THE COMET'S TALE

THE NEWSLETTER OF THE BAA COMET SECTION

https://britastro.org/comet

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C/2025 A6 (Lemmon)
2025 Oct 3.46. 0.28 m RASA, ASI2600MC, 10×120s.
Alan Tough

EDITORIAL

Nick James (ndj@nickdjames.com)

Welcome to this edition of the Comet's Tale. It contains a range of articles and I'm sure that you will find something to interest you. Since the last edition (CT 43, 2025 June) we have had an impressive naked-eye comet (C/2025 A6 Lemmon), two fragmenting comets (240P/NEAT and C/2025 K1 ATLAS), an interstellar comet (3I/ATLAS) and a very successful section meeting. There have also been many other interesting cometary objects to observe. It has been a busy time for Comet Section officers and I would like to record my thanks to all of them for their support.

The Section continues to be very active with observations and images being received daily. We do not have a formal membership but there are 162 people signed up to our mailing list. Anyone can submit observations and join our mailing list but we have a hard-core of observers who regularly provide material. The Section has close links with other observers and comet groups around the world.

Figure 1 – C/2025 A6 (Lemmon). 2025 October 27.83. 21×30s. 5.4×3.6°. RedCat 51 + ASI2600MC. Nick James, Tenerife

The highlight of the period was definitely C/2025 A6 (Lemmon). This comet was discovered as a 21st magnitude, apparently asteroidal, object on 2025 January 3.342 in images taken by David Fuls using the 1.5 m reflector of the Mt Lemmon Survey. The comet would come to a perihelion of 0.53 au on 2025 November 8.54 but, initially, it was not expected to become brighter than 10th magnitude. That changed when it emerged from conjunction in 2025 August when it was much brighter than predicted. It developed steadily through the autumn of 2025, first in the morning sky and then moving to the evening sky from mid-October. UK observers had to deal with some very cloudy weather but many observations were received and these are summarised in a report in the 2025 December Journal of the BAA. At the time of writing, we have a total of 344 images in the section archive. I made a short trip to Tenerife to escape the cloudy weather in the UK but only had one partially clear night (October 27) on Teide. The comet was an easy naked-eye object despite the waxing crescent moon and I could see 1-2° of the dust tail. An image I took using at 100 mm, f/2 lens shows a 15° long ion tail.

Technology has a generally positive influence on our hobby and we have benefitted from amazing developments in areas such as sensors, mounts and software in the past decade. I do feel though that maybe we have gone too far when it comes to the workflow that some observers use on comet images. C/2025 A6 was a good demonstration of the pros and cons with regards to application of recent image processing methods. It is quite common now to have a very complex processing approach where the comet is separated from the star background and each is processed separately using advanced enhancement and noise reduction techniques. This approach can produce impressive images but it can also produce horrible artefacts. In particular, tools which attempt to freeze motion in the fast-moving gas tail using multi-point alignment or even AI based methods can produce spectacular images which have limited scientific value. Our recommendation for images submitted to the section is to keep your processing as simple as possible in order to avoid artifacts.

One other area where technology can have a negative impact is social media. There are many excellent social media comet groups which are friendly and well moderated and which are great sources of information but there are also many groups full of sensational images that are generally completely fake or massively manipulated. It is a sad fact that a great comet image might get a few hundred "likes" in one group but a manipulated image of 3I/ATLAS showing rocket exhaust or aliens peering out of windows can get tens of thousands. This is not helped when supposedly respectable scientists encourage wild speculation. Readers of the Comet's Tale can see this for the misleading rubbish that it is but members of the public are often not so lucky and we should help, wherever possible, to set the record straight. The BAA forum on our website is always a good place to go for up-to-date information.

We are incredibly lucky to be able to observe an interstellar comet with our telescopes. It is not a malign alien spaceship but it is a fascinating natural object from another star system that has been travelling in the cold of interstellar space for billions of years. 3I/ATLAS is now heading out of our Solar System, never to return, and it is fading quickly but it will remain detectable in amateur telescopes through to conjunction this summer. Within a few years the Vera Rubin survey should be detecting many more of these interstellar visitors. I just hope that people will get tired of the same old "alien invasion" rubbish every time one is discovered.

Another highlight of the last few months has been watching the fragmentation of the nucleus of C/2025 K1 (ATLAS). A report is in the 2026 February Journal of the BAA and Denis has included some images in his article on fragmenting comets that begins on page 14. There have been some very impressive, high-resolution images from large professional telescopes but amateurs with smaller telescopes have the advantage of being able to observe the comet more frequently. The components would brighten and fade on a daily basis and so frequent observations were essential. Our image archive for this comet has almost daily coverage from early 2025 November to mid-December and this was crucial in identifying how each component moved.

One of the areas of technology that is definitely beneficial and moving forward quickly is that of Smart Telescopes. The last edition of Comet's Tale included an article describing Owen Brazell's experiences and this edition contains a note (on page 28) by Andrew Pearce describing how he has used a Seestar S50 to perform accurate comet photometry. This is an exciting development for comet observers and I hope that we can include more details in a future edition.

