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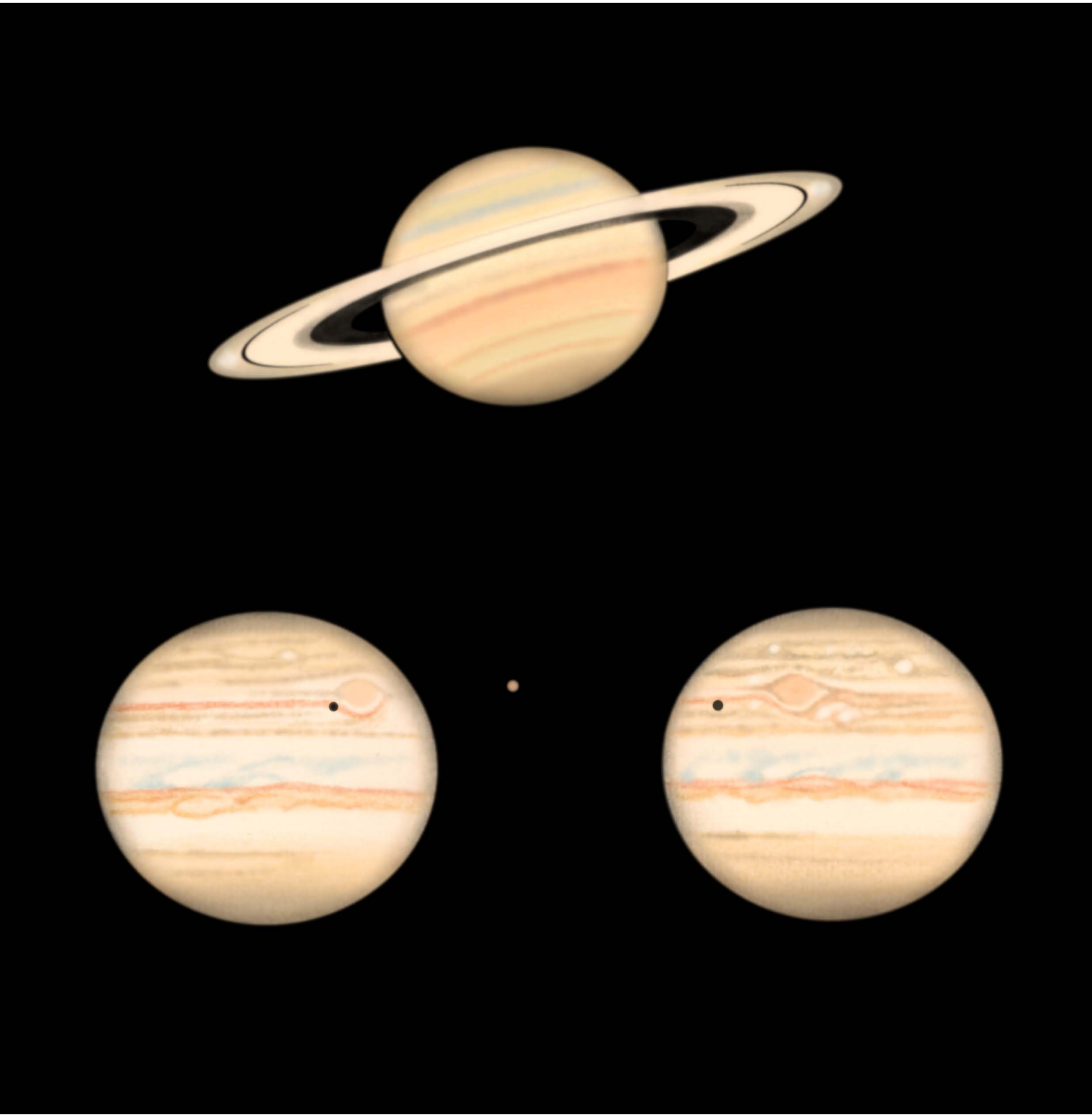

On the shoulders of giants

Journal of the British Astronomical Association

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Contributions

Papers should be sent by e-mail (preferred) or by post (**three** copies) to the **Papers Secretary** at the address shown inside the back cover of each issue. They will be refereed, and, if approved by Council, published as soon as reasonably possible. Those wishing to speak at a meeting should contact the Meetings Secretary.

All other contributions should be sent to the Editor, at **pjennings@britastro.org**. As well as Letters to the Editor, he will be pleased to receive contributions to Observers' Forum, particularly interesting astronomical images, drawings and photographs. Colour images are especially welcomed. Photos and media will be returned only if a suitable stamped addressed envelope is enclosed.

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Membership of the BAA

The annual subscription for Ordinary standard membership of the Association for the 2022–2023 session is £50.50. For details of concessionary rates, digital-only membership and other information, see page 301 of this issue. Members who pay UK income tax are requested to complete a Gift Aid certificate in order to benefit the Association, which is a registered educational charity. [To claim Gift Aid you must pay an amount of UK income tax and/or Capital Gains tax at least equal to the tax which we reclaim on your donations in the relevant tax year (currently 25p for each £1 you give us).]

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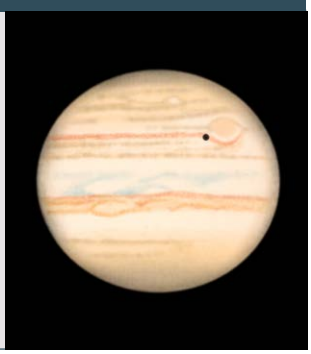
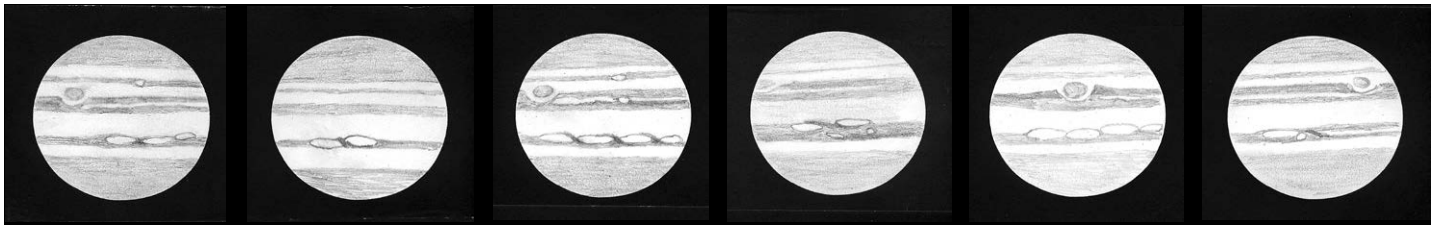
Contents

On the cover

Jupiter & Saturn, 2023 August *Dr Paul G. Abel*

Paul continues a long BAA tradition of recording visual observations at the eyepiece through making meticulous drawings. The rendering of Saturn was made on 2023 Aug 20 (23:06 UT at the midpoint of the observation), while those of Jupiter were made the following day. The latter planet's rapid rotation is obvious when comparing the two views, obtained at 02:11 (left) and 03:29 UT. Both planets were observed using a 305mm Newtonian, at ×230 magnification. South is up.





Some drawings of Jupiter made by David Arditti in 1984 using a 6¼-inch Newtonian.

From the President

David Arditti

I recall a talk some years ago to the BAA by the Astronomer Royal, Lord Martin Rees, where he remarked that, in his experience, astronomers have a different, larger-scale appreciation of time than other people. I think this is the case in several ways. Studying the sky, we are, like farmers and ancient peoples, governed by the annual cycle of the Sun, revealing and hiding the constellations in succession. Familiarity with this slow cosmic parade, gained over a lifetime of sky-watching, comes to feel both comforting, and separating from those who do not share it.

One occasion when I guess many of us feel this is on the annual Perseid meteor watch in August. It is the height of summer but staying up after midnight to see the highest rates of meteors, we see the summer constellations disappear in the west to be followed by Pegasus and Andromeda, heralds of autumn, and then Perseus and Auriga rising, reminding us how winter is just around the corner, astronomically.

Jupiter rising

The movements of the planets give us longer cycles of experience. Mars goes round the sky (its sidereal period) in 1.9 years, Jupiter in 11.9 years, and Saturn in 29.5 years. Uranus takes a lifetime, 84 years; Neptune, two lifetimes, at 165 years. So, we may measure our careers in astronomy in Jovian years, or even Saturnian ones. I first identified Jupiter shortly after reading my first astronomy books (by Patrick Moore, of course), in the autumn of 1976. That is 47 years, or exactly four Jupiter orbits ago. At that time it was in Taurus, just below the Pleiades (which I was also very excited to identify).

At the time of writing, Jupiter is rising in the late evening sky in Aries, slightly to the west of where it was 47 years ago. So this view feels rather familiar, and nostalgic, to me. (This year Jupiter has Uranus close by, which, of course, it did not have in 1976.)

My earliest serious observations of Jupiter date from 1984, after I acquired a 6¼-inch Fullerscopes Newtonian. I was inspired to observe and draw Jupiter by Patrick's books and a member of my local astronomical society (Wessex), noted Jupiter Section member Terry Broadbank, who encouraged my efforts. This phase of activity, however, was short lived, and it was not until 2005 that, inspired by the incredible work of Damian Peach and Dave Tyler, I started to specialise in planetary imaging. In the E&T Section article in this *Journal* (p.290), I say more about imaging Jupiter.

New postholders

I am pleased to announce that we have two new postholders on the BAA Council.

Firstly, following the much-lamented passing of Bob Mizon CBE, Howard Lawrence, previously co-treasurer of the BAA Commission for Dark Skies (CFDS), has volunteered to be Acting Coordinator of the CFDS for the time being, so the important work of this campaigning arm of the Association continues uninterrupted. This is at a time when there is increasing public profile for the issue of light pollution, with the House of Lords Science and Technology Committee having brought out in July a report on the ill effects of light (and noise) pollution.

Secondly, John Berman, who has previously done much work within the Radio Astronomy Section, has volunteered to fill the long-standing vacancy for a BAA Website Manager (or 'Webmaster'). These are both really important unpaid roles within the Association, and I thank them sincerely for volunteering.

Assistant Editor for the Journal

In the last issue, we advertised a vacancy for an Assistant Editor for the *Journal*. This arose out of the 2022 BAA Strategy Group Report's recommendation that we should expand the *Journal* to include more information of value to less experienced amateurs, more practical advice, and more coverage of our members' activities, whilst not reducing the current quota of specialised papers and reports, valued by many as a unique part of our output. The Council recognised that this required not only the printing of a longer publication, but more editorial work, and that we would need to pay to get a professional result. This will increase our costs, but we have reserves that we are willing to spend if it means a better service, and, hopefully, attracting new members. We have started the selection process for the Assistant Editor, and we hope to introduce the extended *Journal* from the first issue of the next volume, 2024 February.

Plaques for William & Caroline Herschel

I was very pleased to represent the Association at a special event organised by the ►

Inauguration of the Herschel plaques at 74 Upton Road, Slough. In the right foreground, Dexter Smith, Leader of Slough Council, talks to Cassie Herschel-Shorland.

Lunar Section

◄ The waxing crescent Moon, imaged at a Chipping Norton Amateur Astronomy Group picnic at Rollright Stones on 2023 Aug 21. *(Steve Knight)*

A word from the Lunar Section Director

Marking one year since formally assuming the role of Director of the Lunar Section, **Dr Tony Cook** discusses his enthusiasm for all things lunar – and how you can get involved in the Section's work.

My enthusiasm for observing the Moon was sparked when I once asked Patrick Moore what would be a good area of amateur astronomy to get into. That was back in the mid-1970s, and I got started by making over a hundred sketches for the Lunar Section, at different selenographic colongitudes, of the lunar mountain Mons Pico. But, like many other well-known amateur astronomers of that era, I was soon recruited into the hunt for transient lunar phenomena (TLP).

Interestingly, although the TLP programme would gain a bit of a bad reputation in terms of misinterpretation of normal appearances of lunar features when observing under different atmospheric conditions, not to mention an unintentional band-wagon effect, it did at least give valuable observing skills to many of those who took part, and even helped launch some science, technical and astronomy careers.

Little did I know that, in 2001, whilst working as a researcher for the Smithsonian's National Air & Space Museum in Washington DC, I would be one of the few to video the flash of light from a couple of Leonid meteoroids slamming into the Moon at 75km/s. That was only the second time amateurs had demonstrated the technique. At least these were definite confirmed changes on the Moon!

Now, looking back, I do wonder if at least a tiny fraction of the 3,000 TLP reports logged could have been impact-related phenomena, such as single flashes seen against the lunar surface, or transient greyness in lunar shadows perhaps from impact ejecta making it into sunlight.

New technology & techniques

My father, Jeremy Cook, was a previous Director of the Lunar Section (1992–1995), and my mother, Marie Cook, has also been an active lunar observer and BAA Council member. Perhaps there was some astronomy gene in our DNA?

For my part, new techniques applied to the Moon have fascinated me, and in 1986 I published a joint BAA paper with my dad on 'Experiments with solid-state imaging devices and image processing in amateur astronomy': basically, using a line-scan camera of just 64 photodiodes to scan the surface of the Moon as it drifted past in the focal plane. Digital images of the Moon were captured and then displayed and processed on a 32kB BBC Microcomputer. That was technologically advanced stuff for the mid-1980s and could replace the cumbersome visual crater extinction device (CED) for comparing the brightness of different lunar features.

Modern cameras allow us to do 12- or 16-bit photometry of the surface and observe high-speed occultations or impact flashes in earthshine; when used with coloured filters and when imagery is ratioed, this can tell us about lunar mineral content. Even affordable thermal infrared imaging is currently possible with Newtonian reflectors. We are also quite active in doing geological studies, utilising telescope photographs and high-resolution spacecraft imagery, or other remote sensing data.

Inspiring the next generation

These days I have the pleasure to teach a few astronomy-related modules in the Department of Physics at Aberystwyth University, in a very scenic part of Wales. It is always fascinating to see young minds filling up with knowledge and expertise, somehow gleaned from my lecture notes, and then discover a few years later that some have gone on to do PhDs and are furthering their careers in astronomy or space. In a similar way, it would be great to encourage younger members of the BAA to join in with Lunar Section activities and establish the next generation of lunar observers.

We have a very diverse range of topics and techniques that we cover in our monthly 50-page circular. So, if you want to adventure into lunar observing, whether it be visual sketching, trying out imaging methods, searching for binary stars with occultations, impact-flash monitoring on the dark side, observing under repeat illumination conditions to disprove past TLP reports, or just undertaking armchair studies of lunar geology, then we have a lot to offer.

► Institute of Physics (whose headquarters we use for our London meetings) that took place in Slough on August 19. New plaques for both William Herschel (1738–1822) and his sister Caroline (1750–1848) were placed by the Institute on the only surviving house in Slough in which they lived (separately, in fact, at different times): 74 Upton Road, Upton, Slough. The plaques were inaugurated by the Leader and Deputy Mayor of Slough Council, and a direct descendent of William, Cassie Herschel-Shorland, was present.

William is buried in the nearby St Laurence's Church, and the friends of the church had organised a big celebration and exhibition there about the Herschel family. Though William Herschel discovered Uranus from Bath, it was while living in Slough that he and Caroline made fundamental advances in our understanding of the Universe, mapping the Milky Way, cataloguing nebulae, and discovering that there was radiation beyond the visible-light band.

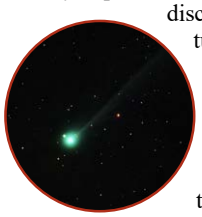
I feel the UK generally does not do enough to honour the great scientists in its history, and, of course, women get particularly overlooked. It is good these two equal plaques now make small amends for that.

The individual plaques.

IN BRIEF

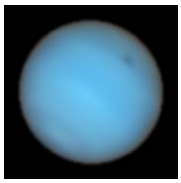
C/2023 P1 (Nishimura)

Early-rising observers were treated to a dynamic display from an unexpected cometary visitor in early September. C/2023 P1 (Nishimura) was discovered at 11th magnitude by Japanese observer Hideo Nishimura on Aug 12, and it rapidly brightened as it neared perihelion on Sep 17. It sported a 10-degree ion tail by Sep 7, but its transition from the morning to evening sky shortly thereafter found it at a perilously close apparent distance to the Sun, with an elongation of just a few degrees.



Comet Section Director Nick James observed it from the visitor centre at La Palma in the Canary Islands on Sep 15, at an elevation of some 2,100m above sea level. He writes: 'The comet was 0.25 degrees above the theoretical horizon but refraction and my altitude made it appear more than a degree up. It certainly wasn't spectacular and it wasn't visible in binoculars.'

Image at top left: The comet on 2023 Aug 31, imaged by Martina McGovern, near Cambridge.



ESO/P. Irwin et al.

Dark spot on Neptune observed from Earth

The Very Large Telescope (VLT) in Chile has made the first-ever ground-based observation of a dark spot on Neptune.

Short-lived dark storms have been known to exist in the ice giant's atmosphere since *Voyager II* imaged a 'Great Dark Spot' during its visit to the planet in 1989, but they are poorly understood. The new research, led by Prof Patrick Irwin at the University of Oxford, suggests that they are formed by ices and haze particles mixing at the base of the visible layer of the atmosphere.

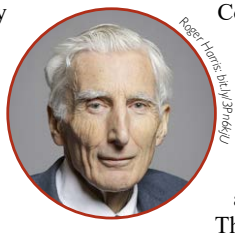
To study the spot, the team used MUSE – a 3-D spectrograph capable of observing the entire planet at once, assigning a full reflection spectrum to every pixel. This enables the chemical composition of different areas to be analysed and compared.

Neptune is currently an evening object, in the constellation Pisces. Observers are encouraged to send observations of its challenging, 2.4-arcsecond disc to the Saturn, Uranus & Neptune Section (see p.339 for contact details).

Show of support for *New Horizons*

A petition started by the National Space Society (NSS) in the USA, calling on NASA to spare the *New Horizons* mission from cuts, has attracted over 7,000 signatures. The probe, best known for its 2015 Pluto flyby, has been earmarked for cuts of $3 million to its annual budget and the replacement of its science team. The plans involve ending its exploration of the Kuiper Belt and turning its attention solely to gathering heliophysical data from next year.

The Kuiper Belt, sometimes referred to as the Edgeworth–Kuiper Belt, was first postulated by Kenneth E. Edgeworth in this very *Journal* 80 years ago this year, in the 1943 July issue. It is a torus-shaped region of the solar system beyond the orbit of Neptune, populated by many icy, enigmatic bodies. These include Pluto and 486958 Arrokoth, which were visited by *New Horizons* in 2015 and 2019, respectively.

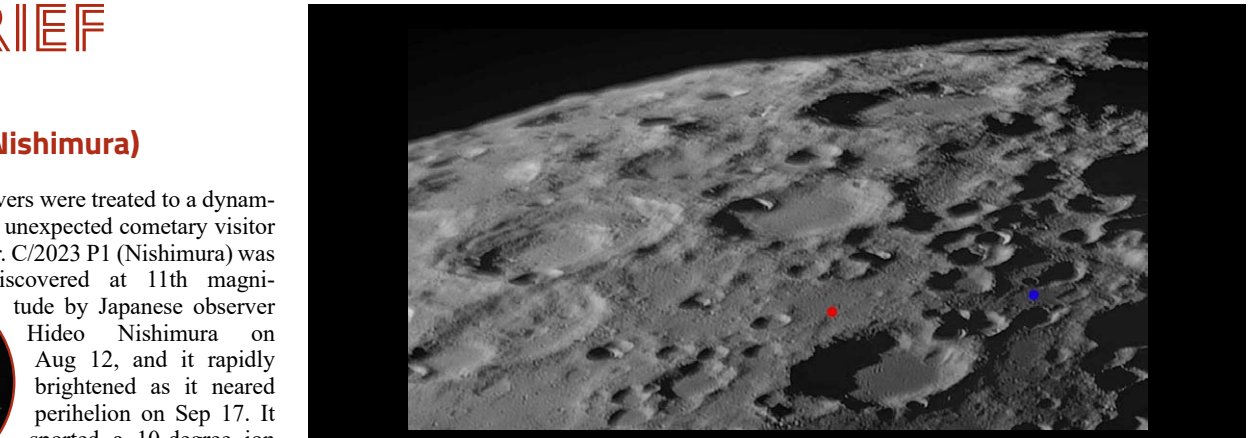


Roger Hollis bit.ly/3Pn6kJU

Amateurs investigate effect of satellite constellations

BAA members contributed this summer to a survey run by the Federation of Astronomical Societies (FAS), designed to gauge the effect of satellite constellations on amateur astronomy. The results will be presented at IAU Symposium 385 on Oct 2–6, recommendations from which will inform policy decisions by the international bodies that regulate the operation of such satellites.

The survey is in response to a recent surge in the numbers of satellites in low-Earth orbit, where they interfere with ground-based astronomical observations. At the end of 2022 there were 5,938 such satellites; 80% were launched within the last three years. About 250,000 more are proposed for launch in the next decade.



Lunar landing success for India

The Indian *Chandrayaan-3* mission, comprising a lander and a rover, successfully touched down in the south polar region of the Moon on Aug 23. The rover, *Pragyan*, is the Moon's first polar explorer, and must rely on its sleep mode to survive the long lunar night.

Upon hearing of India's success, BAA member Alexander Vandenbohede, in Belgium, set to work identifying the landing site amongst the images he had taken of the region using his Celestron 8-inch Schmidt–Cassegrain telescope (f/10). He reports to the *Lunar Section Circular*: 'As far as I understand it, there is quite some distance (about 100km) between the planned landing site, on the Cayley plain between the craters Manzinus and Boguslawsky (indicated in red), and the actual landing site, somewhere between Manzinus C and Simpelius N (indicated in blue).'

Copley Medal for Martin Rees

Martin Rees (the Lord Rees of Ludlow), Astronomer Royal, has been awarded the 2023 Copley Medal – the most prestigious award of the Royal Society, and the world's oldest scientific prize. Lord Rees, a long-time friend of the BAA, is described in the Society's announcement as 'arguably the most distinguished theoretical astrophysicist of his generation'. The Medal was first awarded in 1731 and previous winners include Dorothy Hodgkin, Albert Einstein and Charles Darwin.

Shaun Albrighton passes 100K milestone

Shaun Albrighton has submitted his 100,000th variable-star observation to the Variable Star Section. He surpassed the milestone with a measurement in May of R Coronae Borealis, which dramatically faded in the latter half of that month (see August *Journal*, p.211). Congratulations, Shaun!

Philip Jennings, *Editor*

Eclipse in Exmouth

Seasoned eclipse chasers **Mike Frost** & **Nick James** describe their experiences travelling to Exmouth, Western Australia, to view the great event.

On 2023 Apr 20, the Moon's shadow touched down on Earth and a solar eclipse was visible across much of the planet's surface. Unfortunately, the UK saw none of this, as the eclipse was mostly visible across Australasia and south-east Asia.

The positions of the Sun and Moon in their orbits meant that the two objects had very close to the same apparent angular diameter. This meant that, at the start of the eclipse, the Moon's umbra did not quite reach Earth's surface and the best that could be seen was an annular eclipse, over the southern reaches of the Indian Ocean. The path soon changed to being a total eclipse, which just grazed Australia in its north-west corner, before passing over the eastern part of the island of Timor, the newish nation of Timor Leste, and the Indonesian part of the island of Papua.

Whilst Timor Leste and Papua were appealing destinations, the weather prospects on land were best from Australia. Apart from one or two difficult-to-get-to islands, the only viable option for observing totality was the Ningaloo peninsula, which contained one small tourist-oriented town, Exmouth, and the Royal Australian Air Force base at Learmonth, which co-hosts a civilian airstrip.

Our tour group, Astro-Trails, planned several tours to Exmouth. One of us (MF) was guest astronomer on an overland trip, taking a coach north from Perth to Geraldton, Monkey Mia and Carnarvon, before spending three nights under canvas at the Ningaloo Caravan & Holiday Resort. A second set of around 80 tourists, with NJ as their guest astronomer, flew up from Perth a couple of days before totality, staying in the Exmouth Escape Resort. Finally, 200 flew in on eclipse day on two chartered planes, with John Mason as their guest astronomer.

On the night of their arrival in Exmouth, NJ's group were able to enjoy a night of dark-sky observing from a beach north of Exmouth. MF's group had to postpone their dark-sky stargazing, instead viewing the southern skies from south of Kalbarri *en route* back to Perth. The day before the eclipse, both groups had the opportunity to enjoy the tourist activities for which Exmouth is renowned, either snorkelling off Turquoise Bay, or swimming with the whale sharks (which are whales, not sharks), attending the eclipse music festival, or exploring the town.

Eclipse day dawned with a little cloud to the south of Exmouth, but over the town itself the skies were completely clear. The two Astro-Trails charter planes, departing Perth in the middle of the night, arrived at Learmonth on time. The day visitors observed from a site just to the east of the centreline, at Kallis Rd (22° 07′ 23.2″ S, 114° 05′ 06.6″ E); NJ's group from the Exmouth Escape Resort, 10km north-west of the centreline (21° 57′ 18.0″ S, 114° 08′ 30.8″ E); and MF's group from the campsite, another kilometre north (21° 56′ 42.2″ S, 114° 07′ 56.2″ E), although a few chose to watch from the public viewing area on the beach. The groups were expecting to see between 56 and 62 seconds of totality, depending on how far they were from the centreline.

Mike Frost's account

The eclipse started just after 10 a.m. and the campsite where we were staying turned out to be a good location. We were in control of our environment, so there was no disruption from the other campers. We had a word with the campsite management and got them to put sacks over nearby camp streetlights just in case they came on during totality. The site was shady and so we were able to see wonderful pinhole-crescent effects in the gaps between the leaves, although, of course, I brought out my trusty kitchen colander to view them.

Totality occurred at 11:29, in completely cloudless skies. For 56 seconds, we had a glorious view. It began with a prolonged diamond ring at second contact, and a roar from the crowd on Exmouth Beach as the corona revealed itself. We are approaching solar maximum, so the corona is becoming chaotic, and indeed it was spiky in most directions. To the left of the disc, there was a whole string of prominences – the uppermost of these was quite extraordinary: a thin eruption, arched like a croquet hoop. We did not have a clear horizon, so I could not check for colours there. Jupiter was visible just above the Sun, and Venus was visible lower in the sky; Mercury and Saturn were around too, but I did not see either.

Crescent projections, seen in the run-up to second contact. ***(Mike Frost)***

Top: **This sign was just outside Mike's campsite, taken on the evening before the eclipse. A big festival was under way in the field across the road.** ***(Nick James)***

Stack from a video shot using a GoPro HD Hero 6. *(Nick James)*

◀ **A galah.**

For us in the campsite, the most unexpected phenomenon was not visual but aural. A large flock of galahs – white and pink cockatoos, with a reputation for skittishness and stupidity – decided it was time to roost and came shrieking over our heads during totality. I had set up my phone to record the eclipse, and the squawking drowned out everything – but, of course, not one of the little so-and-sos actually flew through my field of view.

The progress of the eclipsed Sun through the Moon's shadow was visible though, and totality ended with another prolonged diamond ring. I checked the sheet we had laid out, as I did just before totality, but there was no sign of any shadow band; perhaps the air was not turbulent above us.

A lovely eclipse.

Nick James's account

This was one of the most beautiful, but also one of the most relaxing, eclipses that I have experienced.

I was with the Exmouth Stay group, which flew up two days before the eclipse. We stayed at Exmouth for three nights and this meant that the morning of eclipse day involved getting up, eating a leisurely breakfast at the on-site Whalers Restaurant, and then setting up in time for first contact at just after 10 a.m. Compared to the normal 2 a.m. start and long journey on eclipse day, this was absolute luxury!

The day before the eclipse, there was a lot of cirrus cloud in the sky. This would probably not have had a significant impact on the eclipse, although it would have reduced the contrast of the corona. I spent a few hours in the bar diligently studying the weather prospects and sent some pictures of the sky down to John Mason, who was still in Perth, since the larger group would be flying up on eclipse morning. On the evening before the eclipse, I walked into Exmouth town (around 15 minutes) to meet up with the group led by Mike Frost; they were camping (glamping?) at a rather nice-looking campsite. Exmouth was really buzzing that night, with a big eclipse festival and many other events under way.

On eclipse morning I got up around 7 a.m. and walked over to breakfast. The sky was almost completely clear except for a few clouds low in the west, and these had gone by the time the eclipse started.

This was a short eclipse and so I was determined to watch it and not spend time fiddling with cameras. I had three cameras that I planned to leave running during the eclipse. For wide-field video I had a GoPro HD Hero, which would hopefully record the sky effects and Jupiter and Venus. For high resolution, I had a Sony Alpha 7s camera which was mounted on a William Optics Megrez 72mm refractor with a Barlow lens, giving a focal length of around 1,250mm. This would shoot video in a high-dynamic-range mode, called s-log2. The camera was connected to a laptop *via* USB so that I could monitor the video and focus on a big screen. This was really useful. I also had a Sony FDR-AX700 camcorder which would shoot wider-field video at 4K. An advantage of being right next to the accommodation is that I could run a mains power cable from the room and get shade and drinks as needed.

When it arrived, totality was gorgeous. There was a very large prominence and several smaller ones, including a detached prominence near the third-contact point. The corona was beautiful. It was a symmetric solar-maximum corona with multiple streamers. Jupiter and Venus were easily visible in the very clear sky. I did not get a chance to look for shadow bands, but there is no sign of them on my wide-field camera shots.

My YouTube video of the event is here: **bit.ly/44CjKP0**. Gillian and Roger Perry are editing a DVD/Blu-ray of the Australia eclipse which contains material from various locations. This will be available soon.

▼ **From left to right: second contact, totality, and third contact. Stacks from a video shot using a Sony Alpha 7s camera in high-dynamic-range (s-log2) mode, with a William Optics Megrez 72 and Barlow.** ***(Nick James)***

Variable Star Section

Observers team up to study the enigmatic dwarf nova CG Draconis

Maxim Usatov

Jeremy Shears
Director

It has been said that variable star observing is a team sport. Even though observations are made by individuals, it is only by combining the results of many observers that we get sufficient data to fully understand a particular star. Gaps in the light curve of the star can occur, because at any specific location it might not always be visible; perhaps the weather is not cooperative, or maybe the observer has other calls on their time.

For this reason, from time to time the Variable Star Section (VSS) organises intensive observing campaigns on particular targets. The fruits of such a campaign, on the dwarf nova CG Draconis, have recently been published in the journal *Astronomische Nachrichten*.[1] *AN*, as it is familiarly called, was one of the first international journals in the field of astronomy. It was established in 1821 and claims to be the oldest astronomical journal in the world that is still being published. *AN* has a long history of publishing variable-star science, as well as other branches of astronomy. Despite its German name, which translates as 'Astronomy Notes', all papers are now published in English.

CG Dra has remained an enigmatic object for more than half a century. It was discovered in 1965 and was soon classified as a dwarf nova. Rather little was known about its outburst frequency until an intensive monitoring campaign was conducted by VSS observers during 2005, the results of which were published in the BAA *Journal*.[2]. This revealed that the star has frequent outbursts, every 11 days or so, and that it spends very little time at quiescence. Two types of outburst were detected: short, lasting about four days, and long, lasting about eight days. The range is magnitude 14.1 to 17.4.

A subsequent VSS paper presented evidence for very shallow (~0.16 mag) eclipses, with a duration of about 18 min.[3] The times between the eclipses were consistent with an orbital period of 4h 31m 38 (±3)s.

The new *AN* paper presents the most extensive photometric dataset on CG Dra to date. During the VSS campaign in 2022, 27,436 photometric observations were made, including high-resolution photometry from author Usatov's remote telescope in Spain (Figure 1). A total of 106 eclipses were recorded.

Figure 1. Maxim Usatov's 0.43m *A1* telescope, a PlaneWave Corrected Dall–Kirkham (CDK) optical design equipped with the latest-generation back-illuminated Sony IMX455 sensor and located at a remote site in Spain.

This paper summarises the new data available and provides an updated ephemeris, as well as commentary on the observed eclipse profiles. The orbital period found is 4h 31m 38 (±1)s, consistent with earlier findings. Two types of quasi-periodic outbursts are identified: normal outbursts, of ~1.25 mag amplitude, and bright outbursts, of ~ 1.5 mag.

The most intriguing finding is that the light curve (Figure 2) resembles that of the SU UMa-type dwarf novae, which have a few longer, brighter outbursts, called superoutbursts, interspersed by several normal outbursts. In SU UMa systems, superoutbursts are characterised by the presence of small modulations in the light curve known as superhumps, the ►

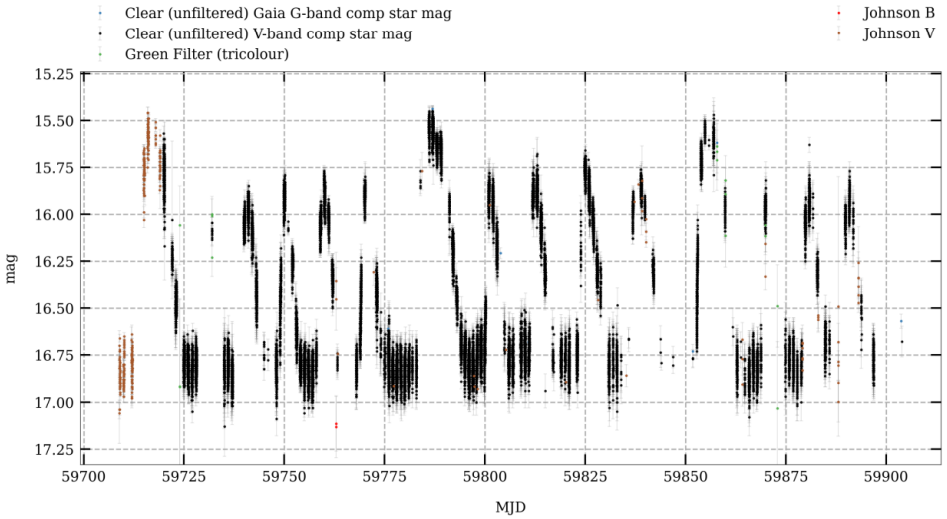


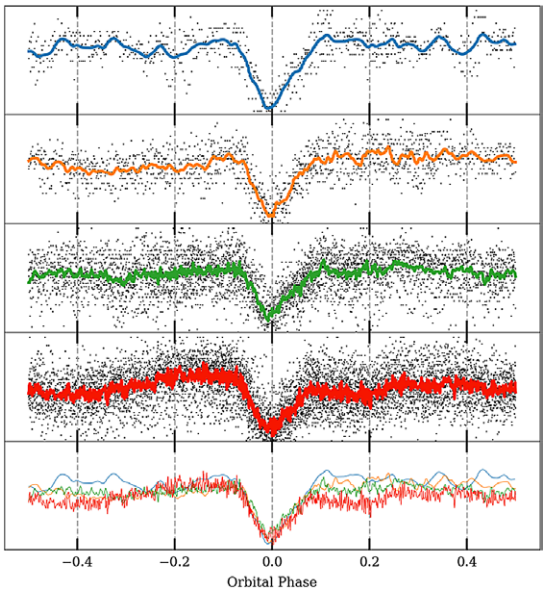
Figure 2. The light curve of CG Dra obtained throughout the 2022 BAA VSS observing campaign. Filters are colour coded. The light curve spans JD 2459709.39673 to 2459904.43000 (2022 May 9 to Nov 20). VSS observers who contributed are D. G. Buczynski, D. Shepherd. F. Tabacco, G. Poyner, I. L. Walton, M. Mobberley, M. Usatov, N. D. James, P. Bouchier, and R. Sargent.

► period of which is very slightly longer than that of the orbit. However, no superhumps were found in the case of CG Dra. The paper goes on to discuss whether CG Dra may represent a new intermediary subtype of dwarf nova between SS Cyg-systems, which show normal outbursts, and SU UMa-type stars, or whether it provides support for superoutburst models that do not rely on eccentric accretion discs.

The unprecedentedly high-resolution photometry (30s cadence) during the VSS campaign revealed that CG Dra exhibits a variety of eclipse profiles throughout all its states (Figure 3). For example, eclipse ingress and egress phases vary from quiescence to bright outbursts, getting slightly wider as the system progresses from quiescence to the bright outburst state. This suggests that the size of the accretion disc varies with the state of the system. Eclipse depth also increases in this sequence.

We hope that observations presented in the paper will be helpful for further research. Further observations are required to fully understand the physical nature of this system and we therefore encourage others to include this star in their observational programmes.

1 Usatov M. & Shears J., *Astron. Nachr.*, **344**, e220113 (2023). The paper can also be read on arXiv at: **arxiv.org/abs/2301.05870**
2 Shears J., Pickard R. & Poyner G., *J. Br. Astron. Assoc.*, **117**, 22–24 (2007)
3 Shears J., *et al.*, *J. Br. Astron. Assoc.*, **118**, 343–347 (2008)



► **Figure 3.** Phase plot of normalised average eclipse profiles for CG Dra in different system states. From top to bottom: bright outbursts, normal outbursts, rising and fading, and quiescence. Ordinates are in the [0, 1] range. Black points represent individual observations of 106 eclipses. The bottom pane compares averaged eclipse profiles.

Update on T Coronae Borealis

Anticipation is rising for the next eruption of the recurrent nova T CrB. As discussed in the August *Journal*, it ended its super-active phase, which began in 2015, and entered a pre-eruption dip in the spring. The previous eruption of T CrB, in 1946, occurred a year after the end of the super-active state.

Prof Bradley E. Schaefer (Department of Physics & Astronomy, Louisiana State University) has predicted the eruption at 2024.4 ± 0.3, i.e., 2024 February to August. In a recent submission to *Astronomy Letters* (**bit.ly/3EOfbWJ**), a team from the Sternberg Astrophysical Institute present their analysis of the long-term light curve and offers their prediction for the eruption: 2024 January. Both predictions assume the next eruption will be identical to the 1946 event, but of course this might not turn out to be the case. No doubt further predictions will follow as the pre-eruption Peltier dip progresses.

A Variable Star Section campaign is under way to monitor the nova. Further details are in the August *Journal* (p.210–211) and on the BAA website: **bit.ly/3PFAMqS**.

Observations, visual and digital, that continue to flow into the database show the progress of the fade, including time-resolved photometry to characterise short-term variations like flickering. Our spectroscopists are hard at work too. At the time of writing, it has a visual magnitude around 10.2.

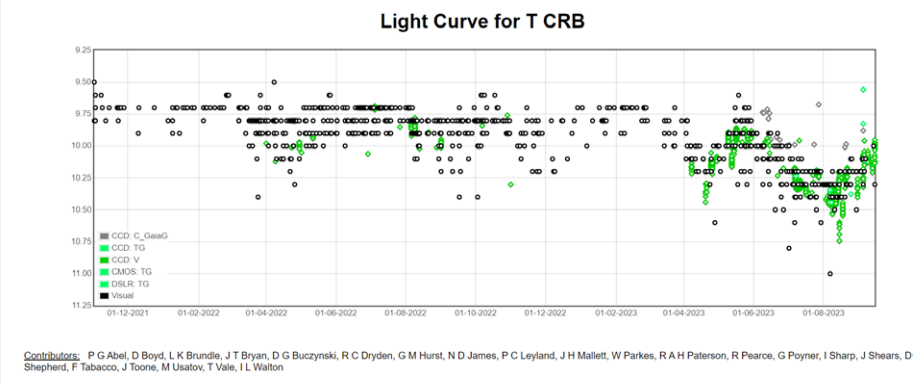
The accompanying light curve covers the interval 2021 Nov 1 to 2023 Sep 16. Note that there is an oscillation superimposed of up to 0.3 magnitudes (V) which means the star will not fade continuously – there will be bumps along the way. This sine-wave-like oscillation is due to ellipsoidal modulation caused by T CrB being a binary star, comprising a red giant which is distorted by the strong gravitational pull of a white dwarf. When we see a side-on distorted profile, the surface area presented by the red giant is larger, hence the star appears brighter. A quarter of an orbital period later, a smaller profile is presented, so the system is fainter. The oscillations are modulated on the orbital period of the binary of 227 days, with a peak occurring at half that interval.

Updates will be posted to the BAA Forum as they occur. As this edition of the *Journal* appears, Corona Borealis is sinking into the west, making it harder to observe. From UK latitudes, depending on local horizons, observations are generally possible in the western evening sky until late November, and in the morning sky after that. Observers are requested to make extra efforts during this period, thus avoiding a seasonal gap. It is essential that we identify the minimum of the dip, which, based on the 1946 light curve, is a three-month warning of the impending eruption.

The 1946 eruption was detected independently by two British observers: BAA Variable Star Section member Norman Knight of Bedford Park, Chiswick, and 16-year-old Michael Woodman of Newport, South Wales. It would be wonderful if an amateur discovered the eruption this time round, too.

