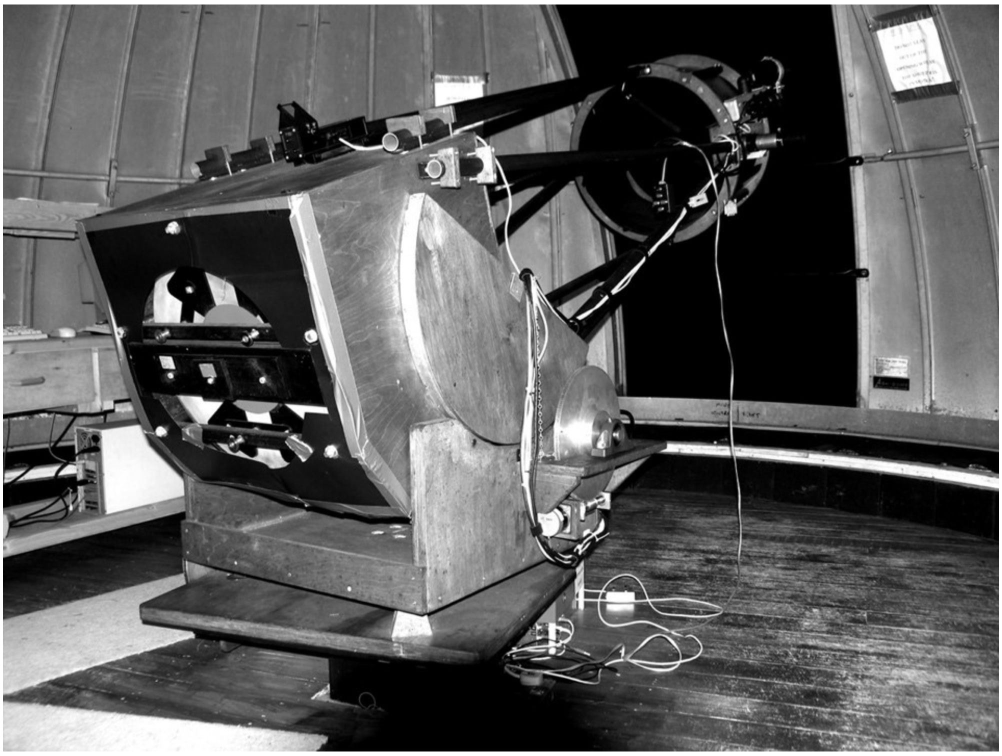
Breckland Astronomical Society

Affiliated to the British Astronomical Association and the Federation of Astronomical Societies

EXTRA TERRESTRIAL

Newsletter July 2023



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Picture of the Month

Contents **Page**

Chairman's Notes	*Dan Self*	4
John's News Bits	*John Geonis*	14
BAA Deep Sky Section Last Update (May-June 2023)		15
Collimating a Schmidt-Cassegrain telescope (SCT)	*Chris Bailey*	18
A Half-Hour on the structure of the telescope.	*R A Proctor*	24
Member's Astrophotography	*Various*	37
Observatory Risk Assessment 2022		50
For Sale and Wanted		53
Equipment available for loan to Members		55
Contacts		58
Programme 2022	*Dan Self*	59

Copy is always needed for this newsletter. Articles with an astronomical theme are welcome but anything of likely interest to the membership will be considered. Text or Word documents preferred but handwritten submissions also welcome.

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Chairman’s Notes July/August 2023

Dear all,

As we rejoice the nights pulling in and those warm observing sessions (casual or otherwise) we restart public observing nights again until August. Members are welcome to do so with us observatory Tuesdays, staying late if clear skies come. I’m thinking of those time I might be at a garden party and casually point out Vega and say 25 light years and show them Deneb and ask how far away they think it is. If you have a small telescope there are some quick and easy things to find in the sky.

Firstly as it’s still probably light, try to find Albireo in the Eastern Sky. It is the second brightest star in the Northern Cross and marks the head of Cygnus the Swan. It shows the best colour contrast and don’t need much magnification. The stars are very far apart in space, and so may just be a lucky alignment but they are likely very weakly gravitationally bound.

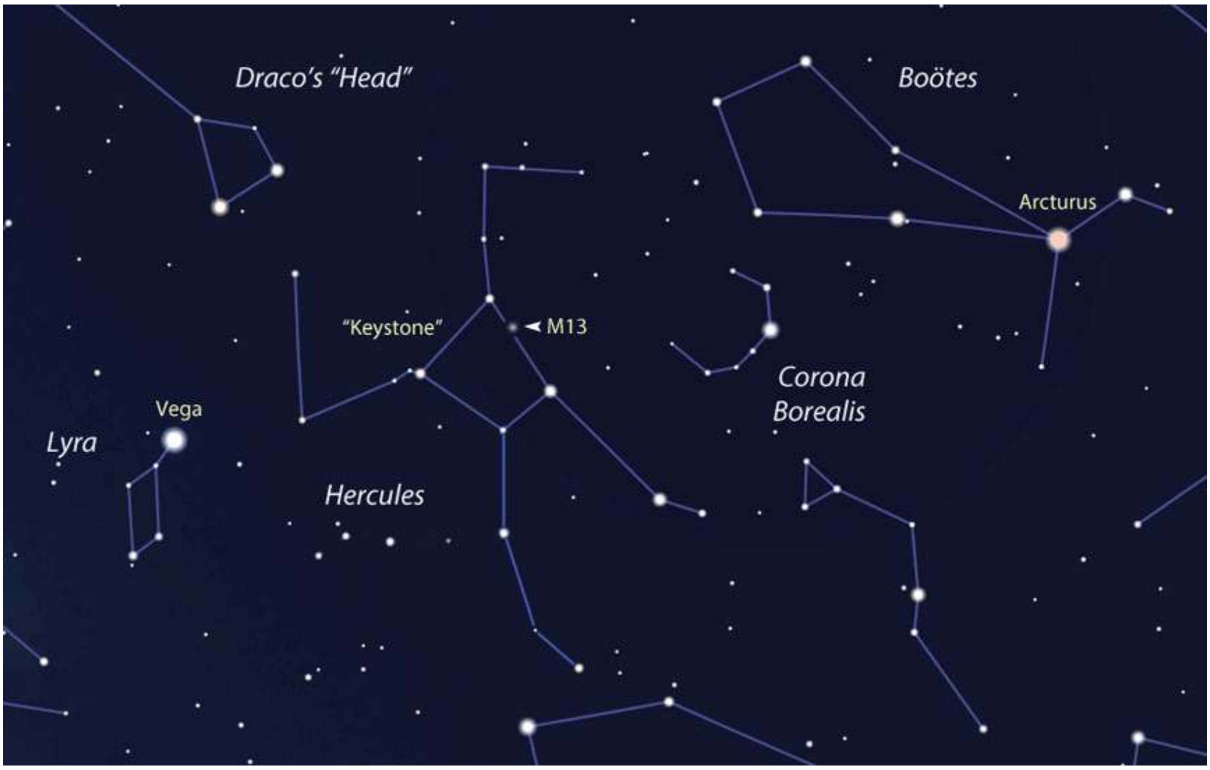
I’ve tried to scale the picture to give a realistic blue twilight effect at the right angle when viewed after dark in the East. Albireo is in the middle of the summer triangle of three stars highlighted here and can be split in binoculars. Always great to show people who haven’t seen much through a telescope. Way below Albireo you may spot Delphinus the Dolphin.

Just above Albireo is the ring nebula, some say it’s hard to find, but it is just above the half way point between the two stars Sheliak and Sulafat at the bottom of the parallelogram of Lyra. If you’ve sorted out your finder scope this is surprisingly visible through twilight or light pollution in any sort of telescope. If you are feeling adventurous try extending the line between the stars downwards, and a little to the right. I was sweeping around this area in an 8” dobsonian and came across M56 a slightly less spectacular globular cluster than M13 in Hercules, but still nice to see.

Credit Stellarium.

Lastly the Hercules globular cluster is a showpiece object in a mid sized telescope upward. It is nicely visible in any telescope but reveals continuously more with increasing telescope aperture, despite a bit of background sky glow. It is found between the stars on the right hand side of the central (slightly asymmetrical) box shape in Hercules, called the “Keystone”, two thirds the way to the uppermost star. I luckily saw this with my naked eye (just!) from a very dark sky in Dunwich in May.

Telescopes reveal thousands of stars, and magnification really helps. Large apertures can reveal the galaxy NGC 6207 nearby and even bigger apertures dark skies and good optics can reveal galaxy IC 4617. I couldn’t quite see this with the 20”, there was a hint of it, but not definite. You certainly need transparent skies and clean, aligned optics…or a camera.



(Above Sky and telescope)

Galaxies near M13, courtesy of Lucas Kalista, printed in Sky and Telescope.

A high magnification can reveal a dark three bladed propeller shadow to the side of the core of the cluster.

The ISS (International Space Station) makes early morning passes for us in the UK from the end of June slowly becoming more favourable towards evening, reaching around 11pm-midnight in mid July, continuing right through July until the 26th and 28th.

Tiangong makes some low passes across the Southern sky at ~10 degrees altitude, best from the 9th to the 12th August around 9-10pm moving from right to left. It is hard to see well from the UK.

Twilight and Moon times for May/Jun 2023

Twilight

Since May 17th there has been no 'night' as Andy tells me. The first sliver of "night" is July 27th and it lasts from 00:48 – 01:15 for Norwich at 52º38' latitude. This is only a strict definition, and uses the end of Astronomical Twilight to define 'night'. This occurs when the Sun is 18 degrees below the horizon, a slightly arbitrary definition around the altitude that corresponds to there being no perceptible scattering of sunlight around the atmosphere.

So for the New Moon days, here are Sunset/rise, Civil twilight times, Nautical twilight times & Astronomical twilight times (Sun at 0º, -6º, -12º and -18º):

July 17th	**21:20**	**22:10**	**23:33**	**…**	**…**	**02:17**	**03:40**	**04:30**
August 16th	**20:19**	**20:57**	**21:47**	**22:47**	**03:07**	**04:09**	**04:59**	**05:38**

Moon

For Norwich the July Full Moon occurs on July 3rd at 12:38 and is called the Buck Moon (it is also a "Honey" Moon – as the low altitude means the atmosphere gives it a yellow colour). In Celtic culture this Moon was known as the Wyrt Moon (a word meaning Herb). In Anglo-Saxon culture it was known as the Hay Moon.

The August Full Moon is on August 1st 19:31 and is a "Super" Moon as it is the closest full moon and appears a tiny bit larger. This is known as the Sturgeon Moon, Corn Moon or Grain Moon.

There is also an August "Blue" Moon, which just refers to the second full moon within a calendar month, this is on August 31st at 02:35.

This means the first dark sky astronomy (over the effect of summer twilight) will occur around the 8th/9th July when the moonrise is 00:15.

The Waxing crescent moon returns to dark skies on the 25th, meaning the last night of good dark sky astronomy will be on Monday the 24th July when the moon sets at 23:15. The International Space Station does a low southern pass at this time also.

The August moon gets out of the way on the evening of the 9th August when last quarter rises as late as 23:40, below the Pleiades. On this evening, Jupiter rises first.

The Moon tracks very low along the south horizon this summer. While it is always beautiful in a telescope, some transient features appear at particular times listed below.

The appearance of the **Lunar X** is visible on the **23rd August in the daytime** from 18:00 BST (UT+1) until moonset at 22:23. In summer it is lower in the South. It is at its lowest phase of 43% illumination for the year, so the moon is ‘pointing’ somewhat to the right (from a UK, North=up perspective) compared to usual. A Lunar V feature usually appears at the centre of the moon, appearing for longer starting around **2 hours before the Lunar X**.

Mary McIntryre, a member of the Society for Popular Astronomy, an Astro Artist and an occasional face on “Space Oddities” keeps a blog at marysastronomyblogs.blogspot.com where annually in advance she calculates and publishes these times. This year she also included times for the visibility of the “Face in Albategnius” and the “Eyes of Clavius”

Albategnius, is a round crater with a smaller crater in its wall at the mid-point in between the Lunar X and Lunar V on the terminator. The face on its floor can be seen about **2 hours after the Lunar X** is at its best, so around moonset on the evening of August 23rd.

Clavius, one of my personal aesthetically favoured craters can be found towards the lunar South Pole. Clavius has a sequence of craters within its large basin, with the appearance of skimming stone ripples on a flat water surface. The ‘**Eyes of Clavius’** appear on the **26th July at about 20:00 BST**, lasting until moonset about midnight.

Clavius is fascinating to watch throughout the year or with changing lunar phase as its appearance is changed a lot by the lunar libration or wobble. It can appear very foreshortened (oval appearance to craters) if the moon’s equatorial plane tilts Southward of the Earth.

Planets

Mercury does have a eastern elongation in the latter half of July but it will be difficult to see in the evening twilight in the West. It is to the lower right of the crescent moon on the 20th a long way to the right of Venus due to their orbits not being aligned in the same plane. It has a favourable western elongation at the end of September though at dawn in the east.

Venus has sunk into the evening twilight for us, it is visible for the Southern Hemisphere for a while. It is at crescent phase now and in early July will still be visible low in the WNW at about 21:30-22:00. The last you may see of it is way below the thin crescent moon on the 20th (if clear and a really good horizon). At the very end of August it will reappear before dawn at 5am

Saturn rises at midnight at the start of July in the South West. Jupiter rises at midnight at the start of August.

Comets and asteroids

I got a picture of 2023 E1ATLAS in Draco and this is brightening still and well visible through summer in the North heading round Ursa Minor into Cygnus, passing through the Milky Way and near nebulae in early August, but it is fairly faint, 10th magnitude.

Going further out - Double Stars in the Spring Sky

Of course Albireo and epsilon Lyrae are always worth a look too but should be easy to find.

Going further out – Deep Sky Objects

Going further out – The Milky Way

Check out Steve Tonkin’s Binocular Sky page for monthly charts https://binocularsky.com/

Upcoming Astronomy Events

Kelling Heath Autumn Star Party organised by Loughton AS will be from Mon 9 to Mon 16th October.

The Space Oddities programme is still happening Monday Nights on facebook and Youtube, well worth a watch. The youtube links change but go up on facebook.

https://www.facebook.com/groups/spaceoddities/?ref=share

Breckland Astro Talks - Reviews

Dan Self – Solar and Lunar evening May 12

As Jerry Workman's train got delayed, I spoke about the Sun and the Moon. I had some interesting presentations I had done at a solar outreach event about how fusion occurred inside the sun. Interestingly Paul Fellows followed up with the same nuclear reaction scheme in June.

We had a look at what was in the sky, how Venus was coming towards us but dipping down in line with the Sun and Mars was rounding the back of the Sun from our perspective.

Malcolm had recently done a huge Lunar mosaic and we zoomed into it looking at the Apollo sites in incredible almost arc second detail, with his new 125mm precision refractor. Jerry will talk more about these on July 14th.

The sun has been active, hence the solar viewing day below. We also had a look at some recent images and then I had experimentally tried creating a talk with AI – in summary, it was quite dull. So we're not out of a job yet then!

It was followed by a quick AGM that was accepted by all present, where we all restood for election although Richard was abroad.

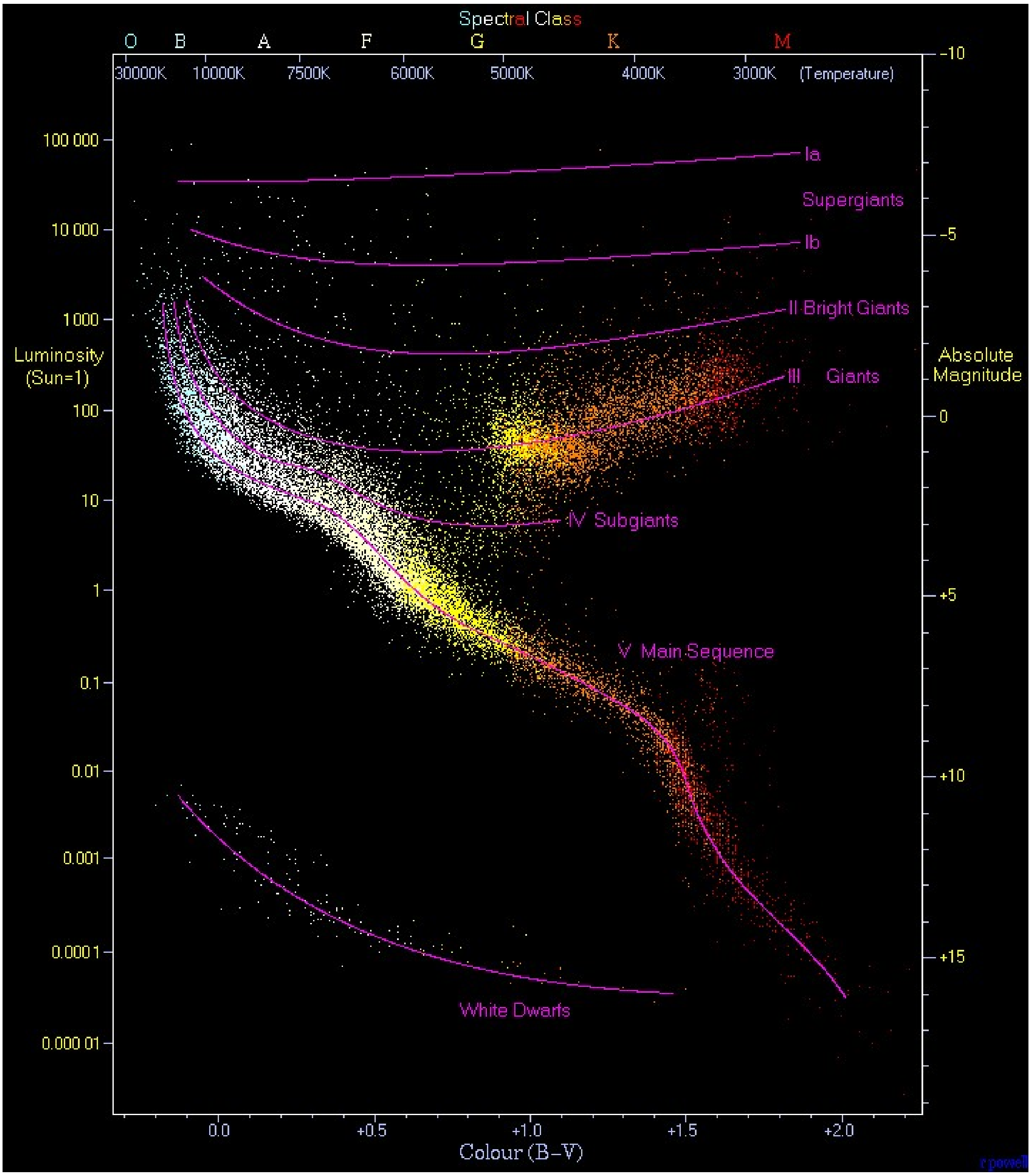
Paul Fellows MA FRAS – Strange Matter and Quark Stars - June 9 (advertised as Strange Stars)

This lecture sparked off a lot of interest, well done Paul for being the first to delve so deeply into this powerful subject. I learnt a lot personally during this talk.

