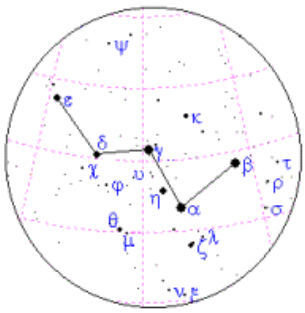


Wadhurst Astronomical Society Newsletter JANUARY 2016

A Happy New Year to all Members of the Wadhurst Astronomical Society and a warm welcome to our 19th year

MEETINGS

COMMITTEE MEETING

Members of the Committee are respectfully reminded that there is a meeting of the Committee on Tuesday the 5th of January 2016 at Phil's house staring at 1930

DATES OF THE MEETINGS FOR 2016

January – Wednesday 20th
February – Wednesday 17th
March – Wednesday 16th
April – Wednesday 20th
May – Wednesday 18th
June – Wednesday 15th
July – Wednesday 20th
August – there is no meeting
September – Wednesday 21st
October – Wednesday 19th
November – Wednesday 16th
December – Wednesday 14th (the second Wednesday of the month)

2016 SUBSCRIPTIONS

Subscriptions to the Wadhurst Astronomical Society become due from the 1st of January 2016. They remain at £16 per adult member and £23 for two members at the same address. Members under 17 years of age and students are free.

Subscriptions can be paid either by cheque made payable to Wadhurst Astronomical Society or as cash at the meetings or by post to:
John Wayte
Members Secretary
Wadhurst Astronomical Society
27 Pellings Farm Close
Crowborough
East Sussex
TN6 2BF

The Subscriptions can also be paid via electronic banking to:
Wadhurst Astronomical Society
Account Number **35104139**
Sort Code **60-22-15**
Putting your name as the **Reference** so we know who is paying.

DECEMBER MEETING

The December meeting was led by Phil Berry who welcomed about thirty members and visitors to what has traditionally become our Christmas meeting.

Phil also mentioned that next month is the start of the next session of the Society and when membership fees become due. (see above)

After describing the evening's programme, Phil said there would be mince pies, stollen, fruit cake and other cakes free to have during the coffee break and thanked members and their wives for providing them.

He introduced the speaker for the December talk given by our own Brian Mills.

What Did Women Ever Do For Astronomy?
Brian Mills FRSA

Until about 50 years ago, astronomy was always said to be done by men, but as Brian told us, women contributed a great deal to the subject. He said that tonight he was going to concentrate on just two or three very early women who had added a significant amount to astronomy.

As far back as 2250 BC the daughter of King Sargon of Babylonia, EnHeduanna calculated calendars that Brian said were moderately good for those days and which were used to determine when to get married, have children and many other important events in their lives.

The daughter of the last head of the museum of Alexandria, Hypatia (370 to 415 AD) studied maths and science and went on to teach Maths and Astronomy. Unfortunately many of her scrolls were lost when the museum was burnt down in 391 AD and Brian said our knowledge of her work was gained from notes to and from her students. It is also possible that Hypatia invented the astrolabe, used to produce tables of star positions. She is also credited with inventing the hygrometer to measure the density of liquids.

Next, we heard about Caroline Herschel, born at Hanover, Germany in 1750 and sister to William Herschel. Her father had educated Caroline much against her mother's wishes but sadly after her father's death in 1767, she had a pretty tough life as a domestic servant until William brought her to England to help run his house in Bath where he taught her mathematics after which she was able to help William with observations. She also helped in making telescopes that were then sold.

Caroline Herschel, sister to
William Herschel

With Caroline's help, William recorded the position of every object they could find during three complete sweeps of the night sky, and found Uranus on the 13th of March 1781.

King George the third gave William a pension on condition he moved near to Windsor Castle so that he could show friends of the King objects of interest in the night sky, so they moved to Datchet in 1782. Caroline continued to work on star tables and it was she who suggested it would make more sense to list the stars in order of Declination rather than by Constellation. She also became an accomplished observer in her own right with nebulae and clusters her main interests.

Brian told us that Caroline worked together with William and between them they discovered over 2,500 objects. This formed the basis for a catalogue of nebulae and clusters of stars. Later this was to be updated by William's son, John Hershel and eventually grew into the General Catalogue of Nebulae and Clusters and finally became the NGC, the New General Catalogue.

In 1786 Caroline discovered a comet by herself and following this the King gave her a pension of her own.

After William's death in 1822, Caroline returned to Germany but continued to help John Hershel.

She died in 1848 aged 97 having been awarded a number of honours such as the Royal Astronomical Society Gold Medal in 1828 and was given honorary Membership. Amongst other awards she received the Gold Medal for Science from the King of Prussia and she has an asteroid given her middle name, Lucretia and even has a lunar crater named after her in the Mare Imbrium.