Only two eruptions of T CrB are known: 1866 and 1946. However, Prof Schaefer has recently searched archival material and has found evidence of two prior eruptions: 1787 and 1217 (**bit.ly/46jnB4t**).

Jeremy Shears



Comet Section

A major outburst of comet 12P/Pons–Brooks

Nick James
Director

It was Jean-Louis Pons at Marseille who discovered this object, whilst sweeping the morning sky on 1812 Jul 21.[1] The comet reached perihelion on 1812 Sep 15 and calculations showed that it had an orbital period of around 70 years. On 1883 Sep 2, William Brooks in New York State discovered a comet which turned out to be the same object.[2] 12P/Pons–Brooks came to perihelion on 1884 Jan 26, and it was an easy naked-eye object at its brightest. It also had a significant outburst on 1884 Sep 22, when it suddenly brightened by two to three magnitudes.

12P is a Halley-type comet with a current period of 71 years and a perihelion distance, *q*, of 0.78 astronomical units (au). The last return was in 1954. On 1953 Jun 20, the comet was recovered by Elizabeth Roemer using the 36-inch Crossley reflector at Lick. This was around 11 months before perihelion, which occurred on 1954 May 22, and we have some drawings by George Alcock in our archive which show how it looked back then (Figure 1).

The next perihelion will be on 2024 Apr 21. The comet should reach 4th magnitude early next year and so will be an interesting object to follow. This time around, the comet was recovered using the 4.3m telescope at Lowell on 2020 Jun 10, almost four years before perihelion, when it was almost 12au out from the Sun.[3] It appears to have quite a large nucleus, with estimates of the diameter ranging up to 34km,[4] although this is probably a significant overestimate and the true value is probably nearer to 20km.

The comet has been followed by amateurs since 2022 June, when it was around 21st magnitude. Throughout early 2023 it slowly brightened and by July it had reached 17th magnitude, showing a faint coma and stubby tail to the south-west.

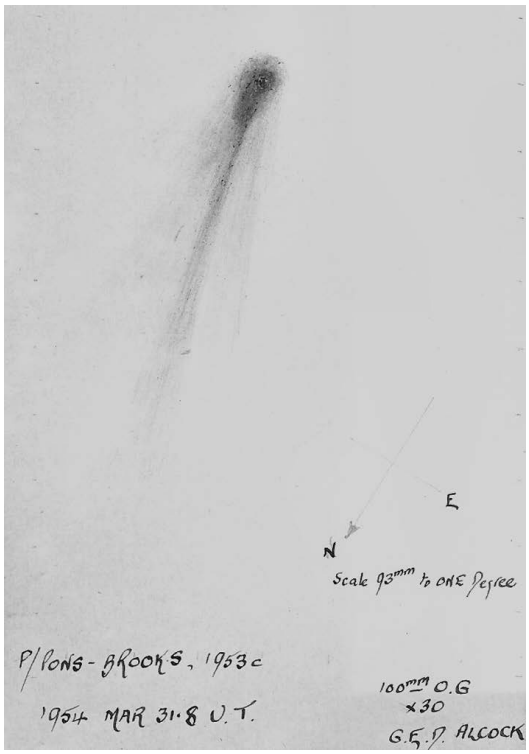
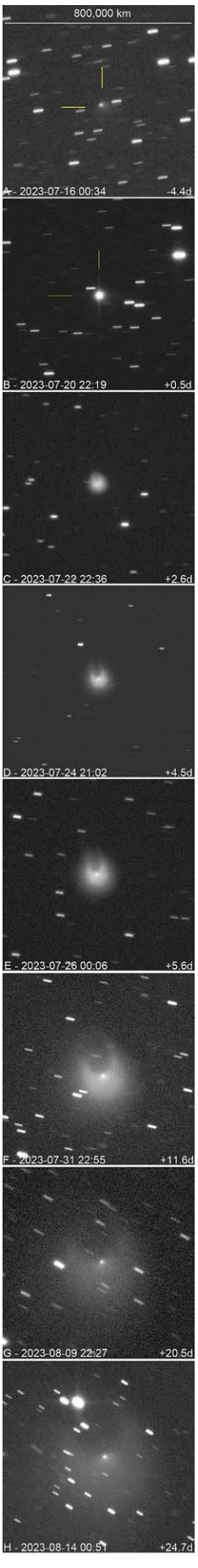


Figure 1. 1954 Mar 31.8. 0.10m OG, ×30. George Alcock, Peterborough.

The outburst

On 2023 Jul 20.82, Elek Tamás in Hungary detected a very large outburst.[5] The comet had risen from 17th magnitude to around 12th magnitude, brightening by a factor of 100 over a very short period. Early images showed an almost star-like point but gradually the new coma expanded outwards. At the time of the outburst, the comet was 3.89au from the



► **Figure 2.** Sequence of images all at the same physical scale, showing expansion of the coma following the outburst. The images were obtained using three systems: Peter Carson's remote telescope at Fregenal de la Sierra, Spain (a 0.315m, *f*/8 Dall–Kirkham operating at 0.61 and 1.22 arcsec/pixel with an IMX455 CMOS sensor); the author's telescope in Chelmsford, UK (a 0.28m, *f*/10 Edge HD operating at 0.56 and 1.12 arcsec/pixel with an IMX455 CMOS sensor) and the Alnitak Observatory at Sierra del Segura, Spain (a 0.43m, *f*/6.8 PlaneWave CDK operating at 0.53 arcsec/pixel with an IMX455 CMOS sensor). The latter telescope was made available under the BAA remote observing scheme.

(A) Pre-outburst on 2023 Jul 16, 00:34 UT (Carson). Exposure 20×60s.

(B) Approximately 12 hours post-outburst; 2023 Jul 20, 22:19 UT (Carson). 20×60s.

(C) Approximately 2.6 days after the outburst; 2023 Jul 22, 22:36 UT (Alnitak). 6×120s, Johnson V.

(D) 2023 Jul 24, 21:02 UT (Alnitak). 12×60s, Johnson V.

(E) 2023 Jul 26, 00:06 UT (James). 21×60s, clear.

(F) Approximately 11.6 days after the outburst; 2023 Jul 31, 22:55 UT (Carson). 20×60s, clear.

(G) 20.5 days after the outburst; 2023 Aug 9, 22:27 UT (James). 30×60s, clear.

(H) 24.7 days after the outburst; 2023 Aug 14, 00:51 UT (Carson). 17×60s, clear.

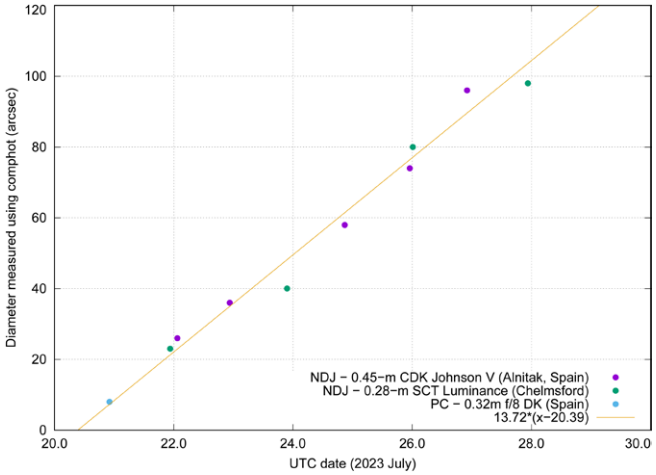


Figure 3. Plot of the coma diameter early in the outburst, showing the linear expansion rate.

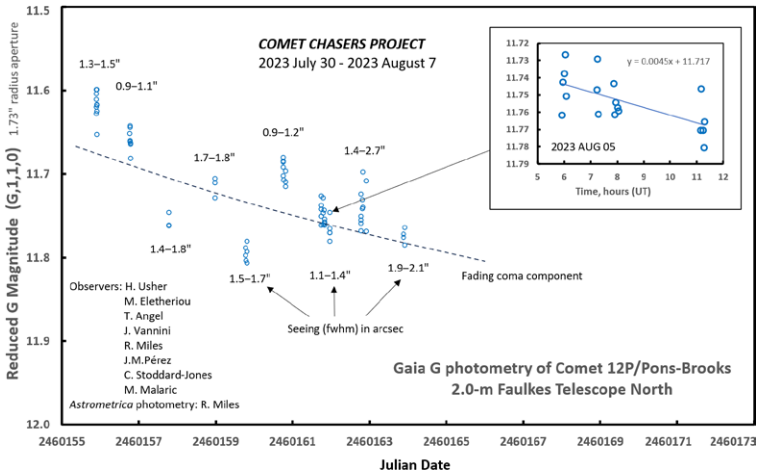


Figure 4. Plot of multi-aperture photometry obtained using a 2m telescope, showing the general coma-fading, and shorter-term variations which may be due to rotation of the nucleus.

Sun and 3.57au from Earth; an arcsecond corresponded to 2,590km projected on the sky at the distance of the object.

Post-outburst images and observations were received from many observers. The BAA observers are listed at the end of this note.

All the images in Figure 2 are presented at the same physical scale and they correspond to a view 800,000km square, projected onto the sky at the distance of the comet. Measurement of the coma diameter was done using the Section's *Comphot* software. This uses an objective approach to determine the size of the coma, which does not require human input.

Around 62 hours after the outburst, the coma had expanded and started to show interesting detail. It was teardrop-shaped, with a dark notch to the north. This notch was probably caused by blocking of the dust expansion by the nucleus, since the outburst happened over a very short time. The material rises above the nucleus and then expands spherically into a vacuum. One direction is blocked by the nucleus itself and the projection of this forms the dark lane. A similar morphology is seen in outbursts of 29P.

By 5.6 days after the outburst, the coma had expanded to a diameter of 80 arcseconds, corresponding to around 200,000km at the comet's distance. The horn structure, dark lane and the demarcation between the inner and outer coma were now much more prominent and there was some visible structure in the dark notch.

The coma continued to expand, but the total magnitude of the comet in an aperture corresponding to the coma diameter remained constant, at around 11.7. This is what would be expected if a large volume of material was suddenly injected into the coma and then expanded away. The reflective area of the dust remains constant. The magnitude only begins to fall when the photometry is no longer detecting the full extent of the coma.

The final two images in the sequence show the late stage of the outburst. The surface brightness of the inner expansion coma had faded considerably, but the dark band to the north was still prominent. By the time of the last image, 25 days after the outburst, the inner coma had expanded to a diameter of around 500,000km, almost four times that of Jupiter.

Analysing what happened

The plot in Figure 3 shows that the coma diameter has a best-fit linear expansion rate of 13.7 arcsec/day. This corresponds to a physical expansion rate of around 200m/s. Projecting the expansion back to zero diameter indicates that the outburst occurred at 2023 Jul 20.39. Using a different approach, Richard Miles and the Comet Chasers team got an outburst time of Jul 20.45 ± 0.08, using data from metre-class telescopes in the LCOGT network, and this is nicely consistent with the results obtained using amateur instruments.

The latest observation known before the outburst was on Jul 20.08 by station A02.[6] At that time the magnitude was measured as 16.9. It appears that Tamás detected the outburst around 10 hours after it happened.

Richard Miles also performed multi-aperture photometry of the inner coma, using data from the 2m Faulkes Telescope North on Maui, collected by Comet Chasers. Their results are plotted in Figure 4 and may show evidence of the rotation of the nucleus. He writes:

> 'The variability is very evident but with observations spaced every 24 hours or so, it is difficult … to arrive at a specific period. [The absolute magnitude is] 12.3R. This was determined using multi-aperture photometry and extrapolating to zero radius. This value is 2.5 magnitudes fainter than [outbursting comet] 29P/Schwassmann–Wachmann, which has a diameter of a little over 60km, so at the same albedo 12P would be about 20km diameter.
>
> 'The amplitude of variation appears to be around 0.15–0.20 magnitudes, which equates to about 0.35–0.50mag for the bare nucleus. The inset shows a 0.025-magnitude fade over 5.5 hours of observation, so we are clearly dealing with a slow rotator of the order of 4–6 days. Since the rotational light curve is likely to be irregular in shape, we have insufficient data to identify any particular value. Only 3–4% of periodic comets outburst strongly (5mag or more) like 12P, and the hypothesis I have put forward in the literature is that such comets are almost certainly slow rotators which develop a surface crust in places of significant strength. Below this crust, cryomagma can form and [a] rupture of this crust leads to a sudden cryo-eruption, which ceases quickly as the fissure refreezes.'

> The inner coma had expanded to a diameter of around 500,000km, almost four times that of Jupiter

At the time of writing (end of August), the faint expansion coma is still visible but very faint, and the comet has almost returned to its pre-outburst form. We expect further outbursts as this comet approaches the Sun, so please keep it under observation.

My thanks to the following BAA observers, who submitted observations of this fascinating object: Denis Buczynski, Peter Carson, Nigel Evans, Alun Halsey, Tim Haymes, Nick James, Martin Mobberley, Grant Privett, Nick Quinn, David Strange, David Swan, Peter Tickner, Bob Trevan, Mazin Younis.

References

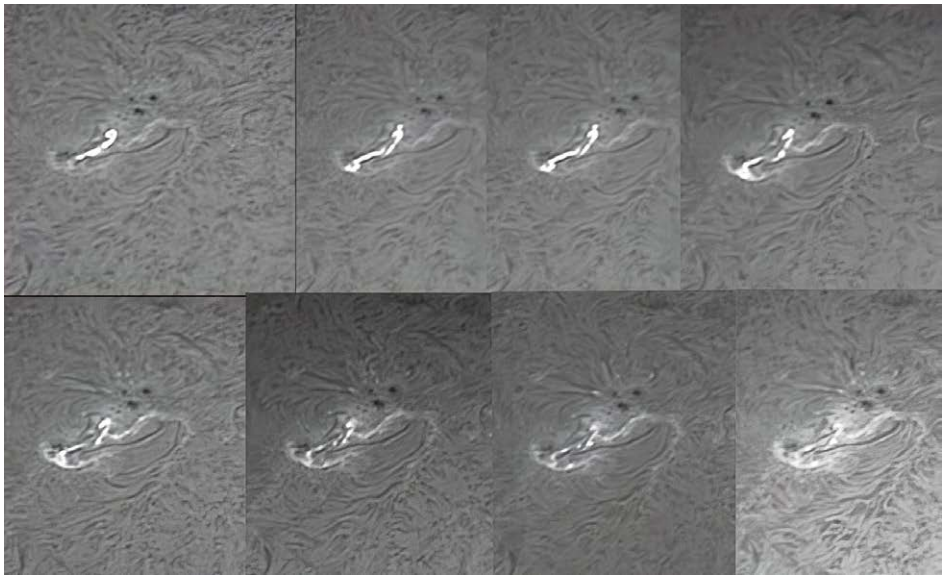
1 *Cometography*, vol 2, pp 30–32
2 *Cometography*, vol 2, pp 521–532
3 *MPEC* 2020-M114 (**bit.ly/3LNqzGD**)
4 Recovery of returning Halley-type comet 12P/Pons–Brooks with the Lowell Discovery Telescope (**arxiv.org/abs/2007.01368**)
5 **groups.io/g/comets-ml/message/31504**
6 *MPEC* 2023-O106 (**bit.ly/469VzYX**)

Solar Section

Lyn Smith
Director

2023 June

Activity in June surged back to the high levels seen in 2023 January. Although there was a slight decrease in northern-hemisphere activity, the southern hemisphere more than made up for the shortfall. The month also produced one of the largest sunspot groups of the cycle so far. Forty-three sunspot groups received Boulder numbers during the month, with multiple groups visible every day. The largest/most complex are reported below.



The evolution of a flare erupting from AR3340, captured in H-alpha between 16:21 and 17:14 UT on 2023 Jun 26. *(John Arnold)*

AR3315 S17°/233° survived from the previous month, now approaching the SW limb. The leader and follower penumbral sunspots were still visible, although the follower started fading on Jun 2 as the leader reached the limb. The group then rotated out of view.

AR3319 S16°/201° also survived on the disc from the previous month and was type Eho on Jun 1, with an area of 540 millionths. The size of the leader reduced the following day, but a few small penumbral sunspots developed between the leader and follower, making the group type Eac. It maintained this configuration until it rotated around the SW limb on Jun 4.

AR3321 S14°/120° was another survivor from May. A penumbral Hax sunspot with an area of 290 millionths, it was in the SE quadrant not far from the limb on Jun 1. The sunspot showed a distinct light bridge across the umbra on Jun 1 and developed an accompanying pore on Jun 3. By Jun 4 the umbra was quite curved but by Jun 6 it had resumed a more circular shape. There was very little further change to this group as it made its way westward, reaching the limb on Jun 11.

AR3323 S07°/099° rounded the SE limb on Jun 1, consisting of several small penumbral sunspots and a few pores. The group was type Eac on Jun 3 with an area of 570 millionths. It was probably at its most impressive on Jun 4 & 5, before it started to decline on Jun 6 as it crossed the central meridian (CM). Sunspots in both the leading and following elements continued to fade and by Jun 7 the group only had an area of 100 millionths. By Jun 9, it was type Cai with an area of 40 millionths. It faded on the disc in the following days as it approached the SW limb.

AR3327 S15°/050° rounded the SE limb on Jun 4, comprising three small penumbral sunspots. By Jun 7, it had grown into a compact Dac group with several small penumbral sunspots and pores. The following day, it became type Eac with an area of 470 millionths. By Jun 10, the leading section had begun to fade and by Jun 12 only a Bxo group remained, midway across the SW quadrant. The group faded on the disc in the coming days.

AR3335 S13°/287° & AR3336 S20°/281° both rounded the SE limb on Jun 14, AR3335 being the major group with AR3336 immediately to the south. AR3336 was initially type Dsc, consisting of two small penumbral sunspots. By Jun 17 only a single small penumbral sunspot was visible, and by the time AR3335 had reached the CM, AR3336 had dissolved on the disc. AR3335 initially appeared as a Dao group which by Jun 16 was showing development into type Eai. Further small penumbral sunspots appeared the following day, making the group type Eac, with the largest sunspot being the leader. By Jun 18, it had an area of 530 millionths. The group reached the CM on Jun 20 and the following section of the group then started to decay. The decay continued in the following days and it was reduced to type Dac and 380 millionths by Jun 22. It was last reported close to the SW limb on Jun 25, surrounded by a network of bright faculae.

AR3340 N23°/237° appeared over the NE limb on Jun 18 as a single Hsx sunspot. The group developed several pores to the east and south of the main spot over the next few days, unusually quite apart from it. By Jun 22, the trailing sunspots had begun to develop whilst the southern pores began to fade. The group was type Esi when it reached the CM on Jun 23, and by Jun 25 had undergone strong development in its following section. This proved to be its peak, as the group started to fade after Jun 26 and was seen approaching the limb on Jun 28, type Bxo.

AR3354 N16°/164° formed in the mid-NE quadrant on Jun 26 as a minor Bxo-type group. It underwent dramatic development overnight however, and by Jun 28 was a complex Dkc-type group containing around 20 penumbral and other minor sunspots. It crossed the CM on Jun 28/29 and developed into type Ekc, with an area of 1,210 millionths. On Jun 29, this group comprised two main irregular penumbral sunspots in its central and following sections, the leaders being a couple of small penumbral sunspots and a few pores. The group was easily seen with the protected naked eye. It further extended in longitude on Jun 30 and became type Fkc.

24 observers reported a quality number of Q = 23.89 for June.

H-alpha

Prominences

18 observers reported a prominence mean daily frequency (MDF) of 6.24 for June.

On Jun 1, a fila-prom was seen on the NE limb. The filament element was the longest and this elongated during the coming days whilst the prominence receded.

A moderately tall hedgerow prominence was seen on the NW limb on Jun 4.

A hedgerow prominence with three tree-type elements was reported on the NE limb on Jun 7, with a length of around 110,000km and rising to about 50,000km. This feature persisted through to Jun 8, although the middle element was reduced. Also, on the SE limb, another substantial hedgerow prominence rose to about 60,000km.

Two moderately tall but separate pillar prominences were seen on the SE limb. The

northernmost formed a detached blob of plasma the following day which seemed to reconnect by Jun 14 and form a large, curved plasma cloud, attached to the limb by a thin stem.

A slightly inclined, tall tower prominence was seen at high latitude on the NE limb on Jun 15.

A long but low hedgerow prominence was on the NW limb on Jun 17, and a pyramid prominence was seen on the SW limb. This pyramid was also present on Jun 18 and had developed an arc of plasma to its northern edge. Further north along the limb was a fine arch prominence. Another fine detached prominence with a complex structure was reported off the NW limb, and on the SE limb, a curtain prominence rose to about 40,000km and extended around the limb for about 100,000km. This latter prominence hearth persisted in various forms through to Jun 24.

A long arch prominence formed on the NE limb on Jun 20, which was reported as a platform arch on Jun 21, extending for 100,000km and rising to about 50,000km, with three small clouds of plasma associated with it. All that was left of the feature on Jun 22 was a single large pillar, with a hooked top curling southward.

A tall slender tower, slightly inclined northwards, was reported on the NE limb on Jun 26, rising to about 100,000km.

Bipolar magnetic regions, filaments & plage

17 observers reported a filament MDF of 8.96 and 14 reported a plage MDF of 6.41 for June.

A very long, broad, roughly north/south-aligned filament survived from the previous month in the SE quadrant; it was estimated to be 375,000km long on Jun 1. It persisted over the coming days into the SW quadrant but was not seen on Jun 4. Also on Jun 1, a fila-prom on the NE limb started to extend onto the disc. This continued over the next few days, with the feature forming an incomplete polar crown in the northern hemisphere. It started to rotate over the NW limb on Jun 10, and remnants could still be seen on Jun 11.

Another long, broad, east/west-aligned filament was reported on Jun 8 over the CM and into the NW quadrant, some distance south of the polar crown feature. The filament reached the NW limb on Jun 12.

Also on Jun 8, a long, broken and roughly east/west-aligned filament was in the SE quadrant south of AR3327. The filament measured about 250,000km in length. As the feature progressed into the SW quadrant, it became more diagonal across the quadrant and extended to 350,000km in length. It reached the limb on Jun 14/15.

Bright plage was observed with AR3327 and AR3331 on Jun 12. Also on this day, a long, curved north/south filament was observed in the NW quadrant, to the north of AR3329. The filament progressed to the NW limb, arriving on Jun 16 when it formed a broad feature close to the limb. (It was also responsible for the long, low prominence hearth on the NW limb on Jun 17.)

On Jun 14, a broken filament was seen in the NE quadrant that developed the following day into a much longer and stronger feature. On Jun 16 it was a strong broken filament into the NW quadrant, aligned mostly north/south. The filament was still strong on Jun 17 but was not seen on Jun 18.

Another curved, north/south-aligned filament was close to the NE limb on Jun 20. It was to the north-east of AR3340 and remained so over the coming days. It reached the CM on Jun 25 and followed the sunspot group towards the NW limb for the remainder of the month. During its progress, it was estimated to be between 200,000 and 250,000km in length.

Bright plage was seen with sunspot groups approaching the W limb on Jun 24, and a bright spot of plage was observed within AR3351 near the NE limb.

On Jun 29, a large irregular bipolar magnetic region (BMR) was seen, associated with AR3354 in the northern hemisphere.

CaK

Almost all CaK emission was associated with sunspot groups throughout the month. The exceptions were an area around N23°/015°, which displayed an emission around 10° across on Jun 8–11 inclusive; an area 10° across that remained after a sunspot group at S20°/093° faded on Jun 11 and remained visible through to Jun 15; and a larger area centred at about N30°/165° which remained visible after the associated sunspot group faded, Jun 26–30.

CaK MDF 7.37 (19 days; observer Brian Mitchell).

Flares

There were many minor flares reported to the Section during the month. Warren Spreng reported an M2.5 flare associated with AR3335 at 13:56 UT on Jun 18, and Andy Devey reported an M-class flare on Jun 28 at 08:57 UT.

2023 July

Activity in July mirrored that seen in June. There was a slight rise in the relative sunspot number (R), maintaining the upward trend for the third consecutive month. The Q number was also slightly higher, again for the third consecutive month, reflecting an increase in the quality of sunspot-group configuration. Sunspots were numerous throughout the month, with 41 groups receiving a Boulder number. The largest/most complex groups are reported below.

AR3354 N17°/165° survived on the disc from the previous month and was now in the NW quadrant. The group had a dramatic appearance, being type Fkc and consisting of several irregular penumbral sunspots, the largest being the follower which had an area of 1,260 millionths. The following day, the overall appearance of the group was similar, although the shape of individual sunspots had changed. However, on Jul 3, as the group approached the limb surrounded by noticeable bright faculae, the middle penumbral sunspots had merged to give a single elongated penumbral spot. Overall, the group appeared as three penumbral sunspots approaching the NW limb, accompanied by a few sporadic pores. As the group rotated out of sight, only a single Hsx-type sunspot remained close to the limb on Jul 5.

AR3359 S19°/070° appeared on Jul 1, not far from the SE limb, as a faint Bxo sunspot ►

BAA sunspot data, 2023 June – July

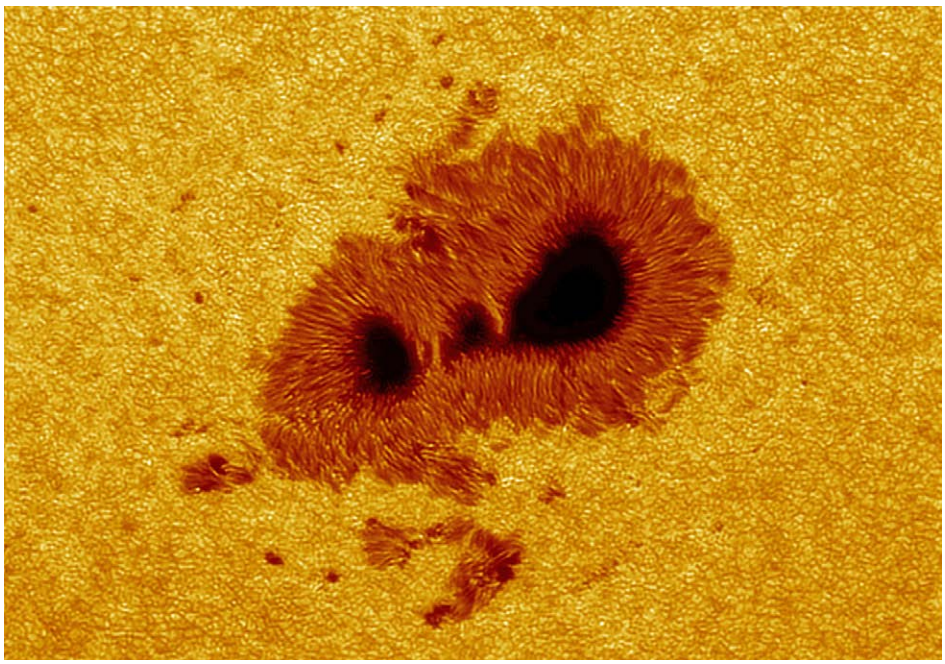
	June		*July*	
Day	*g*	*R*	*g*	*R*
1	7	113	6	102
2	7	108	6	111
3	7	103	6	114
4	7	98	6	98
5	7	117	6	91
6	9	114	7	107
7	9	137	8	120
8	8	124	9	126
9	8	116	9	137
10	7	101	9	143
11	6	104	10	150
12	5	73	10	151
13	5	63	7	107
14	6	84	7	108
15	6	83	6	97
16	6	91	8	119
17	6	101	7	114
18	7	106	8	129
19	8	130	7	130
20	9	141	7	130
21	11	162	7	112
22	12	167	7	117
23	11	154	8	109
24	12	165	7	106
25	9	133	7	101
26	7	112	8	115
27	7	119	8	118
28	6	107	8	129
29	4	75	9	142
30	4	69	9	138
31			8	135
MDFg	7.87 (46)		7.95 (47)	
Mean R	121.08 (44)		129.31 (45)	

North & south MDF of active areas g

	MDFNg	*MDFSg*
June	3.88 (38)	4.14 (38)
July	3.71 (39)	4.43 (39)

g = active areas (AAs)
MDF = mean daily frequency
R = relative sunspot number

The no. of observers is given in brackets.



AR3363 in white light, observed on 2023 Jul 12 at 13:10 UT. *(Ella Bryant)*

► group which strengthened the following day into a compact Dao group with an area of 230 millionths. It was of a similar configuration during the next few days, including Jul 7, when it was just past the CM. The following day, it was showing signs of decay, with the two penumbral sunspots reducing. It was seen as a sole Axx sunspot on Jul 9.

AR3361 N23°/038° formed not far from the NE limb on Jul 4 from a patch of faculae seen near the limb on Jul 3. By Jul 5, the group had strengthened to type Cao with a small penumbral leader. The group continued to grow, developing a penumbral follower by Jul 7. The following day, the group was over the CM, consisting of an asymmetrical leader and follower, type Dao. Over the coming days as the group progressed across the NW quadrant, there were changes, particularly in the follower region, and the penumbral leader became symmetrical by Jul 10. As the group approached the limb, the followers faded, and the leader reached the limb on Jul 14.

AR3363 S20°/346° was reported on Jul 6, just over the SE limb, as a large Hkx sunspot. The following day it was further onto the disc, and it could be seen that it was an isolated large penumbral sunspot, with an area of 1,050 millionths. The umbra was elongated and sported a light bridge between the larger leading umbral area and a smaller follower on Jul 9. There was also a small retinue of pores forming around the outer edges of the sunspot. The group reached the CM on Jul 12 with the light bridge clearly seen. It progressed into the SW quadrant accompanied by sporadic pores. On Jul 16, the group was still described as 'impressive', with the light bridge across the umbra persisting. A small penumbral sunspot was also forming immediately south of the main penumbral area. The group reached the SW limb on Jul 18.

AR3372 (a & b) N25°/274° & N26°/262° rotated over the NE limb on Jul 11 as a large penumbral sunspot. The following day, more sizeable sunspots could be seen with faculae in between. A large penumbral sunspot followed the leader over the NE limb, the group being type Eko. The east-west length of the group was estimated at 510,000km on Jul 15. Over the next few days, the penumbral follower changed shape, becoming highly irregular and showing signs of breaking up as the group crossed into the NW quadrant on Jul 18. In the coming days, any intervening pores faded, and the group not only lengthened to type F, but the leader and follower drifted apart by more than 10° of longitude, defining each component as a separate sunspot group under BAA rules – hence the designation of AR3372a for the leader and AR3372b for the follower (the group received only a single Boulder number). On Jul 20, the leader was a large Hkx sunspot with an area of 370 millionths, but it reduced to type Hax when close to the limb on Jul 23. The follower comprised a few small penumbral sunspots, with an area of 230 millionths, before decaying into a Bxo sunspot group on Jul 23.

AR3373 N09°/246° rotated over the NE limb on Jul 14, type Dao. The group matured over the coming days, with a large irregular penumbral sunspot forming mid-group on Jul 17. Over the next two days, this configuration changed to produce a large asymmetrical follower, another large asymmetrical sunspot preceding it with pores, and a small penumbral sunspot further west, leading. On Jul 20, the group was type Ekc and had an area estimated as 710 millionths on Jul 21. Again, the largest sunspot was the follower, with smaller penumbral sunspots in the middle and leading positions. By Jul 23, the group had reduced to type Eac with an area of 390 millionths and it continued to decay as it approached the NW limb. The group was last seen on Jul 26, close to the limb as a single Hsx sunspot.

AR3376 N24°/228° formed in the NE quadrant not far from the limb on Jul 16, and was notable as it displayed reversed polarity for Cycle 25. The group was fairly insignificant until Jul 18, when it underwent an outburst in activity and developed into a Dso-type group, consisting of two penumbral sunspots aligned north/south with a few pores between. Over the next few days, the southern sunspot grew, the dual umbra coalescing into a single penumbral sunspot by Jul 21. As the southern sunspot matured, the northern decayed and faded altogether by Jul 22. The group looked to be diminishing, but on Jul 24, small sunspots developed to the east and south of the penumbral spot. The following day, the group underwent rapid growth again and was type Dai on Jul 25. It was last reported on Jul 26, nearing the NW limb and consisting of three small penumbral sunspots in close formation.

AR3377 S08°/199° rotated over the SE limb on Jul 18 as a bipolar Dso group with a dumbbell-type appearance. The group changed very little as it progressed across the disc, measuring 360 millionths in area on Jul 21 and reaching the CM on Jul 23. As it crossed the SW quadrant, the follower seemed to catch up with the leader and formed a close compact group by Jul 26. The group was last seen on Jul 29 close to the limb, with the appearance of a single Hax sunspot; foreshortening was possibly responsible for this view.

AR3379 N16°/169° rotated over the NE limb on Jul 19, type Dso. Several followers could be seen on the following day and the group was type Eac with an area of 470 millionths on Jul 21. The group was type Fho on Jul 22, the largest penumbral sunspot being the leader with several smaller followers extending eastward. These followers started to fade on the following days, giving the group a sparse and extended configuration. On Jul 26, SWPC renamed two of the followers AR3382 and AR3383. By Jul 28, only the original AR3379 remained, being a single Hsx-type sunspot. This remained the case until the end of the month, when the group reached the NW limb on Jul 31.

AR3380 S11°/123° rounded the SE limb on Jul 23 as a single Hsx sunspot. A few pores accompanied the penumbral sunspot over the coming days and on Jul 28 & 29 these smaller sunspots multiplied, primarily to the northern edge of the group. On Jul 30, some of these smaller spots began to grow and by Jul 31 the group was type Dkc; the northern

area now comprised a large extended asymmetrical penumbral sunspot with the smaller twin-umbra sunspot to its south.

AR3386 N12°/091° was seen over the NE limb on Jul 26, comprising of two small faint sunspots. The group grew rapidly overnight and sported a penumbral leader and smaller penumbral follower with a few pores between. There was rapid development again overnight, with the follower extending into a large irregular penumbral sunspot, type Dki. This follower sunspot broke up on Jul 29, changing the designation to Dac, with an area of 360 millionths. The largest sunspot was now the penumbral leader which became more elongated on Jul 30. The group crossed the CM on Jul 31, type Eki.

26 observers reported a quality number of Q = 25.55 for July.

H-alpha

Prominences

16 observers reported a prominence MDF of 7.54 for July.

On Jul 3, a curved pillar prominence was reported on the SE limb and a faint, but quite long pillar was on the NW limb. This latter feature had a detached plasma cloud to the northern edge.

A small flame-type prominence was on the NW limb on Jul 5, which lengthened to a thin pyramid shape on Jul 6 and persisted through to Jul 8.

An arc-type prominence was on the E limb on Jul 9, before consolidating into a flame-type feature on Jul 10. It then rotated onto the disc.

On Jul 13, an arch prominence rising to about 50,000km was on the NE limb and a spray-type prominence was reported on the NW limb.

A cloud of plasma was seen reaching about 120,000km in height on the E limb on Jul 15. Also, a flat arch prominence was on the SE limb, about 50,000km in length and 20,000km high. A forked prominence was seen rising to about 40,000km on the NE limb.

An active prominence was observed on the W limb on Jul 17, in the proximity of AR3363; various changes in shape were noted.

A large tree-type prominence was reported on the NW limb on Jul 19 and a detached prominence was seen on the W limb on Jul 21.

On Jul 22 a long, extended prominence hearth was seen on the NE limb, consisting of at least six elements. A smaller prominence was further south, with a detached element at the tip. The extended prominence hearth endured in various shapes through to Jul 24.

A hedgerow prominence graced the S limb on Jul 26 and a moderately sized prominence was also seen on the NW limb, with part of the prominence detached.

A spray prominence was reported on the SE limb on Jul 29 and a hedgerow prominence was on the NW limb, extending for about 120,000km and 15,000km in height.

On Jul 30, an inclined pillar prominence was reported on the NW limb with a length of about 80,000km.

Bipolar magnetic regions, filaments & plage

15 observers reported a filament MDF of 10.19 and 12 reported a plage MDF of 6.89 for July.

At the start of the month, a long, dark filament underscored AR3359, measuring about 200,000km long on Jul 1. Over the coming days, the filament faded in strength and turned to a more north/south configuration to precede the group. It had dissolved by Jul 6.

On Jul 6 & 7, a bright plage area was seen in association with AR3363, following the sunspot, with the chromosphere taking on a whirlpool-like appearance around the group. Plage remained with AR3363 throughout its passage. A filament was seen in association with the sunspot to its southern side, also throughout. The filament had a distinctive forked shape on Jul 9 & 10.

A curved north/south-aligned filament appeared over the NE limb on Jul 10; this eventually preceded AR3372 which rotated over the limb on Jul 12. The filament persisted throughout its passage across the disc, darkening on Jul 18 before fading on the disc after Jul 19 near the NW limb.

A very large BMR was associated with AR3372 on Jul 15, extending westwards. Its east/west length was about 510,000km and it was about half that north/south. An equally interesting BMR was associated with AR3371 in the SE quadrant, with a small dark filament on its northern edge.

A dark curved filament appeared in the NE quadrant not far from the limb on Jul 20 and persisted through to Jul 22. An even larger and darker curved filament appeared over the NE limb on Jul 25, preceding AR3386 near its lower extent. It was of a dramatic appearance over the next few days but was absent on Jul 29. On Jul 26, another dark north/south-aligned filament was close to the SW limb and a fine fila-prom graced the SE limb.

CaK

Two large areas of CaK emission developed around sunspot groups AR3372 and AR3379. The former was within a long-lasting and large area of CaK from Jul 15 to Jul 23. The second was within a very large area of emission from when it was first seen on Jul 20, just over the NE limb, to the end of the month as it approached the NW limb.

CaK MDF 8.63 (19 days; observer Brian Mitchell).

Flares

Numerous flares were reported by Section members. M-class events were reported as follows:

Brian Halls, Jul 12 (a large surge prominence and flare developed within a follower sunspot of AR3372 at 08:45 UT, subsequently rated M6.8). Andrew Johnston, Jul 11 (M1 flare, AR3372, near NE limb, 16:10 UT) and Jul 15 (M3 flare, AR3363, 07:40–07:50 UT). Andy Devey, Jul 16 (M1 flare, AR3363, 08:44 UT), and Jul 31 (M2 flare in SE quadrant, 09:11 UT).

The display on the night of 2023 Jul 18/19, imaged from Rousay, Orkney. *(Callum Potter)*

Aurora & Noctilucent Cloud Section

Auroral & noctilucent cloud activity 2023 June 19 – August 18

Sandra Brantingham
Director

With coronal mass ejections and sunspot numbers regularly in triple figures, the odd X-class flare and several coronal holes, the Sun is out of minimum, and activity is climbing faster than anticipated. The dark sky is starting to return up north as the nights get longer. Aurora sightings over this period are at five, and noctilucent cloud (NLC) sightings are at 77.

Aurora

In late June, there were two G4-class storms, three R1-class storms and no sightings.

July had five G1, twenty R1, two R2, one R3, six S1 and one S2-class storms, and four observations. The first was by Ray Taylor from East Yorkshire on Jul 7/8. The next was by Nick Quinn on Jul 15/16 from Steyning, W Sussex. Ray Taylor saw it again on Jul 20/21 from East Yorkshire, and the last was from Denis Buczynski in Tarbatness on Jul 25/26.

Early August saw one G3, five R1, one R2, two R3 and one G3-class storm, and one observation, by Denis Buczynski from Tarbatness on Jul 7/8.

NLC

The northern season has continued, but much quieter this year. The weather satellite NOAA-21 is having some problems, so there was a gap in information from Jul 19 to Aug 13. There were 77 sightings from 38 observers (see list at right).

There was one sighting on Jun 19/20, five on Jun 20/21, one on Jun 23/24, eight on Jun 25/26 and three on Jun 29/30, making a total of 18.

There was one sighting on Jul 1/2, two on Jul 3/4, one on Jul 4/5, 10 on Jul 5/6, seven on Jul 7/8, two on Jul 9/10, seven on Jul 11/12, two on Jul 12/13, 11 on Jul 13/14, one on Jul 15/16, one on Jul 16/17, seven on Jul 18/19, one on Jul 19/20, one on Jul 23/24, one on Jul 24/25, three on Jul 25/26 and one on Jul 27/28, making a total of 58.

At the time of writing, just one sighting has been received in early August, and that was on Aug 1/2.

General

The use of the NOAA-21 polar-orbiting satellite for noctilucent-cloud observation is a godsend, even if the data are a bit difficult to read. They seem to come only a day late so tracking should be easier.

Sightings from NLCnet are not included in this report.

There is a site for those of you who are out of range of the aurora. It is a webcam (**bit.ly/3ffFAA7**) operated by the Shetland tourist board that looks north and, if there is no cloud, will give a good view of any aurora or noctilucent cloud. In addition, they have added two more cameras further north specifically for the aurora. These are at **bit.ly/3Ghkg9j** and **bit.ly/3w2vfBl**. I have also discovered a very good live cam on YouTube, called Lofoten Live Aurora Cam. It seems to be blessed with good weather.

