Wadhurst Astronomical Society Newsletter October 2014

MEETINGS

COMMITTEE MEETING

Members of the Committee are respectfully reminded that there is a meeting of the Committee at Phil's on Tuesday the 7th of October and starting at 1930.

ASTRO-BARBECUE

On the 23rd of August, Jim Cooper and his wife hosted the Society barbecue when more than a dozen members enjoyed a remarkably pleasant evening. It was warm and dry but despite earlier predictions of clear skies, that didn't happen until the early hours of the next morning.

Before the barbecuing began we were able to enjoy our hosts' huge garden and benefit from late summer smells of the flowers later to be replaced with the smells of sausages and burgers cooking over Jim's two barbecues.

A thoroughly enjoyable evening despite no stars. Thanks Jim.

SEPTEMBER MEETING

The meeting was opened by Phil Berry who began by saying a huge thank you to Jim Cooper and his wife for hosting this year's successful barbecue.

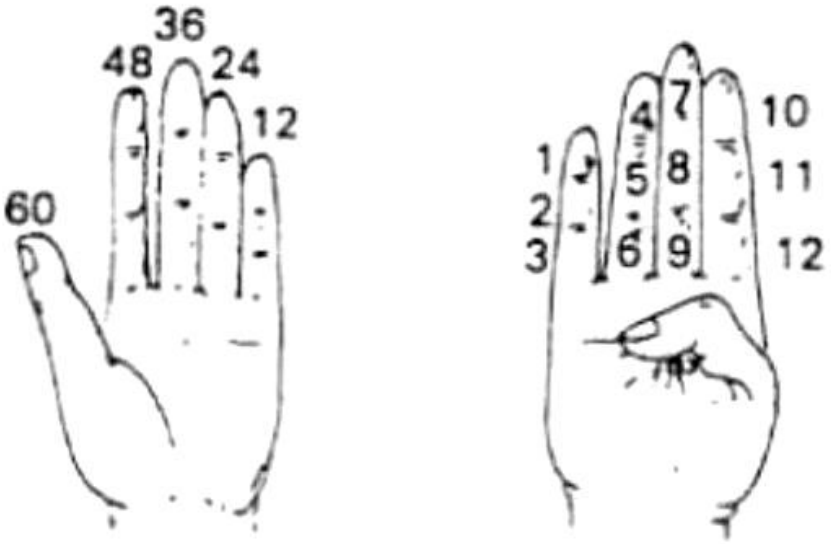
Phil has talked recently at previous meetings about the work of the AONB, Area of Outstanding Natural Beauty Unit and Dark Skies Group and said that they are combining together with ourselves to hold an event at Uplands College which as Phil said is one of the brightest spots in the area and is over the road from our meeting room. It is to be held in the New Year during the month of February on either the 16th, 17th or 25th. More details will be announced nearer the time.

He then introduced our speaker, John Lutkin who is our Vice chairman.

Infinity and Beyond
Some random thoughts on mathematics in astronomy
John Lutkin

John began his talk by telling us that early astronomers were mathematicians and then looked back at early civilisations and said that most of them had some kind of numbering system, very important in astronomy.

He said the Mayans used fingers and toes to use so they had a numbering system based on 20. The Babylonians wore shoes and used only their hands to derive a numbering system based on 60 as shown below, using one hand to count to 12 and the fingers on the other hand to count in 12s.



From this Babylonian system John said we have 360 degrees in a circle, 60 minutes in a degree and 60 seconds in a minute. Also they influence the way we measure time with 60 seconds in a minute and 60 minutes in an hour. 24 also fits in with the Babylonian system as well.

There are other systems such as binary and systems based on eight or ten, and as he said there others.

In the early days, much of astronomy was involved with predictions such as the way the Egyptians used the position of Orion and Sirius to foretell the flooding of the Nile which was so important to them. They did know a year was 365 days and also were aware that this was not exactly right and occasionally had to add or take out odd days. We now use the leap year system.

It was during the time of the Mesopotamians and Babylonians that techniques were developed for working out when eclipses were going to occur and predicting where certain heavenly bodies would appear.

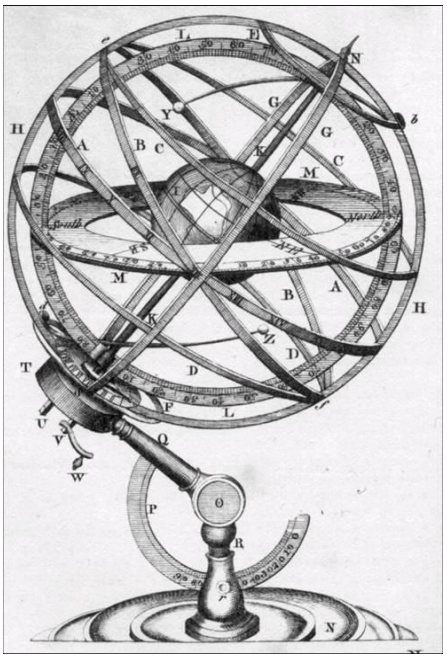
John introduced us to the ideas and evolution of geometry and trigonometry and the development of sine and cosine functions. This was between 320 BC and 620 AD.

The ability to calculate when certain astronomical events were going to take place gave great power to the astronomers who were also astrologers.

John told us that writings from antiquity showed Hipparchus already had a fundamental understanding of trigonometry and even knew about precession and worked it out pretty accurately. There were times in the middle ages when many believed the Earth was the centre of the Universe and the Moon, Sun and planets rotated round the Earth.

In the second century AD, Ptolemy is credited with bringing previous mathematical ideas together and influencing Western thought lasting until the 16th century. He was more of an observational astronomer and began recording positions of the stars and planets in tables. John introduced the idea of spherical trigonometry, which Ptolemy was beginning to understand and with it was able to more precisely predict positions in the night sky where curved trigonometry became necessary using the sine and cosine rule, etc. We were shown diagrams of the celestial sphere, which illustrated various lines such as the celestial equator and the ecliptic, also points of reference such as the spring and autumn equinoxes.

