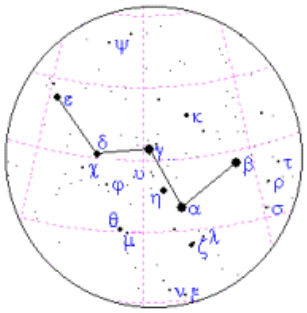


Wadhurst Astronomical Society Newsletter December 2016

MEETINGS

COMMITTEE MEETING

Members of the Committee are respectfully reminded that there is a meeting of the Committee at 1930 on Tuesday the 10th of January. Jim Cooper has kindly offered to hold it at his house.

NOVEMBER MEETING

Our Secretary Phil Berry welcomed members and visitors to the November meeting and then warned that the December meeting will take place on the 14th which is the SECOND Wednesday of the month to avoid being too close to Christmas. He then outlined the evening's format before introducing the talk given by our own Jan Drozd. Jan has talked to us on many occasions and they are always marked by the amount of research he does in preparing his presentation.

A Short History of Humankind's Understanding of the Universe
Jan Drozd

To begin, Jan said today we look up at the night sky and know what is going on but in ancient times, people would have looked up and wondered at what they saw.

Referring to some of the earliest cave paintings, he said he felt that a lot of modern interpretations are sometimes unconvincing but many ancient structures may well have had astronomical functions and the first professional astronomers were in fact priest/astronomers who gained tremendous power by giving predictions of such things as eclipses to people and kings. They were important to farmers who needed to know when rivers were going to flood and when to plant crops.

Many cultures independently developed their own understanding and interpretation of events in the sky and in many ways, these ideas were quite similar.

Jan said one of the first really concrete representations of astronomical objects was the German Nebra Sky Disc dating from about 1600 BC and he told the story of how it had been found being illegally sold on the black market, finally being recovered in a former East Germany shady café by the Swiss police in a sting operation.

The Nebra Sky Disk

It is generally believed that the study of astronomy originated in Babylonia where priest-astronomers used the position of the stars in the night sky to establish an accurate calendar that enabled them to predict certain events. These priests were also astrologers and became very powerful. It was the Babylonians that divided the ecliptic into the twelve zodiacs we still know today.

The Ancient Egyptians also used 'astronomy' for time keeping and religion. Prediction of when the Nile flooded, bringing nutrients to the land was very important. They were also responsible for the origin of the 24-hour clock system.

Jan then talked about how ancient civilisations viewed the Universe. The Babylonians thought the universe was made up of six levels in a complicated manner with three heavens and three Earths with the underground and the underground world of the dead.

The Egyptians interpreted the universe with mythology and Gods in the Sky, although they began to use measurements in their predications.

He said that it was the Greeks who were the first to take a scientific interest in the night sky, using careful measurements and models and they also developed good mathematics. We were told that there is some vague evidence that in the third century BC, Aristarchus suggested a heliocentric system with the Earth and planets orbiting the Sun and the centre but this has never been proved.

But Aristotle who lived between 384 and 322 BC believed that earth was at the centre of 55 concentric perfect crystalline spheres in a finite Universe. Heavenly bodies fixed to these spheres move at a constant angular speed as they had done for all eternity. The occasional retrograde motion of what we now know as the inner planets was explained by Ptolemy as having tiny epicyclical orbits on their crystalline spheres.

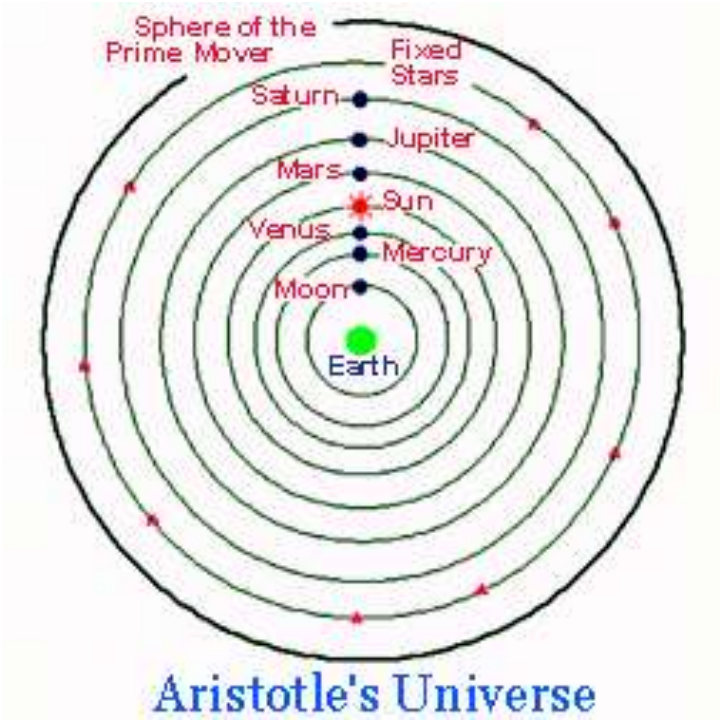


Image – NASA

This view of the universe lasted for 1,400 years. When asked why it had lasted for so long, Jan told us the theory was a pretty successful model for the time at predicting the movement of the planets and there was no clear evidence that the Earth moved.

About 750 AD the Islamic 'Golden Age' of mathematics and science developed using sources of learning from Babylonia, Persian, India and the Greeks. They made instruments such as astrolabes and celestial spheres to make very accurate measurements although they still accepted the geocentric model of Ptolemy.

Most of the Islamic documents were destroyed by the Mongols in 1268 AD when they sacked Bagdad and the famous library.

In Europe in 1440 the Gutenberg Press was invented and this we were told made a great step forward in sharing information.

Religion still believed that Ptolemy's model of the universe was irrefutable with an infinite God and therefore an infinite universe.

