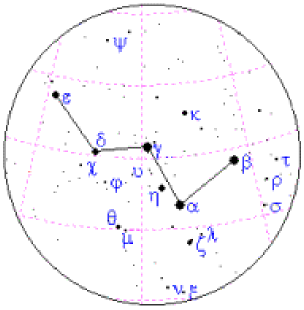


Wadhurst Astronomical Society Newsletter AUGUST 2015

MEETINGS

THE JULY MEETING

July Meeting

The July meeting was introduced by Phil Berry who after outlining the evening's programme mentioned that Brian had already given a talk earlier to a U3A group today and also the National Trust had asked the Society to help with telescopes at Scotney Castle on Saturday the 18th of July providing the weather was good since campers were to be on site. Sadly, the weather was not kind and observing had to be cancelled, but it is good to know that the Society can be asked to help in this way and spread the interest in astronomy.

Phil then introduced tonight's speaker who is our own Director of Observations.

Astronomy from the Ground Up
Brian Mills FRAS

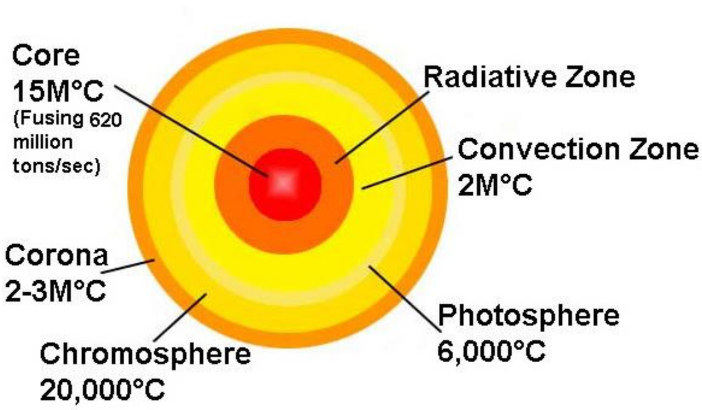
To begin, Brian described Astronomy as that branch of science dealing with celestial objects, space and the physical Universe as a whole and then mentioned some of the questions often asked such as what distances are involved, is there life on other planets and one we have all been asked, how much did our telescope cost?

Our solar system began as a cloud of interstellar dust that gathered together over time to form a rotating disk of material. At the centre of this disk pressures heated up so much that the nuclei of hydrogen began to form the nuclei of helium, and the Sun and planets began to form. This process may have been speeded up in a number of ways such as a large passing body or by the shock wave from a nearby exploding supernova.

Brian went on to explain how some of the particles further out began to collect together in what he called hydrostatic equilibrium, forming into something that would have been roughly spherical which then continued in a circular orbit, collecting material in their paths. He went on to say that because of Jupiter's presence, material in the Asteroid Belt has been prevented from coalescing together.

All stars are not the same size and brightness. In fact if Antares was our sun then even the orbit of Mars would be within its diameter. But because of their distance from us their difference is not always that obvious.

Brian then described the interior of the Sun starting at the core with hydrogen fusing at 15 M° C.



Around this is the Radiative Zone where the material is so compacted that it causes radiation. Next is the Convection Zone where convection currents allow light and heat to work their way up towards the surface. The Convection zone is surrounded by the

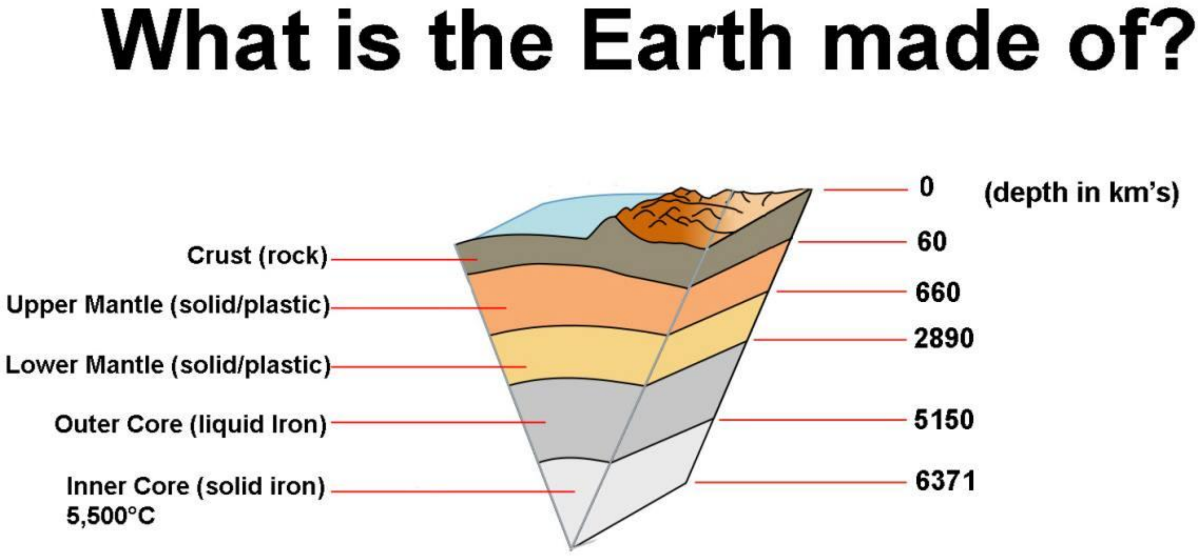
Photosphere which is what we see when we look at the surface and this is where we see sunspots. Around this is the Chromosphere, which is seen during the time of a total Solar Eclipse, as is the Corona that stretches millions of miles out into space.

We next looked at Sunspots that as Brian said appear to increase over an eleven-year period before falling off again to repeat the cycle. He said that at the start of a cycle, the spots begin to appear in the higher latitudes and then as the cycle progresses they begin to appear closer and closer to the Sun's equator. This is repeated in subsequent cycles producing a graph of latitude against time into what is known as the Butterfly Diagram.

Much detail of the Sun's surface can be seen more clearly when viewed in the extremely narrow Hydrogen-alpha band of the spectrum. The granular appearance of the surface is now clear and the sunspots look like very bright areas. Also in this light, the material being thrown out from the Sun becomes visible. As Brian said, it can be seen being thrown off around the rim, but if it is thrown off in our direction this can cause problems with power grids and satellites for instance and also produce the beautiful aurora in the night sky near the poles.