We held a very successful Comets and Meteors meeting in Edinburgh on 2025 October 4. My thanks to the Astronomical Society of Edinburgh for the local organisation and for providing the excellent venue, right in the heart of Edinburgh. My thanks also to the speakers and to everyone who came along. It was a wet and stormy weekend and so there were a few bumpy landings at the airport and few delayed/diverted trains. The talks were all recorded courtesy of ASE and you can find them online here:

https://britastro.org/section_news_item/comet-section-meeting-edinburgh-2025-october-4

The talks are a great example of the range of work being done by amateurs and professionals in this field and I came away from the meeting encouraged that we will have plenty to keep us busy over the next few years.

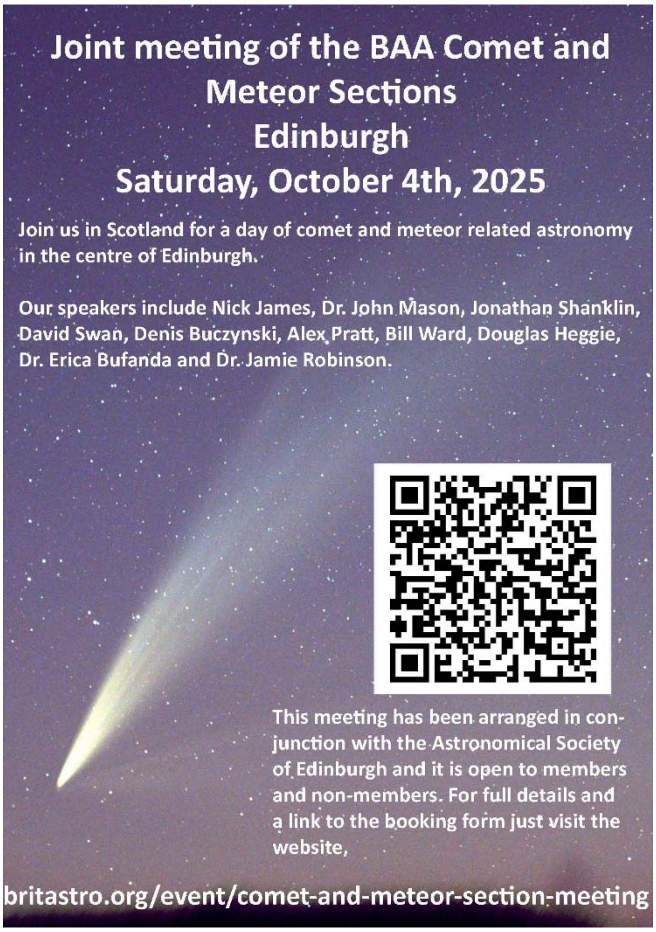

Figure 2 – The poster for the October meeting

The weather had improved by the Sunday for a visit to the City Observatory on Calton Hill where the 6-inch Cooke refractor was looking splendid. The building is an arts centre now but the telescope is well looked after and ASE still use it for public events.

Our next meeting will be sometime in 2027. Please let me know if you have any suggestions for the venue.

Figure 3 - The speakers, presidents and helpers at the Augustine United Church venue. Back row L-R: Jamie Robinson, Douglas Heggie, Jonathan Shanklin, Bill Ward, Alex Pratt, Denis Buczynski, Nick James, John Mason, Martin Mobberley. Front row L-R: Janice McClean, Erica Bufanda, Neil Martin, Tosh White, Ron Morely, Nigel Goodman

Figure 4 - In the dome of the 6-inch Cooke at the City Observatory on Calton Hill. L-R: Graham Winstanley, Peter Carson, Nick James, Janice McClean, Nick Quinn, Jim Nisbet, Fatsuma Bubaram

A SEMI-AUTONOMOUS OBSERVATORY FOR IMAGING COMETS AND OTHER CELESTIAL OBJECTS

*Nick Quinn (*nick@njq.me.uk*)*

Like many of you my astronomical interests and equipment have evolved over the years becoming more and more sophisticated. Decades ago, I was mainly observing visually; capturing images for posterity entailed the use of film cameras and being at the telescope manually guiding it for long periods. The Cookbook CCD Camera brought a computer to the telescope and a liquid cooling system initially utilising a car windscreen wiper motor, then a more expensive peristaltic pump. Increasingly clever electronics and evolving imaging sensors enabled auto-guiding and lessened the need to attend the telescope for every minute of the exposure. Now it has reached the stage that I no longer even have to go outside at all having (almost) totally automated my observatory and telescope. This has made it far easier to operate and much more efficient in utilising the all-too-brief periods of clear sky.

Figure 1 – The equipment in the observatory

My observatory consists of a Pulsar 2.2 metre dome with shutter and rotation drives. The shutter control was provided by Pulsar and the rotation system I have made myself from a large stepper motor and associated electronics. A Celestron C-11 Schmidt-Cassegrain telescope is mounted on a 10Micron GM1000 HPS. I can also mount a second small scope (a Borg 101 refractor) or a RedCat 51 lens and camera. The Borg can be fitted with a Coronado Hydrogen-alpha filter for solar viewing and imaging. I use the Celestron exclusively for imaging currently with a ZWO ASI-2600MM CMOS camera and a Starlight-Xpress filter wheel. A Primaluce Lab Eagle computer sits atop the telescope. A point-to-point wi-fi connection between my house and observatory (a distance of about 35 metres) allows remote access to the system from my main computer.

