CYGNUS

Quarterly magazine of the Norwich Astronomical Society
(Registered Charity No. 262968)

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Spring 2018

EDITORIAL

Amazingly, this is my fourth edition of Cygnus! Where has the time gone? First of all, I would like to thank all Who have contributed to this edition of Cygnus, and the constant barrages of "is it ready to send to me yet" or "I need your article asap". I would also apologise for the intrepidation I cause when you see me approaching knowing I'm going to ask for an article.

I have a new email address. It is **cygnuseditor@norwichastro.org.uk** you can still email me on my other address if you wish, I will receive it and though not straight away, I will answer if needed.

Sadly, Sue has informed me that this last article will be her last. So any future articles by Sue will be re visited from much older editions of Cygnus. I can not begin to describe how grateful the members of the society are for Sue's Articles. We all have to start somewhere, and Sue's Articles are great for people new to Astronomy. So, Sue, THANK YOU!

We have some great Member talks coming up, open weekends (of course!), and Group Visits. Don't be shy in coming forward to help :-D

The front cover was a real dilemma for me. I received this sketch early and decided to put it on the front, then I received some absolutely amazing images and I was placed in a conundrum over what to do! I eventually decided to stick with this sketch.

The results for the *spot the difference* have been given to me and is given on the second to last page.

As always, if anyone would like to contribute an article, pics etc please contact me or just send to me your content to the email above.

Tom

A note from Dale Holt regarding the Sketch on the front Cover

"A recent sketch of the famous Horse Head nebula (B33) in Orion. A difficult object to represent on paper as it is a darker outline against a dark sky, if that makes sense. A holy grail for visual observers and imagers alike :)"

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COVER

The Horse Head Nebula
By
Dale Holt

Sketch made on the 18-1-2018 using the 505mm mirror and cooled Watec 120N+ video cam.

DISCLAIMER

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

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

CHAIRMAN'S REPORT

What a shame – the evenings are beginning to draw out already. How does that happen so quickly? Also, if you are saying to yourself that you have had very few chances to see a clear night sky during this winter, you are not on your own. Recent newspaper articles have discussed the lack of winter sunlight, and the lack of clear night skies, throughout northern Europe. Belgium has been especially badly affected. Mind you, if it is any consolation the effect is pretty widespread. It was reported that during the whole of December 2017, there were about 22 minutes of sunlight in Moscow!

Given that, it was something of an irony that the night of the Society AGM on January 19 was a clear sky night. This did not prevent a good turnout of members for the meeting. Thank you to all of you who attended. There is nothing more demoralising for a voluntary organisation than a poorly attended annual general meeting. There was even a lively debate. Find out more about what happened in the chairman's members' newsletter. Also, the minutes of the AGM together with financial statement, are published on the club house notice board.

One consequence of the AGM is that I am now your duly elected chairman. I am not sure whether I should commiserate with you or you with me, but I will certainly try my best to ensure that our almost unique society continues in good health, but also that you as its members are regularly informed about what is happening. Speaking of which, one of the services that we should be providing for members is telescope training. This has in fact started, with two sessions having been held so far. The main limiting factor currently is a lack of clear sky nights, especially at the weekends. If you wish to sign up, just email me.

You are probably aware that we postponed the children's afternoon event scheduled for Saturday 24 February, partly because of possible poor ground conditions for such a large event. The event will now take place on Saturday 9 June, when hopefully the ground will be much harder. One item on view which will be obvious is our newly installed satellite broadband dish, currently located at the edge of one of the pads. This gives us a much needed reliable internet link. Members will also be interested to know that a major part of the installation cost was paid for under the government's rural better broadband scheme.

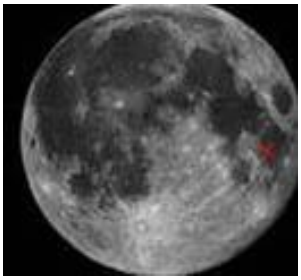
Both open weekends and members' talks have been well attended this season. Personally, I think this is due to a wide range of subject material, well delivered, and, especially for the open evenings, excellent stewarding. If you are used to the observatory and its grounds, it is difficult to imagine how confusing it can seem, arriving somewhere strange, in the countryside and in the dark! From the straw polls we have taken, we are attracting a lot of visitors who have never been before, which makes it even more important to be well organised when receiving them.

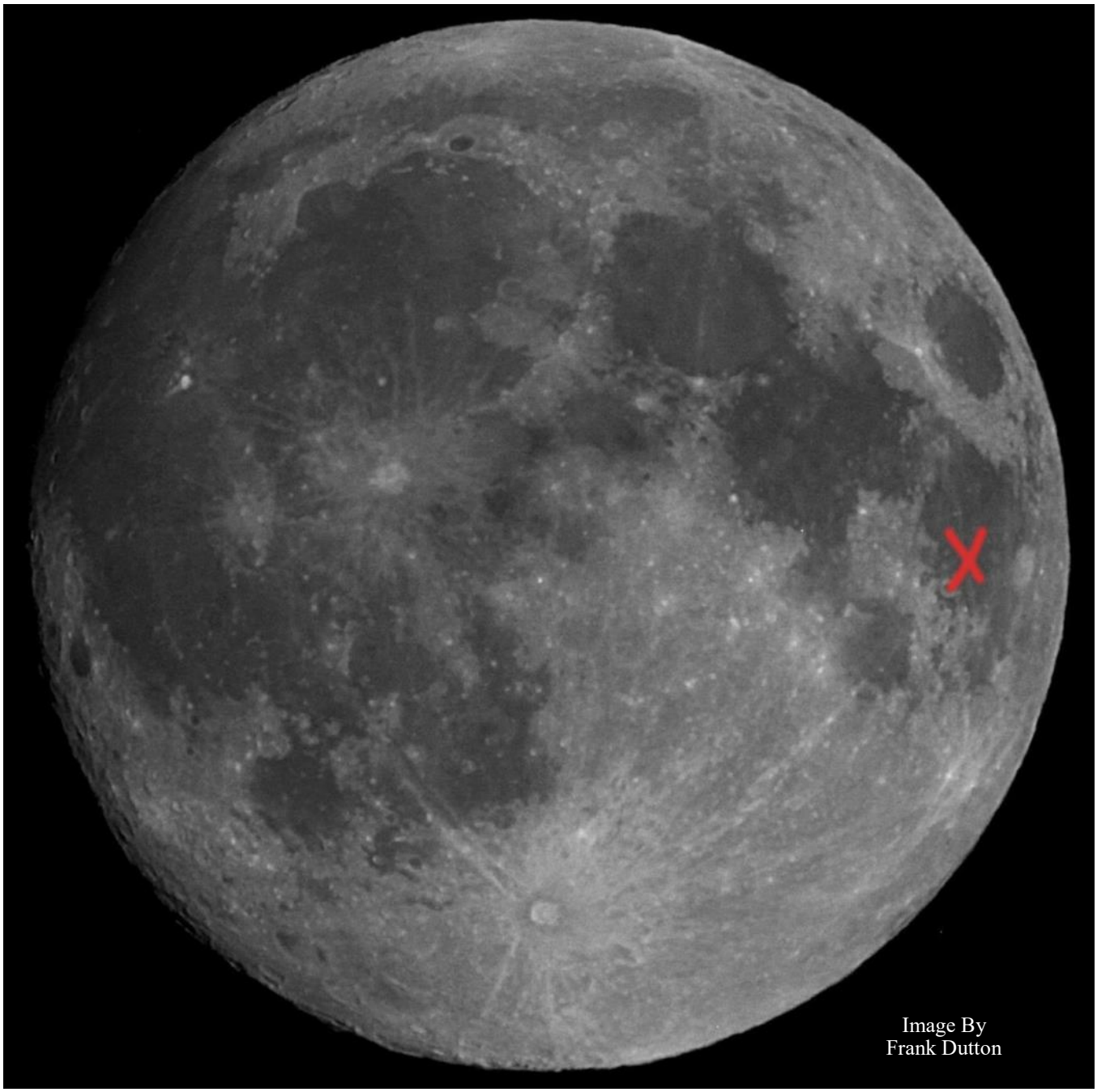
Hopefully, by the time you read this piece, we shall be enjoying an unbroken chain of cloud free nights. One essential requirement of being interested in astronomy is to have an elevated level of optimism. Clear skies!

Roger P.
chairman@norwichastro.org.uk

MOONWATCHERS

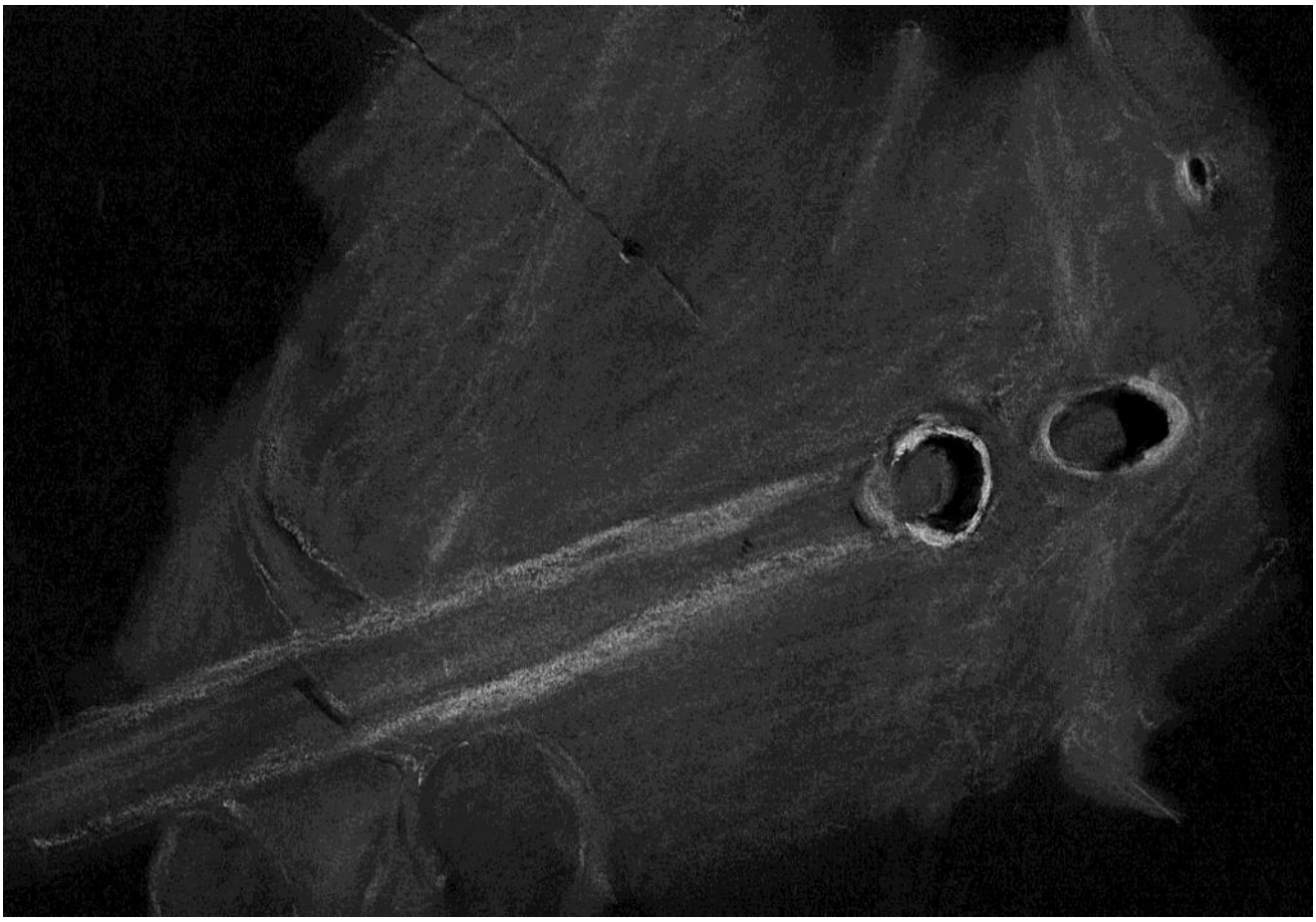
Those Other Messier Objects





Mention the name 'Messier' and most amateur astronomers would immediately think of objects such as The Great Orion Nebula, The Andromeda Galaxy, The Pleiades, Bode's Galaxy – the list could go on and on, and indeed would be an effective, if somewhat boring, way of padding out this article to fill the space allotted me. However, I doubt the editor would let me get away with it, so I'll stop being silly and address the subject in hand in a manner befitting a contributor to Cygnus!

Look at a Moon map and you will see that Charles Messier has not one, but two major craters named after him. They lay in the Mare Fecunditatis (Sea of Fertility) and, as if to avoid confusing any selenite postmen, are labelled 'Messier' and 'Messier A'. This has not



always been the case and older maps and books may well have Messier A marked and listed as 'W.H.Pickering'. This is the case on Elger's *Map of the Moon*, a copy of which I purchased in 1969, and also on my large, framed copy of Patrick Moore's lunar map. Should you have a copy of Charles Wood's *Lunar 100 Card,* you'll find Messier and Messier A are number 25 among the one hundred objects he considers worthy of attention. (If you don't have a copy of this card I urge you to get one. Published by Sky &Telescope and capable of surviving the worst that dewy nights can bring to bear, it is a useful and easy-to -use guide to lunar features.)

The Messier craters are exceptional and are visible at virtually any stage of the lunation. Both are elliptical in shape and are not large by lunar standards, Messier being 9X11 kilometres and A being 13X11 kilometres. They each have dark streaks running along their centres, though a high magnification and large aperture will be needed to see these clearly. I find that in Messier more obvious than the one in Messier A. The latter crater is curious in that it has a sort of extension running west from it, an attached ring, and from this ring almost parallel rays extend for over 100 km across Mare Fecunditatis, always making me think of the twin beams from the headlights of a car. These bright rays make the pair of craters unique and visible on virtually all nights of the lunation. They are quite unlike the rays from any other young impact crater – compare them with the web-like ejecta around Copernicus and Kepler, or with the immensely long rays radiating out in all directions from Tycho.

Over the years there have been many attempts to explain how this pair of craters was created. One theory was put forward that a meteorite struck at a low angle, creating Messier and then ploughed through a ridge to form Messier A. That the body that formed the craters came in low from the east is certain and currently it is believed that it struck; gouging out Messier and either rebounded or perhaps broke up shortly before impact to make Messier A.

These intriguing craters have drawn a lot of attention and over the decades there have been many reports of changes in the area. In the 19th century Franz von Gruithuisen, a Bavarian astronomer, was convinced that the rays were artificial (although he is perhaps better known for his idea that the ashen light that is observed on the unlit portion of Venus was caused by the inhabitants lighting bonfires!) The American astronomer W.H. Pickering (1858 – 1938), after whom Messier A was originally named, claimed to have seen striking changes in both craters and believed these to have been due to patches of hoar frost. Even as late as the late 20th century one observer was convinced that Messier A was moving to the east, leaving a trail of remnants of its previous positions! Alterations in appearance do occur but these can almost certainly be ascribed to changing illumination during the course of the lunar day. They do, however, make the Messier craters a worthy target for both imagers and visual observers and I look forward to seeing any images and/or drawings that NAS members may produce.