Paul started by giving a necessary background talk about atoms and atomic nuclei. The 4th state of matter is what comprises the stars we see shining, namely Plasma. Plasma is a state where the energy of the atoms is so great the electrons are ripped off them and are separated from the remaining nuclear positive ions.

This was followed up with a really nice explanation of the Main Sequence of stars as plotted on the Hertzsprung-Russell Diagram. This is a prerequisite for any sort of study into astronomy. The hottest stars are high mass and are plotted on the left, and are classified B and O type. The coolest, low mass stars are on the right and are red M-type stars, and are very numerous but much much fainter. Here is a picture from Wikipedia, well worth familiarising yourself with. All stars, including White Dwarves can be plotted on here so I have included it in this summary.

A star will move around the HR diagram during its lifetime. As Hydrogen burns to form Helium, Helium accumulates slowly in the core. And it eventually upsets the balance with gravity so it shrinks then it collapses and heats up and a big shell of Hydrogen starts fusing around the outside of the core, as it does this it gets a lot brighter and expands into a red giant. When it runs out of hydrogen fuel totally, the core collapses inward under gravity as there is no pressure to keep it up, and under compression it gets very hot and pushes the outer layers out and what remains of the star is a white dwarf and planetary nebula expanding into space. The dwarf (core) takes a huge amount of time to cool and is hot but small and faint (see bottom of HR diagram) as it isn't undergoing fusion. It is made out of a very dense form of matter, called degenerate matter - more on this later.



The Hertzsprung-Russell Diagram of Stellar Evolution courtesy of Wikipedia

The above scenario plays out for lower mass stars like our Sun, but for those that are 10 solar mass they can collapse and start to fuse Helium into Carbon, Neon, Magnesium, Silicon and ultimately Iron. Each of these fusion processes releases less energy. Iron cannot fuse, if it does so, it absorbs energy instead of releasing it.

At the end of a large mass star's final fusion phase, it collapses and rebounds and produces a Type II supernova. The part that remains in the core forms a neutron star or a black hole depending on how massive it is. Nobody knows how black holes form!

Next Paul says "BUT this is wrong"

There is more detail.

A white dwarf star is the mass of the sun and the size of the Earth. What is resisting gravity?

Then we go into the clever but abstract explanation, of Quantum Mechanics. This is a connection of Cosmic scale and Micro scale of epic magnitude. Quantum means discrete or like counting numbers (integers) or boxes. So he proposes his box model. A picture of a chess board that is as wide as the star (represented by 8 boxes) is filled with electrons. Electrons are quantum particles called Fermions and as such cannot exist on top of each other – they need their own space to exist in. This forms a repulsion, (not the charge repulsion as that is balanced by protons, which here we are ignoring), but an electron field repulsion. As gravity squeezes the chess board down to a narrower width the electrons can jump up the energy level boxes and fill higher ones until the energy of the gravitational field is balanced by the energy increase the electrons have made. This is called "degeneracy pressure" and is why white dwarves exist.

This effect is the same reason we don't fall through the floor, because the electrons in atoms cannot occupy the same space and thus atoms sit on top each other.

This effect works up to 1.44 solar masses. A fairly simple calculation that Chandrasekhar did in the 1950s. If a white dwarf happens to suck in more mass and go over this limit, it will explode suddenly in a Type 1a supernova, these are 10 x more powerful than Type II ones. The white dwarf is destroyed! Mass turns into a huge amount of radiation.

There is a great Hubble picture of a Type 1a supernova that we were shown.

We then go back to the Type II supernovae, which have a remnant that is massive enough to crush the protons and electrons together and make neutrons, this is a neutron star. Neutrons take less space up than the protons and electrons, so gravity can collapse down in energy, providing it to the protons and electrons in order to combine. Normally a free neutron would exist for a few minutes and decay into a proton and electron. This ball of neutrons can be thought of as neutronium, element zero on the periodic table. A sugar cube of this weighs a billion tons, its density is 4×10^{17} kg m^{-3}. Any sci fi uses of this are rather unrealistic as neutrons decay when not under immense gravitational pressure. Dineutrons could exist, and possibly tetraneutrons but not trineutrons.

So a larger star of say 15 solar masses would make about a 1.5 solar mass neutron star, they shrink with increasing mass. The limit in mass of a neutron star is called the Tollman Oppenheimer Volkoff limit, and is about 2.2 solar masses. This is much more complicated to calculate and more uncertain but already stars have been spotted that are awkwardly on or slightly over this limit. Anything over this is supposed to collapse to form a black hole.

So what keeps a neutron star up? The same idea as with white dwarves, Quantum "Boxes", the rungs on a ladder of energy are populated as the star is squeezed and neutrons do something when their energy levels get too high and there isn't the gravitational potential energy. Neutrons are made of 3 quarks, UP DOWN DOWN (charges +2/3 -1/3 and -1/3) so neutral overall. These quarks can delocalise from the bound particle (a.k.a. a hadron) and make a quark soup and exist in the form of UP/DOWN particles and DOWN quarks taking up less space and also less mass. In doing so, that mass (and mass is just bound energy) is released in the form of a "Deconfinement Flashover", where 0.7 solar masses are ejected as radiation. This is a lot of radiation! This forms a theorised 'Quark Star', and the radiation could be seen as looking like a supernova.

The degeneracy effect is based on the *Pauli Exclusion Principle*, which states that the quantum states must be different in order to occupy the same space. And in our Quark Stars we still have some 'boxes' filled with Down quarks. The idea of Strange stars is that half the Down quarks can transform (at a great energy cost) into Strange quarks, and thus all 3 quarks can occupy the same 'box'. While they are still as a quark 'soup' this is analogous to the Lambda particle that was observed to last an unusual amount of time and led to the concept of strangeness and later strange quarks, as theorised by the Physicist Murray Gell-Mann. These strange stars could be spotted as being very small in radius and of fairly low mass.

The 'strange' thing about this theorised strange matter is that all the best computer models of it show that is should be more stable than regular up / down quark matter that the rest of the universe and us is composed of. Look up 'Ice IX' (Ice nine) by Kurt Vonnegut. Any form of matter more stable means if it were to ever touch the rest of the universe, everything would collapse down and form it. Similar to the Midas touch, but with a violent explosion on contact.

So as for evidence, there is some.

A Pulsar 3C58 spins in 65 milliseconds has a smaller than allowed radius.

Another X ray star spins in less than a millisecond. 1122 Hertz is its pulse frequency. XTE J1739-285 It is estimated to have 10 km diameter. (This was queried in the questions).

ASSAS-N 15lh was a bright transient, this may have been the bang of a strange star flashover.

RX CrA (corona australis) X ray source has been measured to have 11km diameter.

Supernova SN2006gy in NGC 1260 was Massive and long lasting. It could have been a new type of supernova where it gave off 10 times the amount of energy, corresponding to the radiation when a quark star (or straight to strange star) formed. The X ray spectrum of element 130+ was inferred from the spectrum of this supernova! WOW! The theoretical maximum according to QED (quantum electrodynamics) is element ~ 137.

SN1987a in the Large Magellanic Cloud showed no neutron star made but many neutrinos detected here on Earth.

Gravitational Wave detection could help, a candidate was seen when a 23 solar mass object collided with a 2.59 mass one – what was the latter object?

Next Paul speculated on whether the next quark the 'charm' could ever be formed by gravitational pressure. They are very massive so unlikely, but there are diminishing returns in energy as charms are very massive and cost energy.

Wow… one to ponder on and research further.

Observing – The talk was followed by a quick observing session in strong twilight where we saw Venus, Mars and split the double stars Castor and iota Cancri, all within about ten minutes.

RSPB Lakenheath Fen Solar Viewing Day – June 18

We beat the forecast, which was looking like heavy thundery showers, and a complete opposite weather scenario played out. Was nice to see Mark & Sue and Gordon & Jadzia there again, with their Solar Scope and we got a few interested people who stopped and wondered about sunspots and solar details. It was an event to support International SUN day, an outreach project. It was a lovely place and good to have Keith and Chris there helping with all the great kit we have.

RSPB Lakenheath Fen are having a Big Wild Sleepout event on Saturday July 29th. I can't make it but if any of you want to do some outreach astronomy there and bring your telescope please contact Heidi.jones@rspb.org.uk as soon as possible and they will make you very welcome. A very southerly gibbous moon will be visible that evening so they will need to find a spot with a good horizon.

Next events

We have Jerry Workman talking about the Apollo missions rescheduled for the July talk, on the 14th. My Night Vision talk coming up in August, where I look at the fascinating way in which our eyes adapt to extreme differences in light levels. Having had much experience observing these effects I have become quite intrigued with the science behind it. On September 8th, in a complimentary sequence of talks, we have Alan Snook. Alan is a long term contributor of observations to the BAA Deep Sky Section and he is talking about observing faint galaxy groups from the UK. Something we could potentially do with the 20 inch telescope.

Society notices

Andy has been sorting out getting the trustee details up to date and the committee consistent with the Charity Commission and our constitution, so we are ready to satisfy the bank account application requirements. Many thanks to him for that and for processing the Gift Aid claims. The committee discussed for future a more democratic nomination scheme for new trustees including a proposal form.

Our society's facebook group sees many posts and can be found here. It is a public group.

https://www.facebook.com/groups/176906152365752/?ref=share

We now have speakers for every month until the end of the year. More good speakers are needed for 2024 though!

Dan Self

JOHN'S NEWS BITS
July 2023

ESA's Euclid probe is ready for launch on July 1 from Florida on a Space X Falcon 9.
The mission of this telescope is to investigate Dark Matter and Dark Energy. It will look not the galactic evolution and the early history of the cosmos and why the expansion of the universe is accelerating. It will be located at the Lagrange 2 position some one million miles from earth. This is a 6 year mission.
https://www.Esa.int/Science_Exploration/Space_Science/Euclid

Reported on space.com, the MOXIE module in the Mars Perseverance Rover has been generating oxygen from Mars' atmosphere. It sucks in the mostly carbon dioxide air and converts it into pure oxygen. If built on a large scale it can produce oxygen for astronauts and rocket fuel.
https://mars.nasa.gov>instruments

Reported in scienvedaily.com, an international team of scientists have discovered a rare gravitational lensing event where the foreground galaxy has magnified a supernova they named "SN Zwicky" by as much as x25. The supernova was 4 billion light years from Earth. The study of this event will give more understanding of the inner core of galaxies, dark matter and expanding nature of the universe.
Published in nature astronomy, www.nature.com

Scientist using JWST have detected a crucial carbon molecule in a planet forming disc.
The international team using data from JWST detected the methyl cation molecule CH_3^+ which reacts with other molecules to initiate growth of more complex carbon molecules. The CH_3^+ was detected in the protoplanetary disc in the Orion nebula some 1.350 light years away.
www.esa.int/science/Exploration

BBC report, scientists have picked up shock waves from colliding galaxies..
The shock waves come from the orbit of two supermassive black holes at the heart of two distant merging galaxies.
This may be the first direct evidence of giant black holes disturbing space and time as they spiral in on each other.
One of the groups making this discovery is the European Pulsar Timing Array Consortium (EPTA) https://www.epta.eu.org

John Gionis

BAA Deep Sky Section Last Update (May-June 2023)

https://britastro.org/section_news_item/deep-sky-update-may-2023 – Callum who heads the Deep Sky Section of the British Astronomical Association recently moved to Shetland, here is the 'blog':

It's amazing how light the 'night' sky is up here at 59 degrees north currently. And also how quickly the sunset is moving north too. But it's enjoyable too. With little or no opportunity for deep sky (and we've not had a clear night sky here for weeks), I have been turning to a few solar observing sessions on those occasions when we have had a sunny day. Sometimes it is a bit of a battle with the wind, vibrating the telescope and mount. Hopefully it won't be too long until the observatory is up and running again – the area for the concrete pad is laid out, and a local contractor is going to supply the concrete pre-mixed, once I have dug it out and shuttered the pad. I am still worried about how the dome will cope with the high winds we occasionally get – I am planning on various tie-downs and guy ropes, I guess only time will tell!

Autumn Deep-Sky Zoom

I am planning on holding a Deep-Sky-Zoom section meeting in the autumn, either late September or early October. It will just be a short session of 1 to 2 hours, and if anyone would like to give a 20 or 30 minute presentation on any of your current or future projects or any other deep sky topic that would be great – just let me know. Further details to come.

Section Meeting 2024

I have also started planning the 2024 Section Meeting. I am thinking about April 20th or 27th – which are both near Full Moon, so should not coincide with any star camps, at least. Maybe if anyone is aware of any major events around those dates you could let me know. I have yet to decide on a venue – so if you would like to help organise the meeting in your local area, please get in touch.

Supernova in M101

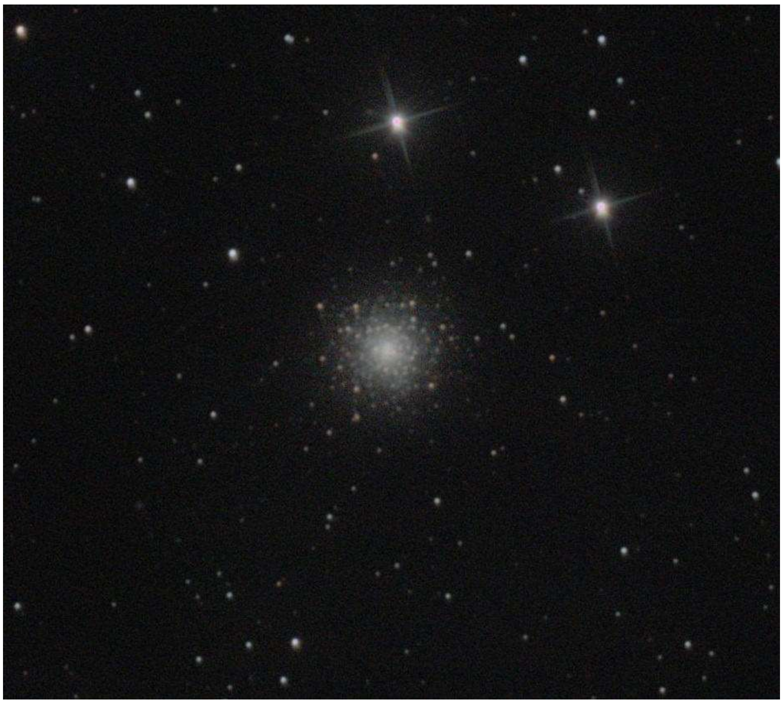
I am glad lots of you managed to get a view of the supernova in M101 – **SN2023ixf**.
It seems to have rapidly brightened from magnitude 12 to nearly 11, and remained at about 11 for a few days but now seems to be slowly fading, and was about magnitude 11.2 on the night of June2/3 by Ian Sharp's photometry. Still worth following, though, if you get the chance.

Black holes in Globular Clusters

There was an interesting paper published in Monthly Notices of the RAS recently about the possibility of an Intermediate Mass Black Hole (IMBH) in the globular cluster Messier 4. An IMBH will have a mass in the range 100 to 1000 solar masses, and is too massive to have formed from the implosion of a single star, and must indicate some sort of combining of black holes. Detailed analysis of stars in M4 suggests that there may be an IMBH in M4 (not necessarily at its core) or that there may be a group of several smaller black holes. The paper is not a particularly easy read, but may be of interest to skim through.
https://academic.oup.com/mnras/article/522/4/5740/7169309

May Object of Interest

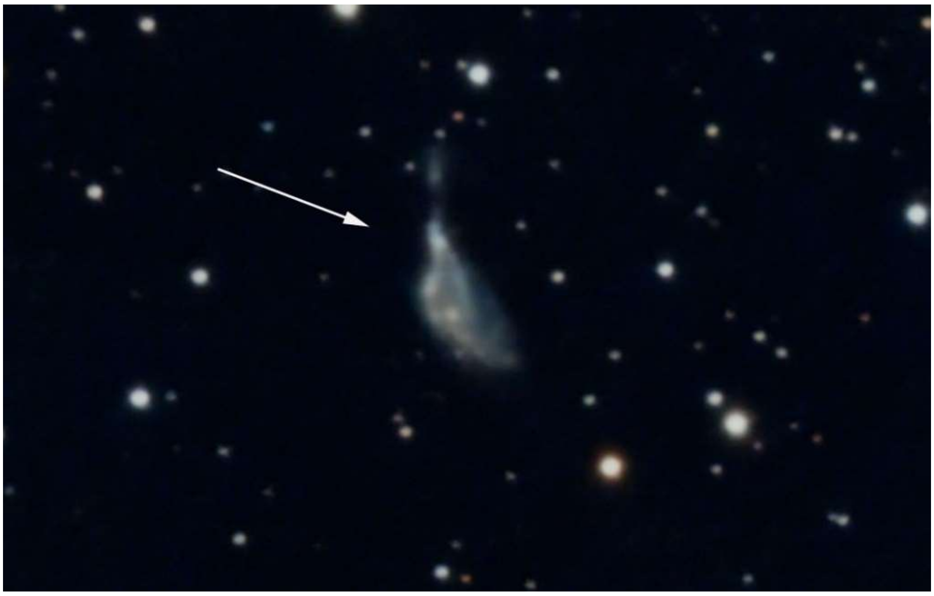
May's object was NGC 6229 – the third globular cluster in Hercules. Many thanks to everyone that had a go at imaging it – obviously not as hard as last month's target (or perhaps the weather was just better!); Pat Devine, Graham Winstanley, Alan Thomas, Ian Papworth, Richard Sargent and Iain Cartwright – Gant Privett also posted his image from 2022.



You can view pics posted by members to their albums in the Object of Interest Gallery

June Object of Interest

For June I have moved just a little eastwards from Hercules to Lyra. Although Lyra is a pretty small constellation, it does have a number of deep sky splendours. One that gets less attention, though, is NGC 6745 an irregular spiral. There are reported two or three components (A, B and C), though it is now thought that there are only two galaxies interacting. Surprisingly Halton Arp did not add it to his catalogue of peculiar galaxies – it would seem to have been an ideal candidate.



