Letters

The role of the visual observer

From the Director of the Deep Sky Section

Tony Markham (letters, October *Journal*) asks whether Sections should direct their efforts to producing quality or quantity, and implies that quality means using the latest technology. While most people reading the *Journal* will be impressed with the deep-sky and planetary images being produced by 'the latest technology', it is untrue that the visual observer no longer has a role to play – indeed the majority of Section Directors are visual observers. Armed with only a simple pair of binoculars it is possible to make variable star estimates, and with no equipment at all to take part in meteor observing – all of which can be regarded as 'scientifically useful'.

As Director of the Deep Sky Section, and myself a visual observer, I am only too aware that visual observations submitted to the Section have declined dramatically over the last few years, although there has recently been a small and welcome revival. Whenever I give talks or meet new members I encourage them to observe visually. Not only do they learn their way around the sky if they have a simple telescope without buttons, but training the eye to see detail is a skill that has to be learnt. If, after looking at an object through the eyepiece for a few minutes, you try to commit it to paper, you soon learn whether you have really seen it or not. Some of these people will go on to imaging, but I always hope that some will remain visual observers.

As Tony himself states, much observing is done for pleasure, and this is particularly true of deep-sky observing. With the exception of a few dedicated supernova hunters – and even here it is possible for the visual observer to take part as many of the Messier galaxies are not patrolled regularly – many people are content to enjoy the aesthetics of observing; pondering over the fact that that faint smudge in the eyepiece actually consists of millions of stars. There is nothing wrong in this and I am keen to encourage it. The universe is a big place and there is room for everyone to enjoy astronomy in whatever way gives them pleasure. But, if the visual observer wants to contribute to an observing programme, the Deep Sky Section would be only too pleased to hear from them.

One concern I do have is that the newcomer to astronomy, reading the many monthly magazines now available, sees all the glossy advertisements for the latest imaging equipment and thinks that unless they own some of it, they will become a second class citizen – there are very few advertisements for pencils and sketch pads! I hope this letter will convince them that is not the case. The Deep Sky Section would be delighted to receive all your observations, visual, CCD, or even, if you still remember those days, photographic film.

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From Ms Lorna McCalman

I am not sure I understand the meaning of Tony Markham's letter in the October *Journal*. Being a prolific visual observer himself I can only surmise that the tone of his letter is ambiguous. But on the first reading, I got the distinct impression that visual observers are indeed quietly considered inferior to the more serious digital observers, whose work will be 'admired by professional astronomers'; that the high-tech BAA members are 'quality' whilst the rest of the rabble are 'quantity' and not worth taking seriously.

That the vast majority of members who use small instruments are 'happy to observe for pleasure and not looking to go beyond visual observing' would suggest that this group are not serious observers, they're just out for fun, the lightweight brigade, while it is up to the 'more driven' high-tech observers to produce the scientifically useful information. Visual observers are as dedicated, enthusiastic and driven as any other observers and are just as committed to the task of producing valid data.

I also worried about the statement that 'Any impression that the BAA no longer caters for this group [visual observers] needs to be avoided'. Are we saying that it's the *impression* we wish to dispel, whilst only paying lip service to this group and their quaint old-fashioned ways?

I strongly suspect that I have mischievously misinterpreted Tony's letter but there's no harm in further stimulating the debate which is of great interest and fundamental importance to many members, as can be seen by the number of letters on the subject.

It has been my good fortune since joining the BAA to have had great support and encouragement from the VSS and from Melvyn Taylor in particular. I have never felt the need or desire to become involved in digital technology, but hats off to the clever, dedicated people who use these techniques to amazing effect. However, the BAA should not be seen to have to make special efforts to cater for the needs and interests of any group of astronomers, but should respect and support all who share this interest and who take the time and trouble to submit their observations, irrespective of technique employed. This, happily, has been my experience of the BAA to date.

Lorna McCalman

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A planetary classification scheme

From Mr Brian Smale

Regarding the controversy over the classification of the planets and what characteristic to use for this purpose, I propose that we simply use the mass. This would take into account the concept of clearing the space around it for large objects and the impact of a collision for small objects. For a given mass one can calculate a typical diameter if one chooses a standard density; I have chosen a density of three in the table below. However the definitive factor is the mass of the object.