Thanks go to Prof Cora Randall, Dr Lynn Harvey and Matt DeLand for all the help and information they have supplied to the Section, and to all the observers who have contributed. I would ask you to keep sending in those reports to **sandra-b@hotmail.co.uk**.

Observers of noctilucent cloud, 2023 June 19 – August 18

Observer	*Location*
George Anderson	Wokingham
Sandra Brantingham	Glenbarry
Steve Brown	North Yorks
Denis Buczynski	Tarbatness
Gerry Doherty	Loch Lomond
Terry Evans	Crowcombe, Somerset
Arthur Fenteman	Medway
Dominique Ferrand	London
Pam Foster	Pitlochry
James Fraser	Alness
David Frydman	London
June Gilchrist	Dundee
Mark Green	North Wales
Jim Henderson	Torphins, Aberdeenshire
Nick James	Chelmsford
Alan Kennedy	Castletown, Caithness.
Ken Kennedy	Broughty Ferry, Dundee
Richard Livingstone	Abergele
James MacKintosh	Cromarty
Alastair McBeath	Morpeth
Ramsay McIver	Edinburgh
Sheila McIver	Edinburgh
Daniel Mehta	Newbury
Arthur Missira	Crewe
Pete Mugridge	Epsom
Mick Nichols	Sheffield
Callum Potter	Orkney
Nick Quinn	Steyning, W Sussex
David Rees	Rye
James Robinson	51°N
Ian Ross	Kintore
Graham Rule	Edinburgh
Tor Schofield	Galten, Denmark
Pete Sherman	Fochabers
David Small	Kelso
Roger Stapleton	St Andrews
Alan Tough	Elgin
Thomas Wocial	London

Noctilucent cloud on the night of 2023 Jul 11/12. *Left:* Imaged from from Edinburgh by Graham Rule. *Right:* Steve Brown captured the view from North Yorkshire at 00:09 UT.

From the *Journal* Archive

John Chuter
Archivist

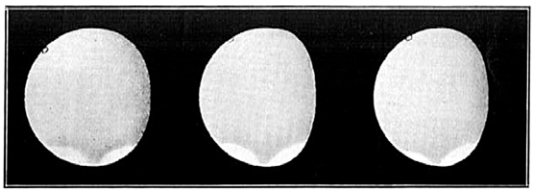
On 2023 Nov 9, there will occur an occultation of Venus by the Moon. This will be visible over much of Europe around 10:30 GMT. Although it takes place in daylight, it will be possible to observe with optical aid. More information can be found at **bit.ly/3Roxjyg**, Dominic Ford's very useful In-the-Sky website. No doubt observations of this will appear in a future *Journal*.

As might be expected, there are hundreds of references to Venus in the *Journal*s from 1890. I tend to use the equivalent month's *Journal*s at 25-year intervals for these pieces. Looking at the 1923 October issue also reminded me of the value of the index produced annually for each volume of the *Journal*. This led me to the 1923 January issue, which had a report by W. H. Steavenson, a former President, entitled 'Observations of Venus, 1922' where he describes white markings on Venus, with the accompanying observations shown here (*right*).

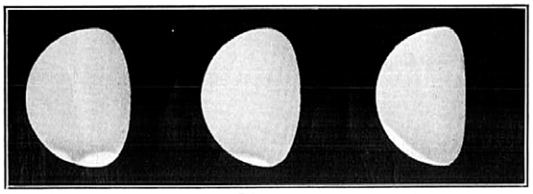
The 1948 October issue has two items I want to mention. One is, to me anyway, a tortuous piece (*below right*) about which I cannot really comment! The other (*below left*) is another index reference, to Venus occulting a star – rather than being occulted – in the 1948 August issue.

The 1973 October issue has a report by J. Hedley Robinson, then Director of the Mercury & Venus Section, on the elongation of Venus in 1972 August. There is a lot of interesting detail regarding the various observations of Venus, with accompanying observational drawings (*bottom left and right*), taken by several notable past members of the BAA. I recommend looking up the report.

VENUS. 1922.



May 7. June 6 June 12.



June 19. July 20. Aug. 7.

As observed in a 6-inch Refractor by W. H. Steavenson.

Venus Occults a Star

Many of the smaller Astronomical Societies maintain the interest of their members by the circulation of a duplicated periodical. Many of these productions—all too often, it must be said, a real labour of love—reach a very high standard, and among such must be numbered "The Strolling Astronomer". This is the magazine of the Association of Lunar and Planetary Observers, and is published under the Editorship of our member Walter H. Haas, in Albuquerque, New Mexico. This excellent production is largely devoted to the observations of members, and in Volume 2, Number 5, three pages are devoted to the observations of an occultation of a star by the planet Venus.

The prediction of this occultation of 36 Arietis was made by Mr. Arthur Burnet in *Journal B.A.A.*, **58**, 28, and considerable interest was aroused in the Eastern States of America. Conditions on the night of March 19 were, however, poor, and haze and cloud prevented some observers from following the occultation. Only six observers are quoted by Haas as being able to follow the star right up to the dark limb of the planet. The instruments used varied from 6 to 10 inches, with powers from 120 to 250. The view was again confirmed that small instruments are not suitable for this class of work, while none of these observers was able to see the reappearance of the star from the bright limb. Exact times are given in three cases:—$2^h\ 40^m\ 34^s$ at Long Beach, Cal.; $2^h\ 39^m\ 56^s$ at Lawrence, Kansas; and $2^h\ 39^m\ 03^s$ at Kimberley B.C., Canada. The first of these is by our member T. R. Cave, Jr.

Four of the six observers noticed a fading of the light of the star before actual occultation, while a fifth suspected it; also two of them found a reddening of the light of the star. Thus once more the effect of the atmosphere of Venus has been demonstrated. Haas quotes at some length the observations of Antoniadi and others in 1910 (*A.N.*, 4435) on a similar slow fading of the light of a star during an occultation by Venus. There are a number of descriptions of this kind in the literature, and Mr. Haas and others might well refer to Campbell's description of the occultation of 7 Aquarii on 1918 March 2. Both disappearance and reappearance were observed with the 36-inch Lick telescope (*Pub. A.S.P.*, **30**) and the results fully confirmed those of 1910.

Observational work of this kind is of the greatest importance, and Mr. Haas and his fellow-observers are to be warmly congratulated on their results.—J. G. Porter.

Lt.-Col. Shortt's Theories

Lt.-Col. Shortt (*J.B.A.A.*, **58**, 192) still persists in his belief that a 365 day calendar did not exist before the Hyksos period, suggesting that the months of the civil calendar did not consist of 30 days. But at the period of the Twelfth Dynasty or near it the inscription to which I previously referred (*J.B.A.A.*, **58**, 153) showed that from the 26th of the 10th month to the 25th of the 12th month comprised two lunar months, from the 25th of the 12th to the 20th of the 1st month one lunar month, and from the 20th of the 1st month to the 16th of the 9th month eight lunar months. Obviously, therefore, at the time with which we are chiefly concerned in this discussion, the civil year consisted of 12 months of 30 days each and 5 extra days.

As regards the record of Uni, Lt.-Col. Shortt's allocation of the date of low water to January is completely at variance with the view previously expressed by him (p. 210) that the record was dated in the 11th month of a year beginning in November. In other words if he really now dates that record to January, the calendrical theory which he adopted must be abandoned.

As for his assertion that Fotheringham on page 43 of *The Venus Tablets of Ammizaduga* "fully endorses" what was written* by Schoch on page 105, I can only remark that Lt.-Col. Shortt's interpretation of the English language differs considerably from that of other people, and I would invite his attention to the terms of the Preface where it is clearly stated: "Although Dr. Fotheringham acknowledges considerable assistance from Herr Schoch, neither is responsible for the views of the other".—Duncan Macnaughton.

* Actually Schoch's statement relative to the observation of the sixth year was first published in 1924 and Fotheringham's subsequent careful examination of five different solutions of the Tablets (including Schoch's two possible solutions) would not have been made, by him, if he had accepted Schoch's dictum as final.

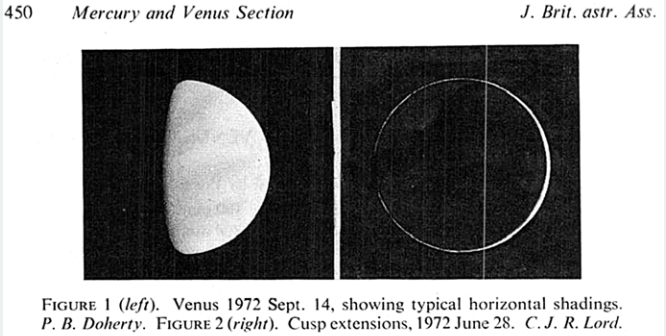


Figure 1 (*left*). Venus 1972 Sept. 14, showing typical horizontal shadings. *P. B. Doherty.* Figure 2 (*right*). Cusp extensions, 1972 June 28. *C. J. R. Lord.*

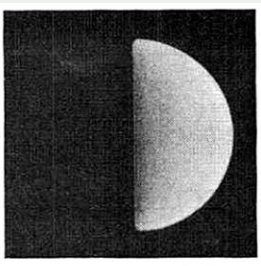


Figure 3. Limb brightening, 1972 Aug. 30. *M. V. Gavin.*

Equipment & Techniques Section

Imaging Jupiter

David Arditti
Director

Jupiter is at opposition on Nov 3, and this will be the best opposition for UK observers since 2015, with the planet above 50° in altitude at culmination from the south of England. Hence, I thought this would be a good time to write something about imaging it.

Imaging of the planets at high resolution is a complicated pastime that I can only sketch out here, describing my own current methods, which are similar to those used by many other observers, though everyone has their own slightly different procedures. Hence what I write here should be taken just as a starting point for personal experimentation and further research.

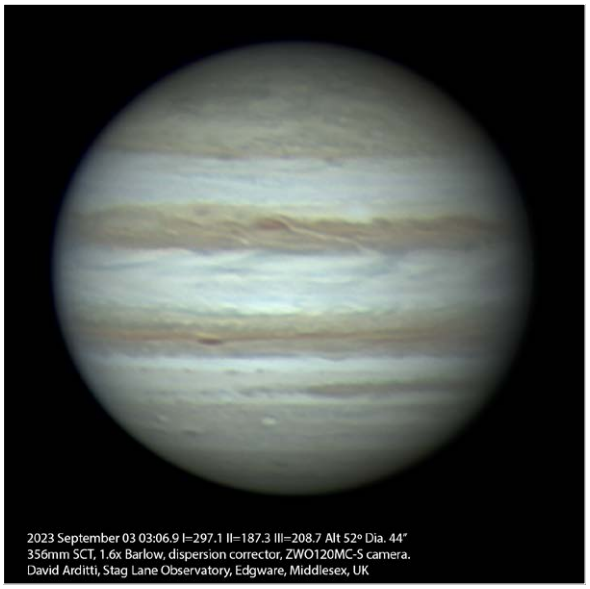


Figure 1. Final image, stacked and derotated from 10 video files taken over seven minutes, rendered with planetographic north up, then further sharpened, adjusted and labelled in *Photoshop*.

Hardware

High-resolution planetary images are nearly always taken with reflecting or catadioptric telescopes, of various designs, over 250mm aperture. The reasons refractors are not so successful in this field are mainly that the apertures are too small (limiting both theoretical resolution and image brightness), image scale is probably too small, and chromatic aberration is an issue. Mountings are much less critical for this work than they are for deep-sky imaging, and anything reasonably stable and free from backlash will work, but without a drive you will struggle to find and keep the planet on the detector at a large image scale, and an accurate drive is certainly very helpful.

In the field of planetary (i.e. fast-frame-rate video) cameras, you have a choice between monochrome and colour. If you intend, as most people do, to create colour images (for Jupiter is a highly colourful object) you either take them 'in one go' with a colour camera, or in three stages with a mono camera and RGB filters. There is some argument that the RGB process gives better results, but with Jupiter above 50° altitude – making atmospheric dispersion (the vertical smearing of detail by the prism-like property of the atmosphere) small – and with sufficient over-sampling (that is, making the image large enough that the smallest resolved details cover quite a few pixels), I doubt you will notice much difference. The one-shot colour process is far simpler and less time consuming, so it is that which I will cover here. Often used in conjunction with a colour camera is the useful accessory of the atmospheric dispersion corrector (ADC). I need not explain this further here, as the ADC was fully covered by Martin Lewis in the Equipment & Techniques pages of the *Journal* previously [**131**(5 & 6)].

The optimal image scale, I suggest, is up to 500 pixels to the diameter of Jupiter, which, with 3.75-micron pixels, works out as a 1.9mm image, or 26 arcseconds per mm. The required focal length is 20,6265 divided by this number: that is, about 8m. Hence with a Celestron 14 (natural focal length about 4m), you will still need a ×2 amplification with a Barlow or Powermate lens. You can repeat these calculations for your own equipment to get an idea of what you need, but there is no substitute for practical experimentation, as every combination produces different results. Bear in mind you can vary the image scale by changing the Barlow-to-chip distance.

There are an awful lot of colour cameras on the market that will produce good results. Popular current choices amongst leading imagers are the ASI 224MC, ASI 462MC, ASI 662MC, QHY 5III462C and the Player One Mars-CII and Uranus-C cameras.

Image capture

If there is lots of choice in telescopes and cameras, pretty much everyone seems to use the same image capture software: the excellent free

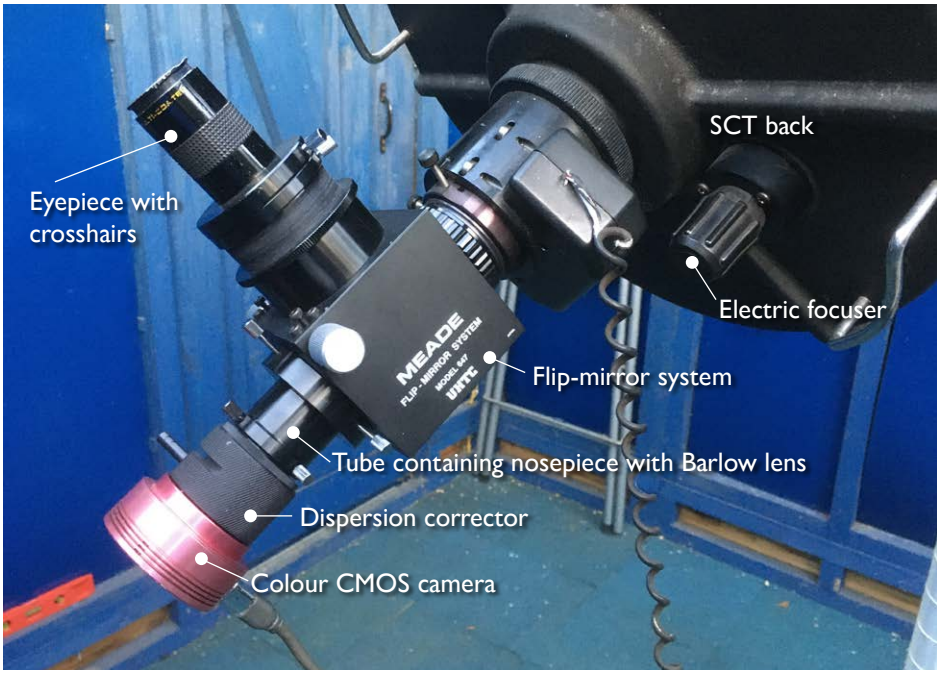


Figure 2. Imaging system on the back of the author's Celestron 14.

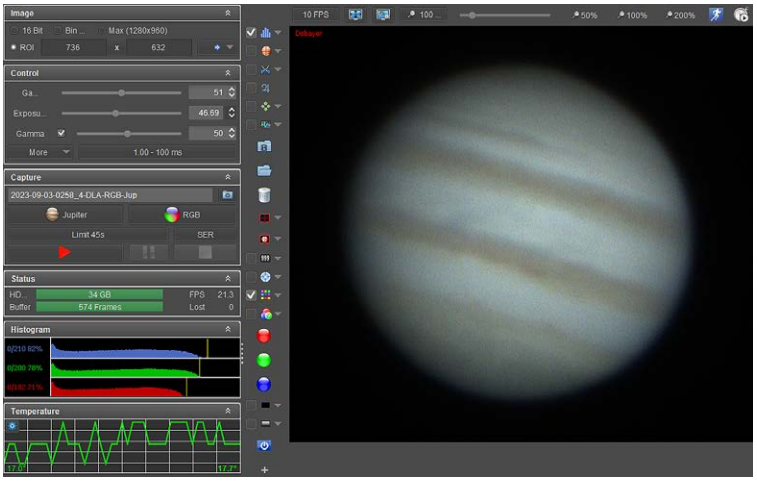


Figure 3. Screenshot of the livestream from the camera as seen in *FireCapture.*

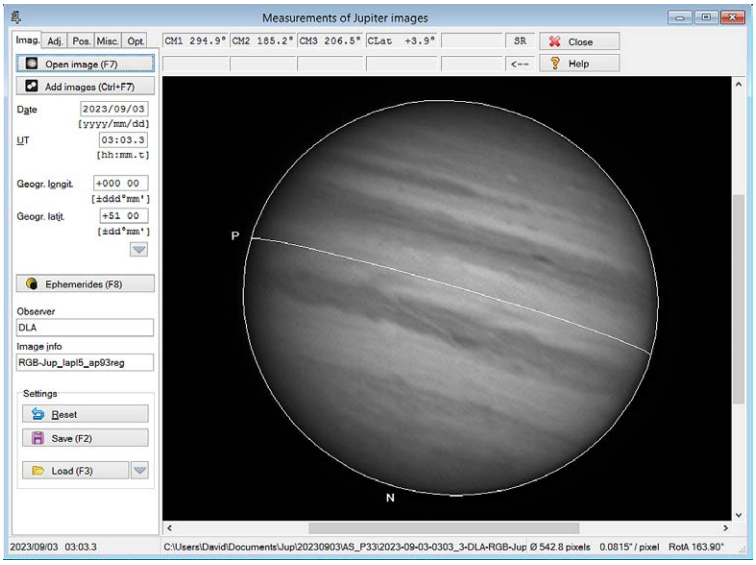


Figure 5. Fitting the outline of the disc ('measuring the image') in *WinJUPOS.*

FireCapture, available for all leading operating systems (though you also need to check if your specific camera is supported by the operating system). *FireCapture* supports a vast range of cameras, and does everything that planetary imagers want, allowing control of exposure, gain, region of interest, etc.; handling automation of imaging runs; and file naming that facilitates subsequent stages of processing. The software displays the useful information of the live histogram: that is, the graph of brightness levels triggered in the camera (Figure 3). I recommend gain and exposure combinations that cause the levels to be 70–80% used up. Lower causes a noisy image and provides insufficient information for the stacking software to work optimally; higher risks 'burn out' in subsequent stages of processing.

The most important specific issue we face with Jupiter imaging is the rapid rotation of the planet. In general, more data is better, hence longer videos are better, but the features move at 45,000km per hour, which converts, at our distance, and at the suggested image scale, to 158 pixels per hour, or 2.6 pixels per minute at the centre of the disc. Hence a minute of videoing is already undermining the sampling. I find that the optimum length of video is 45 seconds. As we will see, multiple videos can be combined, however.

Processing

There are several stages to the processing of detailed Jupiter images, each, unfortunately, requiring a different piece of software, making the procedure quite time-consuming. The first stage is registration and stacking of the individual video frames, to produce a single image from them. Registration means compensating for the various sources of movement in the image. It is seamlessly combined with the stacking in the widely-used *Autostakkert!* package (also free); there are other possibilities. *Autostakkert!* does only this task, so other pieces of software need to be used for subsequent processing.

Figure 4. Stacked image from a single video, sharpened in *Registax 6.*

Many, including myself, still use the venerable *Registax 6* for image sharpening after stacking, but this is now very slow and needs replacing (Figure 4).

The method of dealing with the rotation of Jupiter is to combine a number of stacked and moderately-sharpened images made from short videos taken over a period of a few minutes. This is done by 'measuring' the images in the (yet again, free) package *WinJUPOS*. The 'measurement' is a procedure of producing a .ims file from an image: the .ims file encodes the latitude and longitude of every point in the image, allowing images taken over time to be correctly merged (or 'derotated'). If you have set *FireCapture* up correctly, it will have included the time in the filename; this is carried through subsequent processing, and *WinJUPOS* conveniently can use this to measure the image. The procedure is fairly manual though – you need to ensure that the outline of the planet that *WinJUPOS* uses correctly reflects the limb (Figure 5). Then you save the measurement file, and another section of the software allows you to combine the measurement files. The final result is a new image file referenced to the mean time of all the video files that went into its production.

If the data were of good quality, this new image file may be sharpened further, and other processing – contrast-stretching, curves (or gamma) adjustment to change the way the highlights or lowlights are differentiated, and colour adjustments – may be made in a general image processing package, or a specific astronomical one. Adobe *Photoshop* is a common choice for this stage. The details of the image capture can finally be placed as text upon the image to maximise its usefulness to the Jupiter Section or other groups that collect these images (Figure 1).

Finally, note that the most critical factors in getting any good planetary image are seeing, collimation and focus. The former cannot be controlled; we have to wait for good conditions, and possibly experiment with different sites. Collimation and focus are a matter of effort, skill and practice. The best images require least processing, and no amount of processing can correct an image that is taken in bad seeing, or with a miscollimated telescope, or which is actually out of focus. Best of luck!

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ABTA V7545

A chronology of some lunar drawings by Galileo Galilei

Giancarlo Favero

By taking into consideration the morphological features along the terminator in some of Galileo's watercolour portraits of the Moon, found among his personal belongings, new datings are suggested for the observations reported in Galileo's *Sidereus Nuncius*, earlier than those proposed by Ewen Whitaker in 1978. The new dates solve some inconsistencies found in Whitaker's paper, and in the literature generally, concerning the first telescopic observations made by Galilei during the last months of 1609.

Introduction

Galileo Galilei, Professor of Mathematics at Padua University from 1592 to 1610, published a 41-page booklet titled *Sidereus Nuncius* ('Starry Messenger'; *Nuncius* from now on) in the early days of March in 1610. The printer, Thomas Baglioni in Venice, reported Mar 8 as the date of issue.

Some tables in the end matter (Figure 1) depict five images of the Moon (two of them, nos. 3 and 4, are identical to each other, probably indicating hasty editing) which are not Galilei's work, as may be immediate realised when comparing his watercolours (Figure 2, *e.g.*, nos. 5 and 4) with the corresponding tables of the *Nuncius* (nos. 2 and 4 in Figure 1). The tables were engraved on copper for printing, likely by a worker of Baglioni, and this can explain the otherwise puzzling fact that in some of the tables a large crater appears (nos. 4 and 5 in Figure 1), which is not clearly delineated in Galilei's watercolours (Figure 2, nos. 4 and 3).

The book can be considered the first example and the template of a modern scientific paper. It begins with a short summary of the content (the Abstract), followed by the description of the instrument used in the observations (the Materials and Methods section). The Main Results part follows, first reporting the observations of the Moon, of some fixed and wandering stars, and of the Milky Way, and afterwards accurately recording the appearance of Jupiter and its 'Medicean Moons' from Jan 7 to Mar 2, in 1610 (the latest observations had clearly been added to the text while it was being printed).

Galilei wrote that the instrument he used to observe the Moon and the other celestial bodies described in the booklet was a refractor (made of a positive objective lens and a negative eyepiece) yielding a ×30 magnification. As for the light-gathering power, Galilei wrote: '*Stellula enim quintae aut sextae magnitudinis, per Perspicillum visa, tamquam magnitudinis primae repraesentatur*' ('a little star of fifth or sixth magnitude, seen with the instrument, looks like a first-magnitude star'). According to the same *Nuncius*, the instrument had been built well after 1609 Aug 25, when Galilei showed to the Venetian government (whose authority Padua University was subject to) an early ×8 version: this means that the observations reported without a date had probably been performed between September and December of 1609.

The purpose of this paper is to propose new dating for some of Galilei's lunar drafts.

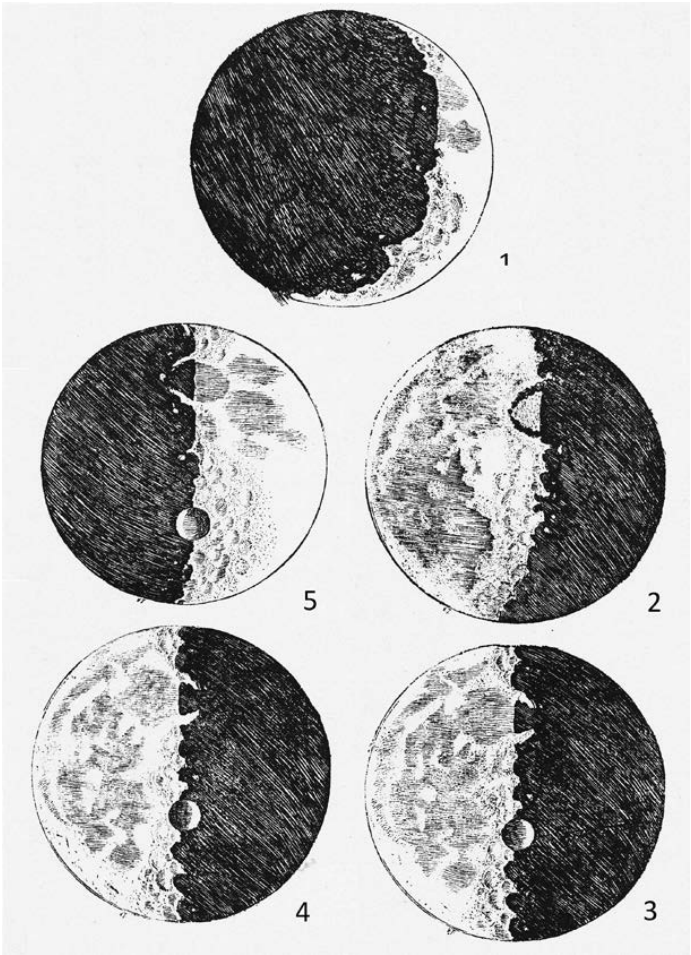

Figure 1. Five depictions of the Moon contained in the end matter of the *Sidereus Nuncius*.

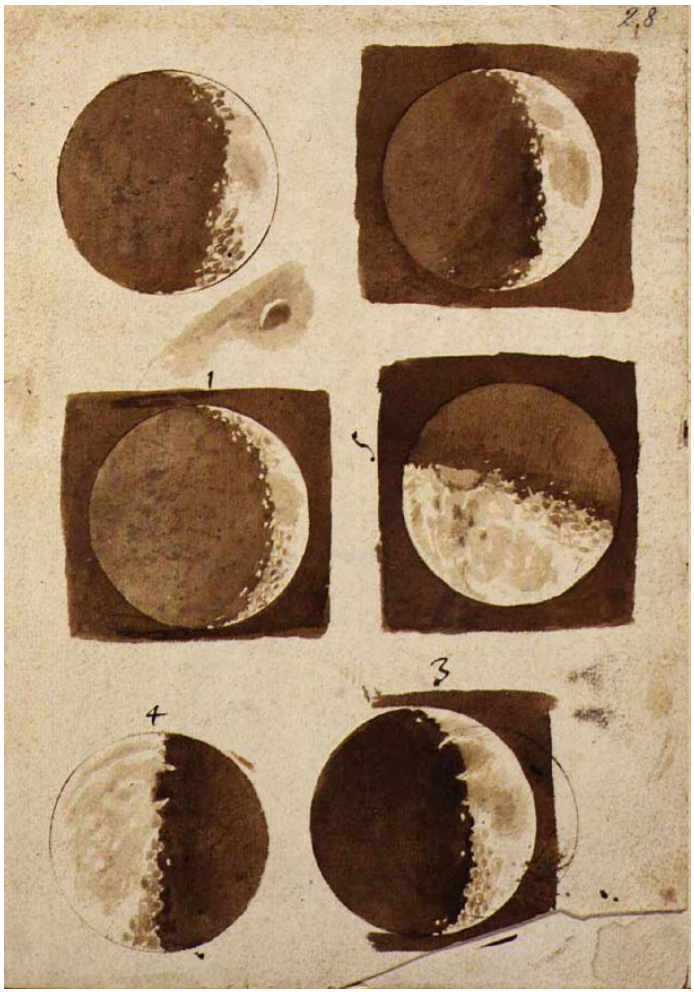

Figure 2. Lunar watercolours by Galileo Galilei.

The observations

After some attempts by different authors to identify the dating of Galilei's drawings, in 1978 a well-documented paper appeared by Ewen A. Whitaker,[1] an English selenographer working in Kuiper's group in the United States after 1960. Whitaker had been an astronomer at the Royal Greenwich Observatory after World War II, and he served as the Director of the BAA Lunar Section between 1956 and 1958.

After estimating the selenographic colongitude in each of Galilei's drawings (both the tables in the end matter and the watercolours found among his personal papers; see Figures 1 & 2) Whitaker used the lunar ephemerides to deduce their dating, thus obtaining Table 1.

Table 1. Dating of Galilei's 1609 & 1610 watercolours (Figure 2) as estimated by E.A. Whitaker[1]

Drawing	*Date & time*
1	Nov 30, 16h
2	Nov 30, 18h
3	Dec 02, 17h
4	Dec 18, 07h
5	Dec 17, 05h
8	Dec 01, 17.5h
8*	1610 Jan 19, 05h

The number 8* refers to Figure 3, where a star reappears from an occultation by the Moon.

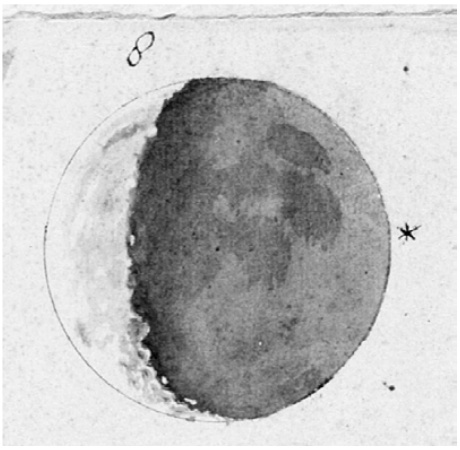

Figure 3. The watercolour 'no. 8*', depicting a lunar occultation of a star.

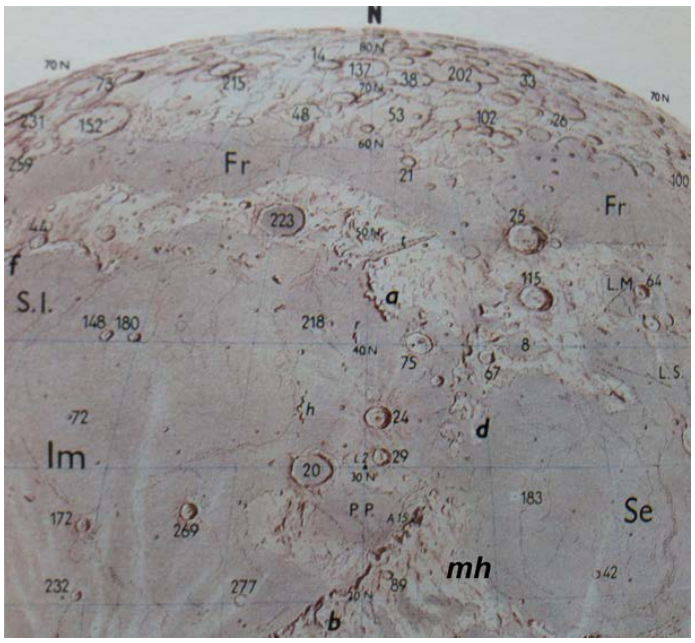

Figure 4. Lunar chart with the locations of key features indicated.

Discussion

Although impressive, Whitaker's analysis is flawed by two significant weaknesses. The first is that Galilei's watercolours were not meant to give a cartographic representation of the Moon, but rather aimed at sketching an idea of the appearance of its rough surface along the terminator. This suggests that evaluating the dating of the drawings should be achieved by taking into consideration, rather than an estimate of the colongitude, the (few) morphological features that can be clearly identified, such as those in the paintings nos. 3, 4, and 5 of Figure 2. A map of the Moon is reported here as Figure 4,[2] which identifies some lunar features with bold letters for the convenience of the reader.

In watercolour no. 3, Mare Serenitatis (Se in Figure 4) is shown partially flooded with light, with Montes Caucasus (*d*) as its north-western edge and Montes Haemus (*mh*) as its south-western edge. In watercolour no. 4, Mare Imbrium (Im) has Montes Alpes (*a*) as the north-eastern edge and Montes Apenninus (*b*) as the south-eastern edge. In no. 5, the western part of Mare Serenitatis

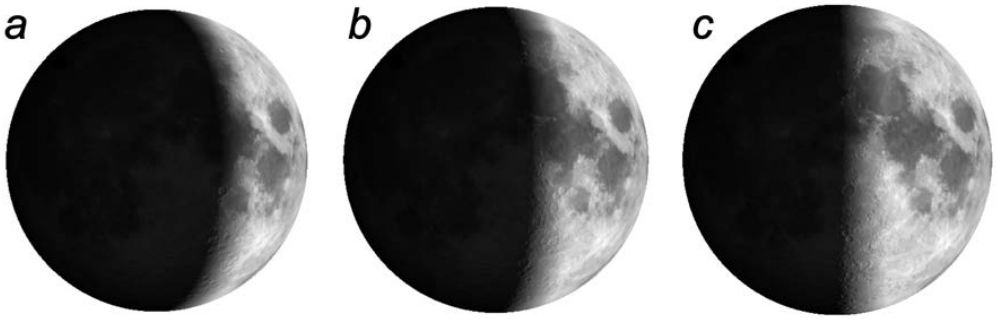

Figure 5. Simulated lunar phases, generated using the software *Virtual Moon Atlas*,[3] for 18h on **(a)** Nov 2, **(b)** Nov 3, and **(c)** Nov 4.

(Se) is bordered to the north by Montes Caucasus (*d*) and to the south by Montes Haemus (*mh*). The massifs near the terminator probably looked exaggeratedly prominent to Galilei, because of the light diffusion by the hand-polished lenses of his instrument.

A simulation of these features generated with *Virtual Moon Atlas* software (Figure 5b) shows that the configuration of watercolour no. 3 (Figure 2) can only have occurred on Nov 3, 18h. On Nov 2 or 4, 18h, the terminator is significantly different to that recorded by Galilei (Figures 5a & c, respectively). Given the duration of 29.5 days of the lunar phase cycle, in early October and December of 1609 the terminator would be compatible only if the observations had been done about 12 hours earlier or later than 18h, and thus with the Moon in full daylight or under the horizon.

Figure 6 shows a terminator like that in watercolour no. 4 on Nov 18, 00h. Figure 7 shows a terminator like that in watercolour no. 5 on Nov 16, 23h. Times in *Nuncius* were expressed by Galilei in Italic hours, measured between two successive sunsets, the interval being divided into 24 equal parts. To do the simulations, they are expressed as UT+1h.

Another weak point in Whitaker's analysis is the identification of the star reappearing from the occultation in watercolour no. 8* (Figure 3), which he deemed to be theta Librae. This is puzzling for two reasons. First, it would be surprising for Galilei to have accomplished a Moon observation at the time of such an occultation, which occurred in the early hours of 1610 Jan 19: according to the accurate diary reported in the *Nuncius*, Galilei was observing Jupiter and its moons both in the early hours of Jan 18 and between 19 and 22h on Jan 19, and no lunar observation is reported on those nights. Secondly, the star in watercolour no. 8* is depicted as a simple six-pointed asterisk, but this is inconsistent with the stellar maps of the *Nuncius*: since theta Librae is a magnitude 4.1 star, it is reasonable to expect that Galilei would draw it as a polygonal six-pointed star, just like he did elsewhere for stars with similar magnitudes (see, for instance, Taygete, magnitude 4.3, in his map of the Pleiades, Figure 8).

Figure 6. Simulated phase for Nov 18, 00h (compare with Figure 2, watercolour no. 4).

Figure 7. Simulated phase for Nov 16, 23h (compare with Figure 2, watercolour no. 5).

Figure 8. Galileo's map of the Pleiades, with apparent magnitudes noted.

With the software *Guide*,[4] it is possible to find that an occultation by the Moon of SAO 119008 (magnitude 8.55) terminated on Nov 20, about 3 o' clock, with the Moon at 10° of altitude. Since his Pleiades map contained stars of magnitude 8.41 and 8.82 (Figure 8; data from *Guide*),[4] Galilei was certainly able to observe a star of magnitude 8.55, even in the presence of one magnitude of atmospheric absorption.

Conclusions

The second column of Table 2 collects the new dating proposed according to the considerations described.

If accepted, such dating would set Galileo's observations of the Moon entirely in 1609, between the end of October and the end of November (or possibly early December). Note that this conclusion fully agrees with Galileo's statement that '*ac Lunam prius* […] *Post hanc, Stellas tum fixas, tum vagas*' ('first I looked at the Moon […] After that, I observed […] the Stars, both fixed and wandering').

As for the other drawings, consider that, in the introduction of the *Nuncius*, Galilei writes '*Nunc observationes a nobis duobus proxime elapsis mensibus habitas recensemus*' ('We now expose the observations we made in the last two months'): it seems that such a sentence cannot refer to the printing time of the *Nuncius* (early March of 1610), because this would place all of the observations in January and February of 1610. Whitaker agreed with this conclusion,[1] and suggested the *Nuncius* to be written around 1610 Jan 15, so that the observations reported would date to 1609 November and December.

The tentative dates for the remaining watercolours, collected in the third column of Table 2, are estimated with the same simulation software cited earlier,[3] and in compliance with the time period identified here.

Table 2. Newly suggested dating of Galilei's watercolours (Figures 2 & 3)

Drawing	*Proposed date & time*	*Estimated date & time*
1		Oct 31, 18h
2		Nov 01, 18h
3	Nov 03, 18h	
4	Nov 18, 00h	
5	Nov 16, 23h	
8		Dec 01, 18h
8*	Nov 20, 03.1h	

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Brightness variations in R CrA & NGC 6729 during 2021

Terry Evans & Grant Privett

An indicative luminance light curve for R CrA created from data collected during 2021 showed a brightness range between magnitudes 10.6 and 13.2, when using *Gaia* DR2 g-band comparisons. The light curve was more consistent with the established 65.767-day period than during 2019 to 2020. Most of NGC 6729 was found to vary in brightness in a manner consistent with light echoes. Evidence for light echoes was detected 52.1 light-days, or ~9,030 astronomical units, away from R CrA. Tentative evidence for the position of the other lobe of NGC 6729 is presented.

Introduction

In recent years, the observation of variable nebulae has become increasingly popular,[1] and digital technology has made it possible to derive useful quantitative results for some nebulae using relatively modest equipment.[2,3] We present herein a further study of NGC 6729 that considers data collected during 2021.

The small, V-shaped nebula NGC 6729 was discovered in 1861 by Schmidt while using the 6.2-inch Plössl refractor at Athens Observatory.[4] Marth later noted that the nebula and star were both variable, with the star varying over a 'short' timescale. This suggestion was later confirmed photographically via images captured between 1911 and 1913 by Knox-Shaw from Hêlwan Observatory,[5] who surmised that there was a relationship between the magnitude of R CrA and the appearance of the nebula.[6]

In a recent study by the authors,[7] the behaviour of NGC 6729 and the illuminating star, R CrA, was monitored using a 203mm TMB refractor similar in aperture to the instrument used by Schmidt.

Figure 1. The Corona Australis molecular cloud, containing the reflection nebulae NGC 6726/7 (middle top) and IC 4812 below it. The fan-like NGC 6729 is to the left of NGC 6726/9 and the globular cluster NGC 6723 is to the right. *(Terry Evans)*

NGC 6729 lies at the edge of a large, dark molecular cloud in which young stars are forming and illuminating the NGC 6726/7 nebulae. The molecular cloud extends over several degrees, but NGC 6729 is a relatively small fan-like nebula, roughly one arcminute long, illuminated by the stars R CrA at its point and T CrA near the open end of the fan. The nebula appears to be a mixture of both reflection and emission components. Within the cloud and surrounding NGC 6729 lies a cluster of infrared sources known as the Coronet Cluster,[8] of which T and R CrA are the most conspicuous members.

The distance to the Coronet Cluster of young stars is 150±4 parsecs, according to a study of potential Gould Belt regions.[9] This value is very similar to the figure of 150±50 parsecs for NGC 6729, determined by Gaposchkin in 1936.[10] However, the star R CrA is, according to the *Gaia* DR2 catalogue,[11] 96 parsecs distant, with the early *Gaia* DR3 release amending that value upward to 125 parsecs.[12] The discrepancy probably arises because R CrA is a triple star shrouded in bright nebulosity.

