CYGNUS

Newsletter of the Norwich Astronomical Society

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COVER

The image of Comet Lovejoy is by Shaun Reynolds.

More of Shaun's images appear in the Bonus Pages of the electronic version of Cygnus.

DISCLAIMER

Cygnus is a quarterly publication produced by and for members of the Norwich Astronomical Society.

Opinions expressed in Cygnus are those of the contributors only and do not necessarily reflect those of the Society.

CHAIRMAN'S REPORT

Once more the AGM has been and gone. I'll paraphrase what happened for those who couldn't attend.

NAS is in a reasonable state, membership is slightly down but healthy and finances are about where we expected considering the upheaval of changing year-end. The site is OK and our reputation in the local area is good. We had some great public events, no real failures and all have been well received by those who attended. Thanks to all who help in any way, shape or form, either with events or around the site. Dave Provan, Yet Wha Lam and Paul Woolley were confirmed as committee members - more volunteers would be welcome! Our attempt to get local Dark Sky Status has been put on hold for now as, we agreed with the organisers of the scheme, that fulfilling the requirements naturally excluded observatories like ours legitimately gaining the status! That was basically 2014!

At the AGM we agreed to replace the Meade 14" with a new 20" telescope - 'aim high'" we were urged! As this will be a massive investment, I intend to try to raise funds via various charities and donations. If the money is not forthcoming then we may have to opt for something smaller in the short-term and make fund-raising and replacement with a 20" the longer-term goal. If members have contacts who may like to donate towards or could help with this please let me know.

Onto more current matters. We have a new secure storage shed for scopes near the pads. This allows us to store portable scopes close to where they're used. We've now got a nice Meade 8" LX200 electronic scope and should soon have a Skyquest 8" Dob, both very generous donations for which I am most grateful. I'm sure members will find both very useful.

I'm glad to say Mercury, Venus and Mars all made a welcome return to our early evening skies. I'm astounded at how many hardened observers haven't seen Mercury. Just because it isn't dark and you don't need a telescope doesn't mean you shouldn't look up! The Venus and Mars conjunction near the Moon made a great naked eye viewing opportunity over Fairhaven Star Party – another successful collaboration to the benefit of both organisers and volunteers.

That's all for now. Until next time, clear skies!

Andy G

EDITORIAL

Once in a while I wish I could feature a really exciting headline in Cygnus. . I suppose all editors feel like this from time to time. It would be something like, 'NAS MEMBER DISCOVERS SUPERNOVA' or 'ANDREW ROBERTSON CHOSEN AS NEXT ASTRONOMER ROYAL'

But during an observing session in Suffolk last month I realised that we don't need the stunning headlines, because everything about this hobby of ours is truly amazing anyway. I was only using my little grab-and-go 80mm refractor, revisiting a few old favourites, but one can't help feeling a teeny weeny bit humble after a few minutes alone under a star-studded sky and, not for the first time, I was struck by how mind-bogglingly beautiful and exciting were the objects I was observing.

We're very privileged, we amateur astronomers. We never stop being amazed by the things we observe, sketch or image and we regularly touch eternity.

Mind you, being human (a fact some of you may dispute) I still hanker after a stunning headline that would make members sit up and take notice—'NAS MEMBER ABDUCTED BY ALIEN TEDDY BEARS—TELLS OF CLOSE ENCOUNTER OF THE FURRED KIND'. Something like that. If you should be abducted don't fail to let me know.

Wishing you clear skies,

Graham

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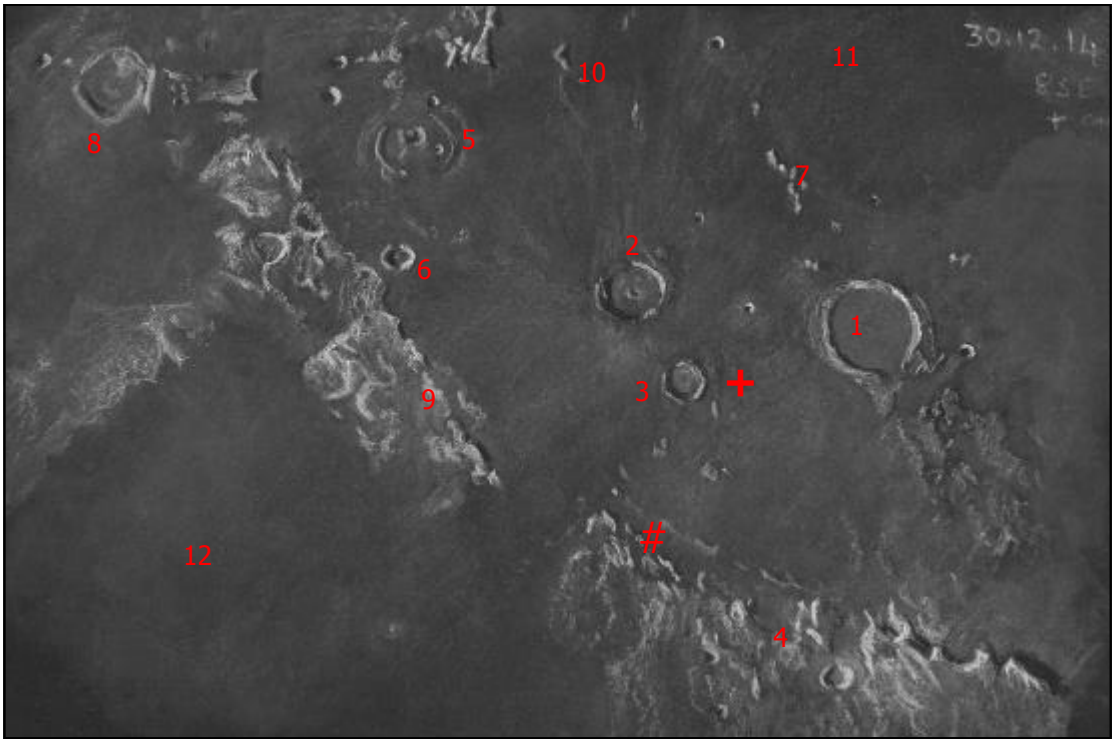
MOONWATCHERS

The 'A' Trio

When I don my walking boots and go for a hike I often head off to follow a favourite route, in an area I'm familiar with; likewise when I point one of my scopes at the Moon, my eye is invariably drawn to one of a number of favourite areas of the lunar surface.

One such area is the eastern section of the Mare Imbrium, where three prominent craters draw the eye. In my early days of observing the Moon these three used to bug me! The reason was that I could not remember their names; well, that's not strictly true, I knew that one was Archimedes and that the other two also began with an 'A' but I always had to refer to a map to remind myself that in decreasing order of size, they were Archimedes, Aristillus and Autolycus.



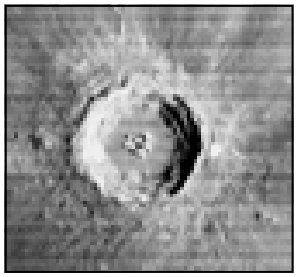
My drawing of the area was made with conte crayon on black paper and shows many other features as well as the 'A Trio'.

1.Archimedes 2.Aristillus 3. Autolycus 4.The Apennines 5.Cassini
6. Theaetetus 7. Spitzbergen Mts. 8. Eudoxus 9. Caucasus Mts
10. Mt. Piton 11. Part of Mare Imbrium 12. Part of Mare Serentatis

+Luna 2 #Apollo 15

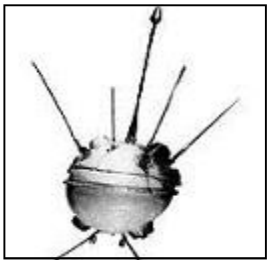
The three lie to the north of the Apennine Mountains, which mark the south-eastern boundary of the Mare Imbrium, a lunar 'sea' that is second only to Oceanus Procellarum in size and was formed by an impact that scoured the land to the south and south-east with ejecta. The basin formed by the impact filled with lava leaving numerous peaks, such as Mount Piton and the Spitzbergen Mountains, protruding through the basalt.

Archimedes, with a diameter of 83 km, is the largest crater on Mare Imbrium and its floor is smooth, having ben flooded by the mare lavas. There are no gaps in its walls, so the lava must have welled up from below, covering the central peak that one would expect to see there. In this respect it is similar to Plato, which lies on the northern edge of the mare. An ejecta blanket, named Montes Archimedes, stretches south-west from Archimedes towards the Apennines.