Montoid: a new term based on Latin, a great rock. All these levels of size may not be needed and the names could be changed, but overall it's an unemotional way of classifying the planets and the more solid minor solar system objects.

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Solar system objects classified by mass

Category	*Mass*	*Typical diameter*	*Examples*
Giant planet	10^{26}kg	40,000km	Jupiter, Saturn, Neptune
Planet	10^{23}kg	4,000km	Mercury, Venus, Earth, Mars, Uranus
Planetoid	10^{20}kg	400km	Ceres, Pallas, Juno, Vesta, Pluto, Sedna
Large asteroid	10^{17}kg	40km	Eros
Asteroid	10^{14}kg	4km	Gaspra
Small asteroid	10^{11}kg	400m	(29075) 1950 DA
Large montoid	10^{8}kg	40m	(4581) Asclepius
Montoid	10^{5}kg	4m	2004 FH

The best conditions for shadowbands?

From Mr Jeremy Calderwood

One of the most striking memories of those of us lucky enough to witness the total eclipse of the Sun in the Sahara Desert in Libya last March 29 was the extraordinary display of 'shadowbands' immediately before and after totality. They became noticeable sweeping majestically across the desert floor about a minute or so before second contact, and as the light began to fade this horizon-to-horizon, subtly striped moving carpet of parallel shadows made me feel quite unsteady – like being on a moving boat. People began to whistle, babble excitedly and laugh almost hysterically as the shadowy pattern moved over everything.

This was my first 'proper' total eclipse but even the seasoned eclipse chasers among us said that this was the best display of this phenomenon they had ever seen; during many eclipses they have been much less noticeable or absent entirely. There must have been conditions at this particular one which combined to enhance their creation. I believe that the secret lies in the combination of several coincidences present during this event.

Previous eclipse observers have put together various well-accepted theories about shadowband formation: Dr Wolfgang Strickling; the team of Szymon Gladysz, Michael Redfern and Barrie W. Jones and their observations of the total eclipse in Botswana 2002/12/04; S. M. Bhandari & S. P. Bagare's study of the Indian total eclipse of 2003/11/23 are among many, and several refer to work by J. Codona and his scintillation theory from 1986. The following websites describe the current ideas in great detail (thank you Nick James):

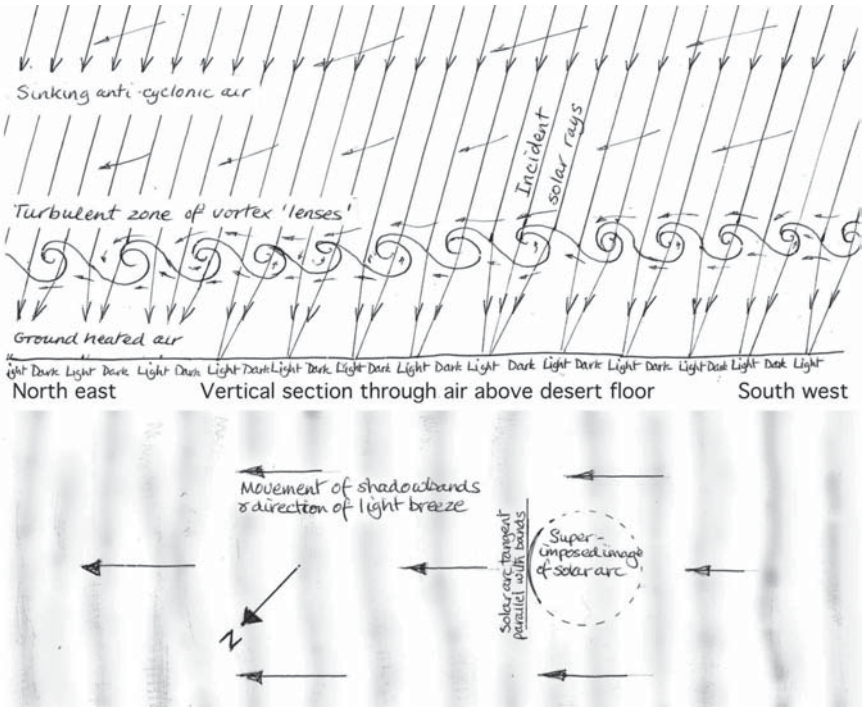
http://www.strickling.net/shadowbands.htm;
http://www.aspbooks.org/publications/314/513.pdf;
http://www.ursi.org/Proceedings/ProcGA05/pdf/B02P.7(0510).pdf;
http://uk.geocities.com/solareclipsewebpages@btopenworld.com/ShadowBands.pdf

