TRANSIT

The Newsletter of

Cleveland & Darlington Astronomical Society

05 March 2007

Light Pollution – unfortunate? – No! Criminal!!!!

Editorial

Last meeting : 9 February - "The Formation of Stars and Planets"
by Dr. Rene Oudmaijer of Leeds University. A very well presented description on the formation of stars and planets from collapsing Interstellar clouds of cold gas.

Next meeting : 9 March -Modern Cosmology
by Dr. Ruth Gregory of Durham University

Star Party : Saturday 17 March 2007, from 7:00pm, Wynyard Woodland Park Planetarium and Observatory. Open to the general public, hopefully all night if the weather stays clear.

Letters to the Editor :

Any new observations, any comments on local or international astronomy, ***anything*** *you want to share with your fellow members?*

Dear Editor,

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Society Members Tackle Light Pollution

from Bob Mullen

Two of our Society members, Jurgen Schmoll of Durham University and Ed Restall, Director of the Wynyard Woodland Park Planetarium and Observatory, are personally tackling the problem of light pollution in the area by inviting members of local Councils to discussion meetings on the subject.

Led by Jurgen they have put together a presentation which discusses light pollution problems caused by present methods of street and property lighting. Equally, they present a number of alternative methods which would not only reduce light pollution in our skies but would provide considerable financial savings to Councils and their Community Charge payers.

To support his argument Jurgen made an interesting photographic journey through his hometown of West Cornforth on a misty night. The mist very convincingly demonstrated the diffusion of light from a variety of different street lights. A considerable amount of light was seen to be diffused directly upwards - annoying to astronomers, diffused backwards into bedrooms - annoying to homeowners and strangely enough very little light reaching the roadway – annoying to road users. Through bad design, bad placement and obviously poor maintenance, most street lighting expended their costly energy to no useful purpose.

Upgrading older street lighting is an expensive and long term objective that Councils have already agreed to eventually tackle – given the time and the money of course. But it does seem strange that some recent Council developments are still using old energy wasting technology in their new lighting installations!!

However, Jurgen and Ed demonstrated through their images how, at a more personal level, we can reduce local light pollution – removing or reducing the ubiquitous "insecurity" lighting found on most private properties. Research now seems to indicate such lighting, whether PIR operated or working continuously, has very little effect on the scale of crime. Now is the time to have a quiet chat with your neighbour with a view to changing his philosophy on property protection. The images also showed the greater scattering effect white security lighting has over the orange sodium street lights, with most of the light being squandered quite uselessly upwards.

Ed took his camera around the Teesside conurbation on a wet night and imaged a number of examples showing lighting overkill on the area's roads and public areas. The density of sodium lighting on most roadways produces a phenomenal night glow over the whole area which discourages both serious astronomers and interested members of the public from viewing in such a polluted night sky.

The first part of their presentation was aimed at shocking the senses of a non-technical audience. The second part was aimed mainly at the Council Lighting Engineers, discussing at length and in superb technical detail the existing cost of energy wastage and their own proposals for modern methods of reducing both light pollution and Council energy bills (as well as reducing that newly created monster – the carbon footprint). With a range of already available energy effective street light fixtures and fittings on the market, coupled with innovative control methods based on computer controlled segmented switchable timings or light-dimming on-demand switching, the overall saving of energy to Councils could be very rewarding and at the same time be of considerable benefit to the astronomer.

On a positive note the Council lighting engineers indicated a very supportive and immediate assistance to local astronomers on a more personal level.
They recounted instances where individual astronomers have approached them with a request to reduce or refine the interference from a nearby street light. In most cases it was possible take action to improve the astronomer's situation. If

you have a local pollution problem why not give your local Council a ring. Members of our Society have already benefited in this way.
Who knows, one day you may achieve the powers of persuasion wielded by Sir Patrick Moore in Selsey. When he has a Star Party or a serious observing session at his home he merely picks up his telephone, dials a special number and hey presto! all the surrounding street lights are extinguished until completion of his observing session.

As a result of these meetings Stockton Borough Council have included in their Environment Policy document commitments to actively reduce light pollution. It goes for SBC Cabinet approval in March 2007.

Here's wishing clear skies and a fortuitous regional power failure (preferably on a new Moon night).

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Completely Lost On The Moors.

from Ray Worthy

I have lost count of the number of times I have spun the projector turntable in the mobile planetarium to show the class that the North Star, to all intents and purposes, it stands still all through the night, whilst the rest of the stars travel round the sky. I explain that this is why in the past, it was the most important star for sailors out at sea with no landmarks to guide them. Glibly I have always followed this up by telling them that this knowledge might one day in the future, save them from trouble, if not at sea, then possibly somewhere like the Yorkshire Moors. I never really stopped to think about it during those lessons, but I should like you to think about it now. Have you ever had to rely upon your knowledge of the night sky to get you home?

Something of the sort did happen to me and my colleagues one dark night on the Yorkshire Moors. It happened like this. If you recall a previous tale in this series, you will know that before my National Service, a long time ago, I actually lived on those moors in an ex-army camp, when I worked for the Forestry Commission.

During a prolonged dry and warm spell of late summer weather, some picnicking idiots had set fire to the heather a few miles to the west of our forest. The Commission could not ignore it. It was too great a risk. If those flames crossed the forest fence into our young trees, hundreds of thousands, if not millions of pounds of damage might have occurred. You can imagine the sense of urgency attending this situation. The Fire Brigade had been out all day and we had been called out to help them.

There is an interesting phenomenon which sometimes occurs during a moor fire and that is the fire can bury itself underground, making the peat smoulder. Because of this, sometimes, hours after you might think it reasonable to suppose that the fire was out, the whole thing starts again with an outbreak many yards away. You can actually feel where the smouldering is happening but you cannot see anything. I happen to be writing this in the middle of July 2006 and this very same phenomenon is happening on the moor above Robin Hoods Bay.

Today, if this sort of situation occurred, special planes might be called out which could scoop up water from a reservoir, or even from the sea and drop the water on to the seat of the fire. In nineteen fifty, we were equipped with beaters on long poles and we had to physically beat the flames out with our own muscular effort. In the middle of the moor, the Fire Brigade soon ran out of water. When a fire did break out, you can appreciate that speed was of the essence, because if a wind got up the fire could actually spread faster than a man could run.

On this occasion, I was in a party which was detailed off to go back home early and try to get a shower and some sleep because we would be out all night standing watch over any possibility of a new breakout.