We were then shown safe ways of observing the Sun, for instance using the projection method with a telescope looking directly at the Sun and then using a card behind the eyepiece to project an image on to. This can also be done with binoculars. Another method is to use a solar filter such as a Baader solar filter and is the only safe way of looking through the eyepiece directly at the Sun other than using a dedicated solar scope such as the Personal Solar Telescope (PST) that uses an Hα filter.

Next, Brian turned to the Earth, describing the interior.



We were told that there are various descriptions but this diagram essentially describes the layers.

Because of the Earth's rotation it is slightly oblate so that the diameter between the poles is 12,712 km and the equatorial diameter is 12,756 km.

Above the surface is where the atmosphere begins and we were introduced to the Mesosphere at up to 85 km where we see meteors begin to burn up, then the Thermosphere up to 600 km where the aurora appear and where the International Space Station orbits. The outermost layer is the Exosphere where the hydrogen and helium particles are so far apart that they rarely collide.

We compared the planets of the Solar System and it was pointed out that only the Earth lies in the habitable zone, often referred to as the 'Goldilocks' zone and where the size, temperature and other conditions are just right for life as we know it to occur on its surface.

The origin of the Moon was discussed next with the latest theory being that the Earth was hit by a passing Mars sized object now referred to as Theia, shortly after the Earth was formed. Material left after the collision then collected together after time to form the orbiting Moon. Brian said that the size of the Moon in relation to the Earth was remarkable in that all other known moons around the other planets are considerably smaller than their parent planet.

A brief look at the cause of the tides in their relation to the position of the Moon and Sun was explained next and then a quick look at the reasons why we see the phases of the Moon in its orbit around the Earth.

Because the moon always shows the same face to the Earth it doesn't mean we only see exactly half of the moon, Brian showed that because the moon's orbit is an ellipse, there are times when the moon is closer to the Earth and appears to gain velocity so that we see a little further round the moon's surface and when further away we see more of the other side. Also, at times in the Moon's orbit, we see more of the 'top' or 'bottom'. This is called libration and over time we see a total of 59% of the surface.

Because of the Earth's unique distance from the Sun and the inclination of the Earth's orbit, there are times when the Moon's position coincides exactly and covers the Sun producing a total Solar Eclipse. When the Earth's elliptical orbit takes us nearest the Sun and the Moon's orbit takes it further away, it doesn't quite fit and we see an annular eclipse.

Total Eclipse in March off the Faroe Islands taken by Phil Berry

Also Brian explained why Lunar Eclipses often produce a deep red colour due to particles in the atmosphere absorbing blue light.

Distances are important in astronomy but also cover a vast range. The distance to the Moon is acceptable in miles, but the Earth's distance from the Sun is referred to as one Astronomical Unit which is a much more convenient unit of measurement throughout the Solar system but further afield, the speed of light becomes a more appropriate measurement when referring to the Milky Way, other galaxies and distances to the limits of the observable Universe.

Brian said our Galaxy is something like 100,000 light years in diameter and 1,000 light years thick, containing about 200 billion stars.

The distance to our neighbouring galaxy, M31 Andromeda, was not known until after the work of Henrietta Leavitt who realised that Cepheid Variable stars had a relationship between their brightness and pulsation period and from this it was possible to use them as distance measuring standards. Using Cepheid variables in the Andromeda Galaxy with its 1 trillion stars, it was possible to show that it was about 2.5 million light years away.

One image taken by the Hubble Deep Field telescope imaged an area of sky 2 arc minutes by 2.3 arc minutes containing a huge number of distant galaxies and from this it has been estimated that there are some 200 billion galaxies in the visible Universe!

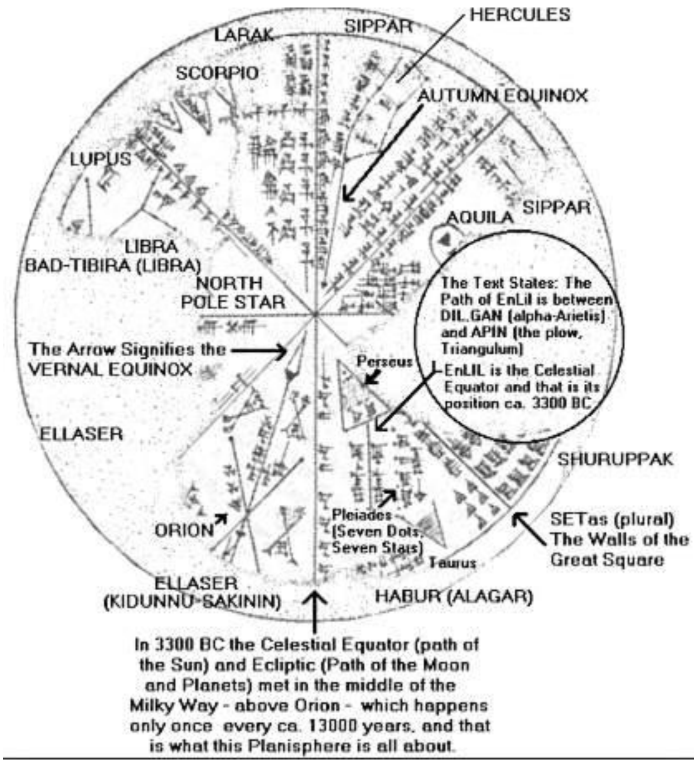
Finally Brian gave a short introduction to different telescopes suitable for astronomical work.

Snippets from the World of Science
John Wayte

Assyrian Clay Tablet

This is copy of an Assyrian Star Planisphere clay tablet originally dated from around 700 years BC.

On it the sky is divided into 8 sectors. The writing is Cuneiform, the first form of the written word where the letters are formed in the clay using a small triangular tool.



It is one of the earliest scientific instruments with angular measurements inscribed around its rim. Recent translations have deciphered its meaning. It is a copy of a night notebook of a Sumerian astronomer as he records the events in the sky in June 3123 BC. Half of the tablet records the night sky but the other half records an object in space at the time that is large enough for its shape to be recorded while still in space.

The ancient astronomers made an accurate note of the object’s trajectory relative to the stars. Since the mapping was so accurate they predicted the landing area. The landing area is consistent with an impact at Köfels in Austria.

The impact threw up a ridiculously large plume of material, blocking out the Sun for several days. The impact has been proposed as the naturalistic explanation for the Sodom and Gomorrah biblical tale.

These links have not been conclusively proved so I leave it up to you to decide.

But I thought it was an interesting story.