Wishing you clear skies,

Spadge

Radio Astronomy

A Member's Talk by Paul Whiting FRAS, at Seething on Friday 8th December 2017

An excellent idea for a Member's talk!

We often have talks by professionals who discuss results from radio astronomy and we see pictures of huge dishes – but what can amateurs do?

Well judging by Paul Whiting's interesting talk – quite a lot.

Paul is Treasurer of Orwell Astronomical Society (Ipswich) and also a member of Felixstowe & District Amateur Radio Society and has many years experience of both hobbies.

We started with a review of the electromagnetic spectrum and the fact that the radio wavelengths are very long compared to those we see in our regular telescopes. This means that a radio telescope cannot resolve the signals it receives in any detail unless it is big – very big! As well as the familiar Jodrell Bank–type dishes, techniques were described where signals from radio telescopes hundreds or even thousands of miles apart can be combined to create sharp images of distant radio sources.

So if sharp "visual-type" imaging is not possible for amateurs, are there other radio astronomy options accessible to us? There are indeed - the aurora, Jupiter and meteors, and Paul talked about each and showed some receiving equipment.

The aurora was difficult, but not impossible. Paul had an excellent portable hand-held receiver with a whip aerial that was ideal but with a substantial drawback – it was only usable provided there was no mains electricity within several miles. Paul had some success however using it sitting on a rock on a desolate beach within the arctic circle!

Jupiter has a strong electro-magnetic field or magnetosphere and as the moons, especially Io, move through it they generate radio waves. These can be received with quite straightforwardly available equipment which Paul described.

Perhaps the highlight of Paul's presentation was his fascinating practical demonstration of receiving echoes from distant meteors. Using an outside aerial consisting of a few feet of metal tubing (of the correct length and spacing), he plugged into a laptop running software which produced a "waterfall" display. The whole display across the screen moved steadily downwards punctuated by sudden disturbances in various positions.

Each disturbance was caused by a meteor and from the direction the aerial was pointing Paul was able to tell us that they were over the Mediterranean Sea. As it enters the atmosphere each meteor heats up and ionises a trail of air and this trail reflects radio waves until it fades away. The receiver is tuned to a distant known radio beacon on earth, and each time a meteor arrives in the area its trail reflects some of this signal to our aerial outside the clubhouse at Seething! We see this as a disturbance on the "waterfall" laptop screen.

Paul explained that with experience the shape of the disturbance could be used to gather extra information such as the height, direction and size of the meteor.

Fascinating – watching the earth being peppered by meteors over the Mediterranean every few seconds; we know it happens because we read about it but so much better to "see" it in real time!

So an excellent introduction to different aspects of radio astronomy, with much to think about and maybe pursue, and many thanks to Paul for coming along. And of course don't forget that once the aerial is set up, this branch of astronomy can be done indoors, in daylight - and when it's cloudy!

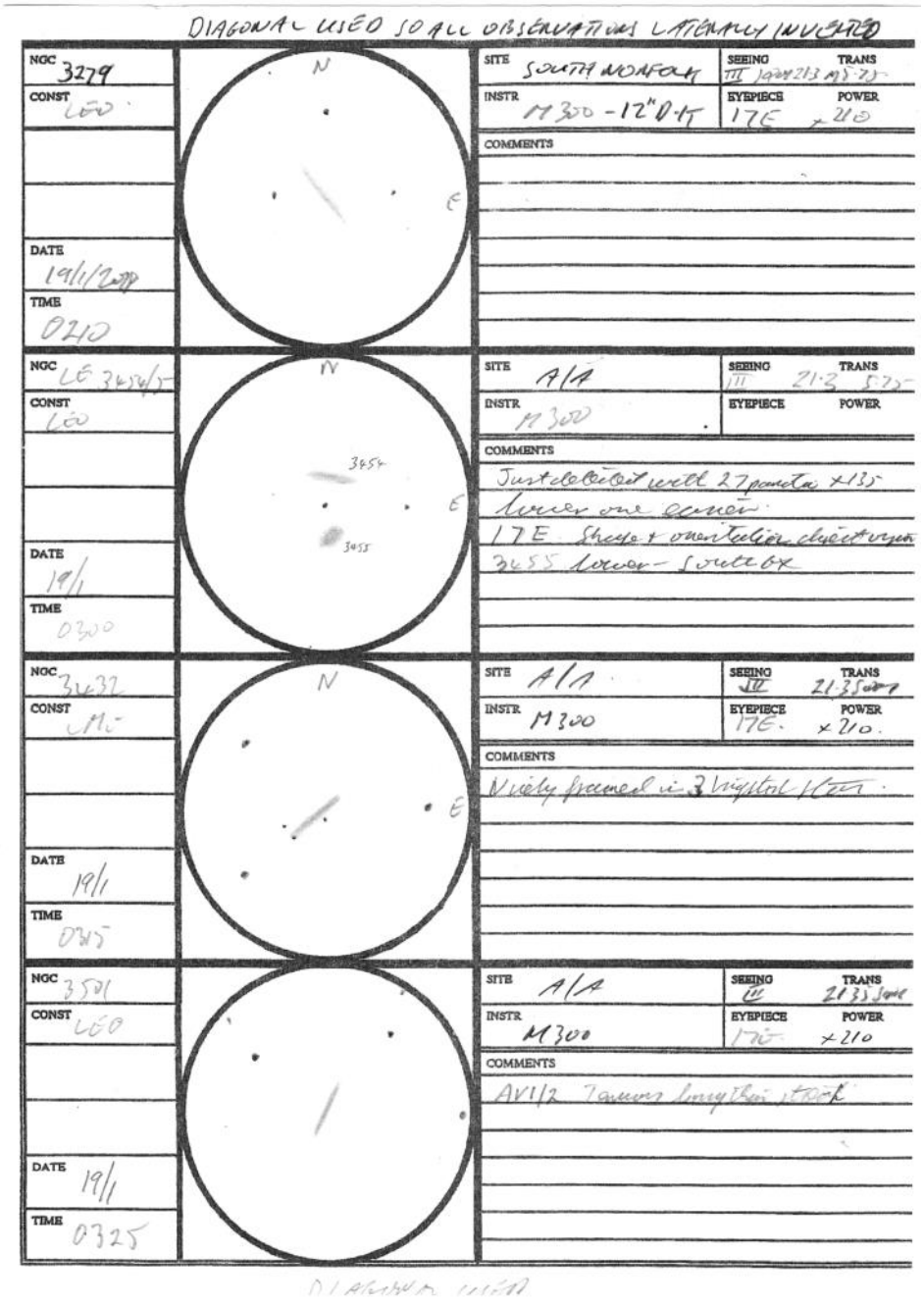
Steve Hubbard
January 2018

Andrew Robertson

A Nights Observation

January has been a very poor month for us observers of the night sky with gales, heavy rain and lots of cloud but being retired I can AND do grab any clear windows whenever they appear. The early hours of Friday 19th January was one of these opportunities. The forecast had been all over the place with it changing to heavy rain showers during the evening but a possibility of clear in the early hours. Sure enough, heavy rain showers on and off from 6pm and still going when I got in bed early at 10pm. But I was ready for a clear sky with flask done and my thermals laid out. I set the alarm for 00:30 hrs. I had already decided to use my 12" Dall-Kirkham Cassegrain on a German Equatorial mount rather than one of my big Dobsonians if I did get out as it was quicker to set up and cover up quickly if needed.

I'd also said to my wife Amanda who's a very light sleeper, "if you see it's clear 'nudge' me." I got the nudge 6 mins before my alarm was due to go off! I was looking through the e/p by 1am and carried on until 6am, a solid 5 hours of excellent skies. I live in Broome on the Suffolk/Norfolk border about 4 miles from Seething. My skies are similar to Seething, possibly a bit better to the North as Porringland and Norwich are closer to Seething than me. As soon as I got out I could see a mag 5.5 star in UMi direct vision with a 5.74 one AV1. By 4am when it was higher, the mag 5.74 one was direct vision also. MY SQM readings were consistent all night between 21.3 and 21.35 – not bad. I had some excellent observations and made 5 sketches: NGC 3279 in Leo; NGC 3454/5 in Leo; 3501 in Leo; 3432 in LMi and 3430 group in Leo.

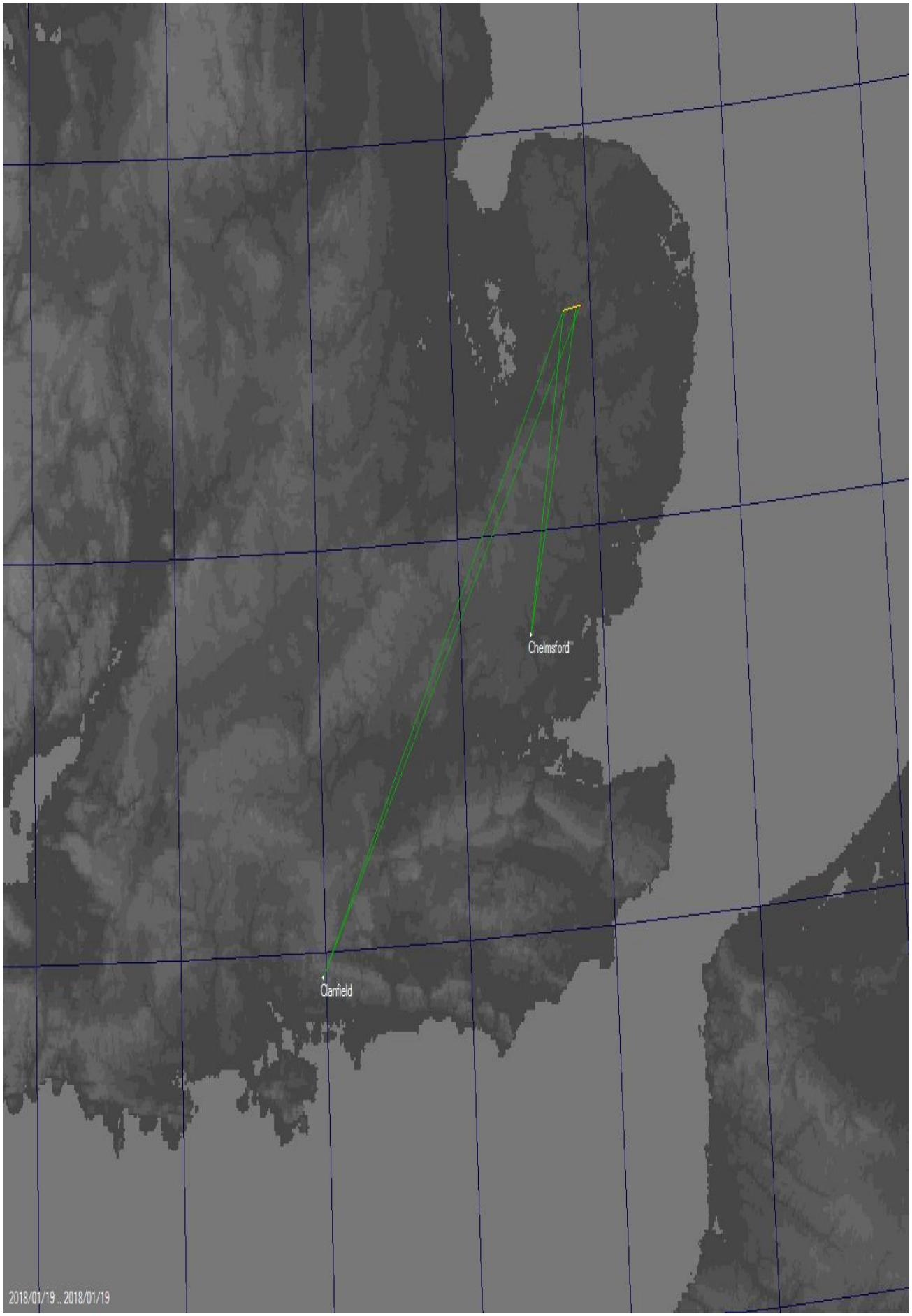


AV1 is from the 'averted vision scale': https://www.webbdeepsky.com/articles/averted-vision-scale

SQM readings: http://unihedron.com/projects/darksky/

Note; the sky quality meter gives an objective assessment of how dark a sky is but doesn't measure transparency. I use a mixture of SQM readings and naked eye visibility to assess how good (or bad) a sky is.

Andrew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SUE'S STELLAR SUGGESTIONS

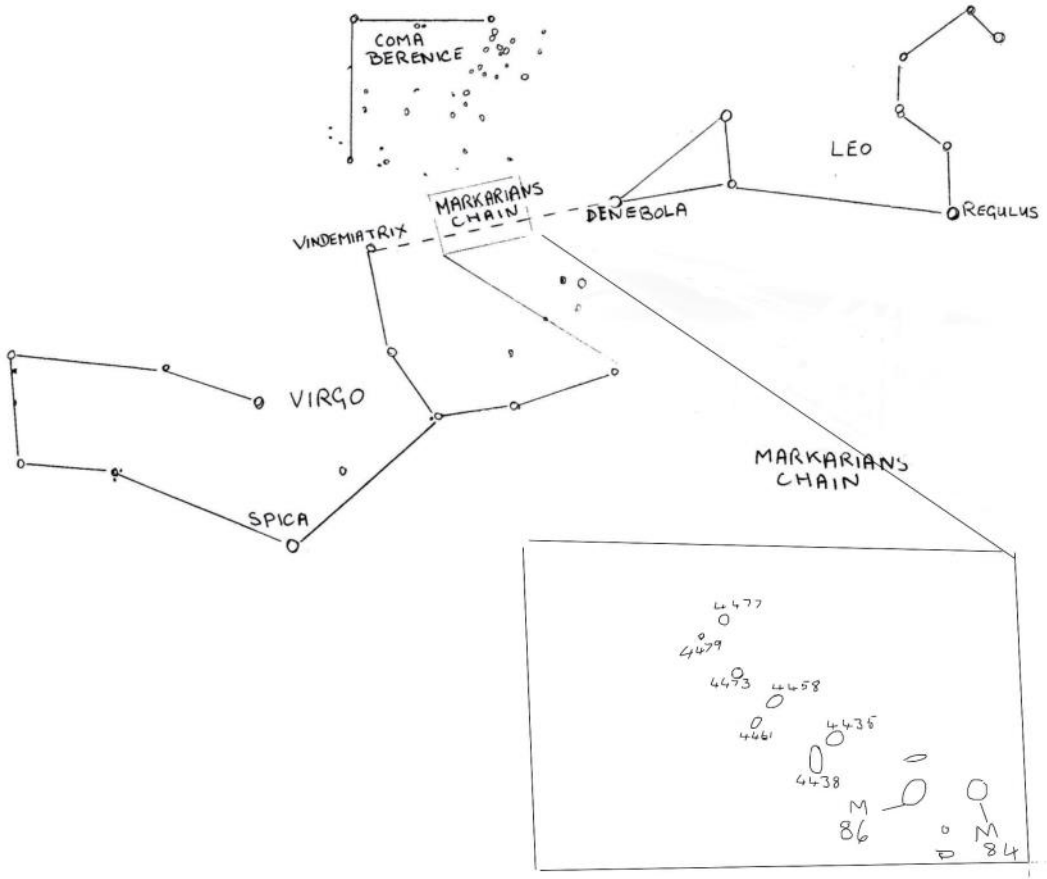
Springtime Galaxies

Looking South in the Spring we see the backwards question mark of Leo. These stars mark the head and mane of the lion with his body, legs and tail following on to the East. Leo is home to several galaxies which are easy to find with a chart but I would like to suggest looking further East beyond his tail. Here we find an amazing field of galaxies filling the night sky from the bowl of Virgo on up into Coma Berenice. A large telescope will reveal so many that it can become difficult to identify individual galaxies! My favourite area of this wonderful part of the sky is known as Markarian's Chain after the Russian astrophysicist, Benjamin Markarian who wrote a paper about this group in 1961.