This was even more clearly illustrated with a photograph of a device called an armillary first built by Ptolemy that enables the sky to be modelled in 3D. Each of the graduated rings represents a planet and by knowing the date, it is possible to see where a planet would be.



An Armillary

Next, John talked about Sacrobosco who wrote books about mathematics and produced huge tables that meant a lot of mathematical calculations were already done for the astronomer and the results just needed to be looked up.

Regiomontanus was the first mathematician to produce trigonometric tables such as the sines and tangents of angles and these were of enormous value to astronomers.

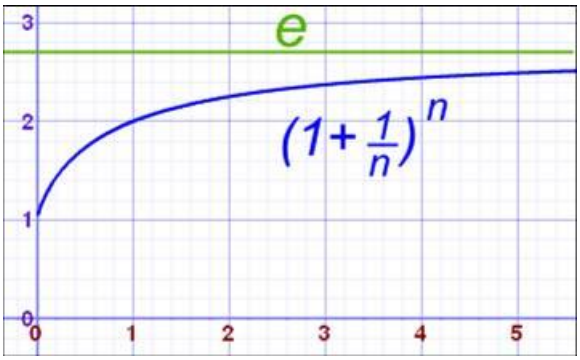
Copernicus in the early 16th century was one of the main figures to put the Sun at the centre of the solar system but as John said, he maintained that the planetary orbits were circular, which did cause some inaccuracies.

He told us that Tycho Brahe was a very clever mathematician and astronomer, producing new trigonometric methods of calculation that enabled him for instance to calculate the position of objects back to the time of Ptolemy 1,500 years earlier and giving accurate results. Tycho Brahe also produced a star catalogue of 777 objects, the first star catalogue since the time of Ptolemy.

We were told that Kepler's reputation was greatly enhanced in 1595 when he correctly forecast a peasant uprising, a Turkish invasion and a particularly cold spell. But he did find the mathematical solution to anomalies in planetary orbits, which up until then had been thought to be circles instead of ellipses.

The next mathematician John introduced was Euler who amongst other discoveries found 'e', an irrational number which has been calculated to a trillion places without recurring. $e = (1+1/n)^n$ which is a binomial expansion and is important when calculating compound interest.

e = 1+1/1!+1/2!+1/3!+1/4!+1/5!... etc. Where ! means factorial.



This number was used by John Napier as the base to his natural logarithms that made mathematical calculations so much easier.

Finally John looked at how modern mathematics is important in the calculations necessary to rendezvous the Rosetta mission with comet 67P. Even before the mission reached the comet, Rosetta had to be accelerated as economically as possible. To reach the speed of 67P it had to be accelerated by close-encountering objects such as a planet to gain added velocity, sometime called "a sling-shot". John used as an example the Cassini mission that gained energy to increase its velocity by taking a very small amount of energy from the planet Jupiter to impel it away from the planet with increased velocity, which he called "stealing angular momentum and getting away with it!".

We were told about a very important use of “sling-shot” when Apollo 13 lost its navigation and had to use the gravity of the Moon to accelerate the capsule back towards the Earth and to safety, all because of the use of mathematics, developed over thousands of years.

Rosetta Update
Video clips

Phil Berry showed a video he had edited together from a number of clips from on the internet. It showed a number of details and data about the mission so far and also contained information about the landing site for the Philae lander, information only very recently released, following careful studies by the mission’s team. This will be a very tricky landing because as the video said, not a great deal is known about the surface and the very complicated manoeuvre to land also includes attaching the probe to the surface.

Sadly, Brian Mills was ill and Phil then bravely and successfully gave the Sky Notes in his place.

OCTOBER MEETING

Wednesday 15th October – Jan Drozd is giving another of his talks, this time he calls it “My First Steps in Planetary Imaging”.

FUTURE MEETINGS

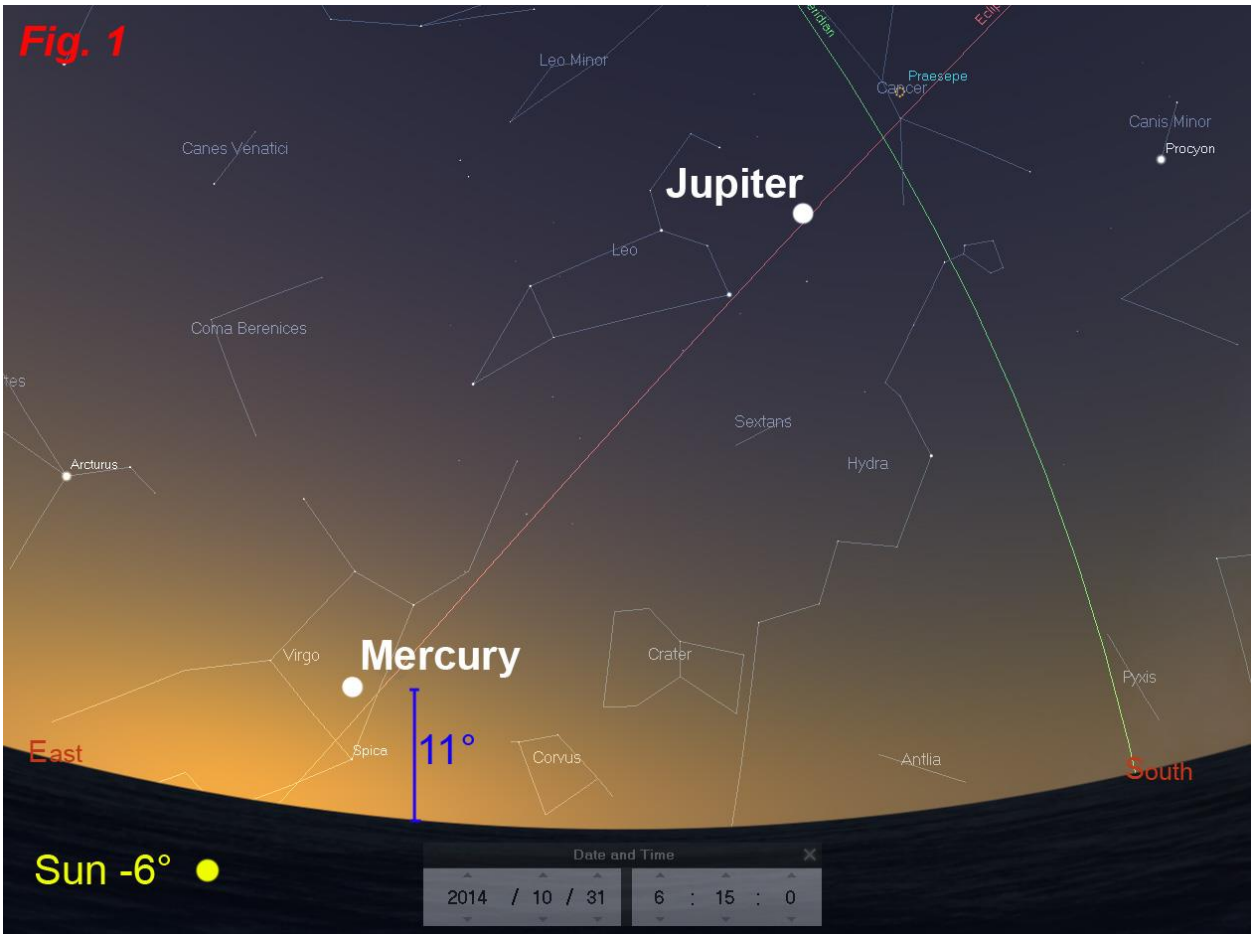
Wednesday 19th November – Members of the Society will be giving short talks about astronomically related subjects.