Pluto

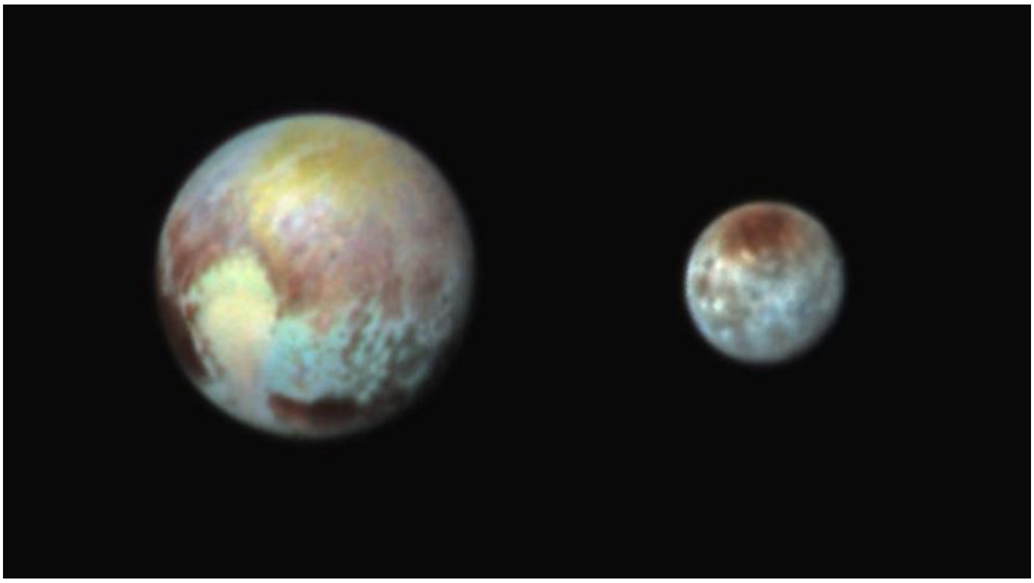
The NASA New Horizons space mission was launched on January the 19th 2006 on a Lockheed Martin Atlas 5 from Cape Canaveral.

It was made to swing past Jupiter to gain gravity boost and carry out scientific studies, then on for a fly-by of Pluto and finally on to the mysterious Kuiper Belt.

Pluto has 5 moons, Charon, Nix, Hydra, Styx and Kerberos.

Part of the orbit takes Pluto closer to the Sun and within the orbit of Neptune for a period of time. Pluto’s distance varies between 30 AU and up to 49 AU.

New Horizons had obtained impressive new images of Pluto and its large moon Charon that highlight their compositional diversity.

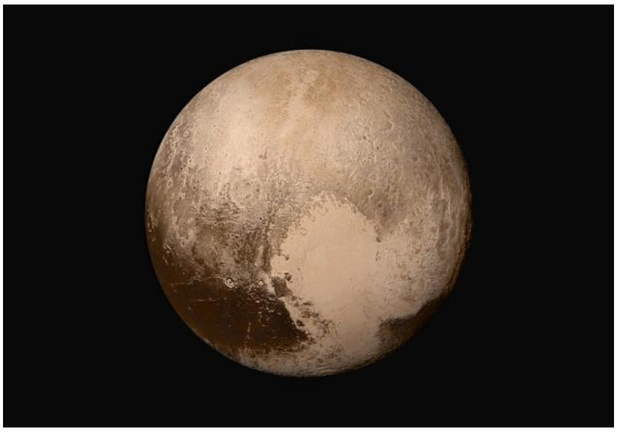


These are not actual colour images of Pluto and Charon – they are shown here in exaggerated colours that make it easier to see the differences in surface material and features on each planetary body.

The images were obtained using three of the colour filters of the instrument on July the 13th at 0338 eastern daylight time (EDT). New Horizons has seven instruments on board the spacecraft. – “These images show that Pluto and Charon are truly complex worlds. There’s a whole lot going on here” said New Horizons co-investigator Will Grundy of Lowell Observatory. “Our surface composition team is working as fast as we can to identify the substances in different regions on Pluto and unravel the processes that put them where they are”.

The colour data helps scientists understand the molecular make –up of the ices on the surfaces of Pluto and Charon, as well as the age of geologic features such as craters. They can also tell us about surface changes caused by ‘space weather’ such as radiation.

The new colour images reveal that the ‘heart’ of Pluto actually consists of two remarkably different-coloured regions.



The second picture shows the relative sizes of Pluto and the biggest moon Charon against the Earth. No wonder it’s been demoted to a dwarf planet.

So where is New Horizons off to next?

To explore the debris in the Kuiper Belt where they expect to find some more Dwarf Planets.

A visit to La Palma
Ian and Margaret McCartney

Recently two of our members, Ian and Margaret McCartney took a holiday that included La Palma and they gave a delightful and informative talk about their visit. Margaret said that apart from their interest in the observatory, they were also presented with beautiful views and were also able to witness one of the religious ceremonies.

They took a coach up to Roque de Los Muchachos at an altitude of 2426 metres to see the telescopes and said it was like being on top of the world.

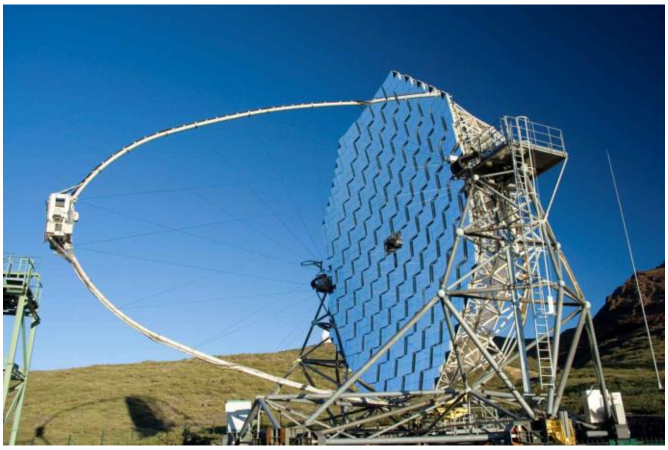
The observatory is perched high up on the edge of a crater where there are many telescopes operated by various countries and is Europe’s most important observing facility in the northern hemisphere.

We were told that the Isaac Newton telescope was the first telescope to be brought up on a specially built road in 1984 from its previous site at Herstmonceux. This was followed two years later by the 4.2 metres William Herschel telescope.

William Herschel telescope and other telescopes on the ridge

The Spanish 10.4 metre Gan Telescopio Canaries. The world's largest single aperture telescope

Ian said they stopped at one quite remarkable telescope on the way back down. It was totally open and didn't appear to have any special security. He was told that it was part of a system was called a Cherenkov telescope array.