Callum Potter – Director, Deep Sky Section, British Astronomical Association

Also, on britastro.org there are a couple of interesting extra notes from other Deep Sky Section members that are of interest. I hope you can all follow the language of Note #3.

May 7 - Deep Sky Note #4

When I read Callum's Deep Sky Update for February, I totally missed the mention of the Cosmic Horseshoe so, it was only when observations started turning up in the BAA Gallery that I became aware of the suggestion to image it [1]. I've imaged the double quasar in Ursa Major before and did try a gravitational arc (and failed) several years back, but I have not attempted any lenses in a long while.
Not that it would have mattered anyway, as the weather here in south west Wiltshire was as miserable as sin – and, whoever coined that expression, clearly lacked imagination. Here, we got lots of rain, the garden pond was overflowing and the few clear nights that did occur seemed always to synchronise with other activities.

Also recently at the observatory I was talking about Albireo, a beautiful double mentioned above.

Jan 1 – Deep Sky Note #3

It has long been a matter of heated contention whether this gorgeous double star is a physical *binary* or merely a chance line-of-sight alignment, and you'll find all sorts of conflicting statements made on the subject in recent books and on current websites. Neither of the modern astrometric satellite observatories *HIPPARCOS* or *GAIA* have yet managed to settle the matter definitively, although their parallax determinations for the two stars do suggest a difference in distance of anything up to 30 light years, well below which the two could not possibly be coupled together in a binary. The transverse separation projected on 'the plane of the sky' is 0.07 light years or 4440 times the Sun-Earth distance but that is obviously only a lower limit to what it could possibly be and the actual separation may be far larger: as yet, we just don't know.

However, despite that, there is now sufficient data available to do a *dynamical* test (rather than a merely astrometric one) of whether the two stars can possibly be gravitationally bound to each other, a fact which does not seem to have been generally noticed (and only a couple of days ago I came across a webpage by a professor in my own university devoted to Albireo as a classic case of a visual binary, which latter at least it most certainly is *not!* But said professor is clearly not a practical, i.e. observational, astronomer). I've been reviewing the latest available relevant data this week, and doing some simple 2-body dynamics with it, with the following results:

The relative velocity (i.e. 'internal' velocity within the AB pair, discounting any shared common motion) of the two stars Albireo A and Albireo B is 6.7 km/sec to about +/- 0.1 km/sec, while assuming the extreme case most favourable to their being bound together by their mutual gravitation – that is, that they have zero separation along the line of sight (extremely improbable) and are therefore 'only' 4440 A.U. apart – and combining that with the best estimates of the stellar masses in a calculation which is essentially the 2-body fully generalized dynamical form of Kepler's 3rd Law, the equivalent escape velocity of A and B from that least-possible separation is only 2.15 km/sec at most, again +/- about 0.1.

Conclusion: Albireo A & B cannot possibly be gravitationally bound to each other even if they are at exactly the same distance from us – so we don't actually need to wait for GAIA to pin down the two distances finally, to settle the matter. This conclusion holds by a very large safety-margin and so is robust in the face of remaining uncertainties of data. It didn't at all have to be so but, as it turns out, it is. To put that in the relevant dynamical terms, to 'bind' A & B gravitationally at that least-possible 4440 A.U. would require approximately 9.4 times their known total mass, making that of the combined A+B 'system' 109 solar masses – completely out of the question by a factor of at least 5.

Albireo is not a binary star – case closed! *BAA Deep Sky Section Members*

Collimating a Schmidt-Cassegrain telescope (SCT)

In the last issue we looked at the methods of Collimating a Newtonian type of telescope. The other most common type of reflecting telescope is the Schmidt Cassegrain (SCT)

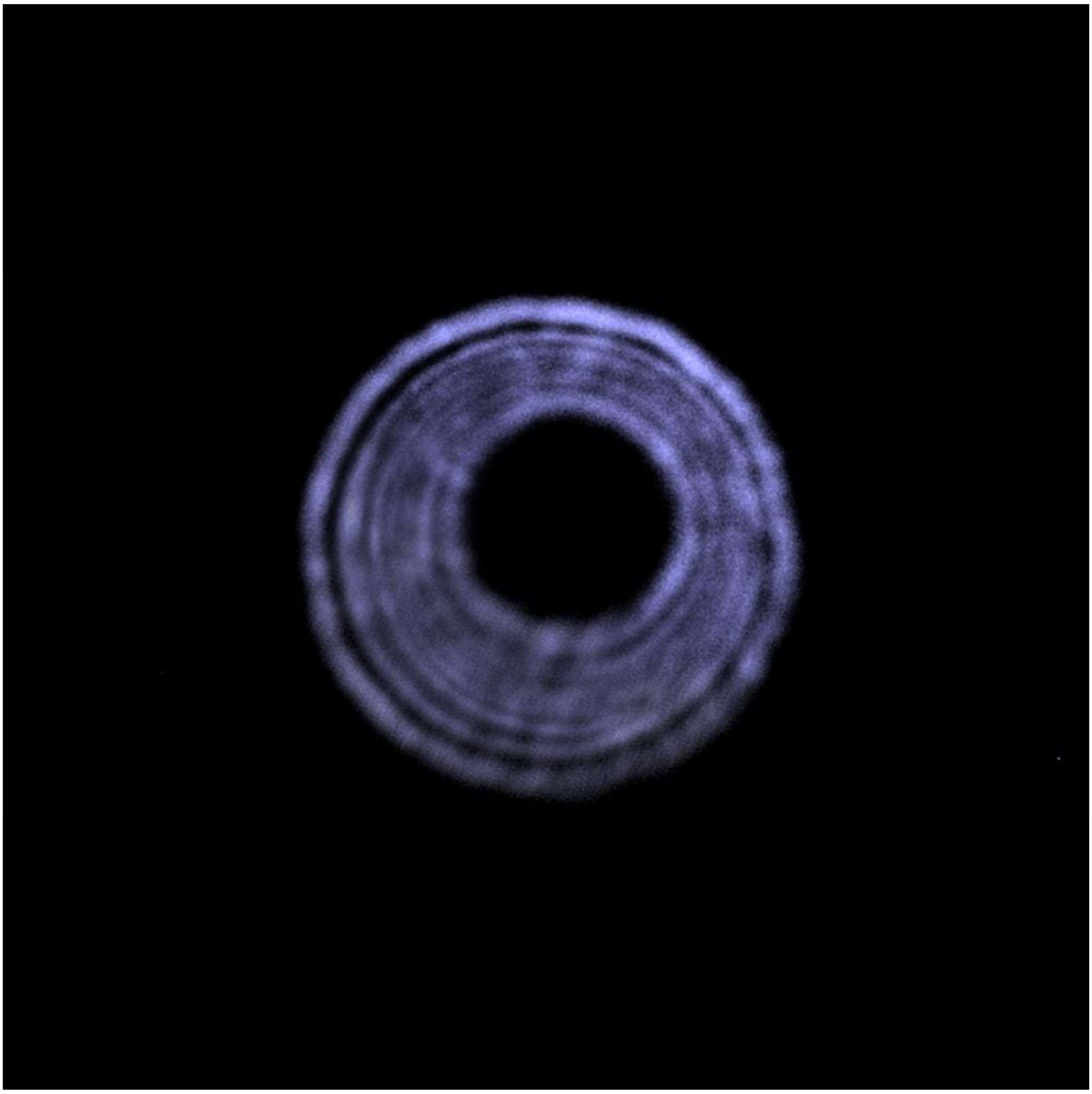
Collimation of an SCT is critical to getting the sharpest images possible, especially when viewing planets at high magnification.

Before attempting collimation always let the scope reach the temperature of the outside or ambient air. If there is a significant temperature difference between outside air and the scope's storage area, you'll need to wait at least an hour, maybe several hours for the scope to reach the ambient temperature. You may need to keep it in an unheated room over a period of a few days.

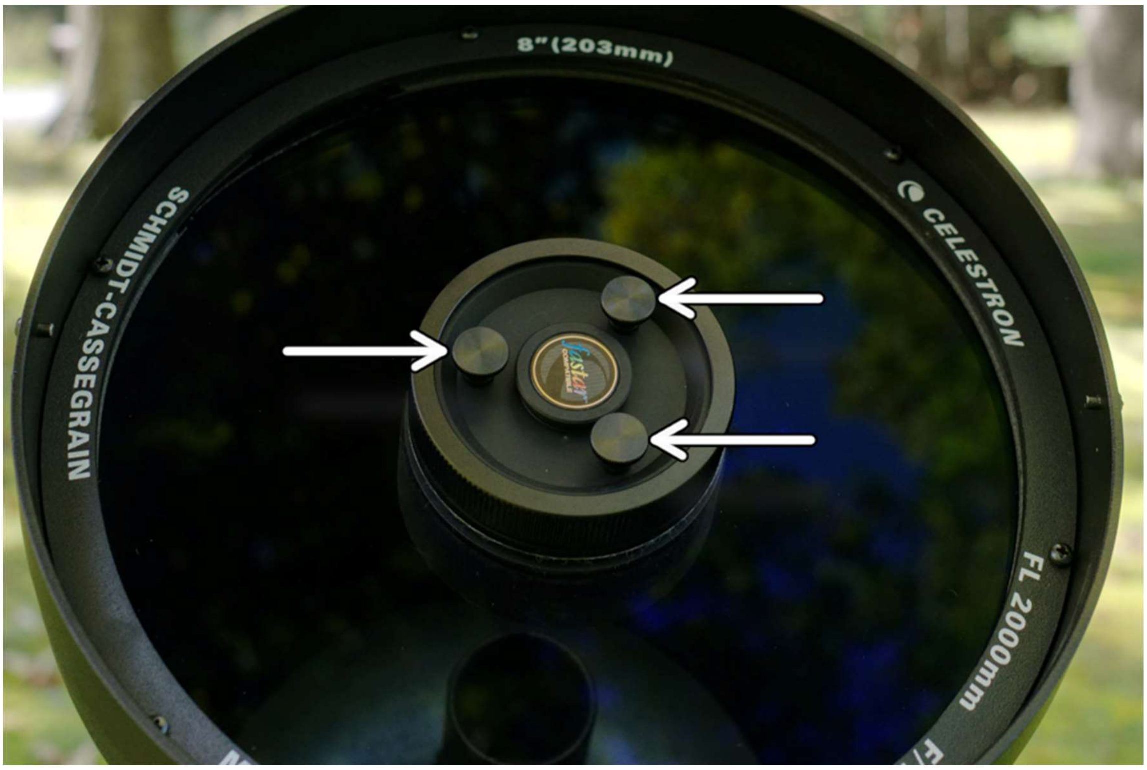
"Seeing" (the steadiness of the atmosphere) also affects your collimating ability. Heat waves and high-altitude winds move air around and cause differing temperatures of air to mix. This makes the air act like a weak lens that interferes with the light from a planet or a star by defocusing it. Choose only nights with superior seeing for collimation. A method that can be used during the day is to use a solar reflection off a distant ball bearing or Christmas tree ornament.

To collimate your telescope:

Start with a rough out-of-focus collimation. This initial step will get you in the ballpark for more accurate collimation later on. Using a medium-powered eyepiece (or camera), centre a medium-brightness star in the field of view. Next, defocus the star until you can see a centre dark spot (this is the secondary mirror shadow). This dark spot will not be in the centre of the defocused star if the scope is out of collimation.



To centre this spot you will need to adjust the collimation screws located on the secondary mirror housing. These may be Allen Key or screwdriver adjustments depending on make or model. Some telescopes have been fitted with aftermarket knobs (e.g. Bobs Knobs) to make the adjustment easier. They are also safer as you are not moving metal tools around near the surface of the corrector plate risking a scratch.



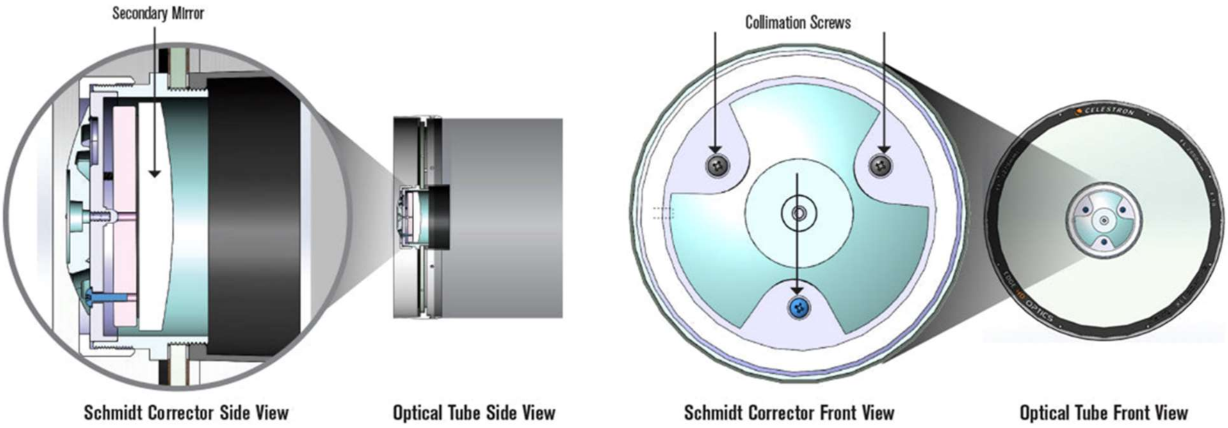
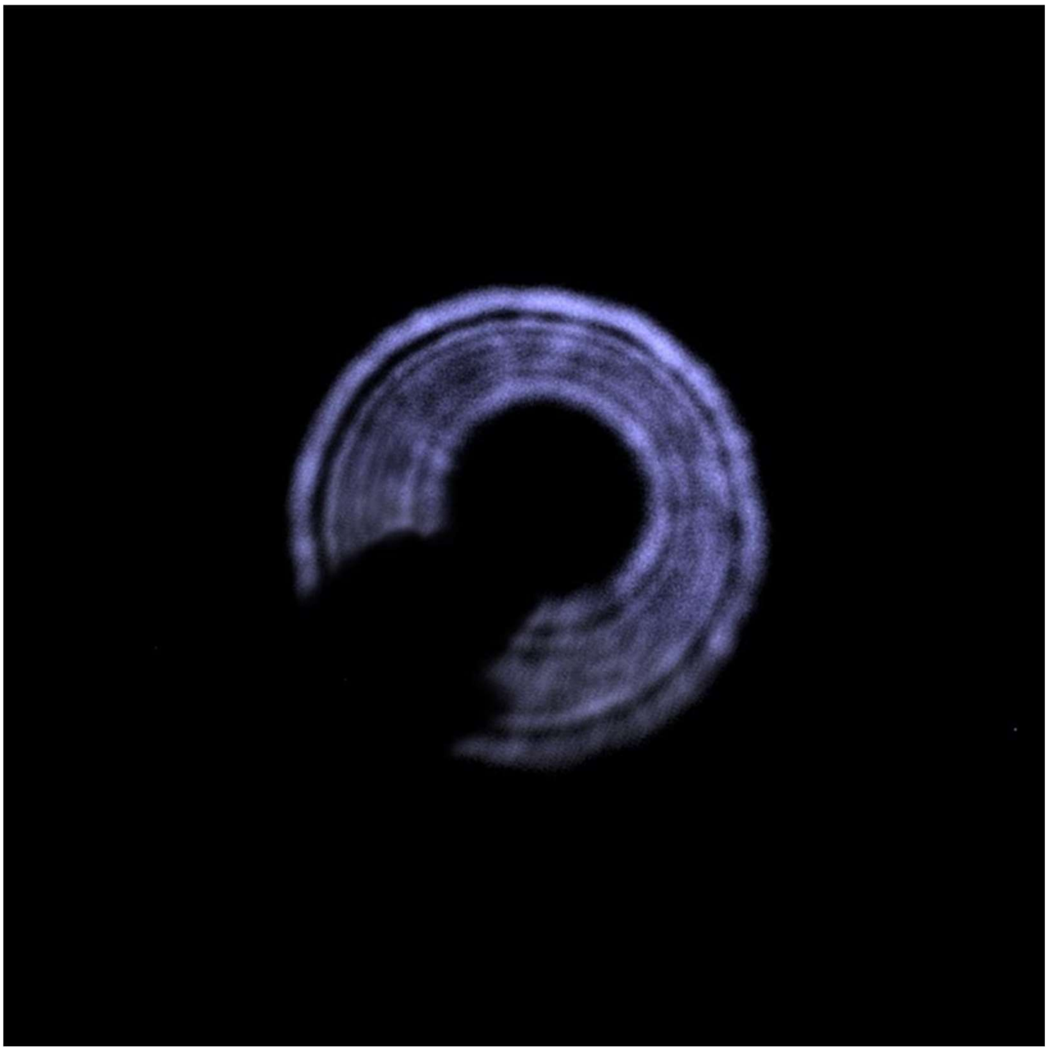


Fig. 1

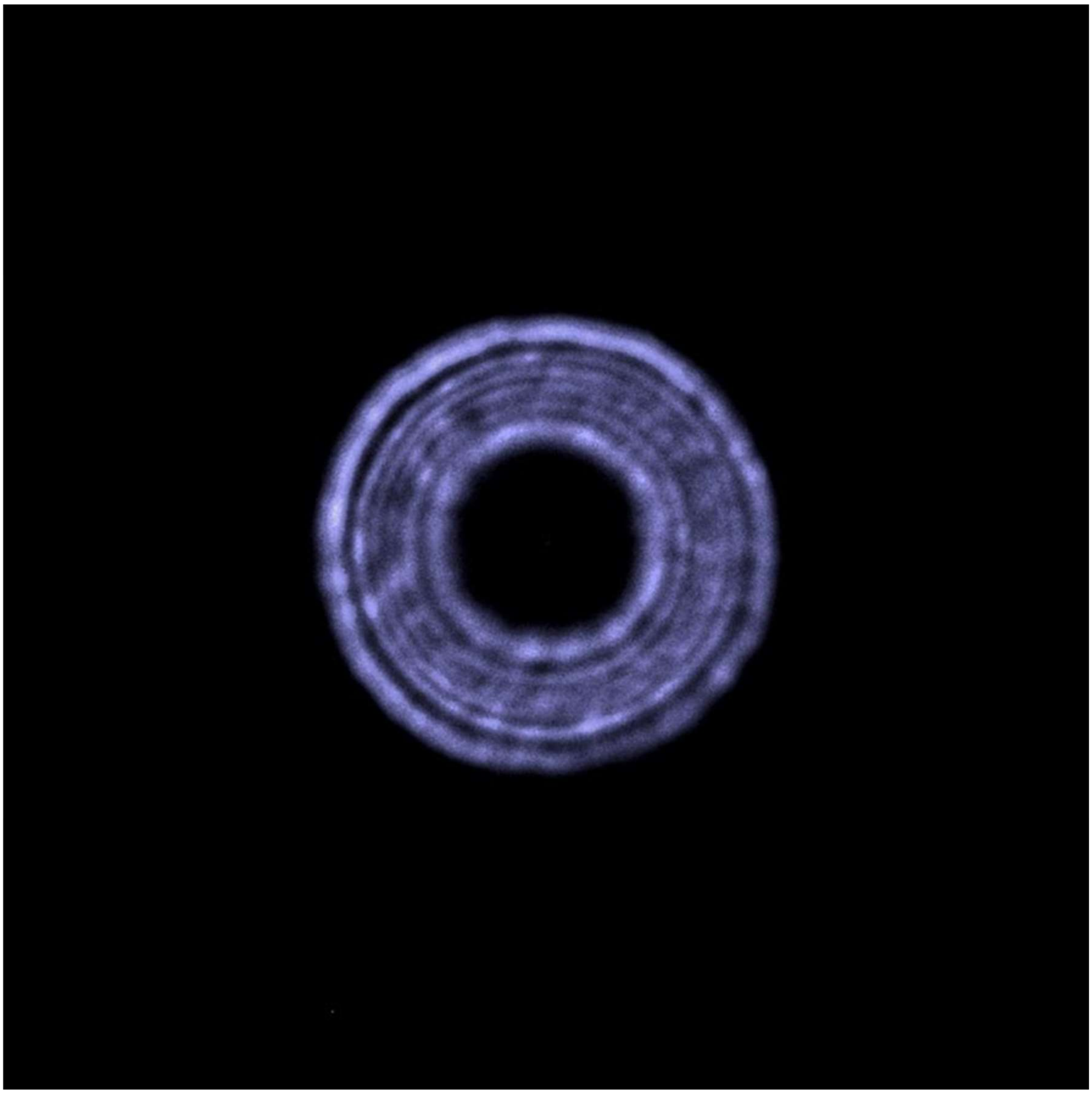
Turn the screws by only 1/6 to 1/8 turn adjustments. Each time you make an adjustment the star will move in the field of view, and you'll need to re-centre the star to check if the scope is in collimation.