For many years I have used AstroArt for imaging. The software runs on the Eagle controlling the mount, camera, auto-focuser and filter wheel. As the system has evolved over the years, I have added various bits and pieces such as a servo-controlled light panel for flats that is mounted at the front of the telescope. Control systems for these homebuilt additions are based on Arduino and Raspberry Pi single-board computers.

The scripting language used by AstroArt is a version of BASIC so is quite straightforward to use. However, some control functions, for example the dome rotation, have to be passed to Python or Perl scripts as the AstroArt scripting language can't handle them directly. Initially my aim was to simplify imaging for the University of Kent's HOYS Project where multiple target fields are regularly imaged in several wavebands. I have since modified the script to make it easier to image objects such as asteroids and comets.

Prior to an imaging run I create a file that contains the name and coordinates of the objects that I wish to image. It also specifies the integration time, number of images, filters and a 'not-earlier' than time. When executed the script reads the list of objects and looks at the first entry. For objects such as galaxies and stars with fixed coordinates the script checks that it is above the local horizon (my garden and observatory are quite enclosed by trees!) and slews the telescope into position. For Solar System objects the Minor Planet

Center is queried automatically to get the current position of the object.

Once at the target field the script will check that the shutter is open and that the dome has rotated to the correct azimuth for that object. Conveniently the 10Micron mount outputs the required dome azimuth via an RS232 interface which the dome controller uses to rotate the dome. The plate-solving routine checks that the telescope is on target (correcting it if necessary), selects the filter, runs the auto-focus routine and executes the imaging run.

After imaging each object, a check is made to see if a flat image is needed. My C-11 doesn't have a mirror-lock and suffers from 'mirror flop' so I generally take a new flat each day, for each filter on both sides of the meridian if necessary. If a flat is required then the light panel is flipped over the front of the 'scope and the image acquired.

The script then moves on to the next target and the process is repeated until the list has been completed. At the end the script will either 'sleep', awaiting a set of new targets or it can close the dome shutter, park the telescope and turn off the camera.

In theory I can prepare a list of objects to keep the telescope busy all night. In practice there are just a few issues that sometimes arise that cause the system to stall or even fail. A Eurotech Aurora Cloud Sensor III will close the dome in case of cloud or rain and provides some sort of failsafe mechanism. I have gone to bed and let the system run for a few hours until the early morning but only when the weather has been very settled!

The system works quite well but I do sometimes make minor tweaks to the code. Writing ASCOM drivers for the dome controller, light panel and cloud sensor would eliminate the 'clunky' interfaces with AstroArt. Ensuring the rotation of the dome stays in sync with the telescope is a complication that would be unnecessary with a roll-off roof or even better, a clamshell observatory. I'm running version 7 of AstroArt, the latest version is 9 which may provide some better features. If starting from scratch there could well be other software that would be better but as I have invested many hundreds of hours in developing the system it is very unlikely that I will switch now!

References

1 http://www.wvi.com/~rberry/cookbook/cookbook.htm
2 https://www.primalucelab.com/computer-and-software/eagle/
3 https://www.msb-astroart.com
4 https://hoys.space
5 http://www.auroraeurotech.com/CloudSensor.php

