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# STARDUST

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**EDITORIAL** 2014 has begun with a prolonged period of cloudy, damp weather and opportunities for observing have been few and far between. As usual the sky has provided much of interest including a fine supernova (peaking around magnitude 10.4) in the bright (a *relative term* for galaxies of course!) galaxy M82 in Ursa Major. The hope that another bright comet will dominate our skies appears to have passed for the time being, but no doubt a fresh denizen from deep space will trigger a new spate of media hype before too long. Turning to the Sun, and although we have seen very little of it, there has been a series of fairly large sunspot groups crossing the solar disk. There have even been a few large CME's, one of which side-swiped the Earth on 27<sup>th</sup> February producing a display which could be seen in the south of England. The display was far from spectacular although it attracted a large amount of

attention from the media. Fingers crossed that there are more to come! The BBC's now annual Stargazing Live, or SGL, coincided with some rare clear skies in early January this year, and it provided a fantastic opportunity for over 4,000 people to sample some real astronomical photons at Cultra – rather than absorb them from the glossy magazines or TV programmes. SGL also provides the IAA with a great opportunity to harvest the immense interest in astronomy and it should provide some excellent membership feedstock to nourish the Association over the coming years. Setting aside some difficulties with the logistics of getting 4,000 people parked and into the Cultra Folk Museum on the night, the whole SGL experience seems to have proven a total success.... Roll on next year!

*Andy McCrea, Editor, STARDUST*

**INSIDE YOUR STARDUST**

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*IAA President, Paul Evans snapped this great view through Brian Beesley's Ha telescope of the active solar disk at the Ulster Museum 'SGL' day – 14<sup>th</sup> February 2014.*

**SUBMISSIONS TO STARDUST**

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The Editor welcomes all items, reports, letters, articles or observations for publication in *STARDUST*. Contributions are particularly welcome by email or on compact disc in MS Word format (Times New Roman, 12 point), or even typed or hand written. The deadline is 4 weeks before the next publishing date, 1st January, April, July, and October. Please send your submissions to:  
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**Please Note: Photos may have to be cropped. Opinions herein are not necessarily those of the Editor or Council.**

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*Above: Jupiter with Great Red Spot - 20<sup>th</sup> January 2014 (image: John Hall).*

**Front cover design by John Hall**

## Members' Observations & Reports January 2014 to March 2014

*Dear Andy, There was a two hour window in the cloud last night (13/01/14) so I grabbed the chance to get a few pictures. Conditions were far from ideal and a gusty breeze shook the scope a lot. Seeing was very variable with some good clear spells. The cloud cover was complete by 23.30. The GRS has now become the Great orange spot, and seems to have shrunk somewhat. (see also John's Jupiter image on the inside front cover).*



John also took the opportunity to capture this great view of Plato and the surrounding area (below). The Plato region is a regular target area for astro-imagers and has been the source of transient lunar phenomena (TLP) in the past. The Alpine Valley can also be seen to the right of Plato.



IAA member **John Purvis** sent us this poem about an astronomer by his daughter **Zoe**, a second year English student at QUB. John says, 'Zoe tells me that the inspiration was me (woolly hat and all!) but she assures me that she does actually know a little bit about the night sky'.

### *A Figure in the Stars*

*I see him there, standing in the middle of the night air.  
His woolly hat on, what is he looking at?  
His breath is a living thing, I can see it in the light from  
the moon.*

*Curious.*

*He looks up, gains some knowledge from the sky which  
I could never tell.*

*Is it some sort of figure in the stars?*

*He uses his tools to get close to what he has seen.*

*Intrigued, I follow the tilt of his binoculars.*

*Stars upon stars, I strain for recognition  
but I cannot make out a pattern.*

*I can see their beauty, yes. But what of their stories?*

*Saddened, I cannot be a part of that knowledge.*

*Unless...I make towards him,*

*like a child eager to learn.*

*But it is too late – he is packing up, to return to his  
home,*

*happy, that the world is so big.*

*I watch him part, through the park gate*

*as I turn back to the furry companion at my feet.*

*I know as much as she of the universe,*

*accepting, that it is beautiful and mysterious.*

**Zoe Purvis**

**Lawrence Hanna** has been imaging the winter showpiece in Orion – the Great Nebula, M42. Lawrence took the image from his light polluted site in east Belfast (indeed from his new dome! – see his article on pages 24-27). Visually the nebula is not visible in these strong colours, it appears as a misty grey-green because the eye is not sensitive to these colours in faint objects. M42 is visible to the naked eye as a hazy patch in clear dark skies.



*Venus was a stunning object on the run up to Christmas 2013 and Martin Campbell captured this shot of the 'Christmas Star' from his observatory in Dungannon (9<sup>th</sup> December 2013).*



### ***A Bright Supernova in M82 – SN2014J*** *- Andy McCrea*

A cloudy night in London led to the discovery of the 21st Century's brightest supernova to date. The new supernova 2014J, the brightest since 1993, is located in the galaxy M82. This Type-Ia supernova reached its peak brightness of magnitude 10.6 in late January 2014. M82 lies at a distance of only about 12 million light years, which explains the brightness of 2014J in our skies. 2014J is bright enough to be seen in small telescopes or perhaps in (very) large binoculars. On the night of January 21, 2014, a group of astronomy students at University College London were scheduled to learn how to use a campus telescope as part of a practical astronomy class.



The telescope is a Celestron C14, a 14 inch (355 mm) catadioptric telescope which is normally considered an upper-end amateur scope. Noticing that clouds were rapidly closing in, The instructor, teaching fellow Dr. Steve Fossey, decided to scrub the formal introduction and simply show the students how a CCD camera is used to image a celestial object. The students chose M82, a galaxy which is a well-known showpiece in the northern skies. Ten minutes later, the group had discovered the new supernova. The photo below shows M82 taken by Andy McCrea after he returned home from the IAA meeting on January 22nd.



Astronomers the world over quickly recorded spectral information that showed 2014J to be a Type-Ia supernova. This is a supernova that results when a white dwarf star in a binary stellar system continually collects additional material from its partner. The white dwarf is a star that has completely fused its stocks of hydrogen and helium. As a result, the white dwarf is mainly composed of carbon and oxygen. Carbon-oxygen white dwarf stars must have a mass smaller than 1.44 solar masses, after which they are no longer able to support their own mass, and collapse into a neutron star. Before they reach this point, however, the increased pressure and temperature at the core is thought to trigger fusion of the carbon and oxygen, resulting in the very rapid conversion of a few parts in 10,000 of the mass of the white dwarf into energy. It is this energy that powers the supernova. Spectra taken of 2014J show distinct reddening of the light heading in our direction, indicating that the light is being scattered by interstellar and intergalactic dust, losing about two magnitudes of brightness in the process. Still, we are left with a magnitude 10.6 supernova to look at, an enticing prospect for amateur astronomers north of the Equator. (M82 is in the far northern skies, so observing the supernova becomes more and more difficult the further south you observe).

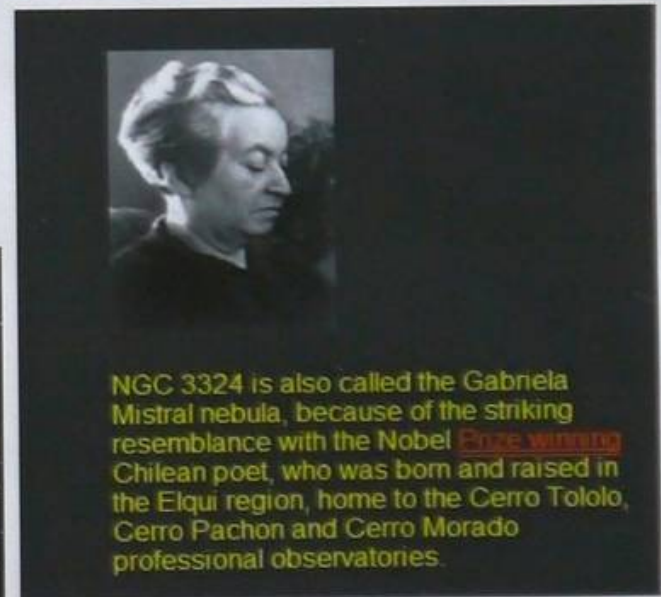
M82 itself is a reasonably bright (as galaxies go! - magnitude 8.4) irregularly shaped galaxy, about eight times brighter than 2014J. It is intrinsically some five times brighter than the Milky Way galaxy, even though it has only one-twenty-fifth of the Milky Way's mass. It is a starburst galaxy, so named because it is undergoing a phase in which star formation is taking place at an extremely rapid rate. This is likely the result of a close encounter within the past few hundred million years with its larger neighbour galaxy M81 (magnitude 6.9, about two-thirds of a degree south of M82 – seen in the lower image above). In the process, a great deal of interstellar gas was transferred into M82, and also gas transport within the smaller galaxy increased considerably, thereby driving the very rapid rate of star birth observed today.

how hard that is.... Well I have a very good image that will blow (hopefully) everyone away and that no-one can say they can't get. Here is NGC 3324 better known as the Gabriela Mistral Nebula. The three images I'm sending you will explain everything. Images one and two are from the internet, the third one is from ITelescope, when I went looking for an in depth detailed listing I found images 1 & 2 below - hopefully you will let me know if it is as good as I think! I have also included a comet image - Comet Lovejoy. Best wishes **Michael Duffy, Belfast**.

***Comet Lovejoy Puts on a Show as the 'Christmas Comet'***

*Andy McCrea*

After the disappointment of Comet Ison, comet Lovejoy provided a fine early-morning spectacle. Lovejoy shone just below naked-eye visibility for most of December as it moved steadily through Bootes, close to Arcturus. The image below taken from my home in Bangor on the 29<sup>th</sup> December 2013 shows a fine tail and some structure. The tail could be seen to stretch for some distance in 10x50 binoculars – definitely worth the 5'Oclock rise!