This idea was challenged by Copernicus who printed his revolutionary ideas 1543, placing the Sun at the centre of the system. As Jan explained, his theory also gave a simple explanation to why the inner planets appeared to have retrograde motion as part of their orbit viewed from Earth. If the Earth orbited the Sun then it should be possible to see some parallax of the stars over a period of six months, but astronomers at the time could not see any.

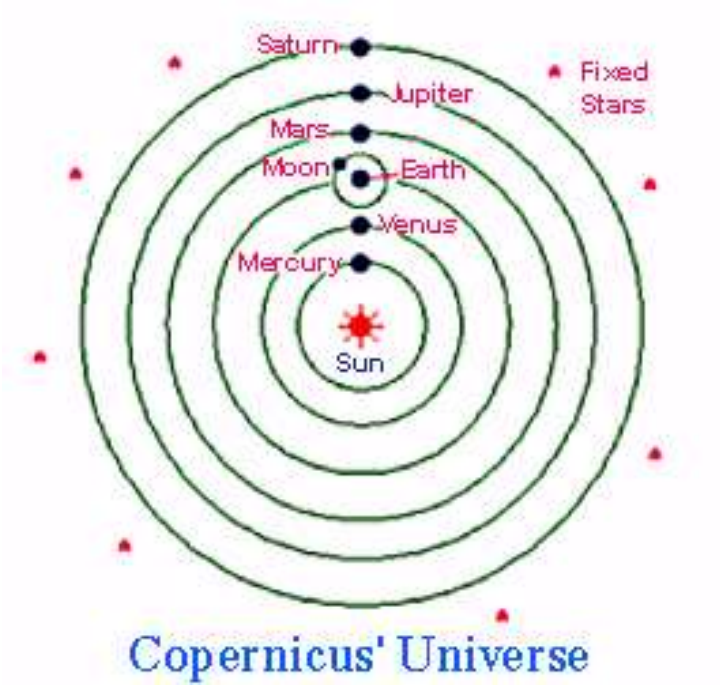


Image - NASA

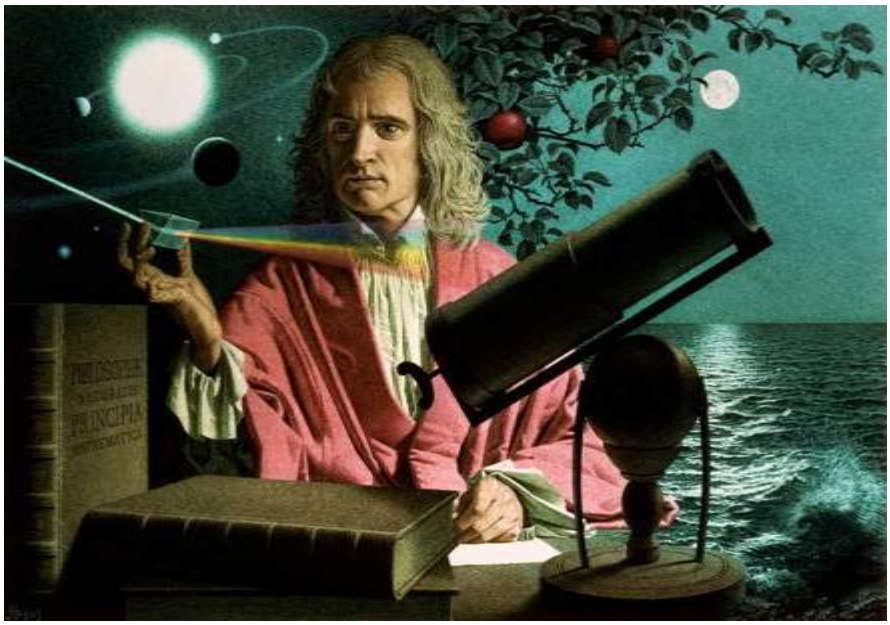
In fact, it wasn't until 1727 that Bradley became aware of aberrations and it took until 1838 when extremely small amounts of parallax were measured by Bessel. Jan described how small the amount of measured parallax was by asking us to imagine an object 1 cm in diameter viewed from 5 km away!

Earlier it was still believed that orbits were perfect circles but it was Johannes Kepler who looked at Tycho Brahe's very accurate pre-telescope observational data and concluded that planetary orbits were in fact ellipses. He then derived his three laws of planetary motion.

Galileo was the first person to use lenses to make a telescope specifically to look at the night sky and publish his findings. In 1610 he published data showing the positions of Jupiter's 4 main moons. He also discovered that the hazy cloud people saw as the Milky Way was fact made up of very many stars, suggesting that the universe was in fact much greater than had been believed.

Despite Galileo's proposals he was accused by the Catholic Church of going against their beliefs and Jan said this was to influence thinking for a long time.

We moved on to Isaac Newton who lived from 1642 to 1726. Jan told us about Newton's development of mathematics, his understanding of gravity and, using Kepler's three laws of planetary motion he derived his laws of motion. Newton also developed theories of light and invented the reflecting telescope.



Isaac Newton – this picture by Jean-Leon Huens depicts some of his achievements such as gravity's effect on the tides, splitting light and his reflecting telescope

William Herschel developed the model of the Milky Way and even at the beginning of the twentieth century it was still believed that the Milky Way was the entire universe but then work by astronomers such as Leavitt, Shapley and Hubble discovered that there were very many other galaxies beyond our own galaxy.

In 1915 Albert Einstein published his theory of General Relativity which now superseded Newton's theories.

Then Jan touched on the nature and composition of stars, explaining how in ancient times it was believed that the basic elements were water, air, fire and aether. In the 18th century Lavoisier and Dalton worked towards modern chemistry and using spectroscopy scientists found it possible to determine what stars were made of.

Jan concluded his comprehensive talk by talking about the Big Bang and the expanding universe.

Snippets from the World of Science
John Wayte

Look around you; what do you see?