Brian moved on to Harvard College Observatory when Edward Pickering became Director in 1877. He gathered together a group of women to act as computers, performing calculations particularly in the field of spectroscopy. Pickering felt that women were much better at doing calculations than men. This lead to the group being known as Pickering's harem…

Edward Pickering's team of female calculators at Harvard University
Williamina Fleming is standing

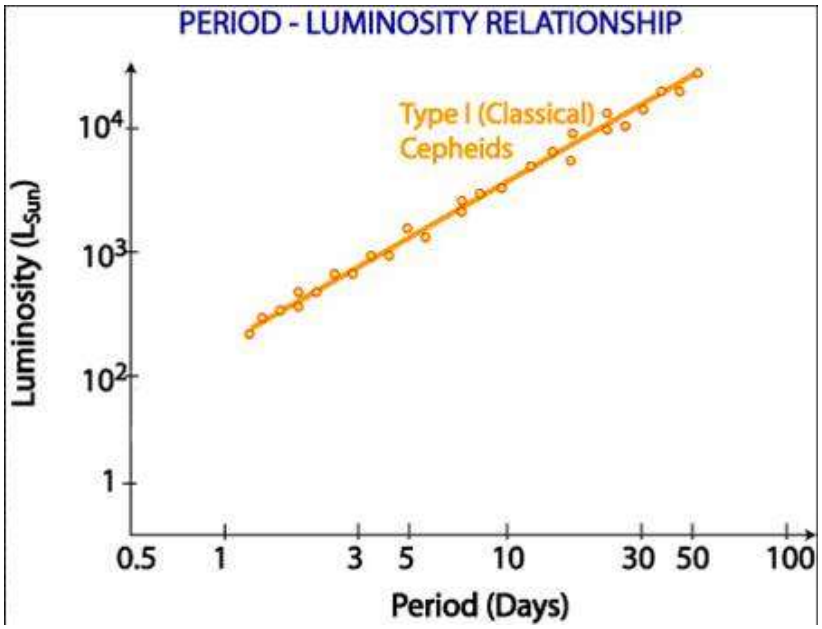
One of his team was Williamina Fleming who had been his housekeeper. She worked on photographic plates checking stellar positions and spectra and went on to develop a method of classification according to the amount of hydrogen present. She also discovered very dense White Dwarfs, the remnants of Red Giants and in 1888, found the Horse Head nebula when looking at one of William Pickering's brother's plates.

Williamina Fleming

The Horse Head Nebula,
one of Williamina Fleming's discoveries

Another of Pickering's team was Annie Cannon who amongst other notable achievements went on to devise the system of star classification by temperature using the letters O as the hottest, B, A, F, G, K and down to M, the coolest. This lead to the mnemonic; 'Oh Be A Fine Girl Kiss Me'.

Williamina Fleming also recruited some members of the group, one of them being Henrietta Leavitt in 1893 who was to work mainly on the Magellanic Clouds.



Henrietta Leavitt recognised the relationship between Brightness and Period of Cepheid Variables

She noted that certain brighter variable stars have longer periods. She had discovered the relationship between what are known as Cepheid Variables. Ejnar Hertzsprung employed this discovery to look at nearby Cepheid Variables in the Milky Way and used parallax to determine their distances. So they became a measuring stick to use in our galaxy and was also used by Edwin Hubble when he found Cepheid Variables in M31, the Great Andromeda Galaxy, showing that M31 was in fact an island galaxy. Sadly, Henrietta Leavitt didn't live to see this although she is recognised by having a lunar crater names after her.

The last word was from Marylou West of Monclair State University who said, "A woman's place is in the dome!"