The 55 km diameter Aristillus has a rougher floor than its neighbour Archimedes, with a complex of peaks at the centre . As can be seen in the Lunar Orbiter image on the right, rays of ejecta spread out from it over the mare, showing the crater to be younger than Archimedes and to have formed after the lava flooding. When the crater is close to the terminator and illuminated by a low Sun it is possible to see the rough ridges and tiny craters caused by its ejecta. At Full Moon the ray system is easily seen.

The smallest of the trio is Autolycus, which measures 39 km across. It too has a ray system, though this is less prominent than that of Aristillus. I remember my excitement, at the tender age of eleven, when I heard the news that the U.S.S.R.'S *Luna 2* had become the first object from Earth to land upon the Moon . Of course this was not a soft-landing and the probe was destroyed as it impacted on the lunar surface somewhere between Autolycus and Aristillus. Coming just under two years after the soviets had launched *Sputnik 1* it seemed to me that the space age had really arrived and that the day when men would land on the Moon could not be far away. And indeed it was only 10 years later that Neil Armstrong took that 'one small step'.



Luna 2

The 4th Apollo landing was not far from here. In July 1971 Apollo 15's LEM, *Falcon,* touched down south of Autolycus at Hadley Rille, but that feature could well have a *Moonwatchers* article all to itself!

As well as this trio of craters there are many interesting features in the Mare Imbrium. Look out for the rather curious flooded crater Cassini and Mons Piton, close to the Montes Alpes, and for rays from Copernicus that spread across the Montes Carpatus and over the mare. It's a fascinating area and one to which I will be returning in future articles.

Graham Sparrow

SUE'S STELLAR SUGGESTIONS

LEO

Throughout the winter we were treated to two special events in the night sky: The comet Lovejoy has been a 'joy' to observe, being so big and bright even in binoculars, and with multiple tails showing in telescopes and in images. Added to this **Jupiter** is especially fascinating to watch this year with the four visible moons performing their dance in line, giving us the rare opportunity to observe multiple transits and the moons passing in front of one another.

Now we can look forward to spring, and for me the first herald of this favoured season is the constellation of **Leo**. Throughout the winter months Jupiter has been moving between Leo and Cancer, the fainter constellation lying to the west of Leo. It will be heading back to Leo, passing below this constellation, during the rest of this year. Watching this giant planet's path, with its retrograde motion, gives a feel of the wandering nature of the planets.

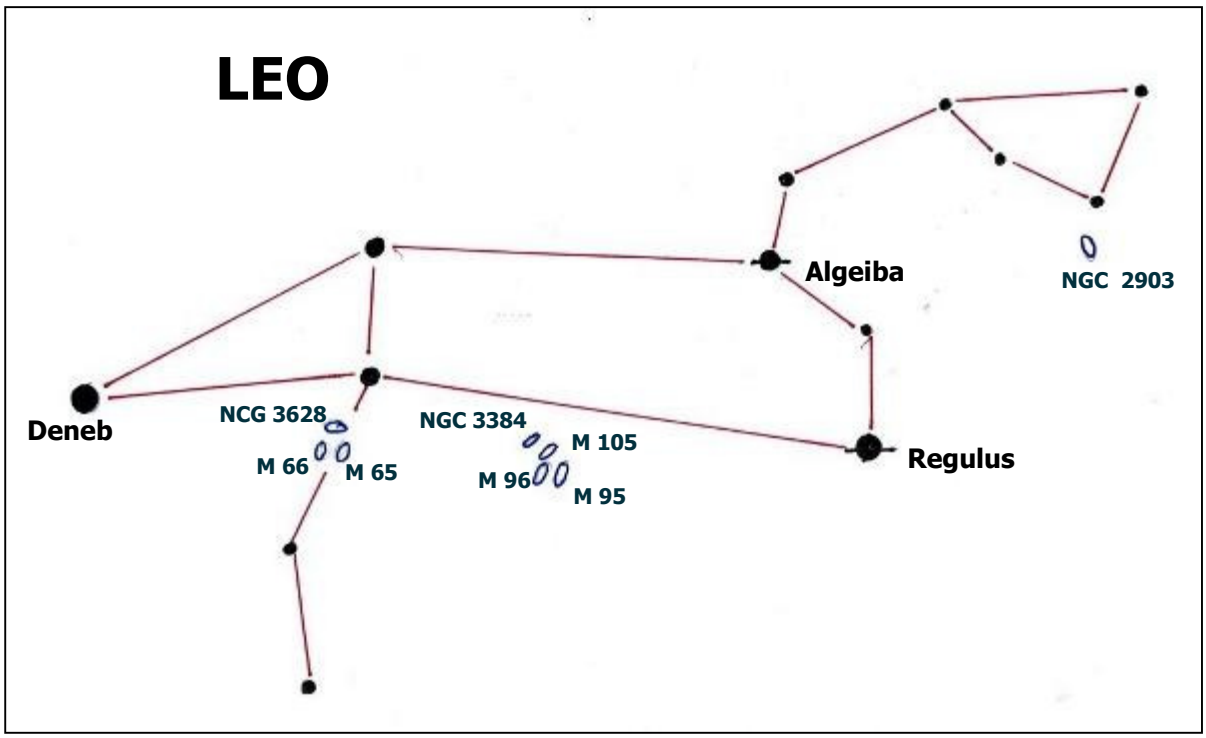
Leo is one constellation which really gives credit to its name, it does look a lot like a lion crouching or lying down facing west, with a magnificent mane forming a sickle or backwards question mark. The lowest star of the sickle is **Regulus**, the brightest, or alpha ,star of the constellation. This star has a smaller, fainter, companion which is just possible to see with a small telescope. The most easterly star of the sickle is **Algieba**, a lovely double star. The two components look yellow, but one is sometimes seen as more orange. It is interesting to compare what you see with other observers and to see if they appear different through different telescopes. The lion's tail is marked by the second brightest star, **Denebola**.

Following the curve of the sickle across the top of Leo's head we can carry on to find **NGC 2903**, a barred spiral galaxy about the same size as our Milky Way. Now we can look for a few more galaxies: On a line from Regulus to Denebola there are two distinct galaxy groups. Firstly, under Leo's belly we come to a group of three, which are fairly bright, **M105**, **M96** and **M95**. The brightest of these is M 96, appearing round with a bright core. M 95 is a barred spiral, looking like a rather faint oval of nebulosity. M 105 can be seen in the same field of view as these two; it is an elongated galaxy, a little fainter than the others. Above these are four fainter galaxies, **NGC 3384**, **NGC 3489**, **NGC 3412** and **NGC 3377**. A larger scope and clear dark skies will help in finding these.

Moving further east along this line towards Denebola we come to the **'Leo Triplet'**. These three are found under the triangle marking the lion's haunches. Here we have two galaxies catalogued by Messier as **M65** and **M66**. Just above these is another which Messier did not mention and which is catalogued as **NGC 3628**.

These are all spiral galaxies. M65 and M66 appear side by side and are bright and easy to see as they are face on. Just above these NGC 3628 appears slightly fainter as it is seen edge on and its light is spread over a larger area. Messier catalogued M65 and M66 when he was following the path of a comet which passed right 'through' them in 1773 and 74. He most likely missed the third galaxy as he was concentrating on the comet.

These are just an introduction to the wonderful springtime collection of galaxies, more of which lie further east of Leo in the constellations of Virgo and Coma Berenices — something more to look forward to in the next few months. Lets hope for some clear skies to enjoy these wonders.



Sue Napper

Another NAS author!

First it was Mark Thompson, now NAS member Malcolm Brown has brought out *Winning Words*, a book that gives invaluable advice to aspiring writers. Go to www.malcolmebrown.co.uk for full details.

NB: Be sure to put in the 'e' between 'malcolm' and 'brown'. Leave it out and Google will take you to another Malcolm Brown who offers to sort out your varicose veins!

Constructing the Hypatia Observatory — Part 2.

Anyone following my account of building this observatory from scratch in the previous issue may remember me saying, 'You will have to wait for the next Cygnus to see how I completed it'. Well I'm afraid I spoke too soon! The project has been considerably slower than I imagined and there's still a fair bit more to do before the finishing line is reached. Well, at least Graham Sparrow will be pleased as this means he will have more copy available for the next issue!
(He is! — Ed.)

1. The next addition to the observatory is the octagonal base where the dome will sit. **See Fig. 1**. This is built from 3/4" plywood on which guides were drawn and then a jig-saw used to cut out the central disc. After that we used a bandsaw to cut off each corner and create an octagon. This was placed on four wooden supporting struts so it rises about 1 1/2" , allowing for the addition of four inclined triangular pieces which ensure rainwater runs away from the observatory.