Part of the Cherenkov Array

Their purpose is to identify and measure radiation from Black holes, Pulsars and quasars and Gamma Ray Bursts. There is quite a bit written about them on the Internet by going to Google.

Another telescope on the ridge was a Dutch 1-metre solar telescope, covered when not in use to keep it cool. There was also a Swedish Solar Tower amongst many other telescopes all run by various European countries.
There is a significant amateur interest on the island and Ian said there were a number of sites where amateur astronomers could take their telescope and set them up for their observations.

But there was one final astronomical indicator:

FUTURE MEETINGS

Saturday 29th August – Astro-barbecue. Our host again is at the generosity of Jim Cooper (details in next month's Newsletter)
Wednesday 16th September – Mike Maunder gives us his impressions of "Observatories of the World".
Wednesday 21st October - Practical Astronomy Evening. Talks on observing - telescopes and other equipment on display with observing if clear.
Wednesday 18th November - Jan Drozd talks on the subject of "Astronomy in Art".
Wednesday 16th December - Brian Mills FRAS takes as his theme "What Did Women Ever Do For Astronomy?"

SKY NOTES FOR AUGUST 2015

Planets

Mercury is an evening object throughout the month, though due to its position it is always very poorly placed for observation from the UK. The ecliptic, in the evenings at this time of year, rarely has an elevation of more than 20°, and as the planets stick to this line (more or less), Mercury is similarly affected. On the last day of August, as the Sun sets, the smallest planet is just 4° above the western horizon. Mercury will reach greatest eastern elongation on September 4th. The next apparition will be a morning one (October 16th) which will be much better seen with Mercury 11° in altitude just before 07.00.

Venus is lost in the solar glare as seen from these latitudes. In spite of being 21° from the Sun, Venus's position just north of the celestial equator and south of the ecliptic means that, despite this angular separation, it sets just eight minutes after the Sun. It reaches inferior conjunction on August 15th passing nearly 8° south of the Sun. Following this it moves swiftly westwards to become a morning object rising 1½ hours before the Sun by the last day of August. It will remain in the morning skies until early June next year.

Mars is a morning object rising at 04.00 BST at the start of the month, moving from Gemini into Cancer on the 5th. During August its brightness drops to +1.8, the faintest it will be this year, before it starts to brighten again from October onwards. It will be mid April next year before the Red Planet becomes an evening object once again and rises before midnight (BST).

Jupiter is now too close to the Sun for observation and indeed reaches solar conjunction on 26th of this month. It should become visible as a morning object, amongst the stars of Leo, in mid to late September.

Saturn is an evening object in the constellation of Libra. It has been travelling retrograde since March but reaches its second stationary point on August 2nd after which it resumes direct motion (west to east) once more.

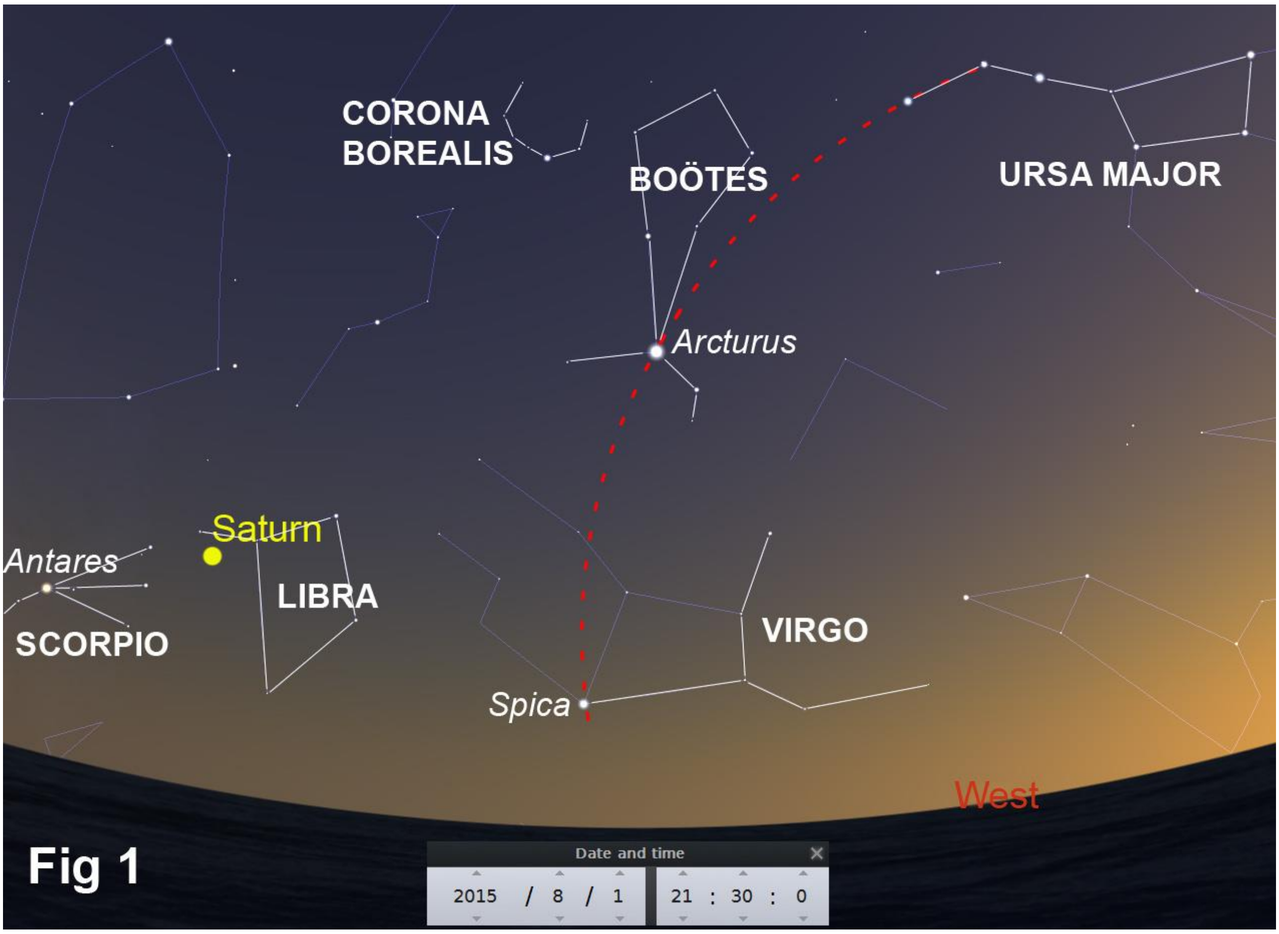


Fig 1 shows its position at the start of August, and although it moves extremely slowly with reference to the background stars, the rotation of the sky will have carried it to the south west by the end of the month. The handle of the plough can be initially used to find the bright stars Arcturus and Spica, after which Saturn can be found to the left of these and not far from the orange star Antares in Scorpio. The planets apparent diameter is slowly decreasing as the distance between the ringed planet and Earth increases towards solar conjunction in November. The tilt of the ring system increases to 24.2° making a fine spectacle even in moderate telescopes. By the end of the year this will have grown to just over 26°.