That night, it was black, black as I had ever experienced. There was no Moon. The sky was obscured with cloud, but, of course, in addition to this, there was a miasma of smoke everywhere for miles in every direction. We had been occupied for several hours beating out the flames which had appeared from time to time. One consequence of this was that we had all lost our sense of position.

We had moved towards each new flame as it had appeared and gave no thought to our exact whereabouts. We each had a torch but that wasn't much use as a compass.

Somehow or other, I had become a little isolated from the main group as I had been detained in one place whilst the rest of the group had moved on somewhere else. However, I could see their flashing torches now and again, so I knew where they were. I heard a whistle which was our recall signal and began to move towards my friends in the main group. I had just started moving when I stumbled over some knee high rocks and fell down a small ditch. It really was dark. As I got off my knees and stood up, I saw in front of me a kind of obelisk with a crude cross at the top . This was one of the many stones which can be found all over the Moors.

Legend had it that any rich man who travelled the Moor would leave a few coins in a hollow at the top as a thanksgiving for a safe journey. I had spent my youth pushing button B every time I passed a telephone box, sometimes with surprising results, so I couldn't resist the temptation. Using the cross bit, I levered myself up and felt over the top. No such luck. No wealthy traveller had passed this way.

Another whistle made me realise that the others had lost contact with me so I hurried along, flashing my torch from time to time to show my colleagues I was approaching. When I arrived, I witnessed a strange sight. One of my friends was actually lighting some straw like stuff and dropping it on to the surface of a tiny stream. The water was moving along so slowly and my friend wanted to discover in what direction the water was flowing.

" What the hell are you doing?" I asked. " You could end up in Whitby if you follow that stream. How do you know where it is going? "Well. We've got to do something. I am tired and hungry. " Said Dave. " There's grub and transport at Saltergate Inn. How on earth can we find it? We'll have to wait until daylight. "

At that moment, like a providential miracle, there was a brief clearing of part of the cloud bank and a couple of stars shone through. They could have been any star for all I knew. There just wasn't enough sky showing to give a proper clue.

Its just as well you're here, Jim, (That was my current nickname.) said Dave. You're our resident astronomer. The trouble was that he said it in a sarcastic tone, because he knew that there were not enough stars to give anyone a clue.
Leave him be said the ganger. We didn't see enough.

Now, at this point, I have to take you on a little diversion and explain a bit of what had gone on about two weeks previously. Living and working where we did in a kind of isolation, we had to make our own entertainment and two weeks before this, I was the chosen victim of a scam.
At bait time, one of the fellows had casually mentioned the town of Middlesbrough, but he had pronounced it as Middlesboro. Naturally, as I came from the town I explained what the correct name was. The man who had mispronounced it insisted that he was right and I was wrong. He came from Hull. The subject became rather heated as I was adamant about the spelling.
"Its OK for you lot, living in Hull, " I said", You can only spell four letter words.
That raised the tempo to a new level, as I found myself arraigned against a phalanx of men from South Yorkshire.
"I'll bet you all any money you like that I am right. It's only the football team that is called the Boro". One of them shouted, " It's no use arguing up here on the moor. What we need is a map or a paper or something." Then one of the men from Scarborough chipped in, " There's a lemonade bottle in the shed that was made in a factory just near Ayresome Park in the Boro. It has the name in the glass at the bottom."
" Right shouted Dave, " Will you take that as the referee?"
" Of course I will. They will know how to spell it. "

" How much do you want to bet?" Asked Dave",
“ I've got half a crown in my pocket. I'll bet that."
" Right!" Shouted Dave back. " I'll match that. " Give your money to Bill (the ganger)) and he can hold it." In the heat of the moment, I did so. One of the men ran the hundred yards or so to the shed cum office and brought back the lemonade bottle.
As soon as I saw it, I realised that the whole thing had been a set up; a little diversion to pass the time. There was the lettering, standing proud around the base of the bottle. Some uneducated person had spelled MIDDLESBOROUGH, with an "O" between the "B" and the "R". All and sundry split their sides with laughing.
" You are nothing but a lot of cheats." I yelled, " I needed that money."
" A bet's a bet " Dave said, collecting his winnings.

The memory of that bet was in my mind, as I looked up into the sky and surveyed the miserably few stars on view.

“ I know the direction to take," I said , " I can get you to Saltergate."
" Don't be daft" said the ganger " There were only three stars."
" There were a few more." I stated as firmly as I could, " There were enough for me to get my bearings."
Then Dave chipped in, " How could you ? You saw three stars for two seconds and now you are Captain Bloody Cook.
" Even so , I saw enough to see what stars they were." I went on, " One of them was called Alpheratz".
"How the Hell did you know that? Did it have a label on it?"
Charlie Taylor joined in. Everything relied upon my acting ability. And lying ability , of course. I resolved to blind them with science.
" I saw enough to recognise a corner of the constellation Pegasus."
" Gerraway man . " Alfie joined in , " You're off your trotter."
" Yes I did, " I shouted back, " It was the part which is joined on to Andromeda. It was unmistakeable.
I was beginning to sound convincing.
Dave came back at me. " You are not that good, I know. You could not find your way out of Charlie's barn if the door was open. The tone was heating up nicely.
" Listen " I lied, " There's a part of the constellation Pegasus which is like a great square, in fact astronomers call it the Autumn square, just like there's a summer triangle"
"Gerraway " from someone.
" And at the top corner of this square , there is a star which seems to be part of the constellation Andromeda, you know, the princess who was chained to a rock as a sacrifice to the Sea Monster."
" Aye. I 've heard about that before somewhere," said Agworm, I must have learned it at school."

"Well , if you did" , said one of the others, " It must have been the only thing".
" Never mind that. I can prove it . " I said , " I could lead you all to Saltergate."
They looked around at the utterly black and smoky night.
Then came the clincher. " I would put money on it."
" Yer what? They all took an interest now. You would bet money; Real money?"
"Aye" I answered. " I have a ten bob note in my pocket.
"I'll have that " said Dave .
" Not so fast you lot. It's all or nothing. Not one of you believes me , so each one of you can put your money in , you miserable sods. "
" OK. Fine by me ." was the general mood.
" Right! Here's my money. Bill can keep it until I prove I know what I am talking about. "

They all examined the note in the light of their torches, to see if it was genuine. It was and they came in one by one. There was an IOU from one of them , but, in our closely knit society, that was a good as money.
" You stand to win four quid if you succeed. " said the ganger. " Are you sure you can spare the ten bob".
" I'll win. You'll see" I answered. " I know what I am doing."