2. As this observatory is an extension to my shed I've had to modify the existing doorway to become about three quarters of its original height but still function as an entrance to the observatory. To do this the upper third of the door was sawn horizontally, nailed shut and covered in roofing felt. The four inclined triangular corners were then screwed to the observatory frame and also covered in roofing felt. **See Fig. 2**. This leaves a low doorway which keeps out airborne dust and debris from the workshop.

Fig.1. Checking octagon fits

Fig. 2. Adding triangular corners.

3. Once all four triangular corners and supports had been covered with roofing felt the octagonal base was screwed into place. **See Fig. 3**. A bathroom sealant was then put in any visible gaps for extra protection against the elements. I used screws rather than nails for most joinery because in the event of moving house I can dismantle the structure and take to a new location.

4.With the base in place the wheels which enable the upper dome to rotate could be added. I purchased eight wheels for vertical attachment plus eight smaller ones to sit horizontally on 'L'-shaped brackets. These keep the dome in position as it turns. It's important to use reasonably large wheels as there's a significant weight for them to support—smaller ones may jam or even break under the load. It may seem counter-intuitive to have the wheels pointing *up* from the base rather than down from the dome, but this arrangement is better for precise positioning. **See Fig. 4**.

Fig. 3. Octagon in place.

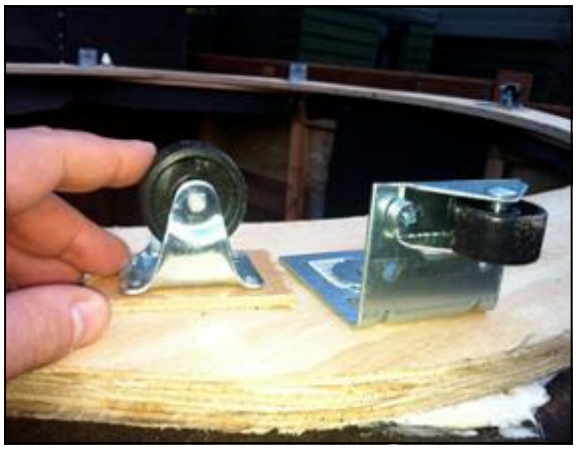


Fig. 4. Fitting wheels.

5. Dome construction can be difficult if you have limited space inside your workshop. Because of this problem I constructed it in two halves which could be screwed together once each section was complete. The hemisphere halves consist of a semi-circular base with a slightly bigger semi-circular section screwed against it at 90 degrees (i.e. one half of the slot that opens to the night sky). There are also three curved 'rafters' holding this section in place, which are needed to attach four pieces of hardboard that create the dome's exterior surface. **See Fig. 5**.

Fig. 5. Semi hemisphere.

Fig.6 Gluing curved rafters.

These pieces were quite hard to cut accurately using a small bandsaw which struggles with 3/4" plywood. (At one point the blade snapped, however I wouldn't advise using thinner plywood because it won't be robust enough to make a sturdy frame). We screwed and also glued these parts for maximum rigidity (**See Fig. 6.**) and then cut out some additional bracing sections for attaching each half of the hemisphere's frame to its counterpart. These were also screwed and glued together and finally clamped to ensure they bonded well, **See Fig. 7.**

Left: Fig. 7. Clamping struts.

Above: Fig. 8. Hardboard cladding.

6. Once the glue had dried, the frame was ready to be clad in hardboard sections. There were eight triangular pieces altogether, four on each side, which had to be cut out very accurately. This was achievable but quite difficult! Once cut they were nailed into place and any resulting gaps were sealed with wood filler. **See Fig. 8**. The hardboard extended over the bottom of the frame because it was easier to cut the base *in situ* than in advance (any miscalculation could have meant the hardboard sections might be too short to fit in the frame, so it was better to have an excess of sheeting rather than any shortages)

7. When the excess hardboard was sawn from the bottom of the dome it became apparent that the lower edges were rather weak as the sheets were too stiff to curve all the way down to the very bottom of the frame and were therefore splaying and creating a weak point. To remedy this glitch we decided to glue an extra strip of hardboard on the inside of the dome's edge as reinforcement. The strip had to be glued and then firmly clamped against the outer surface, but we didn't have enough clamps to complete the job in one go and had to do it in three stages, using all the G-clamps we had available at the time. **See Fig. 9.**

Fig. 9. Clamping down skirting.

Fig. 10. Rotation test.

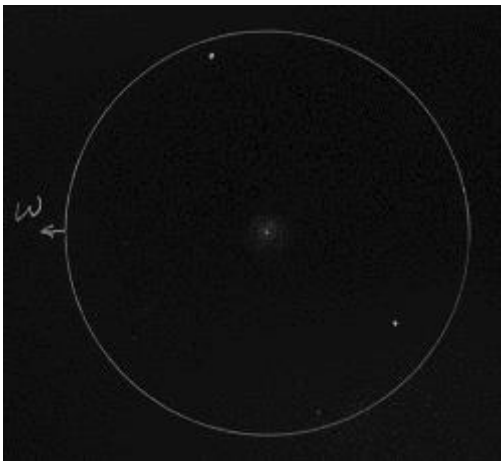
8. When the dome was complete it could be tested *in situ* on the octagonal base. Therefore we needed to take it outside into the garden (once the two halves of the dome were joined it was so big we had to remove a small part of the workshop wall just to get it out!). Forunately everything married up nicely and the dome rotated smoothly as well. **See fig. 10**. This was quite a relief as I wasn't sure whether the wheels were strong enough to support the dome. But I needn't have worried because each one only had to support an eighth of the weight.

* * *

This was the state of play on the 26th of February. I think we can safely say that the next issue of Cygnus should contain the final episode of 'Constructing the Hypatia Observatory' - assuming <u>everything</u> goes to plan! Be warned: although building your own observatory may be considerably cheaper than purchasing one it's a <u>very</u> time consuming endeavour. So far this project has taken more than twice as long as I'd anticipated! Anyway the end <u>is</u> finally in sight, so with any luck it might be ready for me to catch the last few remaining dark nights before the summer months arrive! Find out if I manage it in the final <u>thrilling</u> instalment of 'Constructing the Hypatia Observatory!

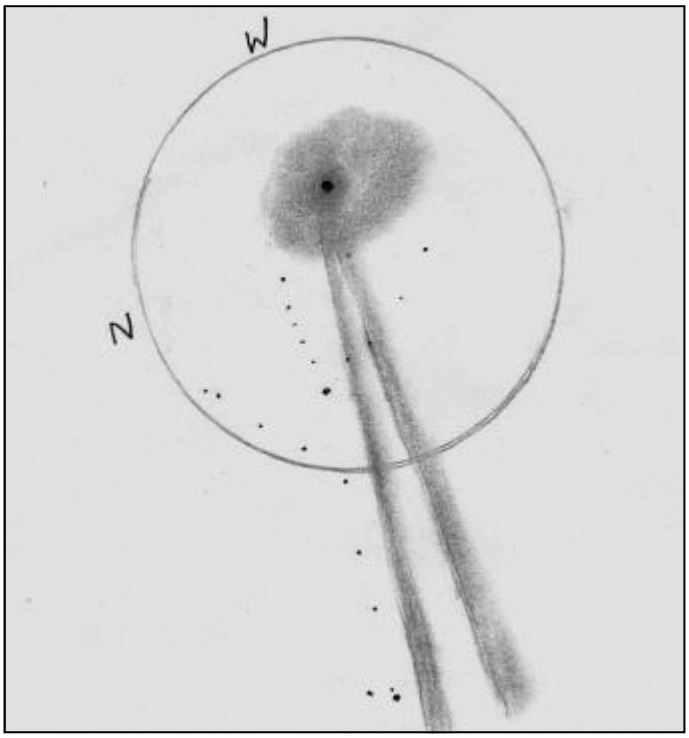
Paul Brocklehurst

SKETCHPAD



Paul Webb's drawing of Comet C/2014 Q2 Lovejoy as seen through his 102mm refractor on 30th December. He used an 11mm Nagler and the Moon was 73%.

Dale Holt's drawings (above and below) were made using pastels, water colour pencil and acrylic paint. He used a 15mm F9 refractor and his Watec video camera.



Dale was seated in comfort before a screen to make his drawings. In contrast Andrew Robertson had to climb a step ladder to view Lovejoy with his 600mm Dob. His 21mm Ethos gave him a magnification of 129X.

