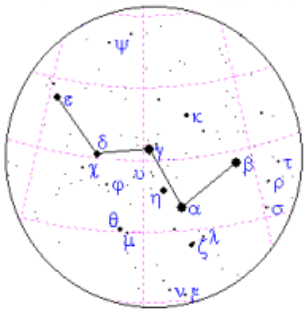


Wadhurst Astronomical Society Newsletter November 2016

MEETINGS

OCTOBER MEETING

The October meeting was introduced by our Secretary, Phil Berry who welcomed members and said how pleased we were to see a number of visitors.

During the last meeting, the fire bell was activated, fortunately due to a fault, but in evacuating the venue it brought to our notice that a number of people hadn't signed-in to say they were present so Phil pointed out that it was important to sign and then in the event of a real fire, we won't leave people to burn.

Phil next welcomed back our speaker David Whitehouse. David is an accomplished author and has also been a BBC science correspondent and tonight he tells us a little about his latest book.

Journey to the Centre of the Earth
David Whitehouse

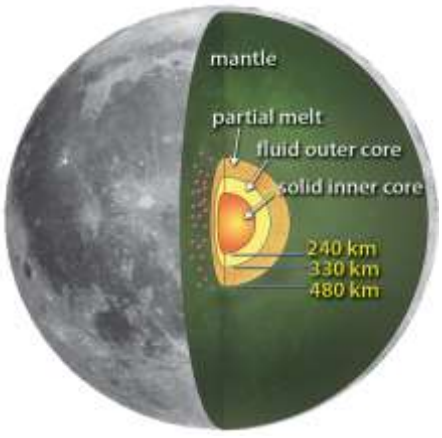
David began by telling us how much he enjoyed writing and described some of the methods and disciplines involved. He said that once having decided what to write about, he found it best to find a publisher that was interested in his book because this gave the writer a timetable which included things such as promoting the book at fairs and festivals and it also acted as an incentive to get on with it.

He also talked about the process of writing and how much is written and then thrown away as the book progresses. He said that a lot of the time was spent gazing out of the window contemplating and how this annoyed his wife who thought he should do his thinking whilst carrying out the shopping…

Another often forgotten consideration is what should be on the cover. David said publishers want a bright cover that will attract the eye but may well have little relationship to the subject and he fought hard to keep a certain relevance.

We looked at other writings about 'A journey to the centre of the earth' such as that by Jules Verne written 150 years ago. David also showed clips from such films as Pat Boone's "Journey to the Centre of the Earth" and "Core" where the centre of the Earth stopped spinning.

Then David turned to the Earth and its creation. It formed from particles close to the Sun which were mainly metallic compared with the dust further away. The deeper we look into the Earth the less we know and the stranger it gets.



With a diagram he showed the rocky crust, the mantle and beneath this the metallic part of the planet with the outer molten core being the size of Mars and then the inner core the size of the Moon. About three thousand kilometres beneath the Earth's surface there is a huge change from the solid to molten state.

The Earth's surface is continually regenerating but we were told that the oldest rock to be found is on the shores of Hudson Bay in Canada which are in the order of 3.2 billion years old. But David said that the oldest material are zircon crystals discovered in western Australia with an age of about 3.4 billion years. He said that these were particularly interesting because trapped inside were tiny fragments that gave some idea of the atmosphere and particles around at that time.

Next, we were told about the deepest hole man has made and this is a gold mine in South Africa at a depth of 3,600 metres where the water is too hot to stand in although the deepest that man has been to is in the Pacific Ocean at the bottom of the Mariana Trench at a depth of about 11,000 metres, although there is a point in the Arctic Circle where the bottom of the ocean is closer to the centre of the Earth by 40 metres because of the shape of the Earth.

The Russians drilled as deep as 15,000 metres at Kola near Murmansk looking for nickel but it was so hot at that depth that the drill bits melted but they were able to recover core samples which we were told are still waiting to be thoroughly analysed.

All that is visibly left of the Kola Deep borehole, the deepest man has reached

On the Isle of Wight in Victorian times, Shide House became the centre for earthquake reporting under John Milne who had learnt a lot about earthquakes after visiting Japan. The centre became the clearing house for reports of earthquakes from all around the British Empire with the result that a lot was learnt about them by comparing these reports with Milne's own readings from his detector.

In Germany a seismic detector identified an earthquake that had occurred as far away as Japan and following this more work was done to find out how different waves travelled through the earth. Richard Dixon Oldham analysed the waves and determined that the outer core of the earth was molten.

A Danish lady surveyor, Inge Lehmann meticulously compared seismic results and found that some waves were bouncing off something and was the first person to discover that the inner core was solid. Following this, analysis of the data from seismic detectors from all around the world has revealed a great deal of detail of what lies inside the earth.

It was a German scientist, Alfred Wegener who discovered that the world was divided into plates that moved relative to each other and at the junction of these tectonic plates, material was rising and continually regenerating the Earth's surface particularly at the ocean floor.