R CrA is a young star of approximately 1.5M years in age and is reported to be the closest Herbig Ae/Be star, with a spectrum dominated by emission lines.[13] The previous observed variability is over a 65.767±0.007-day period and may arise from the binary nature of the star and the accretion disc.[13,14]

Previous observations by the authors during 2018 to 2020 demonstrated evidence that:[7]

– R CrA only weakly conformed with the 65.767-day variability.

– Parts of the nebulosity close to R CrA, and between it and T CrA, vary in brightness cyclically.

– The amplitude of nebulosity brightness change varies as a function of distance from R CrA.

– There is an apparent relationship between the distance from R CrA and the predicted time of R CrA maximum for some parts of the nebula.

– In some years these relationships are less obvious.

The working assumption was that the brightness changes seen across the nebula are light echoes reflected from the surface of a cone of gas and dust partially swept out by the polar winds from the young star.

We report herein the results determined for the year 2021 and compare the behaviours observed with those previously reported.

The dataset

Images of R CrA and its environs were collected by Terry Evans between March and November of 2021. The instrumentation employed to collect the data remains essentially unchanged from that described in our previous paper.[7] The images were acquired using a TMB203 apochromatic refractor mounted on a Software Bisque Paramount ME4000, with the Astronomik L filtered images collected via a Starlight Xpress Trius-694 CCD camera. The system was hosted at the Riverland Dingo Observatory in South Australia.

Batches of dithered exposures of 60s duration were taken, with refocusing performed after every third frame. Flat and dark corrections were collected and applied for every dataset/night. The images were captured with NGC 6729 at elevations of between 30 and 60 degrees but, in practice, the elevation appeared to make little difference to the amount of detail apparent in the images. Images from 134 nights have been used in this study.

Blind astrometric reduction was undertaken via *Astrometry.Net* to ensure the results were of consistent accuracy.[19] Typically, the mean resultant error was reported as ~1.2 arcseconds – slightly more than one pixel, but only one-third of the width of the typical seeing disc.

Data processing

The data in this study were collected using a luminance filter and were not ideal for absolute photometry. However, previous work had suggested that worthwhile indicative results could still be derived,[3] and it does not seem unreasonable to assume that useful quantitative measurements can be obtained when a consistent telescope/CCD combination is used throughout, due to the elimination of instrument-to-instrument offsets and errors.

Photometric solutions were derived for each image using the *Gaia* DR2 dataset,[12] as well as bespoke *Python* software. Care was taken to exclude saturated or nearly saturated stars from the data reduction, with any star containing a pixel count above 50,000 discarded. Similarly, the 5% of stars with most extreme colour indices (*Gaia* bp-g) were discarded from the analysis. The colour indices seen suggest that large parts of the field of view are significantly reddened.

To test the reproducibility of the photometric approach, aperture photometry was employed against three comparison stars lying close to R CrA. These stars are not reported to be variable.

Measurement of all three stars showed a variance smaller than 0.1 magnitudes. The stars were measured as *Gaia* g-magnitude 14.97±0.05, 13.37 ±0.07, and 14.34 ±0.05. Their *Gaia* catalogue values are 14.46, 13.06, and 13.80, respectively. These values are consistent with those obtained during 2019–2020. Consequently, one of them was employed for differential photometry in this study.

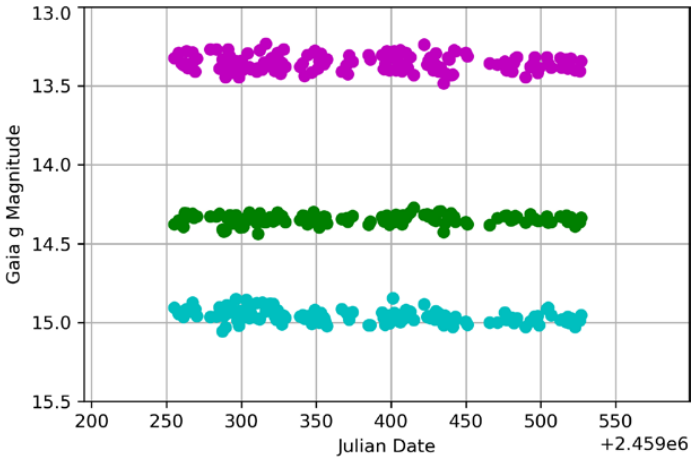

Figure 2. The brightness of three comparison stars obtained using *Gaia* g-band DR2 data as the photometric standard. The data cover the period 2021 March–November.

Results

R CrA photometry

The light curve obtained for R CrA is presented as Figure 3. It varied between magnitudes 10.6 and 13.1. The variations recorded are quite fast – up to 0.5mag per week – with the greatest amplitude variation seen in the first half of the year. There appears to be a diminishing amplitude as the year progresses and a slight dimming. While American Association of Variable Star Observers (AAVSO) observations of R CrA show a secular trend in the variation of R CrA over the last 120 years, the recent variation is not great, so detrending was not attempted.

When the data was folded to generate a phase curve, it was apparent that the 65.767±0.007-day periodicity, described by Sissa (2019),[13] was more obvious in 2021 than during 2020. Also,

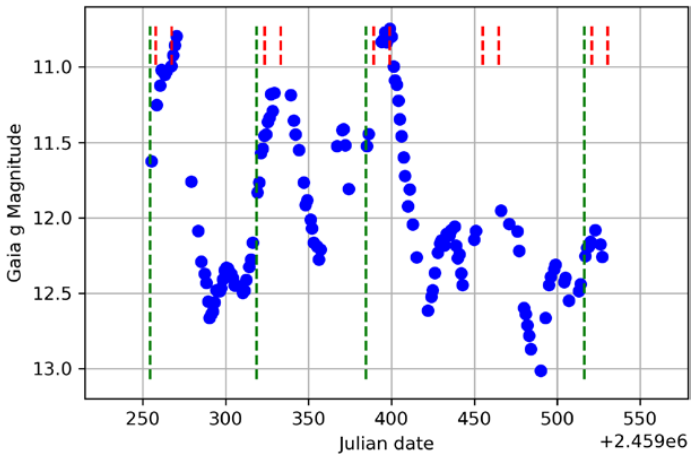

Figure 3. The variation in the brightness of R CrA recorded over the period 2021 March–November.

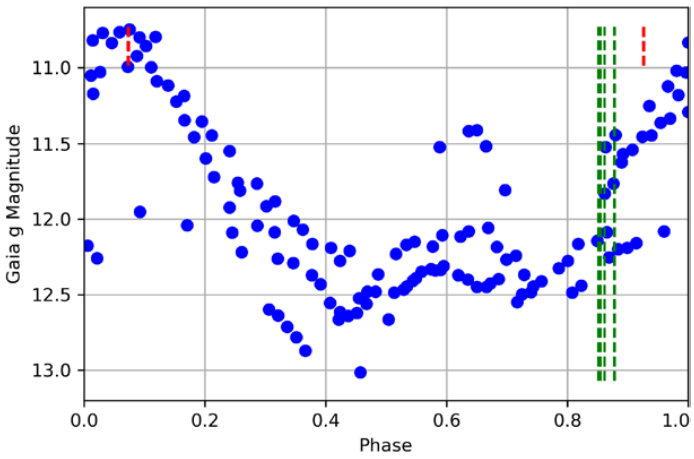

Figure 4. The variation in brightness of R CrA during 2021, folded on a 65.797-day period. The significance of the vertical stripes and markings is discussed later (see text at right).

it was seen that there were several brighter-than-expected observations near the 0.6 phase point. These were also noted during visual assessment of the images. They are again present in the AAVSO data archive.

Nebulosity brightness – qualitative

NGC 6729 retained its overall form throughout the entire period observed. While details did subtly change in brightness or become less obvious, the general form of the nebula was always visible – as is also found for NGC 2261 but is certainly not the case for Gyulbudaghian's Nebula.

Once again, the variations observed typically involved some of the more distinct features (see Figure 5) becoming temporarily easier to see whenever a brightening appeared and spread south-eastward from R CrA toward T CrA and the end of the nebula. The region of brightening moved in a manner consistent with that of a light echo – reappearing at ever increasing distance from R CrA and becoming less obvious as time passed.

The 2021 data were visually inspected and the dates when new features were seen to emerge close to R CrA were noted. The vertical green lines on Figure 4 indicate these events. The red dashes denote the range of dates within which it was predicted that R CrA would achieve peak brightness, if the 65.767-day period was correct and consistent.

With Gyulbudaghian's Nebula and NGC 2261, both lobes of the bipolar flow from the young star are observable in the visible band, albeit quite dimly. In the case of NGC 6729, the north-western lobe is not readily apparent in the stacked image – presumably due to extreme attenuation by the molecular cloud.

Nebulosity brightness – quantitative

Using an approach very similar to that employed in our previous work,[7] an attempt was made to measure the surface brightness of patches of nebulosity within NGC 6729 relative to an in-scene non-variable star that was measured by aperture photometry. We sampled the brightness of NGC 6729 (using a nearest-neighbour approach) at the locations where variations in brightness had been noted, and generated a plot of magnitude versus time.

Because of the unfiltered nature of the imagery, the surface brightness values generated should be seen as self consistent, but not absolutely correct.

It was found that the nebulosity brightness varied in a crudely cyclical manner – strikingly similar in period to that of R CrA, but offset in time and amplitude. Reassuringly, it was apparent that the overall amplitude of these sinusoids was smallest for the features furthest from R CrA. Beyond a distance of approximately 45 arcseconds, the variability amplitude dropped below 0.1 magnitudes and was dominated by image noise. At that distance, the curve fitting solutions became unstable. Attempts using different reference stars gave similar results.

To check for systematic errors, two areas of unassociated nebulosity within NGC 6726/7 that were distant from R CrA were examined for sinusoidal variations. These locations displayed no significant brightness variations.

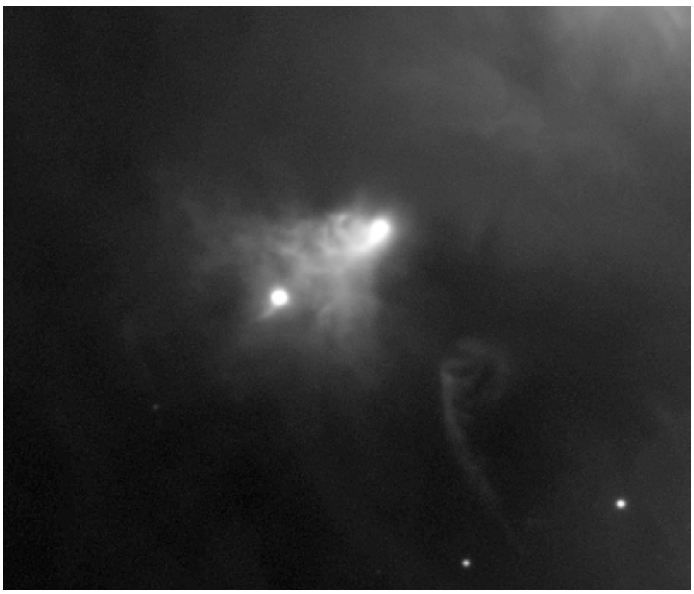

Figure 5. The general appearance of NGC 6729 as derived by aligning and stacking the 134-image dataset. The fainter, hook-shaped HH 100 is seen adjacent. The field is approximately 4×4 arcminutes across.

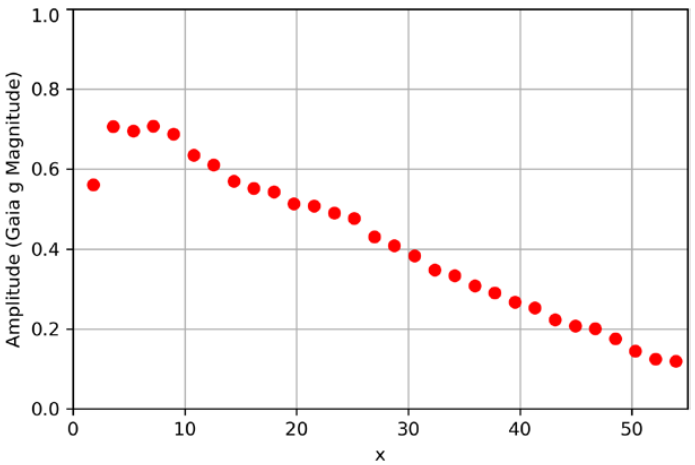

Figure 6. The variation in amplitude of the nebula as a function of distance from R CrA, along a straight line moving outward from R CrA in the direction of T CrA.

Quantitative mapping

The approximately linear relationship found when looking at the nebula along a line between R CrA and T CrA was encouraging, but it was quickly discovered that, when the bearing of the line was varied, the shape of the curve (mainly its slope and smoothness) was not constant. To investigate this more fully, an attempt was made to generate 2-D plots showing the nebula's magnitude, the amplitude of the variation and also the time delay for every pixel within the nebula and across some of its surroundings.

To reduce the impact of statistical outliers and thereby minimise noise in the 2-D plots, each image sample taken was a square of the same width as the typical seeing disc. From this, a median value was extracted. The plots generated can be seen as Figure 7.

The median magnitude plot looks very similar to what was generated when all 134 images were aligned and then combined additively (Figure 5), but it does appear slightly smoothed due to the seeing disc sampling.

The amplitude plot clearly shows that the portions of the nebula that change most in brightness vary by up to 1.2 magnitudes. It also demonstrates that the area varying is smaller than the whole nebula and that some of the nebula is varying in brightness only slightly.

The phase plot demonstrates that the parts of the nebula varying in brightness extend all the way to T CrA and a little beyond, which is over 52.1 light-days from R CrA in the plane of the sky. Also worthy of note is the presence of a patch of sky (below and slightly to the right of R CrA, *i.e.*, west) which appears to contain only dim nebulosity, but which has a distinct phase value offset compared to the background sky. The overall appearance of the phase plot is similar to that of NGC 2261.

Discussion

During 2021, the brightness variations displayed by features within the nebula were relatively simple, and less noisy than was seen during 2020. This difference might be explained if the environment close to R CrA contains obscuring materials that prevent the light of R CrA from continuously, and directly, illuminating the parts of the nebula that we observe, or if interactions are occurring between multiple periods of variability. Young stars are usually intrinsically variable, so two periodicities contributing to the observed behaviour is entirely possible.

Considering Figure 6, it is apparent that the relationship between R CrA brightening and a feature in NGC 6729 brightening remains largely consistent with that of a light echo from dust and gas for much of the nebula. There is a potential problem in that the mechanism that Sissa suggests for the apparent brightening and dimming of R CrA – components of the double star being obscured by portions of the accretion disc – is only plausible if the accretion disc is quite thick and extends to significant elevations above the plane of the disc. However, an e-mail discussion with R. Gratton,[18] one of the authors of the Sissa paper, suggested this would not be unreasonable.

The 2-D plots in Figure 7 showed that most of the nebula varies in brightness – if only slightly – even beyond T CrA. Rudnitskij suggested in 1987 that the structure of nebulae illuminated by variable stars with cyclical variation – akin to R CrA / NGC 6729 – could be probed using techniques similar to those employed herein.[19] However, the interpretation of the data is more challenging than his simple model first suggests. It can be assumed that similar data could be collected for other nebulae that are illuminated by cyclically variable stars. Where clean cyclical variable star behaviour is absent, correlation techniques looking at the delay between the observed behaviour of the star and that of the nebula could be attempted.

The 2-D plots also provided direct evidence for the presence of the other lobe of NGC 6729, slightly to the right (*i.e.*, west) of R CrA. If symmetry was assumed, the lobe might have been expected further anti-clockwise, but it may be that the molecular cloud that R CrA is embedded in is slightly less opaque to the west – permitting some light to escape. Infrared observations would be needed to confirm this contention.

Conclusions

An indicative luminance filtered light curve for the protostar R CrA during 2021 was created. The brightness range was found

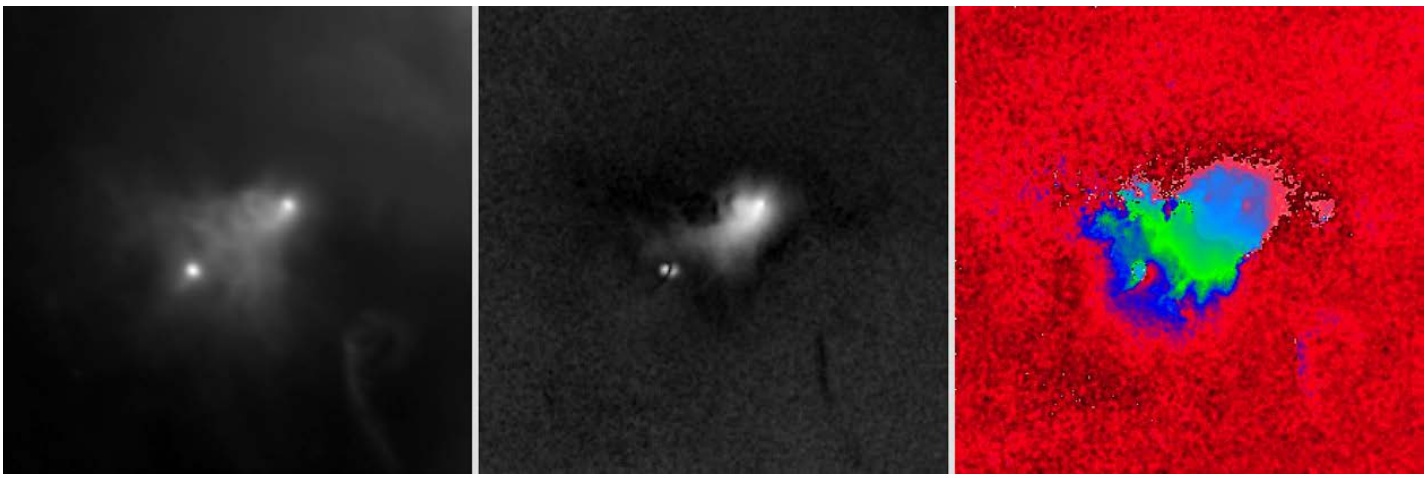

Figure 7. 2-D plots of NGC 6729 and its surrounds, showing (left) the median magnitude of the nebula, (middle) the amplitude of the variation present across the nebula, and (right) phase, a measure of the difference between the brightness changes of R CrA and the individual pixels.

to be between magnitude 10.6 and 13.2, using *Gaia* DR2 g-band data for comparisons. The light curve agreement with the accepted 65.767-day average period was stronger than during 2019 to 2020, especially during the earlier part of the year.

The previously reported nebula variability manifested itself again, with NGC 6729 varying in brightness in a manner consistent with light echoes. The whole nebula was examined and much of it found to exhibit cyclical variation when phase folded on the known period of R CrA. This strongly supports the contention that these variations are directly related to the variability of R CrA, but with the individual response of different parts of the nebula delayed by the additional light-travel time from R CrA. Evidence for light echoes extracted from the phase map of the nebula was detected 52.1 light-days or ~9,030au away from R CrA, in the direction of T CrA.

Evidence for brightness variations, at a very low level, at a location west of R CrA may indicate the location of the other lobe of NGC 6729.

Acknowledgements

The authors would like to thank Dr Raffaele Gratton for his helpful and thoughtful discussions regarding the extent of the accretion disc surrounding R CrA. *Gaia* DR2 and early-release *Gaia* DR3 data was used within the text. The authors would also like to acknowledge the use of the *Astrometry.Net* and *Astropy* software tools in the preparation of this work.

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Noctilucent cloud over Britain & Western Europe, 2022

Ken Kennedy

A report of the Aurora & Noctilucent Cloud Section. Director: S. Brantingham.

2022 Jun 22–23, 00:25 UT. Gordon Mackie, Thurso.

Noctilucent cloud forms in the mesosphere at an altitude of about 83km and appears annually in northern latitudes between the end of May and the beginning of August. A number of observers, situated at widely dispersed locations in the UK and Western Europe, report their sightings to the British Astronomical Association. This paper is an analysis of these observations for the summer months of 2022, together with background information about conditions in the mesosphere which contribute to the formation of polar mesospheric ice: the cause of ground-based sightings of noctilucent cloud.

Introduction

Noctilucent cloud (NLC) is the highest cloud recorded in Earth's atmosphere, at a height of around 83km. It was first recorded in 1885 by Thomas Backhouse and has been seen since then between the end of May and beginning of August in the northern hemisphere. The frequency of sightings has increased gradually over the years; this may be accounted for, in part, by an increase in interest as well as the number and spread of observers and locations.

The increasing number of reports of noctilucent cloud encouraged NASA to launch its *Aeronomy of Ice in the Mesosphere* (AIM) satellite in 2007, with a view to monitoring ice forming in the polar mesosphere in both northern and southern hemispheres. The images produced by the Cloud Imaging and Particle Size (CIPS) instrument on board the AIM satellite are useful to ground-based observers, as they provide the earliest indications of ice nucleation. Following the first positive detection by CIPS of ice in the mesosphere, ground-based sightings of NLC are usually made within a few days.

The critical factors in the production of ice in the mesosphere are the temperature and water-vapour content of the atmosphere at that height. Summer buoyancy waves produce marked adiabatic cooling, allowing the mesosphere to reach the critical temperature for ice nucleation, which is around 150K (–123°C). Water vapour in the upper atmosphere gradually increases towards May, but the

Table 1. Sightings of NLC over Britain & Western Europe, 2022

Date	*Time (UT)*	*Forms*	*No. of obs.*	*Most southerly*	*N. lat. (°)*	*Remarks*
May 26/27	00:16–01:47	II,III	2	Dundee	56.5	
May 31/32	23:34–00:07	III	1	Rostock, Germany	54.1	
Jun 01/02	22:30–02:15	I,II,III,IV	16	Chelmsford	51.7	1 USA
Jun 02/03	02:00–02:30	I,II	2	Stoke-on-Trent	53.0	1 USA
Jun 04/05	23:01–01:32	II	1	Dundee	56.5	
Jun 05/06	19:30–01:17	I,II,III,IV	11	Vácrátót, Hungary	47.7	
Jun 06/07	21:21–02:10	I,II,III,IV	12	Swisttal, Germany	50.7	
Jun 07/08	21:16–00:40	I,II,III	3	Rostock, Germany	54.1	
Jun 09/10	23:33–02:10	I,II,III,IV	4	Deventer, Netherlands	52.3	
Jun 10/11	22:30–01:00	II	4	Codnor	53.0	
Jun 11/12	21:18–02:53	I,II,III,IV	20	Swisttal, Germany	50.7	
Jun 13/14	22:52–01:05	II,III	2	Vácrátót, Hungary	47.7	
Jun 14/15	20:00–02:00	I,II,III,IV	10	Zalaegerszeg, Hungary	46.8	
Jun 15/16	22:36–23:55	II,III	1	Rostock, Germany	54.1	
Jun 16/17	21:30–23:58	I,II,III	2	Fahrenwalde, Germany	53.4	
Jun 17/18	23:09–00:01	II,III	3	Rostock, Germany	54.1	
Jun 18/19	21:40–02:00	II,III,IV	3	Vácrátót, Hungary	47.7	
Jun 19/20	23:31–01:32	II,IV	3	Rostock, Germany	54.1	
Jun 20/21	20:15–02:20	I,II,III,IV	26	Zalaegerszeg, Hungary	46.8	1 USA
Jun 21/22	21:00–00:20	I,II,III	9	North Wales	53.3	
Jun 22/23	21:00–02:00	I,II,III,IV	30	Crowcombe	51.1	1 USA
Jun 24/25	00:33–02:00	I,II,III,IV	3	Chemainus, Canada	48.9	1 Canada
Jun 25/26	22:00–03:00	I,II,III,IV	12	Wokingham	51.4	
Jun 26/27	23:53–02:00	I,II,III,IV	7	Wokingham	51.4	
Jun 27/28	23:15–01:45	I,II,III,IV	8	Epsom	51.3	
Jun 29/30	21:08–01:25	II,III	1	Rostock	54.1	
Jun 30/31	10:30–11:15	III	1	Chemainus, Canada	48.9	Canada
Jul 01/02	21:20–02:40	I,II,III	7	Chemainus, Canada	48.9	1 Canada
Jul 02/03	00:35–02:30	I,II,III	6	Wokingham	51.4	
Jul 04/05	22:46–02:35	I,II,III,IV	19	Swisttal, Germany	50.7	
Jul 05/06	20:05–03:15	I,II,III	15	Zalaegerszeg, Hungary	46.8	
Jul 06/07	00:01–01:02	II,III	2	Dundee	56.5	
Jul 07/08	22:40–02:30	II,III	5	Wokingham	51.4	
Jul 08/09	22:52–23:16	II	3	Dieren, Netherlands	52.1	
Jul 09/10	20:28–00:59	II,III	2	Berlin, Germany	52.5	
Jul 10/11	22:17–23:22	I,II,III	2	Chemainus, Canada	48.9	1 Canada
Jul 11/12	20:51–22:34	II,III	1	Rostock, Germany	54.1	
Jul 13/14	20:10–02:16	I,II,III	5	Vácrátót, Hungary	47.7	
Jul 14/15	21:25–03:05	I,II,III,IV	7	Kraków, Poland	50.1	
Jul 16/17	21:47–01:10	I,II,III,IV	2	Brückentinsee, Germany	53.3	
Jul 17/18	00:29–01:40	II,III	1	Rostock, Germany	54.1	
Jul 18/19	01:10–02:00	I,II,III	2	Vácrátót, Hungary	47.7	
Jul 20/21	00:10–01:52	II,III	1	Rostock, Germany	54.1	
Jul 23/24	00:51–02:30	II,III	2	Abergele	53.3	
Jul 24/25	21:25–02:45	I,II,III,IV	3	Swisttal, Germany	50.7	
Jul 25/26	23:00–02:50	I,II,III	3	Swisttal, Germany	50.7	
Jul 26/27	01:55–02:15	I,II,III	1	Deventer, Netherlands	52.3	
Jul 28/29	01:45–03:13	II,III,IV	4	Vácrátót, Hungary	47.7	
Jul 29/30	00:32–02:10	II,III,IV	1	Rostock, Germany	54.1	
Jul 30/31	01:28–03:08	II,III,IV	3	Rostock, Germany	54.1	1 USA
Aug 01/02	00:45–02:17	II,III	1	Rostock, Germany	54.1	
Aug 02/03	01:32–02:32	II,III	2	Rostock, Germany	54.1	
Aug 04/05	01:32–03:17	I,II,III,IV	2	Dundee	56.5	
Aug 06/07	02:15–02:45	I,II	1	Glenbarry	57.6	
Aug 07/08	16:27–18:27	?	1	In flight	?	USA. In flight, Alaska.
Aug 10/11	19:58–05:00	I,II,III,IV	15	Swisttal, Germany	50.7	
Aug 11/12	21:31–22:45	II,III	4	Kilwinning	55.7	

Summary of reported NLC, 2022 season

	May	*June*	*July*	*August*	*Total*
No. of nights	2	25	23	7	57
No. of observations	3	194	97	26	320
No. of nights for UK & Europe	2	24	23	6	55
Obs. Received from UK & Europe	3	185	92	25	310
Obs. Received from Canada & USA	–	6	3	1	10

amount of water in the mesosphere is not as critical as a low enough temperature in the formation of ice. NASA's Microwave Limb Sounder (MLS), carried on the *Aura* satellite, measures temperature and water-vapour content in the mesosphere, and these measurements can explain changes in the pattern of ice formation throughout the season.

The 2022 NLC season

Prof Cora Randall, an atmospheric scientist at the University of Colorado Boulder, has been the principal investigator of the CIPS data since 2007. She kindly regularly updates the author about ice in the mesosphere and factors such as temperature and water-vapour content, which influence the appearance of ice. On 2022 May 22, she said that ice had not been detected by CIPS, but she had been informed that the Ozone Mapping and Profile Suite (OMPS) instrument installed in Suomi NPP and NOAA-20 satellites may have detected a faint cluster of clouds in the Canadian Arctic on May 21. She also indicated that MLS data were showing that polar mesopause water vapour was rather higher than normal, but temperature was lower.[1]

The first traces of ice in the mesosphere appeared on May 22 and grew to a disthtinct patch over Canada on May 23. The ice was at a very high latitude but by May 25 had grown and, because of the differential rotation of the Earth and the upper atmosphere, was approaching northern Scandinavia, making sightings of NLC in Europe a possibility. The first confirmed sightings of NLC were on the night of May 26/27 by an observer in the Isle of Skye and the author in Dundee. Only one more sighting was received for May, that being on the final night of May 31/32, from Germany.

By Jun 1, the CIPS image showed that ice in the mesosphere had become more southerly, although still showing eccentric distribution round the pole. The southerly extension was situated due north of the UK and the night of Jun 1/2 produced 16 sightings, the most southerly being from Chelmsford. The CIPS images from early June showed ice forming around the pole and with that it was likely that more reports of NLC would follow. Increasing numbers of NLC sightings were received as June progressed, with particularly high numbers on Jun 20/21 (26) and Jun 22/23 (30). The most southerly report received was from a location in Hungary at 46.8°N.

An interesting item reported on Spaceweather.com, Jul 3, mentioned a sharp increase in NLC at the end of June. This comment seems to have been based on data from CIPS which showed a spike in late June but only at 70°N. Whatever the cause of this surge in NLC frequency noted by CIPS, it appears that nothing out of the ordinary was noted

by observers in the UK or Europe. The overall number of NLC sightings during July was significantly less than that in June with only two nights, Jul 4/5 & 5/6, returning double figures. From these dates, numbers remained low until the end of July, although the most southerly sighting was reported from a latitude of 46.8°N, by the same observer who supplied the most southerly sighting in June.

Reports continued to be received into August, with an unexpected burst of activity on Aug 10/11 for which the most southerly report came from an observer at a latitude of 50.7°N – unusually low for this time of the NLC season. The final NLC observations were received for the night of Aug 11/12.

From reports by numerous observers and from personal observations, the author felt that the entire 2022 NLC season was rather muted in terms of NLC brightness and fewer displays reached higher elevations. Both of these factors probably contributed to fewer sightings from more southerly locations being reported, as cloud cover during the season was probably no worse than average.

Towards the end of July, the author contacted Prof Randall to express his feelings about the muted nature of the season. She replied by sending a plot showing frequencies for previous years, with that of 2022 highlighted in red (Figure 1). She commented, 'You'll note that at 58–60 degrees the frequencies this year are indeed less, on average, than in previous years (with the exception of a spike just before solstice which we're investigating as possibly caused by a rocket launch…very speculative still)'.[2]

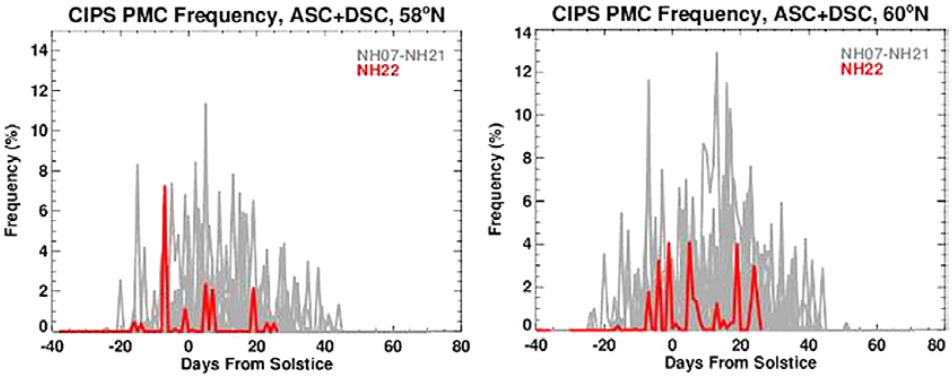

Figure 1. NLC frequency at 58°N and 60°N latitude. *(Courtesy Cora Randall)*

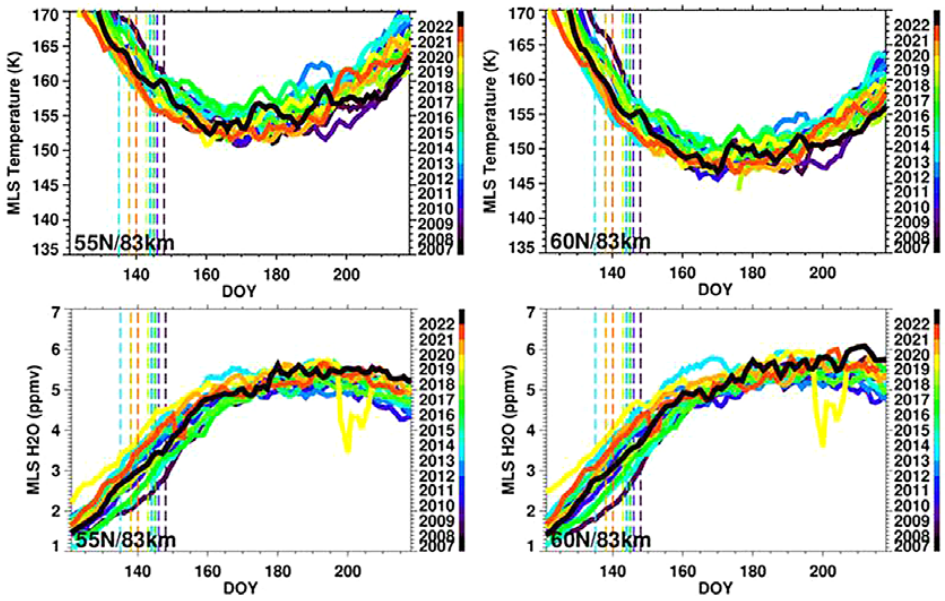

Figure 2. Temperature and water-vapour content at 83km and latitudes 55°N and 60°N. 2022 data in black. *(Courtesy Lynn Harvey)*

Frequency of ice in the mesosphere and the consequent visual sightings of NLC is primarily dependent on that atmospheric layer reaching a low enough temperature for ice to nucleate around particulate material. Nucleation also requires sufficient water-vapour concentration but, even if this is plentiful, ice will not nucleate without a low enough temperature. The unusually large number of reports received on Aug 10/11 was explained by Prof Randall as having been caused by low mesospheric temperature and high water-vapour content at that time. This is illustrated by the plots she sent, which had a final date of Aug 6 (Figure 2). She said: '…through the first week in August, the temperatures were low and the water vapour was high (black line), which would explain the good NLC displays in early August'.[3] The plots show temperature and water-vapour content of the mesosphere at 55°N and 60°N, which reflect the mesosphere at latitudes of the northern UK. They also show a rise in temperature from day 160 (Jun 19) until day 195 (Jul 14) after which the temperature dropped below average until the last day (Aug 6). During the entire time from day 180 (Jun 29) until the last date shown (Aug 6), the water-vapour concentration was higher than average.

Table 2. NLC observers, 2022

Abbott J., Adam T., Anderson G., Arditti D., Armstrong K., Bali A., Ball K., Beata U., Bongartz W., Boyle K., Brantingham S., Brausch J., Briggs D., Brown S., Buczynski D., Burchell J., Burns A., Burton B., Burton W., Carss C., Clitherow A., Cook T., Ebdon C., Eichner A., Entwisle L., Evans T., Fennimore G., Ferguson G., Foster P., Fraser J., Frydman D., Gert van Eck, Glaesemer M., Grayer G., Green M., Harty T., Hattinga V., Hayes T., Haymes T., Heenan A., Hennig D., Herbst S., Holmes S., Howlett M., James N., Jamie M., Joy W., Kennedy A., Kennedy K., Livingstone R., MacIver S., Mackie G., Maloney P., McBeath A., McCouat N., McEwan T., Millar D., Missira A., Moir E., Morrison N., Mugridge P., Newman R., Nicholls M., Norrie S., Osmotherley A., Parkes W., Paterson D., Phillips M., Pollock E., Privett G., Pumphrey H., Rees D., Robinson J., Ross I., Rowlands J., Rule G., Rushford L., Schofield T., Shanklin J., Shepherd B., Small D., Smith T., Snelus T., Squarra O., Stables A., Stapleton R., Steele C., Tate D., Taylor R. & S., Tipping J. & A., Topping B., Tough A., Trzicky T., Ulbricht H., van der Haven M., Vetterlein J., Ward B., Winkler R., Young C.

2022 Jul 14–15, 02:00 UT. James Robinson, Highworth.

Table 1 gives a day-by-day summary of NLC reported in Britain and Western Europe with, for completeness, a small number of reports from regular contributors from Canada and the USA. The NLC forms used in the table are described as follows:

Type I: 'Veil', a faint background brightness which other forms often overlie.

Type II (IIa or IIb): 'Bands' or streaks either parallel or crossing at small angles.

Type III (IIIa or IIIb): 'Billows' or 'waves' which show a typical herring-bone or sand-ripple pattern.

Type IV: 'Whorls' of various curvature.

Acknowledgements

As always, observers throughout the UK and Europe made regular efforts to observe NLC and to report their sightings to the

2022 Jun 22–23, 00:50 UT. Gillian Ferguson, Newport-on-Tay.

BAA Aurora and Noctilucent Cloud Section or to Tom McEwan's NLC website.[4] The officers of the Section would like to thank all observers for their diligence, often despite late hours and frequently poor sky conditions. The names of these observers are recognised in the list shown in Table 2.

The author also thanks Tom McEwan for his continued support in providing a medium where NLC reports can be submitted, often from non-BAA-members residing in Europe. The ease of using Tom's website for reporting probably contributes to its widespread use. Finally, the author would like to thank Prof Cora Randall for her interest in the Section and for her rapid and helpful responses to questions asked by the author. In addition, thanks go to Dr Lynn Harvey, also of the Laboratory for Atmospheric & Space Physics, University of Colorado, for data related to mesospheric temperature and water-vapour content.

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[ken.kennedy42@ btinternet.com]

Notes & references

1 Randall C., *Pers comm.*, 2022 May 22
2 Randall C., *Pers comm.*, 2022 Jul 20
3 Randall C., *Pers comm.*, 2022 Aug 23
4 Noctilucent Cloud Observing Network website: **ed-co.net/nlcnet** (accessed 2022 December)

Received 2022 December 14; accepted 2023 January 21

2022 Jun 22–23, 00:21 UT. Alan Tough, Elgin.

2022 Jun 20–21, 01:21 UT. Steve Brown, Stokesley.

Report of the Council

for the session 2022 August 1 to 2023 July 31

To be presented to the members at the Annual General Meeting on 2023 October 25

The Trustees and Council of the British Astronomical Association present their annual Report and financial results for the session ended 2023 July 31. For the 2022–'23 financial year, the deficit of income over expenditure before gains/losses on investments was £126,835 (2021–'22 financial year: deficit of £98,794).

David Arditti, *President* | **Graham Winstanley,** *Treasurer*

Officers & Trustees

The elected Officers and Trustees for the year ended 2023 July 31 are listed on p.339. Details of the members of the Board and Council may be found inside the back cover of each issue of the Association's *Journal.*

Membership

	2021 July 31	*2022 July 31*	*2023 July 31*
Subscription type			
Ordinary *(Standard)*	760	685	601
Ordinary *(Digital)*	275	274	266
Senior *(Std)*	933	940	919
Senior *(Dgtl)*	181	223	253
Family *(Std)*	213	194	177
Family *(Dgtl)*	30	29	28
Young persons *(Std)*	19	14	20
Young persons *(Dgtl)*	6	5	12
Honorary	193	206	250
Life	40	41	40
Members	2650	2611	2566
Affiliated Societies	38	38	40
Total	2688	2649	2606

232 members joined the Association during the session.

BAA membership outside the United Kingdom:

Europe			
Austria	3	Italy	20
Belgium	7	Luxembourg	1
Bulgaria	1	Malta	2
Channel Islands	1	Netherlands	7
Cyprus	2	Norway	2
Czech Rep.	1	Poland	2
Denmark	5	Portugal	3
Finland	1	Romania	1
France	21	Slovenia	1
Germany	19	Spain	16
Greece	4	Sweden	8
Iceland	1	Switzerland	3
Ireland	16	Turkey	1
Rest of World			
Australia	34	Kuwait	1
Bangladesh	1	Malaysia	1
Barbados	1	Mexico	1
Brazil	1	New Zealand	10
Canada	16	Russia	2
Chile	2	South Africa	3
China	1	South Korea	1
Curaçao	1	Sri Lanka	1
Hong Kong	1	Thailand	1
India	4	Uganda	1
Japan	6	USA	129
		Total non-UK:	369

The Council records with regret the deaths of the following members reported this year:

Mr B. R. Bligh; Mr G. L. Boots; Mr R. P. Bishop; Mr J. W. Bruce; Mrs T. Butcher; Mr P. J. W. Clark; Mr R. A. Davenport; Mr A. F. Dean Jr; Mr F. Dunn; Mr P. N. Edwards; Mr D. J. S. Gibbins; Mr J. Harper; Mr A. J. Havery; Mr A. R. Hutchings; Mr A. A. Langley; Mr. R. E. Mizon; Mr Z. A. Pacult; Mr M. J. Porter; Mr E. M. Rhodes; Mr J. H. M. Richmond-Hardy; Mr A. D. Rousen; Mr R. Smith; Mr A. E. Turpin; Mr K. C. Thomason; Mr W. G. Wood.