Trees grass, wooden chairs, the person sitting next to you. If you dug a small bit of ground, what would you see crawling around? – worms and grubs. Take a walk over Ashdown Forest and again, what do you see? Trees, bracken, deer, sheep and up in the sky, blackbirds and the odd bird of prey. You are on holiday in the middle of Africa and again, what do you see? Elephants, Rhinoceros, perhaps the odd crocodile or two. What did you give your wife or partner last Christmas? A diamond ring? (although this may be pushing it a bit…)

So, as you look around you what is the one thing linking all this together?

Carbon! It is the fourth most common element in the Universe.

So why, if it is so common, am I taking such an interest in it?

Carbon can take many forms and combine with a bewildering number of other chemicals to make it one of the most useful chemicals in the Universe. Without it none of what we see all around could possibly be here and life as we know it couldn't exist.

Well, according to our leading scientists, carbon in the quantities that are around us shouldn't have been formed; but clearly it was formed.

But how? This question has baffled scientists for some 60 years and they still don't know the answer.

Now, do you remember that the kind of water they found on our little friend 6P/C-G asteroid could not have seeded our oceans because of the different molecular signature of its water?

Well exactly the same thing has happened to carbon. The normal route for carbon to be produced in our galaxy could not, so the scientists say, have happened.

Again, taking you back some time ago, well precisely 13.8 billion years, to the time when the Universe was formed at the Big Bang: only the very lightest elements were formed. Hydrogen some helium and a smattering of other elements were the first. After about half a billion years these original elements formed the first supermassive stars with very short lives that went supernova and formed heavier elements.

The process to form carbon atoms starts with the fusion of the lightest element hydrogen to make a second element helium.

This is where it all goes wrong because the next normal step would be to create the next element by the 2 helium nuclei, each containing 2 protons and 2 neutrons fusing to make beryllium-8. This again would normally fuse with a further helium atom to make carbon-12.

But there is one problem!

Beryllium-8 is highly unstable, meaning that it decays in the blink of an eye; so, no carbon in the Universe.

The other possibility was that 3 x helium-4 nuclei fused together in huge bloated dying stars to make carbon-12. But this process is so rare that the stars could not have made sufficient carbon.

So, this proves the statement "I am here so I must have been made".

Professor Fred Hoyle

Fred Hoyle came up with the answer in 1953. He said that there MUST be an excited state of the carbon nucleus; particular configuration of the protons and neutrons, with precisely 7.65 megaelectronvolts (MeV) of energy above the minimum, or ground state. Apparently in an excited state the atoms jiggle around more vigorously than normal and so fuse together. 7.65 represents the combine energy of 3 x helium-4 nuclei whizzing around at 100 million degrees.

This prediction was verified in collider experiments. Hoyle claimed that this was evidence that our universe was very finely tuned for life and that had the energy been slightly different than what is now known as 'Hoyle State" then carbon would not have existed and where would we have been. This universe has been very carefully tuned to support life.

Don't you feel lucky to be alive?

Some theorists claim that, as we heard Brian Cox say recently, other universes or multiverses could exist – and have other laws of physics in which Beryllium-8 is stable.

With that, I will leave you to ponder…

DECEMBER MEETING

14th December 2016 (NB the second Wednesday of this month) – Brian Mills FRAS tells us about "Local Astronomers".

Meetings will take place in classrooms IL5 and 6 which are in the blue walled classroom block at the far end of the drive from the main gate of Uplands College and up by the tennis courts. Signs will direct you. There is car parking near the block. The postcode is TN5 6AZ.

Meetings begin at 1930 prompt although members are invited to arrive anytime after 1900 as this is a good time to exchange ideas and discuss problems and also help set things up before the meeting starts.

Anyone is welcome but non-members are asked if they wouldn't mind contributing £3 towards costs.

FUTURE MEETINGS

18th January 2017 – A short AGM will be followed by three short talks on astronomical subjects.

15th February – Dr David Mannion gives another of his entertaining talks, this time he calls it "ET, Are You Out There?"

15th March – Professor Louise Harra brings us the latest news of "Solar Activity".

SKY NOTES FOR DECEMBER 2016

Planets

Mercury is an evening object, but is very poorly placed for observation from the latitudes of the UK. It reaches greatest eastern elongation on December 11th when, in angular terms, it will be 21° from the Sun. On that date, with the Sun 6° below the horizon, the planet will be just under 4° in altitude in the south west, as shown in fig 1. **Please remember you should not sweep for Mercury, or any object for that matter, until after the Sun has set. To do so would be to risk your eyesight.** At the time of elongation the planet will have an apparent diameter of 6.5 arc seconds and a brightness of magnitude -0.5.