Wednesday 11th December 2014 – Our Director of Observations will be giving another of his popular talks. He calls the December talk “The Story of Longitude”.

SKY NOTES FOR OCTOBER 2014

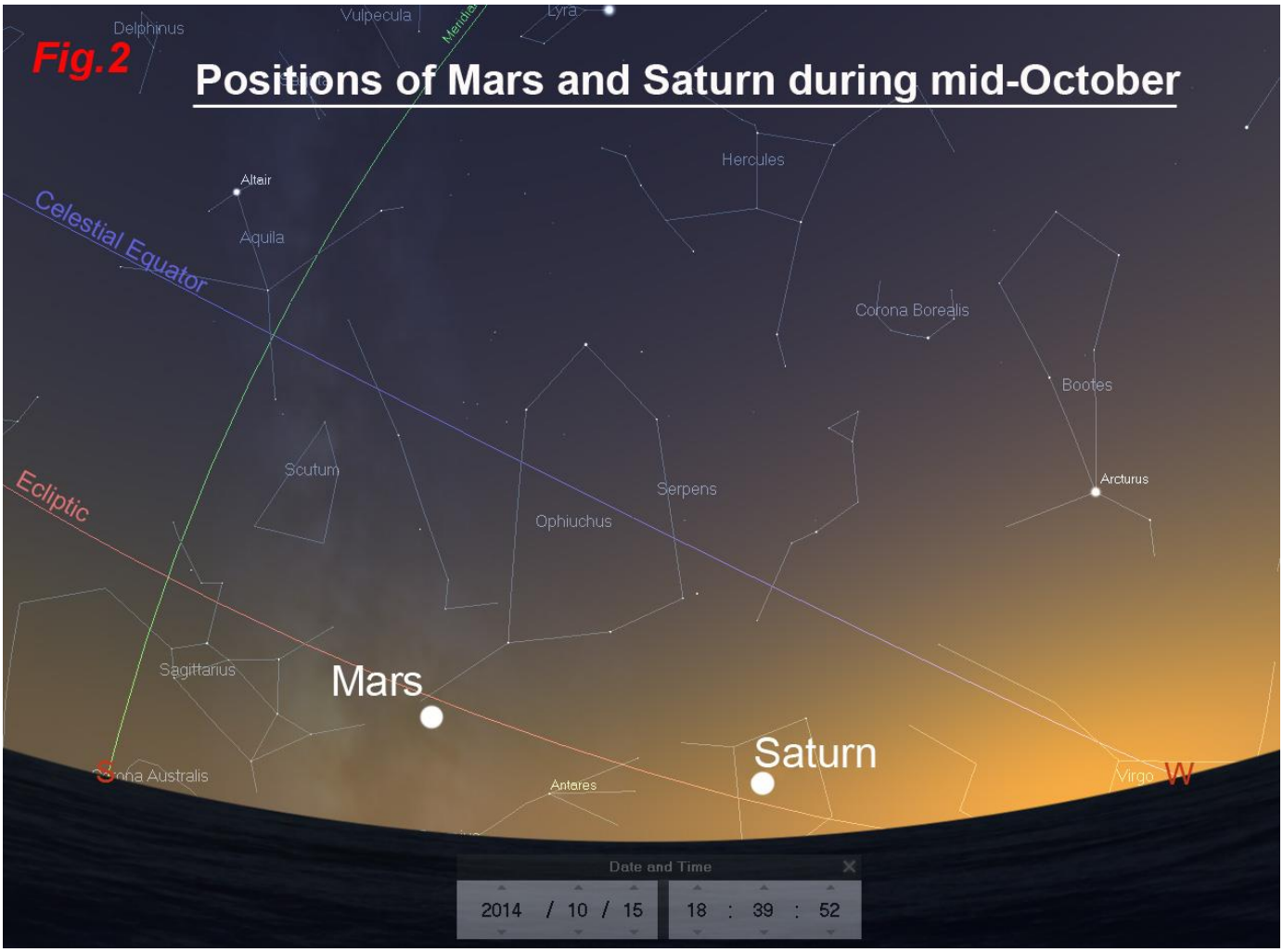
Planets

Mercury is poorly positioned as the month begins, setting only fifteen minutes after the Sun. The smallest planet suffers an inferior conjunction on 16th after which it moves west of the Sun to become a morning object towards the end of October. The map in Fig.1 shows the planet’s position on the last day of the month with the Sun 6° below the horizon. Mercury reaches greatest western elongation the following day, 1st November, when in angular terms it will be 19° away from the Sun providing us with one of the best morning apparitions of the year.