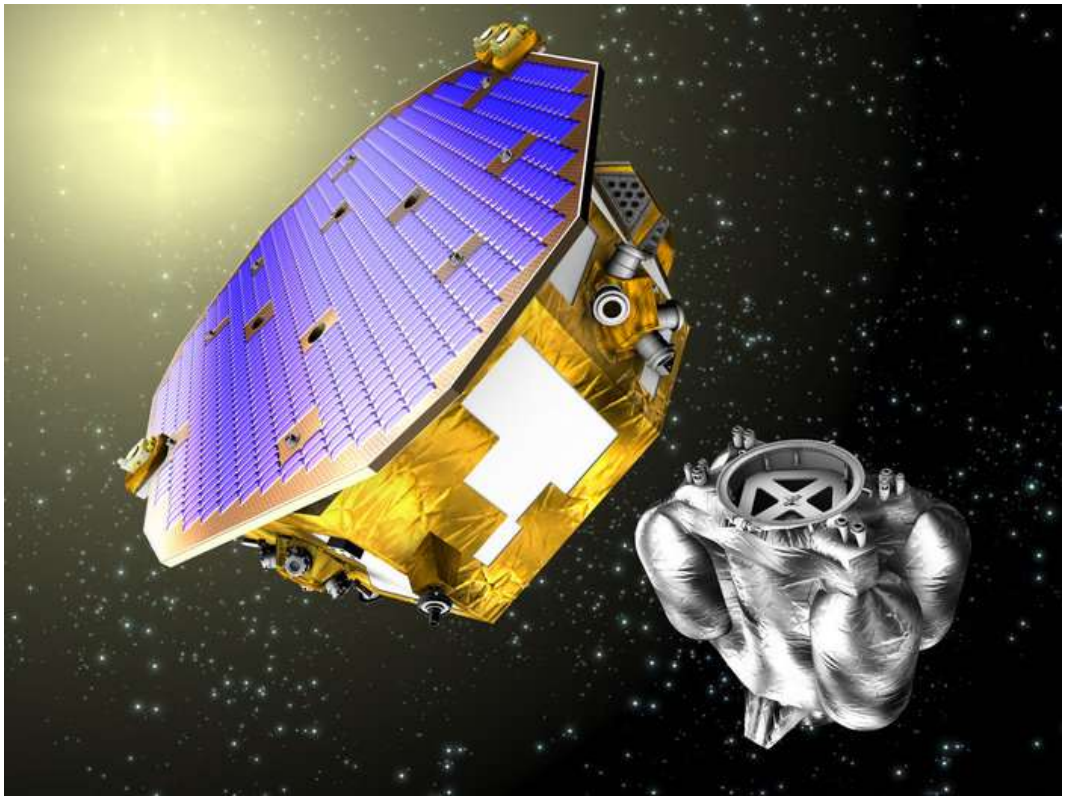
Brian said he had run out of time to cover more modern female contributors to astronomy, but when pressed during questions, he said there were many more recent women such as Jocelyn Bell who, with other students had built a 4-acre radio telescope near Cambridge. From the results of the output recorded on a pen recorder Jocelyn Bell noticed a peculiar very regular pulse. After discarding the idea that they were from an alien source when others were found, theories evolved and it is thought that these pulses are generated by rapidly rotating Neutron Stars with dense inner cores left over from supernovae and are now called Pulsars.

Snippets from the World of Science
John Wayte

So what happened on December the third 1915, 100 years ago?

It was the publication of Einstein's General Theory of Relativity. And on December the third, this year LISA Pathfinder was launched from French Guiana.

LISA, Laser Interferometer Space Antenna, is going to measure gravitational variations to exquisite tolerances to test out gravitational waves left over from the Big Bang and other astronomical events such as supernova and black holes.



Laser Interferometer Space Antenna – esa image

This is an advanced gravitational checking satellite designed to test out gravitational measurement systems. It is a forerunner of a much bigger project due for launch in 2034.

To do this when in its final gravity-free position at L1 which is 1.5 million kilometres from Earth, two gold alloy cubes with sides just 46 mm long will be released into the satellite's enclosure to 'free-fall' in zero gravity. Measurements then measure the effects of any gravity influenced to an astonishing degree of accuracy. Gravity deviation measurements will be accurate to 10^{-12} meters.

To achieve these astonishing measurements, LISA has been designed to be the most perfect physics laboratory ever flown in space. In designing LISA, esa had to build a special satellite that did not interfere with the exceptionally accurate measurements necessary to achieve the end result. So absolutely minimal metal was allowed to be incorporated in the craft and any that was, was positioned as far away as possible. Magnets were banned with the exception of laser and thrusters that had to use very small magnets. The test masses were made of gold and platinum to ensure that the magnetic susceptibility was virtually zero.

The design of the spacecraft had to have every single component balanced so that its mass did not affect the measurements with its own gravitational effect and this meant that parts were placed within a few ten-millionths of a metre accuracy. Moving a copper wire just a few millimetres would throw the spacecraft out of balance. Tests by esa engineers show that at the gold test, masses will generate an internal gravitational effect of just one-ten-billionth of Earths gravity.

So this is the continuation of a programme to find out more about the gravitational ripples in the pond of the universe.

Question: What time do they use on the space station? Is it Russian or NASA?

Answer: Greenwich Mean Time.

Aesop's Fables
A Tale of Caution from Aesop

The Astronomer

There was once an astronomer whose habit it was to go out every night and observe the stars. One night, as he was walking about outside the town gates, gazing up absorbed in the sky, and not looking where he was going, he fell into a dry well. As he lay there groaning, someone passing by heard him and, on learning what had happened said: "While you are trying to pry into the mysteries of heaven, you overlook the common objects under your fee."