"Right everybody. Follow me. "
"Don't worry, Jim boy" said Dave," Your money's precious."
I stood for a moment trying to get my bearings, looking for the rock which I had passed just before meeting up with them.
" OK! Here we go! " and launched myself into the blackness. There was not even any heather left and we trudged through the rising dust. There was no colour at all in anything. The men were trailing behind me in a line so I used that to check that we were moving in a reasonably straight line.

The area we were in was reasonably flat, being part of the top of one of the tabular ridges. Two years later it was closed off for an army shooting range and later still became the site for the Fylingdales Early Warning Station. After half an hour or so we came upon a track, shown by a slight dip in the surface. I turned right and followed the path. After another twenty minutes or so, we came upon a place where there was a tiny bridge over a bit of water. There was a small stone post on the side with a peculiar shape.

" Hey !" Shouted Charlie, " I recognise that. " We ARE on the right path. Bloody Hell Jim.! How did you do it?
As luck would have it, that was the moment that we saw the headlights of a vehicle on the Whitby Pickering road.
" We're only a mile or so from the pub. Jim boy, I take my hat off to you."
" It's not your hat I'm interested in. It's your money. Bill, do you agree that I have won the bet?"
I certainly do," he answered, " Here it is and the IOU."
They all stood around watching their ten bob notes go into my back pocket.

My demeanour must have told them all that I had fooled them and got my own back. They were certain when I said, " I'll be able to buy a lot of lemonade with that little lot."

They gathered round me menacingly.
" Hey you lot , A bet's a bet . Ask Dave."
" Your money's safe all right, " put in Dave," But we don't believe you found your way by the stars."
" Of course not. " I answered. When Bill blew his whistle, I was shinning up Lilla Cross.

The money in my back pocket became very wet indeed when they ceremoniously dumped me in the water below the bridge. I laughed and laughed. The ten bob notes were soaking, but they would dry out.

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Collimation of Relecting Telescopes

by Philip Hoyle

New telescope owners (and some long time owners) have a fear of collimating their reflector telescopes. Not only is this an essential task to get the best out of your telescope but is also quite an easy task. If you are a little unsure on how to collimate and need a helping hand, give us a call at the Wynyard Planetarium and arrange a visit with your telescope. Editor.

Have you ever wondered why your reflecting telescope didn't perform as well as a refractor of even half the aperture? Do you think that perhaps the main mirror in your telescope doesn't quite measure up to others of equal size that you've looked through? Do you always seem to be blaming the seeing conditions for poor images even when someone right next to you thinks the seeing is pretty good? Chances are that the only thing wrong with your reflecting telescope is that it needs to be collimated.

Collimation is the alignment of the optics in your telescope. If the optics are not properly aligned, they cannot bring starlight to an accurate focus. Refractor telescopes are permanently collimated at the factory and therefore should never require collimation. In general, reflector telescopes are prone to go out of collimation, especially when carried in your car.

Lets face it, if you own a reflecting telescope of either the Newtonian or Schmidt-Cassegrain types, you should know how to collimate it accurately. Just like a guitar player tunes up his or her guitar before every performance, you should at least check the collimation of your telescope every time you use it. Just like an out-of-tune guitar makes bad music, a telescope out of collimation is going to deliver bad images every time.

When observing the planets, collimation is extremely critical. When you're observing deep sky objects, collimation is important, but since most of what you are looking at is faint and fuzzy anyway, you might not notice the difference quite as much as you would in planetary observing. When you're doing planetary observing, most of the time, you want the highest magnification the seeing conditions will allow. This is what makes the details really begin to show. It is also the reason precise collimation becomes absolutely critical.

When precisely collimated, even a 4.5 inch Newtonian reflector is capable of showing the Great Red Spot on Jupiter and the Cassini division in Saturn's rings in average seeing conditions. Under good to excellent seeing conditions, a 10-inch telescope is capable of showing:

- Intricate detail in Jupiter's multiple cloud belts,
- Jupiter's moons as disks, not points of light,
- Saturn's A, B and C rings,
- Saturn's Enke Division,
- Saturn's cloud belts,
- Multiple details on the surface of Mars.

It is worth noting here that although precise collimation is a requirement for showing all the details your telescope has to offer, seeing conditions will also limit the detail you will be able to see. The seeing conditions become more important as the aperture of the telescope increases. Therefore to get everything out of a large aperture reflecting telescope, you need precise collimation AND good seeing conditions.

Here are the basics for getting a Schmidt Cassegrain telescope properly collimated (Figures 1 through 6 show what you might see through the eyepiece.):
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1. Collimate the scope according to the owners manual. (I.e. get the shadow of the secondary in the centre of a defocussed star image.) This involves turning the mounting screws of the secondary mirror.

2. Let the scope cool to ambient temperature. (I usually stick to low power views of deep space stuff while I'm waiting.)

3. Getting back to collimating.. Centre a relatively bright star in the eyepiece and defocus the star. Make sure the star is in the centre of the field of view.

4. At this point, you shouldn't notice much difference from the initial collimation. But, here's the first trick...Slowly bring the star to ALMOST focus. If the star is brighter on one side then the other, or looks kind of like the fan of a comet, you've got more adjustments to make. Slowly adjust the collimating screws, only 1/4 to 1/8 of a turn, until you get the brightness of the star even in each direction.

5. Now try to get closer to focus and see if the brightness of the star is still even. If not, adjust some more.

6. Repeat this procedure until you get close enough to true focus that you can't see any collimation error.

7. Now hears the second trick...Put in an eyepiece that will give you a magnification of 60 to 70 times the aperture in inches.

8. Repeat the above process. However, note that you will have to turn the screws even less and that when you turn the screws, the star will move around in the field of view, possibly even leaving the field of view. You will then have to re-centre the star.

9. When it is properly collimated, assuming the seeing is relatively steady, you should now be able to see the classic diffraction pattern of a bright centre spot surrounded by a tight ring.

Letting the scope cool to ambient temperature is an important step in critical collimation. Once I was adjusting the collimation of my Schmidt-Cassegrain telescope attempting to get good views of Jupiter and Saturn in very humid conditions. The corrector plate of my telescope kept getting covered with dew. I removed the dew with a 12-volt hairdryer-style dew remover and continued trying to collimate my scope. I finally gave up in frustration after realizing that the temperature change of the corrector plate was continuously changing the collimation of my scope!

By the time the corrector plate had come to steady-state conditions, it had covered with dew again. I have since purchased the type of dew remover that consists of a battery powered heating strip that wraps around the front of the telescope tube. Although this does not allow the scope to come to ambient conditions, it does allow it to come to steady-state conditions. In other words, the amount of heat going into the telescope is equal to the amount of heat lost and the corrector plate does not have minute changes in size that cause the optics to go ever-so-slightly out of alignment.