David described how the rock changes the deeper beneath the surface we go due to increasing pressure until it becomes 'perovskite' deep in the earth's mantle and went on to say that the whole of the mantle is always going through change.

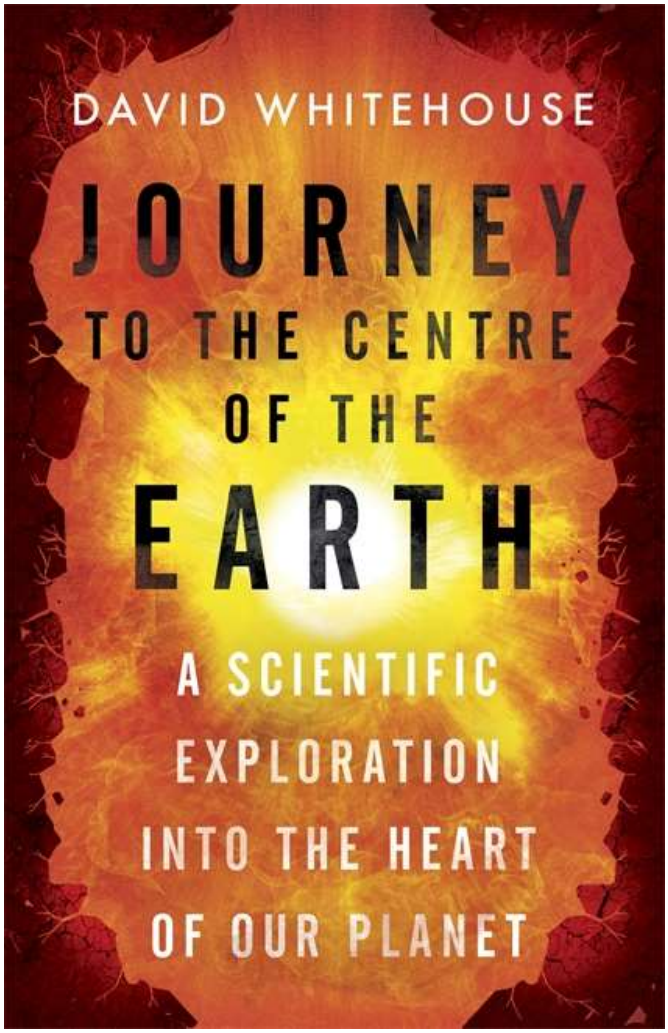
He said that the change from the bottom of the mantle to the molten outer core is actually greater than the change from air to rock we are so familiar with. The molten outer core is continually moving about and it is this that gives us our magnetic field that is so important in protecting us from the solar wind and radiation from space.

Finally, David came to the inner core which he said was really strange.

The first thing we were told was that waves from earthquakes travel through the inner core faster north-south than east-west suggesting it has an axis. It has also been found that it is not exactly at the centre of the Earth and moves about causing it to cool on one side and then on the other. This has allowed tiny crystals of iron to grow on the surface of the inner core so that the core is growing at the rate of about 0.5 mm a year.

David ended by saying that the Sun is predicted to eventually turn into a red giant after about four billion years' time and the Earth would become uninhabitable. This is going to have to be rethought because well before then the core of the Earth will have grown to the point where it will eat up the outer core and stop the magnetic field that protects the Earth and the planet will become barren like Mars. This will happen two billion years before the Sun becomes a Red Giant!

During his talk, David went into a great deal of fascinating detail which can be found in his latest book, "Journey to the Centre of the Earth".



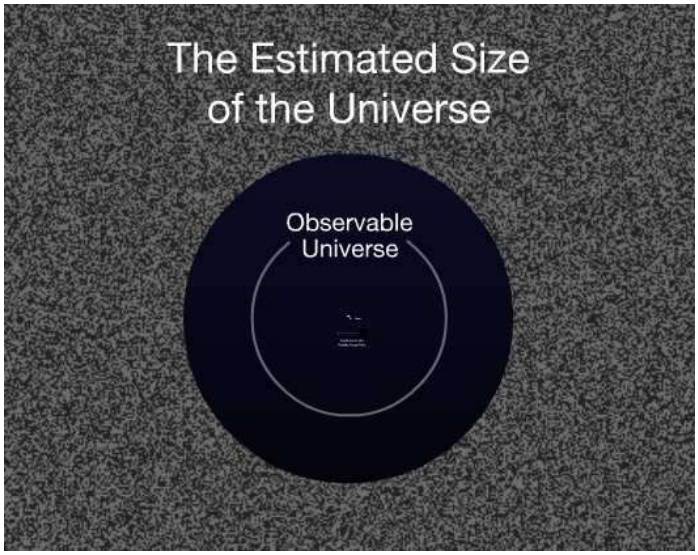
Snippets from the World of Science
John Wayte

On the 13th of October NASA/ESA released some rather interesting data.