We should never look so high that we miss seeing the things that are around us.

JANUARY MEETING

Wednesday 20th January 2016 – A brief AGM of the Society will be followed by a presentation given by Ian King who talks about his life in telescopes.

This meeting will take place in the Drama Studio at Uplands Community College. The address is: The Drama Studio, Uplands Community College, Lower High Street, Wadhurst TN5 6AZ and is through the gates and on the left.

Meetings begin at 1930 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

Wednesday 17th February 2016 – Melanie Davies tells us about "Cassini-Huygens: A Journey to Saturn"

Wednesday 16th March 2016 – The entertaining Dr. David Mannion updates us on "The Search for Dark Matter and Dark Energy"

SKY NOTES FOR DECEMBER 2015

Planets

Mercury was at greatest eastern elongation on 29th December and so is still an evening object at the start of the New Year. On the evening of 1st January it will be 6° above the south western horizon when the Sun is 6° below it (see fig 1). By this date its magnitude will be -0.5 and falling as it heads towards inferior conjunction on 14th January. Following this it moves west of the Sun to become a morning object, although from the UK this will be a poor apparition.

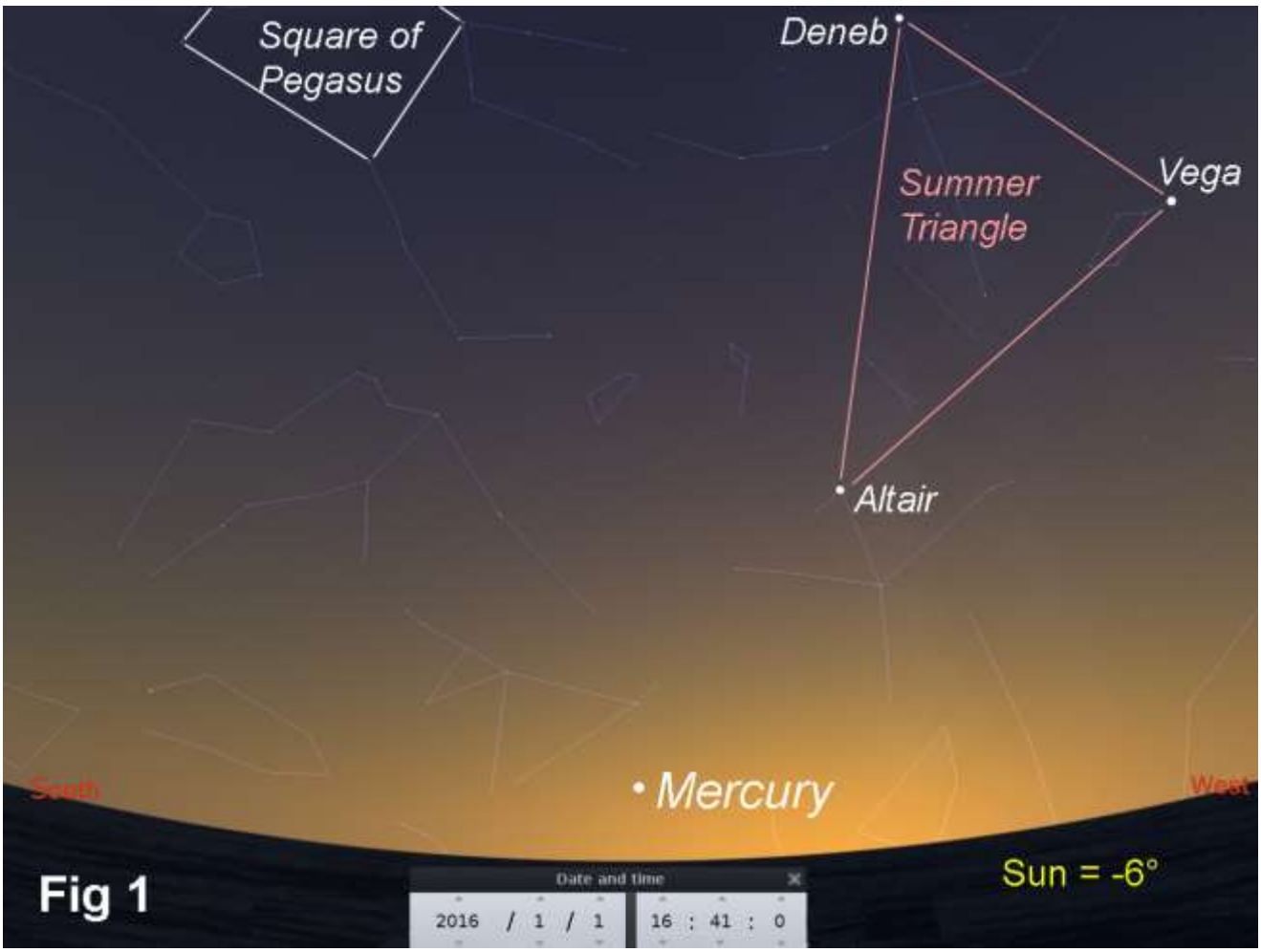


Fig 1

Venus is still a brilliant morning object, at magnitude -4.1, although it is very gradually moving back into the clutches of the Sun. At the beginning of civil twilight on the first of the month, Venus lies at an altitude of 15° above the south-south-eastern horizon. A slim waning crescent Moon is nearby on the mornings of the 6th and 7th, and on the 9th Venus is in conjunction with the planet Saturn as