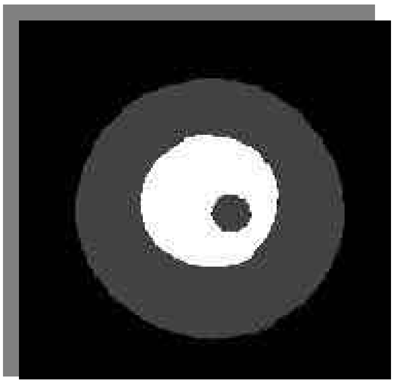

Figure 1: Low power, unfocussed star in a telescope that is not even close in collimation.

Figure 2: Low power, unfocussed star in a telescope that is at least close in collimation.

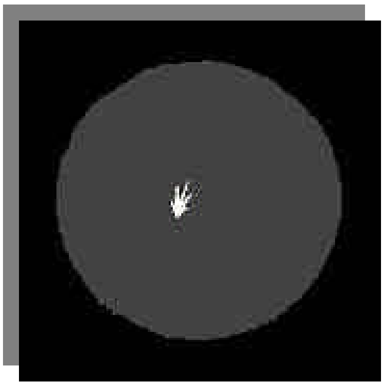

Figure 3: This is what a star might look like in a telescope that is in focus, but not collimated

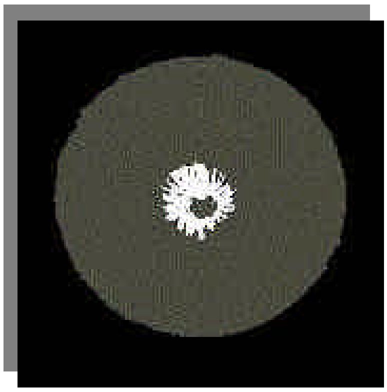

Figure 4: This is what a star might look like in a high power eyepiece when the telescope is just out of focus and slightly out of collimation

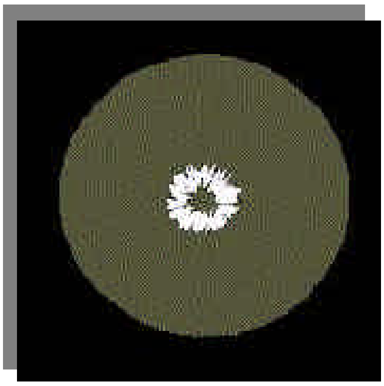

Figure 5: This is what a star might look like in a high power eyepiece when the telescope is just out of focus, but properly collimated

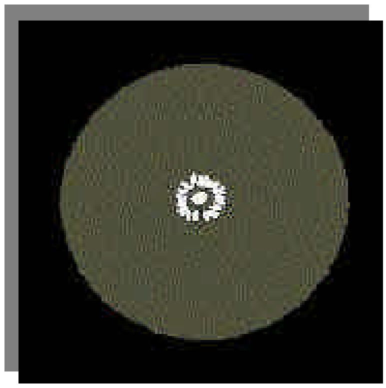

Figure 6: This is what a star might look like in a very high power eyepiece when the telescope is properly collimated

Collimating Newtonian telescopes is slightly more complicated than collimating a Schmidt-Cassegrain. This is because there are two mirrors that have to be accurately aligned. Also, collimation of Newtonian telescopes is usually done in the daytime when it is easier to see the mirrors and screws. To collimate at Newtonian:

1.Take the eyepiece out of the focuser. You will be looking down the focuser to check all of the alignments.

2. Make sure that the secondary mirror is properly centred beneath the focuser. If not, use the adjustments on the support spider to centre it. Depending on your secondary support, you may need to re-centre the secondary mirror.

3. After the secondary is centred under the focuser, make sure that it is aimed in the proper direction. The main mirror of the telescope should be centred in the reflection of the secondary mirror.

4. Once the main telescope mirror is centred in the secondary, all adjustments will be with the support screws under the main mirror. Adjust the main mirror until the reflection of the secondary mirror is centred in the main mirror.

5. When everything is properly aligned, you should be able to see a reflection of your eye; first off the secondary mirror, then off the primary mirror and again off the secondary mirror.

Figures 7 through 10 show what the view through the focuser might look like when performing these collimation steps.

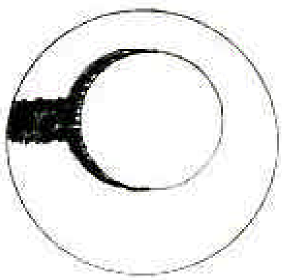

Figure 7: This is what the view down the focuser might look like when the secondary mirror is not centred under the focuser. Centreing the secondary is the first step in collimating a Newtonian.

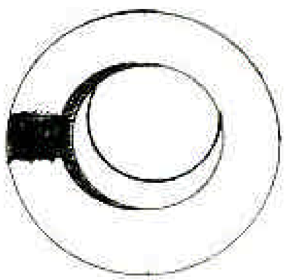

Figure 8: In this sketch, the secondary has been centred, but now needs to be accurately pointed. Depending on your secondary support, you may need to re-centre the secondary mirror.

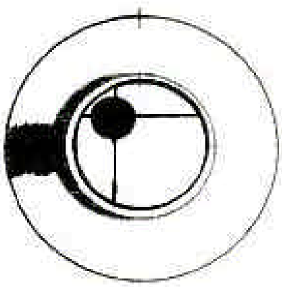

Figure 9: In this sketch, the secondary is now properly aligned. The primary mirror now needs to be collimated. This is done by adjusting the three support screws behind the primary mirror.

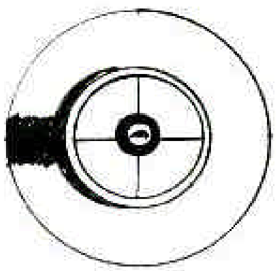

Figure 10: The primary and secondary mirrors are now properly aligned. You should be able to see a reflection of your eye.

When performing these adjustments on a Newtonian telescope it is important to keep your eye centred over the focuser. This can be difficult to do. A “collimating eyepiece” can be a big help here. Orion offers one for less than £30 and it is probably a good investment if you own a Newtonian telescope. If your budget is limited, I have also heard of people using a plastic film canister with a hole drilled in the bottom to perform the same function, but I have never tried this myself.

After the alignment is done in the daytime and you get your scope out under the stars, it is probably going to be worth it to try a star test on the collimation. To do this, just follow the same procedures for collimating a Schmidt-Cassegrain. However, instead of adjusting the secondary mirror, adjust the primary by turning the support screws.