Venus is so close to the Sun that it is effectively unobservable for the entire month. It passes through a superior conjunction on 25th October, although UK observers will have to wait until late December or early January before the planet makes its presence felt in our evening skies. It will be extremely well placed for a large part of 2015 with greatest eastern elongation taking place in June 2015 at an angular distance of 45.4°.

Mars is still visible low down in the south-south-west as soon as darkness falls. It resides in the constellation of Ophiuchus for most of the month but moves eastwards into neighbouring Sagittarius on 21st October. You would think that its presence in Ophiuchus would pose something of a problem for the "loony" element who support the black art of astrology. How often do you see that particular star group mentioned in the horoscope columns of the popular daily's and where do they suppose the planets go after leaving Scorpio and before arriving within the confines of Sagittarius?
The map at Fig.2 shows the position of Mars in the middle of the month. You can see that it is a long way south of the celestial equator meaning that its period of visibility is much shorter for us in the UK compared to those in more southerly latitudes. However, over the coming months this situation does improve somewhat as the angle that the ecliptic makes with the horizon increases and Mars moves closer to the celestial equator.



The red planet's brightness and apparent size both continue to fall as the distance between the two planets increases after this years opposition which occurred in April. There will be no opposition of Mars in 2015 as the synodic period (the time taken by a body to return to the same point with reference to two or more other bodies) is 780 days. This is brought about because an Earth year is 365 days and a Martian one 687 days causing us, on Earth, to require just over two years to catch up with, and eventually overtake, Mars once again. The table below gives the data for this years opposition plus those occurring in the relatively near future.

Date	Constellation	Declination	Magnitude	Apparent Diameter	Dist from Earth in (AU)
08/04/2014	Virgo	-5.1°	-1.5	15.1"	0.62
22/05/2016	Scorpio	-21.6°	-2.0	18.4"	0.51
27/07/2018	Capricorn	-25.4°	-2.8	24.2"	0.38
13/10/2020	Pisces	+5.5°	-2.6	22.4"	0.41
08/12/2022	Taurus	+24.9°	-1.8	17.0"	0.54
16/01/2025	Gemini	+25.1°	-1.4	14.5"	0.64
19/02/2027	Leo	+15.2°	-1.2	13.8"	0.67

From it you can see that the most favourable in terms of closest approach, and therefore size, is in 2018 which coincides with a declination that sees Mars well below the celestial equator meaning its maximum altitude will be around 12°. Contrast that with the 2025 opposition when the planet will be almost 64° above the horizon but sadly nearly half the size of the 2018 event. All things

considered the 2020 opposition looks to be one of the best for UK observers. Mars will be in Pisces giving a respectable elevation of 44° plus, although by no means at its largest, its magnitude and apparent diameter will make imaging so much easier.

Jupiter is a morning object rising five hours ahead of the Sun as the month begins. On the 14th it moves eastwards from Cancer into Leo where it will remain for the rest of the year. By the end of October the gas giant has become an evening object rising at 23.30 GMT. Both its brightness and apparent diameter are increasing gradually in readiness for next years opposition. The position of Jupiter in the early morning is shown on the Mercury map (Fig.1) above.

Saturn may just be glimpsed, at the start of the month, low down in the south west at the end of civil twilight although it will only be 7° high at that time. The current apparition is effectively over as the ringed planet heads for a solar conjunction on 18th November. It then appears in the morning skies until it next becomes an evening object in March 2015. In the late afternoon/early evening of 25th October Saturn is occulted by a two day old Moon. See below for more details.

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. The column headed "mm" (millimetres) shows the minimum aperture telescope required for each event. Please remember that the Society has telescopes that members can borrow, all of which are suitable for the such events.
Times are in BST.

Oct	Time	Star	Mag	Ph	Alt °	% illum.	mm
1st	18.54	ZC 2687	6.6	DD	20	49	70
1st	19.09	SAO161582	7.0	DD	20	49	70
5th	22.20	ZC 3308	6.2	DD	32	91	70

Phases of the Moon for October

First ¼	Full	Last ¼	New
1st	8th	15th	23rd
31st			

ISS

Below are details of 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 from other areas 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.**

Oct	Mag	Time	Alt°	Az.		Oct	Mag	Time	Alt°	Az.
10th	-3.0	20.08	49	SSE		17th	-3.3	19.10	79	N
11th	-2.4	19.19	35	SSE		18th	-3.5	19.57	86	SSW
12th	-3.5	20.05	79	SSE		19th	-3.3	19.07	83	N
13th	-3.1	19.16	61	SSE		20th	-3.0	19.54	58	SSW
14th	-3.4	20.03	82	N		21st	-3.2	19.04	76	SSW
15th	-3.3	19.13	89	SSE		22nd	-2.0	19.50	33	SSW
16th	-3.4	20.00	79	N		23rd	-2.5	19.00	47	SSW