There's a partial solar eclipse on 20th March. **DO NOT ATTEMPT TO VIEW, USE ANY OPTICAL EQUIPMENT TO VIEW OR TRY TO PHOTOGRAPH THE ECLIPSE WITHOUT THE CORRECT SUN FILTERS.** That said, solar glasses are cheap, Astrofilm (or similar) isn't too expensive and easy instructions are available to make telescope and lens filters. A number of members have suggested that they will open up the observatory to view the eclipse if it is clear – members are welcome to join them but keep an eye on the web site.

I'll be at work (a school) and hopefully dragging all and sundry out to watch the spectacle in a clear blue sky.

AndyG

Editor's note: The above warning has been included in the belief that Cygnus will reach you before March 20th. If for any reason it is delayed and you are still reading this it would seem that you watched the eclipse safely or the day was cloudy!

DALE'S DSOs

Ever since I started deep sky observing I have coveted target objects and lists published in various, magazines, journals, newsletters, and books by experienced observers; using these to produce my own observing lists for those rare clear nights around the New Moon period.

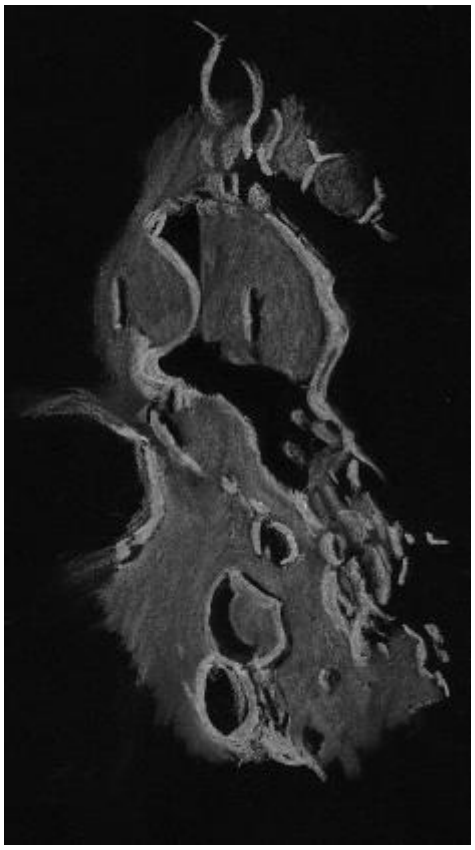
I no longer buy any of the UK or US magazines, finding most of my inspiration these days from the BAA deep sky section projects and Webb Deep Sky Society 'galaxy of the month' and 'object of the season', and of course from like-minded friends with whom I network on a frequent basis sharing experiences and observations.

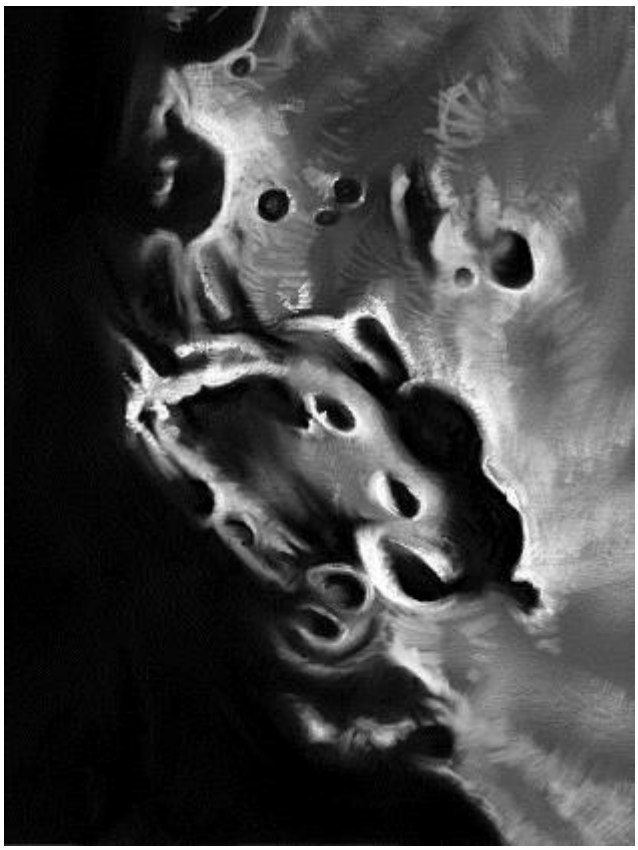
In this newsletter I'm going to share a couple of observations that I picked up from Owen Brazell and Wolfgang Steinicke via the Webb Society website http://www.webbdeepsky.com/

The NGC 2275 group are to be found in the well known constellation of Gemini the twins. This is a galaxy group which lies above the stick like twins whose heads are marked by Castor and Pollux and just below mag 3.6 Theta Geminorium.

Before we go any further I should say that these are not dazzling bright galaxies that we approach, their omission from the well read Night Sky Observers Guide tells us that these are for the, shall we say determined, observer. However the fact that William Herschel is the discover of two of the three galaxies tells us that they are certainly 'doable'.

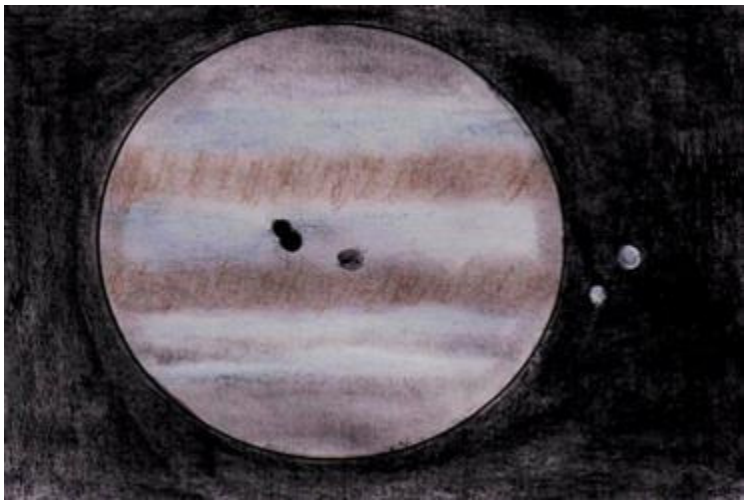
NGC 2275 forms a pair with NGC 2274 and both are likely to be truly associated. NGC 2274 is the brighter of the two and is an elliptical galaxy with a bright core . At mag 12ish it isn't going to be for the small scope user. NGC 2275 is perhaps a magnitude fainter, but is far more interesting, showing a distorted S shape. I'm assuming that



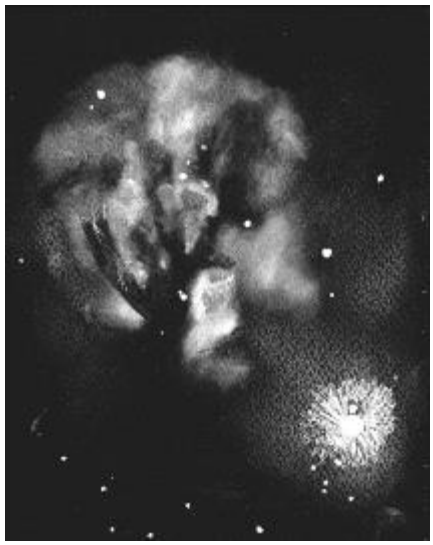


Above left: Your editor made this sketch of Gutenberg, a crater on the western edge of the Mare Fecunditatis 0n January 24th. The telescope was a 200mm SCT.

Above right: Mike Doddington's drawing of Clavius, made on his ipad. The magnification was 220X. This was Mike's first attempt at a lunar sketch on his ipad and is most impressive. I look forward to further contributions from him.