Whether you own a Schmidt-Cassegrain or a Newtonian telescope, try these tips. If you've never tried them before, chances are that your scope will perform just as you'd always hoped it would.

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OBSERVING GRAVITATIONALLY BOUND STAR SYSTEMS

from Mike Gregory

It must be almost twenty-five years ago since I saw my first double star. This was nu Draco situated in the head of the dragon and, viewed through humble 10x50 binoculars, it looked very neat. Miniature headlights in the sky!

About three nights later I had another look. Incredibly the two stars had moved about ninety degrees and were further apart. Wow! The euphoria, however, did not last very long. Surely, stars that could be separated so easily would not move that far in only three nights. Most certainly not, even in three centuries and I soon found out that the second pair were actually 16-17 Draco. Since that time I have moved on with my double star observing but, even though the above two pairs can be comfortably split in my refractor's 6x30 finder, I still enjoy returning to them from time to time. The progenitors of a very satisfying hobby!

About seventeen years ago a friend passed away in middle age and his father gave me his 15x60 Zeiss binoculars as a keepsake.These allowed me to view some closer doubles that included my first true gravitationally bound pair, 61 Cygnii and see the colours in the visual double, Albireo (beta Cygnii) and, in certain circumstances, Cor Caroli (alpha Canes Venatici) when mounted on a camera tripod. During one backbreaking session, I managed to see Mizar as a double. Additionally, these binoculars allowed me to see Saturn separated from its rings.

More than fifty percent of all stars are believed to belong to gravitationally bound systems, travelling through space together as pairs or multiples. If pairs, they travel in an elliptical orbit around a common centre of gravity, though when there are three or more components in the system, their motions are much more complex.

This modern view is different from that held some two hundred and fifty years ago. Up to that time most astronomers were of the opinion that stars were just single like our own Sun. It was about 1776 that the German astronomer, Christian Mayer, began a survey of the night sky and soon produced a catalogue of stars that he thought might be gravitationally bound. This was radical thinking for those times. Most other astronomers thought that stars that appeared to be double were merely chance alignments of a relatively close star and one much further away.

William Herschel shared this view at first. His interest was in trying to find out how far stars were away and he used the parallax method originally devised by Galileo. The motion of the Earth around the Sun would cause a brighter star to oscillate away from a dimmer star that must be much further away. But some pairs appeared to share an identical parallax, suggesting that they were travelling through space together. After measuring many stars from 1779, he decided by 1803 that Castor (alpha Gemini), and a few others, showed a progressive relative motion between the two known components. However, this quarter century period was not long enough to show a curving of the path of the secondary star in relation to the primary.

In 1823 a collaborative effort between James South and John Herschel brought about the publication of William Herschel's measures dating back to 1779 as well as some of their own. The following year (1824) the father, or should this be 'great grandfather' of multiple star measuring, F G W (Wilhelm) Struve began to observe double stars with a 9.6 inch refractor, then the largest in the world, at Dorpat, Russia. This was a thoroughly modern instrument and Struve's measurements compare very favourably with those of our electronic and digital age. One has only to peruse any catalogue to see how often the upper case sigma (S) is used to show one of Wilhelm Struve's original measures.

There is a parallel to be drawn between multiple star measuring/observing and the rise in popularity of the achromatic refractor. Wilhelm Struve's success led the Russian government to build a new observatory fitted out with a fifteen-inch refractor. This was the largest refractor built at that time and Struve's project was to remeasure the S stars as well as search for new pairs. However, this project was taken over by his son, Otto Wilhelm Struve, in 1841 and his numerous discoveries are known by the designation OS.

About this time James South suggested that Struve senior had 'reaped a golden harvest' of all the best doubles and that there was nothing much left, but of course there were millions (billions?) more out there waiting for future technology to find them!

At the same time there was an enthusiastic group of amateurs popularising double star observing in England, these being W R Dawes, H Smyth and T W Webb. Apparently Smyth had either vivid eyesight or a vivid imagination for he came up with all sorts of wonderful descriptions for the colours he saw. Most of these colours cannot be seen today though his descriptions still make good reading.

William Rutter Dawes, who became known as 'eagle-eyed' Dawes, carried out a series of tests with various sized refractors, three of which were the product of the Massachusetts optical company of Alvan Clark. From this research, his famous Dawes' limit gives 4.56"/*A* as the resolving power of a telescope whose aperture in inches is *A.* Today this formula works equally well in our metric world as 116/*D* where *D* is the clear aperture in mm. Whilst Dawes set this formula for unobstructed telescopes such as refractors, as far as the amateur is concerned, it works just as well for reflecting telescopes and the like!

Not to be outdone by his fellow luminaries, the Rev Webb produced a fine catalogue of his own double star observations.

In 1873 the Chicago-born amateur, Sherburne Wesley Burnham, had a paper published in Monthly Notices of the Royal Astronomical Society regarding double star observing using a six-inch Alvan Clark refractor. This paper signalled a new dawn for double star discoveries and the Clark optical company manufactured increasingly larger diameter refractors. Today the forty-inch Yerkes refractor at Williams Bay, Wisconsin, is (I understand) still the largest refractor in the world, and with an American company currently advertising basic eight-inch fluorite refractor tube assemblies at $us 28,000, the Yerkes refractor might well remain the largest.

Using this refractor, and others, the Belgium born astronomer George van Biesbrock made 35,915 double star measures, a lifetime total exceeded only by van den Bos and by Rabe. Van Biesbrock's professional career lasted from 1903 until 1945, but he continued to use the Yerkes refractor until his death in 1974.

I suppose that, before leaving the golden age of multiple star observing, I should mention a little about the Reverend Thomas Espin, Vicar of Tow Law, especially as I have a family connection with that locality going back 500 years.

Thomas Espin was born in 1858 in the Birmingham area and he was later ordained into the Church of England, following his father. He became the Vicar of Tow Law when his father was given the incumbency in 1888 of nearby Wolsingham in Weardale. A devoted amateur astronomer, he set up an observatory in Tow Law that same year and from there studied spectroscopy, made many double star discoveries and observations with a 17 3/4 inches reflector manufactured by Calver (some sources say the reflector was 24 inches). Probably he was the only second, and last, astronomer to carry out a major survey of double stars using visual techniques and with the same telescope, the first being the American astronomer S.W. Burnham. The Rev Espin was also founder of Liverpool Astronomical Society and, on two separate occasions, its President; as well as being founding President of the Newcastle Astronomy Society. He also re-edited the Rev Webb's catalogue of 1904.