NGC 3324 is also called the Gabriela Mistral nebula, because of the striking resemblance with the Nobel ~~Prize winning~~ Chilean poet, who was born and raised in the Elqui region, home to the Cerro Tololo, Cerro Pachon and Cerro Morado professional observatories.



**Hello Andy,** Just a couple of photo's for you, but before I give you some comets, here's one hopefully you might print in Stardust. The other night I had some friends over for a rare clear sky and was showing them around. Trying to explain and name the constellations but as you know it is really difficult for them to grasp. They can't seem to make the name fit the constellation, you know



Allistair Gordon sent this great image of a large gibbous, almost full Moon from 13<sup>th</sup> February 2014. Allistair used a Skywatcher 200pds with a Canon 450d, and the was image taken at ISO 100 and EV at 1/400<sup>th</sup>Sec.



*Andy - In the words of the great poet Robert Service;*

*'We would watch and watch the silver dance of the mystic Northern Lights.*

*And soft they danced from the Polar sky and swept in primrose haze;*

*And swift they pranced with their silver feet, and pierced with a blinding blaze.*

*They danced a cotillion in the sky; they were rose and silver shod.*

*I never thought that I would witness the aurora to do this, but I was in Malselvossen camp site just outside of Bardufoss, Norway. It was Feb 1<sup>st</sup> 2014 a moonless night, and -32 when the sky lit up with the magic of the Aurora Borealis. I have seen aurora many times in Norway but never anything like this display. These pictures do not do justice to what we witnessed that night. A night that will last with me forever. Eugene Furlong, Cork.*



*Aurorae Images above by Eugene Furlong.*

And the aurorae stories continue – following a fairly strong alert on the internet, there was a fine but mild display on the 24<sup>th</sup> February 2014. The display was widely witnessed across the UK and was most intense in northern Scotland. It was also well viewed here, and a few observers with dark clear skies along the north coast were able to see some coloured rays and arcs. IAA Council member, **Brian Beesley** captured some excellent shots from his home in Portballantrae.



## *Dark Matters: with Roy Mitchell*

Can it really be time for me to come up with another hotchpotch of cosmological considerations so soon? I guess so ... so here goes! Actually, I was watching BBC's Newsnight, the other night, when Kirsty Wark mentioned that Dame Jocelyn Bell Burnell had just been elected as the first woman president of the Royal Society of Edinburgh. Ms Wark subsequently went on to interview a couple of guest speakers on the subject of the lack of women in STEM (science, technology, engineering and mathematics) professions. It appears that in the UK, only 13% of posts in STEM jobs are held by women, which to me seems rather unbelievable, if not entirely surprising. Speaking as a freelance teacher (of music, and occasionally maths and physics), I meet a lot of young people, and from many casual conversations over the years, it does seem to me that even in this current age of equality and political correctness, too many girls are led to believe that the world of science and technology, etc., is still mainly the natural habitat of boys and men. And the root cause (in my opinion) appears to be mainly a combination of old fashioned parenting and a lack of stimulation at primary school level.

Once children get to secondary school, the curriculum takes over, and boys and girls appear to be equally immersed in STEM subjects, but by then the stereotyping has taken place and I fear many young teenage girls see a future in maths or engineering as being not something to be seriously considered. One house, in which I teach, has a "year group" photo of two of my students whilst still at nursery school, in which the boys are all dressed as firemen, policemen, doctors and construction workers, whilst girls are all dressed as ... wait for it ... princesses, in pink dresses!! I don't really know what more I can really say on the subject, but the statistic is quite alarming. I know I'm a "boy" and some people might wonder why I should concern myself with such matters. Well quite simply, since I was old enough to think, I have been puzzled and disturbed by many aspects of so-called social conventions and traditions, and a natural consequence of free thinking is a desire for social equality.

As a slight aside, I remember being surprised and delighted to being invited to become a member of

the council of this very astronomical association, quite soon after joining the IAA. However I remember possibly making something of a faux pas at my very first meeting, by asking why there were no women present. I hadn't meant to speak out of turn, and I certainly wasn't trying to be funny, I was simply taken aback at suddenly finding myself in such a homogeneously male dominated environment, having come from an astronomy society in the south of England where the women slightly outnumbered the men. Don't get me wrong, those council members were some of the friendliest and most hardworking people I have ever met ... we must never take the council for granted (!), without which there would be no IAA ... and of course times, and members, have changed since then, in any case. To be honest, I think I felt a little bit like a fish out of water, and I'm afraid I don't really remember personally contributing greatly to the working of the council, other than to significantly lower the collective IQ of the room every time I walked in! It's probably best that I stick to hammering out my opinions, on the old type-writer, down here in the decidedly cold and lonely basement of Stardust Towers, where I was banished to, many years ago.

Anyway ... maybe more girls (and boys) should be told about people like Dame Jocelyn Bell Burnell while they are still at primary school. I'm sure Jocelyn wouldn't mind me reminding my less ambitious students (as I often do) that she "failed" her eleven-plus exam in N. Ireland, and yet subsequently went on to become a major figure in the world of astrophysics. As a teenage astronomy enthusiast, growing up in Mid-Ulster, I had a favourite astronomy book which had a picture of Jocelyn on the page about pulsars or neutron stars (which you all know she discovered). Well you can't imagine how amazed I was to discover that she was one of my tutor/lecturers at my first Open University physics summer school in Durham University (where my son is currently studying physics). I was genuinely star-struck ... absolutely no pun intended ... at our first meeting, but she was incredibly friendly and helpful all that week and I wasn't alone in being very inspired by her obvious passion for her work. On a personal note, she happened to be in the platform party, several years later when I graduated, even taking time to come and chat to my family after the ceremony. More significantly for me, is that, as the then president of the Institute of Physics, it was Jocelyn who eventually signed my certificate of membership, upon my becoming a full IOP member.

Now it won't have eluded the more perceptive amongst you that my quarterly scribblings come under the heading of Dark Matters ... pun absolutely, in this case, intended! Whilst I was casting around in my subconscious, this week, looking for a suitable subject to explore, it occurred to me that we all owe a great deal, philosophically speaking, to the late, Bulgarian born, Swiss astronomer and discoverer of dark matter, Fritz Zwicky. Actually it would probably be fairer to describe Zwicky as having initially "found" a large amount of missing mass, particularly in the Coma galaxy cluster. The technique he exploited to make what became one of the greatest paradigm shifting discoveries in the history of astronomy and cosmology ... i.e., that most of our universe's contents appear to be missing ... made use of the concept of the "virialisation" of a gravitationally bound system. Put simply, his observations led him to conclude that there was more mass, present, in the cluster of galaxies, than could be accounted for, by the total mass of the observed constituent galaxies.

Of course we now know that this phenomenon of "missing mass" is ubiquitous wherever we look, in the Universe, leading to speculation that up to 85% of the contents of the Universe is unaccounted for. Please don't confuse "dark matter" with "dark energy", which is the current name for the, as yet, not understood process by which the Universe appears to be accelerating in its expansion. Coincidentally, I believe that Fritz Zwicky was one of the original proponents of the theoretical existence of neutron stars, decades before they were actually discovered by Jocelyn Bell (as she was then), along with her supervisor Antony Hewish. A nice little cosmic connection for you, there!

Basically, when a system of bodies, for example, stars in globular clusters, or certain types of galaxy, or indeed, galaxies in a galaxy cluster, settle into a dynamic equilibrium, where any further gravitational collapse is prevented by the average kinetic energy of the constituent members, the system is said to be virialized. This can be illustrated quantitatively using possibly the simplest equation in the whole of astrophysics, namely the Virial Theorem, which says:

$$2E_{\text{kinetic}} = -E_{\text{gravitational}}$$

where E denotes energy.

Now the main reason I keep knocking out these articles is simply because trying to explain something to someone else is, without doubt, the best way to understand it. So as usual, with

apologies to real mathematicians and physicists, I will try to show how this simple little equation, with which one can "weigh" star clusters, and elliptical galaxies, and whole clusters of galaxies, can come about.

To start with let me state without proof a couple of simple equations. First, you probably all know that the kinetic energy of a moving body of mass 'm' and velocity 'v', is equal to  $(mV^2)/2$ . Now energy, which can be equated with work, is equal to force times distance. Force 'F' is equal to mass times acceleration 'a' (from Newton laws of motion), so that:

$$F = ma = (GMm)/r^2$$

from Newton's law of gravitation, where 'r' is the distance from a gravitational source and 'G' is the gravitational constant. So that from above:

$$E_{\text{gravitational}} = -GMm/r$$

where the minus sign is due to the fact that gravitational potential energy is always negative, because at infinite distance, the gravitational force (and consequently the potential energy) would be zero. As the body gets closer to the source of gravity, it loses potential energy (i.e. becomes more negative) at the expense of increasing kinetic energy. This is how a collapsing system of bound bodies achieves dynamic equilibrium. At some point, the kinetic energy will "hold up" the collapsing system a bit like the air pressure in a tyre holds up the inner tube. For a single body in a roughly circular orbit we can say that:

$$a = V^2/r \quad \text{so that} \quad F = mV^2/r = -GMm/r^2$$

where I have included a minus sign to show that the force is centripetal, and multiplying through by 'r' gives:

$$mV^2 = -GMm/r$$

which basically says that for a gravitationally bound object in a circular orbit, twice the kinetic energy is equal to the gravitational potential energy ... which is the same as the virial theorem as stated above. Please ... mathematicians ... ignore my lack of vector notation, and of course a rigorous proof of the actual theorem would involve some fairly tricky statistical mechanics and vector calculus. This is just a bit of fun!