To find the chain I start about halfway along a line from Denebola, the star marking the end of Leo's tail and Vindemiatrix in Virgo. Here I find two of the brighter galaxies listed by Charles Messier as M84 and M86. With a fairly low power I find other smaller galaxies NGC 437 and NGC 438 in the same field of view which together give the appearance of a face - making the nose and mouth with a fainter NGC 4402 as a raised eyebrow!

Now moving my scope a little to the left and up I come to a pair of galaxies NGC 4435 and NGC 4438 which are known as "The Eyes ". X-ray observation of this pair show that they are interacting and possibly collided at high speed around 100 million years ago. A large scope or a photo can show some evidence of this interaction. Continuing east and north (or left and up) we come to another pair, NGC 4461 and NGC 4458. NGC 4458 is small, round and quite faint while NGC 4461 is brighter and more oval, pointing more or less north/south. Following on from these we cross over the boundary into Coma Berenice and find NGC 4473, which is quite easy to spot, being small and round with a bright centre. The last galaxy in this chain is NGC 4477, another reasonably bright object and quite easy to see in a small scope. Much fainter NGC 4479 is close by which larger scopes can pick up.

With a goto telescope it should be easy to track along this chain by using the handset menu but I rather like the idea of simply pushing my scope a little bit left and up to find them! With a larger scope, say 10inch, with low power and a wide field of view it should be possible to get the whole chain in the field of view. It can also make a very attractive wide-field astro-imaging target. I would seriously suggest getting a chart and finding some of the other galaxies in this wonderful part of the sky. There are so many galaxies here that they can happily fill a whole night's observing, and while I would always suggest low power to find these faint beauties it is also a very good idea to get comfortable, increase the power and study one at a time teasing out as much detail as you can. Maybe even try to sketch or describe what you can see. It is surprising how much more we see when we concentrate like this. So all we need now are a few clear skies (here's hoping).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Paul Webb

So You Want To Go Observing A Beginners Guide

I have been observing the night sky for several years now but I will never forget the first time. I came to Seething on an open night a looked through a telescope & thought "I'd like to have one of these". You too may be thinking that but many questions prevent you from going ahead.

In order to help you on your journey of discovery I shall try to answer some of those questions & offer some tips & tricks I have learnt along the way.

Before you rush out & buy any equipment the essentials are lots of layers of clothing as good nights are often cold. Footwear should be well insulated. A hat is also a definite necessity. A red torch to preserve your dark adaptation. As an aside our eyes will only see the dim objects of the cosmos when no white light is present for at least 20 minutes. As time goes by our eyes will see many more stars & celestial wonders unless we gaze upon white light. Then the process will have to begin again. I can't emphasize how crucial this is to having a successful observing session. So please remember any mobile phone or tablet will equally ruin your chances of success. Also a planisphere & map of the night sky will aid you in finding your way about the sky. In time you will be able to recognise constellations & deep sky object locations.

The choice of equipment is vast & varies in cost. It is possible to get started for a few hundred pounds. However it is equally easy to spend thousands if you get hooked. Long before you commit to a purchase spend some time looking through some members scopes on open nights & club nights. Sign up to be trained on the clubs considerable collection of scopes. Ask members questions. There is never a silly question & always someone prepared to assist you.

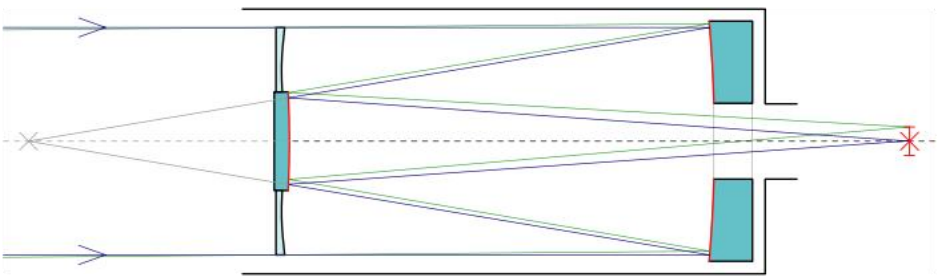
The first question to ask yourself is what do I want to observe?

The types of things you can observe include stars, planets, the moon, comets, asteroids & deep sky objects like galaxies, nebulae & star clusters. If you have a particular preference there is a preferred type of scope to aid your goal. Of course most objects are observable in any equipment subject to the limitations of the optics & sky conditions. We are familiar with fantastic images on the net & in books. What we see in a scope is very different. You will see shades of grey on most objects with the exception of stars & planets regardless of what sort of scope you have. Details of objects will come with experience & more aperture. That is how large the mirror or objective lens of your scope is. More on that later.

There are lots of different types of scope but three main types exist in variants.

Cassegrain telescopes use a combination of mirrors & glass. They tend to be stubby in appearance. These offer views of good contrast with dark backgrounds. Predominantly better on lunar, planetary & star observations like double stars. High magnification is achievable but wide fields of view (how much sky you will see) is limited.

Schmidt–Cassegrain telescope



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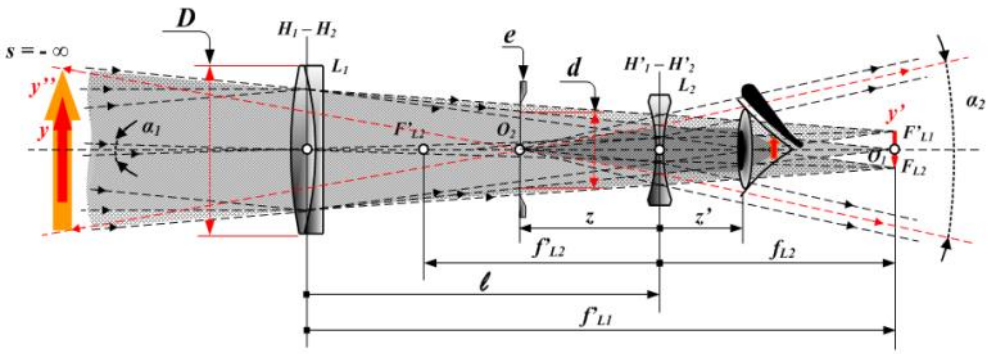
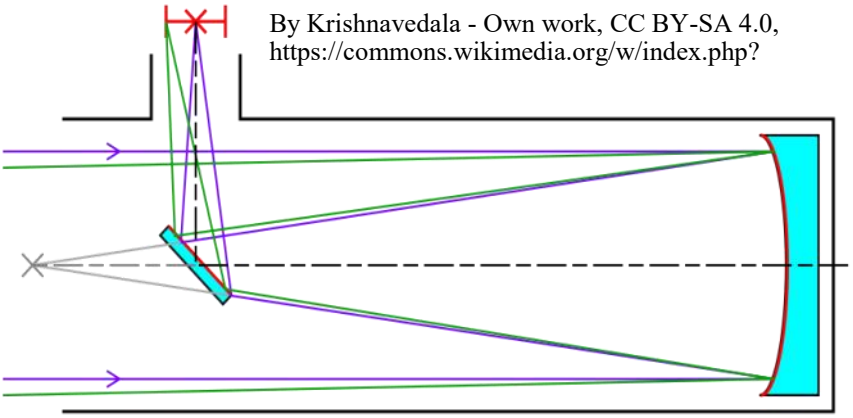


Refractor telescopes use just glass objectives of various types to correct the image & offer the sharpest & widest views. They present colour more vividly. Also good for lunar, planetary & star observations like double stars as well as open clusters of stars. Quality scopes are expensive & larger versions are heavy. Also in damp conditions a good night can be spoiled by dewing on the glass surfaces.

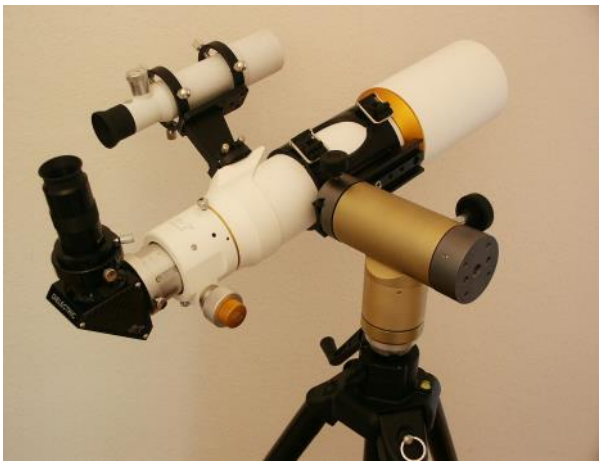
Newtonian telescopes use just mirrors. By virtue of their simplicity & relatively low cost to produce, the optics offer the best value for money. Accordingly you can get much bigger aperture for the same money as the other types. These offer the bests views of deep sky objects. However they can be much more cumbersome to transport.

By Krishnavedala - Own work, CC BY-SA 4.0, https://commons.wikimedia.org/w/index.php?



Another consideration is what to mount your scope on. Tripods come in a further bewildering variety. Alt-az or equatorial. Motor driven or goto computer controlled. All have their pros & cons. The simplest is alt-az which allows your scope to travel up & down & side to side. The most advanced, goto scopes, will allow you to access a catalogue of preprogrammed objects, automatically find them for you & then track them in the sky. Sounds ideal but each time you set up you will have to configure the scope with various information. Align it to some known stars or objects & then you will find sometimes that the thousands of objects listed are often impossible to view as they are outside the capability of the optics. Some purists will argue that simplicity will teach you how to navigate & learn the night sky.

By Marie-Lan Nguyen (Jastrow) - Own work, CC BY 2.5, https://



By I, Kosebamse, CC BY-SA 3.0, https://commons.wikimedia.org/w/index.php?

A telescope is only as good as the eyepieces & once again there are vast variations on the types & prices. It is worth noting that a universal fitting size of 1.25" & 2" is the standard & so interchangeability between scopes is possible. Various focal lengths allow different magnifications to be achieved. Different scopes may offer different magnifications & views through the same eyepiece. Whilst on magnification most objects in the sky do not require huge magnification. Typically between 50x to 200x magnification is all you need to see thousand of objects.

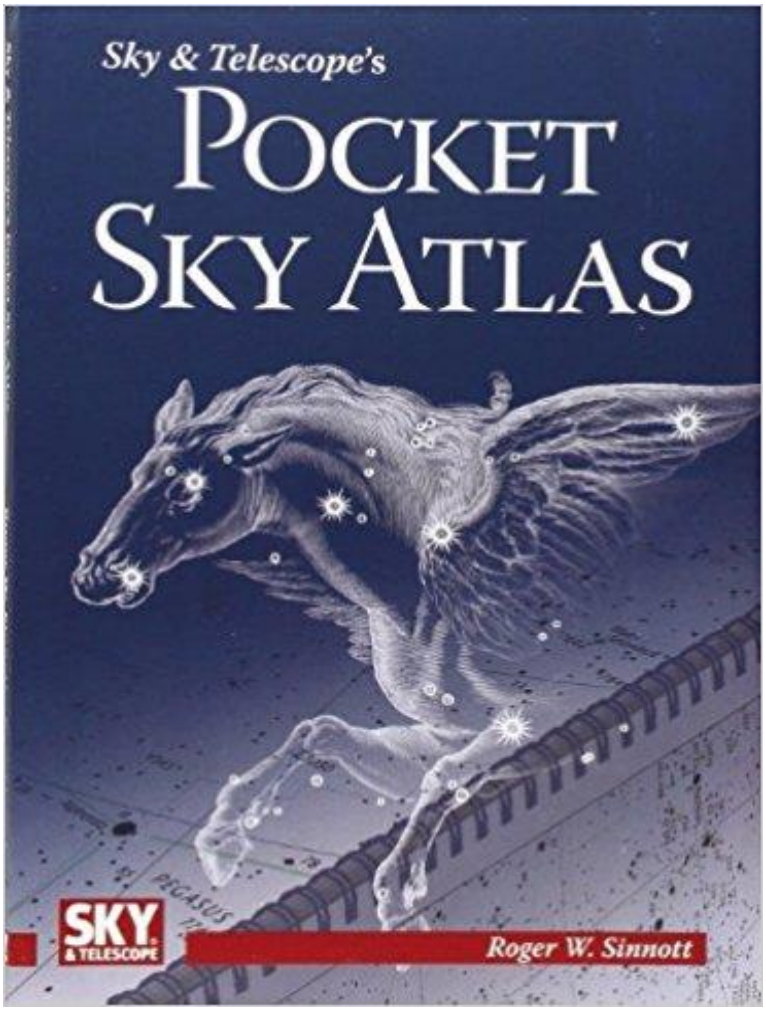
Another important question is how big a scope should I get?

Simply put the larger the aperture the dimmer the objects you will be able to see. A small compact scope may be more practical to transport, quick to set up & to begin with, show you

lots of things. Deep sky objects are often referred to as "faint fuzzies" because they are mostly seen as grey smudges in the eyepiece. With a scope of 4" aperture you will see a few galaxies as tiny fuzzies, planets like Jupiter will show bands on the surface & orbiting moons, Saturn it's rings & great views of the moon. Thousands of stars invisible to the naked eye also will be seen. Upto 8" aperture dozens more faint fuzzies will be observable. Details only really start to become apparent once your aperture is 12" or greater.

The last question is how do I observe?