The Rev Espin died in 1934 but, surely, must be the only resident of Tow Law ever to have a crater on the Moon named after himself (28.1ºN – 109.1ºE), diameter 75Km). His double star discoveries are catalogued in such august volumes as Burham's Celestial Handbook; Sky Catalogue 2000.0 volume 2,; the *Washington Double Star Catalogue* (WDS) and in the *Lick Index Catalogue of Visual Double Stars* (IDS)

When the European Space Agency launched the Hipparcos satellite in 1989, even though the launch itself was problematic and Hipparcos did not go exactly where it was planned to, it was still able to totally revolutionise the measuring of star positions etc down to milli-arc-second accuracies. In its short lifespan of some four years it doubled the number of known multiples and with untold accuracy. However, I feel this has gone just a little bit beyond my amateur efforts from suburban Middlesbrough so time to move on!

When I purchased my 102mm (four inch) refractor in 2001 my double star observing really set off!

left : 102mm refractor on equatorial mount and wooden tripod

Well, no, actually it did not, for moving up from binoculars to a telescope was a bit of a culture shock. Everything I knew of the night sky looked totally different. Nevertheless, I persevered and, after looking at all my binocular discoveries, and realising how wide they actually were, I was able to move on to tighter pairings. At the same time I was aware that most of my targets were not proven to be gravitationally bound, even if they might be, so I decided to search out only for those proven to be so. As recently as 1985 there were only about 1,000 star systems where the orbits were fully determined.

So what is the ideal telescope for observing multiple stars? I suppose the simplest answer is the telescope you already own. Many purists would suggest a refractor owing to its unobstructed optics, which produce good, contrasty views. However, only refractors with a rare earth element lens or those with very long focal lengths can minimise the secondary spectrum.

The main problem with long focal length refractors (say f/12 and longer) is that even an instrument with a four –inch aperture can no longer be classed as easily portable, whilst a six –inch f/12 refractor has a focal length of six feet. Just not practible for transporting in a family car! So the answer then, must be a short focal length refractor with an apochromatic lens. The generally have lens made from rare-earth glass and have focal ratios of around f/5.5 to f/8. Hence such a refractor with a four-inch aperture can be little more than thirty inches long. The downside, however, and in astronomy there is often a downside, is the price of such refractors. This is where the word “astronomical” might come from! Today a true four-inch apochromatic refractor can set you well over £2,000 simply for the lens and tube. Larger diameters considerably more!

According to an article in a recent UK astronomy magazine, sky conditions are now so poor over much of the country that no telescope can resolve double stars with a separation of less than one arc second. Therefore, using the Dawes limit formula, it would suggest that a refractor of 4.5 inches will, in theory, separate two equal magnitude stars which have a separation of one arc second.

I suppose my achromatic refractor, with an aperture of 102mm (four inches) and a focal ratio of f/9.8, is as good as I am ever going to get. Not too large to manage (though near the limit nevertheless) and certainly not too expensive. I have recently priced my ideal refractor, a 140mm TEC, manufactured in Golden, Colorado, and they are over £4,500 just for the optics – about £7,000 complete on a suitable motor driven mount and pier. Most certainly not portable and, thus, a pointless toy for a Middlesbrough-based amateur!

So here follows a few gravitationally bound systems that I have observed with my 102mm refractor, all from my garden here in light polluted Acklam, Middlesbrough. Right Ascension is in hours, minutes and decimal minutes whilst declination is in degrees and minutes north or south. All other information comes from the Washington Double Star bible. Please ask if you cannot understand.

18443+3940 Σ2382 AB 2001 352° 2.5 5.01 6.10 A4V F1V P1165

Σ2382 Cc-D 2001 83° 2.3 5.25 5.38 A8VN F1V P585 – This is the famous ε Lyrae – the Double-Double – and the first multiple star I saw through my refractor. The two pairs are easily separated through binoculars but apertures of 75mm and high magnification (200x) is needed to split the individual pairs. Both are gravitationally bound pairings but there is no clear suggestion that each of these pairs is orbiting each other. If they are, the period must be millions of years.

17053+5428 Σ 2123 mu Draconis (Arrakis) 42° 2.0 5.65 5.7 F7V F6 par 0.043 Gr. 3 – Situated somewhere between the head of Draco and 16/17 Draconis, Arrakis is a relatively tight and almost equal gravitationally bound pair with a period of 482 years. Easily separated in my 102mm refractor at 118x in reasonable conditions.

11182+3132 STF1523 ξ UMa (Alula Australis) AB – 2001 266° 1.9 4.33 4.80 A1IV – Tight, but reasonably easy to split, due to the almost equal magnitudes. A true binary pair with a period of 60 years, B is said to be a spectroscopic binary in its own right.

14514+1906 Σ1888 (ξ Bootes) AB 2002 316° 6.6 4.76 6.95 G8V K5V – This is a beautiful binary system with a period of approximately 150 years. The colours are yellow and reddish violet though I see them as pale yellow and silvery red.

15245+3723 Σ A 28 (μ Bootes – Alkalurops) Aa-BC 2002 170° 107.1 4.33 7.09

Σ1938 BC 2002 9° 2.2 7.09 7.63

Aa-BC pairing share cpm according to Burnham but the BC pair is gravitationally bound with a period of about 260 years. Colour is silver-blue for the Aa primary and yellowish for the BC binary pairing.

23595+3343 Σ3050 AB 2001 331° 2.1 6.46 6.72 F8V – I split this close binary system in September, 2004, during my last decent observing session to date, and before light pollution got just too much. To me, both components look to be silver-blue. The following week I set the refractor up in marginal conditions but managed to find this pair through thin cloud. Quite impressive

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ALGOL (Beta Persei).

Surely one of the most remarkable stars of the sky and appropriately one of the most famed, Algol is the second magnitude Beta star of Perseus, the great mythological hero who rescued Andromeda from Cetus the Sea Monster. The Arabic name, "al Ghul" (related to our word "ghoul"), means "the demon," from a longer phrase that refers to the demon's head. In Greek mythology, Algol represents the Medusa's head with which Perseus turned Cetus to stone, the star considered an "unlucky" one for centuries.