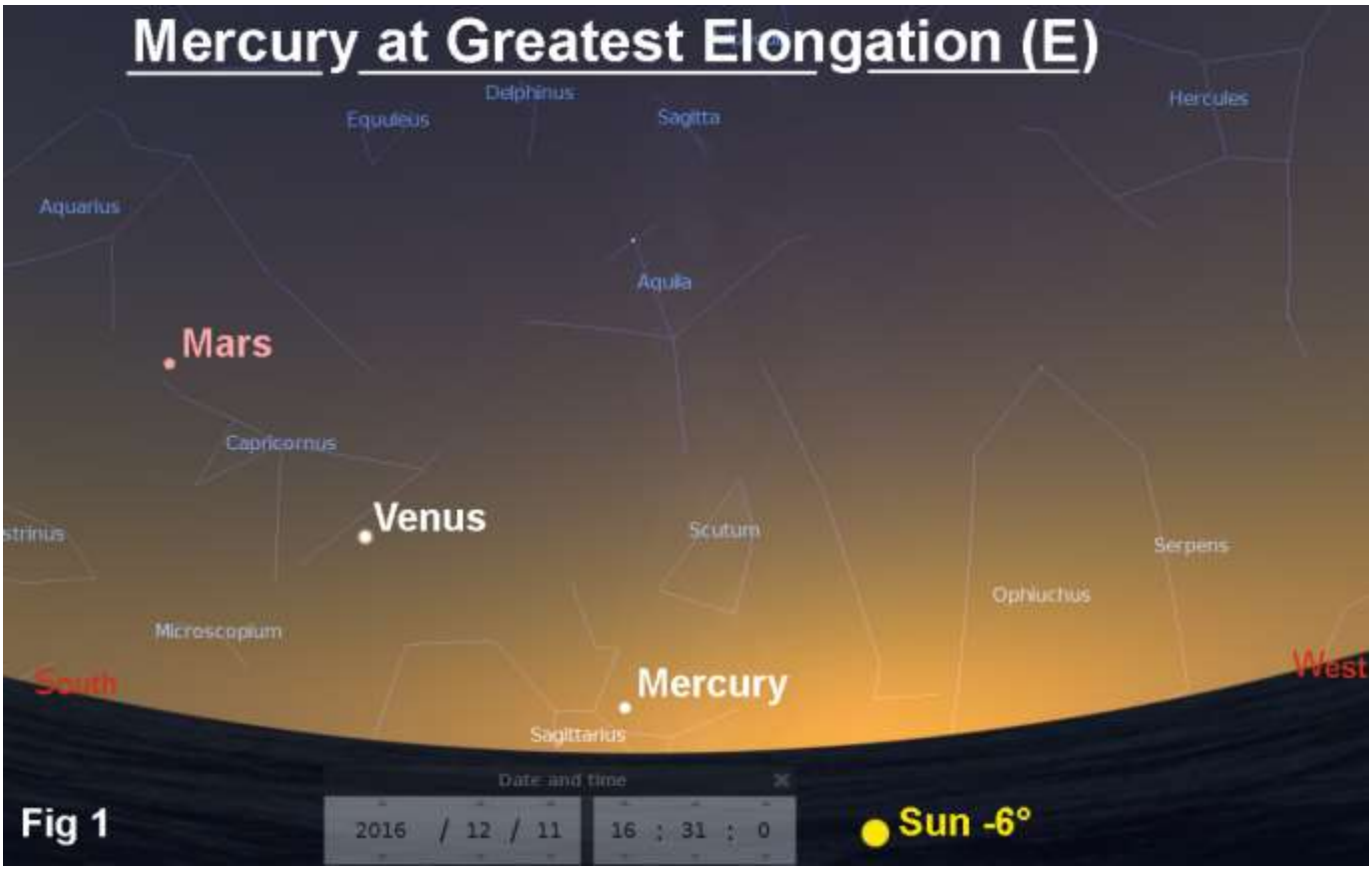
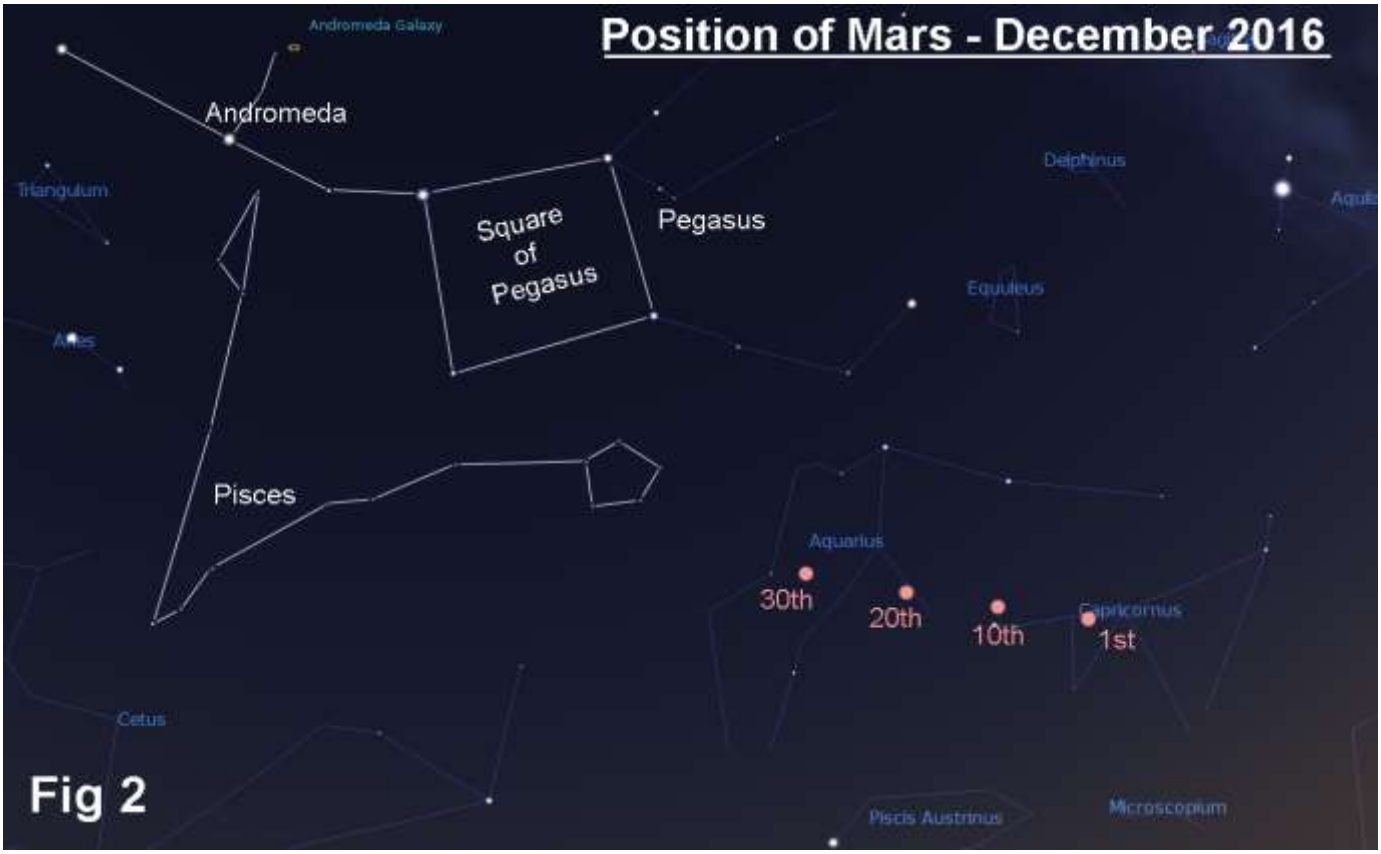