Through practice, persistence & patience you will master the art but there are many resources to aid your quest. The internet is full of useful information but books & maps are most practical to use in the field. Finding things is a most rewarding but challenging task. There are literally thousands of targets already discovered & catalogued in various forms. Most people who are interested in deep sky observing will start with the Messier catalogue. 110 reasonably bright targets. Next is the NGC catalogue with more than 5000 objects. A lifetime of observing is available just hunting down those. A good book with over 1000 objects shown on constellation maps & lists with information like size & brightness is Objects in the heavens by Peter Birren. My first & well used book. If the purist route is chosen then star hopping is the best method to use. Start by aligning your scope on a bright star in the vicinity of your target. My experience has made me realize that a red dot finder is best for this. Then change to an optical finder or low magnification eyepiece to traverse the sky by following the stars you see on a map like Sky & telescope's pocket sky atlas. Sounds simple but this is when patience is required. However the reward is not only finding your target but seeing for the first time an object of unimaginable size & distance. As you perfect the art you will return time & again to favourites like the globular cluster M13. A huge ball of stars seen as a fuzzy cotton wool ball in a small scope & an incredible view of thousands of individual stars tightly bound in much larger scopes. Or a galaxy like NGC 7331 barely a streak in a small scope to a multi layer of bright core to ever dimming halo huge in the eyepiece of a 12" or larger scope. Or the Orion nebula an ethereal grey cloud of ever increasing brightness & detail as your aperture increases. Or the beautiful colours of double stars as ever increasing magnification reveals pairs where initially only one appeared. Or a once in a lifetime sight of a comet. Or seeing the shadow of one of the moons of Jupiter cast on the planets surface. Or the craters of the moon at high magnification on a still clear night. The awe & wonder of the universe holds magnificent jewels for those who persist.



M13 by T Latham

Enjoy the journey though you just might get addicted like me.

Paul Webb

Tracy Money

An Evening with an Astronaut

'An Evening with an Astronaut'
- Dr Michael Foale at UEA, 24th January 2018, Hosted by ISSET & Pint of Science, Norwich.

Norwich Astronomical Society has worked previously with Norwich "Pint of Science" - a group bringing science, quite literally, to the locals as their venues are usually pubs & bars! The group managed to book Dr Michael Foale to speak but, as the event was expected to be particularly popular, it was held at the UEA lecture theatre. The tickets did indeed sell out very quickly but several NAS members were lucky enough to grab seats (and at a discount; many thanks to Pint of Science).

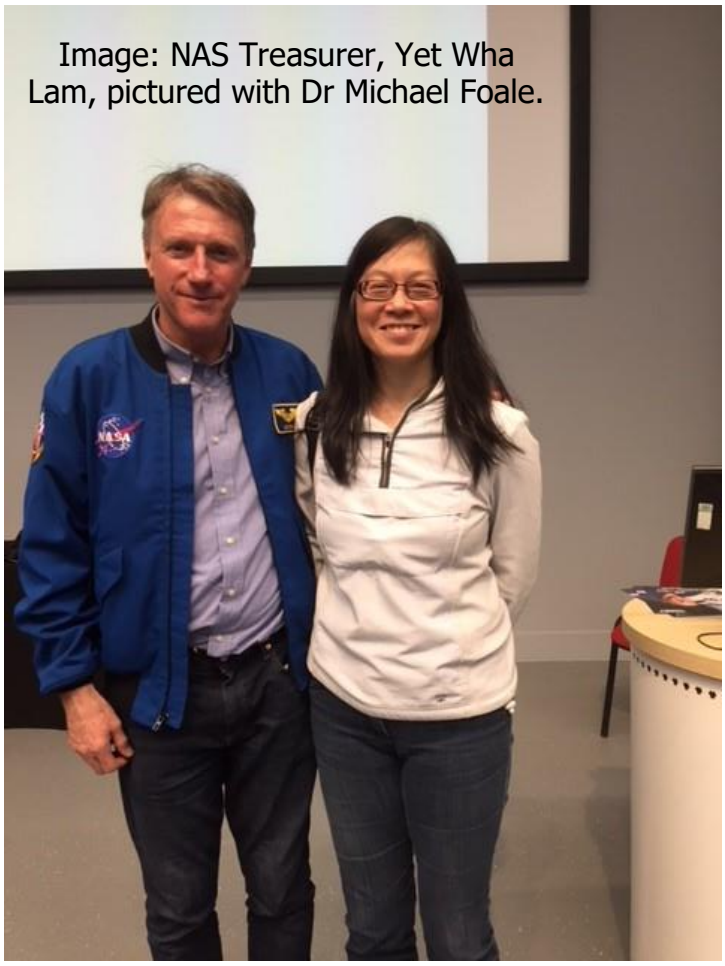


Image: NAS Treasurer, Yet Wha Lam, pictured with Dr Michael Foale.

Who is Dr Foale? He is the most experienced but arguably the least well known British-born astronaut. Incredibly, he flew on six separate Space Shuttle missions (though a couple were only one way) and one Soyuz mission. He was involved in several space walks (EVAs), including an extended one to service the Hubble Space Telescope, and was also named Commander of the ISS Expedition 8. That would be enough for most however Dr Foale was also involved in the politically-inspired mission where US astronauts stayed aboard the Russian Mir space station. What is more, during his time on Mir a serious collision with a cargo vessel placed the occupants of the station as close to dying in space as any astronaut has ever been. Dr Foale took partial control of the situation, despite Russian reservations, and provided a solution to the immediate problem of Mir being out of control which ultimately saved the station.

For someone with such an illustrious career, Dr Foale came across as particularly 'well grounded' with a very pleasant manner and from the start he formed a strong bond with his attentive audience. Explaining how he had started from small beginnings in Lincolnshire, failed to get into the RAF but relied on hard work and a bit of luck to end up working for NASA. Even so it took three attempts before he finally made it to astronaut training. Dr Foale engaged his audience on a very personal level, obviously aiming to enthuse the children and was successful in that - one proof being a 'pogoing' six year old who had just managed to get a selfie with an actual astronaut!

The first half of the talk skated through Dr Foale's early life, Shuttle, ISS and Hubble missions. A bit quickly perhaps but very interesting none-the-less. A break for tea (alas this was a somewhat 'dry' Pint of Science event) resulted in what was apparently a never-ending "selfie" queue to the stage. In the second half, Dr Foale regaled the audience with the drama of the Mir EO-23 mission. Dr Foale recounted how he and the two Russian astronauts were potentially minutes from death yet all remained calm enough to save not only themselves but the station as well by performing a completely untried and theoretical manoeuvre. A fantastic tale to conclude a wonderful talk which we felt privileged to attend. Thanks must go to Pint of Science and Chris Barber of ISSET for making it happen.

Andy Gardiner & Tracy Money

WIDE FIELD IMAGING

By
Shaun Reynaulds

PANORAMICS , THE WIDER VIEW.

To continue on from last months series, to capture the milky way in all its glory requires a large field of view to show it off. Typically, 180 degrees ! So, even with some wide lense, this is not enough to show it in one go. The need for a panoramic of multiple images is needed.

The camera settings as discussed earlier all set to go, focusing done, now its just a case of where to start. For me its always down at the lowest point you want so how from the South and the Galactic centre around Sagittarius. I find that works well as a reference to start with. Obviously, the lense chosen will dictate the field of view available to you and therefore, the total number of images required to achieve a full milky way vista.

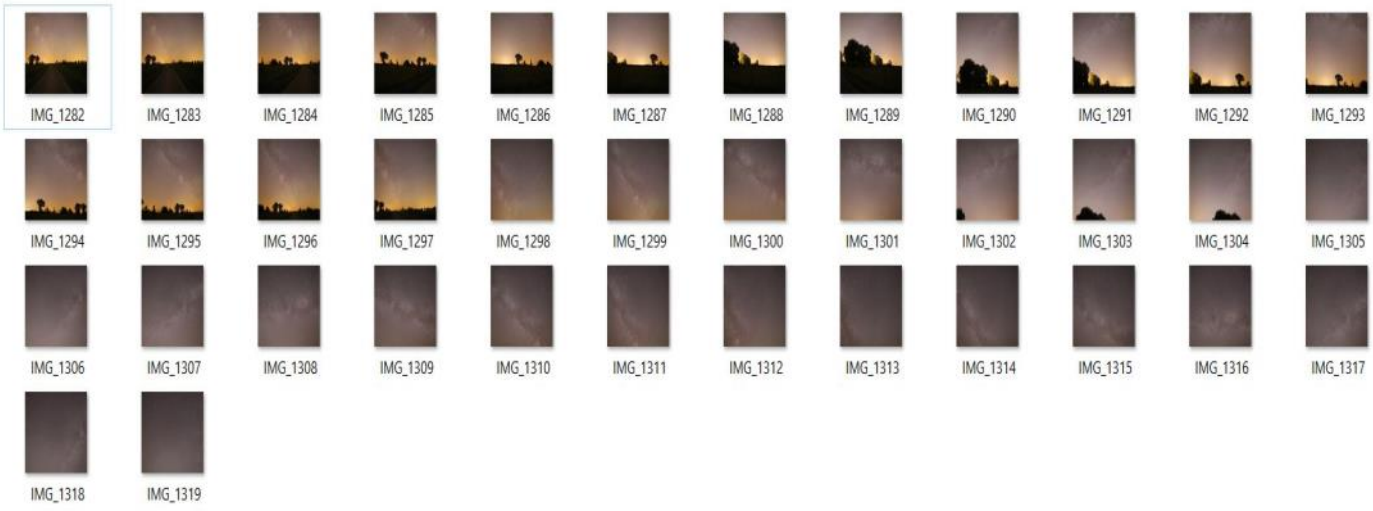
In this example, I am using a 24mm lens on a full frame camera so a FOV of 74 degrees x 53 degrees. So, if I want to capture the span of the milky way, you would think that all id need was 3 images (74 x 3 = 222 degrees) and as the span of the Milky Way is around 180 degrees when its high in the sky that would do. Unfortunately not as the distortion and vignetting would be too much and the software not able to stitch . So, a series of exposures with an overlap of I find at least 25 per cent is required to overcome this. So ideally , at least 6 shots to get the FOV needed. Also however, when the milky way is high in the sky ,

the vertical FOV is up to 90 degrees so the need for vertical FOV is needed .

The way to go about this I have found is to start in the lowest corner , I start on the right towards Sagittarius as mentioned earlier. Thats just my preference , the left side to North would work just as well. Wherever you start , speed is paramount so the settings, focus and position needs to be selected prior to starting as once the sequence is underway, consideration needs to be given to the rotation of our Earth in relation to the skies. When I start the panoramic, as the first image is done and downloading the info to the cameras SD card, I start to move horizontally to the next position.

The image here is of a 200 degree (approx) by 90 degree panoramic which I did last May at Ilketshall St Margrets, it is a total of 4 rows of 10 images starting from the bottom right and moving horizontally across to the left, then moving up vertically from the left and starting the second row of 10 horizontal images until I reached the end of the sequence. The total time for this was around 17 mins so the need to work quickly is the way due to movement of the Earth's rotation. Another consideration is to capture a larger area than you need as once the software puts together the finished picture, there will be parts at the edges that once cropped , will fall outside the area wanted. There are a few programs to do the stitching , one of them which is free is Microsoft Ice. Others can be found like the one from Photoshop an Lightroom. If you want to pay for a separate piece of software then TP Gui or Auto Pano are very good.

The image below is the total amount which went into making the image , as seen , there is a considerable overlap to overcome distortion and vignetting .



The next issue I will talk about Lightroom and processing the Images which is the most important part of the whole process

Shaun

Star Tracker Mount

Astronomy Sector Drive

When I wrote part 1 of this project I thought that it would be a simple-ish project for people with some practical wood working experience. However, I forgot that the project need the use of a router and a metal working lathe and I realise that not everybody has access to these.

So what I have decided to do is provide you with the drawings and open this up to a society wide discussion. I am quite prepared to help people who want to have a go at this project, but I am one of those people who do not own a router or a lathe(Although I have access to both, it is not easily so).
The drawings are scale drawings and the only really important measurement is the radius of the sector itself, which in this case is 270mm.
The prototype has been made from a 6" wide oak shelf available from BandQ and one shelf is more than enough wood to make one sector drive, including the sector itself.

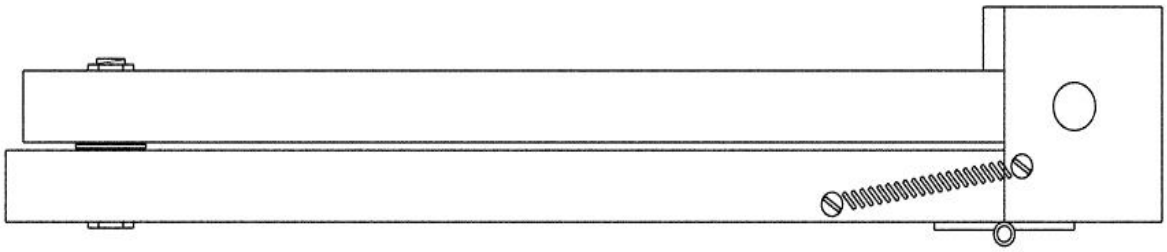
As you will see from the drawings the base board is made from two pieces and is hinged and spring loaded. It is hinged to allow the drive screw and the sector to be separated so the sector can be reset, and spring loaded to make sure that when you are driving a good contact is made between the drive screw and the sector.

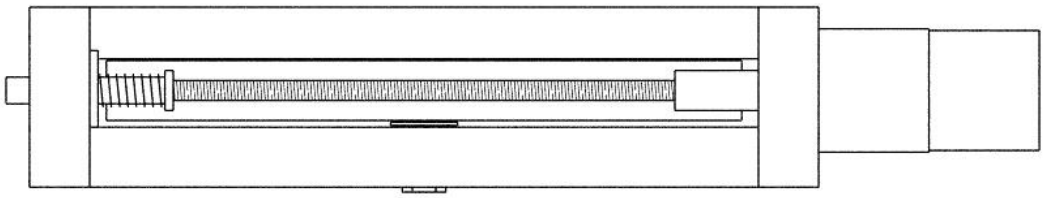
All the parts are relatively easy to obtain and although the drawings show ball races for some of the bearings, these are not absolutely necessary. Simple plain bearings can be made from pieces of 8mm OD Aluminium tube and 6mm bolts. The ID of the aluminium tube is 6mm so is a nice sliding fit. The drive screw is 6mm threaded rod from the above mentioned supplier.
The motor is a simple DC motor with built in gearbox (around 3 RPM) purchased on Ebay as is the adjustable voltage regulator is a DC-DC Buck Step Down Converter Module LM2596 Voltage Regulator TE097.