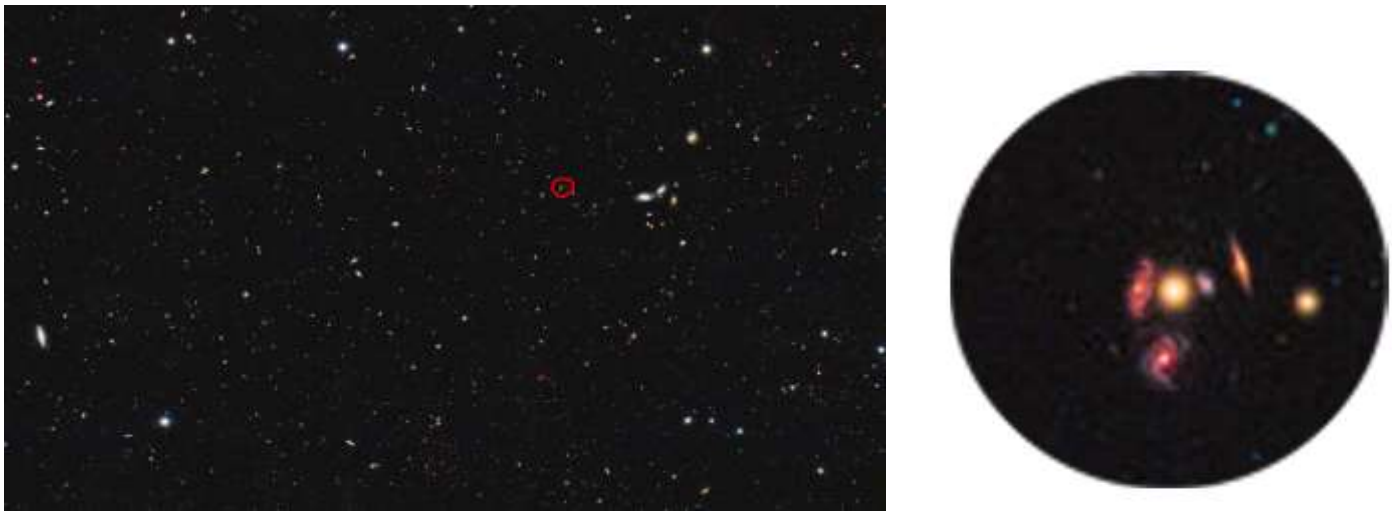
An international team led by Christopher Conselice has been studying Hubble's Deep Field images. You may well remember some pictures that showed galaxies reaching back 10 to 12 billion years. In other words, not very long after they were formed following the Big Bang.

Based on such studies in the 1990s, scientists estimated that there were roughly 100 billion galaxies. That is 100,000,000,000 galaxies. If each galaxy was about the same size as our average Milky Way, then each galaxy would contain more than 10^{12} stars or in English money 1,000,000,000,000.

So the total number of stars would be about 10^{24}. Does anyone know what 10^{24} is called? Septillion. And this as far as we can see! But we can't see it all can we? As the next diagram illustrates.



I thought you might like to see some of Hubble's Deep Field images. When you first see these, you think, ok, there's a few galaxies out there but it is only when you blow them up to an enormous size that you realise just how many galaxies there really about there. I have taken one area at random to demonstrate this point.



On the left is a NASA image from Hubble's Deep Field camera. On the right is the detail marked in red, indicating just how many galaxies are present

So why am I bringing these interesting facts up? It is because Christopher and his team have done a much more accurate head count of the galaxies and have come to the staggering conclusion that they have been undercounted by a minimum of a factor of 10!

This is like saying that there are more stars than there are grains of sand on the Earth only to be told that this is a huge underestimate and there are more stars than there are grains of sand on ten Earths.

So there we are. Ten-times more stars have been found since last Thursday – don't hold your breath!

NOVEMBER MEETING

16th November 2016 – Our own Jan Drozd talks about "A History of Man's Understanding of Our Universe".

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

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

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

15th February – Programme to be announced.

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

SKY NOTES FOR NOVEMBER 2016

Planets

Mercury is an evening object, although it will be extremely difficult to find given its low altitude. It was at superior conjunction on October 27th, so is only now emerging from the solar glare, but even by the end of November the smallest planet sets just 45 minutes after the Sun. This is just 11 days before it reaches greatest eastern elongation (21°). If you do search for Mercury it will be low down in the south west immediately after the Sun has set. **In the interests of safety, please do not sweep for the planet with binoculars until after sunset.**