To be serious though, if you substitute my hypothetical single body, for multiple mutually orbiting gravitationally bound objects, in a virialized system, the theorem can be used to estimate the mass of the system, by "simply" measuring the dispersion of the radial velocities (around the average radial velocity), of the individual constituent members, by observing their



respective red-shifts, and plugging the result into the virial equation in the form:

Total mass of system is approximately equal to the system's radius times the square of the velocity dispersion divided by the gravitational constant, or more simply:

$$M_{\text{total}} \approx R_{\text{system}} (\Delta V)^2 / G$$

Well I hope that's all clear! In the next edition of Stardust ... if I still haven't been fired by the editor ... I intend to explore, either, the so-called Anthropic Principle, or possibly more stuff to do with collapsing gravitational systems.

By the way, I've just realised, much to my chagrin, that my articles sound better in my own head when read in the imaginary "voice" of television's James May. Please feel free to substitute the voice of your choice, whilst reading any future contributions to this column. Come to think of it I've always had a bit of a "thing" for the above-mentioned Kirsty Wark's lilting Scottish accent, maybe I'll try writing with her voice in my head next time!

Until then ...

*Roy – excellent stuff as usual, but I have just come down with a bad case of virial mathematics ... Ed.*

### ***SKYNOTES: April - May 2014***

***N.B. All times are now Civil Time for convenience, except where stated.***

**Magnitude:** this is the astronomical term used to measure an object's brightness. For beginners it can be confusing, as the lower the magnitude (abbrev: mag), the brighter the object! This arose from the convention among early astronomers of describing the brightest stars as 'First magnitude' (written as 'mag 1'); the next brightest as 'second magnitude' (mag 2), and so on down to the faintest stars they could see which were of 'sixth mag' (mag 6). Today, with powerful telescopes and CCD imaging we can extend the scale down to below mag 30. And for the very brightest stars and planets, and the Moon and Sun, we have to extend the scale in the other direction too. So mag 0 is brighter than mag 1, and then brighter than mag 0 we have mag -1, mag -2, mag -3 etc. And each can be subdivided into decimals such as 3.8, or -2.1, etc. If no sign is shown, take the mag as positive, i.e. 'mag 3' means +3. Each magnitude is exactly 2.512 times brighter than the next one, so that stars of mag 1 are exactly 100 times brighter than those of mag 6. To remember which way the scale works, just think 'First' is

better (brighter) than Second, which is better than Third, etc. Then remember that for brighter than 'First', you have to go to zero, and then minus values.

**Spring Equinox:** The Sun crossed the celestial equator northwards on Mar 20d 16h 56m, marking the start of Spring in the N. Hemisphere, and from then onwards days will be longer than nights.

**Zodiacal Light:** the best times to look this spring will be from Mar 18 to 31. You need a very dark sky, and a clear horizon to the West. Look for a faint cone of light extending up from the horizon at about 45 degrees to the left, along the line of the ecliptic.

**Summer Time:** This will commence at 01.00 on Sunday March 30: Clocks go forward 1 hour.

**The MOON:** (all times in GMT)

**NEW:** Mar 30d 18h 44m; Apr 29d 06h 14m; May 28d 18h 40m; Jun 27d 08h 08m

**1st Q:** Apr 07d 08h 31m; May 07d 03h 15m; Jun 05d 20h 39m;

**FULL:** Apr 15h 07h 42; May 14d 19h 16m; Jun 13d 04h 11m

**3rd Q:** Apr 22d 07h 52m; May 21d 12h 59m; Jun 19d 18h 39m

Try to spot a very young Moon (perhaps setting yourself a personal record), on the evening of 31 March. New Moon occurs on 30 Mar at 18h 45m, so if you spot it about 19h 15m next evening it will be just 24.5h old. Look just to the left and a few degrees above the spot where the Sun set. Binoculars will help you locate it (but don't look while the Sun is still above your horizon!), but don't count for your record!

**MERCURY:** The elusive inner planet has a reasonably good Eastern Elongation of 23° on 25 May, and will be visible in the evening twilight about mid month. It will lie 7.5° below and right of the thin crescent Moon on 1 February about 30 mts after sunset, which should make it easy to find. The following data is for about 45 minutes before sunset.

#### **Mercury:**

Date	Mag	Diam	Phase	Elong.
May 07	-1.1	5.6"	83.6%	13.4°
May 11	-0.8	6.0"	72.4%	17.0°
May 15	-0.4	6.5"	60.9%	19.8°
May 19	-0.0	7.2"	50.0%	21.7°
May 23	+0.4	7.9"	40.1%	22.6°
May 27	+0.8	8.6"	31.1%	22.5°

On 21 May it will lie just 3° below and left of Beta Tauri (mag +1.7). On May 27 it will be about 20°

below and right of much brighter Jupiter. The apparent diameter is always quite small, so with a big telescope you might just see some detail on Mercury's tiny disc, but usually all you can make out is the phase. *Never* look for Mercury with optical aid while the Sun is above the horizon, in case you accidentally get the Sun into the field of view, risking very serious eye damage.

**VENUS:** Venus is visible low in the morning sky in the dawn twilight, but is not well placed for our latitudes. But you could look for it on the following mornings, all at about 30 – 60 mts before sunrise in the dawn twilight on 27 March, when the waning crescent Moon will lie about 2.5° above it. 25 April, when the waning crescent Moon will lie about 9° above and right of it. On 25 May, when the waning crescent Moon will lie about 5° above and right of it. On 24 Jun, when the waning crescent Moon will lie about 5° to the right of it. On the morning of 16 May it passes 1° 11' South of Uranus, mag 5.9, but the latter will be very hard to see in the twilight, especially as it's so low.

**MARS:** Our neighbour planet has moved further out from the Sun each morning over the last quarter, as it reaches opposition on 9 April, in Virgo. On 1 April it will have reached mag -1.3, and increased in apparent diameter to 14.6", and the phase will be 99.6%. At opposition it will have brightened to a spectacular -1.5, and with a diameter of 15.1", you can see reasonable detail in a good telescope, if the seeing is steady. The North Pole of the planet is tilted towards Earth, at an angle of 21°, but the polar cap is likely to be barely visible in the Martian summer. It will be 242 million km from the Sun, but only 93m km from Earth. On Apr 14 the Full Moon will lie nicely almost between Mars and Spica. On May 5 Mars will pass just under 1.5° South of Porrima (Gamma Vir), one of the loveliest double stars in the sky. On Jun 7, the gibbous Moon will pass 2.5° South of the planet. But towards the end of the quarter it will have faded significantly and noticeably decreased in size: by June 30 it will be down to mag 0.0, and diameter only 9.5".

**JUPITER:** Our largest planet is now well past its best, but still shining brilliantly in Gemini, at mag -2.2 on 1 Apr; and with an apparent diameter of 36.5" it still appears much bigger than Mars even at its best. At the start of the quarter it is still fairly high up in the Southern sky as darkness falls, and shows plenty of detail in a telescope, such as the dark belts and bright intervening zones, and of course the famous Great Red Spot, which is a

gigantic storm in Jupiter's atmosphere, which has been circulating for almost 4 centuries, and is visible in even a small telescope. But by mid-June it will be sinking low in the evening twilight, making it very hard to observe. On 22 May, it will pass just 30' N of Delta Gem, mag 3.5. Even binoculars will reveal the four 'Galilean Moons', Io, Europa, Ganymede and Callisto. A telescope will show their regular stately dance around the planet, alternately passing in front of it (a transit), or behind it (an occultation), or disappearing into Jupiter's shadow (an eclipse). The shadow of each moon crosses the disc after the moon itself, and eclipses occur after the corresponding occultations. You can find predictions for the times of all the satellite events on various websites, such as <http://www.rasnz.org.nz/SolarSys/JovSatJul.htm>.

**SATURN:** Will become increasingly accessible towards the end of the quarter in the late evening sky as it moves towards opposition with the Sun on 10 May. On 1 April it will be mag 0.3, the diameter will be 18.1", and the ring angle will be 22.4°. At opposition the magnitude will have increased to 0.1, and the apparent diameter will be a reasonable 18.6", with the rings tilted at 21.7°. It's now more than 15° S of the celestial equator, so doesn't get high enough for good observing conditions until it's fairly near the meridian. But from early April it will be an impressive sight, with the magnificent rings well displayed, and the Cassini Division in the rings quite easy to see. Even the narrower Encke Division in the outer ring should be visible in a moderate telescope in good conditions. The Moons range from easy to difficult in terms of visibility. Almost any telescope will show the brightest, Titan, at mag 8.4; the others are fainter, and easiest to see when furthest out from the planet. Rhea will reach mag 9.7, Tethys mag 10.2 and Dione mag 10.4. Enceladus and Mimas are tricky at mags 11.7 and 12.9. Further out beyond Titan lies Iapetus, the two-faced satellite; one side is dark and the other fairly bright. It is always easiest to see when at Western elongation, when its bright side is turned towards us: this will happen in mid-April, when it will reach mag 10.3

**URANUS** is not really observable this quarter.

**NEPTUNE** will reach opposition on 29 August, and becomes visible in the early mornings towards the end of the quarter, but will be better placed next quarter.

**Comet PanSTARRS (C/2012 K1)** may reach 8<sup>th</sup> magnitude in late May, in Ursa Major, below the

bowl of the 'Dipper' before sinking into the evening twilight. But as for all comets, predictions are not totally reliable (remember ISON?). More details on this comet closer to the time in my email bulletins (email me on [terrymosel@aol.com](mailto:terrymosel@aol.com) to get these).

**ASTEROIDS:** The two brightest asteroids, 4 Vesta and 1 Ceres will be well placed for observing, reaching opposition within two days of each other, on April 15 and 17, in Virgo. Although Vesta is the smaller of the two, it has a more reflective surface, and will also be closer to us, so it will appear the brighter, at mag 5.8, just within range of the unaided eye in good conditions if you know just where to look. Ceres will be mag 7.0, but easily visible in binoculars. They lie within 2 degrees of each other throughout this quarter, getting closer all the time as they approach a minimum separation of only 10' on 5 July. More details on that closer to the time in my email bulletins (email me on [terrymosel@aol.com](mailto:terrymosel@aol.com) to get these). I will send a chart giving their positions on request: email me on [terrymosel@aol.com](mailto:terrymosel@aol.com). You can check for details of any asteroids that are above magnitude 10 on [www.heavens-above.com](http://www.heavens-above.com).