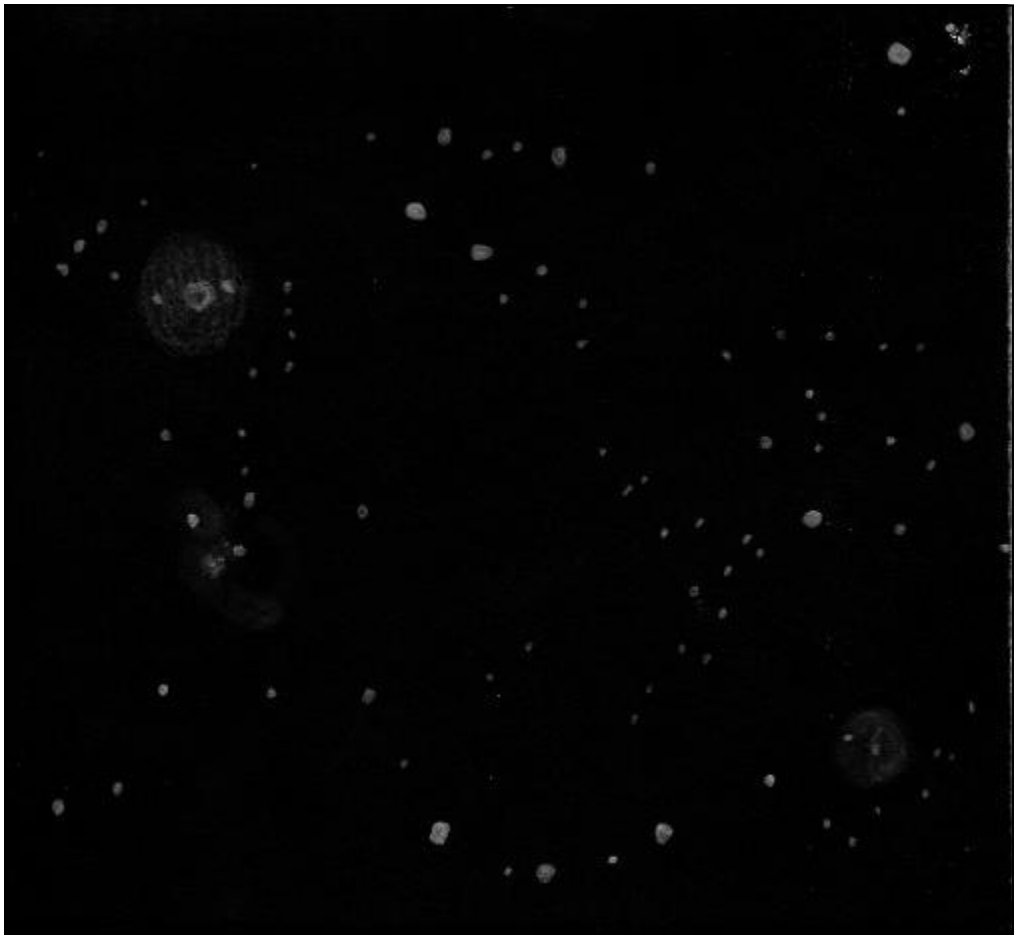
Dale Holt observed and sketched the triple transit of Jovian moons on January 24th.



Dale's drawing of NGC 2024.

some gravitational interaction is going on with its larger neighbour.

I observed these galaxies twice in February of this year and on both occasions sky conditions were poor. However my half meter mirror and deep sky video camera allowed me to capture some of NGC 2275's unusual morphology. In my narrow field of view I was able to see a fainter and interesting third galaxy, UGC 3537. This is shown as being around 15th mag, so faint, indeed, with my set up it appeared round with a slightly ragged outline and a hint of spiral structure going on. I wonder if any members can catch this visually? Or better still take a nice deep image of it!
I hope that my sketch gives you some idea of what the trio look like.

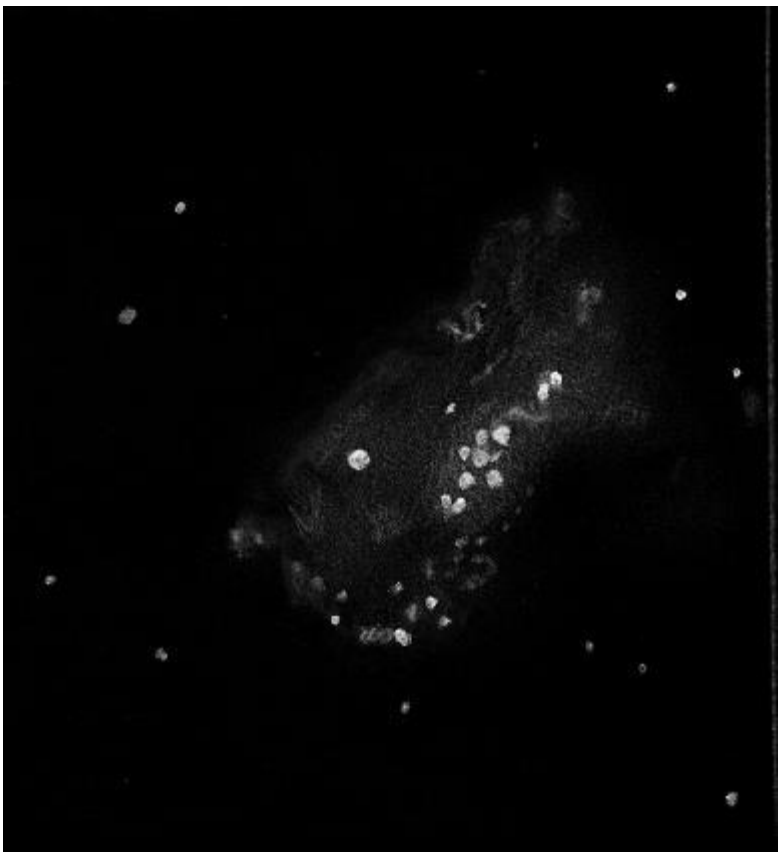


NGC 2274, NGC 2275 and UGC 3537.

NGC 4449 is a reasonably large galaxy in Canes Venatici with a span of 5.5' X 3.6', and according to Wolfgang, a visual magnitude of 9.4, so this will be a relatively easy target compared with the earlier trio. Now this galaxy is unusual in its appearance and is very active in star formation, deep sky images and indeed my own humble sketch, show it as boxy in shape.

Visual observations with instruments up to 24” fail to show the outer regions which give its box like shape, showing instead a more conventional if somewhat irregular shaped galaxy, both Andrew Robertson and David Reynolds have sketched this galaxy during February too!

Observations with larger instruments will show brighter patches within the galaxy which are likely to be the active star formation regions; these are clearly seen in my own sketch which again was made with my half meter mirror and Watec deep sky video camera.



NGC 4449

I hope that a number of you will be inspired to try for these targets during the dark New Moon nights in March and April; I wish you luck and encourage you to share your observations to inspire others.

These observations and many more can be found on my web site and detailed in my blog

Pax stellarum,

Dale

STARS AND THEIR Xs:

Sirius

Look south in the early evening and be dazzled by the brightest star in the sky, Sirius. It might be outshone by the brightest planets Venus, low in the west, and Jupiter, high in the southeast, but neither of these flashes and sparkles furiously like the disco Dog Star. Like many a good night out, the spectacular show is all down to the atmosphere; rapidly moving cells of air refract Sirius's point-like white light, different wavelengths by different degrees, so that what enters our eyes is a coruscating sequence of colours. Sirius is actually a hot, white star like Vega, Castor or Mizar, but appears so much more impressive simply by being even closer to us and by never rising far over the UK horizon, so its brighter light takes a longer path through the disturbing atmosphere. The truly extraordinary thing about Sirius is not the flashy Dog Star but the Pup, a very small, very faint companion that taught disbelieving astronomers that matter can come in the most incredible form, a **white dwarf**.

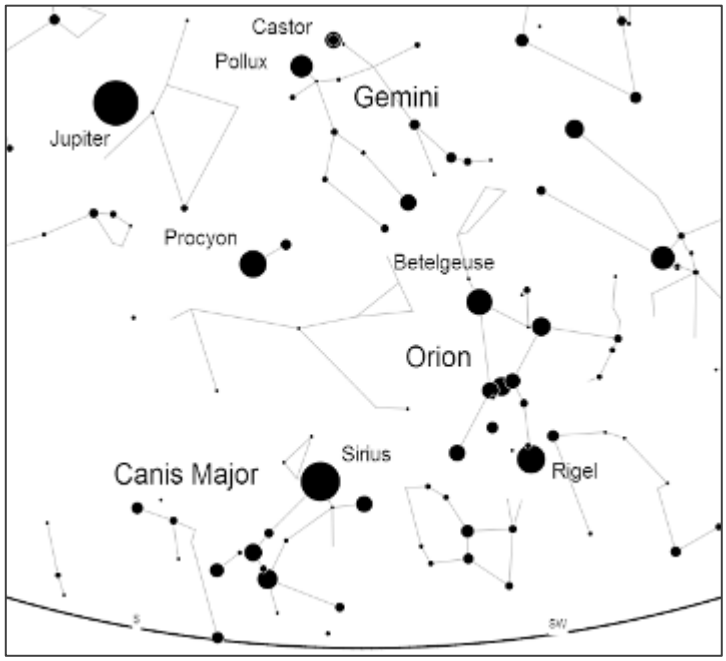


Figure 1. View of sky to the south-southwest from Norwich at 8pm on March 21st 2015. Sirius, the Dog Star, is in the constellation of Canis Major, the Big Dog. (Created using Cartes du Ciel 3.4.1 by Patrick Chevalley.)