the pair pass less than one tenth of a degree apart. The phase of Venus increases (more of its illuminated hemisphere is turned towards us) whilst its apparent size decreases as the distance between us grows. Fig 2 shows its position in the middle of the month.

Earth reaches perihelion on 2nd January when it will be 91.4 million miles from the Sun. Perihelion is the moment in time when the Earth is at its closest to our parent star and perhaps surprisingly is when we, in the northern hemisphere, experience our coldest weather. The variation in distance alters the heating effect of the Sun by just a few percent. The biggest impact by far on temperature at the surface of our planet is caused by the tilt of the Earth's axis. In the winter the north pole points away from the Sun causing solar rays to strike our part of the globe at a more acute angle, providing less of a heating effect.

Mars is also still a morning object although not nearly as obvious as Venus. At the start of the month it rises at 02.00 and by the end it has become visible around 30 minutes earlier. Its eastwards motion, which continues until mid April, carries it from Virgo into neighbouring Libra on 17th January. During the month both the red planets brightness and apparent size increase as it approaches opposition on May 22nd. See Fig 2 for the position of Mars in the middle of January.

Fig 2

Jupiter, on the borders of Leo and Virgo, rises at 22.30 at the start of the month and at 20.30 by the end. Currently at magnitude -2.2 it is brightening and its angular diameter is increasing as it approaches opposition on 8th March. It halts its eastward motion on 8th January and moves retrograde until early May when its second stationary is reached. It then resumes direct motion, west to east, once more. See fig 2 for the current location of the gas giant.

Saturn is a morning object rising at 05.45 at the beginning of January, which is two hours ahead of the Sun. By the end of the month this has become four hours. It is currently moving eastwards (direct) in the constellation of Ophiuchus, which must be a terrible headache for astrologers! On the 9th of the month Venus passes just one tenth of a degree north of Saturn. The position of the ringed planet is shown in fig 2.

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. The Moon finds itself amongst the Hyades again on January 19/20 so there are a large number of events, many of which fall outside our criteria. **Times are in GMT.**

Jan	Time	Star	Mag	Ph	Alt °	% illum.	mm
12th	16.34	ZC 3188	5.6	DD	21	8	60
16th	18.43	ZC 219	4.8	DD	44	48	40
16th	22.19	ZC 237	7.0	DD	20	49	70

17th	18.04	SAO 110516	6.9	DD	48	59	70
17th	19.44	ZC 362	6.4	DD	47	59	50
19th	22.32	ZC 659	6.6	DD	47	81	70
19th	23.59	ZC 667	5.0	DD	36	81	40
20th	00.09	ZC 672	6.7	DD	35	81	70
20th	00.16	ZC 669	3.8	DD	34	81	40
20th	00.55	ZC677	4.8	DD	28	81	40
20th	01.02	ZC 680	6.5	DD	27	81	70
20th	02.18	ZC 685	6.6	DD	16	82	80
20th	22.59	ZC 806	5.0	DD	51	89	40
21st	18.41	ZC 944	5.9	DD	37	94	70
21st	22.30	ZC 970	6.3	DD	56	95	70
21st	23.37	ZC 975	6.8	DD	53	95	100

Occultation of Aldebaran

There is another event in the sequence of occultations of the first magnitude star Aldebaran this month. The times are much less sociable than previously although the Moon's phase is slightly less this time being only 82% illuminated. The big problem, on this occasion, is the altitude of the star. You will need an unobstructed horizon and good steady seeing to have any chance of observing the disappearance. **Times are in GMT.**

Jan.	Time	Star	Mag	Ph	Alt °	% illum.	mm
20th	03.24	Aldebaran	0.9	DD	6	82	40
20th	03.59	Aldebaran	0.9	RB	1	82	70