Publications

The BAA *Handbook* continues to be prepared and edited by Steve Harvey, whose latest edition (enclosed with the print edition of this *Journal*) brings the publication into its 103rd year (see p.320). It is also available in PDF format on the 'Publications' page of the Association's website. Many thanks are due to Steve, as well as the volunteers whose efforts in sourcing and proofreading the data are essential to its continued success.

Six issues of the e-mailed *Newsletter* have been published, edited and predominantly written by Janice McClean. Each issue provides members with news, a meetings diary, and notifications of new publications uploaded to the BAA website. Notices of transient events requiring urgent observation, authored by Section Directors, are disseminated using the BAA Alerts system: six of these were sent via e-mail over the period. Members not in receipt of the *Newsletter* or Alerts are encouraged to visit the BAA website, where they can join the mailing lists for both.

It has been a busy year for the Association's *Journal.* Six fully illustrated issues (400 pages; 16 more than in the previous session) – edited, typeset and laid out by the undersigned – were published in both paper and digital format. Printing was undertaken by the Magazine Printing Company of Hoddesdon, Hertfordshire, overseen by our account manager, Paul Salisbury, with his usual care. Some 167 individuals contributed non-refereed submissions (including images and plotted data), of whom 59 had written pieces printed. A total of 21 refereed papers were published; the *Journal*'s peer-review process remains the most important function of the publication and this is maintained to a high standard through the hard work of Jeremy Shears (Papers Secretary) and the referees.

In each issue, Nick Hewitt's excellent Sky Notes continued to guide readers to the highlights of each observing season, while meetings of the BAA were faithfully reported by Alan Dowdell (Meetings Recorder). The index to the previous volume was again prepared by past Editor Hazel McGee – no mean feat, and one for which the undersigned is very grateful. During the session, Mrs McGee assumed the title of *Journal* Indexer, which is reflective of her work both on the annual index and in maintaining our presence on the Astrophysics Data System.

The indefatigable Marie-Louise Archer has continued her important work as Advertising Manager, giving placements to relevant advertisements both in the *Journal* and on the website. She also expertly produced another edition of her popular Christmas Quiz during the session. We are grateful to First Light Optics, The Astronomer pub, *The Sky at Night Magazine*, Tom Boles, Dr Brian May and Floris Books for donating prizes.

The BAA Strategy Group presented their recommendations to Council in 2022 November, including expanding the *Journal*. To enact this proposal, a *Journal* Working Group was formed in the following spring, chaired by the Editor and with Dr David Arditti, James Dawson, Alexandra Hart, Callum Potter and Jeremy Shears as members. This latter group distributed an online survey to readers in 2023 June, which attracted some 200 responses. (Special thanks are due to James for his excellent work on

orchestrating this and analysing the results.) In that month, the Board of Trustees approved an expansion of the *Journal* in 2024, and the creation of a new Assistant Editor post. The successful applicant will support the work of the Editor and deputise for them if necessary, both roles being considered vital to the future health of our flagship publication.

As ever, the undersigned is very grateful to all who have contributed articles, observations, images and drawings during the session. Thanks also go to John Chuter for setting up the web page for each issue; to Janice McClean for publicising the *Journal* through the *Newsletter*, and to the Office staff (Madeleine Davey, Julia Palmer and Jayne Rickard) for their vital work.

Philip Jennings, *Journal Editor*

Website Operations Team

The BAA website is one of the many ways in which members interact with the Association. The aim of the Website Operations Team ('WebOps') is to keep the site up to date with relevant information and to foster a spirit of community amongst members, especially those who are unable to attend meetings. To bolster the resources available to work on the website, the Association has a Web Content Editor to principally assist Section Directors with their web presence.

To manage the technical aspects of our website infrastructure and lead the WebOps team, Council appointed John Berman as Website Manager for the BAA.

Last session saw the roll-out of the redeveloped website. This session has seen a number of bug fixes and improvements implemented. Many thanks go to the development team: Dave Ansell, Dominic Ford, Andy Wilson, and Emily Bick.

The Members' Albums system is well supported by members, with many images uploaded every day. Do not forget to share your observations with the relevant Section Director to ensure they can be analysed and archived. The discussion Forum remains a useful way for members to interact, share information and ask questions.

The regular Observers' Challenges – suggestions for observing projects of varying degrees of difficulty – are proving popular and play a role in encouraging members to share their observations. Thanks go to John Chuter and Callum Potter, who authored most of these.

Regular articles about current and future events in the world of amateur astronomy also appear on the front page of the site and we thank the many authors who prepare them. We also continue to add articles to our Tutorials section, coordinated by David Swan. There is a wealth of Tutorial material available to help observers move up the learning curve.

Paul Downing manages the website's Picture of the Week, where a recent observation is showcased on the front page of the website.

Callum Potter stood down as the convenor of the WebOps Team, with John Berman now taking on this role. Callum and John would like to thank fellow members for their hard work throughout the year: Andy Wilson, Dominic Ford, Emily Bick, John Chuter, and David Swan.

The WebOps Team thank Callum for his significant contribution as Convenor of the team and unofficial Website Manager. His tenure saw the successful introduction of the new website, a task that required considerable effort over several years.

Callum Potter, *Convenor*

Sales & promotions

The first BAA Sales stand of this session was at the International Astronomy Show held at Stoneleigh Park, near Coventry, on 2022 Oct 13–15. The stand was set up by the Coordinator on Thursday; it was run by Alan Lorrain on Friday, and by the Coordinator and David Boyd on Saturday. This event was not as well attended as in previous years, but we nevertheless gained new BAA members.

The BAA stand was also present at the Federation of Astronomical Societies (FAS) convention in Oxford on Saturday, 2022 Nov 12, where the Coordinator was helped by Janice McClean and David Boyd. The theme of this event was 'Women in Astronomy', which encouraged a different audience, including several parents with their daughters. This was a good opportunity to advertise the BAA to people who may not have known about the Association.

The Sales presence at the BAA Christmas meeting at the Institute of Physics gave members a chance to buy their annual *Stargazers' Almanac*.

AstroFest returned to Kensington Town Hall on Feb 2–4. This is an important event in the Sales calendar as it offers the best opportunity to promote the Association to the public and recruit new members. Planning is key, with the BAA Office organising shipping the sales to Kensington and a team of BAA members helping over the two days. Sales were good and several new members joined. Displays on the stand presented the work of members to good effect, with many Section leaflets and application forms distributed.

Janice McClean organised the BAA stand at the Practical Astronomy Show in Kettering on Saturday, Mar 11, with help on the day from the Coordinator and David Boyd. This was a successful meeting with the stand kept busy the entire day, talking to existing members and recruiting new ones.

The Deep Sky Section Meeting was held at Bedford School on Sunday, Mar 19. This was mostly attended by members, so sales of BAA publications were modest, but two non-member attendees were signed up on the day so it was worth being there.

The 55th BAA Winchester Weekend was organised again by the Coordinator and held at Sparsholt College on Apr 14–16. The Weekend was fully booked for the first time since the pandemic. Interest in sales was good as this was the first opportunity some members had to buy the recently issued publications. The Coordinator is grateful to all who helped with organising and running the event.

Thanks to all who have continued to support the Sales Coordinator during the last 12 months.

Ann Davies, *Sales & Promotions Coordinator*

Events & outreach

The Coordinator took the BAA stand to New Scientist Live for a fifth time in 2022 October. This is a big investment for the BAA, getting our name out to a larger audience than that found at the usual astronomy-specific events. The event now also has a dedicated schools day, which allows the BAA to reach secondary-school-age children. Over 1,200 people came to look through the telescopes at model planets which the BAA displayed around the venue.

Planning is well under way for this October's New Scientist Live – 2023 Oct 7–9. Sincere thanks to Nick Hewitt, Mark Radice, Steve Floodgate, David Grist, Mike Rushton, Diane Clarke, Rita Whiting and Nick James,

The BAA stand was in attendance at New Scientist Live on 2022 Oct 7–9. ***(Janice McClean)***

who have all supported this event over the years, giving generously of their time.

As it closely precedes the International Astronomy Show, the Coordinator has become involved in transporting sales and show items to that event for the Sales & Promotions Coordinator, Ms Davies. There is a lot of logistic work in this role.

2022 November saw the FAS Convention. The Coordinator took the stand to this event in Oxford. Unfortunately, due to organised tours at lunchtime, most of the delegates left the building and sales were very low. However, it was still good exposure for the BAA.

At AstroFest, held in 2023 February in Kensington, the Coordinator managed the Sales stand for Ms Davies on the Friday of the two-day show.

In 2023 March, the BAA stand was taken to the Practical Astronomy Show in Kettering, which is becoming hugely popular with dedicated astronomers. Numbers were high and it is an event at which the BAA gets new members joining.

The Coordinator produced six issues of the BAA *Newsletter*, announcing the availability of the latest digital copy of the BAA *Journal*. The *Newsletter* was reduced in frequency from monthly to bimonthly, mainly due to time constraints upon the writer.

She also arranged monthly advertising of BAA meetings and events in *Astronomy Now* and *The Sky at Night Magazine*, as well as the UK Astronomy Buy & Sell website. She keeps the rolling display updated, which is used at outreach events to advertise the BAA. Whilst the BAA has increased investment in advertising and events, it is disturbing to see that our membership is still slowly dropping.

As a Board member, the Coordinator is involved in managing two long-running legal cases.

Janice McClean, *Events & Outreach Coordinator*

New members

Throughout the session, the Coordinator has continued to welcome new members to the Association by e-mail and at meetings. He has assisted them in finding available BAA resources and made introductions to Section Directors where appropriate. The Coordinator has provided administrative assistance to the BAA Office by dealing with some enquiries and has worked with Office staff to streamline the provision of necessary data to enable the smooth discharge of his duties.

The Coordinator's aim is to convey a sense of value to new members' participation in Section activity by encouraging the reporting of their observations to the website Community Pages and Sections, particularly where the observer may consider their results unworthy.

Whilst not all new members respond to communications from the Coordinator, some members do share details of their interests and activities. This confirms the wide range of backgrounds and experiences of new and existing BAA members.

Peter Carson, *New Members Coordinator*

The Archives

During the session, Max Communications Ltd (in consultation with JC) have produced a customised web portal to allow online access to many scanned BAA archival documents. We are grateful to the Trustees for giving this project additional financial support. In due course (hopefully later this year) this resource will be available to members only. In December, RM completed a detailed catalogue of BAA archives, and of all its publications since 1890. It is also planned to place this online with hyperlinks to those items already accessible. Considerable further rearranging and filing of physical archives has been carried out.

The family of the late Peter Richards-Jones transferred a number of his cine films, taken to the Society for the History of Astronomy (SHA). SHA Librarian James Dawson kindly had them converted into digital form, and two films relating to the activities of the BAA have been copied to us. The first includes a short clip of the *Monte Umbe* total solar eclipse cruise of 1973, and the second a sequence taken at a sunny Winchester weekend. Further research based upon weather records and identifying the lecture panel and other attendees has dated this definitively to 1972 July. The short film was shown by James as a parting surprise to those attending the 2023 weekend. And now Robin Flegg has given us more film records of events such as the 2004 transit of Venus, observed from the home of the late Sir Patrick Moore. These will be edited and transferred to modern format by JC. A set of colour slides of the *Monte Umbe* cruise has been donated by Keith Brackenborough [**133**(3), 190 (2023)], and other materials relating to it loaned for copying.

Most recently, Mrs Margaret Maddison has kindly given us memorabilia and photographs relating to the astronomical work of J. H. Reynolds, who operated a 30-inch reflector for photographic work. These include some original glass plates, originally collected by her late husband, Dr Ron Maddison. Reynolds supplied photographs to our Jupiter Section, as referred to by the Rev T. E. R. Phillips in old *Memoirs*.

Denis Buczynski has given the Archives many plate-glass negatives in various formats, of comets and solar eclipses, taken R. L. Waterfield. It is hoped to scan much of this material. Denis also gave several folders on astronomical history previously belonging to David Gavine.

Steve Wyn-Harris has let us know that his family is in possession of a timepiece that had belonged to A. A. C. Eliot Merlin. We have one of Merlin's notebooks in the Archives. After consulting RM, Steve prepared a letter to the *Journal* Editor about the timepiece.

It is hoped that we shall soon transfer from the care of Dr John Mason the remaining items relating to W. S. Franks (see previous Council reports). We have had discussions with the Patrick Moore Trust regarding Patrick's scanned notebooks (of which a few more have recently been added to the total), and Dr Mason has agreed to arrange to provide us with an electronic copy which the Archivists would hold for serious researchers upon request. RM and Dr Mason are intending to publish a note about the notebooks later.

RM exhibited various astronomical notebooks running from 1882 to 2020 at the Winchester course. These included the original work of G. T. Davis (for the period 1882–1896), R. L. Waterfield (1914–'28), F. J. Acfield (1920s–'50s), E. H. Collinson (1950s–'60s), A. W. Heath (1950s–'60s) and R. J. McKim (2020). JC and RM have continued with their short historical notes for the *Journal*.

Richard McKim & John Chuter, *Archivists*

Commission for Dark Skies

The session beginning 2022 August was momentous for the Commission for Dark Skies (CfDS). The deaths of pioneering campaigners Graham Bryant and Bob Mizon were major upsets for the dark-sky community. Graham was an effective advocate for dark skies over many decades. Bob was an acknowledged expert on dark-sky issues, being the Coordinator and the driving force behind the CfDS. The committee are deeply saddened by their passing and greatly miss their contributions and gentle wisdom. The CfDS is now coordinated by Howard Lawrence on an acting basis.

The past year saw further strengthening of the UK Dark-Sky Partnership (UK DSP). This informal grouping comprises organisations representing parliament, astronomers, lighting professionals, wildlife charities, environmental campaigners and dark-sky landscapes. The UK DSP has the potential to become a major force for achieving some control over constantly increasing light pollution. It works on advising government about effective policies for minimising harms done by the loss of natural darkness. The focus is on the All-Party Parliamentary Group for Dark Skies 10-point plan. The CfDS has supported the UK DSP proactively by sponsoring its website, leaflet production, meetings and events.

One member of the UK DSP is the emergent Dark Sky UK, the local chapter of Dark Sky International, formerly the IDA. This group fosters broad dark-sky advocacy and brings international resources to the problem.

The CfDS attended local and national events, including the International Astronomy Show, the BAA Winchester Weekend and the Local Government Association (LGA) conference. The LGA event involved an exhibition stand titled 'Dark Skies, Dark Habitats', requiring considerable resources, new posters, revamping of leaflets and so on. Three members of the CfDS committee were joined on the stand by other UK

DSP members, including personnel from Cranborne Chase AONB, Dark Sky UK and the Institution of Lighting Professionals (ILP). Discussions were held with circa 150 people, ranging from local and national political leaders, parties, officials, supporting organisations and the media. There is widespread desire within local government circles to reduce light pollution, but insufficient resources. Examples of local good practice include the bat-friendly street lighting in Warndon and Pershore, Worcestershire.

The CfDS produced a feature article about increasing light-pollution levels for the ILP *Lighting Journal* (2023 January). This article included results from long-term photometry studies by amateur observatories at the Hampshire Astronomy Group and Mathon, near Malvern. Also reported were results from surveys conducted at BAA Winchester Weekends. Conclusions broadly agreed with another important study by Chris Kyba *et al.* (2023) in *Science*, which used the Globe at Night data set. They stated: 'The number of visible stars decreased by an amount that can be explained by an increase in sky brightness of 7 to 10% per year in the human visible band. This increase is faster than emissions changes indicated by satellite observations.' The CfDS remains convinced that ground-based observation is critical in tracking changes in light pollution accurately and encourages amateur observers to make regular measurements of sky brightness.

Encroachment of artificial light into the countryside continues to be a major threat. For example, the observatory of the Nottingham Astronomical Society (NAS) would be badly affected by a nearby industrial farming development if planning permission is granted on appeal. CfDS is assisting the NAS with advice and has made objections to the planning application.

The issue of light pollution extends beyond its impact on astronomy. For example, the House of Lords Science and Technology Committee published 'Paper 232: The neglected pollutants: the effects of artificial light and noise on human health'. The CfDS campaign needs to broaden and encompass wider health and environmental issues. Accordingly, the next year should see strengthened interaction with non-astronomical parties.

Howard Lawrence, *Acting Coordinator*

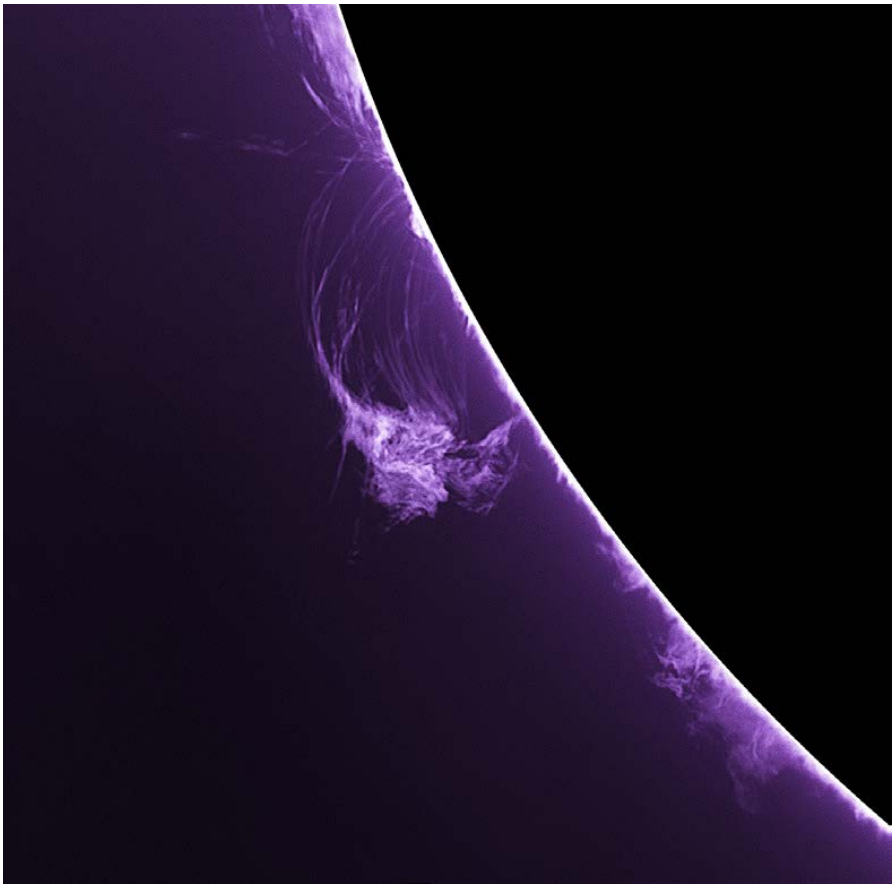
Sections

Solar Section

The Solar Section remains one of the more busy BAA Sections, with a core of around 50 active observers reporting monthly and a further 20 or so imagers regularly submitting images. It is the imaging side that has increased substantially during the Director's tenure of office, from a mere 22 images being submitted in 2006 June, to 316 images in 2022 June and a staggering 551 images being archived in 2023 May. Filing and archiving of images takes a good deal of time and the Director would like to thank Peter Meadows for uploading a selection to the Section's web pages, which takes many hours of work per week. The possibility of members being able to upload their own images is an avenue to be explored.

Sadly, the Section has lost four members during the session: one resigned and three deceased. The Director is sorry to acknowledge the loss of Graham Boots, Frances Dunn and Zbigniew Pacult. Six new members have been welcomed, with the overall membership remaining fairly constant. Occasionally, e-mail addresses become uncontactable, which has led to a slight fall in the circulation list for the Section's monthly newsletter, which now stands at 246. One additional newsletter is sent by post, with the Section being administered at no cost to the Association.

With the marked increase in solar activity over the last 12 months, submissions in white light, H-alpha and Calcium K-line have been numerous. This has led to an extension of the Section newsletter from four pages to six, to incorporate more detailed reports and to include more images. Sketching of solar activity is still on the wane, with imaging being the preferred medium to record solar events. Interest in solar observing remains high and this will remain the case as the solar cycle progresses to its maximum, expected in 2024/'25.



A prominence, imaged in CaK, dominates the south-east limb of the Sun on 2023 Jun 16. ***(Nic Spencer)***

The Section held a BAA webinar on 2023 Feb 18, which was well attended and has since had 440 views on the BAA YouTube channel. The Director would like to thank the speakers that took part, covering a wide spectrum of solar interest. A Section meeting was held on 2023 Jun 16 via the Zoom platform; 22 members attended to discuss solar observing matters and exchange ideas and expertise. Due to the success of this initial meeting, a second is planned for the coming autumn.

The Director attended the BAA Autumn Meeting at Elgin in 2022 September and gave a talk on solar H-alpha features. Further talks have been given to three astronomical societies (Tweeddale, Ayr and Crayford) via Zoom, and to two other societies in person.

The Director would like to thank all the contributors to the Section for their assistance during the last session, and to particularly thank the two Section officers, Peter Meadows and John Cook, for their contribution to the smooth running of the Section and providing essential data. She would also like to thank Martyn Kinder for acting as platform host for the Section Zoom meeting, and to Andrew Wilson for doing so for the BAA webinar.

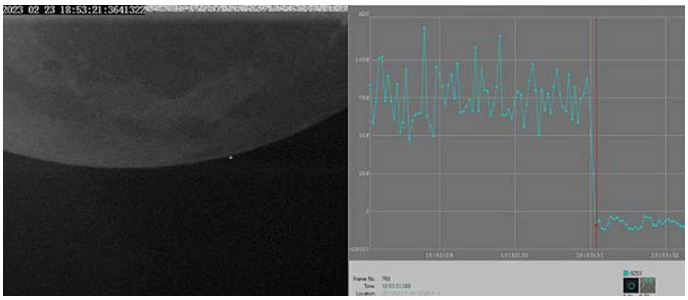
Lyn Smith, *Director*

Lunar Section

In the Section we have three very active programmes: Occultations, Lunar Geological Change, and the Impact Basins & Buried Craters programme. In addition, when members submit observations, the best one from each observer is published in the monthly *Lunar Section Circular*. Barry Fitz-Gerald, our editor, interprets some of the geology present, or alternatively the submitted images and sketches can be used to evaluate past historic observations, if made under similar colongitude. Barry Fitz-Gerald and Raffaello Lena continue to write excellent articles on lunar geological puzzles and domes, and they also utilise observations submitted.

The camera hardware employed by Tim Haymes and others for occultation work can also be used to detect whether stars are binary or multiple, and to find the magnitudes of the individual components. Observations by geographically separated observers can even be used to measure the angular separation and position angle of the stars in such star systems. Similar, and more common, CMOS cameras can also be used to search earthshine for impact flashes. The Director is organising citizen-science observing of impact flashes for the Italian LUMIO lunar-impact-flash CubeSat mission, due to launch in 2027, and so would welcome new members to join in with this activity and support Tim's occultation observing programme at the same time.

Tony Cook, *Director*



Left: **Star SAO 109824 some 10 seconds prior to occultation on 2023 Feb 23, as videoed by Tim Haymes with a QHY174-gps camera.** ***Right:*** **The occultation light curve as recorded by *Tangra* software (written by H. Pavolv).**

Mercury & Venus Section

The 2022–'23 session has been a busy one for the Section. In April and May we had a good elongation of Mercury and a number of observations were received by our Mercury coordinator, Chris Hooker. He also successfully imaged the ion tail of the planet, and this marks a new avenue of Mercury research for the Section. Long-term monitoring of the tail is now within the scope of amateur astronomers and to this end, Chris has successfully obtained a Ridley Grant from the Association, to purchase kit which will allow him to make more frequent observations from the UK. It will be interesting to see what results are obtained.

On 2023 Aug 13, Venus came to inferior conjunction, marking the end of a splendid eastern elongation, which saw the planet well placed for observation in the UK evening sky. The elongation was well observed, with 37 contributors regularly submitting their observations to the Director. The report covering this elongation is currently in preparation and the Director hopes to have it completed in the next few months. If anyone has made observations of Venus during this time and not yet sent them to me, they are encouraged to do so as soon as possible so that they can be used in completion of the elongation report.

A Section meeting was held at the BAA Winchester Weekend on the afternoon of Saturday, 2023 Apr 15 – this was the first meeting held by the Section since the 1980s! The event was very well attended and a write-up of the meeting can be found in the May issue of the Section newsletter, *Messenger*, which is available on the Section website. The Director hopes to hold another Section meeting in 2025, and then to hold them at fairly regular intervals, as they are an excellent way of communicating observational techniques and a great opportunity for members to meet in person.

In the August issue of the *Journal*, the elongation report covering the 2021–'22 eastern elongation of Venus was published. The report covering the 2023 western elongation has been accepted and is awaiting publication in the *Journal*.

Finally, the Director has communicated a number of news items in the *Journal*, *Messenger* and the BAA website during this period. Perhaps the most interesting of these is the discovery of active volcanoes on the surface of Venus, in the old NASA *Magellan* spacecraft archives. A discussion on this can be found in the 2023 May issue of *Messenger* and the April issue of the *Journal*.

Venus has now returned to the morning sky and is well placed for observation. The Director would ask members to send in any observations they make of the planet at regular intervals to assist in regular monitoring.

All that remains is for him to thank the Section committee for their help and of course the Section members, whose observations and dedication to the inferior planets are absolutely essential.

Paul G. Abel, *Director*

Mars Section

Comprehensive Mars reports for the opposition of 2018 appeared in the 2022 October and December *Journals*, and for 2020 in the 2023 June and August numbers, bringing our publications right up to date.

At opposition on 2022 Dec 8, the Martian season was late northern winter. UK observers Dr David Arditti, David Basey, Nick Haigh, Ken Howlett, Martin Lewis, John Saxton, Alan Snook, Dr Peter Tickner and Prof Bill Leatherbarrow were particularly active in sending the Director their latest images throughout the season, while other UK members sent valuable if less voluminous data, and the Section's large international membership considerably swelled the observational totals. Geof Lewis (Bunwell, Norfolk) was able to synthesise a fine digital map from his personal images taken with a 355mm SCT (see overleaf). The Director made 139 drawings, and had good support from Dr Paul Abel, David Graham and Chris Nuttall with the visual programme. Clyde Foster relocated from South Africa to Namibia. His sterling pre-dawn work before opposition was of great importance. In all, 115 observers made well over 10,000 observations. The occultation of Mars by the Moon on the day of opposition was widely observed in this country under good sky conditions.

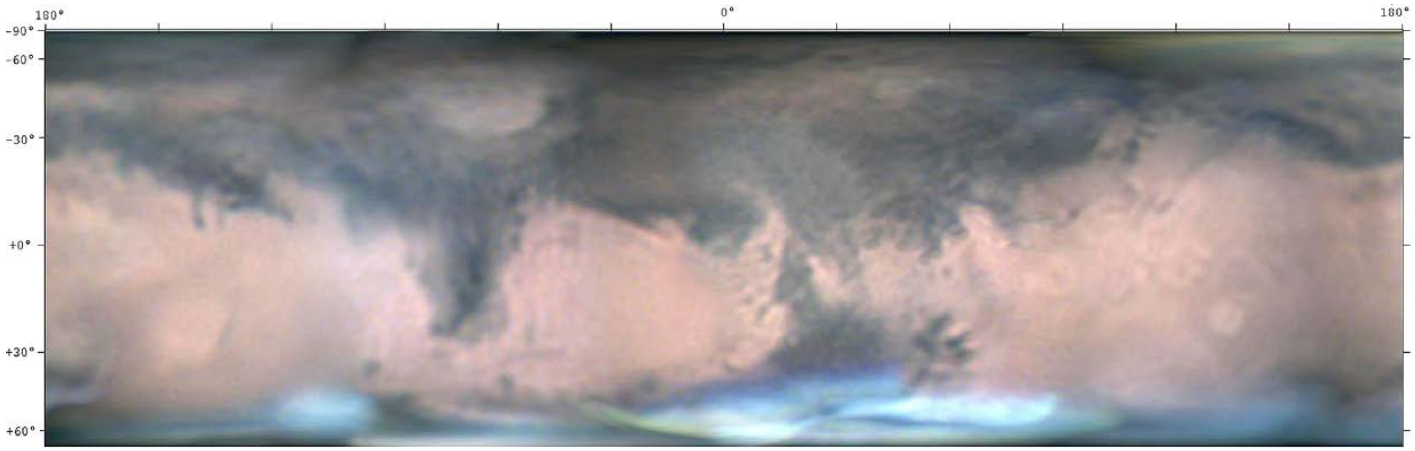
New hand-drawn reference maps by Adachi are posted online. Ade Ashford kindly updated his very useful 2020 *Mars Mapper* programme, which was frequently used by members around opposition time.

Observational news was quickly communicated by illustrated posts (uploaded by Emily Bick) at the Section website, continuing till 2023 Easter, and new dust storms were the subject of BAA Forum alerts by the Director. The biggest event was a large regional one, similar in seasonal incidence and evolution to that of 2020 November. The post-2018 global storm albedo changes, centred upon *Oxia Palus – Indus*, remained prominent throughout.

More and more observers are obtaining images with colour cameras, in lieu of compiling composites from separate exposures through red, green and blue-violet filters. Such work is excellent pictorially, but is more valuable when accompanied by filter images, particularly at the violet end of the spectrum. The Director wishes to repeat his previous advice that broadband blue filters are often not selective enough to reveal white cloud detail in adequate contrast.

The undersigned would like to thank Guy Betrand for kindly photographing for him E-M. Antoniadi's Mars drawings from his Juvisy notebooks, archived at the Paris Observatory, and likewise many original Mars drawings (1877–1895) by E. L. Trouvelot. (The Director had consulted these in Paris in the past.) A recent paper on Martian albedo changes over the last 160 years by W. P. Sheehan, J. Hagen & W. K. Hartmann has appeared in *The Antiquarian Astronomer*, no. 17, pp 64–80 (2023). The Director was pleased to have provided some of the historical data.

The various spacecraft at Mars continued to do good work. NASA's *InSight* lander (which had gathered marsquake and other data about the planet's interior) ceased operation after four years on 2022 Dec 15 (see



A global map of Mars, produced by Geof Lewis of Bunwell, Norfolk from images taken at the 2022 opposition.

Astron. & Geophys., **64**(2), 8 (2023)). Its solar-powered batteries had reached the end of their useful life.

Richard McKim, *Director*

Asteroids & Remote Planets Section

Membership of the Section includes 103 names on the e-mail distribution list, for which 47 IAU observatory codes have been allocated. Tim Haymes, Roger Dymock and the Director contributed 19 pages of asteroid/exoplanet information for the 2023 BAA *Handbook*. During the year it was decided to discontinue the role of Assistant Director (Astrometry), which was held by Peter Birtwhistle, as this technique has nowadays become routine. Peter served in this role since it was created in 2006. The support of assistant directors Tim, Roger and Peter has been much appreciated.

Exoplanets Division

Roger Dymock reports a total of 55 members of the Division. Publication of the Division's e-magazine *Infinite Worlds* continues on a quarterly basis, having reached Issue 19. It covers a broad range of topics including recent discoveries, publications, astrobiology, pro-am projects, the human exploration of space and the possibilities of detecting civilisations beyond Earth. By doing so, it reaches out to those other than dedicated imagers.

BAA members continue to make a significant contribution to the *Ariel* space mission's ExoClock project by determining the times of transit of exoplanets across their host star. In all, three papers have now been published – the latest comprising updated ephemerides for 450 planets. An Exoplanet Online Workshop was held on 2022 Nov 12 and Roger has given a number of talks via Zoom to: Solent Amateur Astronomers, Hampshire Astronomical Group, and the second ExoClock Annual Meeting.

Occultations

Tim Haymes has received 402 reports on behalf of the Section – similar in number to the previous year (414). The observers were: P. Birtwhistle, D. Briggs, L. Broom-Lynne, P. Denyer, T. Haymes, N. James, M. Jennings, S. Kidd, R. Leadbeater, J. Maarten Winkel, M. O'Connell, A. Pratt, W. Stewart, J. Talbot, P. Tickner, and D. Ward.

A number of events predicted for smaller bodies, with diameters of <10km, were observed, and we have contributed to the ERC Lucky Star Project (led by Bruno Sicardy) to observe (624) Hektor, (523643) 2010 TY53, (54598) Bienor, (216462) Polyphontes, (4063) Euforbo, and centaur comet 29P/Schwassmann–Wachmann.

The predictions are sourced from the *Occult Watcher* cloud server (maintained by Hristo Pavlov) and the Lucky Star group. Of the reports, 65 positives were observed as a single chord (two timings) and 12 asteroids were observed with multiple chords from different locations. Notable observations were: (94) Angelina, with four chords; (1021) Flammario, observed on two occasions with multiple chords; and (325) Heidelberga, for which Alex Pratt obtained the chance distinction of recording a graze across the edge – two chords from a single observation. The (4063) Euforbo occultation was one of the longest recorded, at 50.3s in duration (by J. Maarten Winkel). Without doubt, the highlight of the year was the first UK observation of a stellar occultation by a comet nucleus, namely of 29P, by Malcolm Jennings.

John Talbot (Abingdon, UK) maintains the UKOCL prediction feed for *Occult Watcher*. The European Section of the International Occultation Timing Association (IOTA) has a new reporting procedure: observers now upload reports to a new server (SODIS) where they are checked by experienced amateurs in each country or region. In the GB and IE regions, the review team is T. Haymes, A. Pratt and S. Kidd. The observations beginning 2023 January can be found at **sodis.iota-es.de/.**

Photometry

In November, an online group of observers was set up at **groups.io/g/ARPS**; it now has 24 members. It serves as a mailing and discussion facility for active observers, as well as a vehicle for conducting observing campaigns to follow specific minor planets at favourable apparitions, determining accurate rotation periods and phase curves. New low-phase-angle photometry was obtained of the Themis-family objects (1956) Artek, (2405) Welch, (2264) Sabrina, (3981) Stodola and (4151) Alanhale, as well as repeat coverage of (379) Huenna and (846) Lipperta at their 2023 apparition. Photometry and images were received from Steve Arnold, Matt Dawson, Wayne Hawley, Adrian Jones, Paul Leyland, Eric Watkins, Patrick Wiggins, and the Director. Observations at key times were made possible thanks to the Faulkes Telescope Project (Dr Paul Roche, Cardiff University) and access to the Las Cumbres Observatory network.

Peter Birtwhistle has continued his near-Earth object (NEO) observations and has had light-curve analysis papers published in every issue but one of the quarterly *Minor Planet Bulletin* (*MPB*), starting in 2021 January: 11 papers on 80 NEOs in all – a tremendous achievement. Wayne Hawley has also been active observing objects with no known period and has submitted a paper for publication in the *MPB*. Wayne and the Director have created a spreadsheet for logging all asteroids and photometric observations / images reported to the Section since 2004: a total of 13 apparitions and 83 objects.

Richard Miles, *Director*

Jupiter Section

The Section has continued in the same manner as in recent years, as described in our 2021 report, but with observations from northerly regions such as the UK still improving as the planet's declination increases. In 2022, opposition occurred on Sep 26, on the equator. Oppositions in September or October are always close because these occur when Jupiter is near its perihelion, which occurred on 2023 Jan 21. But this was the closest, not just for 12 years, but for 59 years past and 107 years future, because of a combination of orbital cycles. A link to Dominic Ford's analysis of this was given in our 2022/23 Report no.4 on the Section website.

The roster of observers was similar to that in 2021/22; as usual, excellent imagers were spread all around the world. Particular mention is due to Damian Peach, who (with Ian Sharp) spent three weeks in Barbados and produced some of the best-ever ground-based images of Jupiter; and to Clyde Foster, who moved his home and observatory from South Africa to a very remote site in Namibia with excellent skies.

Imaging has been greatly assisted for several years by the 'derotation' function in the *WinJUPOS* software, which enables images to be integrated over several minutes despite Jupiter's rotation. However, as transiting satellites and their shadows do not move at the same speed as Jupiter's surface, they often appeared smeared. Now, this is avoided by a further function that allows them to be derotated separately, to the aesthetic delight of observers.

Imaging Jupiter in the 889nm methane absorption band is useful, and has become better in recent years thanks to a succession of new CMOS cameras with greatly improved sensitivity in the near-infrared, enabling much shorter exposures and better signal-to-noise ratio. The ZWO ASI462MC camera led the way in 2020, and in 2022 Christopher Go reported even better results with the new QHY 5III462M and QHY III200M cameras.

In addition to regular imaging, four observers have been making carefully calibrated images of the planet's belts and spots in suites of narrower wavebands. Their projects enable quantitative conclusions about the colours and vertical structure of Jupiter's atmosphere, which complement professional research. Barry Adcock (Australia) makes composites in several wavebands from infrared to ultraviolet. Antonio Cidadão (Portugal) uses several weak and strong methane filters in IR, performing image subtractions to define the vertical structure of the cloud layers. Steven Hill (Colorado, USA) makes images in weak ammonia and methane bands in red light, using image ratios to measure ammonia abundances above the cloud-tops. Christophe Pellier (France) makes calibrated colour images to objectively measure the visible colours. All these observers summarised their projects in an international BAA webinar on 2023 Mar 1.

Tony Cook (UK) took some images at 1.5–1.7 microns, thus pushing 'amateur' imaging beyond the usual 1-micron limit, although he explained that this required a specialist, probably expensive camera.

The regular analysis of the planet's atmospheric changes has again been done in collaboration with the JUPOS team (the same members as in 2021), the ALPO-Japan (particularly Shinji Mizumoto), and the NASA JunoCam team, using the maps made by Gerald Eichstädt at each perijove from the JunoCam images.

For the 2022/23 apparition, we have posted seven interim reports on the Section's web page. They particularly covered the ongoing changes in the North Equatorial Belt and South Temperate Belt, both of which were gradually reviving. No. 5 included an overview of the main belts and zones. No. 6 was a full report on the mid/high northern latitudes. As part of this, using JUPOS measurements by Gianluigi Adamoli and polar maps by Rob Bullen, it was possible for the first time to measure the systematic drift of features up to 76°N, beyond the highest-latitude jet streams. No. 7 was a review of visual observations, including fine drawings by several observers. No. 8, a full report on the southern hemisphere, is almost ready for posting. We have also posted reports on the JunoCam images taken at each of the *Juno* perijoves in 2022/23 (PJ44 to PJ53).

Other items posted on the web pages were:

– A tutorial on visual observation of Jupiter on the BAA web pages;

– A news item on the first IR images of Jupiter from the *James Webb Space Telescope*;

– A news item on the launch of the new ESA Jupiter mission, JUICE (JUpiter ICy moons Explorer), on 2023 Apr 14. It was imaged leaving Earth about 13 hours after launch by Nick Haigh (Southampton), at approximately magnitude 13. Other BAA members imaged the pair on subsequent nights. JUICE should arrive at Jupiter in 2031.

– Images posted by observers in the BAA Members' Gallery are now automatically copied to the gallery on the Jupiter Section home page.

Three Jupiter-related items were published in the *Journal*: 'Occultation of 44 Cap by ... Io on 2021 April 2', by Eric & John Sussenbach [**132**(5), p.303, 2022 October]; 'Jupiter in 2021/22', a four-page review by John Rogers [**132**(6), p.348, 2022 December]; and 'Detecting Io's sodium emission spectroscopically', by David Boyd [**133**(3), p.142, 2023 June]. Boyd's clear detection raises the question of whether anyone can image Io's sodium cloud. Also, further analyses by Richard McKim of observations in the 1950s are in press.

With the revival of real-world meetings, it was very enjoyable and productive to meet friends and colleagues in person for the first time in several years. The EuroPlanet Science Congress (EPSC) in Granada in 2022 September was attended by the Director and several leading European amateurs, as well as many professional colleagues. The Director presented three posters with colleagues ('The transformation of Jupiter's North Equatorial Belt in 2021–22'; 'Jupiter's high-latitude northern domains: Dynamics from Earth-based and JunoCam imaging'; and Steven Hill's poster 'Jupiter ammonia absorption imaging: Highlights 2020–21'), and a talk at a separate Jupiter workshop. The Director also gave pro-am presentations at two other meetings: a poster at an RAS discussion meeting in 2022 November, and an online talk for a EuroPlanet workshop in 2023 June (along with Clyde Foster).

For the BAA, we presented the online webinar on multispectral imaging mentioned earlier (2023 Mar 1), and an in-person talk was given by the Director (2023 Mar 29). Video recordings of both are available via the BAA website.