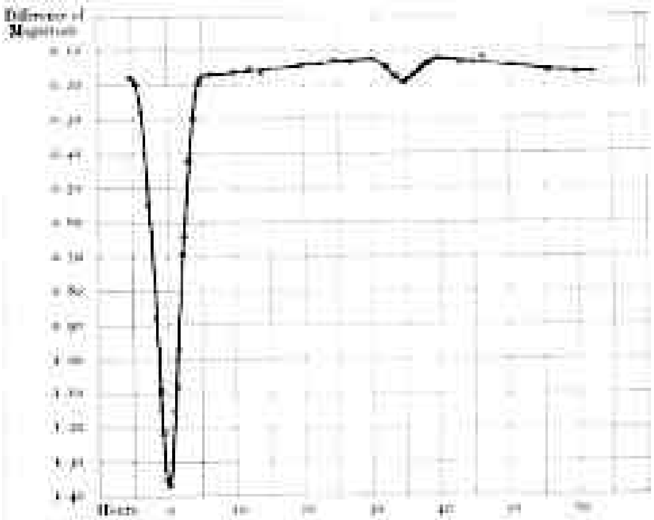
To the eye, this class B (B8) star appears rather normal, its slightly bluish white light radiating from a surface with a temperature of 12,500 K. Like the Sun, it is a main sequence dwarf star fusing hydrogen in its core, though it is 3.5 times more massive. From its distance of 93 light years, we calculate a visual luminosity about 100 times that of the Sun, raised to 180 times if we factor in the invisible ultraviolet light radiated by the hot surface.

Steady observation, however, reveals a surprise. As regular as clockwork, every 2.867days, the brightness of the star plummets from mid second magnitude (2.1) to the dim end of third (3.4, just 30 percent of normal), the whole event (including recovery) taking only a few hours.

Though the variation was discovered in 1667, it was probably known long before that and is probably the reason for the star's bad reputation. The cause of the sudden drop is a stellar eclipse. Algol is a close double star whose components orbit each other every 2.867days.

The companion to the visually observed star is a much dimmer yellow-orange class K giant star with a temperature of 4500 Kelvin and a luminosity 4.5 solar, just 2.5 percent that of the class B star. (The uncertain class of the faint star ranges from G5 to K2, from subgiant to giant. For simplicity, let's call it the "K giant.") The B star, at 2.9 solar radii, is smaller than the K giant (3.5 solar). Each orbit, when the dimmer, larger K star passes in front of the brighter B star, we see a deep eclipse. The eclipse is only partial, some of the light of the principal component still shining brightly through. Between the deep "primary" eclipses is a smaller dip when the bright star passes partially in front of the dim one.

The magnitude scale does not reflect actual visual magnitudes. The primary eclipse at left occurs when the bright class B star partially hides behind the cool K star. The brightness of the system then changes slightly out of eclipse because of the tidal distortion of the stars and the reflection of the B star's light from the K star. Thirty hours after the primary eclipse, the smaller B star passes in front of the K star and cuts out a portion of its light to create the secondary eclipse at center.



left : The eclipses of Algol were first accurately recorded photoelectrically around 1910 with the historic 12-inch refractor at the University of Illinois Observatory.

Algol is famed first as a prototype of the class of eclipsing double stars, of which thousands are known. They are among the most important kinds of stars, as they provide us with information on stellar masses and dimensions. But Algol is equally famed for the "Algol paradox." The higher the mass of a star, the shorter its lifetime, as its fuel is used so much faster. The companion to Algol is the dying giant star. Yet carrying but 0.81 solar masses, it is the LESS massive of the two (the B star weighing in at 3.7 solar).

The only explanation is that the dim companion has lost a great deal of mass. The two stars are so close together, separated by only five percent the distance between the Earth and the Sun, that the brighter smaller star produces tides in the larger one. Matter then flows in from the large one (at a rate of around two hundred- millionths of a solar mass per year) to the small bright one, the effect directly observed through the stellar spectrum as the K giant is being stripped nearly to its core.

A third member of the system, Algol C, a class A or F star of 1.8 solar masses, orbits about 3 Astronomical Units away with a period around the inner pair of 1.86 years. The system is a source of X-rays, though whether they come from a corona around one of the stars or from the flow of matter hitting the B star is uncertain.

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Where is Beagle 2? The Search Continues

PPARC, UK

NASA's Mars Reconnaissance Orbiter (MRO) spacecraft has used its onboard High Resolution Imaging Science Experiment camera (HiRISE) to take a colour image of a region of Mars in the vicinity of the intended landing site of Beagle 2.

Left : H20 crater
Credit: NASA's Mars Reconnaissance Orbiter

Included in the image is new coverage of the crater H2O which was considered by the Beagle 2 team as unique in the area that had been searched for evidence of the missing Lander. Beagle 2 was targeted to land in an ellipse approximately 50km x 10km in size.

The new image does not show any features inside the crater that can be reconciled with peculiarities (i.e. possible components of the entry descent and landing system) encountered in the two previous lower resolution images taken soon after Beagle 2 was due to arrive on Mars in December 2003. The previous images were captured by the Mars Orbiter Camera on NASA's Mars Global Surveyor spacecraft.

Commenting on the latest image, Prof Colin Pillinger of the Open University and lead scientist for Beagle 2, said "Of course this is disappointing. We had hoped that the HiRISE camera would clarify the oddities we had seen in the crater but this is not the case. Nevertheless, I am extremely grateful to the camera team at NASA's Jet Propulsion Laboratory and the University of Arizona for trying and congratulate them on the exceptional quality of the images. I remain optimistic that future images may yet show us where Beagle 2 finally came to rest."

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Earth's Moon Destined to Disintegrate

by David Powell

The Sun is midway through its stable hydrogen burning phase known as the main sequence. But when the Sun enters the red giant phase in around 5 billion years things are going to get a lot rougher in the Earth-Moon system.

During the red giant phase the Sun will swell until its distended atmosphere reaches out to envelop the Earth and Moon, which will both begin to be affected by gas drag—the space through which they orbit will contain more molecules.

The Moon is now moving away from Earth and by then will be in an orbit that's about 40 percent larger than today. It will be the first to warp under the Sun's influence.

"The Moon's actual path is a wiggly line around the Sun, with it moving faster when it is slightly farther out (at full Moon) and more slowly when it is slightly closer (at new Moon)," said Lee Anne Willson of Iowa State University. "So the gas drag is more effective at the farther part of the orbit and this will put the Moon into an orbit where the new Moon is closer to Earth than the full Moon."

Willson's idea about the Moon's demise, explained recently to *SPACE.com*, is an unpublished byproduct of her research into Earth's fate in the face of an expanding Sun.

Moving away

Today, the Moon is on average 239,000 miles (385,000 kilometres) away and has reached this point after a long and dramatic journey.

Earth's Moon was born around 4.5 billion years ago in a titanic collision between our planet and a Mars-sized sibling, according to the leading theory. The enormous impact threw debris into orbit around the young Earth and from this maelstrom the Moon coalesced.