Phases of the Moon for January

Last ¼	New	First ¼	Full
2nd	10th	16th	24th

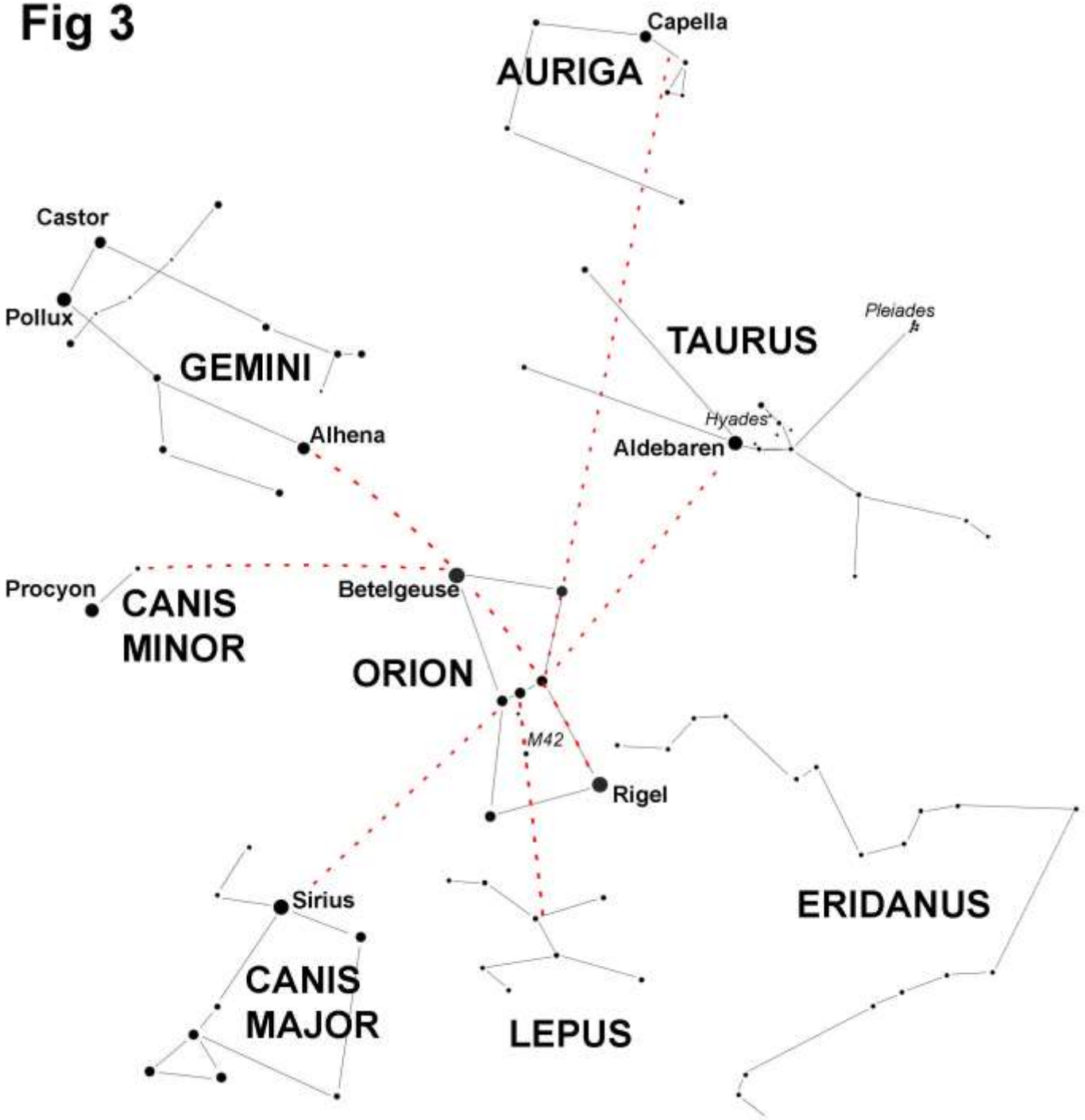
The Night Sky in January (Written for 22.00hrs GMT mid month)

In the north, Ursa Major is standing on its tail to the east of the meridian whilst to the west the constellations of Cassiopeia and Cepheus are descending. Within the latter is the open cluster NGC 7160 which has only around a dozen members but is moderately bright at magnitude +6.1. The head of Draco, the dragon, lies due north but is just 15° above the horizon. As I've mentioned before, one of the stars in the tail (Thuban) used to be the pole star 5,000 years ago before precession of the Earth's axis moved it away to its current position. In another 21,000 years Thuban will once again command the title of "Pole Star".

Looking east, Leo is becoming prominent and ahead of it the faint form of Cancer lies mid way between the lion and the twins of Castor and Pollux. In the centre of Cancer the open cluster M44 shines at a combined brightness of magnitude 3.1, though this is slightly misleading as the 200 or so members are widely spread. The head of Hydra, the water snake, lies just below Cancer although at this time its tail disappears below the horizon.