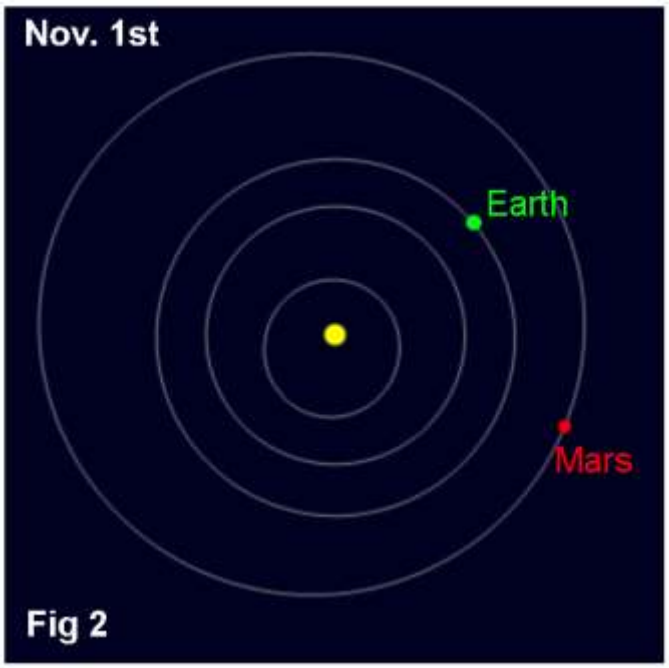
Venus is an evening object, although it too suffers from low altitude thanks to a sizeable negative declination. Fig 1 shows the position of the planet in the middle of the month at the end of civil twilight (Sun 6° below the horizon). I have included both the ecliptic and the celestial equator so that you can see what I mean when I talk about the position of the planets, close to the ecliptic, and the celestial equator. Venus has one advantage over other planets in the area and that is its brightness. It brightens slightly, to magnitude -4.1 during November, and indeed for the rest of this year. The planet's apparent angular size also increases from 14 to 17 arc seconds. Its phase though is decreasing as the illuminated hemisphere is turned more and more away from the Earth.

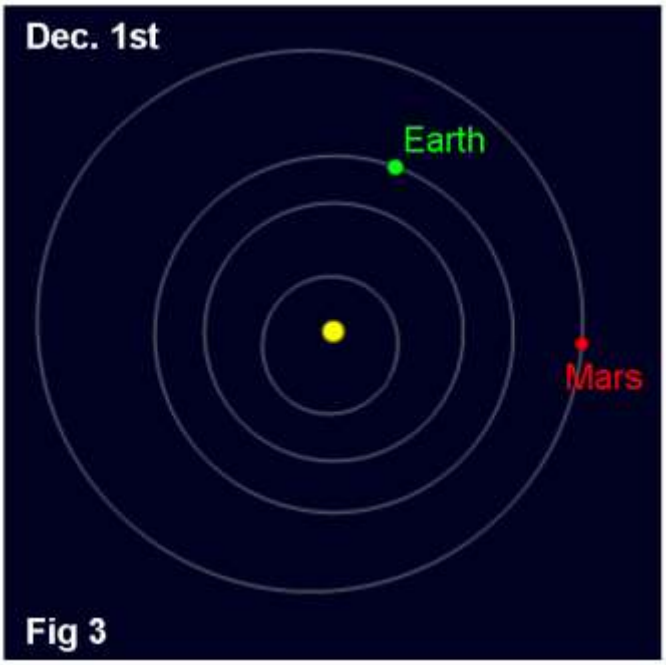
Fig 1

Mars is still an evening object though the Sun is gradually drawing closer despite the red planets swift motion. It begins the month in Sagittarius, but crosses into Capricornus on the 8th, thereafter continuing in an easterly direction (see fig 1). Following the opposition of Mars, something that only happens every two years, the Earth which is moving the more quickly of the two is quite slowly increasing the distance between us. Figs. 2 and 3 illustrate this showing the position of the planets on the 1st of November and 1st December respectively. It will take until the end of July next year for the Earth to pull ahead sufficiently for the two planets to be located on opposite sides of the Sun. In the diagrams we are looking down on the solar system from above so the planets all seem to move in an anti-clockwise direction.

