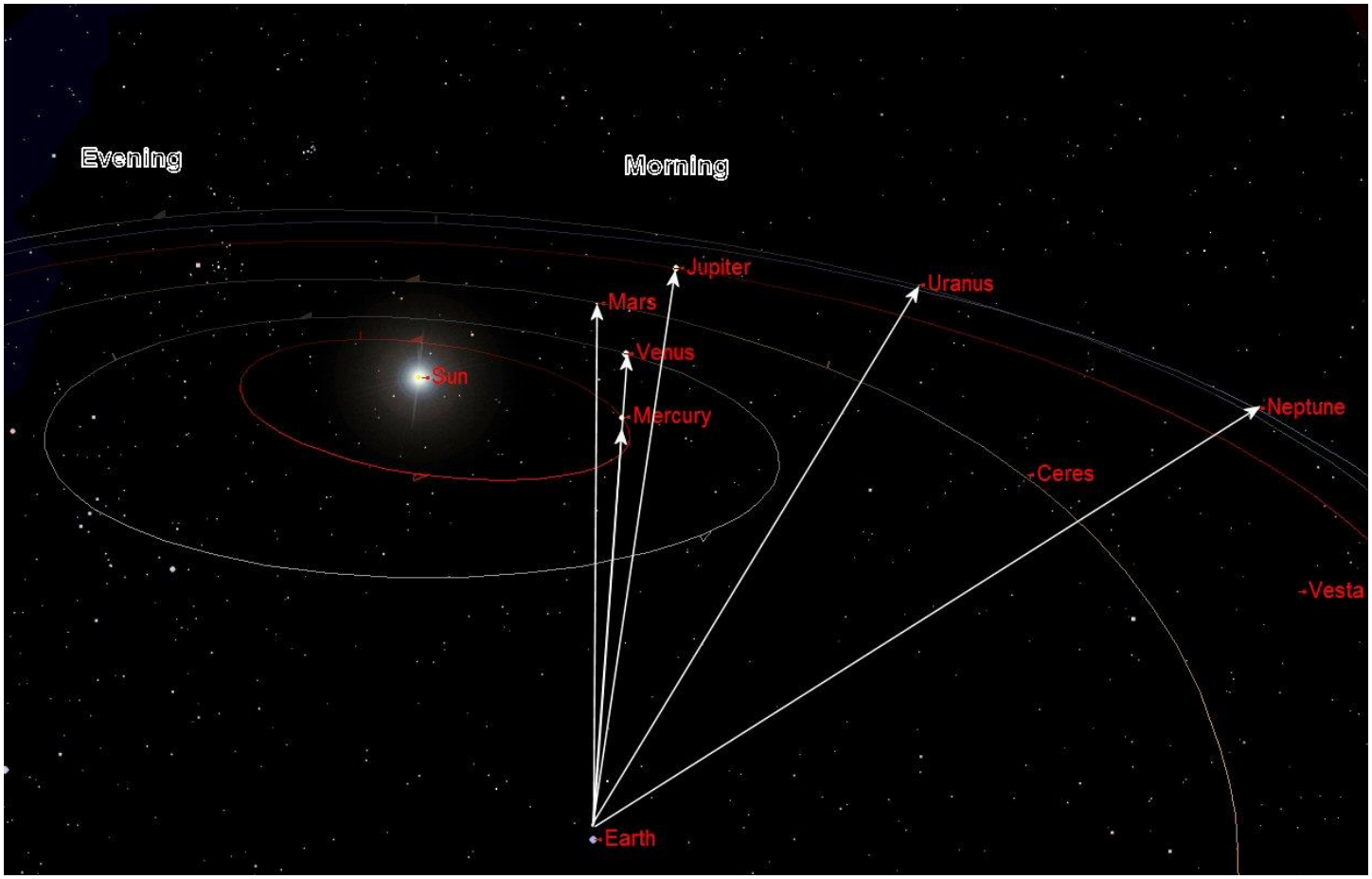


MESSENGER's first image taken from orbit



A close-up of the beautiful rayed crater Bebussy

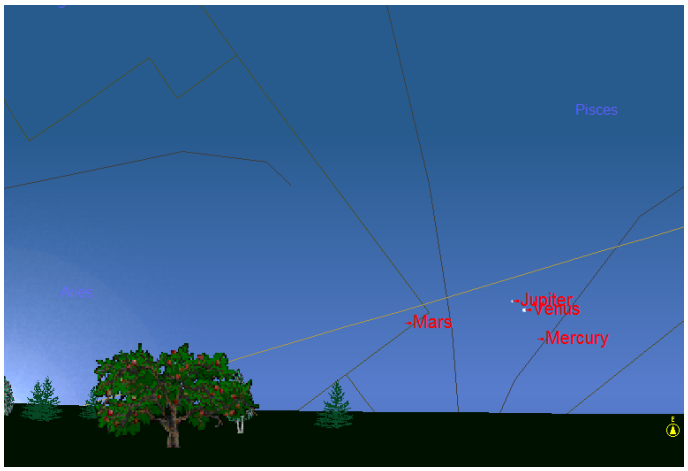
THE SOLAR SYSTEM THIS MONTH



The positions of the planets in the middle of this month (Saturn is behind our point of view)

The chart above shows the positions of the planets as viewed from Earth in the middle of May. Earth rotates anti-clockwise therefore objects will appear over the eastern horizon before the Sun in the morning in a sequence starting from Neptune followed by Uranus, Jupiter, Venus, Mercury and Mars.

There will be an interesting planetary conjunction this month on the morning of 11th May. The planets Mercury, Venus and Jupiter will appear very close together in the early morning just before the Sun rises at 05:00. Unfortunately the event will occur close to the eastern horizon as the sky is beginning to brighten. It will be necessary to have a clear view of the eastern horizon that is not obstructed by buildings, trees and more importantly any higher ground.



The positions of Mercury, Venus and Jupiter on 11th May

MERCURY rises at 5:10 on 1st May, 04:40 on 15th and 04:25 on 31st but will be too low for meaningful observation.

VENUS rises over the eastern horizon at about 5:00 on 1st May, 04:35 on 15th and 04:20 on 31st but will be too close to the horizon for useful observation.

MARS is too small and close to the Sun so will not be observable.

JUPITER rises at 5:10 on 1st May, 04:25 on 15th and 03:28 on 31st. It will just be observable by the end of the month.

SATURN rises over the eastern horizon at about 17:25 at the beginning of the month and 15:20 by the end of the month. It will therefore be visible as the sky darkens and for most of the night. The rings are opening out now after being closed up and almost disappearing last year.

URANUS rises at 03:45 but is close to the Sun and not observable.