A companion to Sirius was first proposed in 1844 by Friedrich Bessell to explain a wobble in the star's motion with a period of around 50 years. It was first seen in 1862, not by a professional astronomer, but by expert telescope manufacturer Alvin Clark and his son, when testing the lenses for the then-to-be largest refractor in the world. Though its faintness, almost 10,000 times fainter than Sirius, immediately cast doubt that it could be massive enough to cause the observed perturbations, continued monitoring of the two stars' motions confirmed the companion to be about as massive as the Sun, Sirius itself being just twice as massive. The orbit is strongly elliptical, the apparent separation of the pair in the sky varying from just 3 to 11 arcseconds, and the true separation from 8 to 30 times the distance of the Earth from the Sun. At its closest, as around 1994, the Pup is very difficult to observe, but for the next decade and more, when it will be more than 10 arcseconds from Sirius, a good 8-inch telescope may well suffice on a steady night. Have a go, or ask at a club night; I imagine some members have experience of spotting it, and several others will be willing to have a go!

The first spectrum of the Pup shocked the greatest astronomers of a hundred years ago by resembling the spectrum of Sirius, implying its dimness was not largely due to being cooler, but entirely due to being much, much smaller, at least a hundred times smaller in diameter, a million times smaller in volume, than Sirius, into which must be packed the entire mass of the Sun. **The mass of the Sun packed into a volume similar to that of the Earth!** Arthur Stanley Eddington, who popularized calling such stars white dwarfs, recalled: *We learn about the stars by receiving and interpreting the messages which their light brings to us. The message of the Companion of Sirius when it was decoded ran: "I am composed of material 3,000 times denser than anything you have ever come across; a ton of my material would be a little nugget that you could put in a matchbox." What reply can one make to such a message? The reply which most of us made in 1914 was—"Shut up. Don't talk nonsense."*

It does seem incredible, unimaginable to us that such material can exist, hundreds of thousands of times denser than water. Yet within a dozen years, the development of quantum mechanics had brought about a theoretical explanation: electrons being forbidden from sharing the same energy state generate a pressure that is independent of their temperature but increases with their density, and holds up the white dwarf against its own gravity in such a way that the more massive a white dwarf the smaller and denser it is. Such matter is called degenerate.

The Pup is one of the more massive white dwarfs that we know of, almost twice as massive as the majority, and therefore one of the smallest. More recent analyses of the white dwarf's spectrum using the Hubble Space Telescope, and ultraviolet and x-ray space telescopes show that it is actually much hotter than Sirius, 25000 K, and enable a more precise measurement of the radius at just 90% that of the Earth.

Despite having told you before that temperatures of over a million Kelvin are typically necessary for x-rays, the 25000 K white dwarf is a bright source of the lowest energy (or "soft") x-rays (Figure 2). The reason is that the absorption features from elements heavier than hydrogen in a star's atmosphere

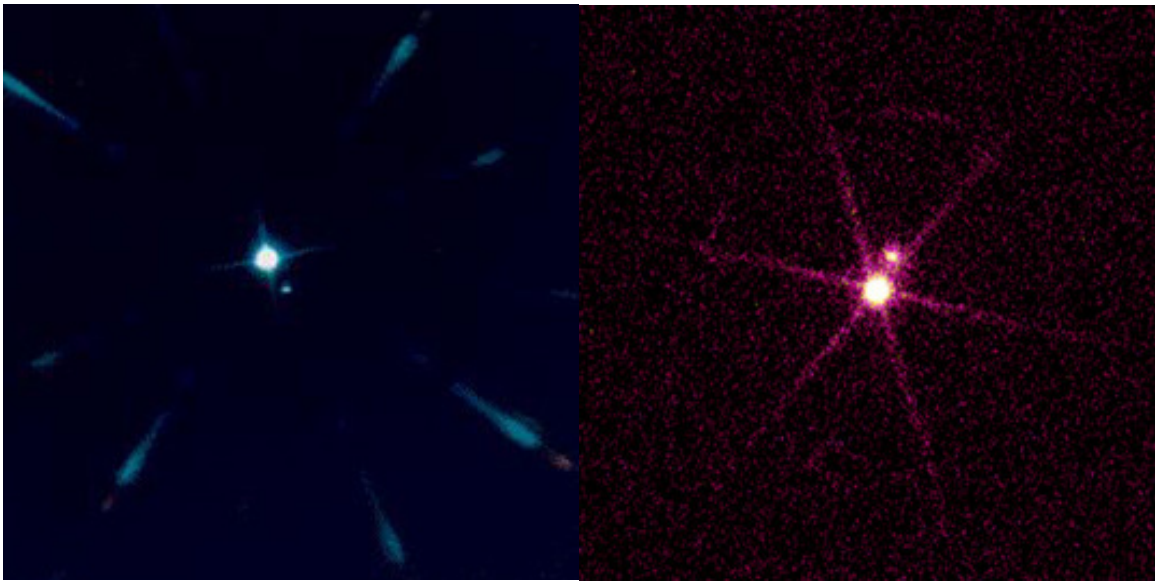


Figure 2: WhilstSirius is overwhelmingly brighter in visible light (McDonald Observatory.left), its white dwarf companion is the bright soft x-ray source (Chandra, NASA/SAO/CXO, right). Even the x-rays apparently observed at the position of Sirius are due to the detector's sensitivity to ultra violet light, not true x-rays from Sirius. The spikes in each image are due to diffraction in the telescope.

that would usually absorb soft x-rays very efficiently are entirely absent from the white dwarf's spectrum. Its surface gravity is so strong - 400000 times the gravity we experience on the Earth's surface - that all the heavier elements have sunk down, leaving a visible outer layer of only the lightest element, hydrogen.

How did the companion of Sirius reach this bizarre state? Was it always like this? If not, what kind of star did it use to be? Stellar evolution models apply the relevant physics to the conditions found in stars of different mass and composition to predict how these stars should change as they produce energy through consuming the lighter elements inside them, initially hydrogen, by fusing them into heavier elements, initially helium. Whenever this is happening, the attempted escape of this energy as photons creates an outward pressure that resists the inexorable inward pressure of gravity and the star is stable, as the Sun and Sirius are now. The heavier nuclei build up, however, in the core of the star until the reservoir of light element under sufficiently high temperature and pressure to fuse is exhausted and the source of outward pressure ceases, allowing gravity to compress the star, whence temperature and pressure increase until in some part of the star conditions enable fusion of light elements again. Although inside, the core is becoming hotter and denser, from the outside the outer layers of the star expand and cool dramatically; it becomes a red giant, stable for a shorter time.

Most stars, like the Sun or Sirius, don't have enough mass to create conditions hot and dense enough to fuse carbon and oxygen once these heavy elements are produced. Such stars become unstable and throw off their cool outer layers to reveal their hot dense core, whose ultraviolet radiation excites the discarded layers to emit light as a planetary nebula for a few thousand years. Unable to generate its own energy any longer, the exposed core collapses under its own gravity into a degenerate white dwarf and cools, very slowly due to its small size, via a thin non-degenerate atmosphere of whatever light elements remain. This cooling of the white dwarf can also be modelled.

From the Pup's observed parameters – mass, radius, temperature, luminosity – a cooling time of around 120 million years can be estimated. Applying stellar evolution models to the observed parameters of Sirius - a mass of 2.0 times the Sun's, a radius of 1.7 times the Sun's, a temperature of 9900 K and a luminosity of 25 times the Sun's – suggests Sirius is 225 – 250 million years old. Assuming the two stars were born together, the Pup must have lived approximately 105-130 million years as a regular star before expiring to become a white dwarf, a lifetime that would correspond to a star of approximately 5 times the mass of the Sun. In its prime such a star would have been around 10 times brighter than the flashy Dog Star so the now small, dim Pup would have been the unrivalled Top Dog in this system.