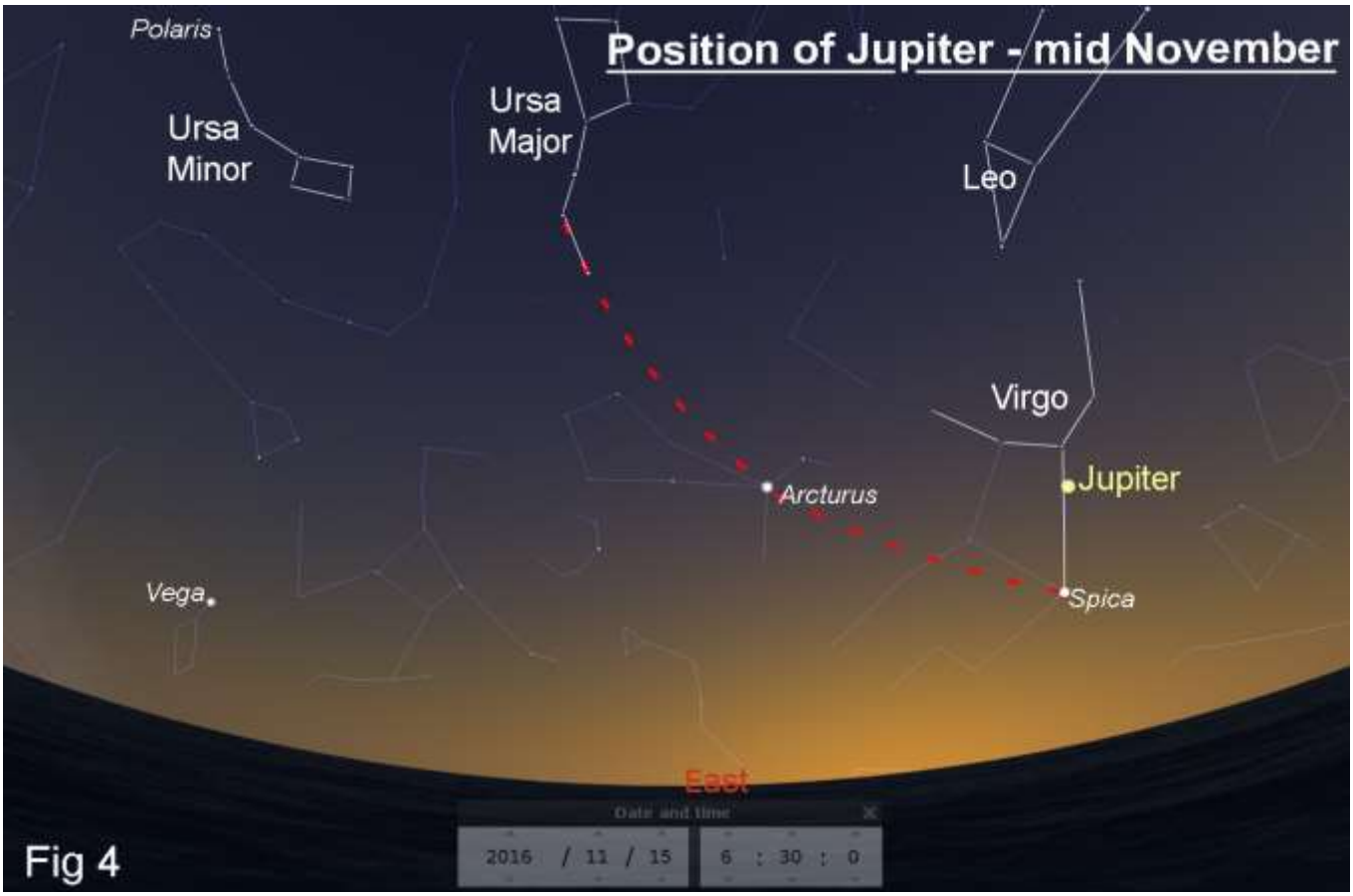
Mars, of course, is currently in the news with the arrival at the planet of the latest mission from the European Space Agency (ESA). The ExoMars Trace Gas Orbiter seems to have performed well until some time during the six minute descent of the Schiaparelli lander. It seems a problem occurred at the time the parachute was to be jettisoned and the rockets were due to fire to bring the craft almost to a halt.

Giovanni Schiaparelli (1835 – 1910) was the Italian astronomer who first observed what came to be known as canals on the surface of Mars, at the 1877 opposition, although he was not responsible for calling them that or for the furore that followed. That was in large part due to Percival Lowell (1855 – 1916) who misinterpreted faint markings on the planets surface, joined them together, and began the canal controversy.





Jupiter is a morning object rising just after 04.00 GMT at the beginning of the month which is 3 hours before the Sun. By the end of November it rises at 03.00 with the planet making its way slowly eastwards in the constellation of Virgo.



On the morning of the 25th, Jupiter is joined by a 15% waning gibbous Moon which will be just over 2° east of the planet making for a pleasing photo opportunity. Jupiter is growing in both brightness and apparent size as it approaches opposition in April next year. The gas giant shines at magnitude -1.7 and has an angular equatorial diameter of 32" (arc seconds). Fig 4 shows the position of the planet at 06.30 GMT in the middle of the month. It can be found a little past east by using the last two stars in the tail of Ursa Major to draw a curved line through Arcturus in Boötes and then on to Spica. Jupiter is just north of Spica.

Saturn is too close to the Sun for observation as it heads towards conjunction on December 10th. It should become visible as a morning object around mid January 2017, although it will be the middle of May before it is visible in the evening skies again.