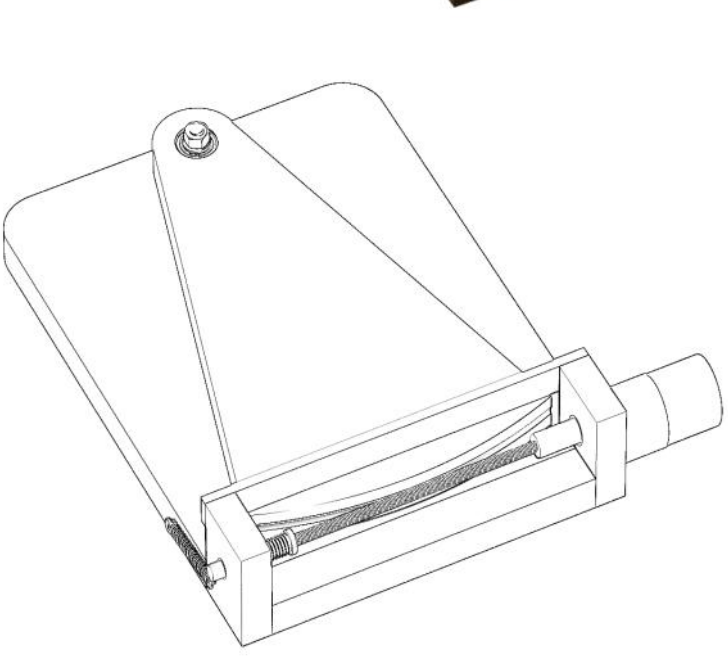
Right that is all I'm going to say here. I have cut and paste the drawings to this doc. So, have a look and let me know if you want to have a go at building it. If there is enough interest we can organise something during the summer and quite possibly get some of the more difficult to make items made all in one go.

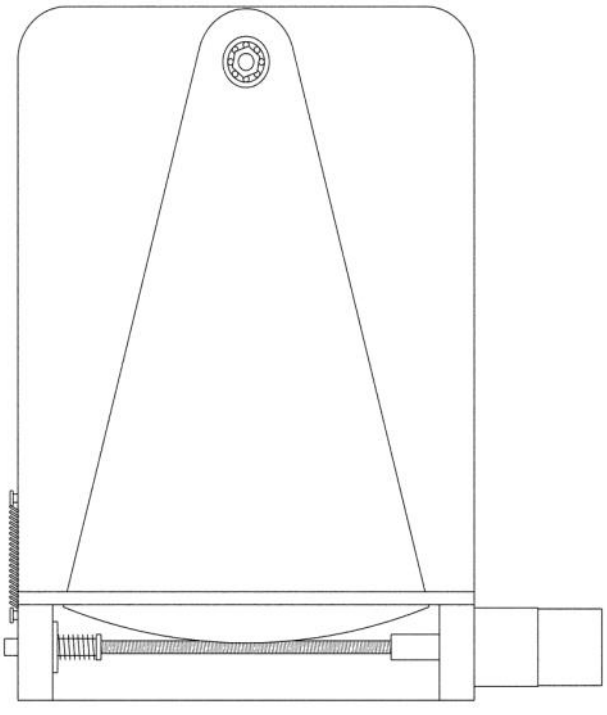
Cheers

Dave EC









Geof Lewis

IMAGING THE PLANETS
Challenges, tips and tricks (Part 3)

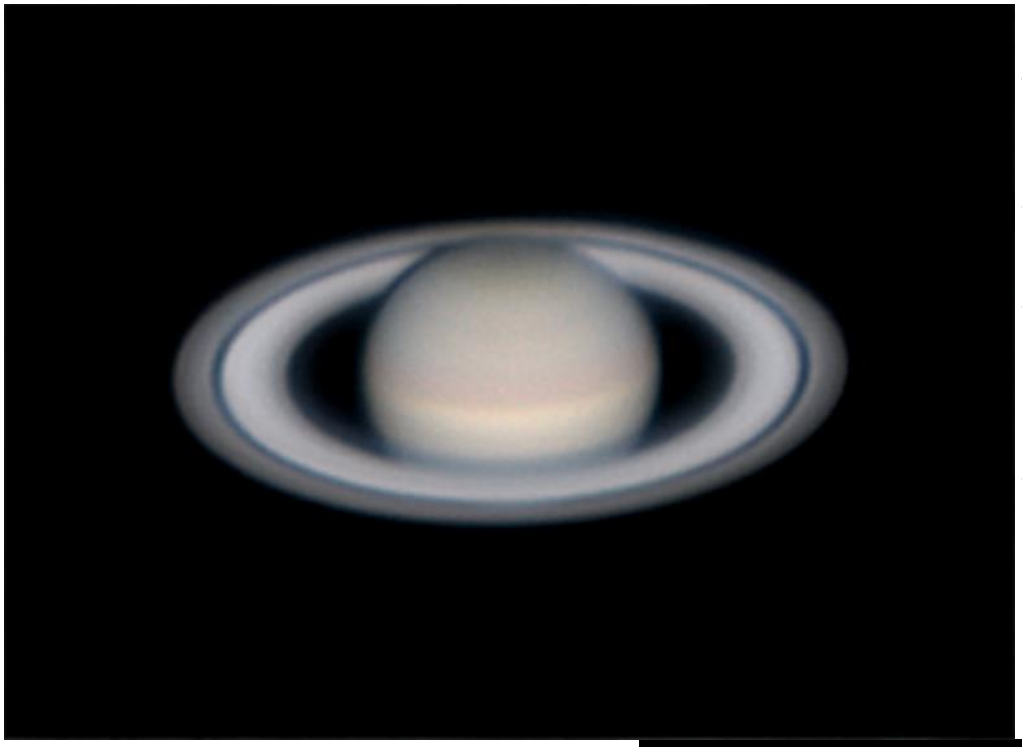
Imaging the planets – challenges, tips and tricks (Part 3)

In Parts 1 and 2 we considered the need to prepare the telescope for planetary imaging, the effects of seeing and atmospheric dispersion and explored tools and software to help mitigate those effects. In this final part we will consider the impact of planetary rotation on image capture, plus the tools available to mitigate that. In conclusion I will summarise my thoughts on all the aspects covered in this three part series.

Rotational speed of planet

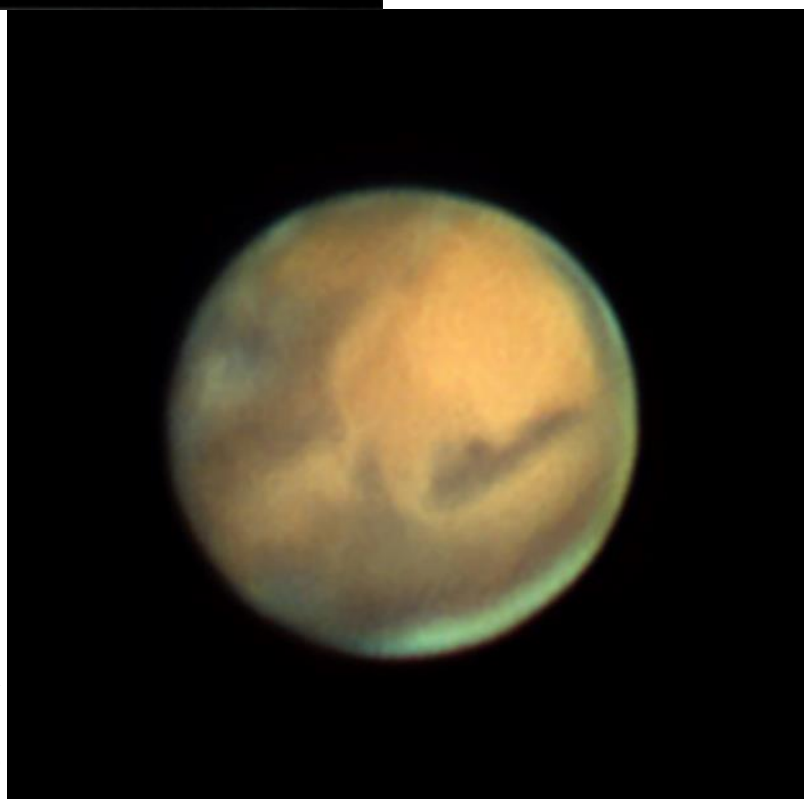
Lastly, at least for the purpose of this series, one further thing to be aware of in particular when imaging Jupiter or Saturn is their very rapid speed of rotation. Earth's day is 24 hours, but both Saturn and Jupiter complete a single rotation in less than 10 hours. There is much less detail visible on Saturn's globe, but huge amounts of detail may be seen on Jupiter, with many features like the GRS clearly being seen to rise, transit and set as Jupiter rotates. As described in Part 2, 'lucky imaging' allows us to grab the best frames from a video and stack them on top of each other to produce a sharp final image. However, if the 'lucky' frames are taken over a long time interval then the revealed detail will have moved between the frames and the stack will appear smudged; hence the recommendation to keep the videos at no more than two minutes duration. Two minutes is a short time period and even with very fast cameras capturing at say 30-60 frames per second, there might not be many good frames to stack. We therefore need a way to capture frames over a longer period and 'correct' them for the known rotation period of the planet. Fortunately software exists which does exactly that; it is called WinJupos. By capturing each video file with a precise time stamp embedded in the file name, WinJupos can calculate the midpoint time of a series of video files, or pre-processed stacked video file images, then advance or retard each to this nominal midpoint before stacking the images. In this way up to 20-25 minutes of video can graded, best frames selected, de-rotated and stacked to produce a high definition image. Firecapture software will automatically capture and save video files with the correct date and time stamp convention required by WinJupos, making this a straightforward easily repeatable process.

The below image of Jupiter with its moon Io in transit was taken by me in April 2015 with my aforementioned 10" Meade and DBK colour camera with the ADC in train, using Firecapture, Autostakkert, Registax and WinJupos to stack the best frames from 22 minutes of video data. A lot of detail is visible on Jupiter with Io passing just above the GRS. It was especially pleasing to show the phase of Io with its own day and night sides clearly visible.



The image of Saturn was taken with my C14 telescope in July last year at an altitude of just 15 degrees using a mono camera with RGB and IR filters.

To complete the set, below is an image of Mars from June 2016 taken with a colour video camera through my former 10" Meade LX200 during its last biennial apparition. I'm looking forward to trying to capture it again in the coming months, despite that it will be at a very low altitude as seen from the UK.



I hope that this series of articles have provided an insight into the requirements for capturing good quality images of our solar system neighbours.
In summary, capturing the planets requires:

- A well collimated, thermally balanced (cooled) telescope of reasonable aperture
- Good seeing
- A target at a reasonably high altitude – the closer to the zenith the better
- A fast frame rate colour or mono CCD video camera
- An atmospheric dispersion corrector (ADC)
- RGB filters (optionally also an IR filter) if using a mono camera
- Capture software – FireCapture is highly recommended
- Stacking software – Autostakkert is highly recommended, or Registax
- Sharpening software – Registax wavelets highly recommended
- De-rotation software for Jupiter and Saturn – WinJupos
- Any other post processing software for final image tweaks, e.g. Photoshop, Gimp, Paintshop Pro, or various astro specific tools such as PI, IP, etc.
- Lots of patience – trust me on this one

Good luck and above all have fun….!!