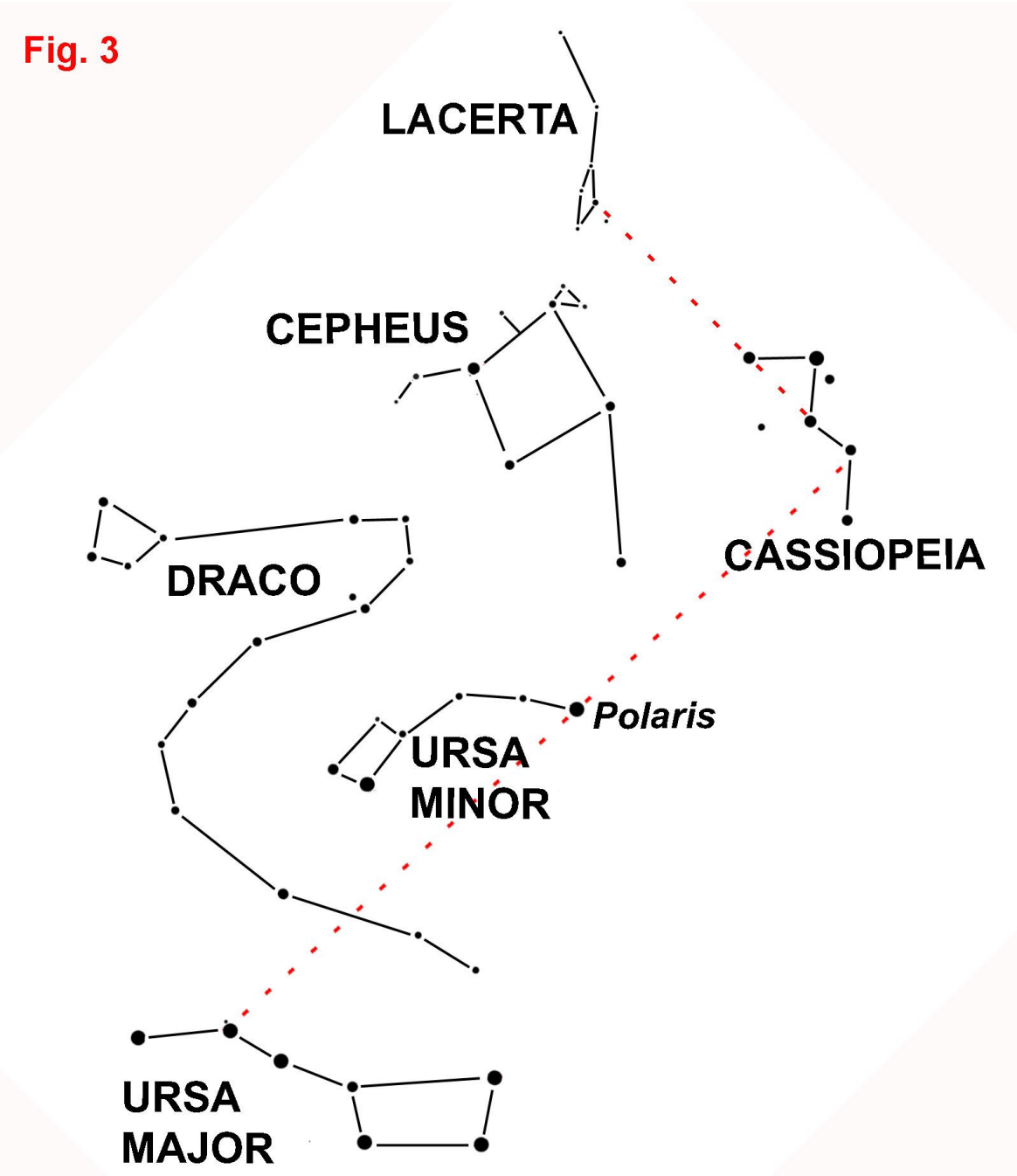
Iridium Flares

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 . 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 unless otherwise stated.**

Oct	Time	Mag.	Alt°	Az.°		Oct	Time	Mag.	Alt°	Az.°
2nd	18.59	-8.2	57	6 (N)		14th	19.52	-5.2	38	12 (NNE)
4th	18.48	-3.1	61	10 (N)		15th	19.45	-7.7	40	13 (NNE)
5th	18.42	-4.6	62	10 (N)		17th	19.33	-4.9	43	10 (N)
6th	18.35	-8.1	64	9 (N)		27th	19.39 GMT	-2.1	11	10 (N)
6th	20.42	-4.2	22	6 (N)		28th	19.30 GMT	-3.4	16	12 (NNE)
7th	18.29	-8.3	66	10 (N)		29th	19.25 GMT	-5.1	19	12 (NNE)
8th	18.23	-6.0	67	12 (NNE)		30th	19.20 GMT	-2.3	20	14 (NNE)
10th	20.16	-3.8	30	9 (N)		31st	19.13 GMT	-4.5	24	15 (NNE)
11th	20.10	-7.4	32	10 (N)						

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

In the north Ursa Major is as close to the horizon as it can get meaning that Cepheus, which lies on the opposite side of the north celestial pole, is close to the zenith. To the east of Cepheus lies the familiar "W" of Cassiopeia, whilst to the west we find the straggling shape of Draco. The boundaries of the dragon are such that they almost entirely envelope Ursa Minor. At the zenith itself lies the tiny and faint constellation of Lacerta the lizard. To locate it use the double in the tail



of Ursa Major and draw a line from it, through Polaris and on to Cassiopeia. Then use two of the stars in the "W" to find Lacerta (see fig 3) which has a number of open clusters and planetary nebulae within its borders, but sadly none of which are particularly bright.

Looking east that harbinger of winter, the Pleiades, are almost due east as is M31, the great spiral galaxy in Andromeda that I mentioned last month. Below Andromeda lies the small but distinct shapes of Aries and Triangulum. On the horizon is just a hint that those doyens of winter, Orion and Gemini, will soon be with us.

Turning to the south we find the constellations of Pegasus, Aquarius and Piscis Austrinis lined up on the meridian. If you draw a line through the two most westerly (right hand) stars in the Square of Pegasus and continue it downwards it will pass close to the bright star Fomalhaut in the constellation of the southern fish which lies just 10° above the southern horizon. Immediately below the square lies Pisces, which for some years now has been home to the planet Uranus. There will be no sudden changes there as the ice giant, which appears to travel at a snails pace against the stars, will not be moving into neighbouring Aries until 2018.

In the west those faint groups of the summer, Ophiuchus and Serpens, are slipping below the horizon although not far behind is Altair, the first member of the Summer Triangle to be lost. Of the other two, Vega is nearly 40° high whilst Deneb is 70° in altitude. The small constellations that lie between the Summer Triangle and Pegasus, Vulpecula, Sagitta, Delphinus and Equules are all still well positioned. Don't forget to look for the "Coathanger" asterism that I described in the August newsletter if you haven't done so already. It is an easy object in binoculars.

What Objects Can I Look For This Month?

1. M34

M34 is an open cluster in the constellation Perseus that is theoretically visible to the naked eye at magnitude 5.2. The cluster, which is thought to have 80 members, has an angular diameter of 35 arc minutes (just over half of one degree) so is ideally suited to binoculars or a wide field telescope.