NASA's *Juno* spacecraft continues to operate very well in its elliptical orbit around Jupiter, with a period of 38 days since PJ45 on 2022 Sep 29. JunoCam has returned a full set of images for us to analyse at every perijove, except for PJ47 to PJ49 when some images were lost (for the first time in six years). Those technical issues seem to have been overcome, for now, although the spacecraft's age and radiation exposure continue to increase. Since PJ50, the track at closest approach has moved round to the night side, so the most important imaging – in addition to that of the polar regions – is done in the final-approach phase, which now enables a good map of most of the planet, with excellent resolution as *Juno* approaches the north pole. Our main role now is to identify features of interest in the resulting maps. In addition to our regular reports on each perijove, the Section web page contains the schedule for all orbits, as well as archives of the global (cylindrical), north polar, and south polar maps that Gerald Eichstädt and the Director have produced at previous perijoves.

The planet itself has not shown major disturbances in 2022/23. The NEB has largely revived in width and darkness, but slowly and mostly quietly: unexpectedly, this revival has not been driven by prominent convective 'rifts' in the main part of the belt, but by small outbreaks in the southern component. The Equatorial Zone had strong colour for several years, but it rapidly faded during summer 2022 and is essentially absent in 2023. The South Temperate domain continues to exhibit interesting changes in various features, to the extent that a dark STB has now revived around most of the circumference. Meanwhile, the Great Red Spot is smaller than ever before, though it is still a uniquely powerful storm.

John H. Rogers, *Director*

Saturn, Uranus & Neptune Section

The opposition of the 2022 apparition of Saturn was on Aug 4. A few observers were able to observe the opposition effect, with the rings appearing brighter for a few days either side of that date.

High-resolution observations revealed a number of small features, particularly in the northern hemisphere. There were a few observations of the long-lived anticyclonic vortex, but this was very difficult to detect.

Attendees at the Comet Section Meeting, held at the National Maritime Museum on 2023 July 8. ***(Jack Martin)***

Transits of Iapetus continued during the latter part of 2022, with Darryl Milika and Pat Nicholas observing a shadow transit on Oct 5. By the end of this apparition, 36 observers had contributed Saturn observations.

At the close of the session, the following observers had provided early observations for the 2023 Saturn apparition: Paul G. Abel, Trevor Barry, David Basey, Andy Casely, Mike Hood, Efrain Morales, Luigi Morrone, Mattia Piccoli, Peter Tickner, John Sussenbach and Anthony Wesley.

These observations showed that the belt and zone structure is broadly similar to that observed during the latter half of the 2022 apparition. However, the reduced polar and ring inclination has allowed more of the southern hemisphere to be observed, which so far has appeared bluer or colder in tone compared to parts of the northern hemisphere. The most prominent belt is the southern component of the North Equatorial Belt, which has a noticeable warm tone. The northern component is much fainter. The Equatorial Zone is bright.

High-resolution observations by Trevor Barry have revealed some fine detail, including a frequently observed light oval at 55°S. In addition, some activity has been observed in the southern component of the South Equatorial Belt, which has sometimes appeared as a bright linear feature or as a series of small white spots in close proximity. However, the anticyclonic vortex has so far eluded detection.

A small number of transits of satellite Tethys and its shadow have also been observed.

The appearance of Uranus during the 2022 apparition was similar to that during the 2021 apparition. Observations, particularly in infrared, showed a bright region surrounding the north pole, with a slightly darker band further south. An occultation of Uranus by the Moon was observed on Sep 14.

During 2022, a few brighter areas were observed near the southern limb of Neptune, particularly in infrared, but no other features were detected.

The following reports were published in the *Journal*: 'Saturn during the 2009/2010 apparition' by the Director [**133**(1), p.23, 2023 February] and 'Neptune in 2016–2017' by John Sussenbach [**133**(3), p.175, 2023 June]. Notes for the 2023 apparition of Saturn have already commenced on the website.

The first Back-to-Basics course since the pandemic was held in York on 2023 Mar 11. This was supported by the Director, who gave a talk on 'Observing the planets'.

The Saturn, Uranus and Neptune part of the BAA Welcome Pack was recently updated.

John Sussenbach is a noted planetary imager. At the beginning of 2009, he became an Assistant Director of the Section, working on updating and maintaining the website. However, he gave up this role in 2020. In 2017, he was appointed as Neptune Coordinator. Recently, he has decided to resign this role. Both personally and on behalf of the Section, the Director would like to thank John for all the hard work he has undertaken in these two roles, and for the excellent advice he has provided.

Mike Foulkes, *Director*

Comet Section

The Section held a very successful meeting at the National Maritime Museum (NMM), Greenwich, on 2023 Jul 8 and this was attended by almost 100 people. The event was made possible by the NMM and Flamsteed Astronomy Society and the Director is immensely grateful to them for the excellent venue and organisation. The initial idea to hold a meeting at the NMM came from Janice McClean and the chair of Flamsteed, Bobby Manno. Thanks also to the speakers – Dr Richard Miles, Helen Usher, Jonathan Shanklin, Thomas Lehmann, Robin Leadbeater, Dr John Mason, and Prof Alan Fitzsimmons for a fascinating range of talks. Feedback after the meeting was universally positive. A recording of the event is currently being edited by Gill and Roger Perry, and this will be put on the BAA YouTube channel when it is ready.

We had a reasonably bright comet at the start of the year. C/2022 E3 (ZTF) was discovered by the Zwicky Transient Facility (ZTF) on 2022 Mar 2, and it made a close approach to Earth in 2023 February. The comet reached naked-eye visibility in 2023 January and many observations and images were submitted to the Section. A report was published in the 2023 April *Journal* [**133**(2), p.78].

Some observers submit comet astrometry to the Minor Planet Center (MPC) and a number use the Section's *Comphot* software to extract total magnitudes from images. Jonathan Shanklin has continued to analyse quantitative data submitted by visual and electronic observers and he reformats the observations into the convention that Guy Hurst uses for publication in *The Astronomer*. Observations are also archived at the Comet Observations database (COBS) website.

Denis Buczynski has continued to manage the Section's online image archive. At the end of 2023 July, this contained 44,005 images. A total of 5,111 images were added during the session, at an average rate of 14 per day.

The number of comet spectra in the BAA spectroscopy database continues to increase. A further nine spectra of two reasonably bright comets

(C/2022 E3 and C/2020 V2) were added during the session. Spectroscopy is an increasingly important tool used by amateur comet observers and is crucial in understanding the chemical evolution of cometary objects.

There has been one issue of the Section's newsletter, *The Comet's Tale*: Issue 42, published in 2023 July. It is available from the website and its 66 pages are packed with a wide range of material. Thanks go to the editor, Janice McClean, for putting this together. We are always looking out for good material, so please contact Janice directly if you would like to write an article for the *Tale*.

The Director provided material for the 2024 BAA *Handbook*. Jonathan also prepares the annual predictions for forthcoming comets, which appear in the *Journal*.

Peter Carson continues to deal with imaging queries from members and non-members. Richard Miles remains as leader of our 29P/Schwassmann–Wachmann project and a number of outbursts have been detected during the session. Richard maintains the 'Mission 29P' pages on the Comet Section website and there is plenty of work to do on this fascinating object. In addition to photometry, precision astrometry by Richard and others has improved our knowledge of the comet's orbit, so that it is now possible to accurately predict stellar occultations. Five of these have been observed, leading to improvements in our knowledge of the position, size and shape of the nucleus. The most recent occultation track passed over north-west Europe and Malcolm Jennings in South London recorded the first-ever positive observation of a cometary occultation from the UK.

Nick James, *Director*

Meteor Section

An undoubted highlight of the 2022/2023 session was the successful observation of the fireball associated with the Near-Earth Object Confirmation Page object Sar2667 (now designated 2023 CX1), which led to the fall and successful recovery of meteorites in northern France on 2023 Feb 13 at 02:59 UTC. Following an alert by Peter Birtwhistle (Great Shefford Observatory), the fireball was successfully observed both visually and by video cameras in south-east England, including by the Director (Barnham), Nick Quinn (Steyning), Crayford Manor House AS Observatory (Dartford), and elsewhere across northern Europe. The distinctive orange colour of the brilliant double terminal flash of this fireball was particularly noticeable.

2023 CX1 was the seventh object to be discovered before impact (previous examples were 2008 TC3, 2014 AA, 2018 LA, 2019 MO, 2022 EB5 and 2022 W11) and the third to lead to the recovery of meteorite fragments. An initial analysis of FRIPON video recordings of the 2023 CX1 event by Jiří Borovička and Pavel Spurný (International Meteor Organization, IMO) enabled the location of a possible strewn field to be determined and subsequent searches led to the successful recovery of several fragments near St Pierre le Viger in Normandy. A later analysis of the video recordings by Denis Vida (Global Meteor Network, GMN) showed that the residuals of the Crayford Manor House AS analogue system compared favourably with other participating digital camera systems.

The number of UK observers constructing and using GMN's Raspberry Pi Meteor Station (RMS) units to collect good-quality data on radiants and orbits continues to increase. GMN is a worldwide network of simple cameras which auto-process their nightly meteor data and upload it to GMN's server at the University of Western Ontario for multi-station analyses. However, observers have noted that the GMN/RMS software currently does not automatically analyse fireball-class meteors. They are saved by its fireball detector, but the user has to manually look for them in its FR files, then use *SkyFit* to manually process each clip frame by frame.

The 2022/2023 session produced the usual crop of bright meteors and fireballs. Observations of such events are usually logged on the IMO website. In many cases, little by way of accurate information about the atmospheric path of an object could be gleaned from visual observers and there were insufficient video data available. In other instances, the events were captured on video from several locations and useful data (including spectra) were obtained.

Other than the event of 2023 Feb 13, the most widely observed fireball events by far were on 2022 Sep 14 at 20:59 UT, AMS 6109-2022, 1,259 reports; 2023 Jan 9 at 20:01:27 UT, AMS 23-2023, 607 reports; Jan 24 at 06:50 UT, AMS 473-2023, 216 reports; and Apr 3 at 05:15 UT, AMS 1891-2023, 172 reports. Of these, the most widely observed was the slow-moving fireball of 2022 Sep 14, which moved on a roughly SSE to NNW trajectory between Northern Ireland and the coast of Scotland. Sonic booms were heard, but if there were any surviving fragments they would have fallen in the sea. The other very well-observed event, on 2023 Jan 9, was recorded by several cameras; it was a slow-moving sporadic fireball travelling roughly south to north from Wiltshire across the border of Oxfordshire and Gloucestershire to Warwickshire.

Unfortunately, moonlight interfered with observations during the peak activity of many of the major meteor showers during the session. The maximum of the Perseids, predicted for the early morning hours (UK time) of Saturday, Aug 13, occurred just after full Moon, but in spite of increasing interference from moonlight, observers took advantage of the run of clear if somewhat hazy nights to record increasing Perseid activity in the run-up to the peak and for a few nights thereafter. Indeed, many visual observers refused to be put off by the bright Moon, which lay far south of the celestial equator in Aquarius, minimising the effects of moonlight by positioning themselves so the Moon lay behind them or was hidden behind a wall or other suitable obstruction. This is easiest when the Moon is fairly low in the southern sky, as it was for the Perseid peak in 2022. In the event, a very fine run of observations was obtained by video, DSLR and visual observers. Of the visual observers, Steven Brown (Stokesley, Middlesbrough) is worthy of mention, contributing watches for eight out of 12 nights between Aug 3/4 & 14/15. Nick James (Chelmsford) supplied a fine series of single-station Perseid counts and magnitudes for his four cameras and Mark and Mary McIntyre (Tackley) provided Perseid-only track stacks of the area around the radiant for the nights of Aug 9 through to Aug 14.

An analysis by Alex Pratt (Leeds) combining the results from RMS and UFO video cameras, with a sample of 1,822 Perseid meteors from 6,668 multi-station captures, gave a radiant at RA $03^h\ 15^m$, Dec. +58.4° at solar longitude $\lambda_\odot$ (2000.0) = 140.0°, with a drift in RA of +1.40° per day and in Dec. of +0.23° per day. Visual observers reported a fairly smooth rise in activity from a zenithal hourly rate (ZHR) of ~10 meteors per hour (m/h) on Aug 3/4 to ~20m/h on Aug 10/11, and a peak on Aug 12/13 at $\lambda_\odot$ (2000.0) = 140.0° (= Aug 13d 01h 20m) of ~55m/h, perhaps rather lower than in previous years, but possibly affected by the moonlight.

A good crop of Perseid fireballs was recorded. Notable examples were on Aug 11 at 01:53:18 UT and at 03:15:45 UT, with Dr Bill Ward (Kilwinning) obtaining spectra of both. Derek Robson (Loughborough) also obtained spectra of two more bright Perseids on Aug 13, at 23:48:23 UT and at 00:15:55 UT. Another high-resolution spectrum was obtained by Dr Ward of a bright non-Perseid (radiant in Cygnus) on Aug 10 at 02:11:16 UT.

A new meteor shower, the August Delta Capricornids, associated with periodic comet 45P/Honda–Mrkos–Pajdušáková, was discovered by the global CAMS networks on 2022 Aug 16. In all, 137 meteors were triangulated mainly during two brief time intervals, the first centred on $\lambda_\odot$ (2000.0) = 143.16° and the second, stronger peak at $\lambda_\odot$ (2000.0) = 143.707° (2023 Aug 16 at 22h UT) with a radiant at RA $21^h\ 41^m$, Dec. –11.4°. (*CBAT* no. 5161 (2022): **bit.ly/3r3m6rS**.)

The Orionids in October were very favourably placed with respect to moonlight, but there was a lot of cloud cover at the time of the peak around Oct 21/22. A total of 226 multi-station Orionids were recorded, including two bright examples: one on 2022 Oct 18 at 03:01:52 UT, for which Bill Ward obtained a nice spectrum, and a second on Oct 18 at 23:54:46 UT.

Several of the autumn showers, including the Taurids and Leonids, were adversely affected by bright moonlight. However, Nick Quinn recorded a bright Northern Taurid fireball on 2022 Nov 11 at 20:06:47 UT.

Observations of the Geminids in December suffered only slight interference from a last-quarter Moon in Leo, but the weather was generally very cold, down to –7°C with snow in some places. There were some long, clear periods and video observers recorded hundreds of meteors near the peak. Nick James recorded 297 single-station Geminids across five cameras between 03:15 and 06:25 UT on Dec 13/14 (before the peak), but 918 Geminids throughout the night of Dec 14/15 (the night after the peak), and only 62 on Dec 15/16, demonstrating the usual steep decline in Geminid activity after maximum. Visual observers, braving challenging conditions, noted a steady rise in activity from a ZHR of ~15m/h on Dec 11/12 to ~40m/h on Dec 12/13, approaching 100m/h before dawn

on Dec 13/14, 70m/h dropping to ~40m/h during the night of Dec 14/15, and only ~15m/h the following night. There was the usual crop of bright Geminid fireballs, and a number of spectra were obtained.

The Director received some very interesting forward-scatter radio results for the Geminids from Stuart Green (Preston), who submitted three successive years' worth of data, comparing the event counts for the whole 24 hours of Dec 14 for the years 2020–2022. Stuart utilised the GRAVES bistatic radar system at 143.050 MHz, designed for space surveillance, whose transmitter is located at Broye-lès-Pesmes, France. The transmitter/receiver alignment with the radiant is less favourable during morning and afternoon periods, but the plots showed interesting variations from year to year, which are worthy of further detailed investigation. The Director is always most grateful to all those observers who submit their radio counts to the Section.

The Quadrantid meteor shower was predicted to reach its peak between 23h and 02h on the night of 2023 Jan 3/4, but the duration of the peak is only about six hours, so observers need to be at a favourable longitude (such as in 2023 for the British Isles) and have good weather. In the event, observers had to contend with considerable cloud cover and a gibbous Moon only two days before full. Alex Pratt recorded a total of 196 single-station Quadrantids on his video cameras.

The April Lyrids mark a welcome break from the generally low meteor rates of the early spring and coincided this year with a virtually new Moon. Maximum activity was predicted for the early morning hours of Apr 23, but the weather in April was rather unsettled and most observers were clouded out at the peak.

The Director has again provided the data for the Meteor Diary in the BAA *Handbook*, and the list of Principal Meteor Showers in the *Diary of the Royal Astronomical Society*. In June he presented the BAA's George Alcock Memorial Lecture, highlighting the important pioneering work of G. E. D. Alcock and J. P. M. Prentice, whose partnership in the 1930s, '40s and early '50s made many important contributions to meteor research. In July, the Director gave a presentation at the BAA Comet Section Meeting in Greenwich, in which he explained the processes which give rise to the formation and fine structure of meteoroid streams and showed how dust filaments laid down at different returns of the parent comets could produce brief outbursts in the activity of meteor showers.

As always, the Director is extremely grateful to all those observers who contribute observations by any means (visual, DSLR, radio and video) to the Section, to Jim Rowe and Ashley King of UKFAll and to all members of the Meteor Section committee for their continued support, enthusiasm and encouragement, and particularly Leonard Entwisle, Tracie Louise Heywood, Nick James, Alex Pratt, William Stewart and Dr Bill Ward. The Director is especially grateful to the Section's Assistant Director Alex Pratt for his many valuable contributions to the work of the Section during the past session.

John Mason, *Director*

Aurora & Noctilucent Cloud Section

Aurora

The Sun is now very active, with R1 alerts almost every day. It has not yet started firing off X-class flares on a regular basis, but that may come soon. Coronal holes and some coronal mass ejections are still the major source of aurora. The numbers of sightings are up on last year and are now from all over the UK. The aurora was observed in all months except June. All these reports came by e-mail, and all reports were replied to.

August (14 observations) had three G1-class storms, one G2, seven R1, four R2 and one S1. September (7) had four G1, two G2 and seven R1-class storms. October (9) had six G1, seven R1, one R2, and one R3. November (18) had six G1, two R1 and one R2. December (7) had four G1, seven R1 and two R2. January (15) had three G1, 12 R1, one R2 and four R3. February (18) had five G1, two G2, one G3, 11 R1, four R2, two R3 and two S1. March (21) had one G1, one G2, one G3, one G4, five R1, three R2, one R3 and three S1. April (10) had two G4 and eight R1. May (1) had five G1, two G2, two G3, 16 R1, six R2 and four S1. June (no observations) had two G1, two G2, 14 R1 and one R3. July (4) had five G1, 20 R1, two R2, one R3, six S1 and one S2. The most southerly observation was made by Jay Brausch from North Dakota. This makes a total of 124 observations from 37 reporters.

Noctilucent cloud (NLC)

In 2022 August, NLC was reported on seven nights with a total of 26 individual observations, the last being Aug 11/12. Fifteen of the 26 observations were for the night of Aug 10/11.

Satellite data indicated first contact for the southern season on Dec 1 and it finished on Feb 18: a very quiet season with no reports received. The Section then received word that the AIM satellite was in safe mode with battery problems and would not be back until after the northern season, if at all. However, NOAA-21 would act as a temporary replacement.

First northern-hemisphere detection by NOAA-21 was on May 26, but no reports were received that month. In June, NLC was reported on 15 nights, with a total of 98 individual observations received. The earliest report received was on Jun 3/4, from Nick James in Chelmsford.

NLC was reported on 26 nights in July, with 112 individual observations received. The total number of observers from May to July was 51. The highest number of individual reports received for a single night was 31 for Jun 15/16. These figures are for observations sent to the undersigned and Ken Kennedy (Assistant Director); they do not include those additionally recorded by Tom McEwan's NLC website.

The Section

Several articles have been produced for the *Journal*, and a paper by Ken Kennedy, entitled 'Noctilucent cloud over Britain and Western Europe, 2021' [2023 February, **133**(1), pp 51–55].

Several talks have been given by various officers throughout the year. Most of these were done by Zoom, as normal visits remain problematic. Aurora images have been supplied for talks by other Sections. The Section is still supplying data to Dr Cora Randall to help with the CIPS module on the AIM satellite, and now with NOAA-21. The Section owes a great deal of thanks to Dr Randall, Dr Lynn Harvey and Mark DeLand for information supplied.

The Section has established links with Gavin Pretor-Pinney of the Cloud Appreciation Society, thus increasing the number of NLC reporters. The Section strength now stands at 220, and it is encouraging to see that there are still many people who are willing to send in reports and high-quality photographs.

Thanks go again to Tom McEwan for access to his NLC website, **ed-co.net/nlcnet**, and the ease with which reports can be entered. Finally, the Section officers would like to thank all those observers who have sent in reports and images of auroral and NLC displays during the past year.

Sandra Brantingham, *Director*

Variable Star Section

Observing highlights & Section news

The cool hypergiant RW Cep has kept observers busy this year with its unusual fade, which some have compared to the 'great dimming' of Betelgeuse in 2019–'20. Recent images of RW Cep obtained with the CHARA Array interferometer, which resolve the star, provide evidence for a mass ejection that created a dust cloud which partially blocked the stellar photosphere, thereby explaining the dimming. The image on the opposite page by Mazin Younis shows the fine field in which RW Cep resides.

In 2022, the Variable Star Section (VSS) alerted the community to the record-breaking maximum of the long-period variable S CrB. Observers have also been delighted by the bright supernova SN 2023ixf in Messier 101. Discovered by Japanese amateur Koichi Itagaki on 2023 May 19, it reached magnitude 10.8 and was identified as a Type II (core collapse) supernova.

The recurrent nova T CrB generated much interest as it ended its super-active phase, which began in 2015, in early 2023. A key indicator was the reappearance of flickering, first reported by John Toone. It has now entered a pre-eruption dip. Prof Bradley E. Schaefer (Department of Physics & Astronomy, Louisiana State University) has pointed out that the previous eruption of T Crb, in 1946, occurred a year after the end of the super-active state. His latest prediction for the eruption is 2024.4 ± 0.3, i.e., 2024 February to August. A VSS campaign is underway to monitor the nova.

Shaun Albrighton, VSS Pulsating Star secretary, recently submitted his 100,000th visual observation to the database. We congratulate him for this remarkable achievement and applaud his dedication.

The Director would like to thank all our observers who go out night after night to monitor the variable stars. He also thanks the Section Officers for their work, and without whose help it would not be possible to run the Section.

BAA VSS Database report (Andrew Wilson)

Observations received

This report covers variable star observations added to the photometry and spectroscopy databases by 2023 Aug 8, for the period 2022 Aug 1 to 2023 Jul 31. There were slightly fewer visual and more digital photometric observers this year, and a small increase in those performing spectroscopy. Overall, the number of observers has remained roughly constant. The number of visual observations has remained about the same, while the number of digital photometric observations reduced by about a half. This was due to a single observer who made a large number of observations in the previous session. The majority of digital photometry was still performed with CCDs rather than CMOS sensors, with a drop in the number of DSLR observations to a few hundred.

Method	*Observations*	*Observers*	*Variable stars*
Visual	30,814	28	742
Digital (CCD/CMOS/DSLR)	165,521	32	1,020
Total Photometry	196,335	55	1,355
Spectra	1,803	18	338

Visual observations

The visual observations received for the period are as follows:

G. Poyner, 12,055; J. Toone, 6,281; S. W. Albrighton, 4,268; L. K. Brundle, 1,458; P. B. Withers, 1,433; J. D. Shanklin, 703; W. J. Worraker, 694; T. L. Heywood, 653; R. C. Dryden, 534; R. Pearce, 509; T. Vale, 418; J. Hilder, 321; M. L. Joslin, 315; D. Dobbs, 265; R. A. H. Paterson, 202; R. K. Hunt, 161; R. B. I. Fraser, 140; J. T. Bryan, 102; C. J. Evans, 90; P. G. Abel, 76; G. M. Hurst, 47; J. Thorpe, 32; D. Hale-Sutton, 30; C. Lloyd, 19; A. J. Wilson, 3; T. Jones, 2; J. Shears, 2; D. Nicholson, 1.

The hypergiant variable star RW Cep and part of the nearby Sharpless 132 H II region. 2023 Jan 1. Field 1° 20′ × 0° 53′. Equipment: Quattro 200mm *f*/4 Newtonian, ASI 294MC-Pro camera, UV-IR filter. Exposure: 20×180s (1h total). (*Mazin Younis*)

The top 10 variable stars observed visually during the period are as follows: R CrB, 558 observations, 17 observers; SS Cyg, 509, 10; CH Cyg, 489, 13; Z Cam, 462, 9; T CrB, 349, 9; Z UMi, 316, 6; RX And, 305, 10; V1405 Cas, 295, 8; Z UMa, 270, 13; AB Dra, 258, 6.

Digital observations

The digital observations received for the period are as follows:

J. T. Screech, 44,068; I. Sharp, 32,290; D. S. Conner, 24,170; C. Watkins, 16,789; M. Usatov, 14,354; D. Boyd, 10,724; M. Larsson, 6,442; T. Vale, 4,867; G. Poyner, 3,063; G. Fleming, 1,692; S. Johnston, 1,475; R. Sargent, 1,190; I. L. Walton, 1,159; N. D. James, 595; J. H. Mallett, 489; D. G. Buczynski, 353; D. Matthews, 290; J. Shears, 235; D. Shepherd, 233; P. Bouchier, 191; M. Mobberley, 154; J. Simpson, 115; P. C. Leyland, 109; D. Loughney, 98; W. Parkes, 88; M. Phillips, 69; G. D. Coates, 54; G. M. Hurst, 51; G. J. Privett, 44; A. R. Pratt, 34; F. Tabacco, 34; A. J. Wilson, 2.

The top 10 variable stars observed digitally during the period are as follows: CG Dra, 14,561 observations, 10 observers; RZ Cas, 14,039, 3; IM Aur, 6,499, 1; MU Cam, 5,118, 3; SW Lac, 4,505, 5; BX And, 4,493, 1; SZ Lyn, 4,475, 1; RU UMi, 3,602, 1; DZ Lyn, 3,533, 1; EV Lac, 2,987, 3.

Spectroscopy observations

The spectroscopic observations received for the period are as follows:

J. Foster, 514; J. Guarro Fló, 447; R. Leadbeater, 241; F. Sims, 164; E. Bryssinck, 124; D. Boyd, 65; R. Diz, 54; U. Sollecchia, 51; A. Leduc, 39; S. Curry, 27; U. Zurmühl, 22; K. Gurney, 14; M. Rodriguez, 14; H. Allen, 13; A. Antonino, 5; J. Coffin, 4; A. Stiewing, 4; G. Gebhard, 1.

The top 10 variable stars with spectra during the period are as follows: alf Cam, 221 observations, 7 observers; EV Lac, 95, 3; RR Lyr, 87, 2; T CrB, 85, 6; VV Cep, 81, 4; SN 2023ixf, 70, 4; RW Cep, 46, 3; zet Tau, 35, 3; 28 Cyg, 31, 4; V1716 Sco, 27, 1.

Cataclysmic Variables & Eruptive Stars programme (Gary Poyner)

Visual observations of objects on the CV&E programme numbered 19,497 of 315 stars for the 2022–'23 session. This is an increase of 2,500 on the previous 2021–'22 session, for seven fewer stars. R CrB replaced SS Cyg as the best-observed star amongst visual observers, with the top five being: R CrB (558 observations), SS Cyg (509), CH Cyg (489), Z Cam (462), and T CrB (349). R CrB was also the most popular, with 17 observers contributing observations.

Digital observers (CCD, DSLR and CMOS) contributed 30,124 observations for the 2022–'23 session, of 651 stars. This is a slight reduction on 2022–'23. These numbers include time-series observations. The best-observed star was CG Dra, with 14,561 observations from 10 observers. The other four most popular targets were V844 Her (1,308 observations), T CrB (1,289), GK Per (1,137), and SS Cyg (865).

Pulsating Stars programme (Shaun Albrighton)

During the past 12 months, the most popular stars for visual observers were Z UMa (270), chi Cyg (193), RY UMa (193), AC Her (164) and AF Cyg (157). In comparison, for digital observers the highest figures were T Cep (473), SU Per (460), V393 Cas (442), RW Cep (431), and AH Dra (383).

The coordinator would like to encourage observers to add to their programmes stars which are close to other variables. For example, R Sct received 142 observations, but V Aql and S Sct, which are on the same chart, only 47 and 44, respectively.

Highlights this year include the very bright maximum of the Mira variable R Aql (5.9) and faint maximum of T UMa (9.1). Also of note was the dimming of the hypergiant SRd variable RW Cep, which faded to 7.8/7.9 between late 2022 December and 2023 April.

Eclipsing Binary programme (Des Loughney)

Predictions for Algol, RZ Cas and RS CVn eclipses have been provided for the BAA *Handbook*. 'Eclipsing Binary News' continues to be a regular feature of the *VSS Circular*, containing information on the systems in our programme and the latest research on eclipsing binaries.

A second edition of the *Eclipsing Binary Handbook* is available as a free download on our website. The *EB Handbook* is meant to be a live document, so it will continue to be revised. We would welcome suggestions for amendments and additions. There is now a printed version of the *EB Handbook*, which can be ordered from the BAA online shop for £8.00. It was written as a beginners' guide, and perhaps we should publish something which describes the more advanced techniques which are practised by our amateurs today. These include the examination of TESS photometry (*VSS Circular* 196, p.39) and the use of remote instruments such as the Open University COAST telescope (*VSS Circular* 196, p.47).

The continuing interest in eclipsing binaries is illustrated by the number of articles on these systems in every edition of the *VSS Circular*. Of special interest was the use of up-to-date techniques to show that the components of eclipsing binaries can be variable in their own right. See in *VSS Circular* 194 David Connor's article 'RZ Cassiopeiae light curves showing activity of the delta Scuti component'.

Numerous requests for information during the year have been answered, covering topics such as suitable binaries for observing programmes, using DSLR methodology for accurate photometry, and information about individual systems.

UK Nova/Supernova Patrol (Guy M. Hurst)

The Patrol continues to be coordinated through the Association's Variable Star and Deep Sky Sections, and also by the editor of *The Astronomer* magazine (*TA*). However, the loss of Ron Arbour, the coordinator's assistant (imaging) who sadly died on 2022 Mar 12, and Bob Evans (visual) of Australia, have been tremendous losses to the team.

Patrol outbursts & discoveries

In support of regular appeals to our Patrol from professionals for follow-up photometry of extragalactic supernovae, permission was obtained from the Open University to use the 17-inch (0.43m) COAST telescope via the Internet, with appropriate filters. COAST has allowed the Patrol coordinator to measure very accurate results, down to magnitude $V = 17$.

The International Astronomical Union supply discovery bulletins, also supported by the American Association of Variable Star Observers' high-quality charts.

George Carey is searching for novae in Messier 31 (Andromeda), both for discoveries and follow-ups. The results are sent regularly to the VSS.

We welcome new members to join the various valuable sub-patrols.

CCD Target List & observing campaigns (Jeremy Shears)

The CCD Target List was developed to provide people who were new to the field of CCD photometry of variable stars with some interesting targets to which they could turn their instruments, whilst developing their techniques. The stars on the list provide a focus for people who wish to take up this branch of astronomy, perhaps desiring to move on from taking pretty picture to doing science. From time to time, campaigns on specific stars are organised.

Two observing campaigns were run during the session. One campaign, coordinated by Stewart Bean, is to detect outbursts of UGER-type dwarf novae. These are frequently outbursting systems and the aim is to study

variation of their supercycles – the time between successive superoutbursts. Targets include ER UMa itself, IX Dra, RZ LMi, V1159 Ori, YZ Cnc and DI UMa.

Another current campaign concerns the neglected dwarf nova G Dra. This is one of the most active dwarf novae, going into outburst every 11 days or so. Many thanks to everyone who has contributed to this observing campaign over the past couple of years: P. Bouchier, D. G. Buczynski, G. D. Coates, N. D. James, P. C. Leyland, M. Mobberley, R. Pearce, R. D. Pickard, G. Poyner, R. Sargent, J. Shears, D. Shepherd, F. Tabacco, M. Usatov, and I. L. Walton. Maxim Usatov has conducted intensive time-series photometry for several months using his remote telescope in Spain, yielding many high-quality data. The coverage has been good and we have not missed any of the outbursts. As a result, Usatov and the Director published a paper on 'The outburst behaviour of the dwarf nova CG Draconis' in *Astronomische Nachrichten* (**doi.org/10.1002/asna.20220113**), including data contributed by VSS observers. It is also available on ArXiv at: **arxiv.org/abs/2301.05870**.

As mentioned at the beginning of this report, a campaign is under way to observe T CrB in the run-up to its next eruption. All forms of data are useful: visual, digital photometry, and spectroscopy (see p.210 of the 2023 August *Journal* for more information).

New observers who wish to contribute to any of our campaigns are always welcome.

Chart report (John Toone)

Updated charts, with minor but important sequence revisions, were released for the following stars: W And, R Aql, RV/RW Boo, omicron Cet, T CrB, RY Dra, AH Dra, g Her, OP Her, BL Lac, U LMi, R Ser and V UMi. Observers of the aforementioned stars are encouraged to download the latest charts from the VSS website.

Variable Star Section mentoring scheme

The Section continues to put people in touch with mentors who can provide advice about the basics as well as the intricacies of variable star observing. This covers visual work, DSLR and CCD photometry, and spectroscopy, as well as data analysis and reduction. However, we are in need of new mentors, especially for visual and for digital photometry. If you think you can help, please contact the Director.

The Section has a LISA spectrograph which is available for loan to members who wish to dip their toes into this fascinating branch of astronomy. Andrew Wilson's four-part series 'An introduction to spectroscopy' was published in the *Journal*.

Variable Star Section Circulars (Gary Poyner)

Four *Circulars* were produced for the period in review: *VSSC* 193 (2022 Sep 1), *VSSC* 194 (2022 Dec 1), *VSSC* 195 (2023 Mar 1) and *VSSC* 196 (2023 Jun 1). These circulars are sent out to 219 Section observers and other interested people by e-mail, and are available for download free of charge from the VSS web pages to anyone interested in variable stars.

The Variable Star Section web pages, Facebook page & Alert Group

The Section maintains its independent web pages, which are updated at irregular intervals with news and light curves and provide access to the *VSS Circular* for free downloading.

The VSS Facebook page continues to be maintained by Tracie Heywood on a regular basis. The BAAVSS-alert e-mail group continues to be operated through Groups.io and is the prime source for disseminating information to variable star observers quickly. The group now stands at 127 members – a slight increase on 2021–'22.

Contributions to the *Journal* and *Handbook* with a variable star theme

In the *Journal*:

- 'Six remarkable northerly novae in 2020–'21', Jeremy Shears [**132**(4), 221];
- 'Follow-up observations of recent novae requested', Jeremy Shears [**132**(4), 208];
- 'BAA variable star observers contribute to research on quasars & dwarf novae', Jeremy Shears [**132**(4), 212)];
- 'An unexpected eruption of U Scorpii', Jeremy Shears [**132**(4), 212];
- 'An introduction to spectroscopy, Part I', Andy Wilson [**132**(4), 219];
- 'Two interesting variables in Sagitta & Aquila', Gary Poyner [**132**(4), 262];
- 'A gravitationally lensed supernova', Jeremy Shears [**132**(5), 272];
- 'New AAVSO Executive Director', Robert K. Buchheim [**132**(5), 272];
- 'Has the colour of Betelgeuse changed?', Jeremy Shears [**132**(5), 282];
- 'An introduction to spectroscopy, Part II: Applying spectroscopy to astronomical objects', Andy Wilson [**132**(5), 283];
- 'Observations of the first confirmed superoutburst of the dwarf nova DDE 39'; Jeremy Shears, Marc Deldem, Eddy Muyllaert, Roger Pickard, Gary Poyner, Richard Sargent, Tamás Tordai & Tonny Vanmunster [**132**(6), 355];
- 'RY Sagittarii fades', Jeremy Shears [**132**(6), 340];
- 'LISA spectrograph available for loan'; Jeremy Shears, David Boyd & Andy Wilson [**132**(6), 347];
- 'An introduction to spectroscopy, Part III: Spectrographs', Andy Wilson [**132**(6), 353];
- 'Summer 2022 – a season of Mira-star excesses', John Toone [**132**(6), 393]
- 'Measuring the light profile of the Crab Nebula pulsar', David Hardwick [**132**(6), 394];
- 'Report on the 41st Symposium on Telescope Science', David Boyd [**133**(1), 6];
- 'Nova Cas 2021 & RW Cep: two variable rarities', Jeremy Shears [**133**(1), 11];
- 'An introduction to spectroscopy, Part IV: Processing spectra', Andy Wilson [**133**(1), 13];
- 'AT Cancri – a unique dwarf nova in Cancer', Gary Poyner [**133**(1), 61];
- 'Revisiting the nova-like variable HS 0229+8016 with data from a BAA VSS campaign & TESS', Jeremy Shears & Stewart Bean [**133**(2), 115];
- 'BAA members' research into circumbinary exoplanets published', Ian D. Sharp [**133**(2), 74]
- 'Variable Star News', Jeremy Shears [**133**(2), 85];
- 'Amateur help sought in classifying variable stars', Philip Jennings [**133**(2), 74];
- 'New Cepheid calibration', Philip Jennings [**133**(3), 140];
- 'Delta Cephei's companion variables', John Toone [**133**(3), 198]

The 2023 BAA *Handbook* also features T Cephei as Variable Star of the Year (Tracie Heywood, pp. 105–107), eclipsing binary ephemerides (Des Loughney, pp. 102–103) and dates for maxima and minima of Mira variables (Bob Dryden, p.104).

Jeremy Shears, *Director*

Deep Sky Section

The Section's annual meeting was held in person for the first time since the COVID-19 lockdowns. It was held at Bedford School, Bedford on Mar 19, with the much-appreciated assistance of Bedford Astronomical Society. The speakers were Alan Snook ('Renovating a 14-inch reflector'), Nick Hewitt ('Variable nebulae update'), Mazin Younis ('In search for dark skies'), and Prof Michael Merrifield ('Update on the Extremely Large Telescope). Martina McGovern was due to present but unfortunately was unwell; many thanks go to David Davies who stepped in at late notice.

Nick Hewitt kindly chaired the meeting in the absence of the Director, who sent a short video message.

An online Section meeting is planned for 2023 September and an all-day in-person meeting is to be held in 2024 April.

Observations

Observations received were mostly digital images of the brighter and more popular deep-sky objects. There are still some visual reports and sketches submitted, which have been very welcome. There were a small number of spectroscopic observations. Many members of the Association post interesting deep-sky observations in their Member's Album on the BAA website – the Director views these whenever possible, but sometimes something will be missed, so please e-mail such observations to him too.

The Section

Section membership now stands at 222 – up four from last year.

Monthly e-mail updates have been sent to members and posted on the BAA website. The monthly 'Object of Interest' has proven very popular.

Stewart Moore, Owen Brazell and the Director have provided articles for each *Journal* through the year on some topic of deep-sky observing, and members' observations are often reported in this publication too. There was also a paper on double-star observing by Christopher Taylor: 'ζ Herculis: a case study in the quoted magnitude differences of close, unequal binary stars' [**132**(4), pp 247–255 (2022)].

The Section website

Deep Sky Notes have been published on the website: *Note* #4,'Cosmic Horseshoe', by Grant Privett; #3, 'Albireo unbound', by Christopher Taylor; #2, 'Going deep – In pursuit of $Z = 5$', by Grant Privett; and #1, 'Observations of the variable star V347 Aurigae and its associated reflection nebula', by Richard Sargent. Many thanks go to the authors.

Callum Potter, *Director*

Radio Astronomy Section

The Section has continued with its monthly Zoom seminar during the period, with about 50 attendees joining the event each month.

Radio Sky News is published monthly by John Cook, with the distribution list increasing throughout the year. This newsletter catalogues observations from Section members from 2005, including sudden ionospheric disturbances (SIDs) and geomagnetic disturbance. Cosmic radiation detection by muon counting is also now included. We are hoping to include technical notes on instrumentation from members in the coming year.

The UK Radio Beacon for meteor detection is up and running at the Sherwood Observatory, and the project is now moving to Phase 2. The Norman Lockyer Observatory will host one of the receivers and stream live raw meteor data over the Internet, for anyone to receive who otherwise would be unable to observe due to poor receiver conditions.

Paul Hearn, *Director*

Equipment & Techniques Section

It has been the case again this year that Section activity has been at a lower level than the Director would like, owing to his duties as President taking precedence. He is very grateful to Andrew Wilson and Peter Anderson for supplying all the Section articles that have appeared in the *Journal* in this session, covering spectroscopy and the performance of refractors and DSLRs.

The Director receives a steady flow of enquiries from within the BAA and outside – typically a few a week. These are replied to by him or another member of the Section committee, or he will forward the enquiry to someone else in the Association, or beyond it, with the appropriate knowledge or experience. One type of enquiry that is common and often requires quite a bit of action is from the relatives of deceased members, who have been left with large collections of astronomical equipment, and/or books and magazines, that they cannot easily deal with. Appropriate advice is given in these cases, sometimes putting them in touch with local societies who are better placed to help out.