SKETCHPAD

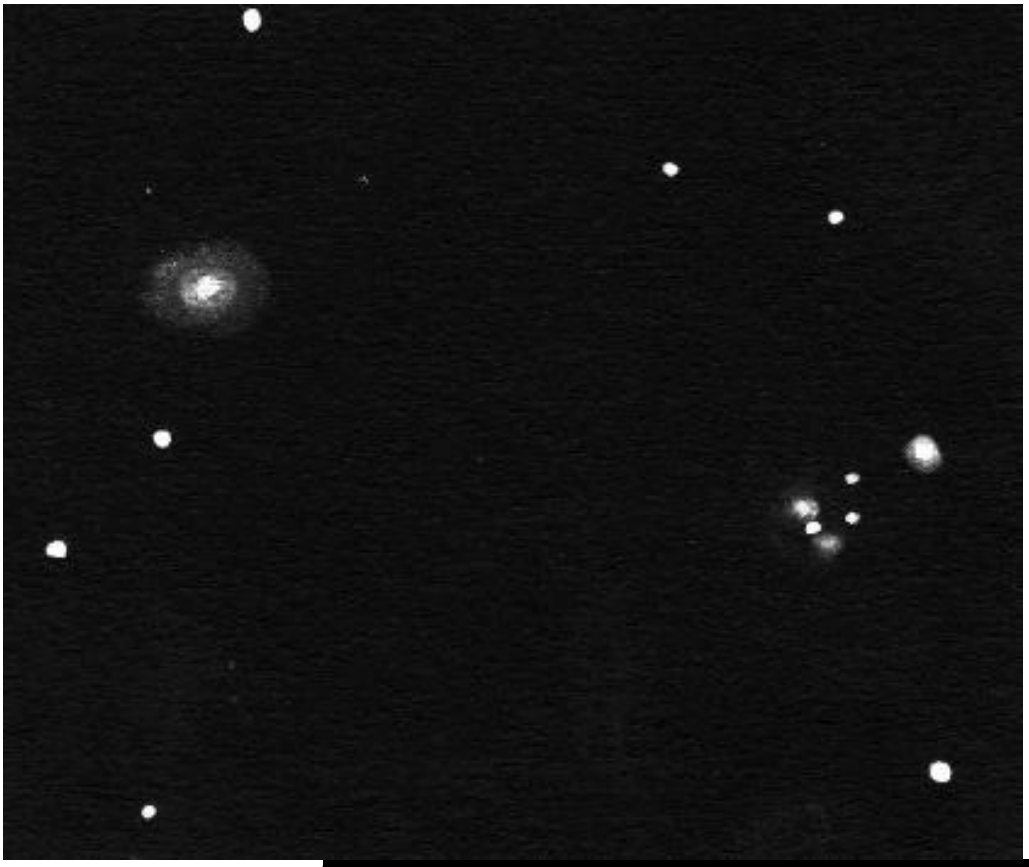
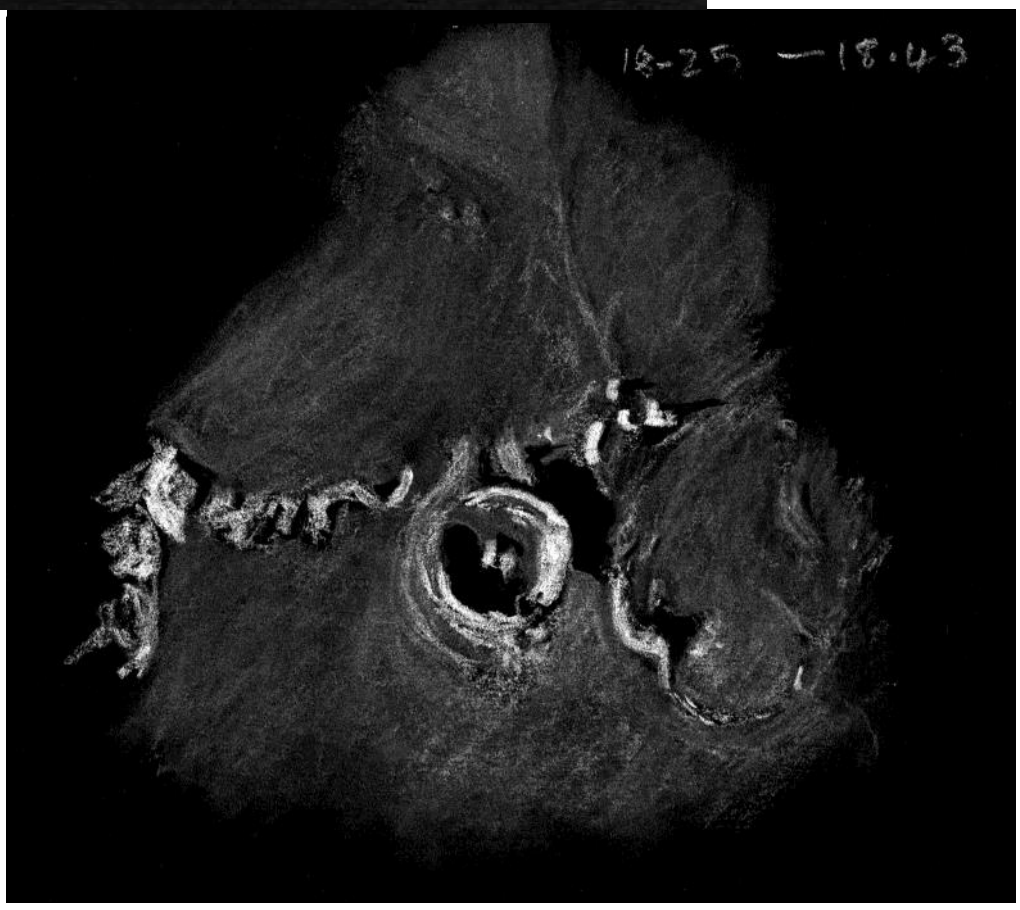
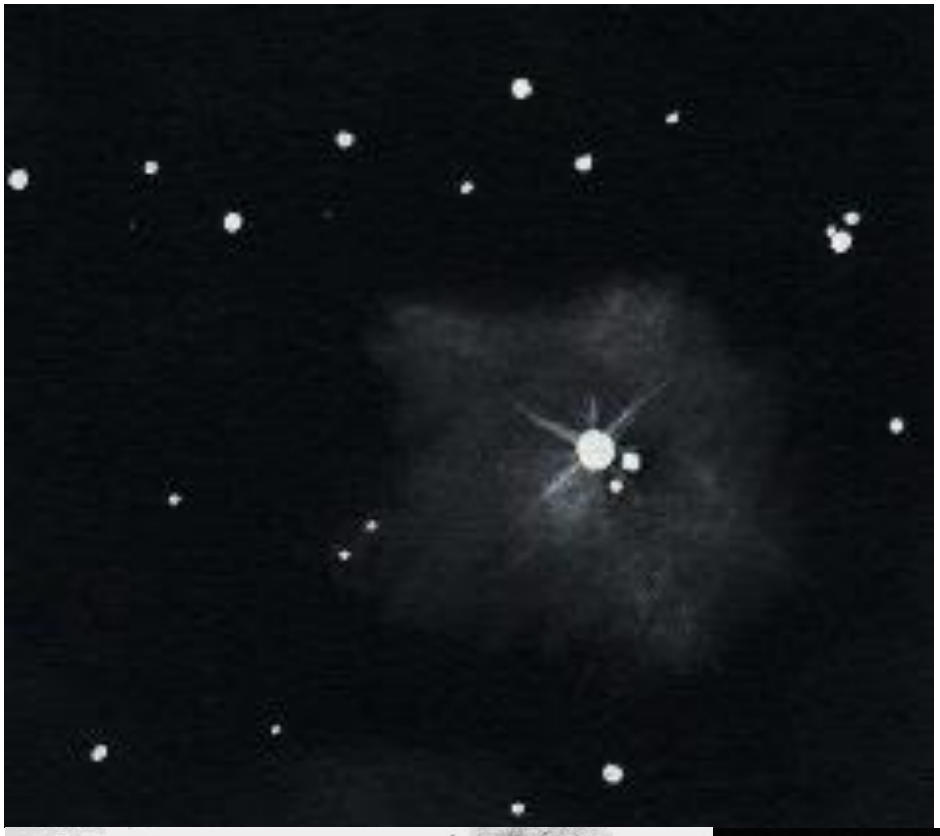


Image by Dale Holt

2018-1-18 Arp 61 505mm-watec120n Jpg b&w

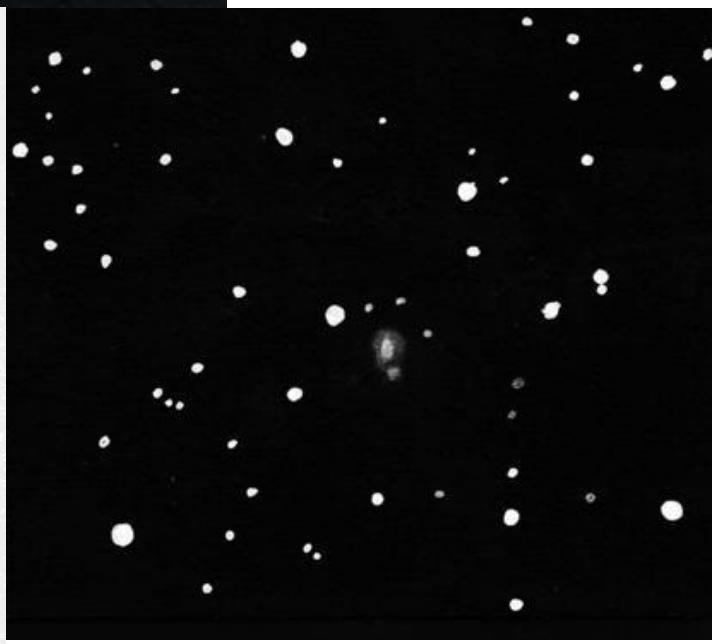
Right:
Eratoshenes
25.1.18
Graham
Sparrow





Left:
2018-1-18 IC 435
505mm-
watec120n+B&W
By Dale Holt

Below:
2018-1-19 Arp 52
505mm-
watec120n+b&w
By Dale Holt



Left:
Lunar X
Graham Sparrow

MEMBERS'IMAGES

Above: IC 1318 Butterfly Nebula and NGC6910 Open Cluster Paul Fearn

Below: IC 1396 (Hubble Pallet) Shaun Reynaulds

Left: M52 and NGC7635
Shaun Reynaulds

NGC2237 Rosette Nebula
Chris Grimmer

A Spot Of Solar Observation

Andrew Gardiner

Solar Observing Part 4

In this final part of my short series I'll cover some more obscure solar observing, a couple of technicalities and give a quick comparison summary.

Calcium K observing.

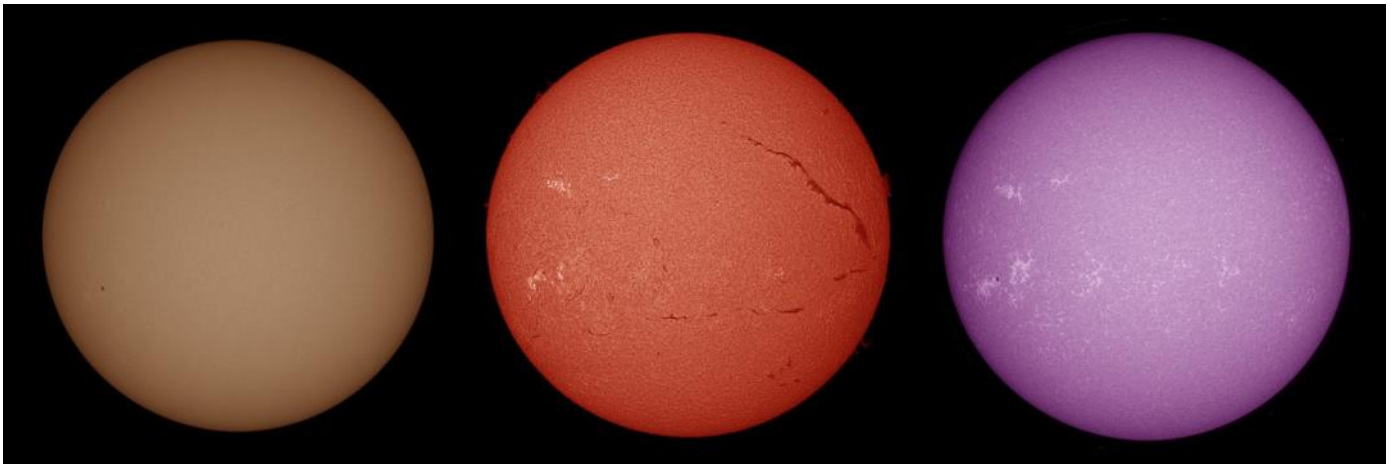
We have seen how Hydrogen alpha is favoured as an easily viewed narrow bandwidth observation. One reason for this is that ideally we need to look at an emmission frequency which is both clearly visible and far enough from other emission lines that the filter required to resolve it from the other 'noise' does not become prohibitively expensive. If there is more than one frequency in the viewing 'window' then the observer will not be able to defferentiate between those frequencies (which may be from more than one source) and the telescope may not focus the two or more frequencies to exactly the same point requiring the optics to be more expensive. Ha is an ideal choice as it's relatively alone in the spectrum, requiring only a sub 1nm bandwidth filter to remove most of the noise, and it is a strong red colour in the visual spectrum so can be observed clearly. Elsewhere is the spectrum is more cluttered. However at the blue end of the visual spectrum is a line produced by calcium - the Calcium K or CaK line at 393.4nm. This has the advantage of being generated by hotter material deeper in the Sun so gives views which would not be possible in Ha and, of course, it is visible visually. So why don't we use this more? There are a couple of reasons. Firstly it is vey close to the ultra violet part of the spectrum which makes filtration accuracy very important. Secondly, there is another line that is very close. Ideally this would be filtered out however it is fairly weak so is generally ignored which enables wider bandwidth filters to be produced and used at economic cost. Unfortunately this can influence the image - sometimes making it somewhat 'soft' - however this is usually deemed to be an acceptable compromise. The third of the 'couple' of issues is more personal. As humans age the lenses in their eyes gradually yellow which filters out the higher frequencies of blue light. We are trying to view extreme blue light so that's obviously not good for older people - in fact some much older viewers cannot clearly see the CaK line at all! On the other hand, observers who have had cataract operations will have clear lenses so will not suffer from this problem and will have the CaK view of a 20 year old!

Having said all this, CaK views are clearly different from Ha. They tend to show finer structures and 'hot spots' and, since the structures are from slightly deeper in the surface of the Sun, they can show events before they are even visible in the Ha view - such as material upwellings which are precursors to potential sunspots and mass ejections. In addition the features of CaK views are often far more tightly associated with magnetic fields so some magnetic field structure can be inferred from an optical view.

So how do you get to see this? Well, the same way as Ha - with a filter set on a refractor! There is a Coronado PST which is built for CaK, and also a Coronado SolarMax 70mm CaK and both apparently work well. There are also Lunt CaK filters built into diagonals which operate on refractors of up to 100mm aperture. Unlike Ha, it is not easy to produce larger scopes with simple energy rejection filters as the filters are prohibitively expensive to make for CaK wavelengths so CaK is really down to purchasing commercial equipment. Be aware but if you can't see CaK easily in a small scope, increasing the aperture only increases the brightness of the image not the frequency so it is unlikely to help you see anything! The moral is to look through a CaK scope before purchasing one.

If you can see it, CaK is quite rewarding however, for most people it's an imaging frequency only and this can be done very effectively. There is a new Baader CaK filter set available which very cheap. It consists of a notch filter for CaK along with an ND3.8 filter to reduce the brightness to acceptable levels but note that this is strictly for imaging only as, apart from bright at the eyepiece, it may leak invisible ultra violet light which is obviously dangerous.

There are other frequencies that can be observed but as they are close to other emission frequencies the filters are difficult to produce thus expensive which really puts them beyond the reach of the average 'back yard' astronomer - Sodium D2 at 589nm is arguably the only one that may have potential but the Daystar filter alone will set you back over £4000!
So let me make a direct comparison:



This series shows how the various wavelengths were imaged at the same time:

(left) white light image – shows little apart from one sunspot.

(middle) Ha – shows significant surface cell granularity, ribbons, filaments and some nice prominences. Also some bright surface components with a very small sunspot.

(right) CaK – the source being deeper shows no filamentous ribbon structure but clearly defines the sunspot and hot material both around it and other components well beyond. In addition there is cell granularity. This proved to be a developing state which displays the power of CaK to 'predict' the future.

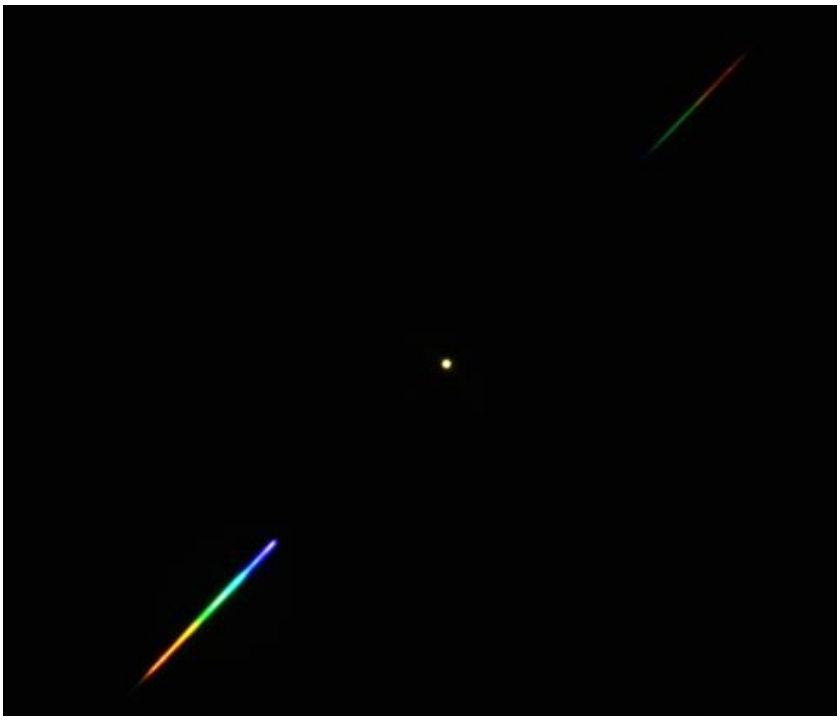
I think this strip demonstrates the 'hit' that can be gained with differing wavelengths – white is cheap but low hit, Ha is mid-high price with good feature definition, CaK is also higher price but doesn't really show its usefulness unless associated with Ha.
If you are considering a step to the light and warm side to observe the sun, there is a lot going for it. It's daylight and generally warm for a start! You can begin with a cheap white-light filter. The next step would be to a small Ha observing tool of some form and that would be as far as it goes for most observers. The step to CaK would be mainly for imagers or younger observers. In general moving beyond that would mean great specialism and deep pockets. The fact that the sun is a dynamic structure means that observing changes visually from hour to hour or even minute to minute is possible. Imaging needs care – artefacts called "Newton's Rings" can plague solar imagers however some cameras give significantly better results than others – eg ZWO 174, IS DMK41 – but stacking images can also help and in any case can generate excellent results. Video can be a really useful tool and with luck can even capture very fast solar eruptions. Solar observation can obviously be of great interest if you like to see the heavens in action. There is loads of help and advice on the internet – try the Solar Chat Forum at solarchat.com or the solar section of Stargazer's Lounge at Stargazerslounge.com. If you get a chance, give it a go!