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 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 GMT.**

Nov.	Time	Star	Mag	Ph	Alt °	% illum.	mm
10th	21.41 UT	ZC 3514	5.9	DD	34	81	50
12th	19.11 UT	ZC 249	4.4	DD	31	95	40
16th	19.52 UT	ZC 878	5.5	RD	12	92	60
18th	23.57 UT	ZC 1198	6.1	RD	30	74	60
20th	23.55 UT	ZC 1441	6.4	RD	11	53	70

Phases of the Moon for November

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

ISS

There are no evening passes of the International Space Station (ISS) visible from this part of the country during November although there are a number visible in the early hours of the morning. To see these go to www.heavens-above.com

Iridium Flares

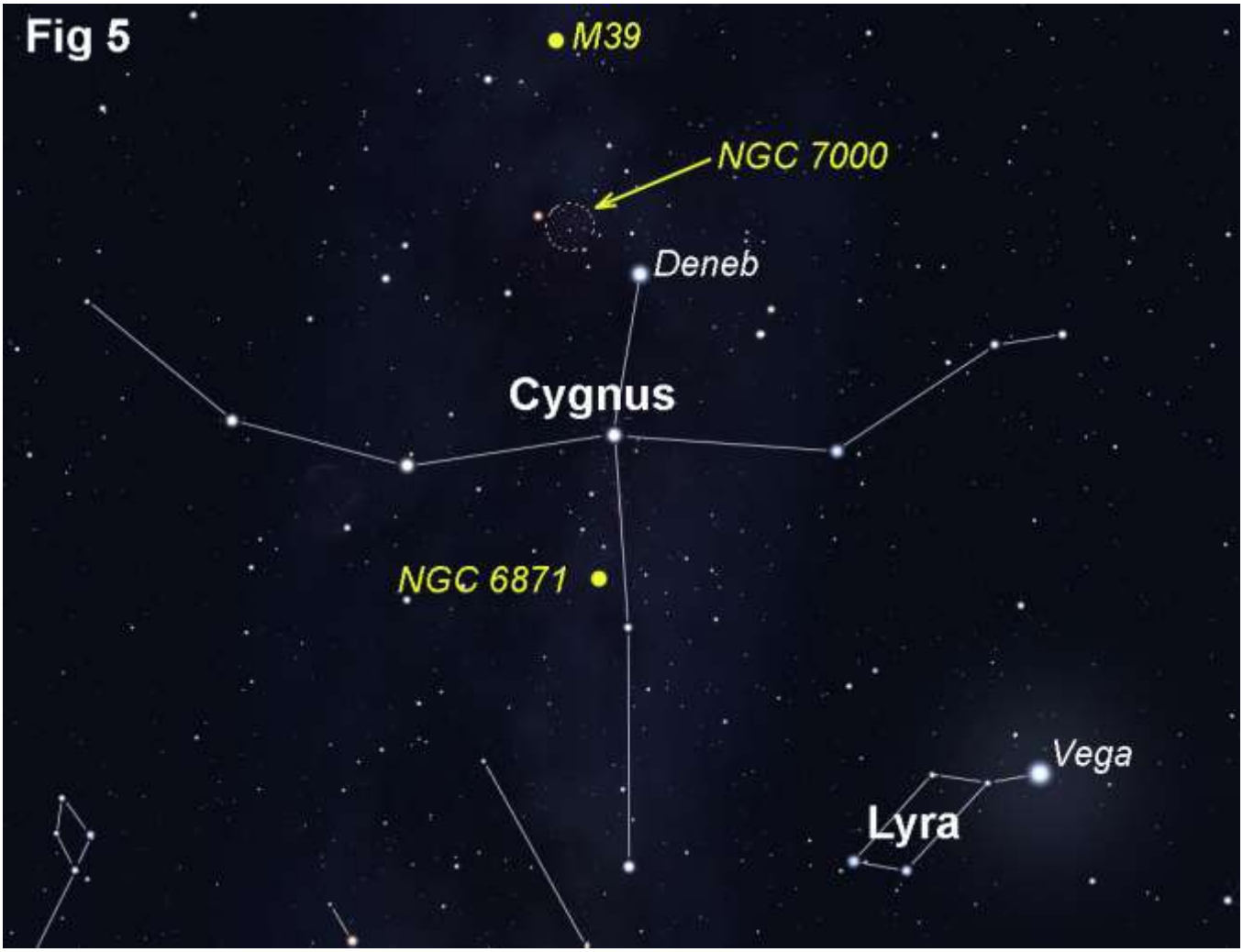
The flares that I've listed are magnitude -2.0 or brighter although there are a lot more that are fainter or occur after midnight. If you wish to see a complete list, or obtain timings for somewhere other than Wadhurst, go to www.heavens-above.com . When one of these events is due, it is sometimes possible to see the satellite before and after the "flare" although, of course, it will be much fainter then. There are a number of very bright events this month with five of magnitude -7 or -8 which are much brighter than, for example, Venus at magnitude -4. **Times are in GMT.**