Lunar Occultations

In the table below I've listed events for stars down to magnitude 7.0 that occur before midnight although there are many others that are either of fainter stars or occur at more unsociable hours. DD = **d**isappearance at the **d**ark limb whilst RD = **r**eappearance at the **d**ark limb. The column headed "mm" (millimetres) shows the minimum aperture telescope required for each event. **Times are in BST.**

August	Time	Star	Mag	Ph	Alt °	% illum.	mm
22nd	21.54	theta Librae	4.1	DD	11	50	40
27th	21.54	13 Capricorni	6.8	DD	21	95	100
27th	23.01	tau Capricorni	5.2	DD	24	95	50

Phases of the Moon for August

Last ¼	New	First ¼	Full
7th	14th	22nd	29th

ISS

Below are details for passes of the International Space Station (ISS) that occur before midnight and are magnitude **-**2.0 or brighter. The details of all passes, including those visible after midnight, can be found at www.heavens-above.com. Please remember that the times and directions shown below are for when the ISS is at it's ***maximum*** elevation, so you should go out and look at least five minutes beforehand. **Times are in BST.**

Aug.	Time	Mag.	Alt°	Az.		Aug.	Time	Mag.	Alt°	Az.
1st	22.33	-3.1	43	SSE		7th	22.00	-3.3	79	N
2nd	21.39	-2.4	29	SSE		7th	23.36	-3.0	56	W
2nd	23.16	-3.5	86	SSE		8th	22.43	-3.4	89	N
3rd	22.22	-3.4	67	SSE		9th	21.49	-3.3	79	N
3rd	23.58	-3.3	78	N		9th	23.25	-2.4	39	WSW
4th	21.28	-3.1	47	SSE		10th	22.32	-3.4	70	SSW
4th	23.05	-3.3	80	N		11th	21.38	-3.4	88	SSW
5th	22.11	-3.4	89	S		12th	22.21	-2.9	46	SSW
5th	23.47	-3.3	76	WNW		13th	21.27	-3.3	66	SSW
6th	21.18	-3.4	71	SSE		14th	22.09	-2.0	28	SSW
6th	22.54	-3.3	79	N		15th	21.16	-2.6	42	SSW

Iridium Flares

The flares that I've listed are magnitude **-**3.0 or brighter although there are a lot more that are fainter or occur after midnight. If you wish to see a complete list, or obtain timings for somewhere other than Wadhurst, go to www.heavens-above.com . Remember that when one of these events is due, it is sometimes possible to see the satellite before and after the "flare" although, of course, it will be much fainter at those times. **Times are in BST.**

Aug.	Time	Mag.	Alt°	Az.°		Aug.	Time	Mag.	Alt°	Az.°
3rd	21.19	-6.3	24	346 (NNW)		20th	22.57	-6.3	17	32 (NNE)
3rd	23.37	-3.3	32	249 (WSW)		23rd	22.49	-3.0	22	40 (NE)
6th	23.28	-7.1	29	254 (WSW)		24th	22.43	-4.4	23	41 (NE)
10th	23.22	-3.5	22	261 (W)		27th	20.57	-6.7	28	352 (N)
12th	23.19	-6.5	19	266 (W)		27th	22.35	-4.6	28	48 (NE)
15th	23.19	-3.7	15	273 (W)		29th	23.47	-4.1	16	250 (WSW)
16th	23.23	-3.8	13	275 (W)		30th	23.50	-4.5	13	253 (WSW)
17th	23.05	-5.2	11	23 (NNE)		31st	22.20	-3.7	33	55 (NE)
20th	22.00	-3.1	11	352 (N)		31st	23.54	-3.5	11	255 (WSW)

The Night Sky in August (Written for 22.00hrs BST mid month)

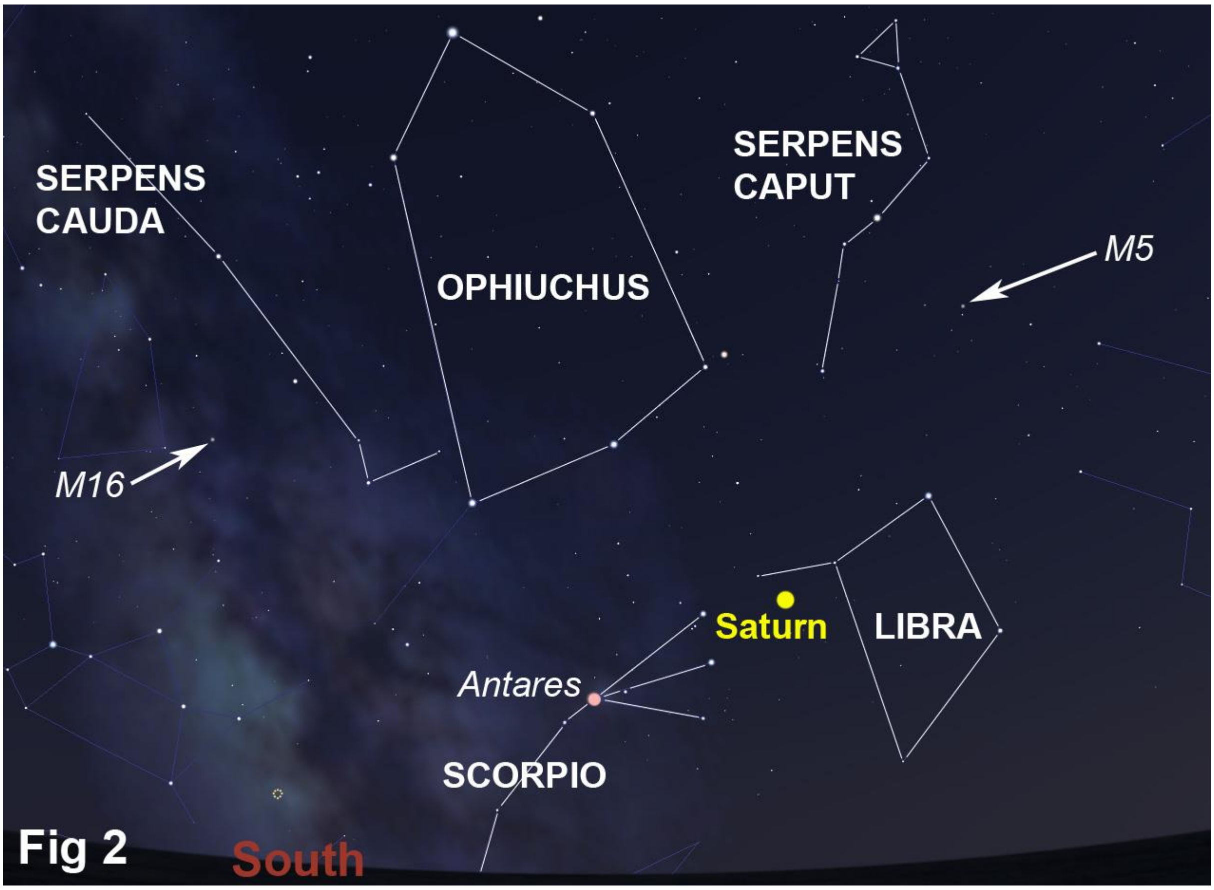
In the west the bright star Arcturus is still 30° in altitude though its period of dominance in that part of the sky is nearly over. Above it we find the compact group that forms Corona Borealis, and closer still to the pole lies the faint and rather indistinct Hercules with its globular jewel of the northern skies, M13. Slightly fainter at magnitude 6.5 is another globular M92 that is an elder statesman of the universe.