**METEORS:** This quarter usually has only one decent shower, the **Lyrids**, which peak on the evening of April 21-22, but the LQ Moon will rise about 02.00 that night, so best condition will be from darkness until that time. The ZHR may peak at about 20.

The **Eta Aquarids** will peak on the morning of May 6, but just at dawn, and the radiant never rises high enough from here to get good views before twilight interferes.

**LINEARIDS?** There is a fair chance that we will see some meteors from Comet 209P LINEAR, when the Earth passes through the trail of the comet in late May, from May 24 onwards. It's too early to say yet, but I'll give updates via my email bulletins closer to the date (email me on [terrymosel@aol.com](mailto:terrymosel@aol.com) to get these). The Zenithal Hourly Rate (ZHR) is the rate which would be seen by an experienced observer, in a VERY dark sky, and with the radiant in the zenith: actual observed rates very rarely reach the nominal ZHR for various reasons.

#### METEOR PHOTOGRAPHY:

If you have a digital SLR which can give longish time exposures, and you can manually focus it on infinity, and adjust it to a high ISO (film speed equivalent), you can image meteors with a bit of luck. Make a suitable lens hood, or heater, to

prevent dew on the camera lens. You'll also need a locking cable release (plus a spare one), and preferably a tripod. Point the camera about 50° up in the sky, about 40° from the radiant, for best results. Consult your camera handbook, or experiment with exposures until the sky fogging becomes too severe.

Clear skies,  
Terry Moseley

### SKY DIARY April – June 2014.

All times are 'clock time'.

See 'Skynotes' for more details of some of these events.

*By Terry Moseley*

D h m

#### April

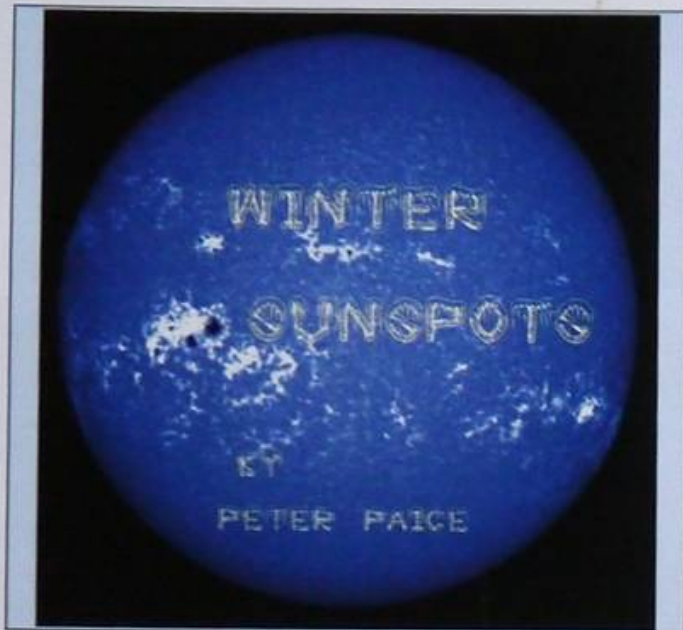
- 01 Global Astronomy Month begins
- 02 19 30 IAA Lecture, Dr Steve Myers, CERN "LHC & Higgs Boson"
- 4-6 COSMOS 2014 Star Party, Athlone
- 08 Mars at opposition, in Virgo, mag -1.5
- 13 4 Vesta at opposition in Virgo, mag 5.8
- 15 1 Ceres at opposition in Virgo, mag 7.0
- 15 Penumbral phase of lunar eclipse, briefly visible from sunset
- 16 Iapetus (Saturnian moon) at E Elong, brightest
- 16 19 30 IAA AGM + another event tba
- 22-23 Lyrid meteors maximum

#### May

- 5 – 6 Eta Aquarids meteors maximum; radiant low
- 10 Saturn at opposition in Libra, mag +0.1
- 13 – 16 Astronomy workshop, NUIG, "Speed and Sensitivity"
- 17 – 24 STfC Roadshow, QUB: Giant telescopes
- 22 Jupiter passes 30' N of Delta Gem (mag 3.5)
- 23-24 Possible meteor shower from comet 209P / LINEAR
- 25 Mercury at Greatest E Elong, evening sky

#### June

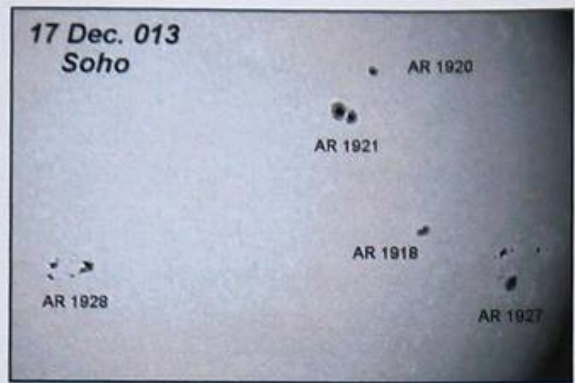
- 7 Gibbous Moon passes 2.5° South of Mars
- 8 – 9 Gibbous moon passes only 36' N of Spica (edge to star)
- 10 Moon passes close below Left of Saturn
- 14 – 15 Rho 1 Sgr (mag 3.9) occulted by Moon, 01.09 – 02.08
- 18 Earliest sunrise, Belfast (04 46m 22s)
- 21 11 51 Summer Solstice
- 24 morning; Venus 4° 40' Left of waning crescent moon
- 24 Latest sunset, Belfast (22h 04m 46s)



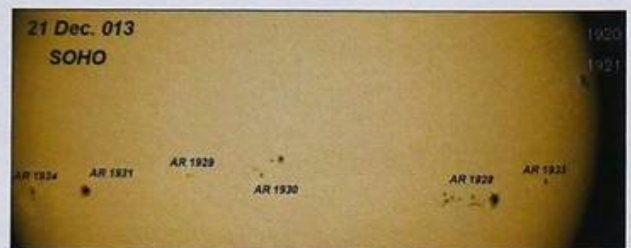
December 2013 continued the weather trend, having many days clouded out giving no possibility what so ever of observing or imaging sunspots. The Winter Solstice period delivering a low solar elevation and with reduced hours of daylight, the “window of imaging opportunity” became only 3 hours between 10.00hrs. until 14.00hrs. Assembling this solar diary and faced with the above situation, it showed the need for using images from the Internet plus the few acquired on days with an hour or so of clear sky. Fortunately solar activity was low with active areas mainly in the southern hemisphere. Examining the SOHO images during first week it showed an average of six sunspots with assigned numbers **AR 1907** to **AR 1913** none even Earth sized. *See cropped SDO/MDI image below.*



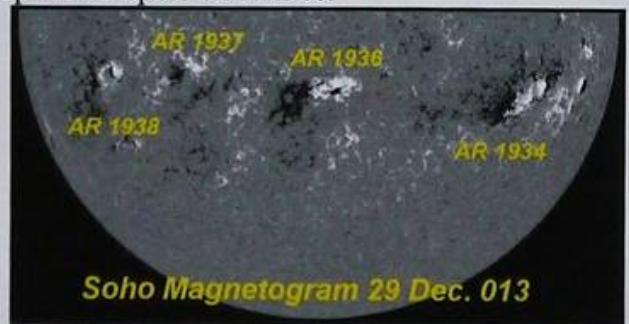
In the second week the disk numbers rose to **nine** with new AA's numbered up to **AR 1925**. The few ‘bright periods’ were too short to set up imaging equipment and with gale force winds no imaging took place. Early in the third week this group neared the west limb with new active areas **AR 1927** and **AR 1928** present. *See SOHO image for 17 Dec. below.*



Over the next few days the daily total sunspot number remained at nine, with the assigned sunspots number reaching **AR 1934**, hidden from view (of course) by rain, gales and even a snow shower. The SOHO image below for **21 Dec.** shows a line of active areas just below the solar equator.

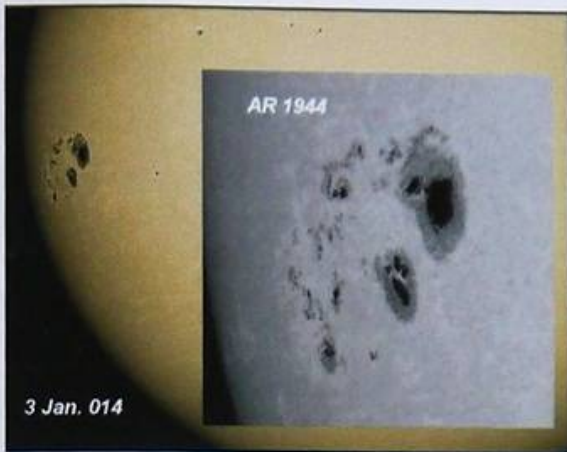


Three of the sunspots, **AR 1928**, **AR 1931** and **AR 1934** were **X2** Earth sized. This line of active areas moved to the W. limb while Ulster experienced cloudy wet weather. Surprisingly on one or two days the cloud cleared by 15.00hrs. however the Sun was too low to image! New sunspots, assigned **AR 1936**, **AR 1937** and **AR 1938** joined the ‘line’ at the E. limb. The SOHO magnetogram for **Dec. 29** (*see below*) shows the activity below the solar equator. **AR 1942** and **AR 1943** joined this ‘line-up’ of sunspots on **31 Dec.**

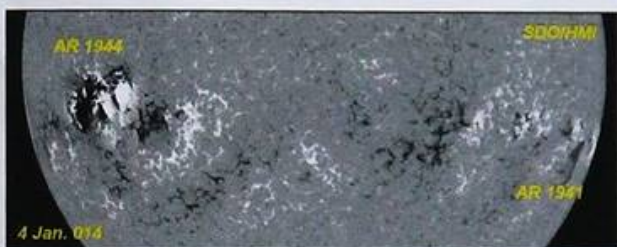


The weather during the last week of December continued the trend of leaden skies and rain. The month having **85%** cloudy/wet days.