Obviously this telescope is in poor collimation! The question now is which of the three screws do you need to adjust to bring the telescope into a better state of tune. To find out, simply reach your hand around and place it in front of the telescope's aperture, without touching the corrector plate. Then move your hand's orientation so that its silhouette is seen in front of the widest portion of defocused light between the shadow of the secondary and the edge of the star. Doing so you will see something like this.

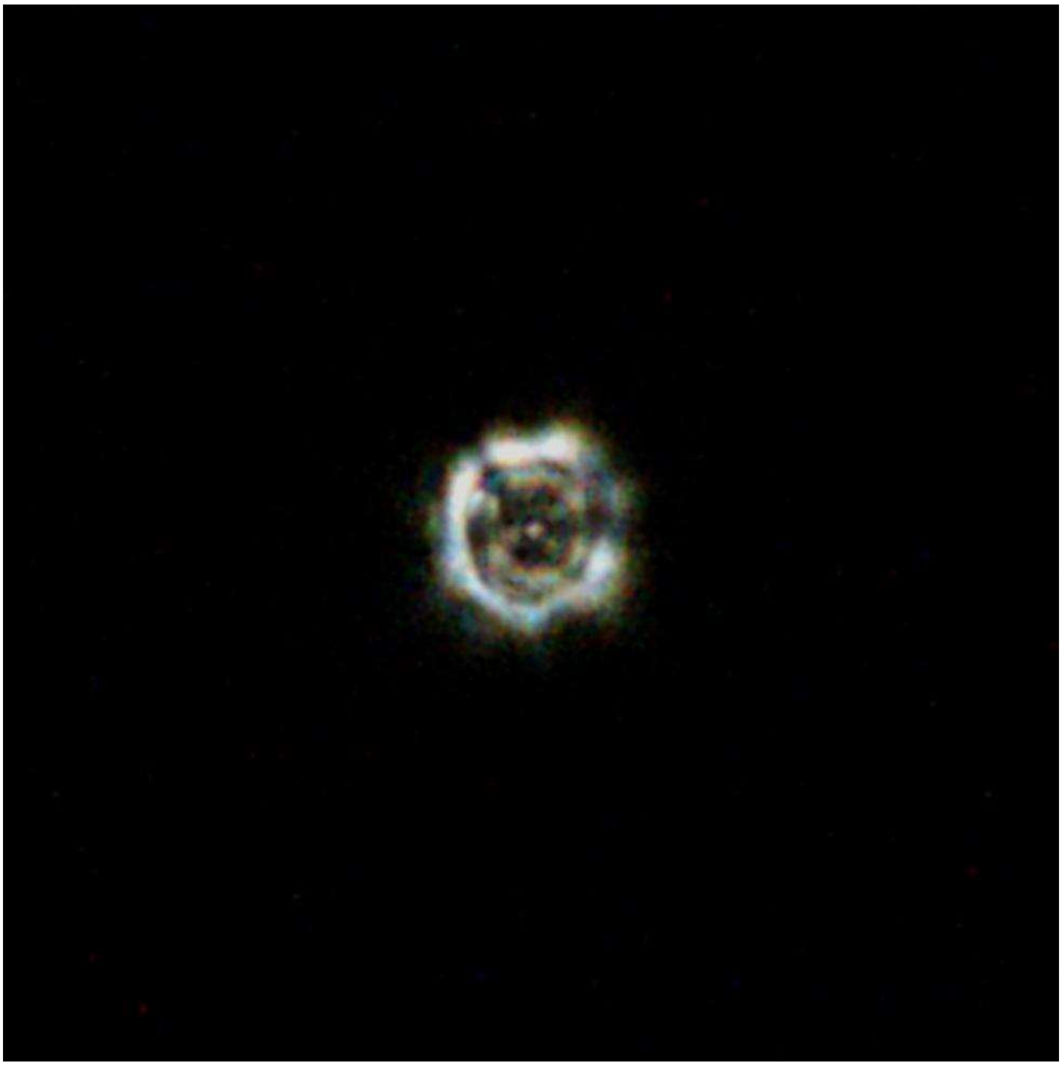


Once this is accomplished, walk around to the front of your scope noting the part of the tube that your hand was over and check to see if any of the three collimation screws are in that same orientation. If you are lucky enough to find a collimation screw in the same orientation, then you will need to adjust that particular adjustment screw. If, however, your hand is between two collimation screws, then adjust the screw on the opposite side.

Make very small adjustments to the collimation screw, always recentring the star within your view to see the results of your efforts. If the collimation looks worse then you are obviously turning the screw in the wrong direction. You may need to adjust more than one screw to finalize collimation, however, you can use the trick mentioned earlier to see exactly which screw needs to be tinkered with. Be patient and make small adjustments until you see something like this: To make the final adjustments a high power (short focal length) eyepiece should be used and the focus taken just out to show the diffraction pattern. It is best to move both sides of the focus point to check they give the same result.



When you do you are almost there. You will want to take one more step to ensure the best results. Tweak your focus a bit so that the star is just slightly outside of perfect focus. If your telescope is perfectly collimated at this point you should see a tiny white dot centred within the shimmering diffraction pattern. This small dot is called “Poisson’s Spot” and it determines the true centre of your diffraction pattern. Only when this spot is precisely centred can you call your work done. If it is off slightly, just keep making small tweaks to one or more of your collimation screws all the while keeping the star image as well centred as you can. If you are patient and persistent you will end up seeing something like this.



This image was taken from a video as due to the shimmering nature of our atmosphere it is difficult to image. Your eyes will have a much easier time seeing “Poisson’s Spot” and discerning that it is indeed centred better than any snapshot ever will. When you get to this point you can enjoy the benefits of a perfectly collimated telescope!

A HALF-HOUR ON THE STRUCTURE OF THE TELESCOPE.

R A Proctor

There are few instruments which yield more pleasure and instruction than the Telescope. Even a small telescope--only an inch and a half or two inches, perhaps, in aperture--will serve to supply profitable amusement to those who know how to apply its powers. I have often seen with pleasure the surprise with which the performance even of an opera-glass, well steadied, and directed towards certain parts of the heavens, has been witnessed by those who have supposed that nothing but an expensive and colossal telescope could afford any views of interest. But a well-constructed achromatic of two or three inches in aperture will not merely supply amusement and instruction,--it may be made to do useful work.

The student of astronomy is often deterred from telescopic observation by the thought that in a field wherein so many have laboured, with abilities and means perhaps far surpassing those he may possess, he is little likely to reap results of any utility. He argues that, since the planets, stars, and nebulæ have been scanned by Herschel and Rosse, with their gigantic mirrors, and at Pulkova and Greenwich with refractors whose construction has taxed to the utmost the ingenuity of the optician and mechanic, it must be utterly useless for an unpractised observer to direct a telescope of moderate power to the examination of these objects.

Now, passing over the consideration that a small telescope may afford its possessor much pleasure of an intellectual and elevated character, even if he is never able by its means to effect original discoveries, two arguments may be urged in favour of independent telescopic observation. In the first place, the student who wishes to appreciate the facts and theories of astronomy should Familiarize himself with the nature of that instrument to which astronomers have been most largely indebted. In the second place, some of the most important discoveries in astronomy have been effected by means of telescopes of moderate power used skilfully and systematically. One instance may suffice to show what can be done in this way. The well-known telescopist Goldschmidt (who commenced astronomical observation at the age of forty-eight, in 1850) added fourteen asteroids to the solar system, not to speak of important discoveries of nebulæ and variable stars, by means of a telescope only five feet in focal length, mounted on a movable tripod stand.

The feeling experienced by those who look through a telescope for the first time,--especially if it is directed upon a planet or nebula—is commonly one of disappointment. They have been told that such and such powers will exhibit Jupiter's belts, Saturn's rings, and the continent-outlines on Mars; yet, though perhaps a higher power is applied, they fail to detect these appearances, and can hardly believe that they are perfectly distinct to the practised eye.

The expectations of the beginner are especially liable to disappointment in one particular. He forms an estimate of the view he is to obtain of a planet by multiplying the apparent diameter of the planet by the magnifying power of his telescope, and comparing the result with the apparent diameter of the sun or moon. Let us suppose, for instance, that on the day of observation Jupiter's apparent diameter is 45", and that the telescopic power applied is 40, then in the telescope Jupiter should appear to have a diameter of 1800", or half a degree, which is about the same as the moon's apparent diameter. But when the observer looks through the telescope he obtains a view--interesting, indeed, and instructive--but very different from what the above calculation would lead him to expect. He sees a disc apparently much smaller than the moon's, and not nearly so well-defined in outline; in a line with the disc's centre there appear three or four minute dots of light, the satellites of the planet; and, perhaps, if the weather is favourable and the observer watchful, he will be able to detect faint traces of belts across the planet's disc.

Yet in such a case the telescope is not in fault. The planet really appears of the estimated size. In fact, it is often possible to prove this in a very simple manner. If the observer wait until the planet and the moon are pretty near together, he will find that it is possible to view the planet with one eye through the telescope and the moon with the unaided eye, in such a manner that the two discs may coincide, and thus their relative apparent dimensions be at once recognised. Nor should the indistinctness and incompleteness of the view be attributed to imperfection of the telescope; they are partly due to the nature of the observation and the low power employed, and partly to the inexperience of the beginner.

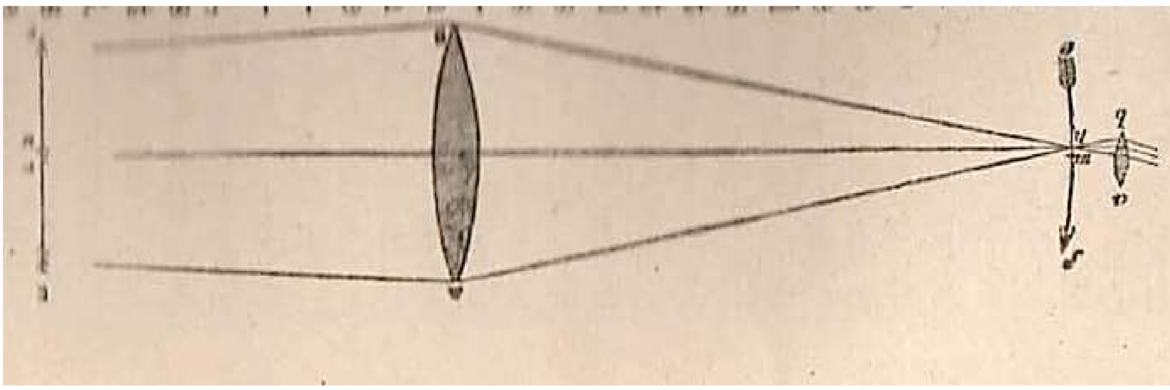
It is to such a beginner that the following pages are specially addressed, with the hope of affording him aid and encouragement in the use of one of the most enchanting of scientific instruments,--an instrument that has created for astronomers a new sense, so to speak, by which, in the words of the ancient poet:

Subjecere oculis distantia sidera nostris,

Ætheraque ingenio supposuere suo.

In the first place, it is necessary that the beginner should rightly know what is the nature of the instrument he is to use. And this is the more necessary because, while it is perfectly easy to obtain such knowledge without any profound acquaintance with the science of optics, yet in many popular works on this subject the really important points are omitted, and even in scientific works such points are too often left to be gathered from a formula. When the observer has learnt what it is that his instrument is actually to do for him, he will know how to estimate its performance, and how to vary the application of its powers--whether illuminating or magnifying--according to the nature of the object to be observed.

Let us consider what it is that limits the range of _natural_ vision applied to distant objects. What causes an object to become invisible as its distance increases? Two things are necessary that an object should be visible. It must be _large_ enough to be appreciated by the eye, and it must _send light_ enough. Thus increase of distance may render an object invisible, either through diminution of its apparent size, or through diminution in the quantity of light it sends to the eye, or through both these causes combined. A telescope, therefore, or (as its name implies) an instrument to render distant objects visible, must be both a magnifying and an illuminating instrument.

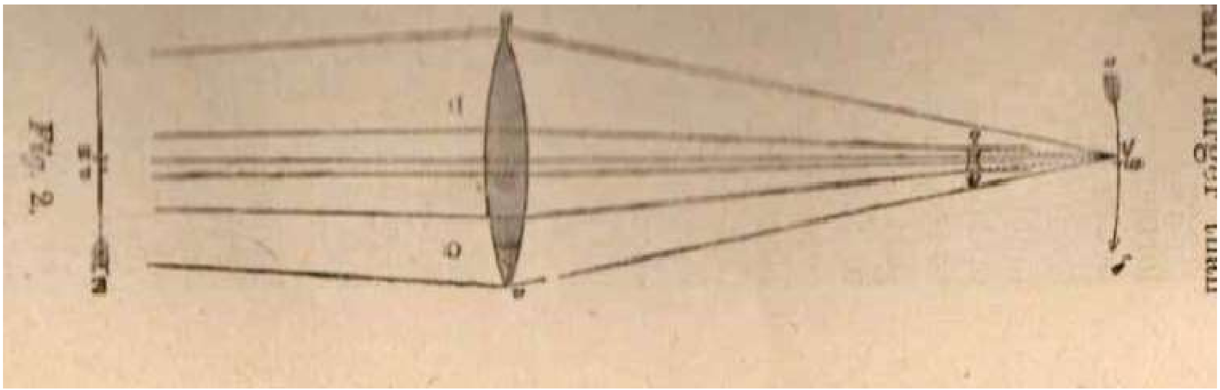


Let EF, fig. 1, be an object, not near to AB as in the figure, but so far off that the bounding lines from A and B would meet at the point corresponding to the point P. Then if a large convex glass AB (called an _object-glass_) be interposed between the object and the eye, all those rays which, proceeding from P, fall on AB, will be caused to converge nearly to a point _p_. The same is true for every point of the object EMF, and thus a small image, _emf_, will be formed. This image will not lie exactly on a flat surface, but will be curved about the point midway between A and B as a centre. Now if the lens AB is removed, and an eye is placed at _m_ to view the distant object EMF, those rays only from each point of the object which fall on the pupil of the eye (whose diameter is about equal to _mp_ suppose) will serve to render the object visible. On the other hand, every point of the image _emf_ has received the whole of the light gathered up by the large glass AB. If then we can only make this light _available_, it is clear that we shall have acquired a large increase of _light_ from the distant object. Now it will be noticed that the light which has converged to _p_, diverges from _p_ so that an eye, placed that this diverging pencil of rays may fall upon it, would be too small to receive the whole of the pencil. Or, if it did receive the whole of this pencil, it clearly could not receive the whole of the pencils proceeding from other parts of the image _emf_. _Something_ would be gained, though, even in this case, since it is clear that an eye thus placed at a distance of ten inches from _emf_ (which is about the average distance of distinct vision) would not only receive much more light from the image _emf_, than it would from the object EMF, but see the image much larger than the object. It is in this way that a simple object-glass forms a telescope, a circumstance we shall presently have to notice more at length. But we want to gain the full benefit of the light which has been gathered up for us by our object-glass. We therefore interpose a small convex glass _ab_ called an eye-glass) between the image and the eye, at such a distance from the image that the divergent pencil of rays is converted into a pencil of parallel or nearly parallel rays. Call this an emergent pencil. Then all the emergent pencils now converge to a point on the axial line _m_M (produced beyond _m_), and an eye suitably placed can take in all of them at once. Thus the whole, or a large part, of the image is seen at once. But the image is seen inverted as shown. This is the Telescope, as it was first discovered, and such an arrangement would now be called a _simple astronomical Telescope_.

Let us clearly understand what each part of the astronomical telescope does for us:--

The object-glass AB gives us an illuminated image, the amount of illumination depending on the size of the object-glass. The eye-glass enables us to examine the image microscopically.

We may apply eye-glasses of different focal length. It is clear that the shorter the focal length of _ab_, the nearer must _ab_ be placed to the image, and the smaller will the emergent pencils be, but the greater the magnifying power of the eye-glass. If the emergent pencils are severally larger than the pupil of the eye, light is wasted at the expense of magnifying power. Therefore the eye-glass should never be of greater focal length than that which makes the emergent pencils about equal in diameter to the pupil of the eye. On the other hand, the eye-glass must not be of such small focal length that the image appears indistinct and contorted, or dull for want of light.