In the north Ursa Major lies to the west of the meridian and is still making its way sedately towards the horizon. It brings with it the lovely "Pinwheel Galaxy", M101 at magnitude 7.7, and that contrasting pair of neighbouring galaxies M81 and M82. East of the meridian Capella is becoming more prominent as are Cassiopeia and Perseus, with the double cluster nearly 30° in altitude.

To the east, the autumn groups of Pegasus, and Andromeda are well above the horizon whilst Pisces, which is still home to the planet Uranus, is just rising. Lying between the Square of Pegasus and the zenith is the tiny constellation of Lacerta (the lizard) which

was added to the sky by Hevelius in 1687. It has no bright galaxies or globulars, but it has a number of open clusters of which NGC 7243 (mag. 6.4) and NGC 7209 (mag. 6.7) are the brightest.
To the south the sky is dominated by the Summer Triangle, though considering its position and the time of year, Autumn Triangle would seem to be more appropriate. Vega lies on the meridian with Altair and Deneb to the east, whilst a small group of constellations (Vulpecula, Sagitta, Delphinus and Equuleus) reach from the head of the swan to the head of the flying horse. Below the Summer Triangle the "Teapot" of Sagittarius is right on the meridian and, due to its low altitude, will soon be setting. The open cluster M25, which can be found within its borders, is still almost 20° in altitude and well worth a look.

What Objects Can I Look For This Month?

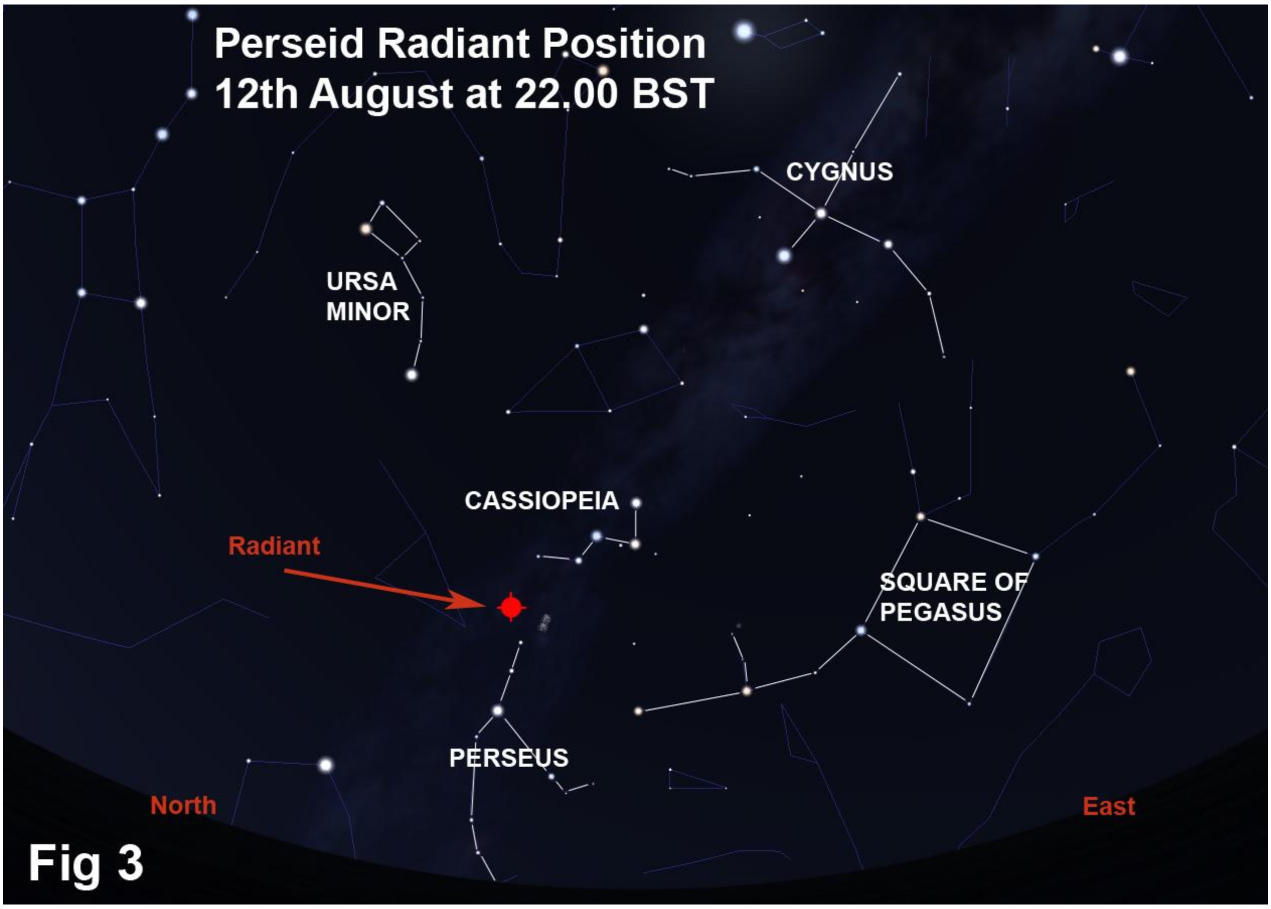


1. Serpens Caput is the head end of the serpent that Ophiuchus (the serpent bearer) has been battling with, whilst Serpens Cauda is the tail. The head, depicted by a small triangle of stars, is the more obvious of the two although the brightest star, alpha, is only magnitude 2.6. Serpens Caput contains the globular cluster, M5, which is easily visible with binoculars although a telescope is required to resolve individual stars. In the tail section, made up of a single line of stars, the brightest member is eta at magnitude 3.2. Within this small constellation lies the nebula M16 which contains the star forming region known as the "Eagle Nebula", part of which is the famous "Pillars of Creation".