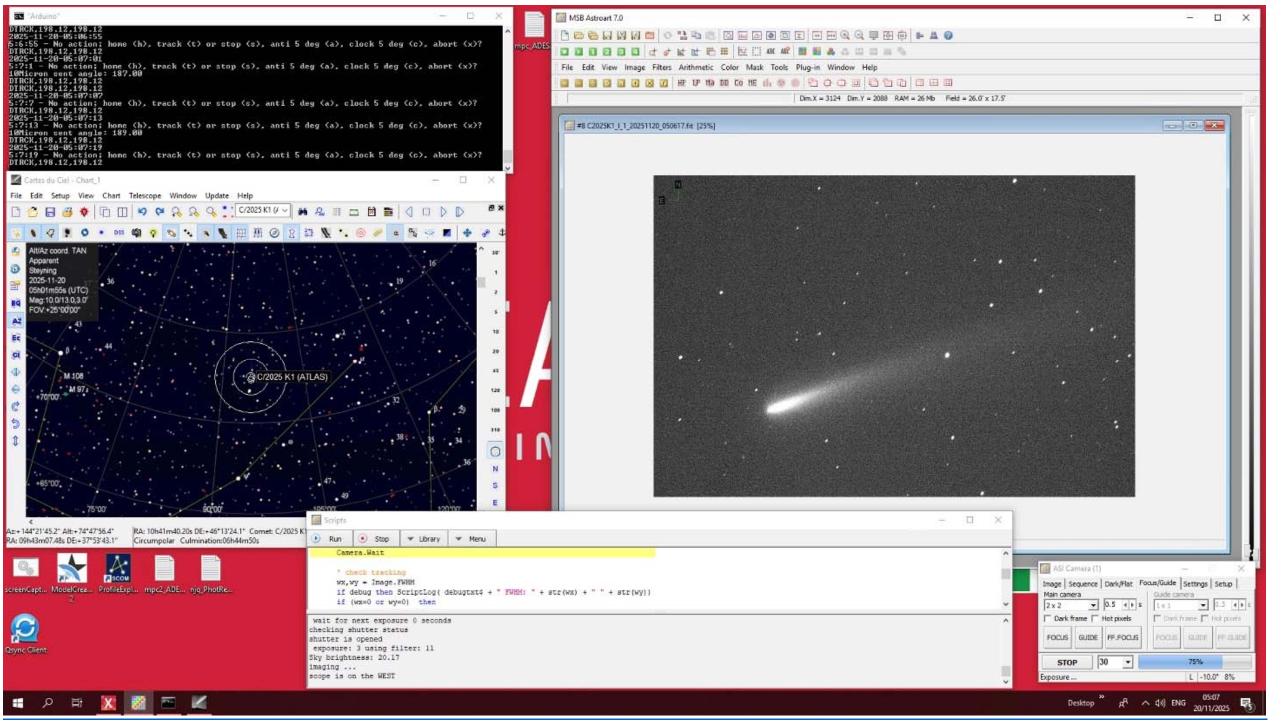

Figure 2 – A screenshot taken whilst an imaging run was in progress. Top-left is the dome-rotation control window, below that is Cartes du Ciel showing where the telescope is pointing. The three windows on the right show the main AstroArt, camera control and script windows.

THE DISCOVERY OF THE IRAS COMETS

John Davies (9064johndavies@gmail.com)

I attended the BAA comet section's meeting in Edinburgh on 2025 October 4 and not only did I meet some friends who I had not seen in years, but I also received a blast from the past as several objects of which I had fond memories were mentioned. Nick James asked me to revisit the events surrounding these discoveries and so cue spooky music and a scene dissolve as we slip more than 40 years into the past.

It is important to recognise how different astronomy, and particularly infrared astronomy, was in the early 1980s. Four metre telescopes were at the cutting edge and the UK had just commissioned what was, at the time, the world's largest infrared telescope, the 3.8 m UKIRT on Mauna Kea (now written Maunakea) in Hawaii. There were no civilian infrared arrays in use and this technology was firmly in the hands of the military, who wanted these detectors for missiles and sniper rifles. Astronomers were limited to single element detectors, just chunks of silicon doped to make them respond to the infrared and fitted to instruments the size of party cans of beer which were cooled with liquid nitrogen or even liquid helium. However, the US, Netherlands and the UK were about to embark on an audacious all-sky survey using a satellite known as the InfraRed Astronomical Satellite, aka IRAS. To comprehend what follows, we need to understand how this ground-breaking mission was designed.

IRAS was a 60 cm telescope contained within a large Dewar of superfluid helium which cooled the entire telescope close to absolute zero. Its focal plane contained 62 individual detectors, for which filters restricted each to one of four wavelength bands centred at around 12, 25, 60 and 100 microns. There were 14 or 16 detectors per band and these were arranged in two blocks of seven or eight at opposite ends of the focal plane. As the satellite scanned the sky from its sun-synchronous orbit, completing one trip over the poles every 90 minutes or so, a real infrared source would trigger a detector in (for example) the 25 µm band and about 3.85 seconds later the same source would trigger a matching detector in the second 25 µm block. This confirmation would allow the putative source to be 'seconds confirmed' and random noise triggering just one detector would be rejected. One orbit later the satellite's pointing direction would have shifted by ¼ of a degree, half the width of the focal plane, so the source would follow a different path across the detectors, be seen twice and again 'seconds confirm'. Two matching seconds confirmation meant four detections at the same position and the source became 'hours confirmed' and valid enough to be included as a real source in the eventual IRAS catalogues. This would eliminate the signal glitches, dust grains, satellites and other spurious sources which had bedevilled earlier infrared surveys. All this data would be returned, twice a day, to a ground station at the SERC Rutherford and Appleton Laboratory (RAL) near Didcot, which also hosted a quick-look science team. These roughly 12-hour operating blocks of scans and data dumps were called SOPS.

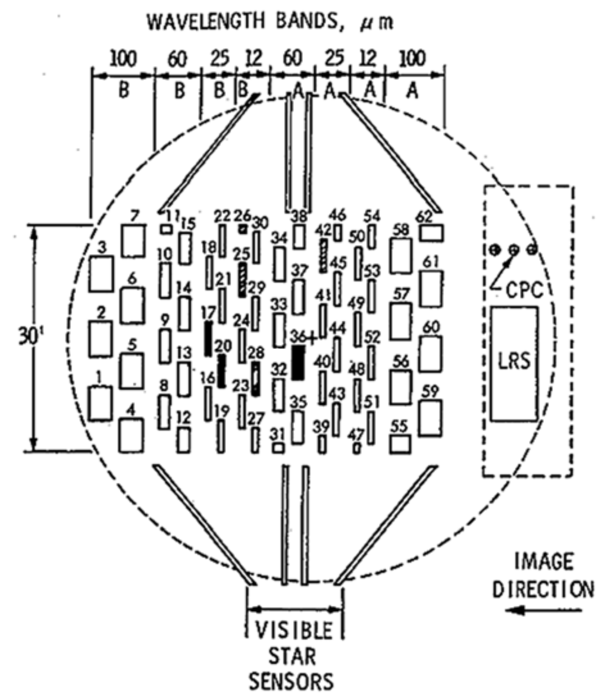

Figure 1 - The IRAS focal plane, the CPC and LRS were for pointed observations and not used during the survey.