Nov	Time	Mag	Alt°	Az.°		Nov	Time	Mag.	Alt°	Az.°
1st	18.33	-2.3	39	21 (NNE)		16th	16.29	-4.7	10	228 (SW)
2nd	16.56	-7.1	35	198 (SSW)		16th	17.10	-8.4	63	42 (NE)
2nd	18.26	-4.0	41	22 (NNE)		17th	16.27	-5.1	24	278 (W)
3rd	18.20	-2.3	43	24 (NNE)		17th	17.03	-8.4	65	45 (NE)
13th	17.18	-4.9	15	287 (WNW)		25th	18.19	-6.0	42	29 (NNE)
14th	17.03	-2.0	17	284 (WNW)		26th	18.13	-5.2	44	31 (NNE)
15th	16.48	-5.9	20	282 (WNW)		27th	18.07	-7.8	45	32 (NNE)
15th	17.16	-8.3	61	40 (NE)						

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

The autumnal equinox is more than a month away now, and the effect on the sky is very obvious. The Sun is 18° below the horizon by 18.30 GMT at the start of November; the measurement that tells us that the sky is now fully dark.

In the west the Summer Triangle, whilst still visible, is well past its best with Altair now just 10° above the horizon. The brilliant Vega fares a little better as does that lovely planetary nebula M57 (NGC 6720) and beta Lyrae the much observed variable. In this case the two bodies in a spectroscopic binary configuration are in the process of transferring material from the primary to the secondary which has now become the more massive of the two. By coincidence their plane of rotation is in the Earth's line of sight so we see the effect of the two eclipsing one another. Above the two Triangle members already mentioned lies the third: Deneb in Cygnus the swan, often referred to as the Northern Cross. Within its boundaries are the two moderately bright open clusters of M39 at magnitude 4.6 and NGC 6871 which is a small group of around 50 members with a magnitude of 5.2. Of course Cygnus also contains NGC 7000 that is more commonly known as the North American Nebula due to an obscuration of dust that resembles the American coast around the Gulf of Mexico. It is large at around four times the apparent size of the Moon but it is rather faint and requires either binoculars or a wide field telescope. The red colour, so obvious in photographs, is not visible to the eye so it appears as a faint misty patch. Fig 5 shows the positions of all three objects. The dotted line indicates the area that NGC 7000 is to be found in.



Looking north Ursa Major is beginning to climb away from the horizon although its tail still occupies the meridian. That curve of stars pointing south tells us that Arcturus in Boötes and Corona Borealis have sadly been lost to view, and that Hercules with his globular clusters is not far behind. The zenith currently lies within Perseus with its lovely double cluster just 8° from the overhead point.

Towards the east the old favourites of winter are once again in evidence to tell us that the pleasures of summer observing are now a distant memory. Taurus, Gemini and Auriga have risen but we have yet to see the Hunter's full retinue. The bright star Capella, in Auriga, is due east an altitude of 55° and will cross the meridian in the early hours of the morning just 5° from the zenith.

The south is dominated by Pegasus and Andromeda with the great spiral, M31, nearly 80° above the horizon. Below them is Pisces, which is still playing host to Uranus and below that the large and generally vague forms of Cetus and Aquarius which contain Ceres and Neptune respectively. A line drawn through the two most westerly stars of the Square of Pegasus and continued southwards will bring you very close to Fomalhaut which is the eighteenth brightest star in the night sky and the brightest star in Pisces Austrinus.

Meteors

The Taurids are visible from October 20th through until November 30th and have two maxima, on November 5th and 12th due to perturbations on the particle streams by Jupiter. The shower is associated with Comet Encke which itself is though to be just a small part of a much larger comet. The particles are travelling at 28 km/s which is less than half the speed of the Orionids that reached maximum last month. The ZHR is predicted to be around 10. There will be no lunar intrusion for the earlier maximum but a nearly full Moon in Pisces will interfere with the later one. Fig 6 shows the radiant position.