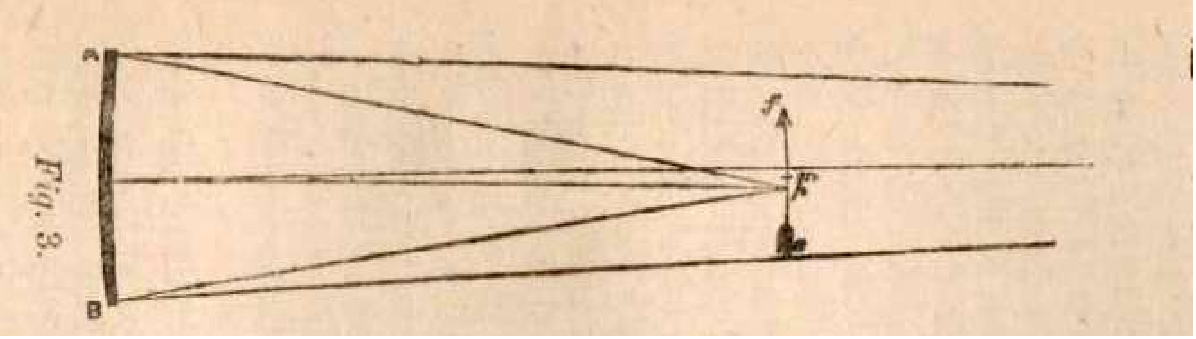
Let us compare with the arrangement exhibited in fig. 1 that adopted by Galileo. Surprise is Sometimes expressed that this instrument, which in the hands of the great Florentine astronomer effected so much, should now be known as the _non-astronomical Telescope_. I think this will be readily understood when we compare the two arrangements.

In the Galilean Telescope a small concave eye-glass, _ab_ (fig. 2), is placed between the object-glass and the image. In fact, no image is allowed to be formed in this arrangement, but the convergent pencils are intercepted by the concave eye-glass, and converted into parallel emergent pencils. Now in fig. 2 the concave eye-glass is so placed as to receive only a part of the convergent pencil A _p_ B, and this is the arrangement usually adopted. By using a concave glass of shorter focus, which would therefore be placed nearer to _m p_, the whole of the convergent pencil might be received in this as in the former case. But then the axis of the emergent pencil, instead of returning (as we see it in fig. 1) _towards_ the axis of the telescope, would depart as much _from_ that axis. Thus there would be no point on the axis at which the eye could be so placed as to receive emergent pencils showing any considerable part of the object. The difference may be compared to that between looking through the small end of a cone-shaped roll of paper and looking through the large end; in the former case the eye sees at once all that is to be seen through the roll (supposed fixed in position), in the latter the eye may be moved about so as to command the same range of view, but _at any instant_ sees over a much smaller range.

To return to the arrangement actually employed, which is illustrated by the common opera-glass. We see that the full illuminating power of the telescope is not brought into play. But this is not the only objection to the Galilean Telescope. It is obvious that if the part C D of the object-glass were covered, the point P would not be visible, whereas, in the astronomical arrangement no other effect is produced on the visibility of an object, by covering part of the object-glass, than a small loss of illumination. In other words, the dimensions of the field of view of a Galilean Telescope depend on the size of the object-glass, whereas in the astronomical Telescope the field of view is independent of the size of the object-glass. The difference may be readily tested. If we direct an opera-glass upon any object, we shall find that any covering placed over a part of the object-glass _becomes visible_ when we look through the instrument, interfering therefore _pro tanto_ with the range of view. A covering similarly placed on any part of the object-glass of an astronomical telescope does not become visible when we look through the instrument. The distinction has a very important bearing on the theory of telescopic vision.

In considering the application of the telescope to practical observation, the circumstance that in the Galilean Telescope no real image is formed, is yet more important. A real image admits of measurement, linear or angular, while to a _virtual_ image (such an image, for instance, as is formed by a common looking-glass) no such process can be applied. In simple observation the only noticeable effect of this difference is that, whereas in the astronomical Telescope a _stop_ or diaphragm can be inserted in the tube so as to cut off what is called the _ragged edge_ of the field of view (which includes all the part not reached by _full pencils of light_ from the object-glass), there is no means of remedying the corresponding defect in the Galilean Telescope. It would be a very Annoying defect in a telescope intended for astronomical observation, since in general the edge of the field of view is not perceptible at night. The unpleasant nature of the defect may be seen by looking through an opera-glass, and noticing the gradual fading away of light round the circumference of the field of view.

The properties of reflection as well as of refraction have been enlisted into the service of the astronomical observer. The formation of an image by means of a concave mirror is exhibited in fig. 3. As the observer's head would be placed between the object and the mirror, if the image, formed as in fig. 3, were to be microscopically examined, various devices are employed in the construction of reflecting telescopes to avoid the loss of light which would result--a loss which would be important even with the largest mirrors yet constructed. Thus, in Gregory's Telescope, a small mirror, having its concavity towards the great one, is placed in the axis of the tube and forms an image which is viewed through an aperture in the middle of the great mirror. A similar plan is adopted in Cassegrain's Telescope, a small convex mirror replacing the concave one. In Newton's Telescope a small inclined-plane reflector is used, which sends the pencil of light off at right-angles to the axis of the tube. In Herschel's Telescope the great mirror is inclined so that the image is formed at a slight distance from the axis of the telescope. In the two first cases the object is viewed in the usual or direct way, the image being erect in Gregory's and inverted in Cassegrain's. In the third the observer looks through the side of the telescope, seeing an inverted image of the object. In the last the observer sees the object inverted, but not altered as respects right and left. The last-mentioned method of viewing objects is the only one in which the observer's back is turned towards the object, yet this method is called the _front view_--apparently _quasi lucus a non lucendo_.



It appears, then, that in all astronomical Telescopes, reflecting or refracting, a _real image_ of an object is submitted to microscopical examination.

Of this fact the possessor of a telescope may easily assure himself; for if the eye-glass be removed, and a small screen be placed at the focus of the object-glass, there will appear upon the screen a small picture of any object towards which the tube is turned. But the image may be viewed in another way which requires to be noticed. If the eye, placed at a distance of five or six inches from the image, be directed down the tube, the image will be seen as before; in fact, just as a single convex lens of short focus is the simplest microscope, so a simple convex lens of long focus is the simplest telescope.[1] But a singular circumstance will immediately attract the observer's notice. A real picture, or the image formed on the screen as in the former case, can be viewed at varying distances; but when we view the image directly, it will be found that for distinct vision the eye must be placed almost exactly at a fixed distance from the image. This peculiarity is more important than it might be thought at first sight. In fact, it is essential that the observer who would rightly apply the powers of his telescope, or fairly test its performance, should understand in what respect an image formed by an object-glass or object-mirror differs from a real object.

The peculiarities to be noted are the _curvature_, _indistinctness_, and _false colouring_ of the image.

The curvature of the image is the least important of the three defects named--a fortunate circumstance, since this defect admits neither of remedy nor modification. The image of a distant object, instead of lying in a plane, that is, forming what is technically called a _flat field_, forms part of a spherical surface whose centre is at the centre of the object-glass. Hence the centre of the field of view is somewhat nearer to the eye than are the outer parts of the field. The amount of curvature clearly depends on the extent of the field of view, and therefore is not great in powerful telescopes. Thus, if we suppose that the angular extent of the field is about half a degree (a large or low-power field), the centre is nearer than the boundary of the field by about 1-320th part only of the field's diameter.

The indistinctness of the image is partly due to the obliquity of the pencils which form parts of the image, and partly to what is termed _spherical aberration_. The first cause cannot be modified by the optician's skill, and is not important when the field of view is small. Spherical aberration causes those parts of a pencil which fall near the boundary of a convex lens to converge to a nearer (_i.e._ shorter) focus than those which fall near the centre. This may be corrected by a proper selection of the forms of the two lenses which replace, in all modern telescopes, the single lens hitherto considered.

The false colouring of the image is due to _chromatic aberration_. The pencil of light proceeding from a point, converges, not to one point, but to a short line of varying colour. Thus a series of coloured images is formed, at different distances from the object-glass. So that, if a screen were placed to receive the mean image _in focus_, a coloured fringe due to the other images (_out of focus, and therefore too large_) would surround the mean image.

Newton supposed that it was impossible to get rid of this defect, and therefore turned his attention to the construction of reflectors. But the discovery that the _dispersive_ powers of different glasses are not proportional to their reflective powers, supplied opticians with the means of remedying the defect. Let us clearly understand what is the discovery referred to. If with a glass prism of a certain form we produce a spectrum of the sun, this spectrum will be thrown a certain distance away from the point on which the sun's rays would fall if not interfered with. This distance depends on the refractive power of the glass. The spectrum will have a certain length, depending on the dispersive power of the glass. Now, if we change our prism for another of exactly the same shape, but made of a different kind of glass, we shall find the spectrum thrown to a different spot. If it appeared that the length of the new spectrum was increased or diminished in exactly the same proportion as its distance from the line of the sun's direct light, it would have been hopeless to attempt to remedy chromatic aberration. Newton took it for granted that this was so. But the experiments of Hall and the Dollonds showed that there is no such strict proportionality between the dispersive and refractive powers of different kinds of glass. It accordingly becomes possible to correct the chromatic aberration of one glass by superadding that of another.

Fig. 4.

This is effected by combining, as shown in fig. 4, a convex lens of _crown_ glass with a concave lens of _flint_ glass, the convex lens being placed nearest to the object. A little colour still remains, but not enough to interfere seriously with the distinctness of the image.

But even if the image formed by the object-glass were perfect, yet this image, viewed through a single convex lens of short focus placed as in fig. 1, would appear curved, indistinct, coloured, and also _distorted because viewed by pencils of light which do not pass through the centre of the eye-glass. These effects can be diminished (but not entirely removed _together_) by using an _eye-piece_ consisting of two lenses instead of a single eye-glass. The two forms of eye-piece most commonly employed are exhibited in figs. 5 and 6. Fig. 5 is Huyghens' eye-piece, called also the _negative_ eye-piece, because a real image is formed _behind_ the _field-glass_ (the lens which lies nearest to the object-glass). Fig. 6 represents Ramsden's eye-piece, called also the _positive_ eye-piece, because the real image formed by the object-glass lies _in front of_ the field-glass.

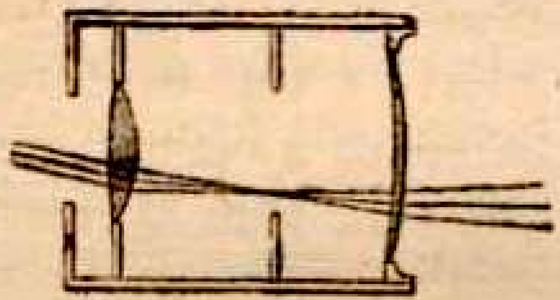


Fig. 5.

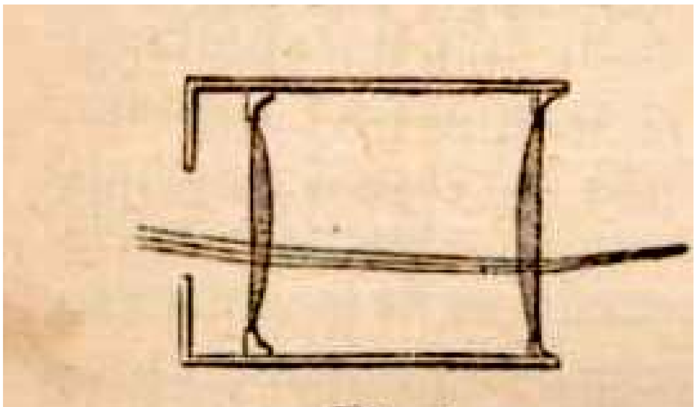


Fig. 6.

The course of a slightly oblique pencil through either eye-piece is exhibited in the figures. The lenses are usually plano-convex, the convexities being turned towards the object-glass in the negative eye-piece, and towards each other in the positive eye-piece. Coddington has shown, however, that the best forms for the lenses of the negative eye-piece are those shown in fig. 5.

The negative eye-piece, being achromatic, is commonly employed in all observations requiring distinct vision only. But as it is clearly unfit for observations requiring micrometrical measurement, or reference to fixed lines at the focus of the object-glass, the positive eye-piece is used for these purposes.

For observing objects at great elevations the diagonal eye-tube is often convenient. Its construction is shown in fig. 7. ABC is a totally reflecting prism of glass. The rays from the object-glass fall on the face AB, are totally reflected on the face BC, and emerge through the face AC. In using this eye-piece, it must be remembered that it lengthens the sliding eye-tube, which must therefore be thrust further in, or the object will not be seen in focus. There is an arrangement by which the change of direction is made to take place between the two glasses of the eye-piece. With this arrangement (known as the _diagonal eye-piece_) no adjustment of the eye-tube is required. However, for amateurs' telescopes the more convenient arrangement is the diagonal eye-tube, since it enables the observer to apply any eye-piece he chooses, just as with the simple sliding eye-tube.

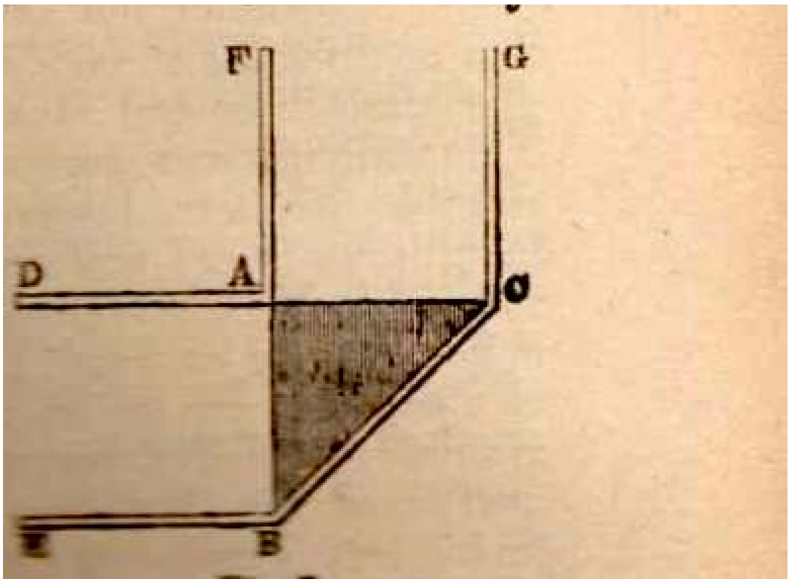


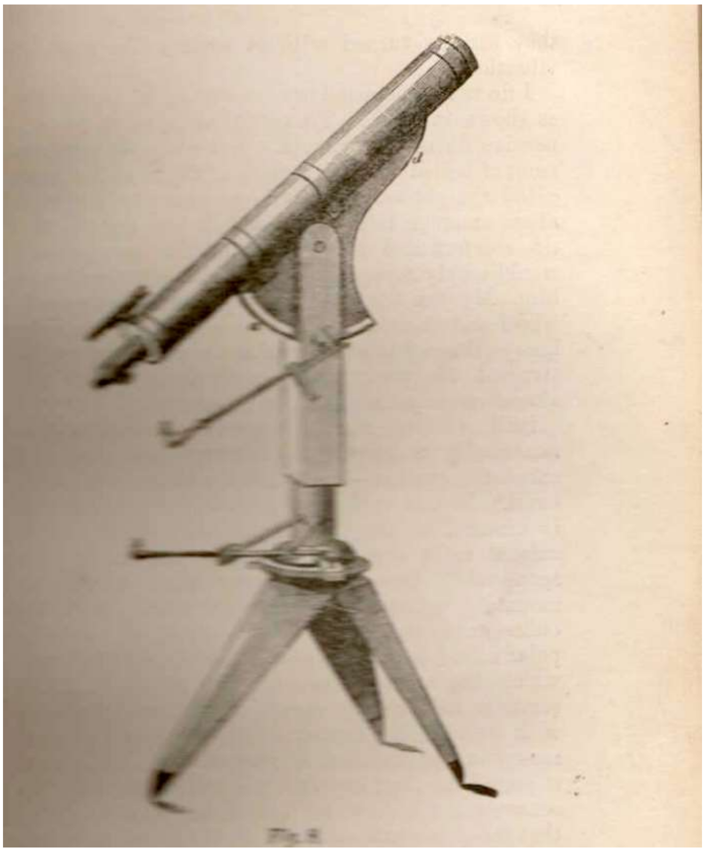
Fig. 7.

We come next to the important question of the _mounting_ of our telescope.

The best known, and, in some respects, the simplest method of mounting a telescope for general observation is that known as the _altitude-and-azimuth_ mounting. In this method the telescope is pointed towards an object by two motions,--one giving the tube the required _altitude_ (or elevation), the other giving it the required _azimuth_ (or direction as respects the compass points).

For small alt-azimuths the ordinary pillar-and-claw stand is sufficiently steady. For larger instruments other arrangements are needed, both to give the telescope steadiness, and to supply slow movements in altitude and azimuth. The student will find no difficulty in understanding the arrangement of sliding-tubes and rack-work commonly adopted. This arrangement seems to me to be in many respects defective, however. The slow movement in altitude is not uniform, but varies in effect according to the elevation of the object observed. It is also limited in range; and quite a little series of operations has to be gone through when it is required to direct the telescope towards a new quarter of the heavens. However expert the observer may become by practice in effecting these operations, they necessarily take up some time (performed as they must be in the dark, or by the light of a small lantern), and during this time it often happens that a favourable opportunity for observation is lost.

These disadvantages are obviated when the telescope is mounted in such a manner as is exhibited in fig. 8, which represents a telescope of my own construction. The slow movement in altitude is given by rotating the rod _he_, the endless screw in which turns the small wheel at _b_, whose axle in turn bears a pinion-wheel working in the teeth of the quadrant _a_. The slow movement in azimuth is given in like manner by rotating the rod _h'e'_, the lantern-wheel at the end of which turns a crown-wheel on whose axle is a pinion-wheel working in the teeth of the circle _c_. The casings at _e_ and _e'_, in which the rods _he_ and _h'e'_ respectively work, are so fastened by elastic cords that an upward pressure on the handle _h_, or a downward pressure on the handle _h'_, at once releases the endless screw or the crown-wheel respectively, so that the telescope can be swept at once through any desired angle in altitude or azimuth. This method of mounting has other advantages; the handles are conveniently situated and constant in position; also, as they do not work directly on the telescope, they can be turned without setting the tube in vibration.