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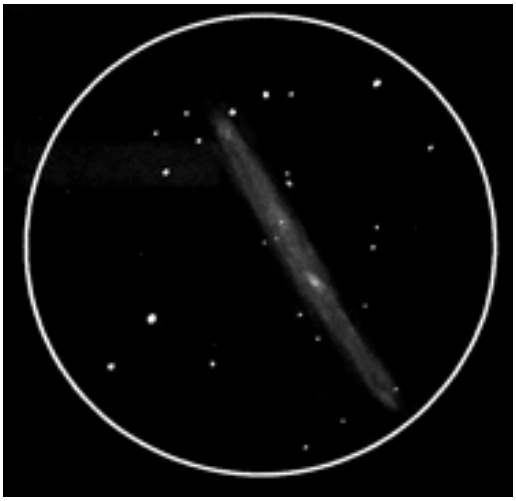
Kevin Briggs

WEBB'S WONDERS

A Silver Needle, A Whale and a Needle.

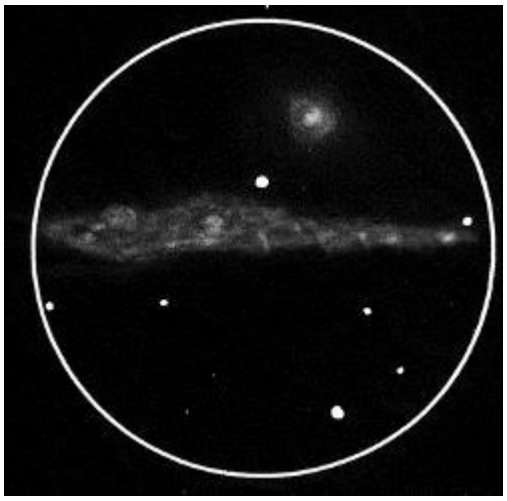
Outside of the familiar Messier catalogue there are many interesting objects to be observed. Edge on galaxies are something quite remarkable to observe as they appear as a gash in the blackness of the dark skies such as we have at Seething. This time three spectacular edge on galaxies are your targets to have a go at observing. They are challenging for smaller telescopes, but some observations have been reported with 4 inch! At least 6 or more inches of aperture are required for the best views. Don't forget the club has larger instruments that can be used after a bit of training or you could grab a look in my scope.



The Silver Needle Galaxy, NGC 4244 (H V-41), was discovered by William Herschel on March 17th 1787. He described it as follows: 'Pretty bright, very large, extremely elongated, very gradually brighter in the middle.'
Kepple & Sanner's entry for 8-10" scopes says: '…is an extraordinarily long, thin, bright 15' x 1.25' NE-SW spindle.'

Left: NGC 4244. Sketch by Dale Holt

The Whale Galaxy, NGC 4631 (H V-42), was also discovered by Herschel a few days later. He said: 'Remarkable, very bright, very large, extremely extended, brighter in the middle to a nucleus, a star of 12th-magnitude attached to north.' This is a surprisingly large galaxy and does resemble its name when seen in a larger scope. In a 8-10" scope it appears 14' x 1.5' with tapered ends. NGC 4627, 'The Pup', is a small dimmer companion close by and it can be seen with larger scopes.

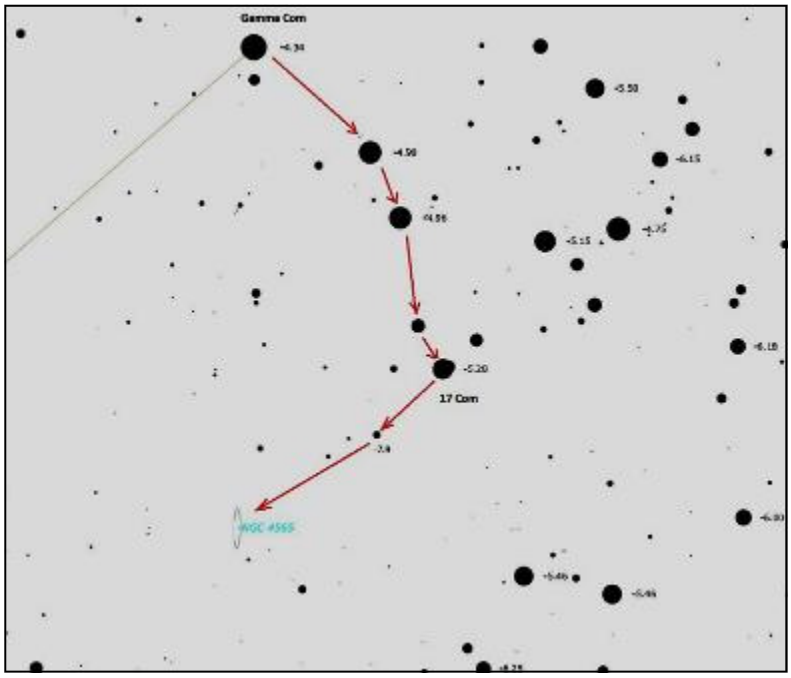


The Whale Galaxy, NGC 4631, sketched by Dale Holt (left) and imaged by Shaun Reynolds (below).

The Needle Galaxy, NGC 4565 (H V-24), is another Herschel discovery from April 6th 1785. This time he recorded: 'A lucid ray 20' long or more. 3' or 4' broad from north preceding to south following [from northwest to southeast]. Very bright in the middle. A beautiful appearance.' This galaxy is also large, at 12' x 1.5', in a 8-10" scope, but has a bulging core at its centre. Sometimes it is described as like two fried eggs back to back or as a flying saucer.

Fortunately all three galaxies reside in fairly close proximity to one another between Canes Venatici and Coma Berenices. Below is a description of how to find them in one session.

Start by locating Canes Venatici (CVn). Cor Caroli is a lovely double on the way to Beta CVn, where the star hop begins. Follow the arrows to 6 CVn, a little under 3 degrees away. With your finder centred on that star your first target, the Silver Needle, is just another 2 degrees further along. Try different eyepieces before you move on.



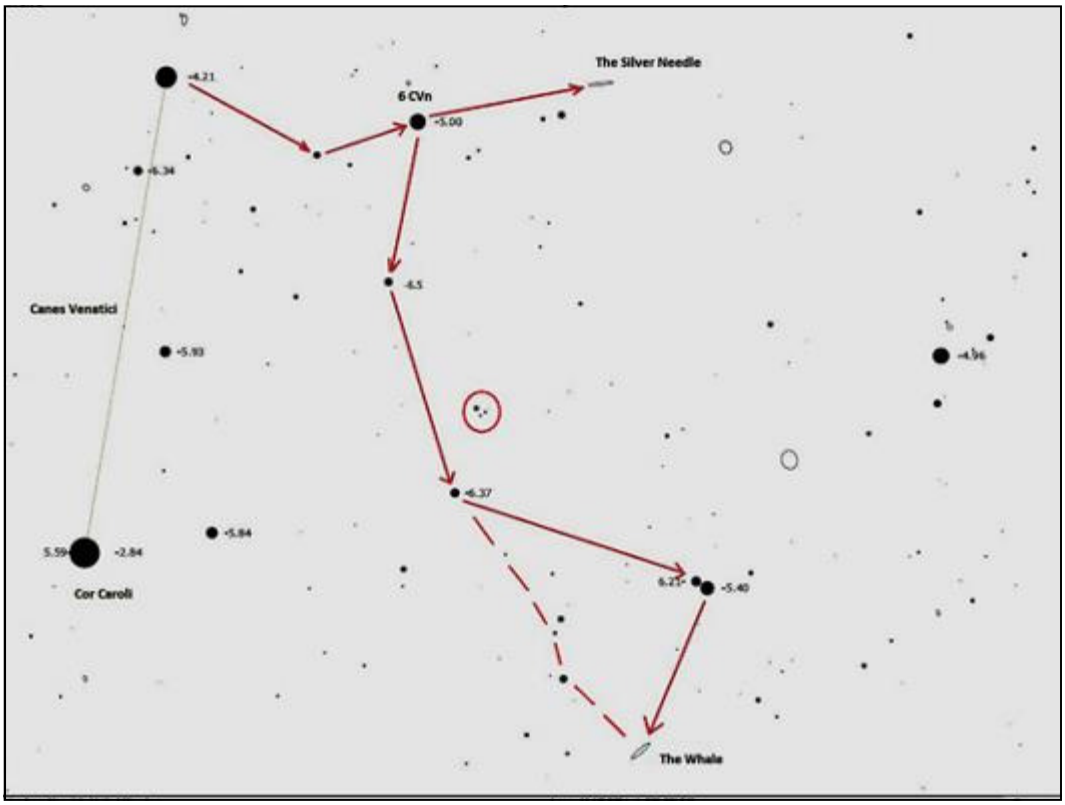
Left:

Finder chart for NGC 4565.