To put it simply the theory is that shadowbands are caused by the arrival on the ground of rays of light from a very narrow source, i.e. the very thin portion of the Sun's visible crescent immediately before and after totality, either in phase (bright band) or out of phase (dark band). The paths these rays take through the atmosphere are governed by scattering due to the varying refractive index of bubbles or vortices of air at different temperatures and altitudes. The twinkling of stars is a typical effect. The wavelength (colour) and slit size of the light source also governs the spacing of the bands and the long axis of the Sun's crescent generally determines their alignment. Calculations from data gathered by the aforementioned observers show the bands most closely spaced just before and after totality.

The totality phase of the eclipse we saw in the Libyan Sahara Desert took place close to local midday, when the Sun's altitude was about 67° above a flat smooth surface heated during the earlier partial phase. The surface temperature had started to fall as the eclipse progressed towards totality, but was still about 30°: 7° higher than the air temperature (see Val and Andrew White's temperature chart in the 2006 June *Journal*). This means that there was still a layer of ground-heated air above the surface of the desert. There was also a light breeze blowing from the southwest, also the direction from which the Moon's shadow was rushing towards us and moving across the face of the Sun, leaving only a small arc across the northeast edge of the sun – the half-past ten mark. Another important factor was that we were under the influence of an anticyclone or high pressure area where the air is sinking and preventing the ground-warmed air from rising to any appreciable altitude. I believe these conditions are ideal for producing a sea of gently rolling parallel vortices of warm and cool air a few metres above the desert. These then act as lenses due to their differing refractive indices, focusing the now almost slit-like image of the shrinking Sun's arc. Add to that the lucky coincidence that the long axis of the arc was parallel with the vortices lying at 90° to the wind direction, thus accentuating the resulting light and dark images focused on the bland desert floor. I don't know if it was my imagination, but the bands seemed to be a combination of groups of fairly widely spaced and distinct waves with a spacing of 40cm or more (I could not chase them with a tape measure!) overlaying a pattern of much finer, more closely spaced bands. Nick James' short piece of video footage (included in the BAA 2006 Eclipse DVD) using an enhanced contrast, comparative negative frame technique also seems to show bands with the appearance of gently breaking waves on a breeze-rustled sea.

I have trawled the Internet since for any published results of research into the existence of such meteorological phenomena as rolling vortices and found some references (see below) to the formation of stable boundary layer vortex production during conducive atmospheric conditions.

If the wind had been stronger I think there would have been too much turbulence to produce the ideal vortices – the temperature differences between the warm and cooler air would have been ironed out. If there had been less air movement the bands may have been more random in nature, as the warm air would perhaps have been rising higher in distinct 'bubbles' or thermals forming more circular lens effects. At sea



Plan of shadowbands on the desert floor, 2006 March 29. *©2006 Jeremy Calderwood.*

the surface temperature would probably have been colder than the air temperature resulting in no vortex production at all. Likewise an early morning eclipse or any low angle eclipse would have meant a lack of warm air near the ground and again the lack of focusing air 'lenses'.

The 2008 eclipse will at no stage be high in the sky on its path across the Arctic and down into Mongolia so I would predict poor conditions for enhanced shadowband visibility. Even the 2009 'Big One' (longest period of totality for over a century) is not so well placed, as the Sun will not be as high before it leaves land near Shanghai and starts its run across the Pacific Ocean. Where it crosses Kitaio Jima at its maximum altitude and duration local conditions may favour enough ground heat to produce a good show if the winds blowing off the sea are from the right direction and not too strong; we'll just have to wait and see.

There will be another eclipse in the Sahara with a likelihood of even better shadowbands, but we will have to wait until 2027 August 2. Then there will be totality for 6 minutes 25 seconds at Luxor, Egypt with a solar altitude of 82°.