I do not recommend the mounting to be exactly as shown in fig. 8. That method is much too expensive for an alt-azimuth. But a simple arrangement of belted wheels in place of the toothed wheels _a_ and _c_ might very readily be prepared by the ingenious amateur telescopist; and I feel certain that the comfort and convenience of the arrangement would amply repay him for the labour it would cost him. My own telescope--though the large toothed-wheel and the quadrant were made inconveniently heavy (through a mistake of the workman who constructed the instrument)--worked as easily and almost as conveniently as an equatorial.

Still, it is well for the observer who wishes systematically to survey the heavens--and who can afford the expense--to obtain a well-mounted _equatorial_. In this method of mounting, the main axis is directed to the pole of the heavens; the other axis, at right angles to the first, carries the telescope-tube. One of the many methods adopted for mounting equatorials is that exhibited--with the omission of some minor details--in fig. 9. _a_ is the polar axis, _b_ is the axis (called the declination axis) which bears the telescope. The circles _c_ and _d_ serve to indicate, by means of verniers revolving with the axes, the motion of the telescope in right ascension and declination, respectively. The weight _w_ serves to counterpoise the telescope, and the screws _s_, _s_, _s_, _s_, serve to adjust the instrument so that the polar axis shall be in its proper position. The advantage gained by the equatorial method of mounting is that only one motion is required to follow a star. Owing to the diurnal rotation of the earth, the stars appear to move uniformly in circles parallel to the celestial equator; and it is clear that a star so moving will be kept in the field of view, if the telescope, once directed to the star, be made to revolve uniformly and at a proper rate round the polar axis.

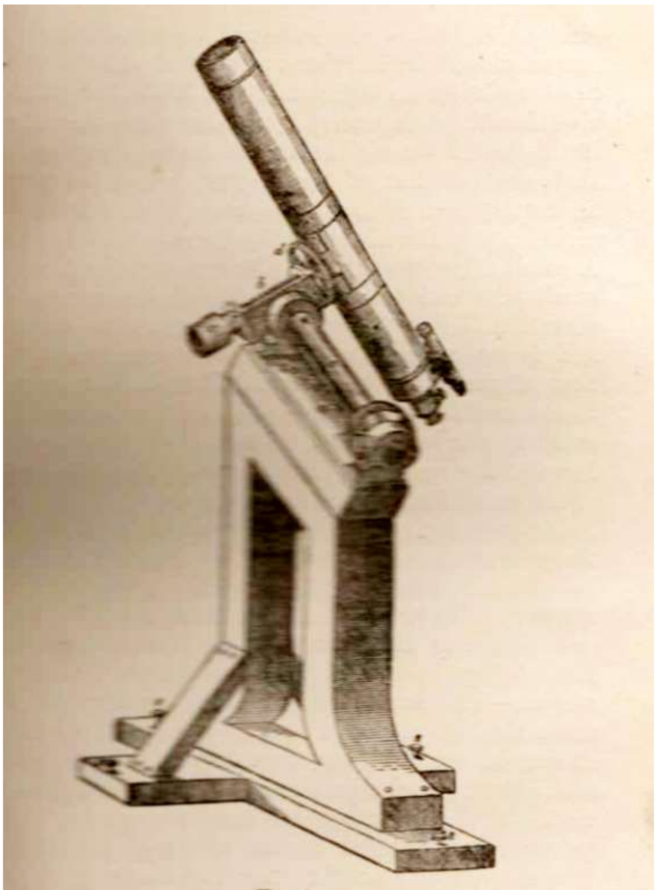


Fig. 9.

The equatorial can be directed by means of the circles _c_ and _d_ to any celestial object whose right ascension and declination are known. On the other hand, to bring an object into the field of view of an alt-azimuth, it is necessary, either that the object itself should be visible to the naked eye, or else that the position of the object should be pretty accurately learned from star-maps, so that it may be picked up by the alt-azimuth after a little searching. A small telescope called a _finder_ is usually attached to all powerful telescopes intended for general observation. The finder has a large field of view, and is adjusted so as to have its axis parallel to that of the large telescope. Thus a star brought to the centre of the large field of the finder (indicated by the intersection of two lines placed at the focus of the eye-glass) is at, or very near, the centre of the small field of the large telescope.

If a telescope has no finder, it will be easy for the student to construct one for himself, and will be a useful exercise in optics. Two convex lenses not very different in size from those shown in fig. 1, and placed as there shown--the distance between them being the sum of the focal lengths of the two glasses--in a small tube of card, wood, or tin, will serve the purpose of a finder for a small telescope. It can be attached by wires to the telescope-tube, and adjusted each night before commencing observation. The adjustment is thus managed:--a low power being applied to the telescope, the tube is turned towards a bright star; this is easily effected with a low power; then the finder is to be fixed, by means of its wires, in such a position that the star shall be in the centre of the field of the finder when also in the centre of the telescope's field. When this has been done, the finder will greatly help the observations of the evening; since with high powers much time would be wasted in bringing an object into the field of view of the telescope without the aid of a finder. Yet more time would be wasted in the case of an object not visible to the naked eye, but whose position with reference to several visible stars is known; since, while it is easy to bring the point required to the centre of the _finder's_ field, in which the guiding stars are visible, it is very difficult to direct the _telescope's_ tube on a point of this sort. A card tube with wire fastenings, such as we have described, may appear a very insignificant contrivance to the regular observer, with his well-mounted equatorial and carefully-adjusted finder. But to the first attempts of the amateur observer it affords no insignificant assistance, as I can aver from my own experience. Without it--a superior finder being wanting—our "half-hours" would soon be wasted away in that most wearisome and annoying of all employments, trying to "pick up" celestial objects. It behoves me at this point to speak of star-maps. Such maps are of many different kinds. There are the Observatory maps, in which the places of thousands of stars are recorded with an amazing accuracy. Our beginner is not likely to make use of, or to want, such maps as these. Then there are maps merely intended to give a good general idea of the appearance of the heavens at different hours and seasons. Plate I. presents four maps of this sort; but a more complete series of eight maps has been published by Messrs. Walton and Maberly in an octavo work; and my own 'Constellation-Seasons' give, at the same price, twelve quarto maps (of four of which those in Plate I. are miniatures), showing the appearance of the sky at any hour from month to month, or on any night, at successive intervals of two hours. But maps intermediate in character to these and to Observatory maps are required by the amateur observer. Such are the Society's six gnomonic maps, the set of six gnomonic maps in Johnstone's 'Atlas of Astronomy,' and my own set of twelve gnomonic maps. The Society's maps are a remarkably good set, containing on the scale of a ten-inch globe all the stars in the Catalogue of the Astronomical Society (down to the fifth magnitude). The distortion, however, is necessarily enormous when the celestial sphere is presented in only six gnomonic maps. In my maps all the stars of the British Association Catalogue down to the fifth magnitude are included on the scale of a six-inch globe. The distortion is scarcely a fourth of that in the Society's maps. The maps are so arranged that the relative positions of all the stars in each hemisphere can be readily gathered from a single view; and black duplicate-maps serve to show the appearance of the constellations.

It is often convenient to make small maps of a part of the heavens we may wish to study closely. My 'Handbook of the Stars' has been prepared to aid the student in the construction of such maps.

In selecting maps it is well to be able to recognise the amount of distortion and scale-variation. This may be done by examining the spaces included between successive parallels and meridians, near the edges and angles of the maps, and comparing these either with those in the centre of the map, or with the known figures and dimensions of the corresponding spaces on a globe. We may now proceed to discuss the different tests which the intending purchaser of a telescope should apply to the instrument.

The excellence of an object-glass can be satisfactorily determined only by testing the performance of the telescope in the manner presently to be described. But it is well to examine the quality of the glass as respects transparency and uniformity of texture. Bubbles, scratches, and other such defects, are not very important, since they do not affect the distinctness of the field as they would in a Galilean Telescope,--a little light is lost, and that is all. The same remark applies to dust upon the glass. The glass should be kept as free as possible from dirt, damp, or dust, but it is not advisable to remove every speck which, despite such precaution, may accidentally fall upon the object-glass. When it becomes necessary to clean the glass, it is to be noted that the substance used should be soft, perfectly dry, and free from dust. Silk is often recommended, but some silk is exceedingly objectionable in texture,--old silk, perfectly soft to the touch, is perhaps as good as anything. If the dust which has fallen on the glass is at all gritty, the glass will suffer by the method of cleaning commonly adopted, in which the dust is _gathered up_ by pressure. The proper method is to clean a small space near the edge of the glass, and to _sweep_ from that space as centre. In this way the dust is _pushed before_ the silk or wash-leather, and does not cut the glass. It is well always to suspect the presence of gritty dust, and adopt this cautious method of cleaning.

The two glasses should on no account be separated. In examining an eye-piece, the quality of the glass should be noted, and care taken that both glasses (but especially the field-glass) are free from the least speck, scratch, or blemish of any kind, for these defects will be exhibited in a magnified state in the field of view. Hence the eye-pieces require to be as carefully preserved from damp and dust as the object-glass, and to be more frequently cleaned.

The tube of the telescope should be light, but strong, and free from vibration. Its quality in the last respect can be tested by lightly striking it when mounted; the sound given out should be dead or non-resonant. The inside of the tube must absorb extraneous light, and should therefore be coloured a dull black; and stops of varying radius should be placed along its length with the same object. Sliding tubes, rack-work, etc., should work closely, yet easily.

The telescope should be well balanced for vision with the small astronomical eye-pieces. But as there is often occasion to use appliances which disturb the balance, it is well to have the means of at once restoring equilibrium. A cord ring running round the tube (pretty tightly, so as to rest still when the tube is inclined), and bearing a small weight, will be all that is required for this purpose; it must be slipped along the tube until the tube is found to be perfectly balanced. Nothing is more annoying than, after getting a star well in the field, to see the tube shift its position through defective balance, and thus to have to search again for the star. Even with such an arrangement as is shown in fig. 8, though the tube cannot readily shift its position, it is better to have it well balanced.

The quality of the stand has a very important influence on the performance of a telescope. In fact, a moderately good telescope, mounted on a steady stand, working easily and conveniently, will not only enable the observer to pass his time much more pleasantly, but will absolutely exhibit more difficult objects than a finer instrument on a rickety, ill-arranged stand. A good observing-chair is also a matter of some importance, the least constraint or awkwardness of position detracting considerably from the power of distinct vision. Such, at least, is my own experience.

But the mere examination of the glasses, tube, mounting, &c., is only the first step in the series of tests which should be applied to a telescope, since the excellence of the instrument depends, not on its size, the beauty of its mounting, or any extraneous circumstances, but on its performance.

The observer should first determine whether the chromatic aberration is corrected. To ascertain this the telescope should be directed to the moon, or (better) to Jupiter, and accurately focussed for distinct vision. If, then, on moving the eye-piece towards the object-glass, a ring of purple appears round the margin of the object, and on moving the eye-glass in the contrary direction a ring of green, the chromatic aberration is corrected, since these are the colours of the secondary spectrum.

To determine whether the spherical aberration is corrected, the telescope should be directed towards a star of the third or fourth magnitude, and focussed for distinct vision. A cap with an aperture of about one-half its diameter should then be placed over the object-glass. If no new adjustment is required for distinct vision, the spherical aberration is corrected, since the mean focal length and the focal length of the central rays are equal. If, when the cap is on, the eye-piece has to be pulled out for distinct vision, the spherical aberration has not been fully corrected; if the eye-piece has to be pushed in, the aberration has been over-corrected. As a further test, we may cut off the central rays, by means of a circular card covering the middle of the object-glass, and compare the focal length for distinct vision with the focal length when the cap is applied. The extent of the spherical aberration may be thus determined; but if the first experiment gives a satisfactory result, no other is required.

A star of the first magnitude should next be brought into the field of view. If an irradiation from one side is perceived, part of the object-glass has not the same refractive power as the rest; and the part which is defective can be determined by applying in different positions a cap which hides half the object-glass. If the irradiation is double, it will probably be found that the object-glass has been too tightly screwed, and the defect will disappear when the glass is freed from such undue pressure.

If the object-glass is not quite at right angles to the axis of the tube, or if the eye-tube is at all inclined, a like irradiation will appear when a bright star is in the field. The former defect is not easily detected or remedied; nor is it commonly met with in the work of a careful optician. The latter defect may be detected by cutting out three circular cards of suitable size with a small aperture at the centre of each, and inserting one at each end of the eye-tube, and one over the object-glass. If the tube is rightly placed the apertures will of course lie in a right line, so that it will be possible to look through all three at once. If not, it will be easy to determine towards what part of the object-glass the eye-tube is directed, and to correct the position of the tube accordingly.

The best tests for determining the defining power of a telescope are close double or multiple stars, the components of which are not very unequal. The illuminating power should be tested by directing the telescope towards double or multiple stars having one or more minute components. Many of the nebulæ serve as tests both for illumination and defining power. As we proceed we shall meet with proper objects for testing different telescopes. For the present, let the following list suffice. It is selected from Admiral Smyth's tests, obtained by diminishing the aperture of a 6-in. telescope having a focal length of 8-1/2 feet:

A two-inch aperture, with powers of from 60 to 100, should exhibit

[alpha] Piscium (3"·5).	[delta] Cassiopeiæ (9"·5),	mag. (4 and 7-1/2)
[gamma] Leonis (3"·2).	Polaris (18"·6),	mag. (2-1/2 and 9-1/2)

A four-inch, powers 80 to 120, should exhibit

[xi] Ursæ Majoris (2"·4).	[sigma] Cassiopeiæ (3"·1),	mag. (6 and 8).
[gamma] Ceti (2"·6).	[delta] Geminorum (7"·1),	mag. (4 and 9).

The tests in the first column are for definition, those in the second for illumination. It will be noticed that, though in the case of Polaris the smaller aperture may be expected to show the small star of less than the 9th magnitude, a larger aperture is required to show the 8th magnitude component of [sigma] Cassiopeiæ, on account of the greater closeness of this double.

In favourable weather the following is a good general test of the performance of a telescope:--A star of the 3rd or 4th magnitude at a considerable elevation above the horizon should exhibit a small well defined disc, surrounded by two or three fine rings of light.

A telescope should not be mounted within doors, if it can be conveniently erected on solid ground, as every movement in the house will cause the instrument to vibrate unpleasantly. Further, if the telescope is placed in a warm room, currents of cold air from without will render observed objects hazy and indistinct. In fact, Sir W. Herschel considered that a telescope should not even be erected near a house or elevation of any kind round which currents of air are likely to be produced. If a telescope is used in a room, the temperature of the room should be made as nearly equal as possible to that of the outer air.

When a telescope is used out of doors a 'dew-cap,' that is, a tube of tin or pasteboard, some ten or twelve inches long, should be placed on the end of the instrument, so as to project beyond the object-glass. For glass is a good radiator of heat, so that dew falls heavily upon it, unless the radiation is in some way checked. The dew-cap does this effectually. It should be blackened within, especially if made of metal. "After use," says old Kitchener, "the telescope should be kept in a warm place long enough for any moisture on the object-glass to evaporate." If damp gets between the glasses it produces a fog (which opticians call a sweat) or even a seaweed-like vegetation, by which a valuable glass may be completely ruined.

The observer should not leave to the precious hours of the night the study of the bearing and position of the objects he proposes to examine. This should be done by day--an arrangement which has a twofold advantage,--the time available for observation is lengthened, and the eyes are spared sudden changes from darkness to light, and _vice versâ_. Besides, the eye is ill-fitted to examine difficult objects, after searching by candle-light amongst the minute details recorded in maps or globes. Of the effect of rest to the eye we have an instance in Sir J. Herschel's rediscovery of the satellites of Uranus, which he effected after keeping his eyes in darkness for a quarter of an hour. Kitchener, indeed, goes so far as to recommend (with a _crede experto_) an _interval of sleep_ in the darkness of the observing-room before commencing operations. I have never tried the experiment, but I should expect it to have a bad rather than a good effect on the eyesight, as one commonly sees the eyes of a person who has been sleeping in his day-clothes look heavy and bloodshot.

The object or the part of an object to be observed should be brought as nearly as possible to the centre of the field of view. When there is no apparatus for keeping the telescope pointed upon an object, the best plan is so to direct the telescope by means of the finder, that the object shall be just out of the field of view, and be brought (by the earth's motion) across the centre of the field. Thus the vibrations which always follow the adjustment of the tube will have subsided before the object appears. The object should then be intently watched during the whole interval of its passage across the field of view.

It is important that the student should recognise the fact that the highest powers do not necessarily give the best views of celestial objects. High powers in all cases increase the difficulty of observation, since they diminish the field of view and the illumination of the object, increase the motion with which (owing to the earth's motion) the image moves across the field, and magnify all defects due to instability of the stand, imperfection of the object-glass, or undulation of the atmosphere. A good object-glass of three inches aperture will in very favourable weather bear a power of about 300, when applied to the observation of close double or multiple stars, but for all other observations much lower powers should be used. Nothing but failure and annoyance can follow the attempt to employ the highest powers on unsuitable objects or in unfavourable weather.

The greatest care should be taken in focussing the telescope. When high powers are used this is a matter of some delicacy. It would be well if the eye-pieces intended for a telescope were so constructed that when the telescope is focussed for one, this might be replaced by any other without necessitating any use of the focussing rack-work. This could be readily effected by suitably placing the shoulder which limits the insertion of the eye-piece.

It will be found that, even in the worst weather for observation, there are instants of distinct vision (with moderate powers) during which the careful observer may catch sight of important details; and, similarly, in the best observing weather, there are moments of unusually distinct vision well worth patient waiting for, since in such weather alone the full powers of the telescope can be employed.

The telescopist should not be deterred from observation by the presence of fog or haze, since with a hazy sky definition is often singularly good.

The observer must not expect distinct vision of objects near the horizon. Objects near the eastern horizon during the time of morning twilight are especially confused by atmospheric undulations; in fact, early morning is a very unfavourable time for the observation of all objects.

The same rules which we have been applying to refractors, serve for reflectors. The performance of a reflector will be found to differ in some respects, however, from that of a refractor. Mr. Dawes is, we believe, now engaged in testing reflectors, and his unequalled experience of refractors will enable him to pronounce decisively on the relative merits of the two classes of telescopes.

We have little to say respecting the construction of telescopes. Whether it is advisable or not for an amateur observer to attempt the construction of his own telescope is a question depending entirely on his mechanical ability and ingenuity. My own experience of telescope construction is confined to the conversion of a 3-feet into a 5-1/2-feet telescope. This operation involved some difficulties, since the aperture had to be increased by about an inch. I found a tubing made of alternate layers of card and calico well pasted together, to be both light and strong. But for the full length of tube I think a core of metal is wanted. A learned and ingenious friend, Mr. Sharp, Fellow of St. John's College, informs me that a tube of tin, covered with layers of brown paper, well pasted and thicker near the middle of the tube, forms a light and strong telescope-tube, almost wholly free from vibration.