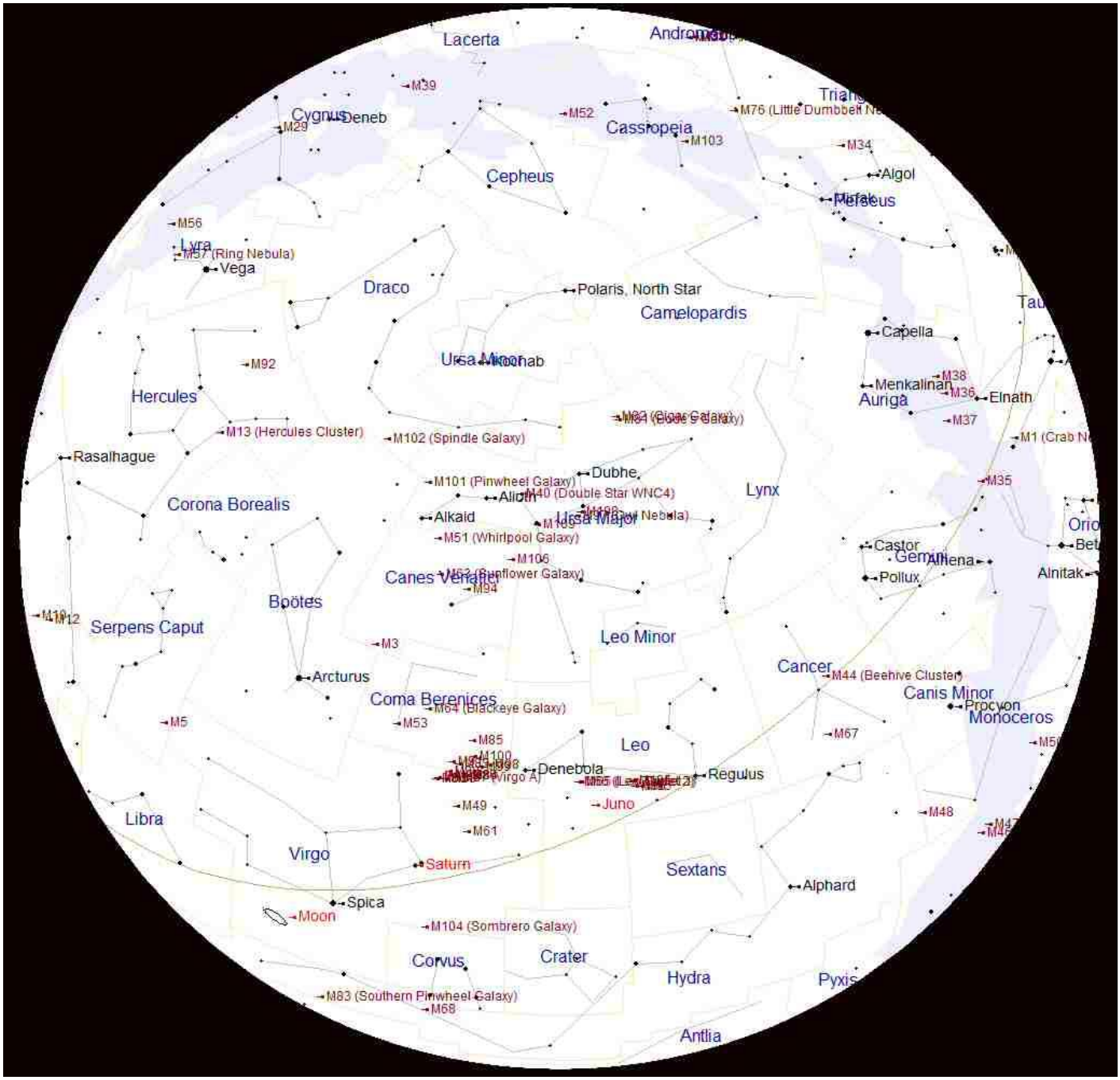
NEPTUNE rises at 02:45 but will still be low in the south east at sunrise.

METEORS. There are two minor showers at the beginning of May called the Aquarids and the Scorpiids. The Aquarids may have a reasonable maximum on 6th May with up to 40 per hour.

THE MOON is always a good target for binoculars or a small telescope. It is also the first object for a beginner to go for because it is large and bright.

THE SUN has an eleven year cycle of increasing sunspot activity. The build up to the next maximum activity has been slow to start, however a number of large spots appeared during March. The Solar maximum will reach its expected peak during 2013 when there should be more activity and more Sun Spots.

THE SKY THIS MONTH



The chart above shows the night sky as it appears on 15th May at 9 o'clock in the evening British Summer Time (BST). 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 BST at the beginning of the month and at 8 o'clock BST 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. This month the constellation of Ursa Major is 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 directly overhead as previously stated. 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.

The planets in the evening sky are: Saturn.

The planets in the morning sky are: Mercury, Venus, Mars, Jupiter, Uranus and Neptune.