Fig 1

Venus is now a brilliant evening object that sets three hours after the Sun at the start of the month, whilst by the end this figure has stretched to more than four hours. At magnitude -4.2 it is unmistakable due to its brilliance and the fact that there are no bright stars anywhere nearby. On the evening of December 3rd the 15% illuminated Moon is immediately north of the planet, to set up a pleasing photo opportunity. Venus's observability improves during the month as its declination becomes swiftly less negative. On the 1st it lies 24° below the celestial equator whilst on the 31st it is just 13° south of it, though it does not achieve positive declination until the end of January. The planet's phase continues to decrease from 68% to 56% whilst its apparent size grows from 17 to 21 arc seconds. The position of Venus is included in fig 1.

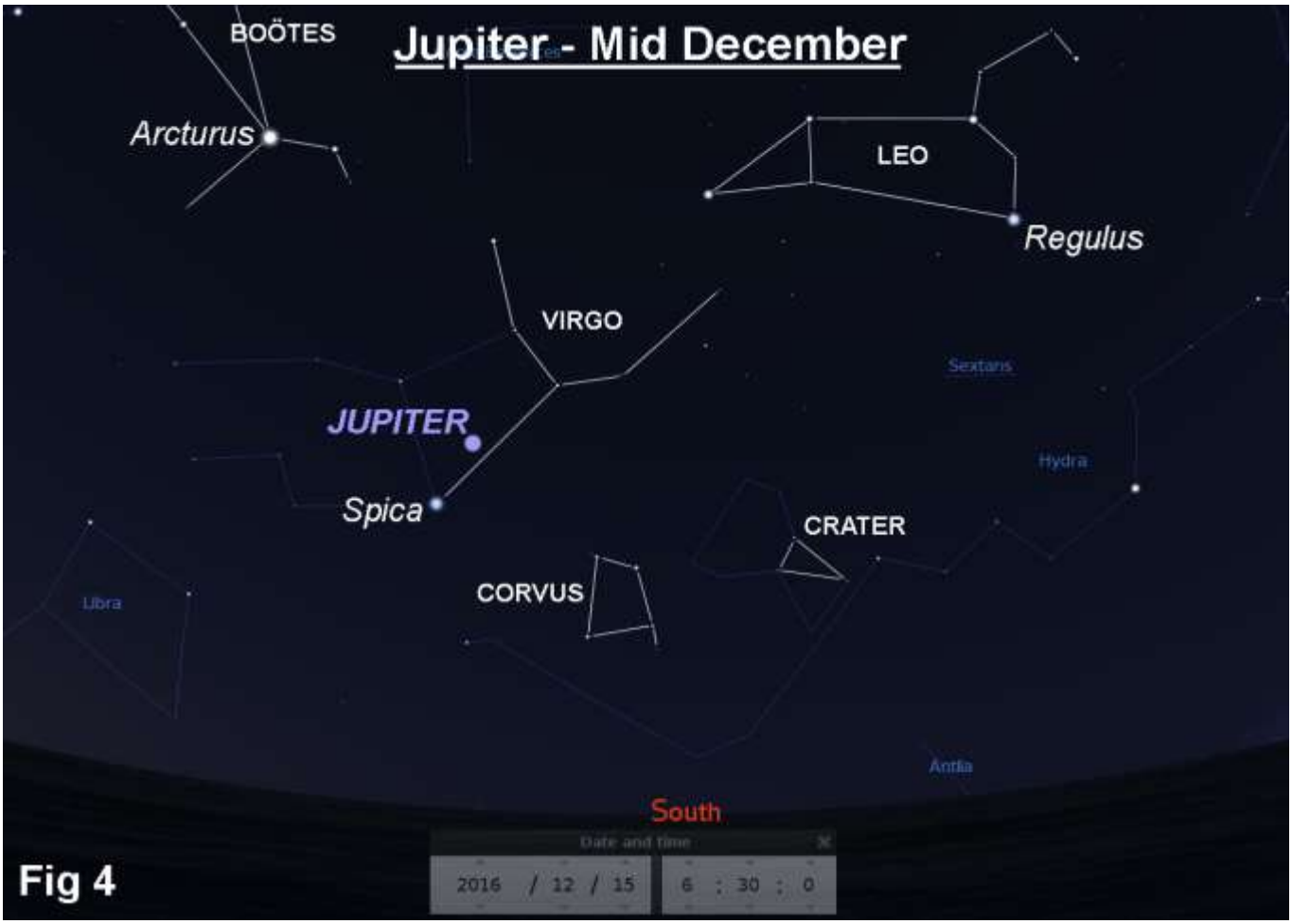
Mars continues its speedy easterly journey, beginning December in Capricornus but crossing the border into neighbouring Aquarius on the 15th as shown in fig 2. The red planet makes a very close approach to Neptune (mag. +7.8) on the last day of the year although technically the conjunction occurs at 07.00 on January 1st. At that date and time the two bodies will appear to be just 0.02° apart.

The Earth and Mars are moving progressively further apart as the Earth, on the "inside track" so to speak, is travelling more quickly. The relative positions of the two bodies over the last few months (on the nights of WAS meetings) are shown in fig 3. This gives an indication of how gradual the process is; don't forget that the time between successive oppositions of Mars is a little over two years. Bear in mind that in fig 3 we are looking down on the solar system from above so that the planets are orbiting anti-clockwise.