Suffer no inexperienced person to deal with your object-glass. I knew a valuable glass ruined by the proceedings of a workman who had been told to attach three pieces of brass round the cell of the double lens. What he had done remained unknown, but ever after a wretched glare of light surrounded all objects of any brilliancy.

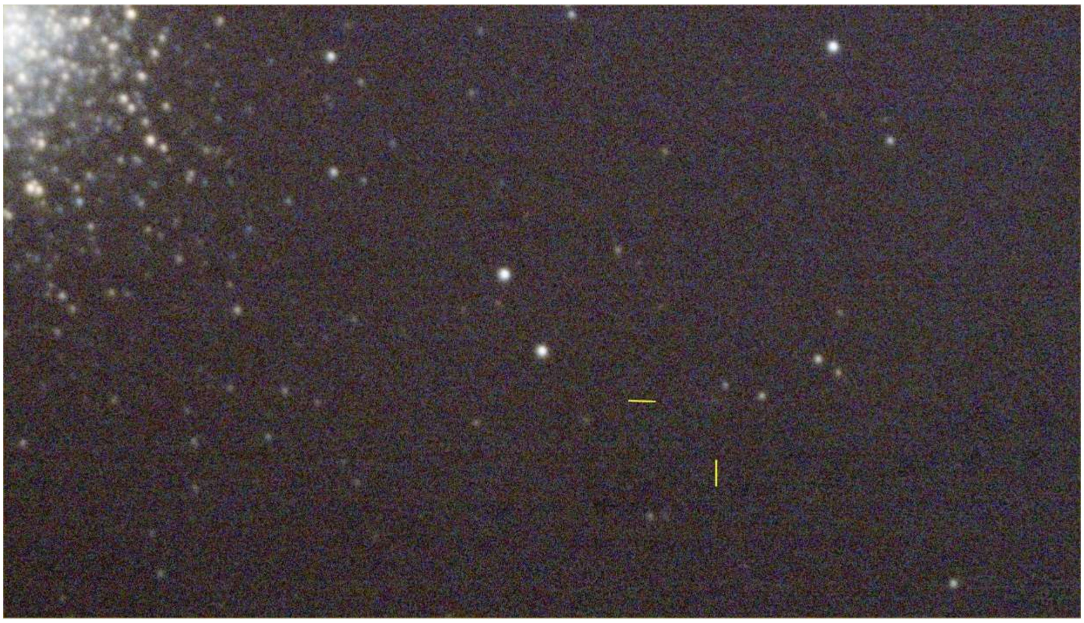
One word about the inversion of objects by the astronomical telescope. It is singular that any difficulty should be felt about so simple a matter, yet I have seen in the writings of more than one distinguished astronomer, wholly incorrect views as to the nature of the inversion. One tells us that to obtain the correct presentation from a picture taken with a telescope, the view should be inverted, held up to the light, and looked at from the back of the paper. Another tells us to invert the picture and hold it opposite a looking-glass. Neither method is correct. The simple correction wanted is to hold the picture upside down--the same change which brings the top to the bottom brings the right to the left, _i.e._, fully corrects the inversion.

In the case, however, of a picture taken by an Herschelian reflector, the inversion not being complete, a different method must be adopted. In fact, either of the above-named processes, incorrect for the ordinary astronomical, would be correct for the Herschelian Telescope. The latter inverts but does not reverse right and left; therefore after inverting our picture we must interchange right and left because they have been reversed by the inversion. This is effected either by looking at the picture from behind, or by holding it up to a mirror.

Members Astro-photographs.

Dan Self

M101, 7 X 30sec, SN2023ixf June 11th near peak.



M13 close up IC4617 8X30sec

M13 & NGC6207 8X30sec

Dunwich Monastery at night

Cygnus wall close up DLSR 23 X 30sec 20 Inch observatory telescope

Comet 2023 E1 11th June Draco 43 X 30 Sec average stack

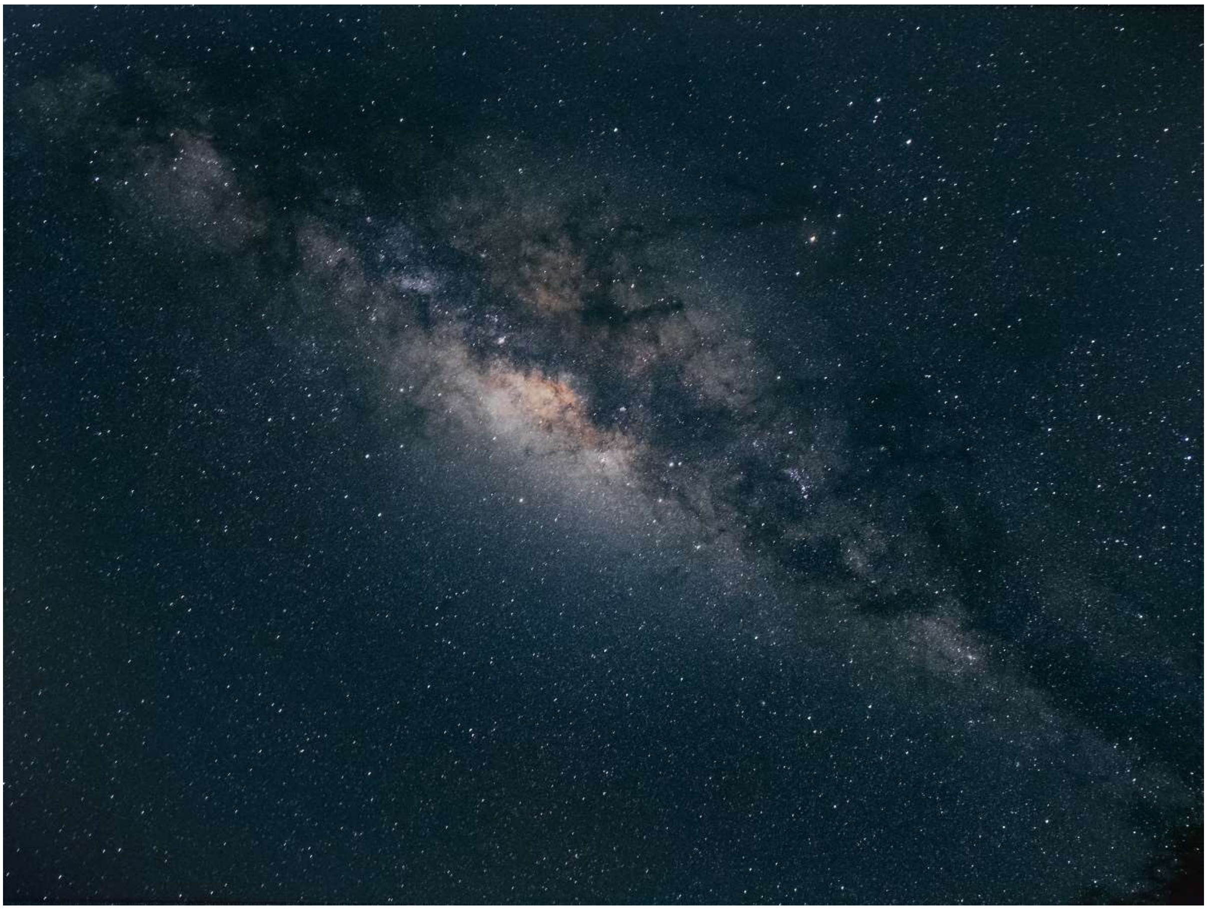
Albireo 7 X 5sec colour enhanced stars Shrunk.

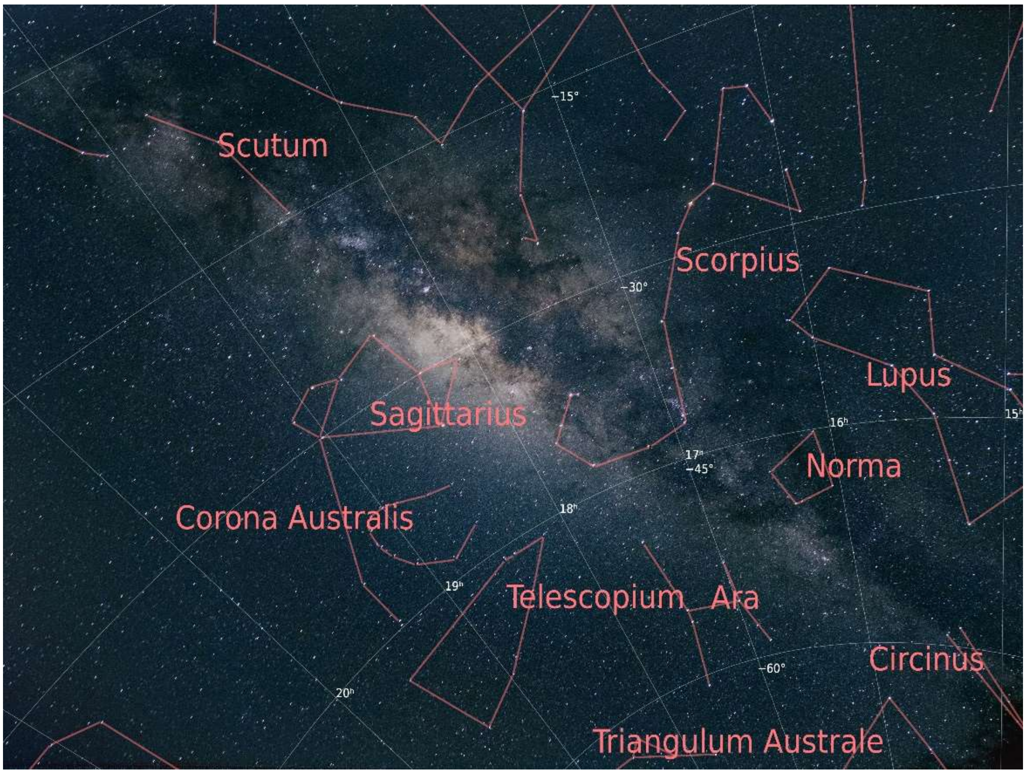
Sea at Dunwich May 20th 12 X 90 secs

John Gionis

Crescent Moon taken May 24, Canon DSLR and 10 inch Meade SNT

Richard Harmon





Andy Weller

Deer Lick (NGC7331) Group

The Ring Nebula and IC 1296 Galaxy.

150 x 10-second exposure stack.

Malcolm James Dent

127mm refractor. Approx 30000 frames

M12

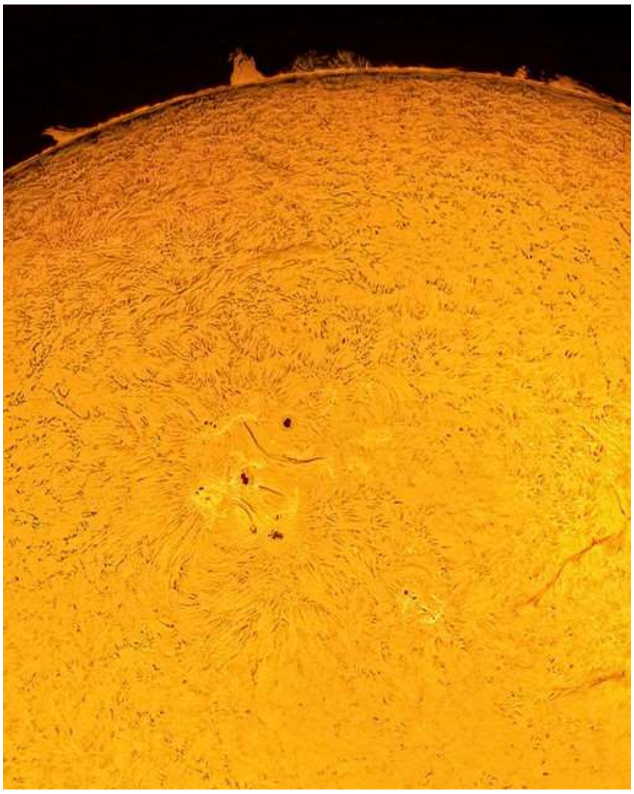
Altair Astro 130EDT, ZWO ASI2600mm, Optolong 7nm Ha Filter, ZWO ASI Air Pro 2, EAF, EFW
84 x 300 seconds. Calibrated and processed in Pixinsight.

Cygnus wall. 2 hours of data so far from the Optolong 7nm Ha filter.

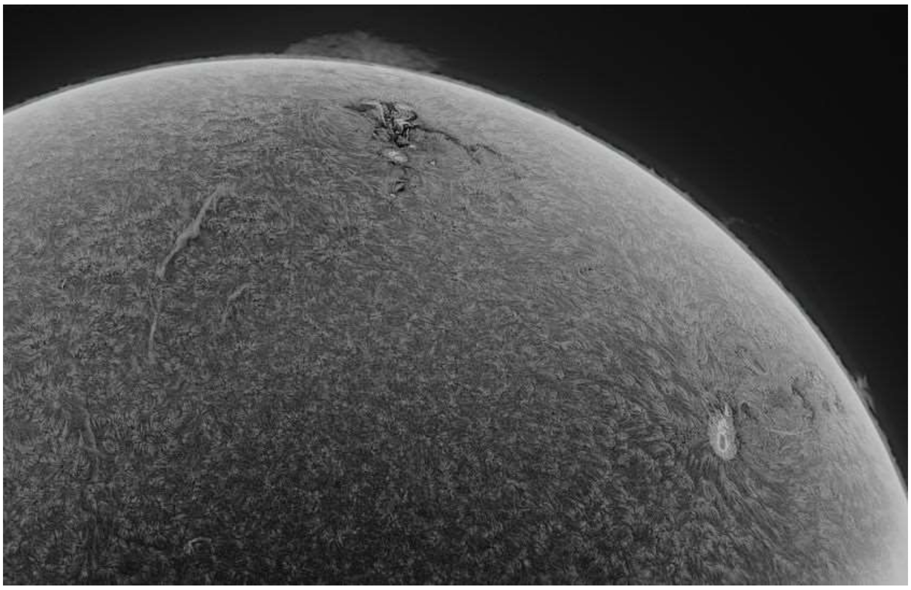
My Final version of the Cygnus wall area In HaHoo. 9 hours total integration time.

Elephant trunk, (or is it a lady walking away into the mist.)

Roger Hyman.

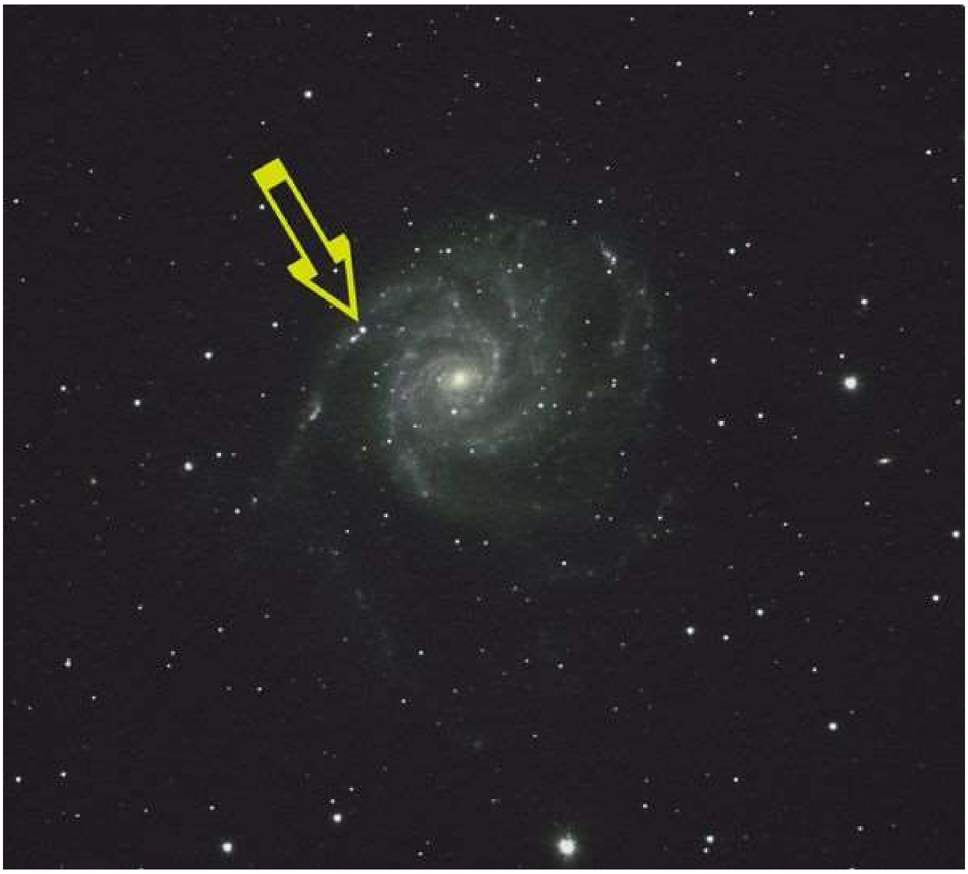


WO GT71, Quark Chromosphere, Baader UV/IR cut filter and ASI174MM. Processed in Autostakkert, Registax and Photoshop

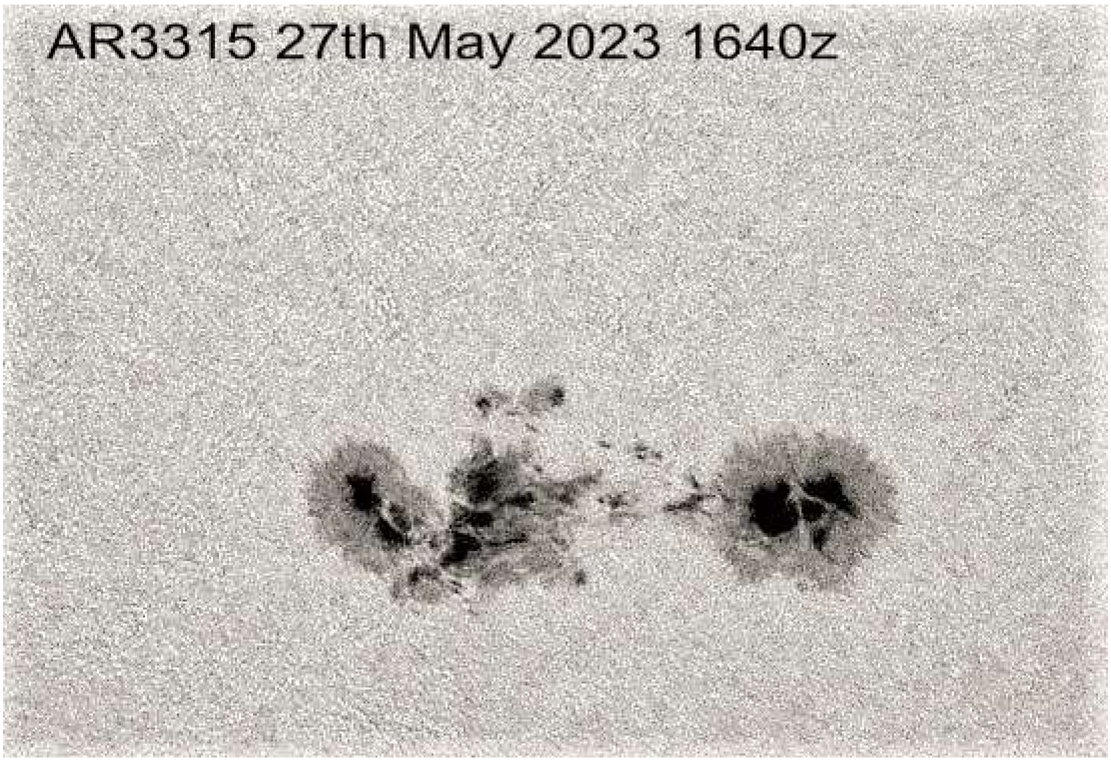


WO GT71, Quark Chromosphere, UV/IR cut filter and ZWO ASI174mm mounted on a Skywatcher Solarquest mount.