However solar system astronomers realised that many asteroids would seconds confirm but would move enough in 90 minutes to fail the hours confirmation test and so would be rejected by the survey software. In particular near-earth asteroids, which would need rapid follow up for orbit detection, would be missed, so Brian Stewart of RAL and Simon Green, a PhD student at the University of Leicester, wrote a Fast-Moving Object (FMO) programme which would search the seconds confirmed sources which had failed to hours confirm and look for linked pairs of similar brightness that might represent asteroids which had moved between scans and thus escaped detection. This software was essentially the last sieve before the dustbin, it would only examine sources already rejected by the survey and anything not caught by it was likely to be rejected totally.

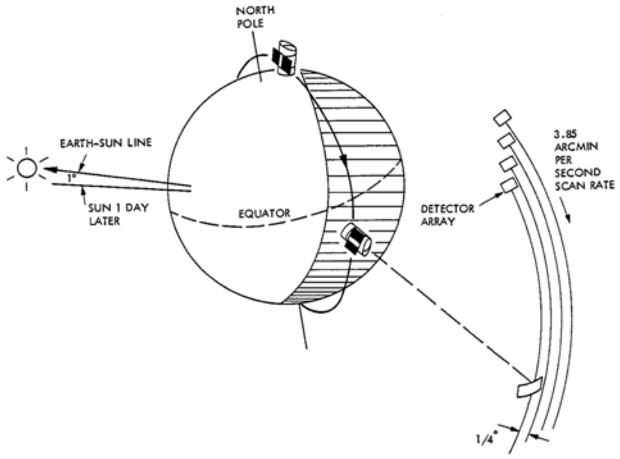

Figure 2 - The IRAS orbit, showing how the scan advanced by half a FoV every orbit.

Figure 3 -John Davies (on console) and Simon Green at the IRAS control centre at the Rutherford and Appleton Laboratory. (Photo Leicester Mercury)

This was where I came in, I had moved from a job at British Aerospace at Warton, Lancashire to a short-term research post (a PDRA) at Leicester University to use IRAS to search for near Earth objects. Of course, the FMO software produced only lists of positions and fluxes (IRAS was not a camera) and so we set up a network of ground-based Schmidt telescopes who agreed to follow up IRAS alerts by taking images and looking for any asteroids which might correspond to the IRAS detections. So, when IRAS launched in January 1983 I spent my weekdays in a temporary building at RAL and waited for the detections to roll in. At weekends I went home to my wife in Blackpool as we tried to sell our house in the midst of a recession.

Alas it was not that simple. Early on IRAS had many issues, and frequently the positional information from orbit to orbit was not correct, so the FMO software detected nonsense, or worse still fast-moving stars and galaxies which were obviously not real. By late April, after almost 3 months away from home, not a single credible source has been found. Then on April 26th, during the 180th dump of data, SOP180, it looked like the bingo moment had finally arrived. The FMO software flagged a bright source, visible in 3 of the 4 IRAS bands, which seconds confirmed but had moved between two scans made a few hours earlier. At just after 5pm that day, Tuesday May 26th, I finally sent my first alert. This was long before the days of routine e-mail and mobile telephones so the message went out by telex to six observatories. It read 'IRAS has detected an unusual asteroid-like object (reference 180-1) at high ecliptic latitude'. This was followed by positions and an estimated B magnitude of 12-15. Two days later, on the morning of the 28th came a crashing blow, a telex reply from one observatory reporting 'IRAS object reference 180-1 not found'. Depressed beyond belief I wrote an account of the logic behind the apparently false alarm (I do not recall if I ever circulated it) then packed up and went home to my wife in Blackpool for the weekend.

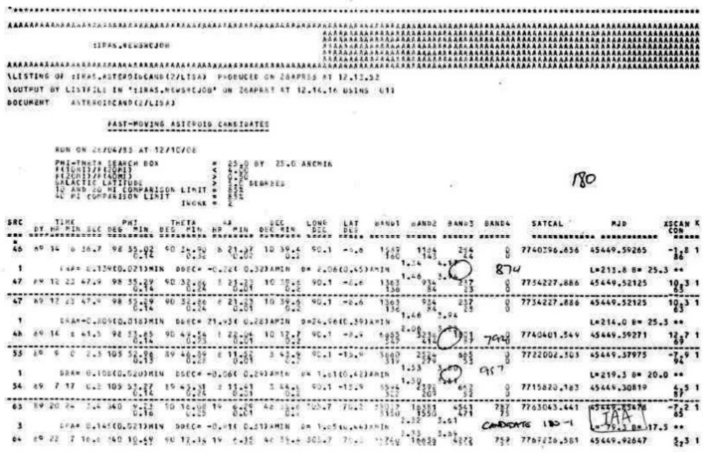

Figure 4 - Printout from the FMO programme showing the first detection of would become comet IRAS-Araki-Alcock. The other 3 object pairs were known asteroids.

Monday May 2nd 1983 was a bank holiday, so it was not until Tuesday that I drove to Leicester for a meeting with my boss, Professor Jack Meadows of the astronomy department. I was ready to quit but he persuaded me to stick with it a bit longer and so I went back to my digs in Didcot. When I arrived at RAL on the morning of Wednesday the 4th, things began to happen very quickly. I was asked something like....

'Have you seen the telex?',

'Yes', I replied 'I have no idea what went wrong.'

'No not that telex, the other one, about the comet.'

'What other one?'