The first two days of **January 2014** were clouded out – not a good start! However on **3 Jan.** there was a ‘bright period’ lasting about 30 minutes allowing some quick imaging in white light. Surprise, a new and large active area had already arrived at the E. limb. *See image below.*



The next two days reverted to cloud and drizzle so a magnetogram was downloaded from SOHO showing AR 1944.

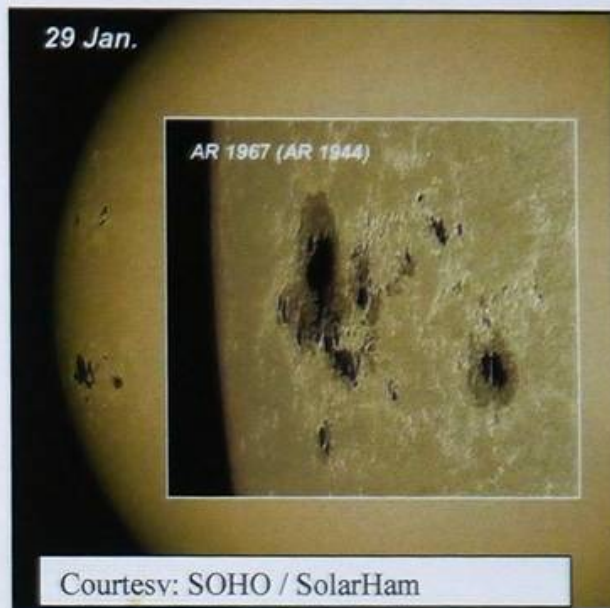


On **5 Feb.** there was a brief 'window' to image the solar disk in CaK using a PST. The resulting image appears as the title. New sunspots on the solar disk during the next week of dull, frosty days were AR 1945 to AR 1952. Unfortunately this weather regime continued for yet another week. The monster sunspot some 200,000 km. in length exited the W. limb on 14 Jan. Dull, wet weather continued so by reference to SOHO the numbered sunspots present were found to have reached **AR 1959** and **AR 1960** – both **X2 Earth** in size. See image below for **20 Jan.** (A sunny, clear day!)



The next week had a variety of weather, bright days, other days foggy with rain and strong winds. Sunspots **AR 1963**, **AR 1965** and **AR 1966** were present on the disk. The long awaited possible **return** of **AR 1944** was resolved on **28 Jan.** by the presence of the AA at the E. limb, now re-assigned as **AR 1967**. Dull, wet weather made any

possibility of imaging impossible so recourse to Internet sites produced the image below.

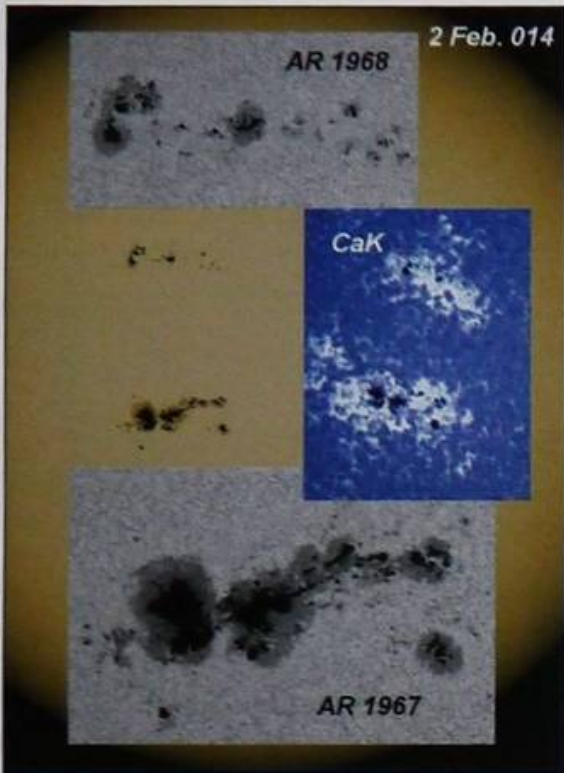


The sunspot was still very active, producing a M-class flare every two hours. Brief clear skies by 1300hrs. allowed a chance to do some imaging on **31 Jan.** See below.

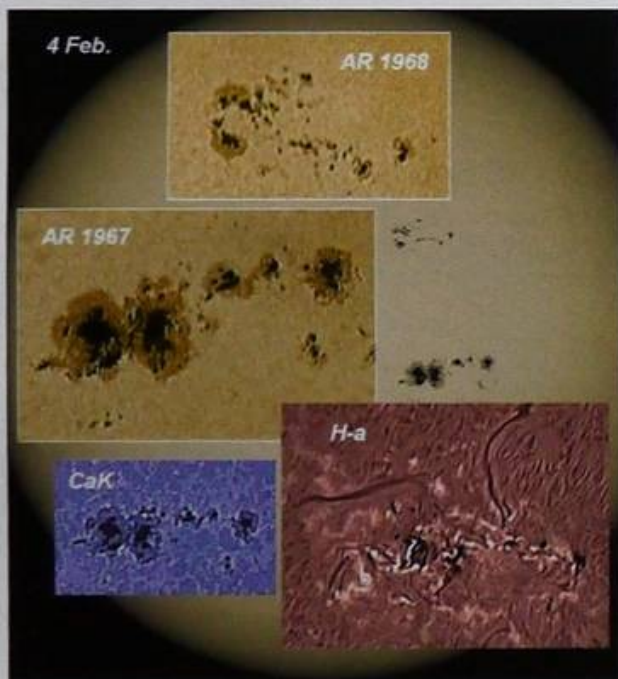


January was a repetition of the previous month with **85%** clouded out by rain. Meteorologists were already hinting that the winter so far was the wettest on record. Comments by astronomers are un-printable! Hopefully next month would not live up to the saying "**February Fill Dyke**".

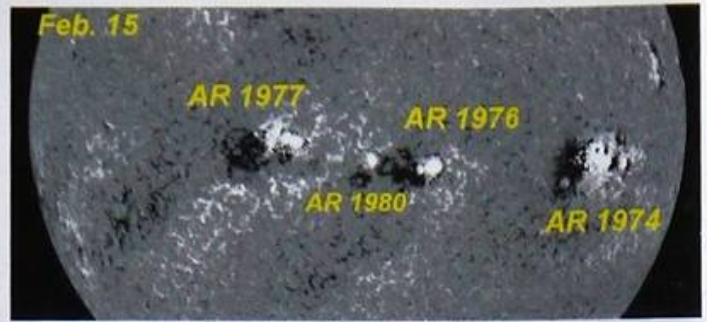
However **Feb. 1** had rain and a gale in progress! Surprisingly, the next day was clear until 1300hrs. The image below shows AR 1967 (aka. AR 1944) on a second transit.



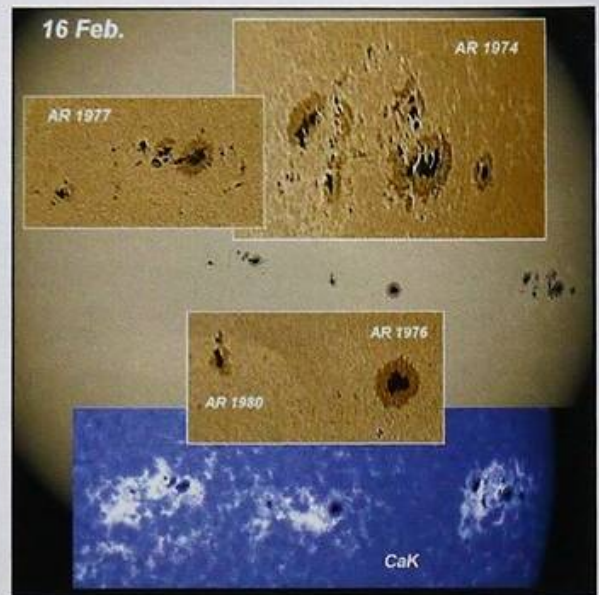
Next day the weather reverted to a gale and rain but on **4 Feb.** there were clear periods until 1400hrs. Active area AR 1967 was almost mid-disk and appeared to harbour several flares in progress. See montage below.



In return for the imaging success of the past week, the next week or so reverted to cloudy and wet weather conditions. By reference to SOHO images on **Feb. 9** found AR 1967 about to leave the W. limb. Would it return intact at the end of the month for a third transit? By **15 Feb** sunspots AR 1973 – AR 1980 were present 'strung out' along the solar equator. The SOHO magnetogram (*below*) shows the strong activity of these sunspots.



Dull, cloudy days persisted for the next week interspersed with 'bright intervals' (as described by weather forecasters but useless for imaging). One such interval on **16 Feb.** allowed imaging at 1200hrs. until 1300hrs. See image below

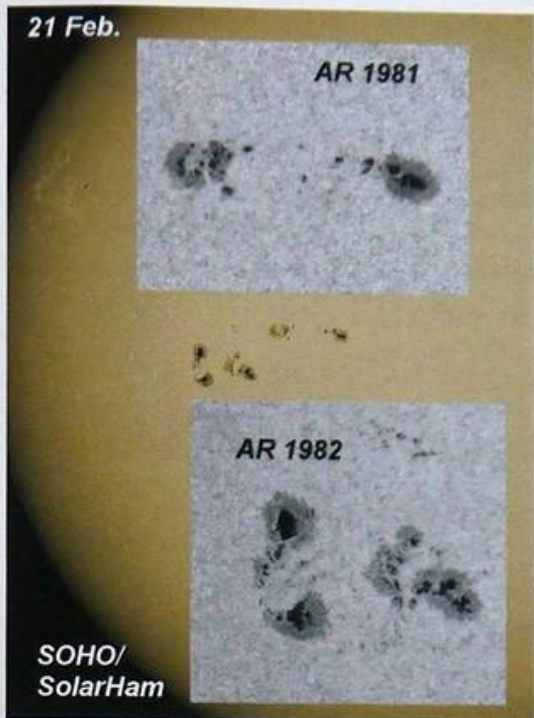


Three new sunspots arrived at the E. limb on **17 Feb.** assigned AR 1981, AR 1982 and AR 1984.