2. Ophiuchus is a large dim group whose brightest star is alpha (proper name Rasalhague) of magnitude 2.0. The map at fig 2 shows the shape of the constellations and is drawn for 22.00 on August 1st when the sky has become dark enough to show some of the fainter stars in these groups. It should be easy to locate as it is almost due south and lies immediately above the bright star Antares in Scorpio. Some of the area is also shown in fig 1, which may aid identification. The constellation, which contains a large number of globular clusters and a few nebulae, lies close to the galactic centre which is in neighbouring Sagittarius.

Meteors

The Perseid meteor shower reaches its peak at around 07.00 BST on the morning of August 13th. This means that the best time for us in the UK to view is on the night of the 12th, once darkness has fallen, and onwards towards dawn. Watches are also worthwhile on the nights immediately before and after maximum and can result in a moderate number of events. On the night of peak activity we can expect to see one meteor per minute although it is common to see a few close together followed by a quiet period. The radiant, which moves gradually due to the Earth orbiting around the Sun, lies close to the double cluster in the sword handle of Perseus. It is not necessary to watch towards the radiant as meteors are seen over a large area of the sky. It is, however, useful to know the approximate position of the radiant so that when meteors are seen you can trace their paths backwards to see whether they came from that particular part of the sky. If they did not then they are meteors unconnected with the shower and are known as "sporadic".



Advance Warning

September 5th - Occultation of Aldebaran.
Disappearance at the bright limb at 05.51 (Sun at -5°)
Reappearance at the dark limb at 07.08 (Sun at +7°)
Note: there is a further occultation of Aldebaran on October 29th that occurs during the evening.

September 28th – Total Lunar Eclipse
This is an early morning eclipse that lasts from 02.07 until 05.27 BST.

Magnitudes
Depending on which book you read you will find that the method we use for quantifying star brightness is attributed to either Ptolemy or Hipparchus, making the system in the order of two thousand years old. Ptolemy certainly popularised it is his book "The Almagest" or "The Great Compilation" in English, which was written in the second century. The system said that the brightest stars are 1st magnitude and the faintest the human eye can see are 6th magnitude, although it didn't attempt to quantify the magnitude of the Sun! Incidentally, we ought to add a "+" sign to these to show that these are positive numbers, but that distinction was not made originally. Using this system it was decided that a first magnitude star was 100 times brighter than a sixth magnitude star using a logarithmic scale that said each magnitude was 2.51 times brighter or dimmer that the one above or below. The table below may help to explain this.

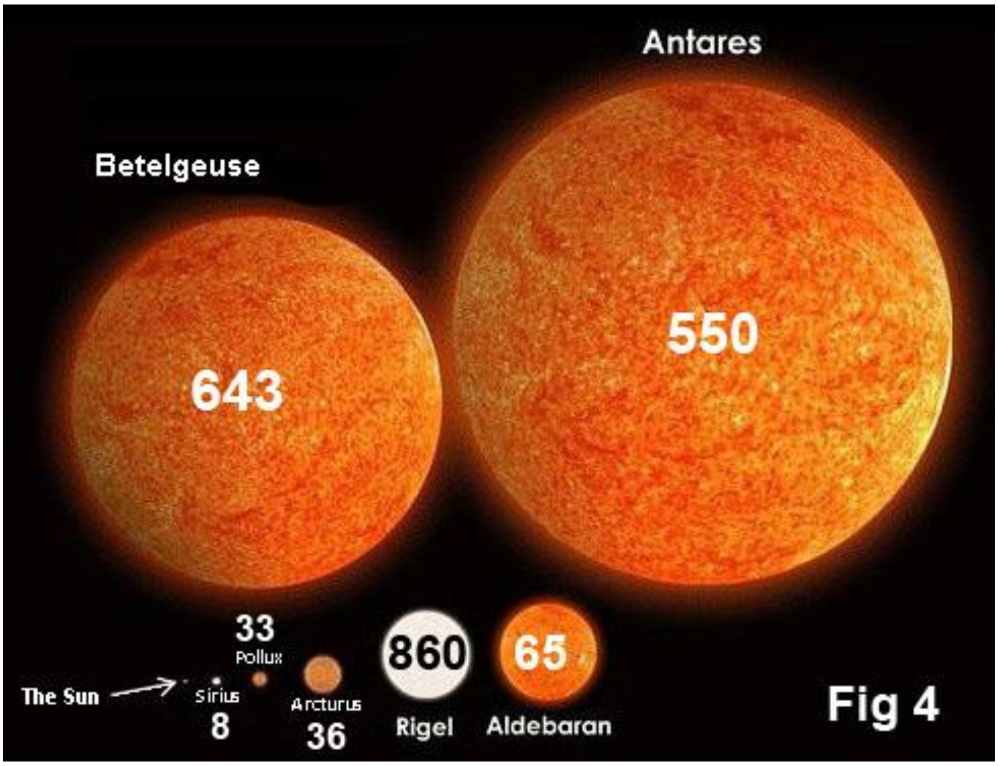
Mag 1 star is 100	times brighter than a mag 6 star	or	(2.51 x 2.51 x 2.51 x 2.51 x 2.51)
Mag 2 star is 39.8	""""""		(2.51 x 2.51 x 2.51 x 2.51)
Mag 3 star is 15.8	""""""		(2.51 x 2.51 x 2.51)
Mag 4 star is 6.3	""""""		(2.51 x 2.51)
Mag 5 star is 2.51	""""""		(2.51 x)
Mag 6			

In modern times of course the system had to be extended to accommodate, for example, the bright star Sirius at mag. -1.44 and the Sun at -26.7 or in the other direction mag. +30 for objects viewed by professional telescopes. To extend the table, multiply by 2.51 for each magnitude step. So a mag. 0 star is 2.51 times brighter than a mag. 1 star and a mag. -1 star is 2.51 times brighter than a mag. 0 star.
For decreasing brightness a magnitude 7 star is 2.51 times fainter than a magnitude 6 star and so on.