I would like to know if there have been any experiments done to attempt to replicate the shadowbands phenomenon. I am only an amateur astronomer and meteorologist but with what I've picked up about fluidics and refraction I think this is not too wild a theory as to why we had such a magnificent show. I'm sure someone out there will put me right if I've made some wrong assumptions.

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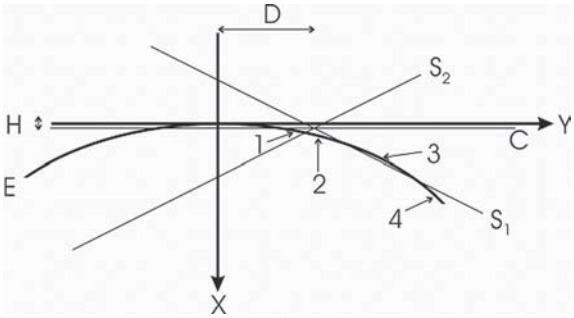
Mahrt Larry *et al.,* 'Vertical structure and flux formulations for the stable boundary layer', Oregon State Univ, Corvallis College of Oceanic and Atmospheric Sciences.

Jumper George Y. *et al.,* 'Comparison of recent measurements of atmospheric optical turbulence', Air Force Research Lab, Hanscom AFB MA, Space Vehicles Directorate.

A new type of solar eclipse

From Mr Jens Buus

In addition to the usual types of solar eclipses, it has previously been shown by Jean Meeus[1] that it is possible to have *non-central* annular-total eclipses where the eclipse is *simultaneously* annular and total, depending on the position of the observer. A non-central annular-total eclipse is an extremely rare event; Meeus made an estimate showing that the expected average interval between such eclipses is about 250 million years, based on the present orbital parameters and neglecting secular variations. It turns out that it is also possible to have *central* eclipses which are simultaneously annular and total.[2] This type of eclipse is even rarer and does not appear to have been described before. The figure explains the situation.



In this figure the shadow cone of the moon (the umbra) is defined by the boundary lines S_1 and S_2. The curve E represents the surface of the earth, and C is the centreline defined by the centres of the Sun and the Moon. The Y-axis is tangent to the earth, parallel to C, and the X-axis is perpendicular to the Y-axis; the Sun is in the direction of the Y axis. The key parameters are D, which is the distance from the X-axis to the tip of the umbra, and H, which is the separation between the centreline and the Y-axis. For central eclipses the centreline is 'below' the Y-axis; for non-central eclipses it is 'above' the Y-axis. An observer at point '1' will see an annular eclipse, whereas an observer at point '3' will see a total eclipse. Observers at points '2' and '4' will see a partial eclipse. For some of the observers a part of the Sun/Moon will be under the horizon.

The figure is highly exaggerated since in reality the umbra cone is only about ½ degree wide (the angular size of the Sun/Moon). Consequently an extreme amount of 'fine tuning' is required to get a simultaneous annular-total eclipse. For a central simultaneous annular-total eclipse to occur the value of D has to be between 0 and 29.7km, and the value of H has to be between 0 and 69 *meters*. However, only 1/12 of the possible D,H combinations within these limits will give an eclipse of this type. The estimated expected average interval between such eclipses is six times longer than the expected average interval between non-central simultaneous annular-total eclipses, i.e. about 1500 million years,[2] again using the present values of the orbital parameters.

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1 J. Meeus, originally published in Dutch in 1961. An English version can be found in chapter 19 in J. Meeus, *More Mathematical Astronomy Morsels*, Willmann–Bell, 2002

2 A more detailed account, including an estimate of the expected average interval, can be requested from the author.

A sighting of 'mock moons'

From Mr Howard Miles

I should like to report the sighting of a phenomenon which I have never seen before. On the night of 2006 October 9 at 20:10 UT I went into the garden and assumed there was much high cloud (cirrus and cirrostratus) because I could see only the brightest stars. I saw the gibbous Moon (2 days after full) at an altitude of approximately 18° in the eastern part of the sky. I then noticed the presence of a 22° halo, and on closer study I saw what I am calling 'mock moons' in the extreme positions along the halo, just as one sees parhelia or mock suns when observing the 22° halo round the Sun in daylight. There was no colour to the 'moons' or halo but the southern 'moon' was much brighter than the northern one.