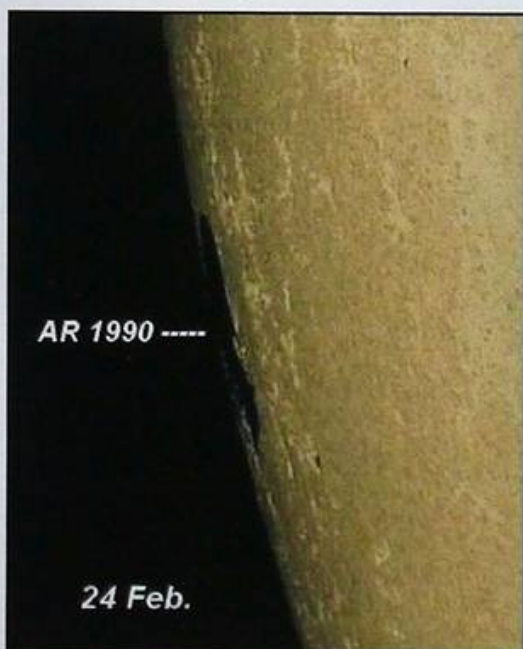


Mediocre weather persisted for the next few days with dull skies, 'bright periods', gales and rain; so no imaging!

Seeking some solar images for the Readers, recourse was made to Internet sources. So this was the solar disk on **21 Feb.** See image below.



SOHO coronagraphs detected major activity behind the SE limb. Was this AR 1967 returning for a **third transit**? On 24 Feb. 'the old friend' appeared at the limb edge. See below.



Now assigned **AR 1990** it soon announced its presence, firing off a powerful **X4.9** flare in the early hours of **25 Feb.**- the most powerful this solar cycle. The SOHO image (below) for **25 Feb.** shows that the sunspot has become less complicated in structure but is still capable of releasing 'pent up' magnetic energy. Should this happen when in mid-disk, depending on the type of discharge, satellite communications will suffer.

The Author now requests that the Reader refer to the '**Sunspot Extra**' section in Issue 4, Oct. to Dec. with a chart plotting the International Sunspot Numbers against time showing six solar cycles. After the last five, the descending plot (red) indicated that the excess sunspots were in the S. hemisphere. This is caused by a 'flip over' of the magnetic poles, an event thought to happen at every cycle. The current sunspot distribution (**Feb. 28**) shows that four of the ten sunspots are in the N. hemisphere. Perhaps an indicator that Cycle 24 is slowly ending? Another chart with a series of plots **black** to **blue** shows the International Sunspot Number (R) plotted against Yearly Means, 1700 till the present. It would require several pages to show the methods used to *calculate* the sunspot number using the Wolf Equation, used by world wide solar observatories like the Royal Observatory of Belgium with input from NOAA and Boulder Colorado. However some sunspots have no outer penumbra and the umbra core is very 'small' - these are called solar **pores**. The monthly (or yearly) tally of these is then added to the tally of 'normal' sunspots, elevating the number.

Rather confusing? If left to the Author, a method would be to subtract an assigned sunspot number e.g. AR 1969 from AR 1993 giving 24 (the current number for this **February**). December was 36, January 24. Do this over 12 months or more and a Solar Cycle plot can be drawn. The peak of our current **Cycle 24** is so low that it is close to the maxima of Cycle 5 and 6 around 1800. It is to be hoped that the sunspot numbers between the Cycle 24 and Cycle 25 do not repeat a Dalton or Maunder minimum. The Solar Diary will then perhaps consist of just one side and few images!

## *Stargazing Live 2014 – a personal perspective*

Paul Evans, IAA President

We started talking to the production team in BBC Northern Ireland about Stargazing Live some months before the event itself. Initially it wasn't clear whether it would be going ahead here as the production team in Salford – BBC North as it's called – had decided to cut down the number of centres involved in the programme – as before it would be centred on Jodrell Bank. However, much of the attraction of Stargazing Live, particularly for us in the IAA, has always been the supporting events, probably more so than the programmes themselves. So fortunately BBC Northern Ireland decided to run their own events as in previous years and enlisted the IAA as their main partners.

One of the first decisions made was the choice of location. Having run the event very successfully at Lough Neagh Discovery Centre (LNDC) for the previous three years it looked like an obvious choice to repeat the formula. However there is always the desire to try something different and, probably following on from the success of the RSPB's Big Wild Sleep Out in August 2013, the team considered the possibility of holding the event at the Ulster Folk and Transport Museum. This was a quite different venue from LNDC. The decision having been made, Terry and myself attended a recce at the site. Having taken part in the RSPB event we knew there were a few things we didn't want to do – mostly Kelly's Coal Shed was a much less than ideal location for the AP Stardome, and fortunately we found the Lagan Room was available for that which was much more satisfactory. Up the hill was a church with a large tarmac area outside and this would be a good area for setting up scopes, though the southerly view wasn't terrific. There would be a good view upwards and to the north however and we felt this would work well. A lot depended on the date of the event of course, and Thursday 9<sup>th</sup> January was looking like the favourite. In astronomical terms

this could hardly have been better with Jupiter and its moons being high up in Gemini, and our Moon being just past First Quarter so high up in the sky from the start of the event, set for 5pm. Traditionally we have organised events for all three evenings of Stargazing Live and this year was to be no exception. Having established the

date for the main event we gave some consideration to holding a Moon and Jupiter Watch outside QUB on the same night as our scheduled lecture meeting. Unlike the previous two years, Jupiter would be less favourably placed, only making an appearance later in the evening as it climbed over the roof of the Lanyon Building, but the Moon would be perfectly placed. When we thought through the practicalities we decided that combining that event with our lecture meeting wouldn't work in practice, so we scheduled the Watch for the Tuesday evening. With our lecture, to be delivered by QUB's excellent Dr Stuart Sim, arranged for the Wednesday evening we had a full three nights of entertainment lined up!

The BBC team had been working away and had put together a breath taking range of activities involving the full range of people including W5, QUB Astrophysics Research Centre, Armagh Planetarium and Observatory, Mid-Ulster Amateur Radio Club and many others. So, the time came, and our first event was the Moon and Jupiter Watch with the QUB Astronomers. Just a small problem for me – I was working the early shift at the BBC so I was up at 4am. I managed to go home for a sleep in the afternoon and returned to Belfast for the evening activities. This was to be the pattern for the next three days!



*Thin cloud, but not a showstopper. (Paul Evans)*

Setting up outside Queens' we were a little discouraged by the sky. There was a fair bit of cloud and although the Moon was visible, the views weren't great. However the queues started to form at the 'scopes and with occasional pauses to allow the thicker clouds to pass we managed to show members of the public some adequate and occasionally good views of our closest celestial neighbour. We soon realised that for many this was the first time they had seen anything through a telescope and that actually a bit of cloud doesn't make the Moon look any less impressive. Later in



the evening Jupiter rose above Queens' and those who stayed enjoyed good views. It was estimated that over the course of the evening some 500-600 people got a view through the 'scopes, so that counts as a success.



*Queues at the 'scopes. (Image: Prof Alan Fitzsimmons)*

Wednesday's lecture event was routine by comparison, though as excellent as ever, but it was Thursday that was now the focus of our efforts. Not only was the weather looking promising, but another event was raising considerable interest. A particularly large sunspot had appeared on the face of the Sun, the largest of Solar Cycle 24 so far in fact. And on the Tuesday it was pointed directly at Earth. And as luck would have it, at just the right time Active Region 1944 let go with an X1.2 flare sending a Coronal Mass Ejection towards Earth, to arrive sometime around Thursday afternoon! This was looking really exciting. Our BBC colleagues were informed and this provided just a bit of extra interest for the News outlets, resulting in QUB's Ryan Milligan being interviewed on Evening Extra and me getting a prime time spot on Good Morning Ulster, so there went my one lie in of the week! As we arrived at Cultra during the afternoon the sky was looking very promising indeed, with the forecast giving us clarity until late evening and the 8 day old Moon rising in the East.

We set about setting up 'scopes, setting up the Stardome and our other exhibitions as others set their up too, and then, from 5pm onwards, we waited for the public to arrive. And arrive they did, slowly at first, but then the trickle became a torrent. By this time I had delivered the first session in the Stardome and had to leave Andy and Brian to deliver the remaining five shows between them. I was required for Star Walk duties and the BBC had provided me with a number of iPads running Sky Safari for this purpose. However we quickly realised that whilst these would have been a great backup if the sky had been cloudy, the fact that we had a pristine sky above us rendered them

unnecessary at this stage, so, armed with only a green laser and my voice I set about guiding the gathered few around the night sky. We started with finding The Plough and testing the keenness of eyesight by splitting Mizar and Alcor, then of course finding North and taking it from there. Orion was rising nicely in the East, and of course Jupiter was beautiful in Gemini and although the Seven Sisters were quite near the Moon, we were still able to have a counting competition! One problem arose – it was envisaged that I would take 10 or 20 people in each session, but there were now about 100 people standing around me and only those closest could hear me! Word got back to the BBC crew and I was issued with a microphone and "boom box" for future Walks and that helped enormously.



*Terry Moseley on BBC Newline (Image: Paul Evans)*

The BBC media interest came two different ways – the BBC Newline crew were doing a live inject into the News via satellite. Our own Terry Moseley was interviewed by reporter Julie McCullough, then after the News BBC Radio Ulster presented a two hour extravaganza presented by Anne-Marie McAleese which included interviews with many astronomers from the local community along with space inspired music and Vox Pops from those being amazed by the views through the 'scopes.