This was a message from Brian Marsden at the Minor Planet Center stating that 'Your April 25 object apparently comet independently discovered by Alcock May 03. Is being named for him but can add IRAS discoverer if informed of it by noon UT May 4th' Well it was already the morning of the 4th by then so I drafted the world's fastest telex to Brian and sent it at 09:24 that morning. I included the IRAS positions and a report, which had come in while I was in Leicester, that the object was a comet. It seems that Brian Marsden had received some vague rumours about the IRAS alert and, combining this with reports from Hans Rickman and from Jim Gibson who was observing at Mt Palomar. He had put two and two together and made the connection between IRAS 180-1 and comet reports from Araki and Alcock.

All heck then broke loose. The comet was announced as IRAS-Araki-Alcock (1983d, now C/1983 H1) on IAU circular 3796 on the 4th of May, which included a long explanation of the discovery circumstances. At some point, I don't remember the exact date but it was probably the afternoon of Wednesday 4th, I was sent to London for an interview with Lawrence McGinty, then the ITN News science correspondent. As arranged, I met with Eric Dunford, the manager of the IRAS quick look facility on the platform at Didcot, only to find that as a senior manager he had a 1st class ticket whereas, being a junior post-doc, I had bought the cheapest 2nd class ticket I could get. Eric kindly sat with me for the journey, and we worked out a story for the press. We met up with ITN as planned and, after the interview, I rang home from a payphone. I had only one 10p coin which gave me just enough time to tell my wife 'watch the ITV news and tell my parents' before the dreaded pips cut me off. On the 5th of May Eric Dunford telexed a number of senior SERC people about the value of the RAL quick look facility. The next day SERC made a press release about the discovery and the phone just kept ringing. I recall one such conversation with a journalist from a tabloid newspaper which went something like this.

Is this comet going to hit the Earth?

No.

If it were could we do anything about it?

No.

Oh well, that's another good story ruined by the facts. (A phrase I have treasured ever since.)

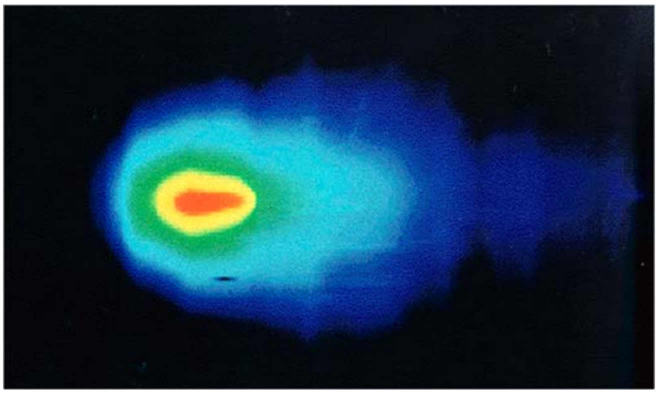

Figure 5 - An infrared image of the comet, made from IRAS pointed data. This was literally a Polaroid photograph of a screen display.

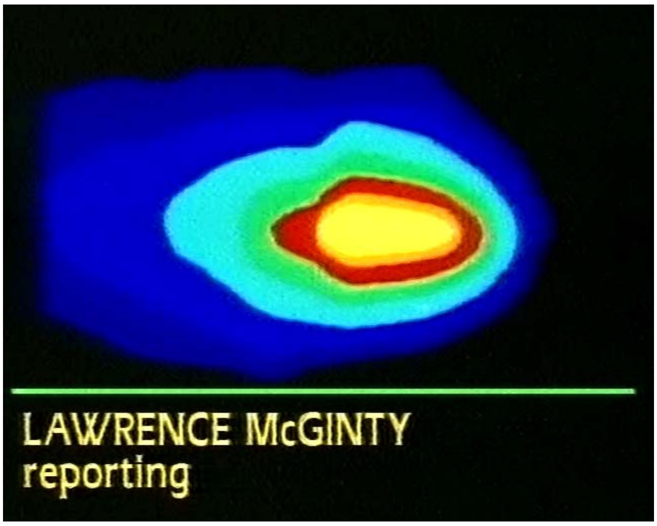

Figure 6 – The image as it appeared on the evening ITN News broadcast on 1983 May 10.

Some of the comet section will remember comet IRAS-Araki-Alcock. It was diving almost directly down on the North pole and so was circumpolar for a few nights then, one evening it moved from near Cassiopeia to below the horizon in a few hours. Watching via binoculars one could actually see the comet passing star after star as it headed south. It was the closest approach to Earth by a comet for 200 years.

Figure 7- C/1983 H1 photographed by Mike Hendrie on 1983 May 8.93. 22 min exposure using a 50 cm FL, f/5.8 camera + Tri-X film.

Once the comet had disappeared the press interest vanished, but I had had my 15 minutes of fame and gone from abject failure on the verge of quitting to success almost overnight. Comet IRAS-Araki-Alcock was a huge boost to my morale and to the credibility of the moving object search. IRAS went on to discover five more comets and a huge dust trail of Comet Temple-2, visible only at 25 microns (but that is another story). Finally, in October 1983, Simon Green, who was taking a spell at RAL, detected a fast-moving asteroid which, since it was moving in the same direction that the IRAS scan was advancing, was seen on seven consecutive orbits. Designated 1983 TB, and soon after numbered (3200) Phaethon, this turned out to be the elusive parent body of the Geminid meteors and has been extensively studied ever since.