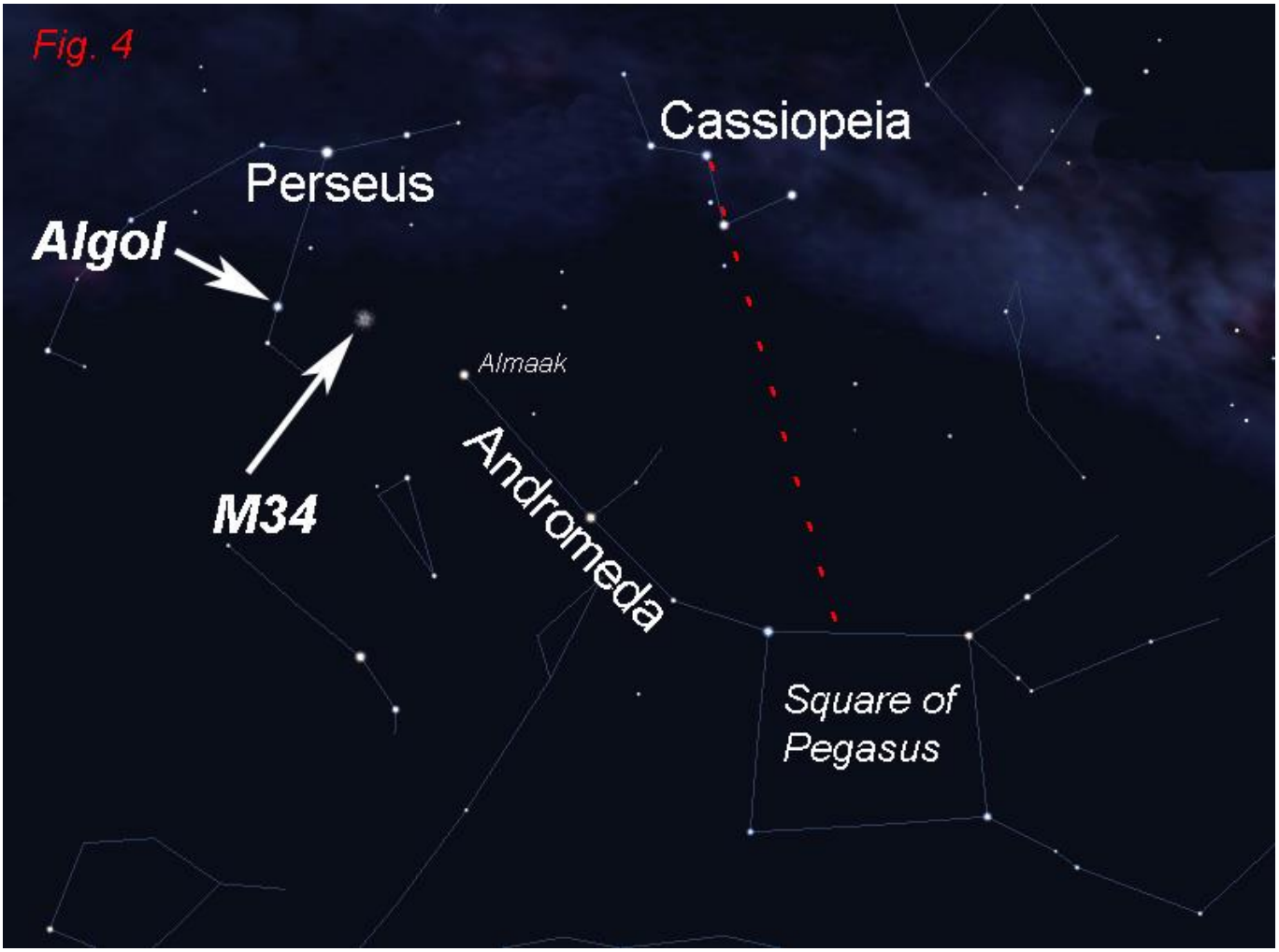


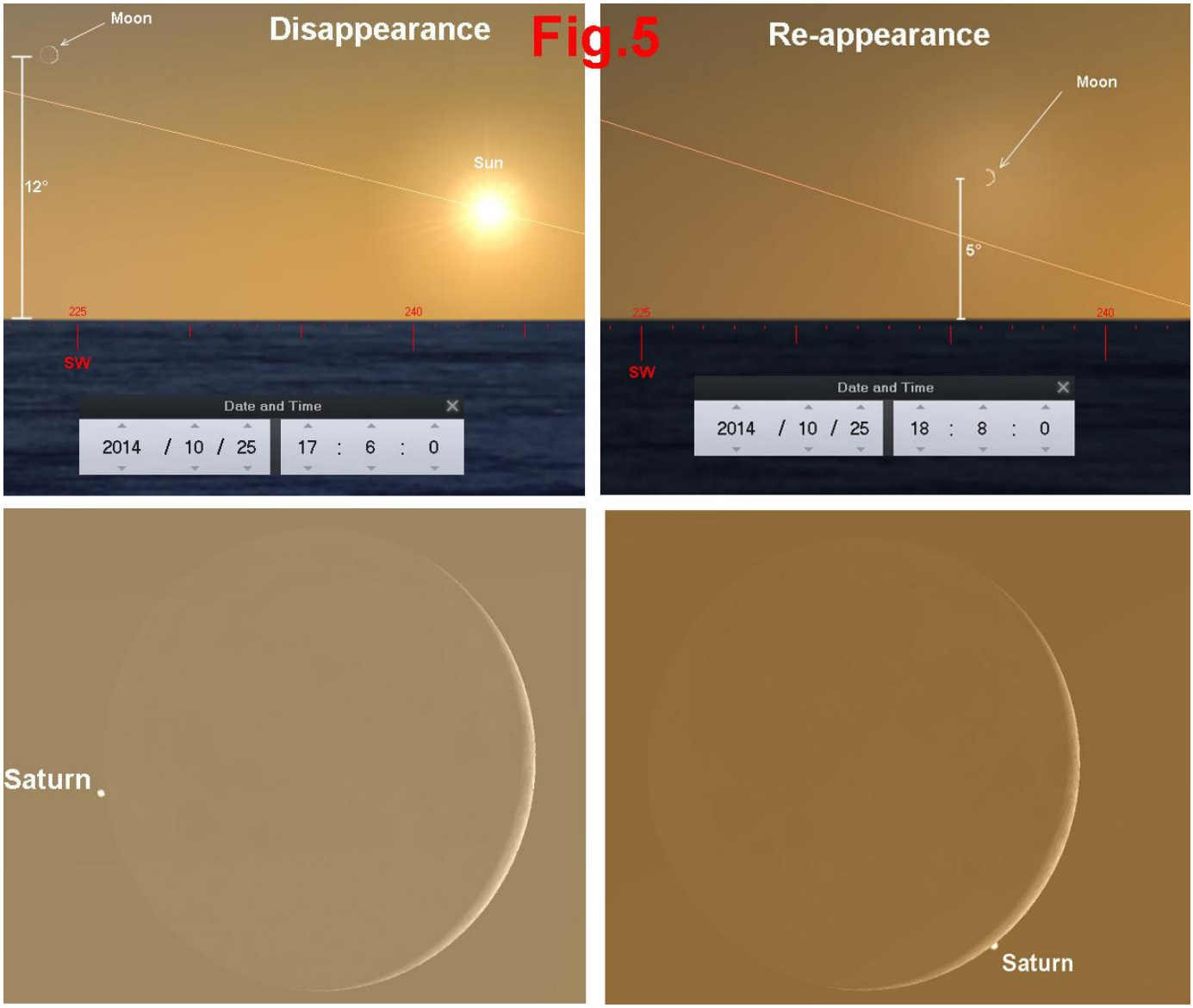
Fig. 4 shows the general area and suggests, in the first instance, that you find Pegasus by using the two stars in Cassiopeia as shown, although the "Winged Horse" should be easily visible high up in the south. Then follow the line of stars that is Andromeda to the west starting with the top left star in the square. The cluster can then be found roughly midway between Almaak and Algol.