Recently (as already reported in the From the President column), the Director has been testing out the Alnitak remote telescope system in Spain, on which the owner has generously donated a certain amount of time to BAA members. A Working Group within the Association is developing a plan for how this time can be allocated to members' projects.

The Director gave a talk on equipment in the Back-to-Basics meeting in York in March and gave several BAA-badged talks on equipment and techniques to local societies this session. His Presidential Address was on 'The history of the telescope'. An edition of the Section newsletter *E&T News* was published in 2022 September, with 26 pages of members' projects, equipment reviews and discussion, and another is in production at time of writing. A Section meeting is planned for 2024 Apr 13, during the Winchester Weekend, and the Director would be delighted to hear from anyone who would like to give a talk on that occasion.

Andrew Wilson has continued to maintain the BAA Spectroscopy Database. Between 2022 Aug 1 and 2023 Jul 31, a total of 1,962 spectra were added to the database by 19 observers. The total number of spectra is now 13,134. The split by BAA Observing Sections over the past year was 1,803 spectra of variable stars, 87 of deep-sky objects, nine of comets and two of Jovian moons. There were also 61 spectra that could not be easily assigned to a BAA Observing Section, such as those of high-proper-motion stars. A total of 26 different spectrographs were used to make these observations. These were mainly the commercially available LHIRES III, Alpy 600, LISA, UVEX and Star'Ex. There were also contributions from custom-built and modified spectrographs.

David Arditti, *Director*

Computing Section

A large part of the work carried out by the Section continues to be the production of the annual *Handbook*. The 2024 edition marks the 103rd year of production and is enclosed with the paper edition of this *Journal*. It is also available to members for download in PDF form, which has the advantages that the material can be cut-and-pasted if required, and that the web links may be clicked on to take you directly to the referred website. Note too that the pages containing the web links are available on the BAA Computing web page: **britastro.org/computing/links.html** (this is due to space restrictions).

Please check with the Director first if you wish to use or publish any such data.

The Computing Section also provide data for the Royal Astronomical Society, for use in their *Diary*.

We have lots of people to thank for the data which they submit for use in the *Handbook*. The Director would also like to thank them for checking their own and other contributors' material. Special thanks are again due to the proof-checking work of both Richard Miles and Tim Parsons.

Drew Walker is our printing company account manager and does a great job handling the *Handbook* production. Unfortunately, as should be expected, costs have again increased. However, I am sure that the quality will still be retained.

The other main segment of the Section's work is the website: **britastro.org/computing**. This is a marvelous resource of both useful information and applets to assist with your observations. Many of the applets are of significant use to other Sections, in particular the Variable Star and Asteroids & Remote Planets Sections.

Applets available on the website include:

– What's observable? – makes an observing list (including Kreutz comets)
– A digital orrery – plan view of the solar system
– The Galilean satellites of Jupiter
– The eight main satellites of Saturn
– Julian date – calendar converter
– Date/time intervals (*e.g.*, for variable star min/max prediction)
– Equatorial coordinates and precession
– Camera field of view and star trail calculator
– Angle subtended, object size and distance
– Finder charts for comets
– Asteroid opposition charts
– Exoplanet data

The software to update the asteroid appulses and comet charts has been completed, and these charts continue to be generated for use by the Asteroids & Remote Planets Section. Comet charts for use by the Comet Section are also produced, based upon the observable list found at **www.ast.cam.ac.uk/~jds/**.

We always need more help, so if you have time to spare to assist with the work of the Section, such as the *Handbook*, software for the website, or articles for a *Newsletter*, then please do not hesitate to get in contact.

Steve Harvey, *Director*

Historical Section

For the first time since 2019, the Section was able to hold a 'real-world' meeting during this session. This took place on 2023 May 20 at the Birmingham & Midland Institute, central Birmingham. The meeting had five excellent speakers.

Mark Edwards began proceedings with a history of the early years of Jodrell Bank (where he had worked), featuring voice recordings of many of the key protagonists. Marie-Louise Archer told us about 'Ulugh Beg: Sultan, astronomer, mathematician and visionary', whose observatory in Uzbekistan she had visited. During the lunch break, many of the attendees visited the Robert Stawell Ball Library of the Society for the History of Astronomy (SHA), and the SHA sold off some of their excess library stock.

In the afternoon, John Chuter, a late replacement speaker, showed us some of the recent acquisitions of the BAA Archives, including memorabilia from the legendary *Monte Umbe* cruise to the solar eclipse of 1973, and film of Patrick Moore, both at Farthings in Selsey, and touring Russia. Then Lee Macdonald talked about astronomy at the Greenwich Observatory during the Great War, concluding with some new insights he had discovered on the reasons why Eddington was persuaded to attend the eclipse of 1919, where he measured the deflection of sunlight round the eclipsed Sun. The keynote speaker was Andrew Lound, who gave a trademark performance, in contemporary costume, to introduce us to 'Herschel's lunatick friends'.

Attendance at the Birmingham meeting was lower than at previous Section events, so perhaps there is still some reluctance post-COVID to meet in person. We will continue to organise such meetings but will also look at running an occasional webinar; this would also allow us to showcase speakers from outside the UK. Prof Wayne Orchiston (now resident in Thailand), who gave a webinar to the Section in 2022, has been supportive of the Section in many ways; for example, he sent posters to display at the Section meeting.

The Section newsletter is in good health. Prof Orchiston contributed an article about the *Journal of Astronomical History and Heritage*, which he co-edits with Shi Yunli; it is perhaps the pre-eminent journal of astronomical history. He also supplied an enigmatic picture of an observatory and its owner, for Section members to try to identify. Alan Thomas wrote an account of his visit to the Herschel Museum in Bath, and Robert Persse showed us how Kepler extracted his laws of planetary motion from Tycho's observations. Section Deputy Director Bill Barton contributed articles about the solar eclipse expeditions of 1914 and 1973. The Director wrote about George Abell's prediction (hopefully proven wrong by the time this is published) that humanity could not survive beyond 2023 Aug 20. James Dawson and Bill Barton both sent pictures of flyleaves from astronomical books which featured signatures of interest.

One rewarding line of enquiry resulted from a query to the Director from Rik Hill, now retired from the Catalina Sky Survey, about Elizabeth Beckley (1846–1927), daughter of the superintendent of the Kew Observatory. She received payment for some of the work she did at the observatory, making her one of Britain's first paid female astronomers. Rik was keen to honour her by naming an asteroid after her and sought help with the citation; Lee Macdonald obliged and wrote a newsletter article about her life.

We have gone on to name several more asteroids after pioneering women from the early years of the BAA. To date we have named 50724 ElizabethBrown (first director of the Solar Section), 50725 MargaretHuggins (pioneering spectroscopist), 50726 AnnieMaunder (solar astronomer *par excellence* and early Editor of the *Journal*), 50727 Aliceverett (Alice Everett, astronomer, physicist, electrical engineer, TV pioneer), 50728 CatherineStevens (Director of the BAA Meteor Section 1905–'11, researcher into solar eclipse shadow bands), 50729 Fiammetta (Fiammetta Wilson, prolific meteor observer, mandolin virtuoso), 50739 GraceCook (meteor observer) and 50753 MaryBlagg (variable star analyst, lunar nomenclature expert), and hope to be able to honour more of our distinguished early members, male and female.

In parallel with this, we tried to definitively list every member of the BAA, past and present, who has an asteroid named after them. We now have nearly 300 recorded. Thanks to everyone who suggested names, but especially to Peter Meadows, who wrote a Python program to cross-check our obituaries database against an asteroid database; and to past Director Tony Kinder, who contributed 130 candidate names.

Most sessions feature papers in the *Journal* with historical themes, and the last 12 months have been no exception. Martin Mobberley, a prolific researcher, turned his attention to 'The enigmatic Miss Cicely M. Botley (1902–1991)' [**133**(2), 89–101 (2023)]. One unexpected consequence of Martin's paper was the activation of the prize in her name mandated by Council many years ago but never awarded – the inaugural winner of the award was another regular contributor of historical papers, John Simpson (well deserved, John!). The Section Director contributed a paper to the *Journal* on 'The Revd George Fisher (1794–1873) – Arctic Astronomer'. The fascinating contributions to the *Journal* from the Archivists should also be acknowledged.

Contributions from all members of the Association are welcome. We hope to see you at Section meetings!

Mike Frost, *Director*

Section Officers

The following list of Section Officers is current from 2023 October 25:

Solar

Assistant Director / web manager	Peter Meadows
Assistant Director (data analysis)	John Cook

Lunar

Director	Tony Cook
(BAA/ALPO Lunar Geological Change programme, BAA/ALPO/SLA Impact Basins & Buried Craters programme)	
Editor	Barry Fitz-Gerald
(Lunar Geology)	
Section Committee	
Historical consultant	Robert Garfinkle
Occultation programme	Tim Haymes
Historical archivist	Bill Leatherbarrow
Lunar Domes programme	Raffaello Lena
Committee member	Nigel Longshaw

Mercury & Venus

Mercury coordinator	Chris Hooker
Section Committee	Gianluigi Adamoli, David Arditti, Chris Dole, Bill Leatherbarrow, Richard McKim

Mars

Website manager	Richard McKim

Asteroids & Remote Planets

Assistant Director (Exoplanets Division)	Roger Dymock
Assistant Director (Occultations)	Tim Haymes

Jupiter

Section Committee	Gianluigi Adamoli, David Arditti, Mike Foulkes, Hans–Jörg Mettig, Damian Peach

Saturn, Uranus & Neptune

Assistant Director	David Graham
Uranus coordinator	Kevin Bailey

Comet

Visual observations & analysis	Jonathan Shanklin
Secretary	Denis Buczynski
TA liaison	Guy Hurst
CCD imaging adviser	Peter Carson
Editor, The Comet's Tale	Janice McClean

Meteor

Assistant Director	Alex Pratt
Video network coordinators	William Stewart & Alex Pratt
Spectroscopy coordinator	Bill Ward
Committee members	Leonard Entwisle, Tracie Heywood, Nick James, George Spalding

Aurora & Noctilucent Cloud

Assistant Director (Noctilucent Cloud)	Ken Kennedy
Assistant Director (Radio Aurora)	Geoffrey Grayer
Website manager	Sandra Brantingham

Variable Star

Secretary	Bob Dryden
Chart secretary	John Toone
CVs & Eruptive Stars secretary	Gary Poyner
Pulsating Star secretary	Shaun Albrighton
Nova/Supernova secretary	Guy M. Hurst
Eclipsing Binary secretary	Des Loughney
UK Nova/Supernova Patrol coordinator	Guy M. Hurst
Circulars editor	Gary Poyner
Website manager	Gary Poyner
Database secretary	Andrew Wilson

Deep Sky

Assistant Director	Jonathan Blake
Supernova search coordinator	Guy Hurst
Variable nebula coordinator	Nick Hewitt
Double star adviser	John McCue
Website/galleries manager	Paul Downing

Equipment & Techniques

Assistant Director	Gary Palmer
Equipment adviser	Martin Lewis
Imaging adviser	Tony Morris
Optics adviser	Es Reid
Spectroscopy database manager & adviser	Andrew Wilson
Historic equipment adviser	Patrick Lindfield

Computing

Editor of the BAA Handbook	Steve Harvey
Website manager	*(vacant)*

Historical

Deputy Director	Bill Barton

Radio Astronomy

Assistant Director	*(vacant)*
Archivist & editor, Radio Sky News	John Cook

The British Astronomical Association

Trustees' Report and financial results for the year ended 2023 March 31

Legal and administrative information *as at 2023 March 31*

Name: The British Astronomical Association

Registered Office: 25 Farringdon Street, London EC4A 4AB
Company Regn. No: 117572 Charity No: 210769

Trustees

Dr D. Arditti *(President)*
Mr A. Lorrain *(Vice-President)*
Mr G. Winstanley *(Treasurer)*
Mr W. Tarver *(Company Secretary)*
Mrs A. Davies
Dr G. King
Ms J. McClean
Dr R. McKim
Mr T. Parsons

Independent Examiner: RSM UK Tax & Accounting Ltd, Chartered Accountants, Highfield Court, Tollgate, Chandlers Ford, Eastleigh, Hants. SO53 3TY

Bankers: Bank of Scotland, The Mound, Edinburgh EH1 1YZ

NOTE

The annual financial statements are 22 pages long and for reasons of space are not printed in full in the Journal. *As in previous years, selected extracts are given here for the information of members. The full financial statements for the year ended 2023 March 31 are available on the BAA website at* ***https://britastro.org/gov_documents****, and any member who requires a printed copy may request one from the BAA Office.*

The financial statements will be presented to the members of the Association at the Annual General Meeting on 2023 October 25.

Trustees' Report (including Directors' Report)

The Trustees of The British Astronomical Association present their annual report and financial statements for the year ended 2023 March 31 and confirm that the financial statements have been prepared in accordance with the accounting policies set out in note 1 to the financial statements and comply with the charity's Memorandum, Articles of Association and By-laws, the Companies Act 2006 and 'Accounting and Reporting by Charities: Statement of Recommended Practice applicable to charities preparing their financial statements in accordance with the Financial Reporting Standard applicable in the UK and Republic of Ireland (FRS 102)' (as amended for accounting periods commencing from 2019 January 1).

Objectives and activities

The British Astronomical Association ('the Association') was formed in 1890 and is open to everyone interested in astronomy. The Association is registered as a limited company, limited by guarantee. The Association is also registered as a charity with the Charities Commission and its charitable objectives are as follows:

- To promote the science of astronomy and all branches of astronomical research;
- To promote the association of observers of all abilities, for mutual help, and their organisation in the work of astronomical observation;
- The circulation of current astronomical information;
- The encouragement of a popular interest in astronomy.

Through these objectives we aim to educate and train the general public in Science, Technology, Engineering and Mathematics (the STEM subjects), which are key to the furtherance of the society in which we live.

The activities to achieve the aims and objectives include; the publication of a journal and other materials, the establishment of a membership base, the provision of observing sections to specialise in various areas of astronomical observation, the holding of meetings at various locations around the country, attendance at science and astronomy exhibitions and fairs, attendance at professional conferences, a website, electronic newsletter and social media presence.

The criteria we use to measure our success include: membership numbers, engagement via our website, and attendance at meetings.

The governing document is the Memorandum, Articles of Association and Byelaws.

The Trustees, when making decisions, have due regard to the Charities Commission public benefit guidance when exercising any powers or duties to which the guidance is relevant. To help achieve this, the Trustees maintain a spreadsheet of all products and services provided by the Association, noting the public benefit components of each item.

Officers, management and organisation

The Trustees, who are also the Directors for the purpose of company law, who served during the year were:

Dr D. Arditti *(President)*
Mr A. Lorrain *(Vice-President)*
Mr G. Winstanley *(Treasurer)* (Appointed 2022 October 26)
Mr W. Tarver *(Company Secretary)*
Mr J. Chuter (Resigned 2022 October 26)
Mrs A. Davies
Dr G. King
Ms J. McClean
Dr R. McKim
Mr T. Parsons

Mr W. Tarver is Company Secretary and Trustee only.

The affairs of the Association are managed by two bodies: The Board of Trustees and the Council.

The Board of Trustees constitutes the Trustees of the Charity and the Directors of the Company (revised Articles of Association, para. 12). The Board has 'control over, and management of, all financial and administrative affairs and all property of the Association'.

The Board consists of a maximum of nine Trustees (President, Vice-President, Treasurer, Business Secretary and five further members of the Association). All Trustees are elected annually by the members before the AGM, except the Vice-President who is *ex officio* the immediate past President and who serves as Vice-President for the duration of their successor's term. Trustees are normally long-standing members of the Association. The President is responsible for overall management of the operations of the Association. The Treasurer is responsible for all finance matters, reporting to the Trustees on the Association's financial

position. The Business Secretary acts as the Company Secretary and has the management of all persons employed by the Association, and the management of the correspondence of the Association, the Board of Trustees and the Council.

New Trustees are provided with induction information and training by officers as required to meet their responsibilities. The Board holds monthly meetings via Zoom and meets in person at least once per year to deal with the governance and management of the Association.

The Council consists of the Board of Trustees, two additional Secretaries, the Section Directors and Postholders and five further members of the Association. The latter five, and the two additional Secretaries, are elected annually before the AGM. The two Secretaries deal with matters relating to scientific papers and meetings. The appointment of Section Directors and Postholders is confirmed annually by the Council.

The Council regulates and organises the scientific and public activities of the Association and the services to Members, subject to the financial and administrative control exerted by the Board of Trustees. The Council meets on a regular basis, at least six times per year. Section Directors are responsible for the management of their Section, reporting to the Council on all matters arising.

Achievements and performance

Membership recorded at 2023 March 31 was 2,579 across all categories. The equivalent number at 2022 March 31 was 2,647, giving a decrease of 68 members during the year. It is one of the main aims of the Board and Council to grow our membership and the loss of even one member is disappointing. In order to increase public awareness of its aims and activities amongst a wider community, the Association is undertaking an advertising campaign in some of the UK's popular scientific magazines.

For the financial period 2022/23 the deficit of income over expenditure excluding any gains/(losses) on investments was £126,835 (2021/22: deficit of £98,794). In common with many recent years, the Association received substantial bequest income. This year we benefited from a bequest of £5,000 from the estate of James Leonard Lindsell of Lingfield, Surrey, and £500 from the estate of Arthur Andrew Langley of Aberdare, Mid Glamorgan.

Excluding the bequests and other donations, there was an operational deficit of income over expenditure of £132,788 (2021/22: £121,501). The operational deficit is largely due to staff costs, legal costs, and the overall increase in costs of meetings and other member benefits.

The majority of the Association's long-term investments are invested with CCLA in their COIF Investment accumulation fund. This fund has performed less well than in recent years, resulting in the total value of all of our investments decreasing by £14,141 (2021/22: increase of £164,886). We experienced a total deficit during the year of £140,976 (2021/22: surplus of £66,092).

The Board continues to review the costs of the Association in order to identify efficiencies, but will draw on its reserves as necessary in the short term to meet our charitable objectives of promoting amateur astronomy, assisting observers in developing and publishing their work, and circulating current astronomical information.

We remain indebted to those members and others who have in the past supported us with their donations or by remembering the Association with a legacy. Any member who would like guidance about including a legacy to the Association in their will should contact the Treasurer.

This was the first complete session for which the BAA no longer maintained a permanent physical headquarters, having moved out of Burlington House, Piccadilly, London, in 2022 April. The three members of staff on the payroll (one full-time, two part-time) have been working from home. The registered office address (the address required by law at which the company documents may be inspected) is now provided by our accountants RSM UK at their London office in Farringdon Street. The correspondence address of the Association, which members should use, is PO Box 702, Tonbridge, TN9 9TX. This forwards to the Office team.

Apart from our payroll staff, important work for the BAA is done by four part-time contract staff. These are the *Journal* Editor, the Systems Manager, the Web Content Editor and Website Maintenance contractor. They have contracts with the Association that are reviewed annually by the Board. The Editor is also a member of Council, while the Systems Manager attends Council as a non-voting facilitator. A weekly meeting is held between the Office staff, the Systems Manager, and one or more of the President, Vice-President, Treasurer or Business Secretary. These meetings allow the operations of the Office to be monitored by the Trustees, for feedback to be received from staff, and guidance given by the elected officers. The Trustees believe that this system has now bedded in and is working well, and have no plans for significant change (except, as mentioned later, the creation of a remunerated Assistant Editor post for the *Journal*).

The Board continues to review the efficiency of office procedures, and the cost-effectiveness of services provided. Amongst changes implemented this session to reduce costs have been moving our meetings booking system from Eventbrite to Ticket Tailor, and moving our accounts to a cloud-based version of the *Sage* accounting software. Work is ongoing to migrate direct-debit subscription payments to a new system, GoCardless, which should significantly reduce the amount of manual work staff need to do in processing direct debits. Staff are provided with appropriate training to use new systems when needed.

The Association's historic archives are now stored in appropriate, controlled conditions by a specialist firm, Max Communications, in Woolwich, London, and a small retained collection of instruments of historic relevance to the Association is kept at a storage facility in Bedford, along with some of the non-digital Section records and stocks of old publications, under the control of the Archivists. A smaller storage facility at Dartford, Kent, more easily accessible to the staff, is used for the stock of current publications. Max Communications has now scanned and digitised a considerable part of the archives (additional to those parts which we had digitised already), and we are in the process of commissioning them to create a web interface for the digital archive, based on open-source software, that will allow us to give members and approved external researchers access to it.

The Board has been overseeing two ongoing legal cases. The first is a continuation of steps to recover all instruments that were in the custodianship of the last Curator of Instruments, R. A. Marriott. Following the recovery from him of a laptop that contained a database of the Instrument Collection, a second claim has been opened in Northampton County Court, both for further missing instruments, and for part of the costs of the first case, ordered by the judge to be paid by Mr Marriott, that remain unpaid. The second case, which has been reported in the press, is that of the Will of deceased member Roy Panther. Mr Panther made a Will leaving substantial property to the Association, but this Will is contradicted by a later document produced by a claimant, the validity of which is disputed by the Association. There have been substantial costs incurred so far in this case, and the Trustees keep this situation under regular review. It is their belief that the Association has a very good chance of winning the case, and that the final value of the property will exceed costs, but it is understood that there is a possibility that the case could be lost, and a possibility that the Association could have to pay the costs.

As usual, six issues of the main BAA publication, the *Journal*, were produced, containing reports of astronomical happenings, Association news, reviews, letters, obituaries, and refereed papers, often reporting work undertaken by the Observing Sections. The *Journal* is distributed in print to those members with a paper subscription, and as a PDF to those with digital membership. Parts of it are also placed on the website. As usual, the *Handbook* was produced by the Computing Section, issued both in print and as a PDF. Monthly e-mail newsletters were sent out to those members who opt in to them, and various Sections produced their own PDF newsletters.

The Association's website is another major service that we provide to members and to the wider astronomical community, and into which we invest considerable resources. The WordPress system that replaced the previous content management system in the last session has worked well, and small improvements continue to be made to the programming. It is integrated with the Sheep membership database, so content can be made available to the public or to members only. The Website Operations Team, consisting of volunteers and contract staff, meets regularly to plan new material for the site, keep it generally up to date, and raise any issues with service providers. A new volunteer Website Manager, John Berman, has taken up his post, filling a vacancy that has existed for some time.

Over its many meetings, physical and virtual, the BAA provides in-person events across the country and online events accessible to members wherever they may be. As we have moved beyond the COVID-19 pandemic, there has been a trend towards holding fewer online meetings or webinars and more in-person ones. Attendance at the five London meetings has been rather below that in pre-COVID times, but the meetings held in Elgin in September, York in March and Cardiff in May had good attendance, and the Winchester Weekend in April was at capacity again. The Association continues to benefit from our relationship with the Institute of Physics, who provide the accommodation for our London members' meetings, as well as for most Council meetings, at no cost to us, and also provide technical support that allows us to live-stream meetings, so those unable to attend in London may participate. We are extremely grateful to the Institute for this support.

In the past session there have also been meetings of the Deep Sky Section in Bedford, the Mercury & Venus Section as part of the Winchester Weekend, and the Historical Section in Birmingham. The Solar Section, the Exoplanets Division and the Radio Astronomy Section have held online meetings, in some cases more than one. Videoed meetings, including the London ones, and those in other locations where recording facilities are available, are placed on the BAA YouTube channel where they are accessible to non-members. The channel currently has 2.18K subscribers.

Of external events, the BAA had a presence at New Scientist Live in London in October, the International Astronomy Show near Coventry in November, the Federation of Astronomical Societies 'Women in Astronomy' convention in Oxford, also in November; European Astrofest in London in February, and the Practical Astronomy Show in Kettering in March. We have continued to sponsor the SolarChat! web forum.

Plans for future periods – developing the Association

The 2021 Strategy Group, chaired by the President, and consisting of nine other members drawn from both Council and outside it, presented its final report to Council in 2022 October. Its recommendations encompassed seven areas:

1 Diversity (measuring it and improving it)

2 Working with schools, universities, and other types of groups and charities

3 Developing members' skills

4 Developing and expanding the *Journal*

5 Redesigning the subscription structure, combatting lapsing and encouraging legacies and donations

6 Changing the management structure

7 Investing in services for both income and member benefit.

The Strategy Group also recommended that Working Groups be set up over the next year and beyond to study these areas further and formulate recommendations for the Board and Council. At a meeting in November, Council agreed to all seven points of the plan. Working Groups have so far been created for areas 1, 4, 5 and 7, and have been meeting. The *Journal* Working Group (4) has produced interim recommendations for an expansion of the *Journal* and has carried out a survey of the membership to discover which additional content would be most popular. It has also recommended the creation of a contract for a paid Assistant Editor. These recommendations have been accepted by the Board, and an Assistant Editor is now being sought. The Subscriptions Working Group (5) has made two final reports; its recommendations have been accepted by the Board and Council, and changes to the subscriptions structure and associated by-laws will be introduced in the next session, if approved by the members. On the Services area (7), separate Working Groups have been set up to manage the online archive project and to look into the provision of remote-telescope access for members. The Board discussed, but rejected, the idea of significantly changing the management structure at present (area 6).

Financial review

Reserves policy

The reserves policy of the charity is to retain a level of reserves which will provide an annual income sufficient to meet any operating deficit and which will also meet expenditure commitments for at least the 36 months following the approval of these financial statements, including the distribution of awards and grants as decided by Council in accordance with any conditions applicable. The reserves held are sufficient to meet the expected expenditure. Restricted reserves and unrestricted reserves at 2023 March 31 amounted to £4,338 (2022: £5,114) and £1,543,460 (2022: £1,683,660) respectively. The Association had free reserves at the year end of £1,531,626 (2022: £1,671,035), that is, unrestricted funds after allowing for resources held in tangible fixed assets.

Going concern

At the time of approving the financial statements and in consideration of the events surrounding the cost of living crisis, the Trustees have a reasonable expectation that the charity has adequate resources to continue in operational existence for the foreseeable future. In reaching this conclusion, the Trustees have considered the current year's level of operational deficit and the expected future results. They have compared these figures with both the working capital position of the charity, which includes an adequate cash balance, as well as the significant investments held as fixed assets, which would be capable of realisation should this prove necessary. The Trustees are confident of their conclusion even in the case of a significant reduction in income caused by numerous members becoming unable to afford their subscriptions. At the year end the charity had total assets less current liabilities of £1,547,798 (2022: £1,688,774). Thus, the Trustees continue to adopt the going concern basis of accounting in preparing the financial statements.

Risk management

Issues involving significant risk are brought before the Board on a routine basis as and when such issues arise. Where a matter is complex, an appropriate working group is formed from a small number of Board or Council members to evaluate issues and formulate recommendations. An assessment of the major risks to which the Association is exposed is updated from time to time. The Association's systems of internal controls are designed to provide reasonable but not absolute assurance against material misstatement or loss. Board members are satisfied that the systems in place mitigate exposure to major risks.

Investment policy

In accordance with the Memorandum, Articles of Association and By-laws, the Board has the power to invest in such stocks, funds, shares, securities or other investments as it sees fit. The investment objective of the Association is to make investments which will maintain the real purchasing power of the portfolio over time and provide a level of income sufficient to meet operational needs while exposing the Association to a low level of risk.

The majority of our investments are with the CCLA, utilising our COIF Charities Investment accumulation fund, which meets the Association's investment policy and which is managed in accordance with accepted Environmental, Social and Governance (ESG) objectives. A total of £100,000 was withdrawn during the year (2022: No investments or withdrawals). At the year end, this CCLA account contained £1,463,095 (2022: £1,575,868) in listed investments as well as £8,559 (2022: £8,411) held as cash. Further investments held by the charity total £8,819 (2022: £9,214). At the year end, the market value of total investments held by the charity is £1,480,473 (2022: £1,593,493).

This report has been prepared in accordance with the provisions applicable to companies entitled to the small companies' exemption.

The report was approved by the Board of Trustees.

Dr D. Arditti (President)
2023 September 19

Mr G. Winstanley (Treasurer)
2023 September 19

THE BRITISH ASTRONOMICAL ASSOCIATION

Statement of financial activities including Income & Expenditure Account for the year ended 2023 March 31

	2023			2022
	Unrestricted funds	*Restricted funds*	*Total*	*Total*
Income and endowments from:	£	£	£	£
Donations and legacies	5,953	–	5,953	22,707
Income from charitable activities	126,032	–	126,032	112,623
Investments	270	149	419	223
Royalties	228	–	228	4
Total income	132,483	149	132,632	135,557
Expenditure:				
Charitable activities expenditure	(258,542)	(925)	(259,467)	(234,351)
Net expenditure and net movement of funds before gains and losses on investments	(126,059)	(776)	(126,835)	(98,794)
Net (losses)/gains on investments	(14,141)	–	(14,141)	164,886
Net (expenditure)/income	(140,200)	(776)	(140,976)	66,092
Other recognised gains and losses				
Gain on revaluation of tangible fixed assets	–	–	–	3,390
Net movement of funds	(140,200)	(776)	(140,976)	70,082
Total funds brought forward	1,683,660	5,114	1,688,774	1,618,692
Total funds carried forward	**1,543,460**	**4,338**	**1,547,798**	**1,688,774**

THE BRITISH ASTRONOMICAL ASSOCIATION

Balance sheet as at 2023 March 31

	2023		2022	
	£	£	£	£
Fixed assets				
Tangible assets		11,834		12,625
Investments		1,480,473		1,593,493
Total fixed assets		1,492,307		1,606,118
Current assets				
Debtors	24,831		16,568	
Cash at bank and in hand	47,301		85,482	
	72,132		102,050	
Creditors: amounts falling due within one year	(16,641)		(19,394)	
Net current assets		55,491		82,656
Total assets less current liabilities		**£1,547,798**		**£1,688,774**
Income funds				
Restricted funds		4,338		5,114
Unrestricted funds		1,543,460		1,683,660
Total funds		**£1,547,798**		**£1,688,774**

The company is entitled to the exemption from the audit requirement contained in section 477 of the Companies Act 2006, for the year ended 2023 March 31. No member of the company has deposited a notice, pursuant to section 476, requiring an audit of these financial statements.

These financial statements have been prepared in accordance with the provisions applicable to companies subject to the small companies' regime.

The financial statements were approved by the Trustees on 2023 September 19.

Dr D. Arditti (President) **Trustee**

Mr G. Winstanley (Treasurer) **Trustee**

Notes to the Financial Statements for the year ended 2023 March 31

Income and expenditure analysis

	2022/'23			2021/'22
	Unrestricted funds	*Restricted funds*	*Total*	*Total*
Income from charitable activities	£	£	£	£
Subscriptions	72,917	–	72,917	80,455
Digital subscriptions	16,047	–	16,047	12,320
Receipts from meetings and courses	17,436	–	17,436	–
Advertising revenue	758	–	758	1,111
Sales of publications	3,749	–	3,749	2,000
Other income	1,601	–	1,601	2,517
HMRC Gift Aid	13,524	–	13,524	14,220
Total income from charitable activities	126,032	–	126,032	112,623
Investment income				
Dividends received from listed investments	230	–	230	207
Interest receivable	40	149	189	16
Total operating income	**126,302**	**149**	**126,451**	**112,846**
Expenditure: charitable activities				
Publications and cost of sales items	64,493	–	64,493	59,586
Meetings and courses	29,287	–	29,287	5,790
Section costs	1,431	–	1,431	224
Document collection and archives	16,548	–	16,548	3,987
Grants and awards	1,750	925	2,675	4,819
Commission for Dark Skies	2,100	–	2,100	8,500
Other donations	–	–	–	500
Total charitable activities	115,609	925	116,534	83,406
Support costs (see below)	142,933	–	142,933	150,945
Total operating expenditure	**258,542**	**925**	**259,467**	**234,351**
Net operating income (outgoings) for the year	**(132,240)**	**(776)**	**(133,016)**	**(121,505)**

	Total 2022/'23	*Total 2021/'22*
Expenditure: support costs	£	£
Salaries and wages	46,191	44,868
Professional fees	34,456	8,823
IT and database costs	24,341	40,102
Independent examination fees	3,600	3,450
Accountancy fees to independent examiner	5,300	5,289
Other accountancy costs	2,354	–
Telephone, printing and stationery	4,439	5,792
Membership promotion	8,205	7,234
Trustees & Council members' expenses	2,378	1,109
Election costs	2,160	1,931
Bank charges	3,177	1,447
Depreciation	667	1,537
Pension costs	2,449	2,291
Premises costs (including insurance)	3,496	31,052
Instruments collection costs	–	1,356
Profit on disposal of instruments	–	(5,612)
Sundry costs	(280)	276
Total support costs	**142,933**	**150,945**

Included in support costs are governance costs of £45,710 (2022: £17,562) which relate to accountancy and legal fees.

The average number of employees in the year was 3 (2022: 3).
No employee received emoluments exceeding £60,000 during the year in the current or prior year.
No Trustees (who are the key management personnel of the entity) received any remuneration or benefits from employment with the charity.
A total of £1,039 (2022: £544) was reimbursed to 6 (2022: 4) Trustees to cover travel expenses incurred on behalf of the charity.

Dr D. Arditti (President)
2023 September 19

Mr G. Winstanley (Treasurer)
2023 September 19

BAA Christmas Meeting, 2022 December 10

Institute of Physics, 37 Caledonian Road, London N1 9BU | President Dr David Arditti | **Secretaries** Bill Tarver, Hazel Collett & Prof Jeremy Shears

Alan Dowdell
Meetings Recorder

The President, Dr David Arditti, welcomed members in the lecture theatre and viewers of the YouTube livestream. He said this meeting had our largest attendance since the COVID lockdown, with about 90 people in the audience. There was a change of programme, since the advertised speaker, Gordon McKay, could not attend. Luckily, one of the members on the BAA Council, Timothy Parsons, had stepped in at very short notice.

The President then welcomed John Archer from Crayford as a new member. The Papers Secretary, Prof Jeremy Shears, read out the list of papers approved by Council that day for publication in the *Journal* (see panel below).

Dr Arditti announced that a Christmas social gathering, kindly organised by Marie-Louise Archer, would take place in The Astronomer pub after this meeting. He then noted that the next formal meeting of the Association would be on Saturday, 2023 Jan 21.

There were a number of medals to be presented at this meeting, because some of these had been awarded during the lockdown, when in-person presentations could not take place. (The nominations for each are summarised on p.330.) The first to be presented was to Prof Bill Leatherbarrow, who had been nominated in 2020 for the Walter Goodacre Medal: the senior medal of the Association. It was awarded for a significant contribution to the progress of astronomy over many years. Prof Leatherbarrow thanked the Council but said he was even more grateful to his wife, who has put up with a house full of telescopes and the unsociable hours of observing. He said that above everything he was grateful to the BAA itself which, over many years, has given so much in the way of support and encouragement, and that he was very proud to be a member.

Timothy Parsons (left) and Simon Kidd. ***(Courtesy of Alan Dowdell)***

Unusually, in 2020 the Council decided to award the Goodacre Medal twice, as it had not been awarded for several years. And so Gary Poyner was also awarded the Medal, for a lifetime's achievement in astronomy. He thanked his wife and everyone on the Council, saying he had two years to get over the shock, but the thrill of actually winning this medal would last for the rest of his life.

The next award was the Horace Dall Medal & Gift, which is presented in recognition of marked ability in the making of astronomical instruments. This year it was awarded to a maker of virtual tools for amateur astronomy: Dr Dominic Ford, who has been a member for many years and was the Association's webmaster. Dr Ford said it was a huge honour to receive it and noted that working on the BAA website was a lot of fun thanks to the excellent articles and images contributed by members.

The Sir Patrick Moore Prize can be awarded for a collaborative research project between amateurs and professionals, and this year, for the first time, it was awarded to a team of amateurs who have been working with professionals on the ExoClock exoplanetary research project: Martin Crowe, Simon Doors and Adrian Jones. After gratefully accepting the award, they encouraged other imagers to get involved in the project.

Cicely Botley, who died in 1992, was a much-liked member and was well known for her erudite contributions to the *Journal*. When she died, the Council announced that there would be a Cicely Botley Prize for an outstanding contribution to one of the Association's publications. Thereafter nothing was heard about it and the Prize was never awarded. Council this year decided to award it to John Simpson, for his series of *Journal* papers on historic observations of sunspots and aurorae. John could not attend the meeting as he lives in France, but via Zoom he thanked everyone who had commented on his papers and encouraged him to keep going. He concluded by saying a few words about Cicely Botley.

The President then introduced the main speaker of the afternoon, Timothy Parsons, who is a solicitor and postgraduate astrophysics student at University College London, as well as a Trustee of the Association.

'A Massive Star Menagerie: touring through the upper reaches of the H–R diagram'

The speaker started by saying he has been a BAA member for about 25 years, but never thought he would speak at a meeting, let alone give the Christmas lecture.

Mr Parsons expected that most had heard of the main-sequence stars, of giants, and of red supergiants. However, there are all sorts of other crazy, large, and exotic objects, like blue supergiants, yellow hypergiants and Wolf–Rayet stars. He said that his talk would describe what these objects are and how they relate to each other.

Every red-dwarf star ever formed in the history of Universe still exists, but this talk would be about things that change: specifically, about massive stars of at least eight solar masses. This makes them and their subsequent evolution fundamentally different to stars below that mass. They are characterised by brief lifetimes, sometimes of just a few million years, and are very rare because it is very difficult to form massive stars. We do not know exactly how the last stages of formation takes place. Notwithstanding their rarity, they are absolutely essential to the processes of synthesising heavier elements.

Red supergiants are very cool stars; there are also yellow supergiants, hypergiants and blue supergiants. The key features of these objects are their tremendous luminosity. Hydrogen core-burning OB stars are classified as main-sequence stars because they are still fusing hydrogen in their core. Their structure is however very different to that of the Sun. There is so much energy and radiation being produced within the core that it can only escape through convection; this convective core is surrounded by an envelope that is radiative (the opposite way round to the Sun). The radiative zones of these massive stars are therefore far out from the core.

There are two ways in which blue supergiants can form. They can initially be a very massive

Papers accepted by Council on 2022 December 10

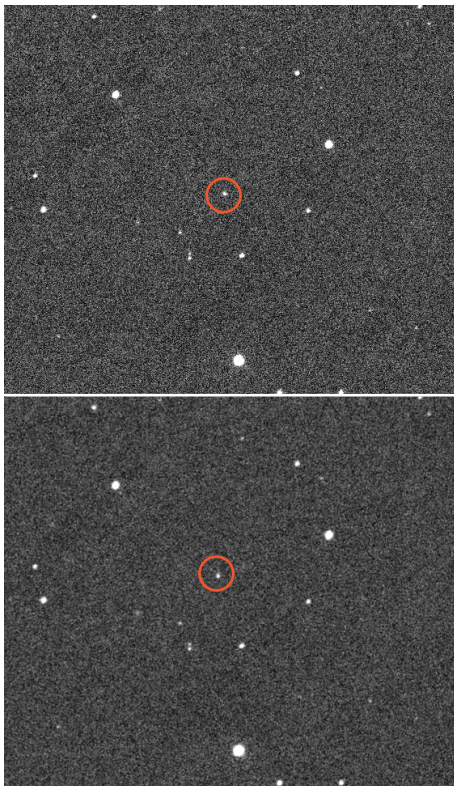
Two papers proposed by Prof Jeremy Shears, Papers Secretary, were accepted for publication in the *Journal* by the BAA Council:

The tortuous discovery of the Gegenschein, false zodiacal light & zodiacal band – Brorsen vs. Jones, by Marinus Van der Sluijs;

Evidence of abrupt changes in the orbital periods of two cataclysmic variables, by David Boyd.

Philip Jennings, *Editor*

The open star cluster NGC 2090, located at the heart of the Tarantula Nebula in the Large Magellanic Cloud, contains many massive stars – including one of the most massive known, R136a1, at 215 solar masses. This image was obtained on 2020 Feb 19 at the El Sauce Observatory in Chile, by Nik Szymanek.



On 2022 Dec 6, Grant Privett (near Salisbury) used a 300mm *f*/4 Newtonian to capture the motion of NASA's *Artemis I* mission on its way home from the Moon, when it was at a distance of 398,000km.

star that leaves the main sequence and expands, then begins to cool. In addition to that, they pass through yellow- and red-supergiant phases.

Mr Parsons continued by talking about Wolf–Rayet stars. These objects are characterised by a lack of hydrogen in their spectra; the outer layers that envelope the star have been lost, leaving the inner layers exposed. For this to have been possible, the star must be the source of very strong stellar winds, leading to vast rates of mass loss which can amount to a solar mass over a period of tens of thousands of years. These objects were first discovered through their distinctive spectra at the Paris Observatory in 1867, by Charles Wolf and Georges Rayet.