For the last few billion years the Moon's gravity has been raising tides in Earth's oceans which the fast spinning Earth attempts to drag ahead of the sluggishly orbiting Moon. The result is that the Moon is being pushed away from Earth by 1.6 inches (4 centimeters) per year and our planet's rotation is slowing.

If left unabated the Moon would continue in its retreat until it would take bout 47 days to orbit the Earth. Both Earth and Moon would then keep the same faces permanently turned toward one another as Earth's spin would also have slowed to one rotation every 47 days.

Solar influence

The Sun's mutation into a red giant provides a huge stumbling block to the Moon's getaway and is likely to ensure the Moon ends its days the way it began; as a ring of Earth-girdling debris.

"The density and temperature both increase rapidly near the apparent surface (photosphere) of the future giant Sun," Willson explained. As the Earth and Moon near this blistering hot region, the drag caused by the Sun's extended atmosphere will cause the Moon's orbit to decay. The Moon will swing ever closer to Earth until it reaches a point 11,470 miles (18,470 kilometers) above our planet, a point termed the Roche limit.

"Reaching the Roche limit means that the gravity holding it [the Moon] together is weaker than the tidal forces acting to pull it apart," Willson said.

The Moon will be torn to pieces and every crater, mountain, valley, footprint and flag will be scattered to form a spectacular 23,000-mile-diameter (37,000-kilometer) Saturn-like ring of debris above Earth's equator. The new rings will be short-lived. Theory dictates they'll eventually rain down onto Earth's surface.

"Particles of different masses will have different survival times; the smaller particles will be removed first, and the biggest ones last. Most of the ring particles would be gone by the time the Earth reaches the stellar photosphere," Willson said.

If the Sun's photosphere reaches Earth, our planet too will experience drag and spiral into the Sun to be incinerated.

Possible out

There are possible natural alternatives, however.

If the Sun as a red giant sloughs off enough material before Earth evaporates, our planet will be revealed from its stellar cocoon in a Moon-less guise. Earth, robbed of its companion, would undertake a lonely vigil as the Sun turns eventually into a stellar corpse called a white dwarf, fading to black over the ensuing trillions of years.

Alternatively, if the swelling Sun loses 20 percent of its mass prior to it reaching our vicinity, both Earth and Moon could be spared incineration and remain together facing each other for eternity. The actual outcome remains a theoretical uncertainty because no red giant star has been observed during this crucial phase.

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Our Sun, again

from Bob Mullen

I love our Sun, for many reasons - the inevitable warmth and brightness on a rare day in this country, its an essential factor in sustaining life on our planet and, more interestingly to me, the academic challenge it provides as a nearby representative of the rest of the stars in the Universe.

As a dedicated subscriber to a number of astronomy websites it amazes me how much scientific information pours in daily on the activities of both our own Sun and the many other distant suns continuously under scrutiny by Earth-based and spacecraft-based telescopes.

With this wealth of information it is possible, as some commentators often claim, to think our Sun is just an insignificant star in the order of things.

In fact our Sun is one of the biggest and brightest stars in our Galaxy.

Stars are classified by a letter indicating their spectral type. This classification is based on the temperature of their surface and the content of their light spectra. Each class is allocated a letter in the following sequence from brightest to dimmest – OBAFGKM.

The Sun is classified as a G class star. Below are some estimates from Armagh Observatory on how common each class of star is.

O - very hot blue stars, 1 star in 30,000
B - blue and very bright stars, 1 star in 1,000
A - white stars, 1 star in 100
F – yellowish white stars 1 star in 30
G – yellow stars, 1 star in 15
K – cool orange stars, 1 star in 8
M – red dwarfs, 4 out of 5 stars.

Class M stars are obviously the most common stars in our part of the Milky, their very faintness prohibits seeing them at any great distance. Of the 100 stars closest to Earth 80 are red dwarfs, most requiring a telescope to observe them. A red dwarf radiates only about 4% as much energy as our Sun and has a diameter and mass of less than one third of our Sun.

Although most of stars we ourselves see in the night sky are brighter than our Sun, this gives a misleading impression. From the statistics above it appears that approximately 9 out 10 stars in our galaxy are smaller and dimmer than the Sun and only a small proportion (about 3%) are significantly brighter. In fact our Sun is actually one of the biggest and brightest stars in the Galaxy!

I think the previous impression that our Sun is only a small star in the way of things stems from the post-Copernican days after he moved the Sun into the centre of our Solar System and there followed a philosophical tendency to minimise our place in the Universe ("we live on an ordinary planet, orbiting an ordinary star in an ordinary galaxy").

So, even on these miserable dark winter days do have good thoughts about our Sun, its bigger and brighter than you may have previously thought.

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In the Beginning

By Primo Levi, 13/8/1970 (submitted by Alex Menarry)

Fellow humans, to whom a year is a long time,
A century a venerable goal,
Struggling for your bread,
Tired, fretful, tricked, sick, lost;
Listen, and may it be mockery or consolation.
Twenty billion years before now,
Brilliant, soaring in space and time,
There was a ball of flame, solitary, eternal,
Our common father and our executioner.
It exploded and every change began.
Even now the thin echo of this one reverse catastrophe
Resounds from the furthest reaches.
From that one spasm everything was born;
The same abyss that enfolds and challenges us
The same time that spawns and defeats us,
Everything everyone has thought,
The eyes of every woman we have loved,
Suns by the thousands
And this hand that writes.

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Transit Tailpieces

We don't know anything about the Universe until it reaches the mature age of a billionth of a trillionth of a second – that is, some very short time after creation of the Big Bang. When you read or hear anything about the birth of the Universe, someone is making it up! We are in the realm of philosophy. Only God knows what happened at the Very Beginning (and so far **She** hasn't let on).

Leon Lederman , Particle Physicist.

Phycisists defer only to mathematicians, and the mathematicians only defer to God (though you may be hard pressed to find a mathematician that modest).

Leon Lederman , Particle Physicist.

I wonder sometimes if manufacturers of foolproof items keep a fool or two on their payroll to test things.

Alan Coren

The battle of the Intellectual Giants – Neils Bohr and Albert Einstein often walked the forests to argue about the quantum theory. One day they came across a huge bear. Bohr immediately drew a pair of $300 Reebok running shoes out of his backpack and began lacing them up. "What are you doing Neils? You know you can't outrun a bear", Einstein – the fundamental theorist – logically pointed out. "Ah, I don't have to outrun the bear dear Albert", responded Bohr – the adaptive theorist – "I only have to outrun you".

from "The God Particle", by Leon Ledermann (Fermilab Director)

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