2. Algol

Algol, colloquially known as the "Demon Star", is an eclipsing binary although it is more correctly referred to as the three star system Beta Persii A, B and C. The two components A and B just happen to pass in front of each other as seen from our viewpoint on Earth giving rise to regular fluctuations in brightness as one eclipses the other. Algol is normally of magnitude 2.1 but every 2 days 20 hours and 49 minutes it dips to magnitude 3.4 when the fainter of the two components passes in front of its brighter partner. There is also a secondary dip when the brighter star covers the fainter one but this is not visible to the naked eye. This is of course one of the methods used to detect exo-planets orbiting distant stars. The tiny dips in brightness can be measured providing that the orbit of the planet causes it to pass in transit across the face of its host star as seen from Earth.

Occultation of Saturn

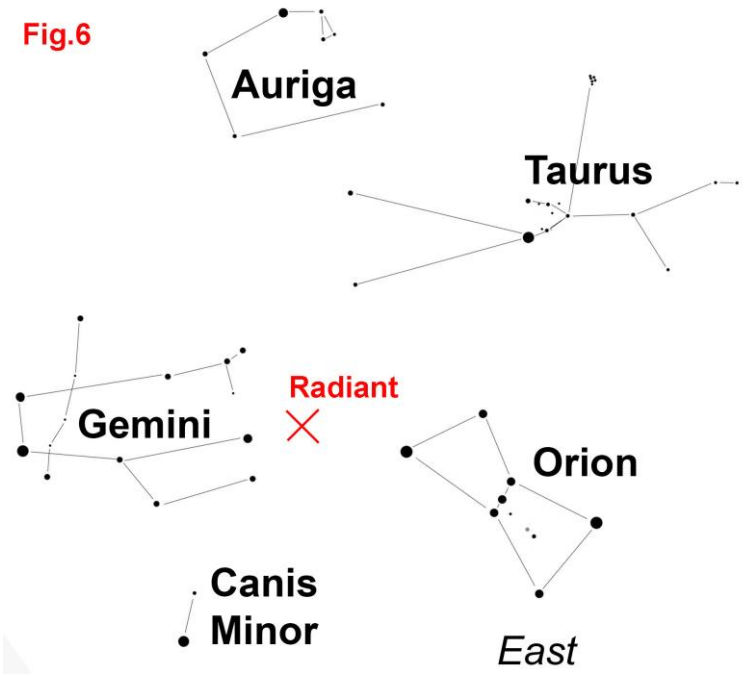
As I mentioned above there will be an occultation of Saturn by the Moon on October 25th. The disappearance occurs at 17.06 BST on the dark limb with the Sun still above the horizon, so care must be exercised as the two day old Moon, which you will not be able to see, is relatively close to the Sun. The Moon and Saturn lie almost exactly in the south west at 223° in azimuth and with an altitude of 12°. The bright limb re-appearance takes place at 18.08 BST with the Sun safely below the horizon, but only by 4°. At This point the Moon is just past south west (236°) and is 5° above the horizon.



The upper diagrams in figure 5 show the relative positions of the Moon, and therefore Saturn, to the horizon at both disappearance and re-appearance, whilst the lower ones show in close up where Saturn is with respect to the Moon's limb for both events.

Meteors

The Orionids are active from October 16th to 30th with a very broad peaked maximum that lasts from October 21st to 24th. At maximum the ZHR is expected to reach 25 although extinction when the radiant is low will reduce this although with new Moon occurring on the 23rd this year it will not produce any interference. The meteors from this shower are very fast, often leaving ionised trails behind them. The location of the radiant is given in fig. 6, although be aware that it doesn't rise in the east until 22.30 BST.



BST ENDS

Don't forget that British Summer Time (BST) ends on Sunday 26th October at 02.00, so you need to put clocks back by one hour. Greenwich Mean Time (GMT) will remain in force until 01.00 on March 29th 2015.

Brian Mills

NASA SPACE PLACE

Twinkle, twinkle, variable star

By Dr. Ethan Siegel

As bright and steady as they appear, the stars in our sky won't shine forever. The steady brilliance of these sources of light is powered by a tumultuous interior, where nuclear processes fuse light elements and isotopes into heavier ones. Because the heavier nuclei up to iron (Fe), have a greater binding energies-per-nucleon, each reaction results in a slight reduction of the star's mass, converting it into energy via Einstein's famous equation relating changes in mass and energy output, E = mc2. Over timescales of tens of thousands of years, that energy migrates to the star's photosphere, where it's emitted out into the universe as starlight.