Andy

Andrew Sutkowski

The Colour of the stars

Having been a mad scientist for Shell and Infineum for over 27 years, I thought it would be interesting to apply a little science to Astronomy and investigate the spectra of the stars. Actually acquiring spectra from stars is simpler than you would think. All you need is a diffraction grating, something that will split the incoming light into the various wavelengths it contains (remember using a prism to split white light into the colours of the rainbow?). Paton Hawksley Education Ltd produce two diffraction gratings for star spectral analysis, the Star Analyser 100 & 200 mounted in a 1.25" filter housing.



For my setup I obtained the Star Analyser 200 which was mounted ~40 mm from an Altair Astro 183C camera via 1.25" nosepiece. This was mounted in a Celestron 8" SCT in order to capture spectra from stars. Then wait for a clear night, calibrate and focus the telescope, mount the filter and take an image. The image to the left is of the star Navi and is one of the first images captured with a 3 second exposure time.

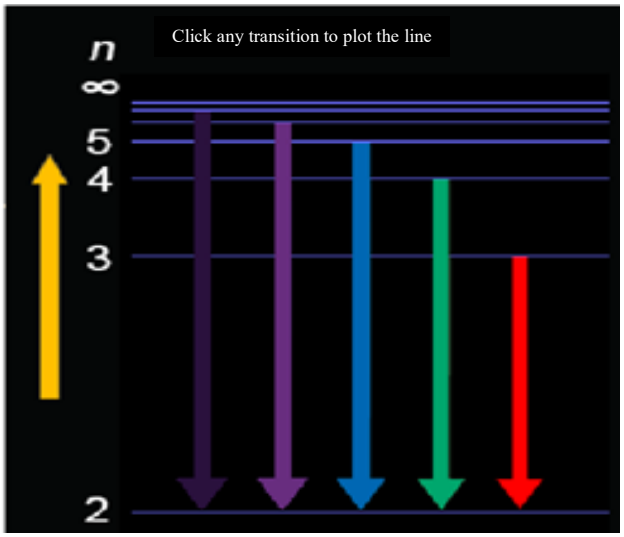
Navi is roughly in the centre of the image with an intense colour band heading to the bottom left corner and a fainter colour band heading for the top right corner. These coloured bands are the spectra for Navi, and it is the intense colour band that we are interested in.

When setting up the equipment you are supposed to orientate the Star Analyser grating such that the intense spectrum is horizontal and to the right of the star. (Note to self – read instructions next time!)

Before continuing with my star spectroscopy journey, it's probably worth going into a bit of the science behind what we are seeing. Going back to our prism and white light example, we have white light being split into the spectrum of colours it contains. Each colour is at a specific wavelength of light going from violet (shortest wavelength of visible light) to deep red (longer wavelength). The eye observes the different colours because it can sense the visible wavelengths of light. When we look at a star we observe the 'combined' colour from the various wavelengths emitted by that star.

The light from a star is a continuous spectrum, as opposed to an absorption spectrum where the light from the star passes through something else, like a gas cloud, before reaching the observer. In this case the spectrum will contain dark bands where the gas cloud has absorbed light at specific wavelengths corresponding to its own composition. Thus the spectra we will observe contain absorption lines corresponding to the stars atmosphere through which the light has to pass. The inverse of this, Emission spectroscopy, results from the release of energy at specific wavelengths from an element or atom. When you increase the energy in an element or atom, the electrons inside move into higher orbital spheres. This is a bit (although very simplified) like stretching a rubber band.

The more you stretch the band the more energy you put into it and the further it travels when you release it. However, in the case of electrons energised into higher orbitals, when they jump back to their normal position (level 2) they emit energy at a specific wavelengths. In the case of hydrogen the 'Balmer series' is the name given to its emission lines represented in the diagram from RSpec.

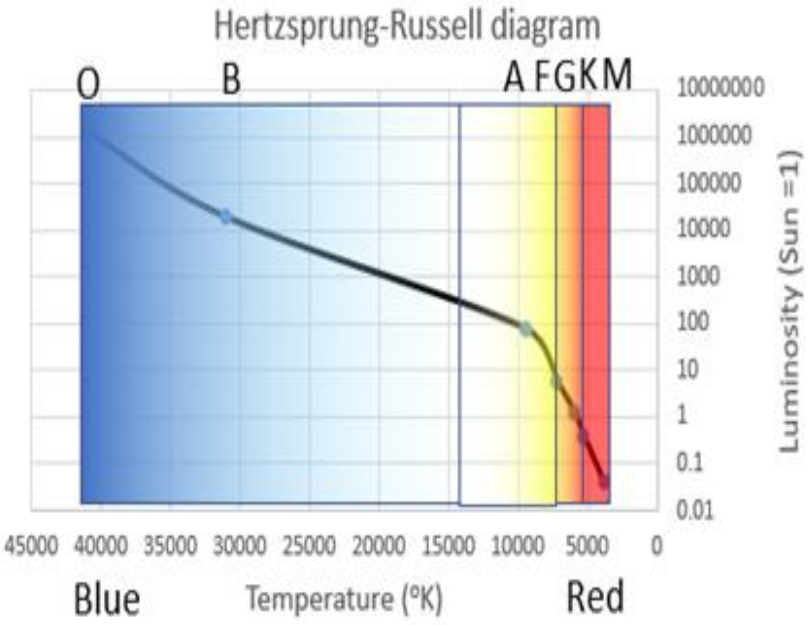


The Hydrogen Balmer emission lines occur at:-

Hη = 3835.38 angstrom (jump from level 9 to 2)
Hζ = 3889.05 angstrom (jump from level 8 to 2)
Hε = 3970.07 angstrom (jump from level 7 to 2)
Hδ = 4101.74 angstrom (jump from level 6 to 2)
Hγ = 4340.47 angstrom (jump from level 5 to 2)
Hβ = 4861.33 angstrom (jump from level 4 to 2)
Hα = 6562.81 angstrom (jump from level 3 to 2)

Some time ago I watched a program on the 'seven stages of stars'. My summary of this is that when a star is born (somewhere around stage 3), it is typically composed largely of hydrogen as this is the most abundant element in space. The complex nuclear reactions going on in the core typically involve fusion of the elements that the star is composed of to generate heat and light. Thus new stars typically convert hydrogen to helium and are very hot. As the hydrogen source depletes, over billions of years, the star will start to convert helium into carbon and heavier elements, but this occurs at a lower temperature. Eventually stars end up as a red giant, like Betelgeuse, which given enough time, reaches an imbalance between its size/mass and core gravity separating into a planetary nebula surrounding a white dwarf (the remnants of the core).

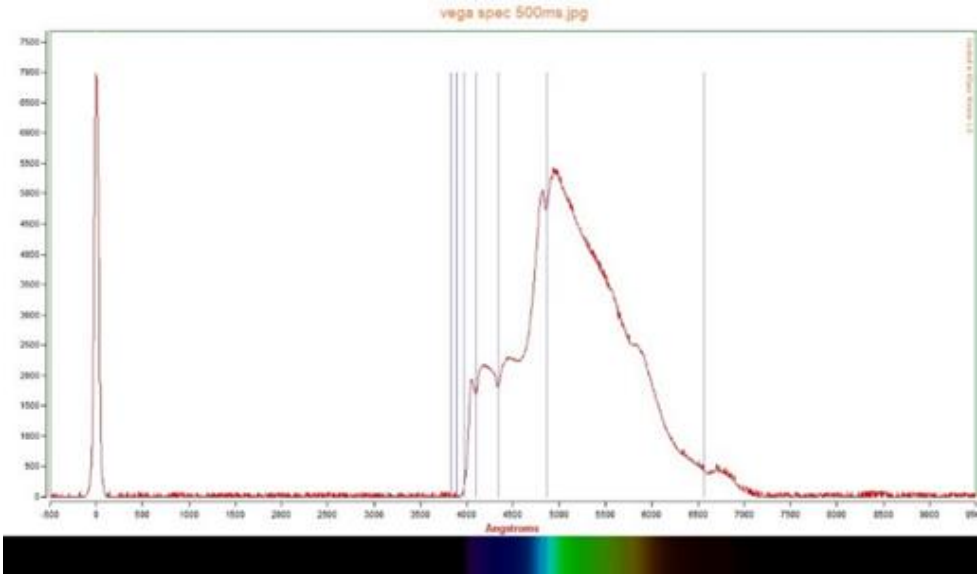
Astronomers in the 19th century observed these differences in star spectral composition / temperature and devised a classification system from hottest to coolest (O, B , A, F, G, K, M) which are then divided into 10 sub classes (The Hertzsprung-Russel diagram tries to show the relationship between temperature and colour). Additional roman numerals can also be added to include the luminosity. The Sun is a G2 star. Classification is based largely on the complexity of absorption lines in the spectrum, where the hot stars (O & B) have simple absorption lines owing to presence of very few elements. Thus, we are looking for the dark bands (or dips in intensity) from the continuous spectrum of light emitted by a star to tell us what elements are present, as these will absorb light at the wavelengths corresponding to their emission spectra. This is easier to observe than explain!



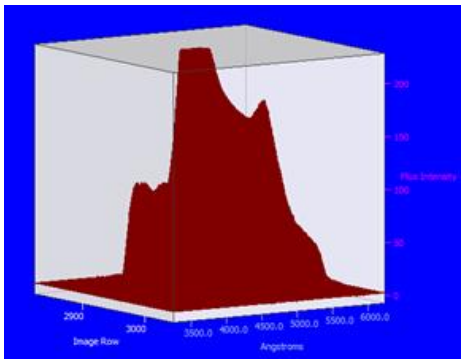
Enough science, back to observations with an improved setup and data analysis. Capturing images with Star Analyser is simple. Given the brightness of a star exposures range from 250 ms to 40s in a series I performed. You can use greyscale or colour, I just like seeing colour images so captured in colour. I did try capturing video files, but this caused many headaches with my setup. With an image size of 5440 x 3648 pixels the video files rapidly become large. For some reason anything over 2 Gb could not be read by windows media player or other tools. Eventually I was pointed in the direction of PIPP (Planetary Image PreProcessor) which could read the files and reduce the number of frames giving me a useable video file. I chose to use 'RSpec' software for data analysis as this was comprehensive and looked easy to use. However, this could not read my video files so I ended up capturing images as 'jpg' still images (converting selected video frames to jpg's).

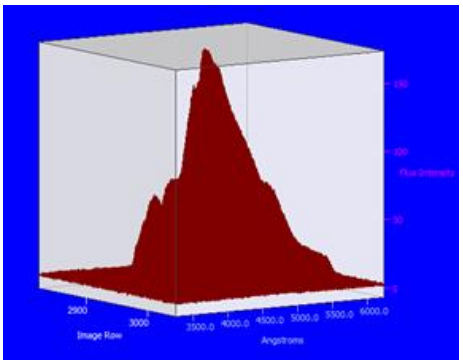
RSpec recommends calibrating your equipment using images of Vega. If you have a simple webcam or proper video driver for your camera you can capture images directly within RSpec. In my case I had to capture the images and post-process them with RSpec, this requires capturing images of each star at a series of exposure times. When you bring the image into RSpec there are simple tools to allow you to perfect the rotation so that the star is on the left and the spectrum is horizontal.

You place horizontal lines to define the band within which the star and spectrum lies, resulting in a plot of intensity versus pixel position in the right -hand window. The image of Vega below has been calibrated and the Hydrogen Balmer line series are shown as vertical lines which correspond to 'dips' (absorptions) in the spectrum.



It is important to choose an image with the optimum exposure as too much exposure could result in loss of detail in the brighter areas through saturation. Finding the optimum exposure is simply performed using a 3D tool in RSpec. You select the area of the spectrum in the star image and RSpec can show a 3D plot of that area. You can go through a series of images, which assuming they were taken at the same time will open in exactly the same position in the software, and you simply ensure that you select an image where the maximum intensity is not flat at the top (left image below). The right hand image, at a shorter exposure time, reveals detail in the peak which would be lost if the left hand image was used.

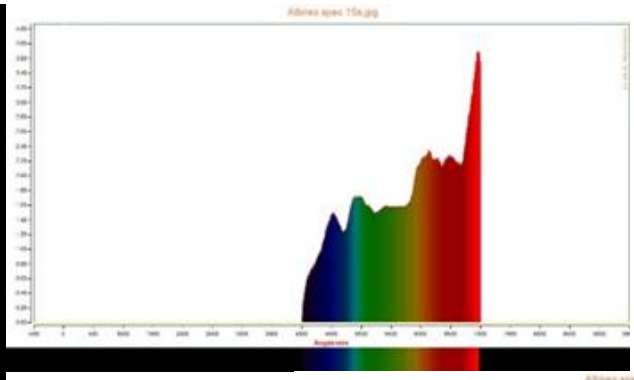




The next step is to 'Calibrate' the software so that is recognises how many angstroms/pixel for the setup that you are using. In RSpec this is simple, the star becomes point 0, you then select a Hydrogen Balmer absorption dip in the spectrum from Vega and assign it the correct value. In the Vega spectrum image above the Hβ line at 4861 angstrom is just to the left of the main peak. All you need to do is click on the respective 2 points in the spectrum to calibrate the system. Once this done, calibration of subsequent images taken with the same setup only requires you to zero the spectrum on the star, which invariably comes at a different point in the image each time.

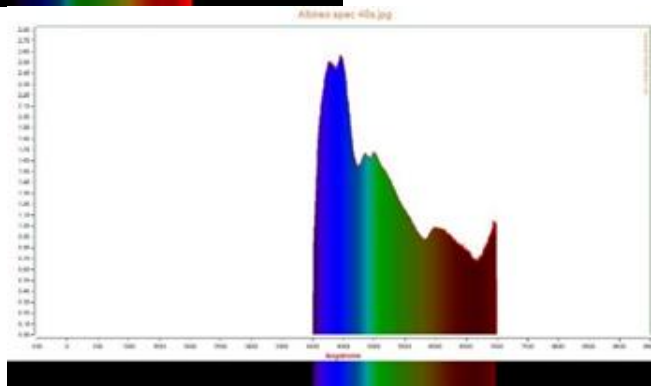
A further sequence of calibration steps can be performed to compensate for the 'instrument response' factors in your camera and setup. The steps are well documented (video tutorials) within the RSpec site allowing you to generate spectrum that can then be compared to the library of star types.