Jupiter is a brilliant morning object in Virgo, rising five hours before the Sun at the beginning of the month. At the end of nautical twilight/beginning of civil twilight the gas giant is already 30° above the south-south-eastern horizon at magnitude -1.8. As the month progresses, Jupiter pulls further away from the Sun until by the end of December it rises around 01.00. However, it will not become an evening object until late January next year. Fig 4 shows the position of Jupiter in the middle of this month at 06.30 with the Sun more than 12° below the horizon so the sky is still comparatively dark. The planet is currently moving direct (from west to east) and is gradually approaching the bright star Spica in Virgo.

A pair of binoculars, providing they can be supported in some way, will show the four brightest moons. These are known as the Galilean moons after their discoverer, Galileo Galilei, who first saw them in 1610 although the choice of names Io, Europa, Ganymede and Callisto were not of his choosing. There is a claim that a Chinese astronomer saw at least one of them as early as 360BC, although we would have to assume that this would have been with the naked eye. At the current time we have identified 67 natural satellites of which Ganymede is the largest, and in fact is larger than the planet Mercury. The Galilean moons may be the brightest but they are not the closest to their parent body; there is another group that lies even closer and therefore has much shorter periods. This group contains, in order outwards, Metis, Adrastea, Amalthea and Thebe of which Amalthea is by far the largest. It was discovered in 1892; 282 years after the Galilean group were first seen. Metis, the closest to Jupiter completes one orbit in just seven hours.



Saturn is not visible this month because of its proximity to the Sun. It passes through solar conjunction on December 10th and should become visible as a morning object in mid to late January. The tilt of the planet's axis is such that the rings will be well presented to us throughout the coming year until conjunction occurs in December 2017.

Lunar Occultations

In the table below I've listed events for stars down to magnitude 7.0 that mostly 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 RB = **r**eappearance at the **b**right limb. The column headed "mm" (millimetres) shows the minimum aperture telescope required for each event. The evening of December 12th through to moonset on the morning of December 13th sees our satellite pass once more through the Hyades, an event that culminates in a low altitude occultation of Aldebaran, seen as a graze from parts of Scotland. **Times are in GMT.**

Dec	Time	Star	Mag	Ph	Alt °	% illum.	mm
6th	17.14	ZC 3313	6.5	DD	29	43	50
9th	19.23	ZC 192	5.1	DD	42	76	40
11th	17.56	ZC 462	6.0	DD	29	92	70
12th	16.30	ZC 608	6.0	DD	10	97	100
12th	19.40	ZC 626	6.3	DD	38	98	80
12th	21.39	ZC 635	3.7	DD	52	98	40
13th	05.23	Aldebaran	0.9	DD	10	99	40
13th	05.53	Aldebaran	0.9	RB	6	99	60

Phases of the Moon for December

First ¼	Full	Last ¼	New
7th	14th	21st	29th

ISS

Below are details for passes of the International Space Station (ISS) that occur before midnight and are magnitude -2 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 GMT.**

Dec	Time	Mag.	Alt°	Az.		Dec	Time	Mag.	Alt°	Az.

3rd	18.10	-2.1	32	S		12th	16.48	-3.3	79	N
5th	18.03	-3.1	58	SSE		12th	18.24	-2.5	50	W
6th	17.11	-2.5	40	SSE		13th	17.33	-3.4	89	S
7th	17.56	-3.4	83	S		14th	16.41	-3.3	81	N
8th	17.04	-3.1	65	SSE		14th	18.17	-2.5	46	SSW
9th	17.48	-3.4	81	N		15th	17.25	-3.0	65	SSW
10th	16.56	-3.3	89	SSE		16th	16.33	-3.2	83	SSW
11th	17.40	-3.4	79	N		17th	17.17	-2.0	40	SSW

Iridium Flares

The flares that I've listed are magnitude -2.0 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 . 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 then. **Times are in GMT.**

Dec	Time	Mag	Alt°	Az.°		Dec	Time	Mag.	Alt°	Az.°
8th	17.09	-8.4	62	51 (NE)		21st	18.00	-4.2	50	38 (NE)
16th	16.29	-3.5	70	76 (ENE)		25th	17.39	-3.4	55	45 (NE)
17th	18.19	-8.0	43	34 (NNE)		26th	17.33	-8.4	57	46 (NE)
19th	16.11	-6.0	72	92 (E)						

The Night Sky in December (Written for 22.00hrs GMT mid month)

In the west, the autumn groups of Pegasus, Pisces and Cetus are now approaching the horizon although the Great Spiral, M31 in Andromeda, is still at an altitude of almost 60°. The open cluster NGC 752 lays a little further along the line of stars that form Andromeda, whilst M33 is just across the border in neighbouring Triangulum. Between the appropriately named triangle and the zenith we find Perseus riding high with the "Demon Star" Algol just over 10° from the overhead point. More correctly known as Beta Persei, it is one of the best known eclipsing binaries and varies in brightness from +2.1 to +3.4.

Looking north, the head of Draco the dragon and Ursa Minor are almost at their closest to the horizon. It follows then that Ursa Major is to the east of the meridian and rising whilst on the other side of the north celestial pole Cepheus, which lies partly in the galactic plane, is sinking. At this time of year the arc of the Milky Way rises from just west of north and makes its way, via Cygnus, Cepheus and Cassiopeia to the zenith. The whole area is rich with clusters like the Dragonfly and Sailboat as well as nebulae such as the Cocoon and the Heart and Soul. Vega lies less than 10° from the horizon and will soon be lost along with Altair that has already set. The third member of the Summer Triangle will not suffer the same fate; at least not from the southern UK as from here it is circumpolar.