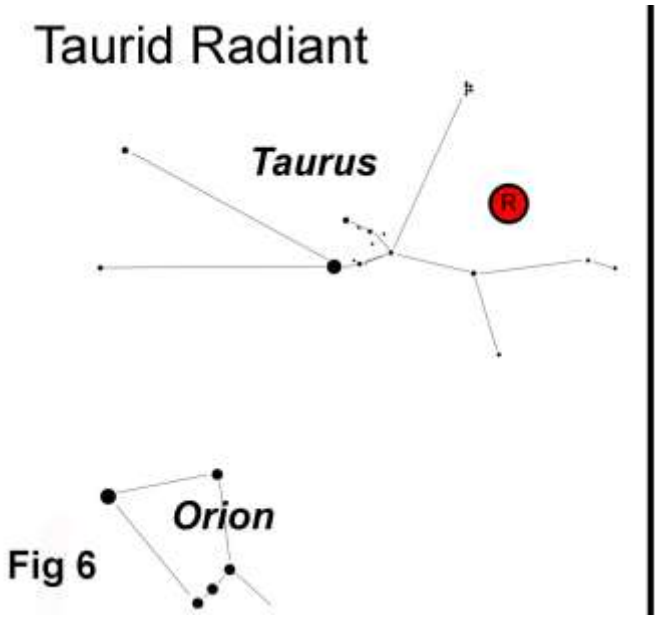


Fig 6

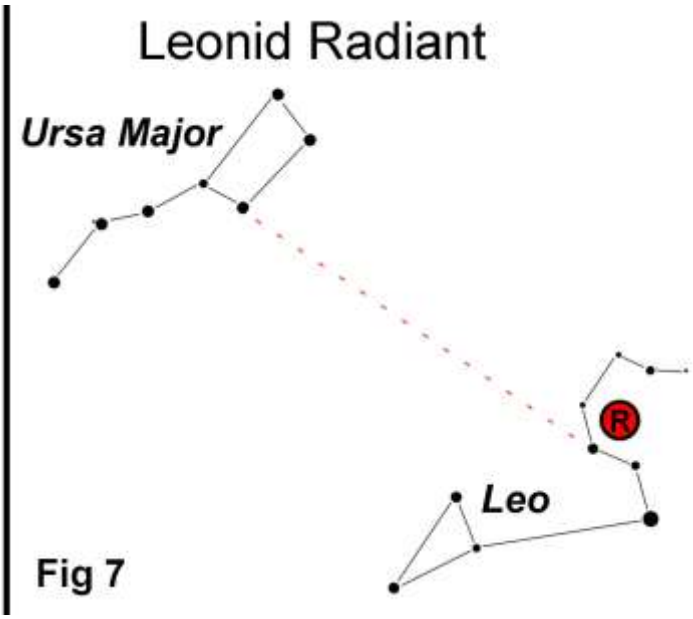


Fig 7

The Leonids, a product of Comet Tempel-Tuttle, can be seen from November 15th to 20th with a maximum predicted to occur at 04.00 UT on November 17th. Unfortunately, a 72% illuminated waning Moon in nearby Orion will spoil a show that provides some very swift events which often leave persistent trains behind them. Fig 7 shows the position of the radiant.

Incidentally, the outlook for meteor observers is much better next year with hardly any problems with moonlight although it will interfere, to a degree, with the Perseids.

Brian Mills

SPACEPLACE - NASA

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Is Proxima Centauri's 'Earth-like' planet actually like Earth at all?
By Ethan Siegel

Just 25 years ago, scientists didn't know if any stars—other than our own sun, of course—had planets orbiting around them. Yet they knew with certainty that gravity from massive planets caused the sun to move around our solar system's center of mass. Therefore, they reasoned that other stars would have periodic changes to their motions if they, too, had planets.

This change in motion first led to the detection of planets around pulsars in 1991, thanks to the change in pulsar timing it caused. Then, finally, in 1995 the first exoplanet around a normal star, 51 Pegasi b, was discovered via the "stellar wobble" of its parent star. Since that time, over 3000 exoplanets have been confirmed, most of which were first discovered by NASA's Kepler mission using the transit method. These transits only work if a solar system is fortuitously aligned to our perspective; nevertheless, we now know that planets—even rocky planets at the right distance for liquid water on their surface—are quite common in the Milky Way.

On August 24, 2016, scientists announced that the stellar wobble of Proxima Centauri, the closest star to our sun, indicated the existence of an exoplanet. At just 4.24 light years away, this planet orbits its red dwarf star in just 11 days, with a lower limit to its mass of just 1.3 Earths. If verified, this would bring the number of Earth-like planets found in their star's habitable zones up to 22, with 'Proxima b' being the closest one. Just based on what we've seen so far, if this planet is real and has 130 percent the mass of Earth, we can already infer the following:

It receives 70 percent of the sunlight incident on Earth, giving it the right temperature for liquid water on its surface, assuming an Earth-like atmosphere.
It should have a radius approximately 10 percent larger than our own planet's, assuming it is made of similar elements.
It is plausible that the planet would be tidally locked to its star, implying a permanent 'light side' and a permanent 'dark side'.
And if so, then seasons on this world are determined by the orbit's ellipticity, not by axial tilt.

Yet the unknowns are tremendous. Proxima Centauri emits considerably less ultraviolet light than a star like the sun; can life begin without that? Solar flares and winds are much greater around this world; have they stripped away the atmosphere entirely? Is the far side permanently frozen, or do winds allow possible life there? Is the near side baked and barren, leaving only the 'ring' at the edge potentially habitable?

Proxima b is a vastly different world from Earth, and could range anywhere from actually inhabited to completely unsuitable for any form of life. As 30m-class telescopes and the next generation of space observatories come online, we just may find out!

Looking to teach kids about exoplanet discovery? NASA Space Place explains stellar wobble and how this phenomenon can help scientists find exoplanets: http://spaceplace.nasa.gov/barycenter/en/

An artist's conception of the exoplanet Kepler-452b (R), a possible candidate for Earth 2.0, as compared with Earth (L). Image credit: NASA/Ames/JPL-Caltech/T. Pyle.

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Any material for inclusion in the December2016 Newsletter should be with the Editor by November 28th 2016