Towards the south the winter constellations are very much in control as Orion straddles the meridian with his retinue arranged around him. The advantage that Orion has is that it is bright and easy to find, and once located it can be used as a celestial signpost to a host of other objects. For example the stars in the belt point generally south towards Sirius, the brightest star in the night sky and north in the general direction of Aldebaran in Taurus. Fig 3 shows the area in full and includes the Hyades and Pleiades clusters as well as M42, the Orion nebula. The constellation of Eridanus, the river, disappears below the horizon and in fact ends just 30° from the south celestial pole. Beta Eridani, the second brightest star in Eridanus, lies close to Rigel and is often mistaken for one of the stars in Orion. However, despite their closeness, the border as defined by the International Astronomical Union (IAU) passes between the two stars. It was at their first General Assembly in 1922 that the IAU produced a definitive list of 88 constellations, their names and their three letter abbreviations. At the following General Assembly in 1925, which was held in Cambridge, a proposal was made that boundaries should be standardised. By the Assembly of 1928 the Belgian astronomer, Eugène Delporte, had prepared a new system of boundaries which followed lines of right ascension and declination. Delporte's proposal was accepted at that meeting and has been the standard ever since. Before this general acceptance came about the sky was full of strange anomalies. For example, one of the stars in Taurus appeared on occasions to belong to Auriga and the upper left star in the Square of Pegasus transferred allegiance from Pegasus to Andromeda depending on which map you used.

Fig 3



If we turn towards the west the constellations of Pegasus and Pisces are preparing to set although the Andromeda galaxy, M31, is still at a healthy altitude of 40°. A little further along the horizon towards the north we can still see Deneb, the last remaining member of the Summer Triangle which is still visible and the only one that is circumpolar from these latitudes. Above the outstretched lines of stars that form Andromeda lies Perseus with the lovely double cluster which is an ideal object for binoculars or a rich field telescope.

ISS

There are no evening passes of the International Space Station (ISS) this month. However, there are a number that occur in the period after midnight and through to sunrise. If you would like to find out when these occur please 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 . 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 GMT.**

Jan.	Time	Mag.	Alt°	Az.°		Jan.	Time	Mag.	Alt°	Az.°
3rd	18.40	-3.3	34	153 (SSE)		12th	18.04	-4.7	34	172 (S)
4th	18.34	-4.5	33	154 (SSE)		13th	17.00	-5.1	12	221 (SW)
5th	17.11	-2.5	21	203 (SSW)		13th	17.23	-3.0	19	287 (WNW)
8th	17.02	-3.7	19	208 (SSW)		19th	17.37	-4.4	32	188 (S)
8th	18.19	-4.2	34	163 (SSE)		22nd	18.57	-4.4	38	148 (SSE)
10th	16.59	-4.4	17	213 (SSW)		23rd	17.25	-3.9	30	196 (SSW)
11th	17.53	-3.8	13	293 (WNW)		26th	17.16	-3.8	27	204 (SSW)
11th	18.10	-2.6	34	171 (S)		26th	18.42	-6.3	39	156 (SSE)
12th	17.38	-5.8	16	290 (WNW)		30th	18.27	-3.6	40	166 (SSE)

Brian Mills

SPACEPLACE - NASA

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How will we finally image the event horizon of a black hole?

By Ethan Siegel

One hundred years ago, Albert Einstein first put forth his theory of General Relativity, which laid out the relationship between spacetime and the matter and energy present within it. While it successfully recovered Newtonian gravity and predicted the additional precession of Mercury's orbit, the only exact solution that Einstein himself discovered was the trivial one: that for completely empty space. Less than two months after releasing his theory, however, the German scientist Karl Schwarzschild provided a true exact solution, that of a massive, infinitely dense object, *a black hole*.

One of the curious things that popped out of Schwarzschild's solution was the existence of an event horizon, or a region of space that was so severely curved that nothing, not even light, could escape from it. The size of this event horizon would be directly proportional to the mass of the black hole. A black hole the mass of Earth would have an event horizon less than a centimetre in radius; a black hole the mass of the sun would have an event horizon just a few kilometres in radius; and a supermassive black hole would have an event horizon the size of a planetary orbit.

Our galaxy has since been discovered to house a black hole about four million solar masses in size, with an event horizon about 23.6 million kilometres across, or about 40 percent the size of Mercury's orbit around the sun. At a distance of 26,000 light years, it's the largest event horizon in angular size visible from Earth, but at just 19 micro-arc-seconds, it would take a telescope the size of Earth to resolve it – a practical impossibility.