Towards the east Leo and Cancer have both risen, as has the head of Hydra, which belongs to the largest constellation by area of the 88 modern groups. Immediately above Leo at this time are the generally faint and shapeless forms of Leo Minor and Lynx which were both added to the sky in the 17th century by Hevelius. They both contain a small number of faint galaxies but Leo Minor's claim to fame is that it contains the interestingly named "Hanny's Voorwerp" which translated means Hanny's Object. Hanny is a Dutch schoolteacher who found this unusual specimen whilst volunteering on "Galaxy Zoo". The object is described as being a "quasar ionisation echo" which glows green due to the ionisation of oxygen.

In the south the winter constellations are coming to dominate the area as Orion and his entire retinue have all now risen, save for the southern extremities of Canis Major. At just 15° from the zenith, Capella in Auriga is approaching the meridian as is Aldebaran some way below it. South of these two, Orion and Lepus are yet to culminate as is the rest of Orion's entourage which lies mostly to the east of him.

Meteors

The **Geminids** are active from December 8th to 17th with maximum occurring on December 13th at 20.00. This is the year's most productive shower but unfortunately, on that night, a full Moon is located nearby in Taurus. However, if you can position yourself in such a way that the Moon is obscured by a fence or building then it should be possible to see the brighter events. Fig 6 shows the position of the radiant.

The normal limits of the **Ursids** are from December 17th to 25th, reaching maximum during the night of December 22nd/23rd when the Moon will not rise until 02.00. Rates of around 10 meteors are expected, although this is a shower that would benefit from more observations. The radiant, whose position is shown in fig 6, is circumpolar so that it is always above the horizon from the UK.

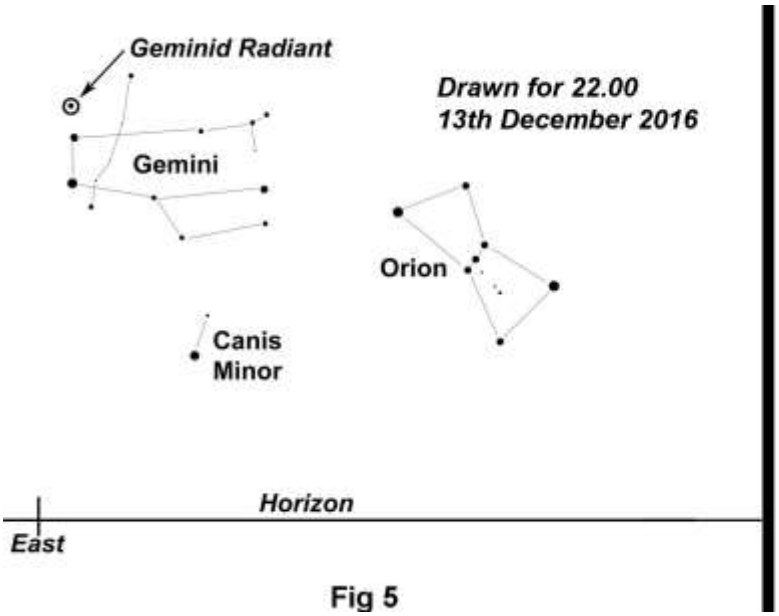


Fig 5

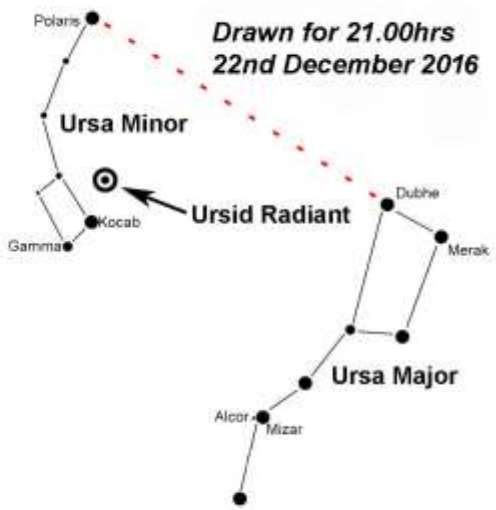


Fig 6

Advance warning for 2017

January 3rd – Quadrantid meteor maximum
January 12th – Venus at greatest eastern elongation (evening).
January 19th – Mercury at greatest western elongation (morning).
February 11th – Penumbral eclipse of the Moon.
April 1st – Mercury at greatest eastern elongation (evening).
April 28th – Daylight occultation of Aldebaran.
June 3rd – Venus at greatest western elongation (morning).
July 25th – Daylight occultation of Mercury by the Moon.
August 7th – Partial lunar eclipse (Moon rises during eclipse).
August 16th – Daylight occultation of Aldebaran.
August 21st – Total solar eclipse, "The Great American Eclipse". There are certain to be numerous live feeds available on the internet.
September 12th – Mercury at greatest western elongation (morning).
November 6th – Early morning occultation of Aldebaran.
December 14th – Geminid meteor maximum.
December 31st – Early morning occultation of Aldebaran.

Brian Mills

SPACEPLACE - NASA

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Dimming stars, erupting plasma, and beautiful nebulae
By Marcus Woo

Boasting intricate patterns and translucent colors, planetary nebulae are among the most beautiful sights in the universe. How they got their shapes is complicated, but astronomers think they've solved part of the mystery—with giant blobs of plasma shooting through space at half a million miles per hour.

Planetary nebulae are shells of gas and dust blown off from a dying, giant star. Most nebulae aren't spherical, but can have multiple lobes extending from opposite sides—possibly generated by powerful jets erupting from the star.

Using the Hubble Space Telescope, astronomers discovered blobs of plasma that could form some of these lobes. "We're quite excited about this," says Raghvendra Sahai, an astronomer at NASA's Jet Propulsion Laboratory. "Nobody has really been able to come up with a good argument for why we have multipolar nebulae."