Chris Bailey



Supernova in M101



BRECKLAND ASTRONOMICAL SOCIETY

Charity No.1044478
www.brecklandastro.org.uk
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Dr Dan Self, Chairman, 56 Lindley Street, Norwich, Norfolk, NR1 2HF.
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OBSERVATORY RISK ASSESSMENT 2022

This policy document applies to the aforementioned charity and covers all instances of normal use of the observatory building and equipment within it. All other statements of intent are laid out in the society's constitution.

The purpose of the society (Breckland Astronomical Society) is to promote and to advance public education in the Science of Astronomy and all branches of scientific research and in so doing the following policy statements are necessary.

Persons visiting are members and public of all ages by pre-arrangement, or on public open nights.

Section 2 - Risk Assessment

Hazards (*visit leaders must identify any additional hazards where applicable)*	**Risk Control Measures**	**Outcome risk rating**
For external parties: Safety whilst travelling to observatory.	Responsibility is with individual regarding transport.	Low
Lost people	A nominal roll should be available for parties with minors. Stay in groups and count in and out, especially risky when young children running around on dark	Tolerable

	field. Responsibility with teachers/akelas.	
Pre-existing medical conditions	Visitors have been asked to bring with them anything they need with regard to medicine/ first aid training. DS is first aid trained as part of job.	Tolerable
In the Observatory: Moving the telescope dome - Mechanical hazard from cogs and metal clips on dome motors and sliding parts. Falling from dome.	Supervision is necessary to prevent visitors' fingers being caught in dangerous places before moving. Train supervisors. Gears are located in inaccessible places. Signs to keep head out of opening while moving it. Failure of clips holding very difficult due to strong fastening.	Tolerable Tolerable
Electrical hazards	All electrical circuits are protected by RCD trip switches, which have been checked. Equipment should only be used by trained demonstrators as PAT testing is not viable.	Tolerable
Light intensity from laser pointer, bright LEDs	A low power class 2 laser can be used to collimate scope, this should not be used during visits. An upper end- class 2 green laser is sometimes used for pointing out stars outside. This should NOT be pointed near people, or planes, only switched on briefly and used by supervisors/demonstrators only. Laser is currently broken.	Low
Skin contact with dangerous chemicals	Fly spray, propanol, and cleaning fluid kept in cupboard in small quantities. Keep cupboards shut when visitors are present and supervise.	Tolerable
Standing in dome - Falling (height is 7 feet)	Shutter opening is guarded by 2 bars at child / adult heights. Limit numbers in dome 7 + supervisors can easily fit.	Tolerable
Standing in dark places - Stumbling in low light	Use dim red lights on floor to preserve night vision. Dim lights gradually.	Low
Climbing ladder in dark - Falling while viewing through telescope.	Ladder must be shown to people first, but enough light is available. Check for mobility difficulties.	Tolerable
Ascending stairs - Falling or being hit with trap door	Be sure demonstrator to go up first and lock door open. A knocking procedure is known if the door is shut.	Tolerable
Fire risk	Large items are not flammable. Mainly metal fixtures and fittings. Sources of ignition (sparks) are contained in electrical equipment. Flammable gases are not kept in building. Radio linked smoke alarms installed. Fire extinguishers available and annually checked. Call 999 in emergency. Can exit via dome opening in emergency	Tolerable

Standing in dark cold field - frostbite	Weather could be freezing in most months. Warm clothes to be advised to visitors. Heaters indoors if cold and keep a blanket at the observatory.	Tolerable
Trips and slips	Trip hazard in dark. Torch guidance will be provided but is limited because of dark sky observing. Advised to dip and dim lights.	Tolerable
Child protection risks (under 18s)	Two adults should be available at all times. DBS checks should be in place for group supervisors. The organisation that runs the observatory, Breckland Astronomical Society, operates a child protection policy. The committee are vigilant with regard to risks.	Low
Airborne viral transmission indoors	The place is fairly well ventilated with vents in toilet and loose fitting door and dome and dome floor hatch. Open internal doors Physically Distance 1m+ between groups Limit numbers to what any national guidelines state at the time. Space is quite limited. Provide outdoor activities, e.g. electronically assisted astronomy. Telescopes outdoors.	Tolerable – as we have very good ventilation.
Outdoor transmission	Risk is found to be low outdoors. Follow national guidelines. Be mindful of face to face breath transmission.	Tolerable
Surface transmission	Sanitisers are available. Wipe surfaces. Limit one to use of kitchen/bathroom area. Offer people option of using own mugs and washing up. Clean toilet regularly.	Low
Reporting	Not needed, ask permission, but a record of visitors names is good to keep a for any future possible information purposes. It will be destroyed before 5yrs (GDPR).	N/A

Signed………………………………...………………………………………………………
Chairman, Breckland Astronomical Society, UKCC 1044478.

For Sale or Wanted

This section is for the sale of Astronomical items and any wants from members. Details of items for sale (With photographs where applicable) should be forwarded to the newsletter editor at newsletter@brecklandastro.org.uk

It is suggested that a donation of 5% of the final sale price be given to the Society to assist with funds. If sellers do not wish to make their contact details public then please make this known to me and I will field any enquiries on a box number system. Please send any sales details to me before the 26th of the month for inclusion in the next issue.

Please ensure that if any item is sold by another means prior to publication that I am advised so it can be removed to avoid confusion.

David Murton is selling his Astronomical equipment as listed below. David is known to many of you and was also the Chairman of OASI for a number of years.

Type	Manufacturer	Model	Description	Price £
Mount	Skywatcher	NEQ-6	With Tripod, handset, 240v power supply, 12v lead. Mains power switch has been disabled and bi-passed. Good working order.	695
Mount	Skywatcher	Star adventurer	With Tripod and photography, camera optional extra kit, and 5v power lead. All in aluminium travel case. Good working order.	175
Telescope	William Optics	Zenith Star 71	APO doublet ED glass refractor. With WO dedicated field flattener/focal reducer including Canon bayonet fit adaptor, WO star diagonal. All in WO travel bag	400
Telescope	Meade	LXD 55	Ultra high contrast F/10 Schmidt Cassegrain. 203.2mm dia, f-2000mm. With Moonlight 2” focuser and Meade finderscope	500
Pier	None		Very substantial steel observatory pier with adapters for Skywatcher HEQ-5 and NEQ-6 mounts. Fully adjustable for levelling.	250
Tracker	Omegon	Mini track LX2	Clockwork tracker for cameras. Fits on ordinary photographic tripods. No power required.	95
Dovetail	Altair	Losmandy	300mm long dovetail bar	20
Dovetail	Skywatcher	Vixen	130mm long dovetail bar	10
Camera	Altair	GP-Cam IMX224	Colour planetary camera	70
CCD camera fitment	Bader	Variolock	Variolock T2 variable extension 29-46mm	30
Camera adapter			2” Canon bayonet fit dslr adapter for telescope with light pollution filter	20
Laser collimintor	Altair	V2		25
Digiscoping adapter	Bader	Microstage 2	For connecting cameras to telescope eyepiece.	25
Solar filter	Orion		3.38” dia White light glass solar filer for telescope	30
Camera filter	Astronomik		Ha 12mm CCD EOS clip filter (hydrogen alpha)	50
Camera filter	Astronomik		CLS CCD EOS clip filter (light polution)	50
Bahtinov Mask			For 200mm telescope	10
ADC	ZWO		Atmospheric dispersion corrector. 1.25”. For use when taking planetary pictures.	50
Illuminated eyepiece	Skywatcher		Illuminated cross hairs eyepiece. 1.25” dia fit.	25

Eyepiece	William Optics	P-F6A-Z71 Swan	25mm f/l, 72 degree, 2” eyepiece	55
Eyepiece	Starguider	ED 5mm	1.25”, 5mm eyepiece	20
Eyepiece	Starguider	ED 8mm	1,25”, 8mm eyepiece	20
Eyepiece	Starguider	ED 15mm	1.25”, 15mm eyepiece	20
Eyepiece	Starguider	ED 25mm	1.25”. 25mm eyepiece	20
Eyepiece	Meade	Super Plossil multi coated	1.25”, 12.4mm eyepiece	15
Eyepiece	Meade	Super Plossil multi coated	1.25”, 15mm eyepiece	15
Eyepiece	Meade	Super Plossil multi coated	1.25”, 20mm eyepiece	15
Eyepiece	Meade	Super Plossil multi coated	1.25” 26mm eyepiece	15
Eyepiece	Meade	Super Plossil multi coated	1.25”, 32mm eyepiece	15
Eyepiece case	Meade		Aluminium carry case for eyepieces	20
Barlow	Revolution Astro		ED coated 2x Barlow, 2” dia with 1.25” adapter	50
Powermate	Tele Vue		4x Powermate, 2” dia with 1.25” adapter	180
Extension tube	William Optics		2” dia extender 2” long	15
Extension tube	Revolution Astro		2” dia extender 80mm long	15
Extension tube	Skywatcher		2” dia extender 40mm long	5

For any enquiries or further information David can be contacted on dmurton90@gmail.com

Equipment available for loan to Members

As well as our fantastic library members of the society can borrow our equipment. Here is an equipment list that can be used or borrowed by members, subject to personal responsibility for replacement value. Discuss your plans with one of the regulars first, as it is not easy for beginners to use some of this kit. We are here to help show you how to use it, when the weather holds up, then you will need to sign it out and get approval by a member of the committee. We can discuss a reasonable term.

Refractors:

William Optics Megrez 102 S.V. F7 D102mm f/7 and reducer to f/5.6 – this may be unavailable soon.
William Optics GT-102 2019 D102mm F703mm f/6.9
Vixen 4” Refractor f/9

SCT/Maks:

Celestron C925 Starbright F10 SCT FL D234.95mm F2350mm f/10 Refractor – preferably this should not be taken off the premises.
Celestron C8 SCT D203.2mm F2000mm f/10 Refractor (orange tube)
Meade LX200R SCT D203.2mm F2000mm f/10
Konus Motormax-90 Maksutov-Cassegrain 90mm F1200mm f/13 #1795
Meade ETX125 D127mm F1900mm f/15 Maksutov-Cassegrain Reflector
Mak-Newt:
Skywatcher 190MN DS Pro Maksutov-Newtonian Optical Tube Assembly D190mm F1000mm

Dobsonians:

Skywatcher Skyliner 200mm F1200mm Dobsonian Reflector
Helios D200mm F1000mm Dobsonian Reflector
8-inch Dobsonian (turquoise tube, hand-made)

Solarscope:

Coronado Solarmax 40

Meade 8x50mm Guide Scope

Binoculars:

Vanguard KR-7500 7X50mm Field 7 degrees Binoculars – a little out
Konus #2253 7x50 Field 6.8º Binoculars
Chinon RB Optics 8-20 x 50 HB Zoom Binoculars
Prinzlux 10x50 Binoculars – needs optically cleaning

Mounts:

Berlebach Planet Tripod with Double Clamps
Orange EQ4 telescope mount
Skywatcher SynScan EQ5 Equatorial Mount & Tripod
SynScan mount controller
Meade LXD German Equatorial Mount & Autostar Controller
SynScan mount controller
iOptron IEQ45 Mount and Pier
iOptron Go2Nova mount controller

Eyepieces:
Tele Vue Delos 17.1mm 2"
Antares Speers-Waler 4.9mm SWA Series 2 2"
Antares Speers-Waler 9.4mm SWA Series 3 2"
Meade Ultra Wide Angle 14mm 1.25/2"
Antares W70 Series 8.6mm
Meade Super Wide Angle 18mm 1.25"
Celestron 32mm Plossl 1.25"
Celestron 26mm Plossl 1.25"
Antares 17mm Plossl FMC 1.25"
Intes-Micro Q74 WA 21mm 1.25"
Orion (Or) Circle-T 9mm 1.25"
Vixen K 18mm 1.25"
Fullerscope K 25mm 1.25"
66 Ultrawide 20mm Long Eye Relief 1.25"
Or 6mm 1.25"
Plossl 40mm Multi-coated
Plossl 17mm Multi-coated
14mm (7mm 21mm) 1.25"
Super 20mm 1.25"
Soligor PE-6mm 1.25"
Super Plossl 32mm 1.25"
Lanthanum LV 2.5mm 45 degree 20mm 1.25"
Televue 2x Barlow 1.25"
Televue 2.5x Barlow Powermate 1.25"
2x Barlow Lens
Meade Telenegative 2x Barlow 1.25"

Telescope accessories:
William Optics AFR-IV Adjustable Flattener Reducer
Meade Zero Image-Shift Microfocuser
Meade 4000 Series f6.3 Focal Reducer
Meade 4000 series f3.3 CCD Focal Reducer with T-Adapter
Celestron Reducer/Corrector f6.3 (Model: 94175)
Tamron Adaptall-2 Custom Mount

Eyepiece accessories and filters:
Meade Electronic Eyepiece
Meade Illuminated Reticle MA12mm
Celestron Radial Guider (#94176)
Light Pollution Filter 1.25"
Meade #908 O-III Nebular Filter
Variable Polarizing Filter #3
Baader Planetarium Contrast-Booster Filter (#2458360) 1.25"
Celestron Colored Eyepiece Filters (#25 Red, #38A Blue, #47 Violet, #53 L Green)
Baader G-CCD Filter 1.25" (Cat: 2458470G)
Baader R-CCD Filter 1.25" (Cat: 2458470R)
Baader B-CCD Filter 1.25" (Cat: 2458470B)
Baader UV/IR Cut/L-Filter 1.25" (Cat: 2459207A)
Baader H-alpha 7nm CCD Narrowband-Filter 1.25" (Cat: 2458382)
Baader O-III 8.5nm CCD Narrowband-Filter 1.25" (Cat: 2458435)
Baader S-II 8nm CCD Narrowband-Filter 1.25" (Cat: 2458430)
Baader H-beta 8.5nm CCD Narrowband-Filter 1.25" (Cat: 2458425)
Astronomik L-RGB Type 2c Filterset 1.25" (4 filters, Cat: 10220125)
Astronomik CLS-Filter 2" (Cat: 10213200)
Astronomik CLS-Filter 1.25" (Cat: 10213125)

Astronomik CLS CCD-Filter 1.25" (Cat: 10208125)
Star Analyser 100 (Model: PHEL-SA100) – produces spectra

Cameras:

Atik Focal Reducer 58mm
Atik 383L + FW 11/4"+Filters
Atik Infinity Camera
Atik 314L+ CCD Camera (SNI1003041)
Atik One 6.0 Monochrome CCD Camera (SN: 1191452-0093)
Atik 460EX Color (SN21223-26)
ZWO ASI290MM Mini USB 2.0 Monochrome Small Format CMOS Camera
Imaging Source DBK21AU618.AS 640x480 USB2 planetary camera
STV (‘vintage video CCD AV camera) and Filter Wheel
Astrovid 2000 (‘vintage’ CCD camera)
Nikon D100 DSLR
Sigma EX DG Macro 105mm 1:2.8 DLSR Lens
Geoptik CCD Adapter x Canon (Model: 30A189)

CONTACTS

Chair Dan Self
Contact chairman@brecklandastro.org.uk

Observatory/Visits Mick Ladner
Contact visitors@brecklandastro.org.uk

Webmaster Andrew Luck (temporary)
Contact webmaster@brecklandastro.org.uk

Newsletter Chris Bailey
Contact newsletter@brecklandastro.org.uk

Membership/Treasurer Andy Jones
Contact treasurer@brecklandastro.org.uk

Secretary Rebecca Greef
Contact secretary@brecklandastro.org.uk

Please check with any of the contacts in bold before visiting the observatory. Please ensure you are wearing appropriate footwear and clothing and bring a torch (preferably one showing a RED light)

Breckland Astronomical Society Events – 2023 7:30pm Great Ellingham Recreation Centre, Watton Road, Great Ellingham, Attleborough, Norfolk between NR17 1HZ and **1HX** **£2.50 adults £1 children** *what3words:octopus.vibrates.hubcaps*		
Friday, July 14th	**The Apollo Missions**	Jerry Workman
Friday, Aug 11th	**Night Vision**	Dr Dan Self, BAS
Friday, August 25th	**Public Open Evening** (first of season)	Observatory 8:30pm
Friday, September 8th	**Arp Peculiar Galaxies –** **How to See Them from England**	Alan Snook, expert visual observer (BAA)
Friday, Septembr 29th	**Public Open Evening**	Observatory
Friday, October 13th	**Jupiter (and Saturn)'s Radiation Belts**	Dr Emma Woodfield, British Antarctic Survey
Friday, October 27th	**Public Open Evening**	Observatory
Friday, November 10th	**Quiz Night (General Knowledge)**	Quizmaster Dan
Friday, November 24th	**Public Open Evening**	Observatory
Friday, December 8th	**The Kepler Space Telescope and The Discovery of Exoplanets**	Dr Thomas North, Sir Isaac Newton 6th Form
Friday, December 29th	**Public Open Evening**	Observatory