Below:

Dale Holt's drawing of the Needle Galaxy, NGC 4565.

Return to 6Cvn and this time turn roughly 100 degrees to the mag 6.5 star, visible in your 50mm finder. The next guide star may be just on the edge of the finder, but note the three mag 7—8 stars circled and head that way. Then you will see the mag 6.37 star. You are getting close. There are two routes to the target. Just outside the finder's reach are two close stars, mag 6.21 & 5.4, or follow the trail of dimmer stars to spot the Whale.



To find the next target we begin on naked eye star Gamma Coma Berenices (Com) just 2.5 degrees away from the Whale. A much easier hop along an easy chain of stars passing through the large open cluster Melotte 111. Don't miss the wide double star 17 Com on the way to your final destination, the magnificent Needle Galaxy.

Paul Webb

You will find more of Paul's hints on how to find celestial wonders online. Just go to the NAS Forum Observing Section.

CAPTION COMPETITION

When he's not busy building his observatory Paul Brocklehurst is dreaming up other things to fill the pages of your club magazine.

He challenges members to come up with a witty caption for the picture o the left.

Send suggestions to the editor, who may even come up with a small prize for the one that amuses him most.

Grateful thanks to the individuals who donated these telescopes to the club.

The Meade LX200 and the Orion 200mm will be kept in the new storage shed and will be available for members to use on the pads.

QUICK QUIZ

Inspired by Andy's quiz at the NAS Christmas party here are ten questions, just for fun, to test your knowledge. Try answering them before resorting to Google, etc. and see how much you really know! (The questions relating to space travel and science fiction are included to give President Mark Thompson an excuse for not getting ten out of ten.)

1. Where would you find Gale Crater?

2. In which year was the planet Neptune discovered?

3. In which month would you expect to see the Lyrids?

4. What type of astronomical object was first discovered in 1967 by Jocelyn Bell, working at Cambridge?

5. What was the principal difference between Kubrick's film *2001, a Space Odyssey* and Arthur C. Clarke's novel of the same name?

6. Where in the night sky would you see Alcyone and Celaeno?

7. In Nigel Kneale's four Quatermass series for TV, what was the Christian name of Professor Quatermass?

8. By which name is the lunar feature Rupes Recta more commonly known?

9. By what name is the star Alpha Pegasi also known?

10. The concept of the Oort Cloud was postulated by astronomer J.H. Oort. What nationality was he?

Answers, should you require them, on the back cover (no peeking!).

PUBLIC OPEN NIGHTS

3rd/4th April – *New Horizons Pluto Arrival*—Mark Turner

MEMBERS' TALKS

27th March – *What's Up in the Night Sky* —Andrew R.
(Don't miss this last talk by Andrew!)

5th June—Dale Holt

Quick Quiz Answers

1. On Mars. 2. 1846. 3. April. 4. Pulsar. 5. In the film the 2nd monolith was located in orbit around Jupiter; in the book it was on Saturn's moon Iapetus and Saturn, not Jupiter, was therefore the destination of the spacecraft *Discovery* . 6. The Pleiades. 7. Bernard. 8. Straight Wall. 9. Markab. 10. Dutch.

LETTER TO THE EDITOR

Dear Sir,

I really must protest at the depths to which your august magazine has sunk. I refer of course to the image of buttocks that appears purporting to be a drawing of Mars. I have heard of the practice of 'Mooning' but did not realise it also applied to Mars. I am afraid I have had to hide the magazine from the eyes of my good lady lest she become over excited. I trust that your next issue will not sink to the same low.

Yours truly

Disgusted of Seething

Ivor Hangup

NEW MEMBERS

The Society extends a warm welcome to the following new members:

Richard Williams
Aaron Maas & James Goldsmith
Clive Kilby
Ivan Rukaber (welcome back!)
Reg Osborne
Elizabeth Gatheral
Preston & Susan Thomas
Perry Warburton
Adam Cooke & Melody Brooke
Peter Connell
Timothy & Joanna Carpenter & family
Roger Preece

THE DEADLINE FOR COPY FOR THE NEXT ISSUE OF CYGNUS IS 5th June 2015

This is the very latest date by which articles should reach the editor. Sooner than the 5th would be much appreciated and would make the poor old chap smile!

BONUS PAGES

Above:

Shaun Reynolds stunning image of the Rosette Nebula.

Left:

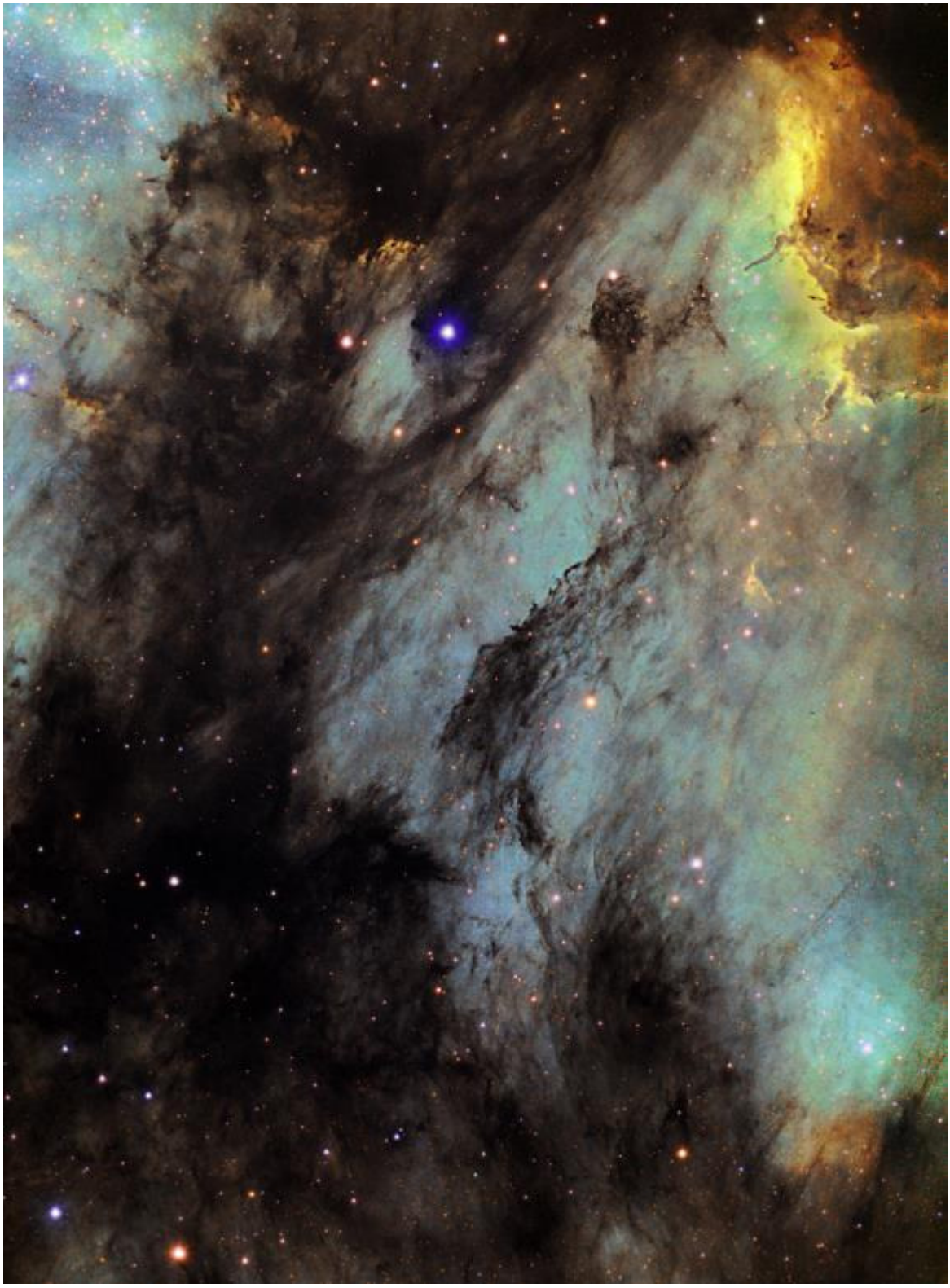
Jupiter imaged by Chris Grimmer.

Above:

NGC 1333, imaged by Shaun Reynolds.

Right:

You may have seen Chris Grimmer's image of the Heart Nebula before, as it appeared in *Sky at Night* magazine.



A final contribution from Chris Grimmer, his glorious image of the Pelican nebula.