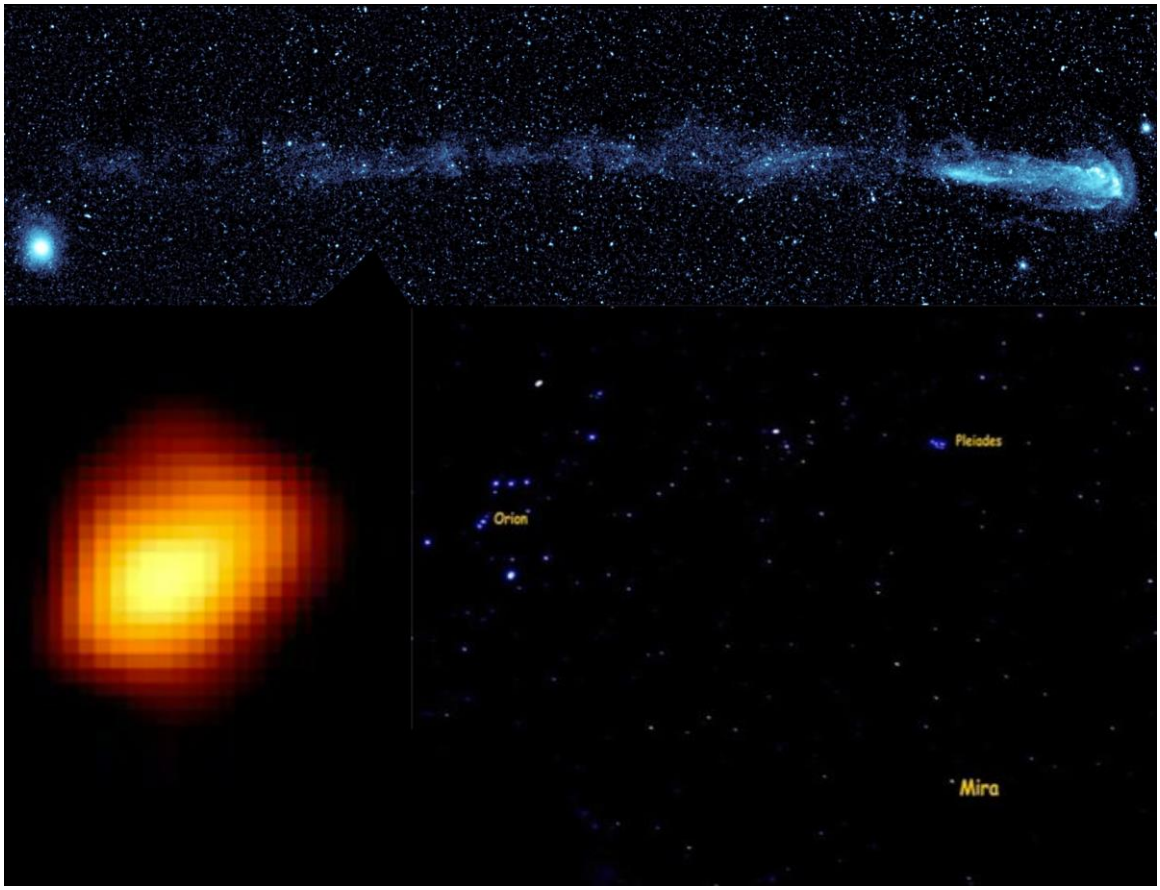
There's only a finite amount of fuel in there, and when stars run out, the interior contracts and heats up, often enabling heavier elements to burn at even higher temperatures, and causing sun-like stars to grow into red giants. Even though the cores of both hydrogen-burning and helium-burning stars have consistent, steady energy outputs, our sun's overall brightness varies by just ~0.1%, while red giants can have their brightness's vary by factors of thousands or more over the course of a single year! In fact, the first periodic or pulsating variable star ever discovered—Mira (omicron Ceti)—behaves exactly in this way.

There are many types of variable stars, including Cepheids, RR Lyrae, cataclysmic variables and more, but it's the Mira-type variables that give us a glimpse into our Sun's likely future. In general, the cores of stars burn through their fuel in a very consistent fashion, but in the case of pulsating variable stars the outer layers of stellar atmospheres vary. Initially heating up and expanding, they overshoot equilibrium, reach a maximum size, cool, then often forming neutral molecules that behave as light-blocking dust, with the dust then falling back to the star, ionizing and starting the whole process over again. This temporarily neutral dust absorbs the visible light from the star and re-emits it, but as infrared radiation, which is invisible to our eyes. In the case of Mira (and many red giants), it's Titanium Monoxide (TiO) that causes it to dim so severely, from a maximum magnitude of +2 or +3 (clearly visible to the naked eye) to a minimum of +9 or +10, requiring a telescope (and an experienced observer) to find!

Visible in the constellation of Cetus during the fall-and-winter from the Northern Hemisphere, Mira is presently at magnitude +7 and headed towards its minimum, but will reach its maximum brightness again in May of next year and every 332 days thereafter. Shockingly, Mira contains a huge, 13 light-year-long tail -- visible only in the UV -- that it leaves as it rockets through the interstellar medium at 130 km/sec! Look for it in your skies all winter long, and contribute your results to the AAVSO (American Association of Variable Star Observers) International Database to help study its long-term behavior!

Check out some cool images and simulated animations of Mira here: http://www.nasa.gov/mission_pages/galex/20070815/v.html

Kids can learn all about Mira at NASA's Space Place: http://spaceplace.nasa.gov/mira/en/



Images credit: NASA's Galaxy Evolution Explorer (GALEX) spacecraft, of Mira and its tail in UV light (top); Margarita Karovska (Harvard-Smithsonian CfA) / NASA's Hubble Space Telescope image of Mira, with the distortions revealing the presence of a binary companion (lower left); public domain image of Orion, the Pleiades and Mira (near maximum brightness) by Brocken Inaglory of Wikimedia Commons under CC-BY-SA-3.0 (lower right).

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Any material for inclusion in the November 2014 Newsletter should be with the Editor by October 28th 2014