The President thanked Mr Parsons once again for giving this talk at short notice. After a few questions, the meeting was adjourned for a tea break.

On return, the second speaker of the afternoon, Simon Kidd, was introduced.

'Asteroid occultations: an observer's view'

Mr Kidd, who has been involved in astronomy since the 1960s, began his short talk by explaining that he had started observing asteroid occultations in 2015 September, when (275) Sapientia occulted HIP 14977. He showed a short video of this event, and illustrated the kind of information that can be obtained from such observations by showing an occultation by a possibly hazardous near-Earth object, 99942 Apophis. The shape of this 340m asteroid could be determined through the occultation, while further unknowns such as whether it had rings or was double could similarly be investigated.

Such information can be extracted using any size of telescope; even a 60mm refractor is suitable for occultations of brighter stars, plus a camera and a laptop with suitable capture software installed. A camera that can provide a time stamp is ideal. Laptop times are not accurate, so Mr Kidd uses GPS as a time source, using a one-pulse-per-second flashing LED light to calibrate the system. When observing, it is important to a have a reference star recorded so that atmospheric effects on the timing can be understood. All results are valuable to the pro-am community.

Mr Kidd was thanked for his talk and the President next introduced Nick James, to give the Sky Notes.

Sky Notes

Mr James started his summary of what to observe in the coming weeks with the Sun, which was increasingly active. Recent images of solar activity were shown, taken by Dave Smith and James Weightman, as well as video footage of the partial solar eclipse on Oct 25.

Aurora images were also presented, taken by Denis Buczynski and Callum Potter.

Images of the Moon taken by Bill Leatherbarrow were shown and these were followed with those of Saturn by Geof Lewis, Martin Lewis and Anthony Wesley. Jupiter images from Ian Sharp, Damian Peach (imaging from Barbados) and Martin Lewis were included, as well as a drawing of the planet from Paul Abel.

Uranus was imaged by Peter Tickner, and his capture clearly showed associated moons.

Observations of Mars were next discussed, starting with drawings by Paul Abel and David Gray; these were followed by images from Martin Lewis, Peter Tickner and Geof Lewis.

Mr James continued by saying that Neptune would be well positioned at the end of January.

An image of the nova in Cassiopeia V1405 was shown, taken by Mazin Younis, along with an image he had recently obtained of the Crab Nebula. Hubble's and Gyulbudaghian's variable nebulae had been observed by Richard Sargent and Nick James.

Comets were represented with an image by Nick James of 29P/Schwassmann–Wachmann, pictured in outburst on Nov 29.

The spacecraft *Orion* had been imaged during its *Artemis I* mission by Grant Privett and Nick James. After reminding members that the Geminid and the Quadrantid meteor showers would soon be occurring, Nick finished with his annual 'press award' for strange comments in the media's reports on astronomical phenomena. These included the size of the meteoroid 2022 EB5 being referred to as equivalent to the height of 'half a giraffe', and the distance to a near-Earth object being reported as 750 light-years.

After thanking all the speakers and those who had helped to organise the event, the President closed the meeting.

Awards at the 2022 Christmas Meeting

David Arditti
President

At this meeting I presented two Walter Goodacre Medals awarded in 2020, that could not be given in person at that time because of the lockdown, plus the Horace Dall Medal, and certificates to three joint winners of the Sir Patrick Moore Prize and one winner of the Cicely Botley Prize.

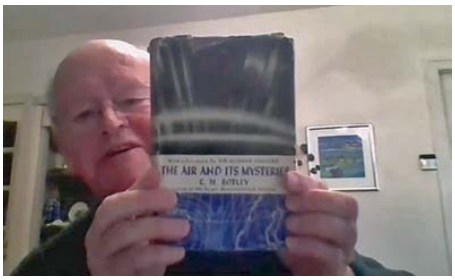
Bill Leatherbarrow was nominated for the Goodacre Medal and Gift by Richard McKim and Paul Abel. Bill joined the BAA in 1965 and has been contributing to the planetary Sections and Lunar Section since then. He was Secretary of the Mercury & Venus Section in the 1970s, and became Director of the Lunar Section in 2009, which he led with great energy until 2021, always kindly encouraging observers. He was a benevolent and readily approachable President from 2011 to 2013, during which time he started several positive developments in the BAA, including the first Strategy Group.

Gary Poyner was nominated for the Goodacre Medal and Gift by Jeremy Shears, Roger Pickard and David Boyd. Commencing observing in 1965, in 1975 Gary started making observations of variable stars and he has since made in excess of 300,000 visual magnitude estimates, making him one of the most prolific visual observers of these objects in history. He was Director of the Variable Star Section from 1995 to 2000 and is highly active in helping to run the Section today. From 2000 to 2018 he edited the variable star pages in *The Astronomer* magazine. He is an expert on cataclysmic variables and has done important collaborative work with professionals on them, coordinating observing campaigns that have led to new astrophysical insights.

Dominic Ford was nominated for the Horace Dall Medal and Gift by Callum Potter and Andrew Wilson. Dominic, who has been a member of the BAA since 2001, was designer and webmaster for the last iteration of the BAA website. The image library, which BAA members use every day through the website, was created by him, and provides a wide range of facilities including automatic plate-solving of images. Dominic's own website In-The-Sky.org lists forthcoming astronomical events, generates charts, and provides other useful information; it supplies the observing calendar on the BAA website. Other software projects that Dominic has developed include *Pi Gazing* – a project to triangulate the three-dimensional trajectories of meteors, satellites and aircraft – and HillTopViews.org.uk, a three-dimensional interactive terrain map of the Earth and Moon. Dominic has been an important member of the BAA website team, maintaining our technical infrastructure over many years, and has provided advice, help, and assistance in the new website design and implementation.

The Sir Patrick Moore Prize can be awarded for a number of things, including the carrying out of a collaborative research project between amateurs and professionals. This year it was awarded to the team of **Martin Crow**, **Simon Dawes** and **Adrian Jones** for their participation in just such a project, *ExoClock*. This project is designed to support the efficient targeting of exoplanets by ESA's *Ariel* space telescope, scheduled for launch in 2029, through observation of transits of known bodies and comparison of the observed timings with those predicted by the literature. These ongoing observations will allow accurate, up-to-date ephemerides to be used when the space observations are undertaken. At 2022 October, this team had 255 sets of transit observations published between them. For Martin, the project was made possible, in part, through his receipt of a BAA Ridley Grant in 2019, enabling him to purchase a new CCD camera.

John Simpson won the first ever Cicely Botley Prize for his series of *Journal* papers on historic observations of sunspots and aurorae. Mike Frost and Bill Barton wrote that these papers will be regarded as important source material for future researchers, and proposed they be recognised as an outstanding contribution to the *Journal*.



Above: John Simpson, here seen with his copy of the Cicely Botley book *The Air & its Mysteries*, joined the meeting via video link.

Top: From left to right (pictured with the President, David Arditti): Prof Bill Leatherbarrow; Dominic Ford; Adrian Jones, Martin Crow and Simon Dawes; Gary Poyner. *(Photos by Alan Dowdell)*

Historical Section

2023 Historical Section Meeting

Bill Barton
Deputy Director

Twenty-seven BAA members and guests attended the 2023 Historical Section Meeting, held in the Lyttelton Theatre at the Birmingham & Midland Institute in central Birmingham on Saturday, 2023 May 20. Mike Frost, the Section Director, opened the meeting at 10.00 a.m. with an introduction. This was followed by five talks interspersed with breaks for informal discussions.

The first speaker of the day was Mark Edwards, who presented a talk on the 'Early History of the Jodrell Bank Observatory'. Bernard Lovell was a physicist who was seconded to Bawdsey on the Suffolk coast to work on radar for the duration of the Second World War. There he noticed some unexplained signals.

After hostilities ceased, he decided to follow up on the mystery by carrying initial radio-wavelength observations from central Manchester, but passing public-transport trams caused electrical interference, so the work was restarted out of the city at a botanical research farm at Jodrell Bank. The agricultural nature of the site meant much early work was carried out in simple wooden buildings and often knee-deep in mud when the weather was bad. One unusual experiment there was an investigation into the Earth's magnetic field using a suspended 10cm-long solid-gold cylinder, borrowed from the vaults of the Bank of England. Mark's presentation included sound recordings of some of the actual astronomers discussing their work.

The second speaker was Marie-Louise Archer, who told the meeting about the Islamic astronomer Ulugh Beg (1394–1449) and his observatory. Beg lived in Soltaniyeh, Timurid Empire (now Zanjan Province, Iran) and Samarkand (now Samarqand Region, Uzbekistan). He was state governor at the early age of 16. In 1428, Ulugh Beg built an observatory, similar to Tycho Brahe's later Uraniborg. Beg achieved a high level of accuracy in his observations by building a very large naked-eye sextant; the so-called Fakhri sextant had a radius of about 36 metres (118 feet) and could separate down to one twentieth of a degree. Ulugh Beg used his observations to compose a star catalogue consisting of 1,018 stars. He determined the length of a year to within thirty seconds of its currently accepted value. In further work he looked at the axial tilt of the Earth. Beg was killed, along with his brother Abdal-Aziz, by Beg's son Abdal-Latif Mirza in 1449.

Mike Frost (Section Director), Marie-Louise Archer, Andrew Lound, John Chuter, Lee Macdonald, and Mark Edwards.

The Lyttelton Theatre at the Birmingham & Midland Institute.

The Birmingham & Midland Institute is home to the Society for the History of Astronomy's (SHA) splendid Sir Robert Stawell Ball Library, and during the lunch break, several attendees took the opportunity to view the collection. The SHA also had a table of excess library stock for sale, which proved popular. Delegates were able to view a number of posters on Antipodean topics submitted by Prof Wayne Orchiston, who spoke at the Section's previous meeting, a webinar in 2022.

After the lunch break, John Chuter informed the audience about 'Some Recent Donations to the BAA Archives'. These included material relating to the solar eclipse in 1973 June, as well as videos of observations of the 2004 transit of Venus and a 2008 partial solar eclipse, observed from Patrick Moore's home, Farthings, West Street, Selsey. A fourth video was, again, of Patrick Moore, but this time shot in Russia in 1960. John concluded by announcing that the BAA Archive was going online. Digitising work has been started in conjunction with Max Communications.

The next speaker was Lee Macdonald, who spoke on 'Refugees, Star Clusters and Relativity: Astronomy at Greenwich Observatory in the First World War'. At the beginning of the 20th century, the staff of the Observatory were predominantly young and they were 100% male. By 1914 October, with the war just two months old, the staff of 61 had been reduced by nine. E. W. Maunder, who had retired in 1913, came back, initially on a voluntary basis. Ladies, including Annie Maunder, were used to replace the young men who left for military service. Another source of astronomers was the arrival of those displaced by the war, who came to the UK as refugees. These included Robert Jonckheere and P. J. Melotte.

There were two significant total solar eclipses during the period under discussion: one in 1914 and the second in 1919. A few observations of the first were carried out from Minsk; the observers only just got home before things hotted up. Their instruments, however, were sequestered in Russia until the mid-1920s. The 1919 eclipse was the famous one at which Arthur Eddington and others validated Einstein's predictions of light bending. Lee concluded by saying that as Einstein was German, his work would probably not have been accepted in the UK had it not been transmitted through the Belgian astronomer Willem de Sitter, a trusted friend of Eddington's – Lee's research has uncovered this correspondence.

After a short refreshment break, the final speaker of the day was Andrew Lound, who gave an immersive presentation about 'Herschel's Lunatick Friends'. Andrew discussed the relationship between the astronomer William Herschel and the Birmingham Lunar Society. This group met in Matthew Boulton's home, Soho House, to discuss scientific ideas of interest to them. Boulton's business partner was the engineer James Watt and when they wanted to find out what other engineering firms were up to, they sent the famous scientist Herschel to find out the answers to questions they could not ask their rivals themselves.

Mike closed proceedings at 4.50 p.m. He thanked all those who had helped make the meeting happen.

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From the BAA Archives

John Chuter
Archivist

Robin Flegg recently contacted the BAA and offered us copies of some very interesting digital images and videos concerning Sir Patrick Moore. There are three categories: a Soviet Union visit by Patrick in 1960, the transit of Venus in 2004, and a partial solar eclipse in 2008.

I featured Venus in the 'From the *Journal* Archive' piece in this issue (see p.289), so here concentrate on the transit. There are nearly 40 pictures of that event and a one-hour video taken at Farthings, Patrick's home, on 2004 Jun 8. Three images (*top right*) show Farthings and the refractor that Patrick used for the event. Four others (*right*) are of general views; one shows Robin with Patrick. I think the lady in orange was the producer of *The Sky at Night*, for which a recording was being made of the event.

Finally, I show three frames from the video. The first (*below left*) shows Sir Brian May explaining to Chris Lintott how pleased he is with the images of the transit he is getting. The second (*below centre*) shows Patrick talking to camera and being interviewed by a BBC News presenter, with the producer and Chris Lintott listening intently. The third (*below right*) is of Patrick observing the transit and explaining that he will never see anything like it again.

I hope to revisit this interesting donation to the Archives in future.

New members

The BAA welcomes the following new members.

2023 September 6

SIMPSON Leonard, Somerset
MILGATE Kelvin, Essex
SCHNEIDER Charles, Ocean, USA
DAVIS Anthony, Fife
PRATA Fred, Victoria, AUSTRALIA
KOLOSOWSKI Vincent, Renfrewshire
HUNT Gary, Kent
KANAI Toshimasa, Shiga Pref., JAPAN
GLENDINNING Sally, Sir Gaerfyrddin
SPRENG Warren, Warren, USA
FELLAH Franco, Fairfield, USA
PARSONS Robert, Edinburgh
BRADBURY Wayne, Leicester
CANDY John, Tyne & Wear
MORGAN Melvyn, Worcestershire
JAWORSKI Stephen, Staffordshire
FORMOSA Eric, Zebbug, MALTA
GRIGSON Victor, Paphos, CYPRUS
TYSON Jack, Southampton
CLELLAND John, Bedfordshire
FISHER John, USA
ECHAURREN Hernan, RM, CHILE
IQBAL Ayesha, Sheffield
WHEELER Dan, Suffolk
WEST Kevin, East Sussex
SAGUES Alberto, Florida, USA
PENDER Niall, Dublin, IRELAND
GOSSAGE Calvin, Bristol
MORGAN Alan, Cambridgeshire
HAMILL Frank, Gloucestershire
GIROUX John, Onondaga, USA
MOHAN Murali, Derbyshire
HINGLEY-HICKSON John, Lincolnshire
BOWYER Paul, Devon
NATH Arushi, Ontario, CANADA
BURGESS Alan, North Somerset
DANIELS Mandy, Derbyshire
O'FEARGHAIL Aengus, County Meath, IRELAND
NORMAN David, Cornwall.

Deep Sky Section

Swimming with the fishes – exploring the constellation Pisces

Callum Potter
Director

Sitting below Pegasus and Andromeda, the constellation Pisces is well placed for observing in the autumn months. However, it is a rather faint and indistinct constellation, with just two stars brighter than fourth magnitude and a limited range of deep-sky objects available. In fact, there are only galaxies! But there are plenty here for the dedicated galaxy hunter. None are particularly bright, being real challenges for both visual observers and imagers.

Just a short hop west of the star eta Piscium is the only Messier object in Pisces – the lovely face-on spiral galaxy M74. Due to its low surface brightness (visual magnitude 9.4 and about 10 arcminutes in diameter) it is one of the most difficult objects to observe in Messier's catalogue. It was actually discovered by Méchain, who found it in 1780. In the 1850s, M74 became amongst the first nebulae to be noted as having a spiral structure, though it was of course not recognised as a galaxy at that time.

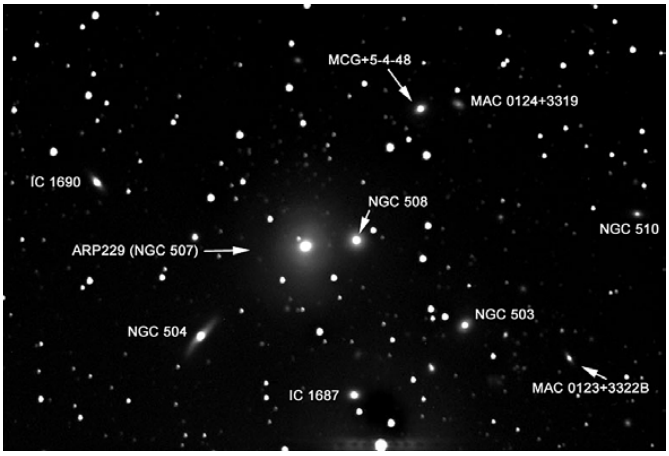
It is quite challenging for the visual observer, but the core should be detectable in a 150mm-aperture telescope. A larger telescope and excellent conditions are needed to view the spiral arms in detail. These arms contain many H II regions and there is very active star formation going on. Three supernovae have been discovered in M74 in the 21st century, so it would certainly be worth checking for 'guest stars' when observing it.

The NASA/ESA/CSA *James Webb Space Telescope* was trained on M74 in 2022 and a remarkable image of the central portion was created using its Mid-InfraRed Instrument (MIRI). Delicate filaments, tendrils and voids in the spiral arms are shown in amazing detail.

To the north-east of Pisces, near the border with Andromeda, there is a fascinating trail of galaxies to be found – too many to list here, but two groups stand out. The NGC 507 group is the most easterly. NGC 507 itself is a large lenticular galaxy and nearby NGC 508 is a smaller elliptical. NGC 507 is listed in Halton Arp's *Atlas of Peculiar Galaxies*, as Arp 229. There are numerous other galaxies in the vicinity, many of which are elliptical or edge-on spirals. I was able to spend a very happy session viewing this group with my Electronically Assisted Astronomy (EAA) set-up.

Messier 74. ***Top of page:*** Imaged by Kevin Gurney. ***Above:*** Imaged by the *James Webb Space Telescope* in 2022. *(ESA/Webb, NASA & CSA, J. Lee & the PHANGS-JWST Team)*

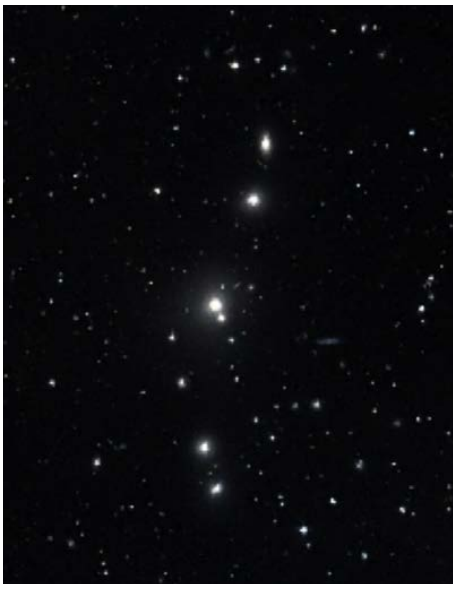
The trail continues west and south with many more faint galaxies, until alighting on 12th-magnitude NGC 410. It is then a short step further west and south to reach the fascinating NGC 383 group of galaxies, also known as Arp 331 or the Pisces Cloud. This string of galaxies is about 20 arcminutes long, comprising NGCs 379, 380, 382, 383, 384, 385, 386, and 388. NGC 383 is the brightest, at 12th magnitude.



► **Arp 229.** ***(Paul Downing)***

Other galaxies to target are a bit more widely distributed around Pisces. In the south of the constellation, NGC 488 is another splendid face-on spiral galaxy, but more difficult than M74 at magnitude 10.4 and about 5 arcminutes in diameter. It is a challenge for imagers to obtain detail in the spiral structure.

NGC 520 is a really interesting pair of interacting galaxies. Another of Halton Arp's – this



NGC 383 'and friends'. Digitized Sky Survey imagery.

one is Arp 157 – it is a faint target at 12th magnitude and has a diameter of 4.5 arcminutes. The galaxies are thought to be in the early stages of the merger, which began about 300 million years ago, and much star formation is going on.

► NGC 7732, imaged by the Sloan Digital Sky Survey.

In the west of Pisces, look out for NGC 7541 and NGC 7537, a nice pair of spiral galaxies seen edge on. NGC 7541 is the brighter and might be detectable with a 250mm-aperture telescope.

Looking at my *Interstellarum Deep Sky Atlas*, my eye was drawn to the only named object in Pisces: Zwicky's Pierced Galaxy, NGC 7732 (assuming you do not count the Pisces Dwarf, PGC 3792, which is less of a nickname and more a description). NGC 7732 is an interesting object when seen in Digitized Sky Survey or Sloan Digital Sky Survey imagery – there appears to be a notch in the southern side of the galaxy. It forms a pair with NGC 7731, which lies close to the north. They are rather faint for visual observers, though they have been seen in large telescopes, and should probably not be too hard to image for those with the right kit.

I have tried to do some detective work, but it is hard to find where the name might have come from; it is not commonly used elsewhere.

Arp 157. *(Mattia Piccoli)*

It would seem that the galaxy is mentioned as 'pierced' in an appendix to Zwicky's work *Catalogue of Selected Compact Galaxies and of Post-eruptive Galaxies*, and from there the description flowed to a few other publications.

Of course, there are many other galaxies to hunt down in Pisces and I hope that one night you might spend a few hours observing there. As always, please post your images to your Members' Album on the BAA website, and send to the Deep Sky Section.

Sky Notes

by Nick Hewitt

2023 October & November

(Written for 22:00 GMT in the UK on November 1)

Figure 1. Messier 52 (left) and the 'Bubble Nebula' NGC 7635 (right), imaged from Hampshire on 2021 Jan 23. Sharpstar HNT15028 150mm Newtonian, EQ6-R mount, ASI 183MC Pro, Optolong L-eNhance LPF. 34×30s unguided. *(Simon Paul Davis)*

Oct 29 sees the end of British Summer Time and we are deep into autumn. Nevertheless, the northern summer stars remain prominent, with Cygnus flying high from early October until Christmas.

The best guide to the autumnal constellations is Pegasus, the flying horse. The large Square of Pegasus is not a brilliant asterism, but once located is most useful and sits on the meridian at 21:00 UT at the beginning of November. The western stars of the Square are both magnitude 2.4, alpha (Markab) the lower, beta (Scheat) the upper; the eastern stars are gamma (Algenib) and delta (Alpheratz), the latter being the brightest of the Square at magnitude 2.0. It is shared by Andromeda as alpha Andromedae.

From the Square, it is straightforward to find Pisces to the south and east, Andromeda streaming from the north-east corner, Aquarius to the south-west, and the regal pairing of Cepheus and Cassiopeia to the north. Epsilon Pegasi (Enif) supervises summer giving way to autumn, and nearby is the superb globular cluster Messier 15. Slightly to the west of Enif lies a waste of space in the form of Equuleus, the foal. Why Hipparchus felt the need to add this little horse is a mystery! Represented on most atlases as just a head, it possibly represents Celeris, the brother of Pegasus, but has unpleasant shades of a scene from *The Godfather* film. Other names include Kitalpha, although this more commonly refers to its undistinguished alpha star. It is the second smallest constellation and contains nothing of interest other than the doubles delta and epsilon Equulei.

Delta is a very tight binary of magnitude 4.49, with a separation never exceeding 0.35 arcseconds, so is a real test for larger apertures. However, it is known for having one of the shortest periods of any visual binary pair: just 5.7 years. Another close binary is epsilon Equulei, a 5th-magnitude system currently at periastron and only 0.1 arcseconds, so wait a while until an apastron of 1.1 arcseconds. Lambda poses yet another close test, its evenly matched stars both being magnitude 7.4, but at a manageable 2.8-arcsecond separation. There are also a few unexceptional galaxies in the constellation.

In late October, Lacerta the lizard scuttles to the west of the meridian while magnificent Cassiopeia regally lies to its east. Lacerta is faint – a narrow zig-zag of 4th- and 5th-magnitude stars nestled between eastern Cygnus and western Andromeda – but by skulking on the edge of the Milky Way, it contains several attractive open clusters in a rich star field. NGC 7209 is one of the best: a large, irregular array of 10th-magnitude stars on the western border with Cygnus. Others include IC 1442 and NGC 7245, which lie close together in the north of the constellation and form a target for wide-field imaging. IC 1434 is a faint, rich tick shape just to their south-west.

Lacerta boasts an extraordinary Active Galaxy that can be followed by amateurs. BL Lac was thought to be a highly irregular variable star when discovered in 1929, but in 1968 it was found to be a bright variable radio source. Then the faint host galaxy was picked up and its true nature realised. Now the prototype of its class, BL Lac objects are 'blazars,' a class of active galactic nuclei (AGN). It sits in a rich star field on the western aspect of Lacerta and is quite tricky to identify, especially at minimum (around 15th magnitude).

In contrast to Lacerta, Cassiopeia is one of the grandest and most familiar of the northern constellations, with its characteristic W shape (in autumn). Sweep the northern Milky Way with binoculars, and you will find it chock-a-block with plums for telescopic observers. Lying near the zenith at the end of October, the numerous open clusters alone can occupy several evening sessions. Sweeping from west to east, some of the best open clusters in the sky can be easily found. Messier 52, NGC 7789, NGC 457 and Messier 103 are all superb and varied in appearance.

NGC 7789 is nicknamed Caroline's Cluster as it was discovered by Caroline Herschel, sister to William. It is wonderfully rich and easily found, a little south of beta Cassiopeiae (Caph) at the end of the 'W'. More tricky targets include the emission nebula NGC 281 (the Pacman Nebula) and the faint nebulae near gamma Cassiopeiae, IC 59 and 63. IC 63 ('the Ghost') is an emission nebula energised by nearby gamma Cassiopeiae, while IC 59 reflects the light of Cassiopeia's central star. Imagers enjoy tackling the huge diffuse emission-nebula complex to the south-east of epsilon Cassiopeiae, nicknamed the 'Heart and Soul' nebulae (IC 1805 and 1848); these respond spectacularly to narrowband imaging.

Nestled below Andromeda, east of Pisces and north of Aries sits Triangulum; its shape is in the name. It has one major object of interest: the Local Group galaxy Messier 33. This is on the western edge of the small constellation, an easy sweep north-west from alpha Trianguli. The galaxy, a face-on spiral, is magnitude 5.7 but this is spread over 67×42 arcminutes, an area greater than the full Moon, rendering it low surface-brightness. While technically visible to the naked eye from the darkest of sites, it is rarely seen without aid. Normally fairly easily picked

Figure 2. IC 1434 in Lacerta. 2022 Jan 14. Unistellar eQuinox 112mm reflector, 36s. Alun Thomas, Norbreck Observatory, Warrington, Cheshire, UK.

Figure 3. NGC 7789: Caroline's Cluster. Imaged on 2013 Aug 4. TMB 115mm *f*/7 and Canon 650D. *(Nick Hewitt)*

Figure 4. IC 63 (lower left) and IC 59 (upper right), near gamma Cassiopeiae. 2018 Oct 10. 190mm Maksutov–Newtonian. Exposure 25 min. *(Steve Arnold)*

► **Figure 5.** The low-surface-brightness galaxy Messier 33 can be a difficult target from less-than-pristine skies. NGC 604 is at lower right. 2022 Oct 24; Nailsea, north Somerset; 12-inch GSO RC telescope, ASI 2600 MM Pro. *(David Bennett)*

up in binoculars, its large size can make it elusive in telescopes if not wide-field. Persistence is rewarded once found, as numerous knots can be found in the spiral arms, several having separate NGC numbers. The best is NGC 604, an enormous emission nebula 40 times the size of our Orion Nebula. If placed at Messier 42's distance from us, it would outshine Venus and cast shadows!

Lunar occultations

Date	*Time (UT)*	*Star*	*Mag.*	*Ph.*	*% Illum.*
Oct 6	03:6.6	49 Aur	5.3	DB	–54
Oct 6	04:5.4	49 Aur	5.3	RD	–54
Oct 29	23:11.5	δ Ari	4.4	DB	–98
Oct 30	00:23.5	δ Ari	4.4	RD	–98
Oct 30	06:22.5	63 Ari	5.2	RD	–98
Nov 9	09:47.2	Venus	–4.4	DB	–15
Nov 9	10:47.7	Venus	–4.4	RD	–15
Nov 21	18:38.6	91 Aqr	4.2	DD	+65
Nov 21	19:48.9	91 Aqr	4.2	RB	+65
Nov 29	06:17.2	136 Tau	4.6	RD	–96
Sep 28	23:40	29 Psc*	5.1	DD	+100

Selected occultations of objects brighter than magnitude 5.5 as seen from Greenwich. DB = disappears at bright limb; RD = reappears at dark limb. Please see the *Handbook* of the BAA for more details and for occultations of fainter objects.

Grazing occultations

There are several grazing occultations in October and November listed in the *Handbook*. The table shows those involving stars brighter than 7th magnitude.

Date	*Time (UT)*	*Star*	*Mag.*	*Notes*
Oct 5	02:19	ZC 840	6.3	S. Eire to Scottish Borders
Oct 6	03:30	49 Aur	5.3	Northern Scotland
Nov 9	05:43	ZC 1732	6.8	South-west Cornwall
Nov 19	18:17	35 Cap	5.8	Hampshire to the Wash
Nov 22	19:16	4 Psc	6.4	South-west Cornwall to Newcastle
Nov 22	19:38	5 Psc	6.2	Exeter to Hull

The solar system

Hopefully the **Sun** will remain active and well observed despite its diminishing altitude. There is an annular eclipse visible on Oct 14 but only from the USA, Central America, and Brazil. Nothing of it can be seen from the UK.

On Oct 28, a partial lunar eclipse is visible from the UK. Only a small part of the southern aspect of the **Moon** enters the umbra, although the whole Moon falls into the penumbra. First contact with the penumbra occurs at around 18:00 UT (geography-dependent), and the umbral phase is between 19:35 and 20:52 UT so if clear, it is at a comfortable time of evening.

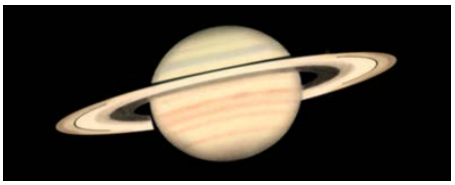
Mercury is just visible before dawn early in October, ending its fine morning display, but it then heads towards superior conjunction on Oct 20. It is too difficult to view throughout November evenings.

Venus is at greatest western elongation on Oct 23, but is brilliant throughout November. There is a daylight occultation by the waning crescent Moon on Nov 9. This is at a safe distance from the Sun and the pair provides a stunning sight before dawn, which will be a good time to set up. It should then be easy to follow them into daylight and enjoy Venus disappearing on the bright side of the Moon around 09:45 UT, reappearing from the dark side at around 10:48 UT. Exact times depend on your geography.

Mars is unobservable, being at conjunction with the Sun on Nov 18.

Jupiter dominates the autumn evenings and is at opposition on Nov 3, so is observable all night. It is magnitude –2.8 in Aries, so no star competes.

Saturn is well placed for early evening observation, slowly moving through Aquarius. The rings are quite obviously closing up, although the ring-plane crossing is not until 2025. Identifying the brighter moons is fun, with Tethys, Dione and Rhea being around 10th magnitude, and Titan an easy 8th magnitude. Try for Mimas at magnitude 13, or Iapetus – not that faint (11th magnitude) but often distant from Saturn so tricky to identify.



▼ **Figure 6.** Drawing of Saturn on 2023 Jul 30. *(Paul G. Abel)*

Uranus is in eastern Aries and well positioned at opposition on Nov 13. Its small greenish disc (3.7 arcseconds) should differentiate it from the nearby stars.

Neptune is past its September opposition in Pisces, but gives a good evening opportunity for location and observation with large-aperture telescopes. Within a rhomboid pattern of stars of around 6th to 7th magnitude, its somewhat fainter bluish disc (2.4 arcseconds) should identify it well enough. Spot Triton orbiting Neptune around every six days, in its unusual retrograde path.

Meteors

This is a very good season for meteor enthusiasts, all the showers of October and November being favourable. The **Draconids** may be worth watching on the evening of Oct 8, as the Moon will not interfere. The shower derives from comet 21P/Giacobini–Zinner and is generally weak, but occasionally puts on a good display. The radiant is in the head of the dragon, so is high up in the north-west by mid-evening.

The **Southern and Northern Taurids** have a splendidly favourable showing in 2023. The Southern Taurid maximum is on Nov 5 when the Moon is at last quarter; the Northern Taurids peak a week later, when the Moon is new. Both of these showers have wide ranges of activity between mid-September and early December, the Southern stream being swift, often with persistent trains, the Northern being slower. They are therefore easily distinguishable, although both radiant points are near the Hyades star cluster.

The **Orionids** will not be compromised by the Moon when they peak on the night of Oct 21–22, although their maximum is broad. These speedy meteors derive from comet 1P/Halley.

It is now 24 years since the famous **Leonid** display of 1999 November, and we must wait a further nine before the next potential storm in the 33-year cycle. The shower peaks on Nov 18 and the Moon sets in the early evening, so what meteors there are should be readily seen. The shower is derived from comet 55P/Tempel–Tuttle.

Phases of the Moon
2023 October & November

Last quarter	*New*	*First quarter*	*Full*
Oct 6	Oct 14	Oct 22	Oct 28
Nov 5	Nov 13	Nov 20	Nov 27

Comets

Perhaps the most interesting comet this autumn is **103P/Hartley**: one that the Comet Section is eager to monitor. However, it is not bright! It was discovered in 1986 and was visited by the EPOXI spacecraft in 2010, showing us that its 2km nucleus is peanut shaped. One of the Jupiter family of comets, with an orbit of 6.5 years, it passes through Gemini in October and is at perihelion on Oct 12. See more at: **bit.ly/3EMlNFa**.

Notice Board

Meetings diary

Entries for this diary should be sent to the *Journal* Editor [**editor@britastro.org**] as soon as dates and locations are known. Details of all astronomical meetings of regional or national interest are welcome. The Editor's decision on inclusion or otherwise of any meeting in this listing is final.

Joining BAA webinars

Webinars are hosted on Zoom and virtual attendance, either online or by phone, is free. Joining instructions for each event are on the BAA website at **britastro.org/meetings**. All times given here are for the UK. Live streams of webinars, and recordings of past events, are also available on the BAA YouTube channel (but please note that those viewing live on YouTube will be unable to take part in speaker Q&As).

Small advertisements

25p per word, minimum £5.00.

Small adverts must be typed or printed clearly and sent with the correct remittance in sterling, payable to the British Astronomical Association, to the BAA office at PO Box 702, Tonbridge TN9 9TX, UK. Free Members' adverts may be sent direct by e-mail to the Editor: please contact him at **editor@britastro.org**

Friday 2023 October 6
Webinar of the BAA Radio Astronomy Section, held at 19:30 *via* Zoom. Talk – 'Amateur SDR based interferometry, hardware and software (Getting started)', presented by Marcus Leech (President, Canadian Centre for Experimental Radio Astronomy). The link to the meeting will be sent to those on the Radio Astronomy Section e-mail list. To join the list, contact **paul@hearn.org.uk**.

Saturday–Sunday 2023 October 7–8
New Scientist Live. ExCeL London, Royal Victoria Dock, 1 Western Gateway, London E16 1XL. The BAA will again be an exhibitor. See **live.newscientist.com**.

Saturday 2023 October 21
Annual Conference of the Society for the History of Astronomy (SHA). Doors open 09:30. Large Lyttelton Lecture Theatre, Birmingham & Midland Institute, Margaret Street, Birmingham B3 3BS. Speakers: Gerard Gilligan, Jesse Garrison FRAS, Graham McLoughlin FRAS, Kevin L. Johnson FRAS, Mike Frost FRAS, FIET, and Dr Wolfgang Steinicke FRAS. Please book in advance, at £15 per person for SHA members, £20 per person for non-members. To pre-register, please contact **meetings@shastro.org.uk**.

Wednesday 2023 October 25
BAA Meeting & Annual General Meeting. 17:00–20:00 at the Institute of Physics, 37 Caledonian Road, London N1 9BU. Featuring the Presidential Address and annual Review of the Year, by Dr David Arditti. Further details TBA – see **britastro.org/event/agm-2023**.

Saturday 2023 October 28
Meeting of the Society for Popular Astronomy. University of Wolverhampton Science Park. BAA members are welcome at SPA meetings under a reciprocal arrangement. For further information about SPA events, visit **popastro.com**.

Wednesday 2023 November 1
Webinar of the Society for the History of Astronomy, 20:00 on Zoom. Talk – 'Fantasy Flights to the Moon: from Roman writer Lucian to the flight of Apollo 11' by Bob Garfinkle. Zoom link details will be made available to SHA members near to date. Please contact: **meetings@shastro.org.uk**.

Friday 2023 November 13
Webinar of the BAA Radio Astronomy Section, held at 19:30 *via* Zoom. Talk – 'Deep Science at Boulby Underground Laboratory: The search for Dark Matter and Beyond', presented by Prof Sean Paling (STFC UKRI). To receive the meeting link, sign up for the Section e-mail list by contacting **paul@hearn.org.uk**.

Wednesday 2023 November 22
Webinar of the BAA Historical Section, 20:00, livestreamed on the BAA YouTube channel (**bit.ly/46aQaBf**). Talk – 'The Australian Eclipses of 1857 and 1871' by Prof Nick Lomb (University of Southern Queensland).

Friday 2023 December 1
Christmas Lecture of the BAA Radio Astronomy Section, held at 19:30 *via* Zoom. Talk – 'Active Galactic Nuclei', presented by Prof Clive Tadhunter (University of Sheffield). To receive the meeting link, sign up for the Section e-mail list by contacting **paul@hearn.org.uk**.

Saturday 2023 December 9
BAA Christmas Meeting, 14:00–18:00 at the Institute of Physics, 37 Caledonian Road, London N1 9BU. See advertisement at left and to book, visit **britastro.org/event/christmas-2023**.

Members' private sales and wants

One advertisement of up to 35 words per member per issue is accepted FREE OF CHARGE, at the discretion of the Editor. This offer is not available for business advertisements or to non-members.

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Founded in 1890

British Astronomical Association

Programme of Meetings 2023–2024

Mrs Hazel Collett,
Meetings Secretary

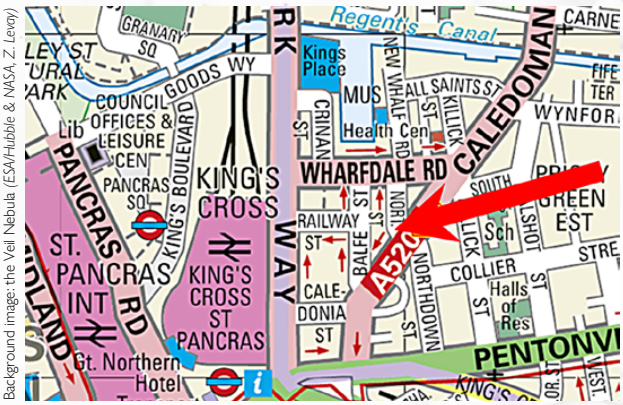
Notes

Wednesday evening meetings commence at 17:30 and end at approximately 20:00. Doors open at 17:00. Meetings on Saturdays commence at 14:30 and end at 18:00. Doors open at 14:00. The building must be vacated immediately following the meeting.

Speakers and principal topics at the Association's meetings are also advertised in the bimonthly *Journal*.

Please Note: *All details given are provisional and subject to change. See the* Journal *for latest information and additional meetings, or consult the BAA website:*

www.britastro.org/events



Background image: the Veil Nebula (ESA/Hubble & NASA, Z. Levay)

2023 Meetings

Friday October 6
Radio Astronomy Section Webinar
19:30, Zoom

Wednesday October 25
BAA Meeting and Annual General Meeting
17:30–20:00, Institute of Physics, London

Friday November 13
Radio Astronomy Section Webinar
19:30, Zoom

Friday November 24
Solar Section Meeting
To be held on Zoom; details TBA

Friday December 1
Radio Astronomy Section Christmas Webinar
19:30, Zoom

Saturday December 9
BAA Meeting and Christmas Lecture
14:30–18:00, Institute of Physics, London

2024 Meetings

Saturday January 20
BAA Meeting and Special General Meeting
14:30–18:00, Institute of Physics, London

Wednesday March 27
BAA Meeting
17:30–20:00, Institute of Physics, London

Friday–Sunday April 12–14
BAA Winchester Weekend
Sparsholt College, Winchester
Including Equipment & Techniques Section Meeting

Saturday May 11
BAA Spring Meeting, Greenock
Beacon Arts Centre

Saturday May 18
Historical Section Meeting, Ipswich
10:00–17:00, Venue TBA

Wednesday June 5
BAA Meeting and George Alcock Lecture
17:30–20:00, Institute of Physics, London

September (dates TBA)
BAA Autumn Meeting, Rutherford Appleton Laboratory

Wednesday October 30
BAA Meeting and Annual General Meeting
17:30–20:00, Institute of Physics, London