*Prof Stephen Smartt being interviewed by Anne-Marie McAleese on "Starry, Starry Night" (Image: Paul Evans)*

## *China Lands Chang'e 3 and 'Jade Rabbit' Rover on Moon*

China landed an unmanned spacecraft on the moon on Saturday 14<sup>th</sup> December 2013, in the first such "soft-landing" since 1976, joining the United States and the former Soviet Union in managing to accomplish such a feat. The Chang'e 3, a probe named after a lunar goddess in traditional Chinese mythology, is carrying the solar-powered Yutu, or Jade Rabbit buggy, which will dig and conduct geological surveys. China has been increasingly ambitious in developing its space programs, for military, commercial and scientific purposes. It has moved in lock step with its emergence as a major global economic and political power. China's Xinhua news agency said, "*The dream for lunar exploration once again lights up the China Dream*".



In its most recent manned space mission in June, three astronauts spent 15 days in orbit and docked with an experimental space laboratory, part of Beijing's quest to build a working space station by 2020. The official Xinhua news service reported that the spacecraft had touched down in the Sinus Iridum, or the Bay of Rainbows, after hovering over the surface for several minutes seeking an appropriate place to land. A soft landing does not damage the craft and the equipment it carries. In 2007, China put another lunar probe in orbit around the moon, which then executed a controlled crash on to its surface. China Central Television (CCTV) broadcast images of the probe's location along with a computer generated image of the probe on the surface of the moon on its website. The probe and the rover are expected to photograph each other during the initial phase of the rover mission. The Bay of Rainbows was selected because it has yet to be studied, has ample sunlight and is convenient for remote



*The 'scopes outside (Image: Paul Evans)*



*SGL looking from the Lanyon building (Image: Professor Alan Fitzsimmons).*

By this time we were getting a handle on the numbers attending and they were astonishing! Altogether the event was attended by over 4,100 people, a fantastic turnout! Indeed in some ways it was too many.



*Tony and family with Childrens' table and VR demo – very popular! (Paul Evans)*

We heard stories of those who had to give up trying to get parked as all the overflows were full, and we knew ourselves that we could have done with more 'scopes as the queues were upwards of 20mins long, so all lessons learned for next year, and we're all very hopeful that we will be doing it again next year. We were so busy I didn't even get a chance to see most of the exhibits – maybe more time next year! **Paul Evans**

communications with Earth, Xinhua said. The rover will be remotely controlled by Chinese control centres with support from a network of tracking and transmission stations around the world operated by the European Space Agency (ESA). The moon landing will be seen as a demonstration of China's ability to engage in sophisticated space operations with dual use potential. China is also developing its own satellite system to rival the U.S. GPS system and has sold satellites to other countries. The landing will also be a point of national pride in the country, which is undergoing difficult economic transitions. Less than five days after leaving Earth atop a blazing Long March launcher, China's Chang'e 3 spacecraft reached lunar orbit on Friday, December 6th, to prepare for an historic rocket-assisted touchdown in the moon's Bay of Rainbows. Outfitted with a six-wheeled robotic rover and smart navigation control to avoid hazards in the landing zone, Chang'e 3 is China's boldest unmanned space mission to date, extending feats achieved by a pair of lunar orbiters launched in 2007 and 2010. The four-legged lander fired its propulsion system for six minutes and braked into orbit around the moon at 0953 GMT (4:53 a.m. EST) Friday 13<sup>th</sup> December.

The mission lifted off on December 1st on a Long March 3B rocket, which put the probe on a direct four-and-a-half day trajectory from Earth to the moon. The lander has terrain recognition sensors to feed information into the probe's guidance computer, ensuring the spacecraft does not come down on a steep slope or in a boulder field. A few feet above the moon, the lander autonomously cut off its engine and dropped to the surface. Engineers fastened shock absorbers to the landing legs to cushion the impact. Named Yutu or "jade rabbit," the mission's rover drove off the landing platform a few hours after landing, according to ESA officials. The rover has a mass of 140 kilograms, or about 308 pounds, and carries radioisotope heater units to keep the spacecraft warm during the two week-long lunar nights. The heaters are likely powered by small quantities of plutonium-238, the isotope of plutonium preferred for space missions, according to respected space researcher Dwayne Day, who discussed the rover's heaters in a story published in the Space Review. The Yutu rover carries advanced radars to study the structure of the lunar crust at shallow depths along its path, and it is outfitted with spectrometers to detect the elements making up the moon's soil and rocks, said Pei Zhaoyu, a spokesperson for the Chang'e 3 mission, in a report by Xinhua. Four

navigation and panoramic cameras are mounted on the rover to return high-resolution images from the moon. The mission also has an optical telescope for astronomical observations from the lunar surface, according to Pei. China's lunar program is focused on robotic missions for now, with plans for an unmanned mission to return rock samples to Earth by 2020. China's military-run human space program is focused on development of a space station in Earth orbit around the same timeframe, but scientists have studied a manned lunar mission in the next decade. Chang'e 3 will be China's first mission to test the technologies required for future lunar surface exploration.

**Book Review – “A Starry Story”**  
“The Star of Bethlehem” by David Collins, Amberley Publishing 2012, 192pp. (Reviewed by Derek Heatly, IAA Member)

Anyone familiar with the “Festival of Nine Lessons and Carols” performed each December – not to mention Armagh Planetarium’s annual “Star of Bethlehem” Star Show, will know of St. Matthew’s account of this stellar apparition. Its enigmatic appearance has already been investigated by Sir Patrick Moore (“The Star of Bethlehem”, 2001) and David Hughes (“The Star of Bethlehem Mystery, 1979), but never as exhaustively as this six year long labour of love by our IAA council member, David Collins. He covers just about every possible explanation of what the star could have been – apart from a UFO or a supernatural visitation – to the believer, the last description will always be the correct one.

The author shows that “Matthew” – the unknown author of this Gospel, writes the account – not mentioned in any other Gospel – c. 75 A.D. to bolster up Christianity, which at that time was one of several competing religions around the Mediterranean. David examines such diverse explanations as a comet, planetary conjunctions and bright meteorite falls – the latter may have attracted the Magi’s attention. They seem to have been amongst the few who actually noticed the star. David thinks that the Magi may symbolise the Gentiles who will accept the Messiah or “The Light”, while Herod and his Jewish advisors remain in “darkness”. An excellent review of the options and great read - If you like this book, give it your rating on Amazon.

**I completely agree with Derek – and David’s book has received great reviews elsewhere – Ed.**

## *A Dome in Your Back Garden?* *Lawrence Hanna – IAA*

Peter Martin in the April to June Stardust 2012 article justified the purchase of his dome on the basis of climate change. My justification - I joined the IAA and during my attendance at IAA lecture nights I caught the dreaded "Astronomy Virus". So you see, it's your fault! It all started with the telescopes then progressed to the drives, quickly followed by purchase of a DSLR (a deadly symptom) and finally the onslaught of *Dome Fever*. My main defence is "well other people have hobbies when they retire so mine is Astronomy". This worries my wife as I am only actually semi-retired so she thinks when I actually retire I may go for the whole hog and start chasing solar eclipses or auroras? (For those just starting astronomy these are not women).



Well so much for my domestic situation why indeed did I go for a dome? Photograph 1 shows my back garden. In the direction of the roof of my house and garage I am looking South wards, actually SSW. I live about two miles from the Belfast city centre and light pollution is all around me. I needed a solution that would give me some shelter from the elements and also some shelter from the worst of the light pollution. The front garden was out of the question as there is a street lamp outside my next door neighbour's driveway and security could be an issue. However adjacent to the garage did give a degree of protection from the glare of the street lights from the front of the house. This is the area where I usually assemble my 9.25" SCT on a CGEM drive, night after night (stage 2 of the virus). The final position was a trade-off between the best sky views and the shade the garage provided from the street lights. There is

a school behind the house but they turn off the lighting about 22:30 during the week and usually all of the week-end. During this time I can view quite successfully the Eastern sky and a portion of the Southern sky above the house line. Looking to the West and North is not as good as I am looking out over Belfast and the light pollution is bad though not prohibitive. I did cost out a garage conversion and a roll off shed but due to space limitations and costs I decided on a 2.2 metre Pulsar dome.



I ordered the 2.2 metre Pulsar Dome through Andy McCrea, the proprietor of North Down Telescopes and the editor of Stardust. I looked at several pillars from different manufacturers and decided on the Altair Skyshed 8" Observatory Pier complete with mounting plate and CGEM adaptor. This was duly placed on order with Andy's help. One of the reasons I went for the Altair pier was the ease you could polar align after installation. The SkyShed pier mounting plate can be adjusted in tilt and 360 degree rotation after the installation and tightening down of the pier base bolts. I will return to this later. Photograph 2 shows the excavation for the concrete base including some of the base hardcore and the shuttering. You will notice the deeper excavation in the centre for the pier. I decided to elevate the base somewhat to gain a few extra inches to improve my view of the southern sky. Every little bit helps when you have a house and garage in the way. Photograph 2 shows the base after pouring.



You will also notice the two conduits, one for power and one for the pillar supplies and future communications. If I was doing this again I would add in another conduit specifically for communications. The electrical supplies were fed from a separate board in the garage through their own circuit breakers (another expense). Now all I needed was the pier and dome. Although both the pier and dome had been ordered at different times and from different suppliers they both arrived on the same day, what were the odds on that happening? Taking delivery of the pier was a simple matter, however the dome was a different story. It took me, the driver and my son to manhandle the pallet off the delivery vehicle and up the driveway into the garage. The driver had a pallet truck and without that it would not have been possible. Photograph 4 shows the delivered dome on the pallet within the garage. You can see it just about fitted through the 2.13 metre wide up and over door (7 foot in old money). If you go down the route of installing a dome consider how you will take delivery and transport it to your destination. You can of course remove the elements from the packaging and carry them to your destination one by one, they are not heavy individually, but you do need to plan the delivery process.