A good example of the difference in star colour/temperature and spectrum is to compare the twin stars in Albireo. The left hand plot below shows the spectrum from Albireo A (β1 Cyg) which is the lower larger star in the image on the left, is reddish-yellow in colour. The companion star in Albireo (Albireo B = β2 Cyg, smaller upper star in image on left) is blue in colour.



Albireo β1 Cyg is a type K3II star (an old cooler star ~4865°K, placing it in the red colour range)

Albireo β2 Cyg is a type B8v star (a younger hotter star ~13800°K, placing it in the blue colour range)



I managed to acquire images of 18 stars in couple of hours and subsequently generated spectra from these. A sample of my results are shown in the following table.

Star		Spectral Type	Distance (ly)	Magnitude	Spectrum
Achird		F9v	19.42	7.35	
Albireo A (β1 Cyg)		K3II	385.53	5.45	
Albireo B (β2 Cyg)		B8ve	399.7	5.1	
Arcturus		K0III	36.71	0.15	
Caph		F2III	54.74	2.25	
Dubhe		G8III	123.64	2	
Izar		G9II	209.75	2.5	
Mirach		M0+	197.43	2.05	
Mirfak		F5Ib	506.45	1.75	
Mizar A		A1V	78.16	2.2	
Mizar B (Alcor)		A6V	81.72	3.95	
Navi		B0.5IVe	549.08	2.15	

In conclusion, it is very easy to obtain spectra of stars using just basic equipment, especially as short exposures are required for brighter stars. Analysis of the spectra brings more details of the differences between the bright dots in the night sky, revealing the differences in age (and temperature) of the stars we see. This is a great way to enhance your understanding of and to marvel at the uniqueness of the universe we live in.

Andrew

Chris
Grimmer

Astrophotography Image Processing

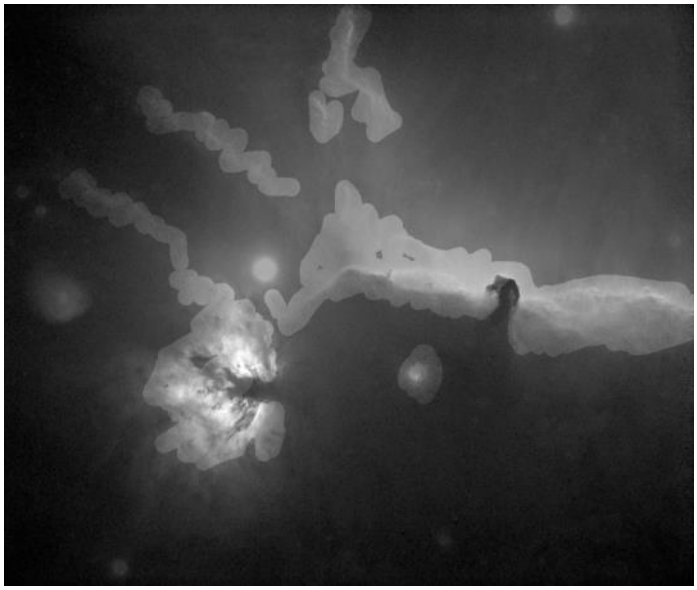
Astrophotography Image Processing – Part 2

Hello and welcome to the second part of my Astrophotography image processing guide. Sorry for the absence in the last edition of Cygnus, but work commitments of late have been taking there toll. So in this article I will still be working with Photoshop however most other image editing tools will contain something similar to achieve these results.

In my opinion one of the most powerful tools in an Astrophotographers processing tool box is ability to use 'Masks' and in particular 'Hide All' and 'Reveal All' masks. Once you have mastered the use of Masks these come in to play in nearly all the processing you will do, from brightness to colour, Sharpening to contrast adjustments.

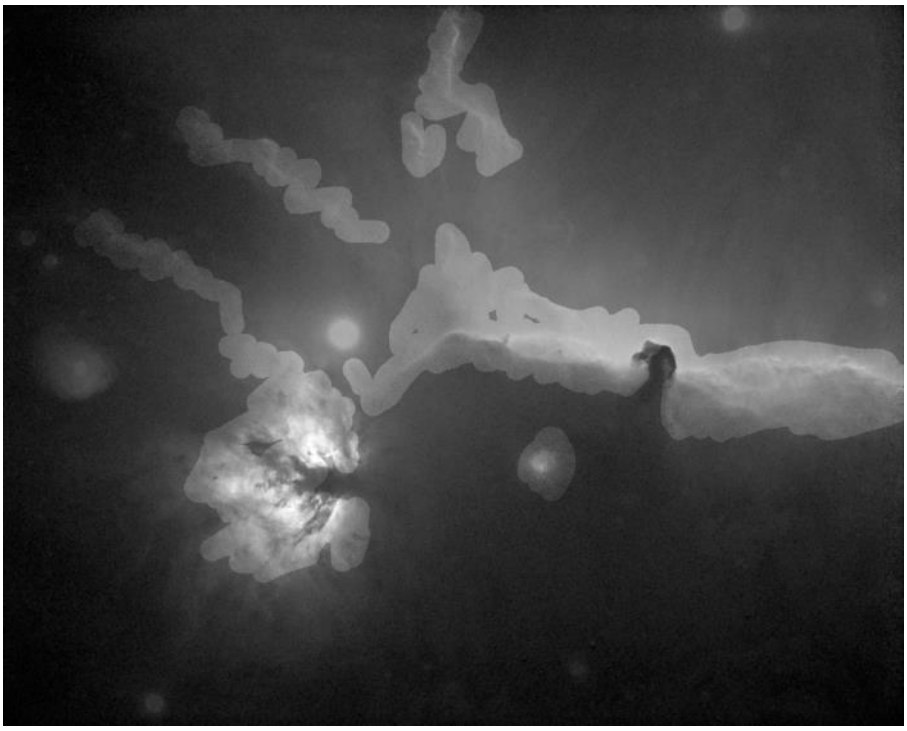
Ok so what is a Mask? In simple terms its a glass plate with your image on that you can overlay over an underlying image, either allowing you to scape away the top layer, revealing what is underneath in areas you want(Hide All) or showing all the layer below and then painting the areas, hiding the layer underneath (reveal All)

As a first example I am going to use the Hide all mask with an untouched image (above) and a stretched image (right) using 2 layers. So as you can see below stretching the image has pulled the fainter nebula out but at the expense of the darker background and noise.

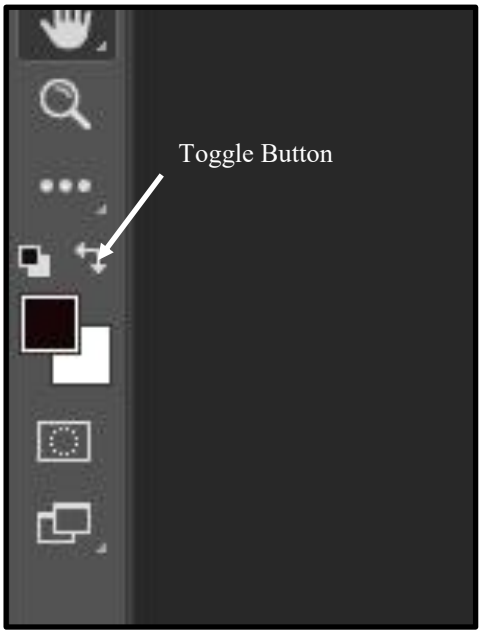


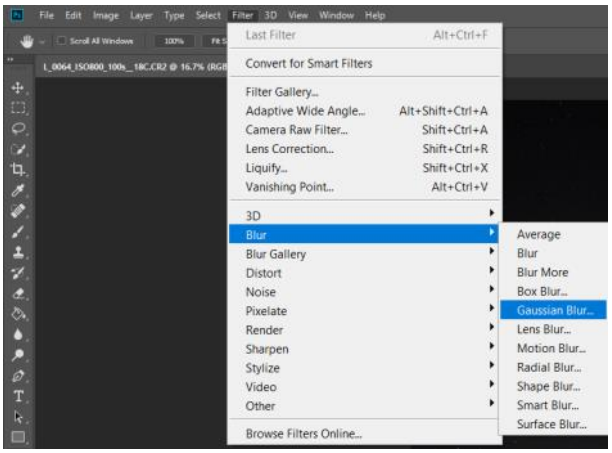
So what I am doing to do is apply a hide all mask to the stretched layer, to do this select the stretched layer and go to - image – Layer mask – Hide All.

What you should now see is your original image on the screen and a black layer next to your image in the layer tab as in this image.

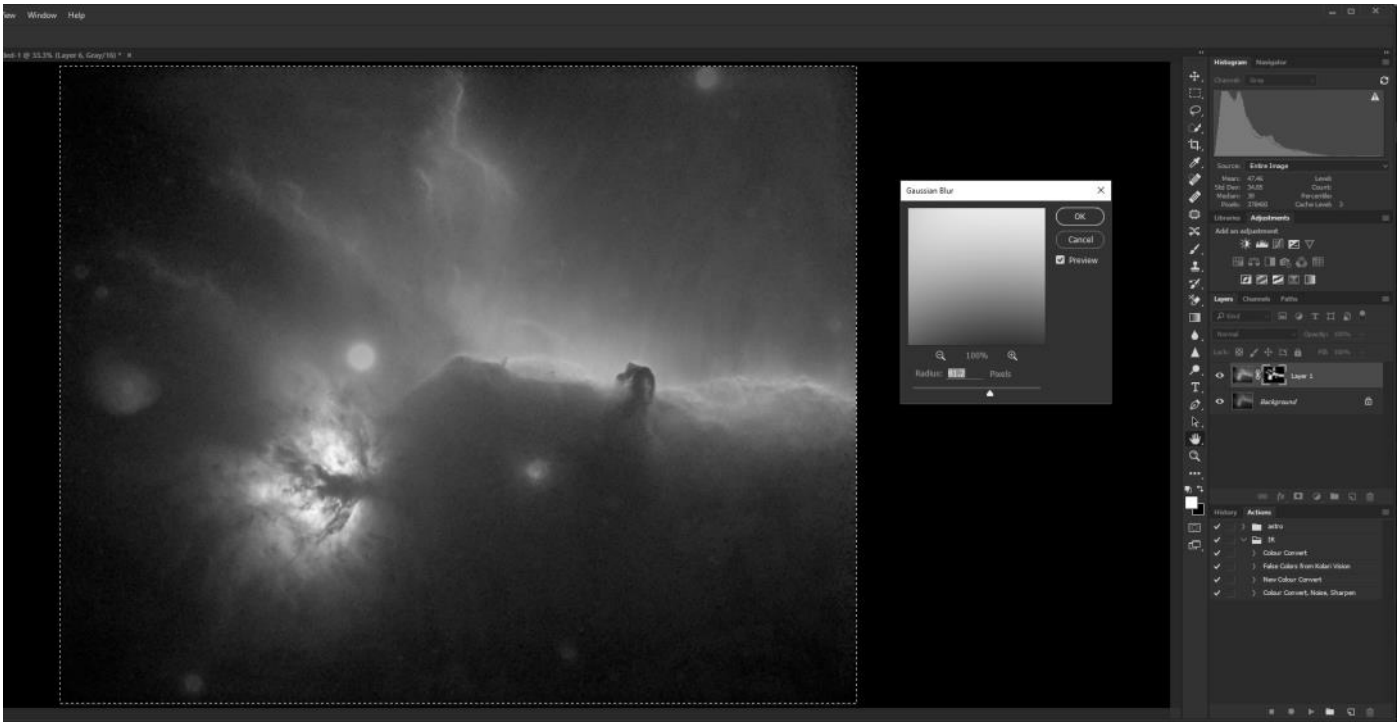


Now ensure the background colour is set to white (the bottom highlighted box in the image). With layer masks black hides and white reveals. Now you want to select your paintbrush tool and paint in the areas you want to brighten.





You may now be thinking that this looks awful and well it does, so what we need to do is blur the effect so you can't see the edges. So if you go to – Filters – Blur – Gaussian Blur. This will load a box with a slider to adjust the strength of the blur, depending on what you are doing. A setting between 50 & 100 will usually suffice, however this is image and process dependent so just increase the strength until the image looks natural and you can't see the borders.



Under normal circumstances I wouldn't apply such a heavy stretch/brightening in one go, I normally end up applying this process multiple times with varying degrees of strength depending on the details I am trying highlight or hide. I also use this technique with:-

- Brightness/Contrast – helps to define the dust in the nebulosity.
- Levels/Curves – to brighten sections as above and also to darken areas.
- Sharpening – Selectively sharpen the areas of detail without introducing extra noise to areas with little or no detail.
- Noise – Use this to apply varying degrees of noise reduction, Strong noise reduction on background areas without any detail and apply lightly to areas of detail so not to destroy the detail.
- Colour correction/Saturation – allows for selective colour adjustments or apply increased saturation where needed.

And the result of all the layers and adjustments is this finished image.

I hope the above makes sense, but if not Google and Youtube are your friends, search for 'how to use masks in photoshop' and there are 100's if not 1000's of video tutorials, guides and the such. Or feel free to speak to me at the club and ask questions, I am more than happy to help out.

Chris

The competition brought an avalanche of entries! Of these **David Nobbs** was the only one to find all 20 differences so he will receive his copy of Stargazing With a Telescope in due course. Above shows the corrections

A snap from the Fairhaven evening, Sue Napper Caught in the act eating cake, surprised Shaun Reynaulds isn't there !!!

THE DEADLINE FOR COPY FOR THE NEXT ISSUE OF CYGNUS IS
5th May 2018

This is the very latest date by which articles should reach the editor. Sooner than that would be much appreciated .

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Michael Szpytko and Family
Clifford Andrews and Family
John Dye
Rob and Rachel Dye
Charlotte Daniels
Frank and Carolyn Cliff
Robbie Carr

FORTHCOMING EVENTS

02 March:	Members Talk: Xraying the Universe and Galaxy Clusters. David Lumb
23/24 March:	Open Weekend. Cassini's Saturn. "cosmic" Dave Cook
30 March:	Members Talk: An Introduction to Variable Star Observing. Gary Poyner
20/21 April:	Open Weekend: Mr Rea and Mr Cook's Magic Lantern Show
27 April:	Members Talk: One Thousand Years of Great Comets and Great Dissapointments
04 May:	Members Talk: Six Things You Never New Make Up Everything. Ivica Hausmeister
01 June:	Members Talk: Space Weather With The British Antarctic Survey. Dr Andrew Kavanagh
09 June:	Members Talk: Astronomy For Young People at Seething Observatory
30 June:	Members Talk: SHA Visit