The phenomenon lasted about 15 minutes but by 20:30 UT, no halo or 'moons' were visible. My wife Norma saw the halo and the southern 'moon' at about 20:20 UT but by this time the northern one had faded.

The halo around the Moon is certainly not a rare sight but I have never seen mock moons before. I would therefore be pleased to hear from any member who has witnessed such an event, in an attempt to assess how rare such events are.

Howard Miles

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Longitudes of the central meridians of Jupiter and Saturn

From the Director of the Jupiter Section

Gordon Taylor[1] is to be thanked for pointing out the new definition of Jupiter's System III longitudes,[2] and for using it in the *Handbook*. However, may I make one point, in case readers are confused by the columns labelled 'Possible Error' in his table. There is no possible error in Jupiter's Systems I and II. The definitions given are exact (as they have been for over a century). For instance, System I is defined by a sidereal motion of exactly 877.9000... deg/day, to any number of decimal places. Where error can arise is in the use of System III, since it has now been redefined several times, most recently in 2000.[2] Longitudes in the new System III are now nearly 2° higher than those in the old System III which is still in use by some authorities.

The reason for these changes is that the IAU intends System III to represent the true rotation period of the bulk of the planet, as measured by its magnetic field. At least with Jupiter the latest adjustment in period is only 0.000642 seconds. With Saturn, the existing definition seems to be in error by nearly 8 *minutes* according to *Cassini* data.[3]

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1 Taylor G. E., 'Longitudes of the central meridians of Jupiter and Saturn', *J. Brit. Astron. Assoc.*, **116**(5), 273 (2006)
2 Seidelmann P. K. *et al.*, 'Report of the IAU/IAG Working Group on Cartographic Coordinates and Rotational Elements of the Planets and Satellites: 2000', *Celestial Mechanics and Dynamical Astronomy*, **82**(1), 83–111 (2002)
3 Giampieri G. *et al.*, 'A regular period for Saturn's magnetic field that may track its internal rotation', *Nature*, **441**, 62–64 (2006)

Ronald N. Irving

From Mr Bud Ellis

I have only recently read in your periodical of the death of Mr Irving in Teddington.[1]

I knew him for many years in the 1950s and '60s as he used to get the astronomical mirrors I made aluminised. Also when I could not find an answer to a particular problem in my wonderful *Scientific American* books called *Amateur Telescope Making* when I was grinding and polishing, he would always be of help to me. A great friendly man. I shall never forget the large pile of magazines, letters and documents on the huge table in his front room.

I have had many super years of observing with the particular satisfaction of knowing that with his help what I was looking at was the result of my own efforts. I wonder how many young amateur astronomers grind and polish their own mirrors today?

A super man. Greatly missed.

Bud Ellis

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1 *J. Brit. Astron. Assoc.*, **116**(3), 146 (2006)

Poetry and the aurora

From Mr William Williamson

Re poetry and the aurora, it seems strange, given the awesome nature of a great display, that so few poems have been written about it.

I know of only one and it is not in English. Rather cumbersomely titled 'An Evening Meditation on the Divine Majesty on the Occasion of the Great Northern Lights' by Mikhail Lomonsov, it can be found in *The Penguin Book of Russian Verse*. There is a prose translation, but I have translated one verse directly to give a flavour of the original:

> But where, O nature are your laws?
> From polar seas erupts the dawn
> Sun's throne set up there, night withdraws
> And fire from icebound seas is drawn
> Now we are covered in cold light
> Day steps upon the earth in night

There are two points of some interest concerning this poem. It seems clear from the title that it was inspired by an actual great display. Lomonsov grew up in Northern Russia, and would have been very familiar with the phenomenon. The display which inspired his 'Meditation' must have been exceptional. The poem is undated but Lomonsov lived from 1711–1765.

Secondly, I remember someone telling me many years ago that at one time there had been a theory that aurora was caused by the Sun's rays being reflected from the polar ice and transmitted over long distances by some sort of mirage effect. In the verse quoted and another which speaks of 'sun's rays bent towards us through thick air', Lomonsov seems to be hinting at this.

Lomonsov was a distinguished scientist and would have known of this theory if it was current in his lifetime, though it seems he was not entirely convinced!

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