With the concrete base assembled and cured, the next step was to assemble the dome on the base, position the pier in the centre and bolt everything down. I had a lot of help from a builder and without him it would not have happened as quickly as it did. I do not possess the tools and without the appropriate tools at hand the job could prove very time consuming and tedious. The hemispherical top (dome) needed some careful shimming to ensure the six assembled wheels stayed on the guide rail when the dome rotated. Thankfully it all came together just before Christmas 2012. As my wife remarked, - "to Lawrence from Lawrence". Photograph 5 shows the recently constructed dome sitting on the base. As a matter of interest the

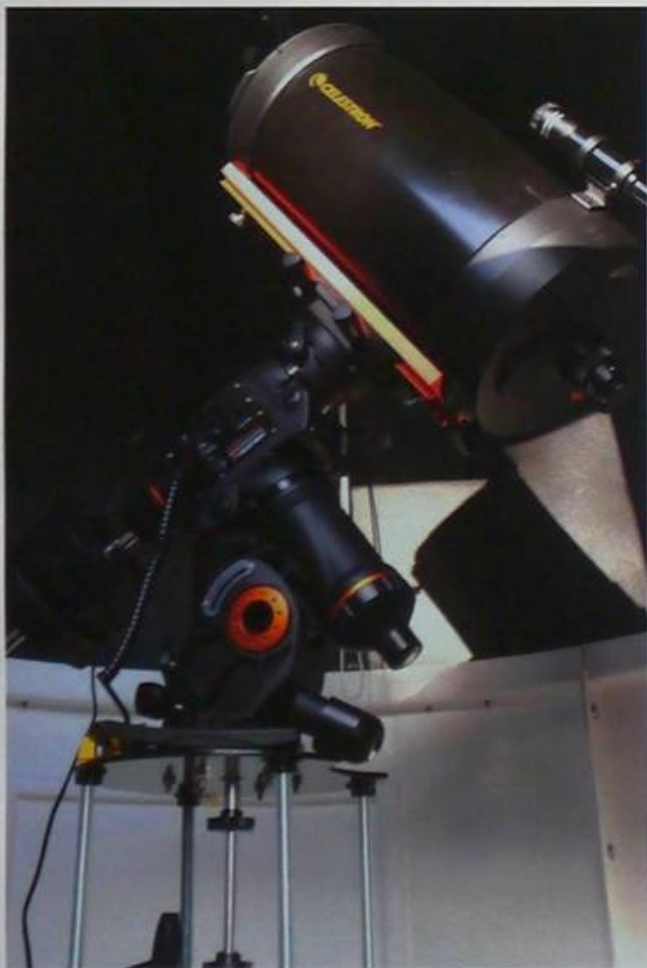
neighbours were suitably impressed. Several have been in to visit and view and many more have expressed an interest. One teenager even apparently thought the Dome was "cool". This was wholly unexpected.



I will now return to the issue of the pier I discussed earlier. Photograph 6 shows the pier top plate complete with the 16mm support bolts. I found that the whole assembly sat a mite low for my SCT. No worries, I purchased several lengths of 16mm studding and cut them somewhat longer to give me further adjustment for height. This works well although it may look a bit delicate in photograph 8; however remember this is substantial 16mm studding. There are also four 16 mm horizontal bolts that secure the top plate to the pier and this facilitates the initial polar alignment. The top plate can be rotated through 360 degrees and secured in any position with the four bolts. I had no difficulties aligning the mount using these bolts and the pier is solid as the proverbial rock once they were locked down. I did have a few difficulties with water ingress into the dome however the builder was able to seal the vast majority of the initial leaks and I managed to eliminate the remaining few with Tec7. It even claims to work under water and I would believe it. I did notice some residual dampness at the internal edges of the dome but after numerous attempts at further sealing I realised that the problem was not water ingress but internal condensation. The remedy - installing a small dehumidifier on a timer and hey presto it vanished. Peter Martin did advise me about this issue earlier when I visited his dome. Photograph 7 shows the lighting inside the dome (one white and one red bulkhead) and the two power sockets. Picture 8 shows the power supply to the pier - 8 sockets and I hope that is enough! You can also see the assembled pier, pier top plate and CGEM drive. OK I know what you are thinking, look he did not even cut the last bolt to length. Too right I didn't, after sawing three of the

four 16mm studding to length my arms give up.....literally, I still recall the pain and the numbness and I was way past caring about the aesthetics at that point. Photograph 9 shows the 9.25" SCT finally mounted on the drive.

Since then I have, of course, purchased a camera (stage 3 of the virus), modified it (stage 3.1) and mounted a 3" refractor in parallel with the SCT on a parallel mounting plate (stage 2).....but that is a whole different story. The budding medics among you will realise that in the progression of the virus it can unexpectedly jump stages and then regress, with devastating and somewhat expensive consequences. Photograph 10 shows this more recent set up. You will also notice the complete interior of the dome has now been painted black. The concrete floor has also been covered with rubber based under-felt and covered with York Fitness floor guard. Thanks for the tip Peter, it works a treat. The tootsies are now warm as toast.....well nearly.



Was it all worth it? The dome is not a cheap option. There is the cost of the dome and pier initially and there is also the cost of the excavation, the base and the electrical work to consider. Of course the more you can do yourself then this will reduce the outlay. I know my answer to this

question. For me it is a resounding yes. To be able to view the glorious sights of the Milky Way, the Orion Nebula, Jupiter, Saturn, numerous galaxies, double stars, planetary nebula, and much, much more within the relative shelter of a dome in your back yard is priceless. If it rains or clouds arrive just pull down the shutter, go indoors and have a cuppa. Then when it passes, out you go again to enjoy the rest of the night. Not just priceless, absolutely priceless. And of course if you tire of the visual views there is always astro-photography. But now we are talking of severe viral runaway with no known cure and bacterial complications.



I would like to thank Andy for all the practical help and support, Peter Martin for allowing me to view his dome and for the advice, Ron and Linda Patterson for allowing me to view their observatory and their advice and Barry Loane for visiting the dome and giving much needed advice and support. And finally if anyone wishes to view the dome I would be happy to oblige. But be warned. The virus is contagious....

*Lawrence Hanna, Belfast*

*The IAA would like to welcome the following new and re-joining members;*

<b>W.J. Whitcroft</b>	<b>Mark Hind</b>
<b>Nicholas Stewart</b>	<b>Mary Hamill</b>
<b>Adam Leech</b>	<b>A.H.M. Sinclair</b>
<b>William Williams</b>	<b>Andrew Rawding</b>
<b>Declan Green &amp; family</b>	
<b>Alex McGarel</b>	<b>Brenda Daly</b>
<b>Robert Chapman &amp; family</b>	
<b>Paul Gardner</b>	
<b>Dr. Jack Smith</b>	<b>Claire Samways</b>

Peter Martin has been imaging some of the spectacular objects from the winter sky below. The clear skies of County Fermanagh, Peter's skill and top class equipment have allowed Peter to capture the subtle detail of some of the deep sky's most beautiful nebulae and gas clouds.



This shot of **Melotte 15** open cluster was taken under pretty tough conditions the Ha was very windy but good visibility and 7 degrees, the OIII was taken through mist and high cloud 6 degrees, both had 1/2 to 3/4 moon interference. Melotte 15 is embedded within a central portion of the much larger glowing nebula identified as IC 1805 Heart Nebula. The nebula's intense red output and its configuration are driven by the radiation emanating from a small group of stars near the nebula's centre.

Date of shoot: 16/12/13 , 8/1/14 ,10/1/14  
 Ha: 10 subs at 900s 1\*1  
 OIII:13 subs at 900s 1\*1  
 RGB: 4 subs of 60s 2\*2 each, for stars  
 Camera Starlight Express SXVR-H694  
 Sample Rate 0.98 asp at 1\*1 , 1.97 asp at 2\*2  
 Filter Wheel : Starlight Express Mini Wheel  
 Mount : Avalon fast Linear  
 Scope: Orion Optics UK AG10  
 Filters : Astrodon LRGB, Ha 5nm, OIII 3nm.



#### NGC896

Date of shoot: 13/12/13 16/12/13 9/12/13

Ha: 16 subs at 900s 1\*1

OIII: 12 subs at 900s 1\*1

RGB: 8 subs at 60s each channel

Camera Starlight Express SXVR-H694

Sample Rate 0.98 asp at 1\*1 , 1.97 asp at 2\*2

Filter Wheel : Starlight Express Mini Wheel

Mount : Avalon fast Linear

Scope: Orion Optics UK AG10

Filters : Astrodon LRGB, Ha 5nm, OIII 3nm

**The Heart Nebula, IC 1805, Sh2-190**, lies some 7500 light years away from Earth and is located in the Perseus Arm of the Galaxy in the constellation Cassiopeia. This is an emission nebula showing glowing gas and darker dust lanes. The nebula is formed by plasma of ionized hydrogen and free electrons.

The very brightest part of this nebula (the knot at the right) is separately classified as NGC 896, because it was the first part of this nebula to be discovered.

Ha, OIII and RGB stars



#### IC410

Bi colour with sync green

Date of shoot: 17/10/13 4/12/13

Ha: 13 subs at 900s 1\*1

OIII: 12 subs at 900s 1\*1

Camera Starlight Express SXVR-H694

Sample Rate 0.98 asp at 1\*1 , 1.97 asp at 2\*2

Filter Wheel : Starlight Express Mini Wheel

Mount : Avalon fast Linear

Scope: Orion Optics UK AG10

Filters : Astrodon LRGB, Ha 5nm, OIII 3nm

IC410 is home to a pair of intriguing structures popularly known as the "**tadpoles**." These are clumps of gas and dust left over from the formation of the cluster, and are likely forming yet new stars within them. The tails of the tadpoles are caused by the radiation pressure and solar wind from the stars of NGC 1893; note how they point away from the star cluster.