Sahai and his team discovered blobs launching from a red giant star 1,200 light years away, called V Hydrae. The plasma is 17,000 degrees Fahrenheit and spans 40 astronomical units—roughly the distance between the sun and Pluto. The blobs don't erupt continuously, but once every 8.5 years.

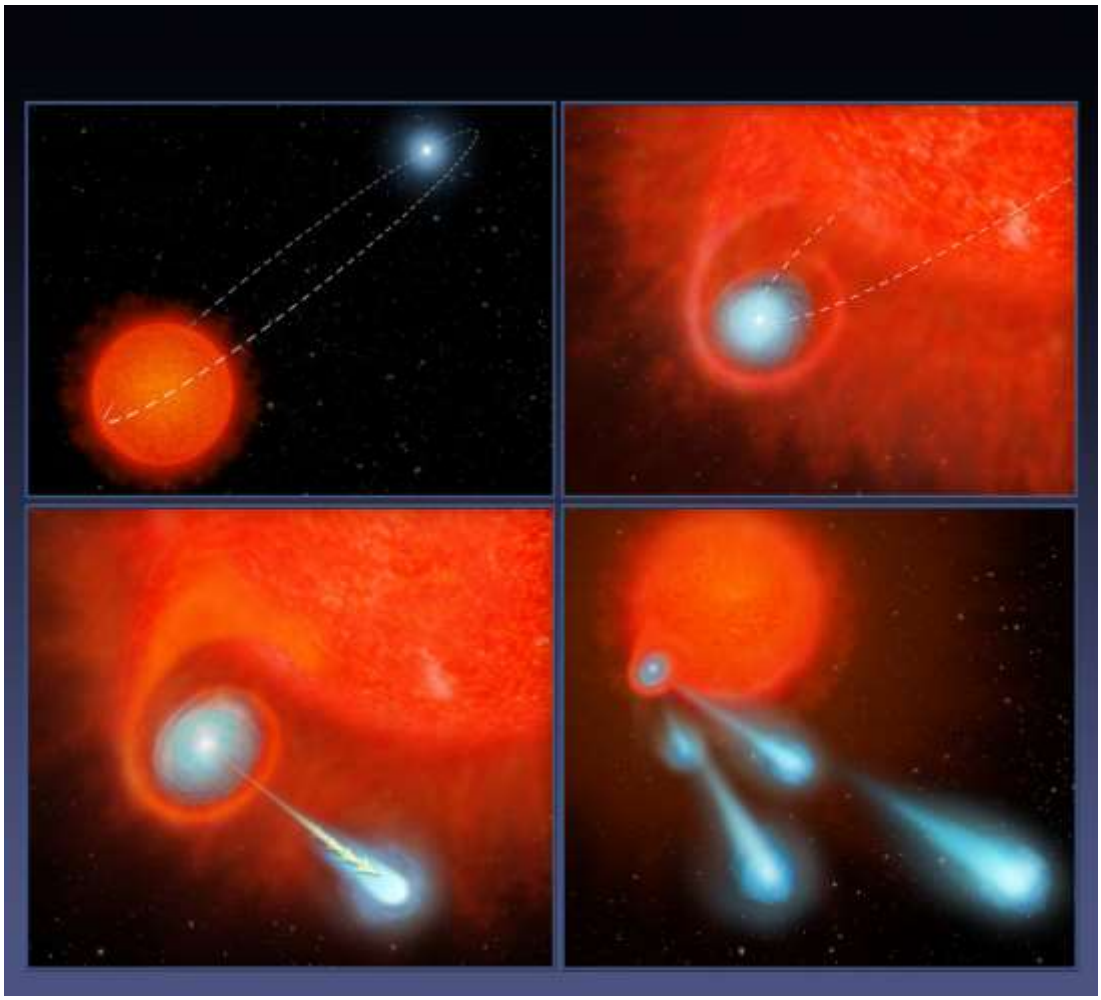
The launching pad of these blobs, the researchers propose, is a smaller, unseen star orbiting V Hydrae. The highly elliptical orbit brings the companion star through the outer layers of the red giant at closest approach. The companion's gravity pulls plasma from the red giant. The material settles into a disk as it spirals into the companion star, whose magnetic field channels the plasma out from its poles, hurling it into space. This happens once per orbit—every 8.5 years—at closest approach.

When the red giant exhausts its fuel, it will shrink and get very hot, producing ultraviolet radiation that will excite the shell of gas blown off from it in the past. This shell, with cavities carved in it by the cannon-balls that continue to be launched every 8.5 years, will thus become visible as a beautiful bipolar or multipolar planetary nebula.

The astronomers also discovered that the companion's disk appears to wobble, flinging the cannonballs in one direction during one orbit, and a slightly different one in the next. As a result, every other orbit, the flying blobs block starlight from the red giant, which explains why V Hydrae dims every 17 years. For decades, amateur astronomers have been monitoring this variability, making V Hydrae one of the most well-studied stars.

Because the star fires plasma in the same few directions repeatedly, the blobs would create multiple lobes in the nebula—and a pretty sight for future astronomers.

If you'd like to teach kids about how our sun compares to other stars, please visit the NASA Space Place: http://spaceplace.nasa.gov/sun-compare/en/



This four-panel graphic illustrates how the binary-star system V Hydrae is launching balls of plasma into space. Image credit: NASA/ESA/STScI

CONTACTS

General email address to contact the Committee
wadhurstastro@gmail.com

Chairman	Brian Mills
Secretary & Events	Phil Berry 01892 783544
Treasurer	John Lutkin
Membership Secretary	John Wayte
Newsletter Editor	Geoff Rathbone 01959 524727
Director of Observations	Brian Mills 01732 832691 email: brianm@wkrcc.co.uk
Committee Members	Jim Cooper Eric Gibson

Wadhurst Astronomical Society website:
www.wadhurstastro.co.uk

SAGAS web-site:
www.sagasonline.org.uk

Any material for inclusion in the January 2017 Newsletter should be with the Editor by December 28th 2016