The above method of describing brightness is known as *apparent* magnitude and is quite simply a measure of the brightness of an object as seen from Earth. There is however another way of quantifying brightness and that is known as *absolute* magnitude.
This system takes account of true luminosity by placing all objects at a distance of 10 parsecs before calculating their brightness. This provides a meaningful comparison for bright objects that appear dim because they are extremely distant, and objects that only seems bright because they are very close to us. To demonstrate this, compare the apparent and absolute magnitudes below. You can see how the Sun at 10 parsecs would become a very ordinary star, demonstrating it is simply its closeness that accounts for its apparent brightness.

Star	Apparent mag.	Absolute mag.
The Sun	-26.7	+4.8
Sirius	-1.44	+1.45
Spica	+1	-3.6

However, when we discuss magnitude, amateur astronomers will always be talking about apparent magnitude unless they specify otherwise.
In the diagram at fig 4 you can see a comparison between the sizes of a number of stars along with their distances in light years. Immediately you can see that Sirius is the brightest star in the night sky because, although it is a comparatively small body, it lies only 8 light years away from us.



Telescope Evenings
This is an evening designed to help those with telescopes who need some guidance in setting up, aligning and using them. Very often new users lack confidence and may be working from a manual not designed for the complete beginner. The dates allocated are **September 21st, 22nd and 23rd**. We will use the first one of these where the conditions are reasonably good. Those who have contacted me about this should have received an e-mail notifying them of the dates.

DSLR Evening
Following the success of our last visit to the Ashdown Forest, we plan to return there on **October 12th, 13th or 14th**. We will use the first evening out of those three where conditions are considered to be good enough for photography. We aim to take multiple images of a Milky Way region that can be combined, at a later date, using suitable software.

Outreach Events
Phil and I attended a meeting of the Wadhurst U3A on July 15th and gave them an introductory talk about Astronomy. This seemed to be well received and drew a large number of questions on a wide variety of topics.

Brian Mills

SPACEPLACE - NASA

On The Brightness of Venus
By Ethan Siegel

Throughout the past few months, Venus and Jupiter have been consistently the brightest two objects visible in the night sky (besides the moon) appearing in the west shortly after sunset. Jupiter is the largest and most massive planet in the solar system, yet Venus is the planet that comes closest to our world. On June 30th, Venus and Jupiter made their closest approach to one another as seen from Earth—a conjunction—coming within just 0.4° of one another, making this the closest conjunction of these two worlds in over 2,000 years.

And yet throughout all this time, and especially notable near its closest approach, Venus far outshines Jupiter by 2.7 astronomical magnitudes, or a factor of 12 in apparent brightness. You might initially think that Venus's proximity to Earth would explain this, as a cursory check would seem to show. On June 30th Venus was 0.5 astronomical units (AU) away from Earth, while Jupiter was six AU away. This appears to be exactly the factor of 12 that you need.

Only this doesn't explain things at all! Brightness falls off as the inverse square of the distance, meaning that if all things were equal, Venus ought to seem not 12 but 144 times brighter than Jupiter. There are three factors in play that set things back on the right path: size, albedo, and illumination. Jupiter is 11.6 times the diameter of Venus, meaning that despite the great difference in distance, the two worlds spanned almost exactly the same angular diameter in the sky on the date of the conjunction. Moreover, while Venus is covered in thick, sulfuric acid clouds, Jupiter is a reflective, cloudy world, too. All told, Venus possesses only a somewhat greater visual geometric albedo (or amount of reflected visible light) than Jupiter: 67 percent and 52 percent, respectively. Finally, while Venus and Jupiter both reflect sunlight toward Earth, Jupiter is always in the full (or almost full) phase, while Venus (on June 30th) appeared as a thick crescent.

All told, it's a combination of these four factors—distance, size, albedo, and the phase-determined illuminated area—that determine how bright a planet appears to us, and all four need to be taken into account to explain our observations.

Don't fret if you missed the Venus-Jupiter conjunction; three more big, bright, close ones are coming up later this year in the eastern pre-dawn sky: Mars-Jupiter on October 17, Venus-Jupiter on October 26, and Venus-Mars on November 3.

Keep watching the skies, and enjoy the spectacular dance of the planets!

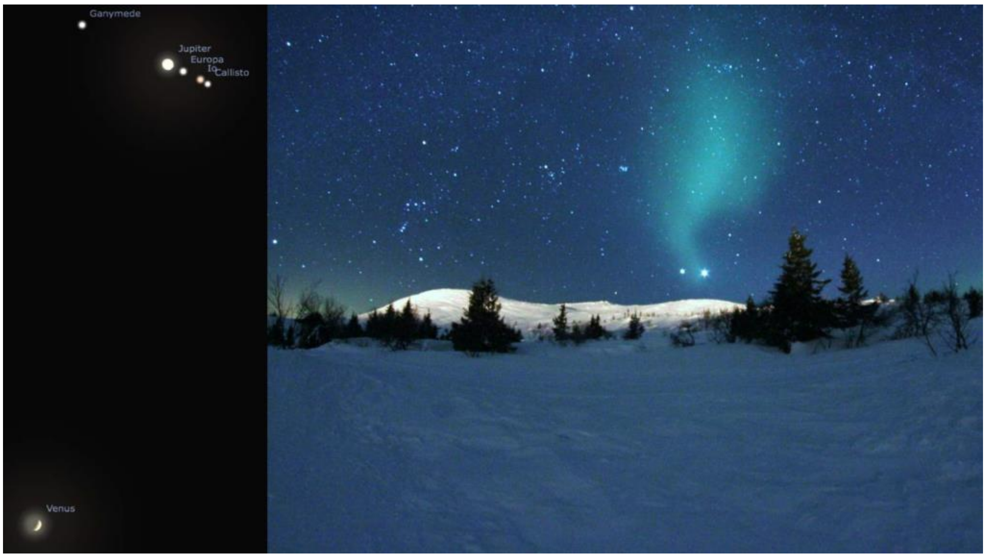


Image credit: E. Siegel, using the free software Stellarium (L); Wikimedia Commons user TimothyBoocock, under a c.c.-share alike 3.0 license (R). The June 30th conjunction (L) saw Venus and Jupiter pass within 0.4° of one another, yet Venus always appears much brighter (R), as it did in this image from an earlier conjunction.

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