Simon went on to be a successful astronomy lecturer at the University of Kent and then at the Open University. Myself, buoyed by the success of the IRAS comets, I stayed at Leicester for a while helping to co-ordinate the UK preparations for comet Halley. Then I moved to Birmingham to work on the ROSAT X-ray and UV sky survey. When the space shuttle 'Challenger' crashed and the ROSAT launch vanished into the far future I moved to the Royal Observatory in Edinburgh to work on the ESA Infrared Space Observatory. I used my guaranteed observing time to look at comet dust trails. In 1993 ROE sent me to UKIRT in Hawaii where I observed comets such as C/1996 B2 (Hyukatake) and C/1995 O1 Hale-Bopp as well as making some of the first infrared observations of the newly discovered Centaurs and Kuiper Belt objects. I returned to Edinburgh in 2001 and saw out my career helping to co-ordinate a large EC grant for the integration of European astronomy. Today I help run the Tweedale Astronomical Society and still observe the occasional comet, but now just for the fun of it.

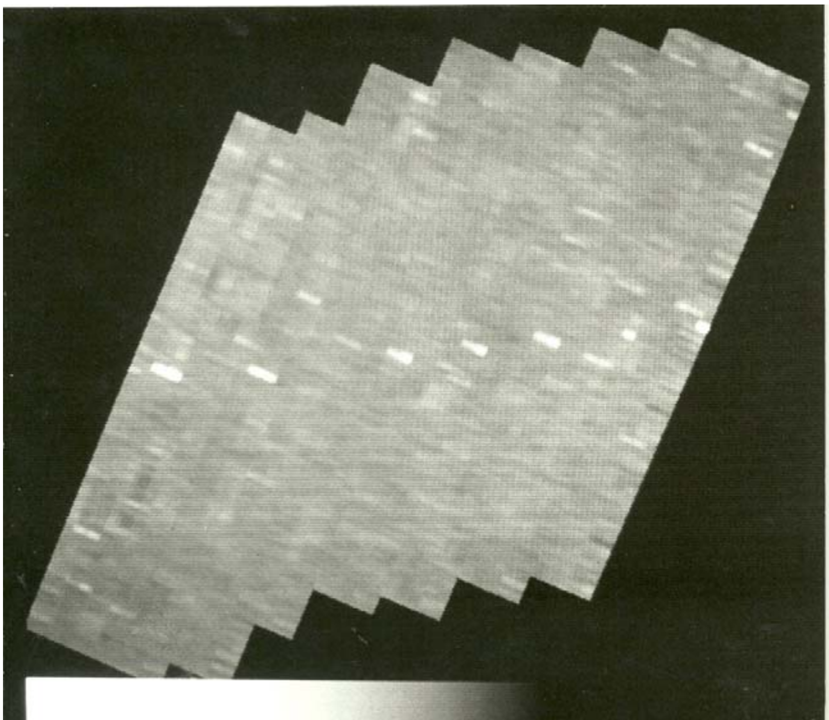

Figure 8 - After the IRAS mission ended, new software allowed scans to be merged and displayed as images. This showed (3200) Phaethon, being detected in seven successive orbits. Such images were not possible in real time.

COMET SECTION VISUAL OBSERVATIONS

Jonathan Shanklin (jdsh@bas.ac.uk)

The comet section was founded in 1891 with W.F. Denning as its first director. The focus of early work was the discovery of new comets, measurement of positions and computation of cometary orbits, with some work on the structure of coma and tail. Occasional reports appeared in the Journal and it might be possible to recover some visual observations from these reports. All the early records of the section were reputed to have been lost during the second world war. The earliest records remaining in the archive date from the 1940s.

Exactly what was recorded varied from observer to observer: some reported a nuclear magnitude, others approximated a total magnitude. W.H. Steavenson gave some guidance in the Journal in 1952. Details of techniques were also given in the BAA pamphlet Nature, Aims and Methods, which first appeared in 1948 with a second edition in 1969. Things were put on a firm footing with the publication of Observational Astronomy for Amateurs by J.B. Sidgwick in 1955, which gave clear instructions on how to make a magnitude estimate. My copy is the 3rd edition from 1971 and I received it as a school prize. Sidgwick's technique remains the standard one for visual observers, though it has sometimes been modified by others.

I'm not sure when standard report forms were first introduced, perhaps in the 1960s and I was certainly using them in the 1970s. All the details were written by hand on the forms and then sent in batches to the section director of the day.

Michael Hendrie digitised records of 1P/Halley for his report on that comet and also records from 1948-1954. Graham Keitch digitised some records from the 1970s and 80s when he was section director between 1987 and 1990. I processed the remainder during several voyages to Antarctica in the 1990s. I consigned boxes of records as ship's cargo and then once on board collected them from the cargo hold and, at least on calmer days, set to typing up the hand-written reports. The majority of these were submitted via email to Dan Green of the International Comet Quarterly (ICQ) for publication and archiving. The original forms are now in the BAA archive.

One problem with the ICQ was accessing the records but fortunately we now have the COBS archive, where observations are freely available. The ICQ format has its problems: it was designed as a fixed format suitable for computers of the 1970s, so had an 80 column width. It couldn't cope well with free text and this is an issue that still besets the format. Guy Hurst developed an alternative format for The Astronomer (TA), which did allow for the possibility of free text descriptions and this format was used by some observers to submit observations. Today the majority of observers submit their observations directly to the Comet Observations Database (COBS), from where they can be extracted for analysis. Since I commenced editing the comet contributions for TA I have dispensed with the TA format, but encourage observers to submit free text descriptions for the introduction to each comet.