But all hope isn't lost! If instead of a single telescope, we built an *array* of telescopes located all over Earth, we could simultaneously image the galactic centre, and use the technique of VLBI (very long-baseline interferometry) to resolve the black hole's event horizon. The array would only have the light-gathering power of the individual telescopes, meaning the black hole (in the radio) will appear very faint, but they can obtain the resolution of a telescope that's the distance between the farthest telescopes in the array! The planned Event Horizon Telescope, spanning four different continents (including Antarctica), should be able to resolve under 10 micro-arc-seconds, imaging a black hole directly for the first time and answering the question of whether or not they truly contain an event horizon. What began as a mere mathematical solution is now just a few years away from being observed and known for certain!

Note: This month's article describes a project that is not related to NASA and does not suggest any relationship or endorsement. Its coverage is for general interest and educational purposes.

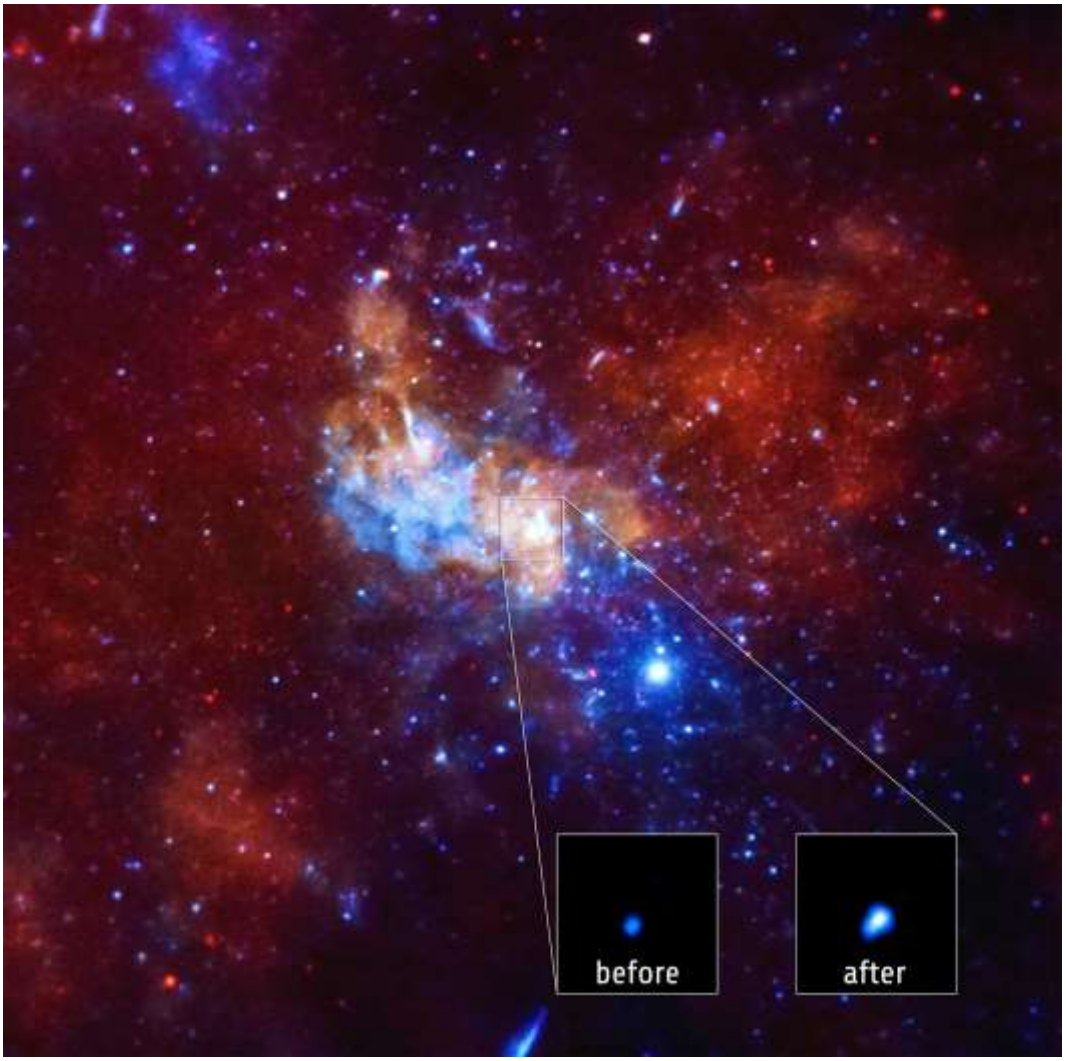

Image credit: NASA/CXC/Amherst College/D.Haggard et al., of the galactic centre in X-rays. Sagittarius A is the supermassive black hole at our Milky Way's centre, which normally emits X-ray light of a particular brightness. However, 2013 saw a flare increase its luminosity by a factor of many hundreds, as the black hole devoured matter. The event horizon has yet to be revealed.*

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

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

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