On the assumption that all observations have made their way to COBS it is possible to do some statistics of the observations, which reveal some changing patterns. The following make use of the statistical data in COBS, using all observations, not just those of the BAA (Figure 1). Often the basic observations obscure information, for example I have made comet observations from Antarctica and the Falkland Islands, but COBS assumes that they were made in the United Kingdom.

The number of observations per year is on the rise, particularly for electronic observations. There is however a curious dip between 2008 and 2012.

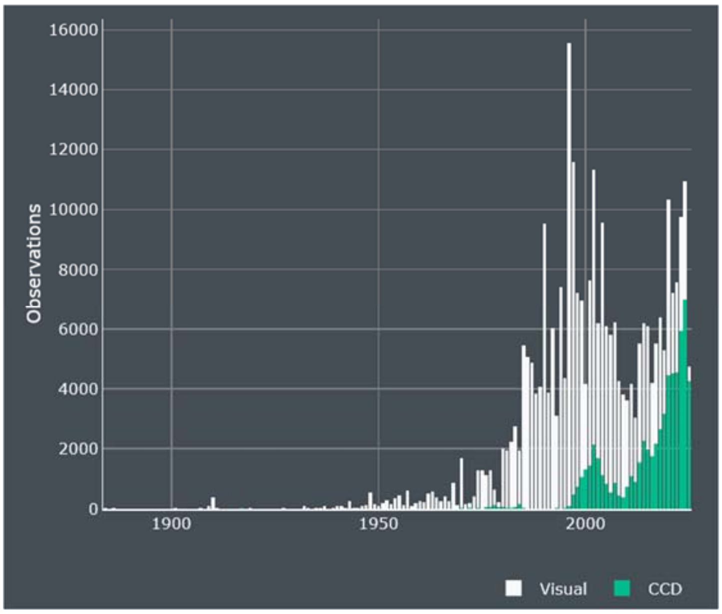

Figure 1 - Distribution of COBS observations by year

The BAA is the largest contributor to COBS, with a total of 93,787 observations. At the present rate of increase it will be only a few more years before 100,000 is reached with around 250 observations a month coming in. The next largest contributor is the ICQ with 51,098. Overall COBS has 292,674 observations. Curiously the United Kingdom is rated third with 25,613 observations, behind Germany and Japan.

The most observed comet is 1995 O1 (Hale-Bopp) with 14,661 observations, largely on account of its long period of visibility as a bright object. 1P/Halley is next on 7,133, largely due to the intensive observing campaign for this iconic comet, though it will soon be overtaken by 29P/Schwassmann-Wachmann.

Eight observers have made more than 4000 observations and three of these routinely contribute observations to the BAA. Kevin Hills leads with 7462, with all but five being electronic. Andrew Pearce has 6976, with a roughly 50/50 split between visual and electronic. Jonathan Shanklin has contributed 4425 visual observations and is third on the visual observations list. Partly as a result of preparing this note I discovered that COBS was missing some of my observations (and by inference those of other observers) and I was able to track down those missing. The totals given here are prior to the discovery.

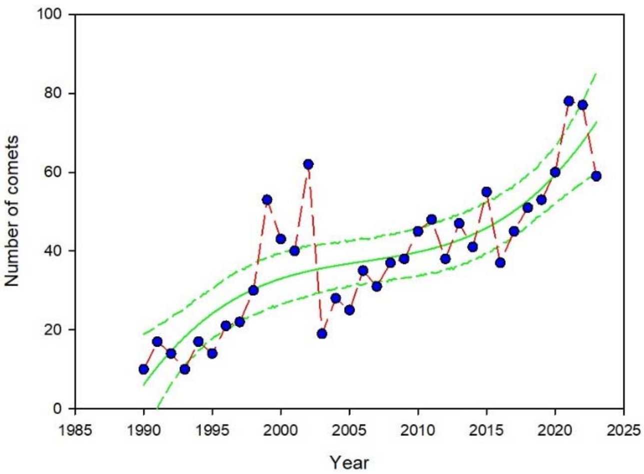

Figure 2 - The number of comets with computed magnitude parameters each year. Taken from "The comets of" series. 2002 was noted as an anomalous year, with several bright comets. The curve is a 3rd order polynomial with 95% confidence limits, which helps emphasize the three periods (visual, CCD, CMOS+remote). A linear fit is equally possible.

Other stats are rather harder to extract directly from COBS, so the following are based on observations in the BAA files and particularly from "The comets of " series published in the Journal, which began with the comets of 1990. When observations were purely visual or photographic there were relatively few comets under observation each year (Figure 2). A bright comet would draw in a large number of casual observers, but there was a small core of dedicated observers who observed all those within range of their equipment. Today, with a group of observers contributing VEM observations the number of comets under study has increased substantially. Technology plays a part in the increase. In the 1990s most observations were visual, augmented by some photographic estimates. CCD observations were beginning to be used by 2005 and by 2015 were in a majority. Over the next ten years the development of remote observing, the switch to CMOS detectors and development of good reduction software produced a further increase in the number of observable comets.

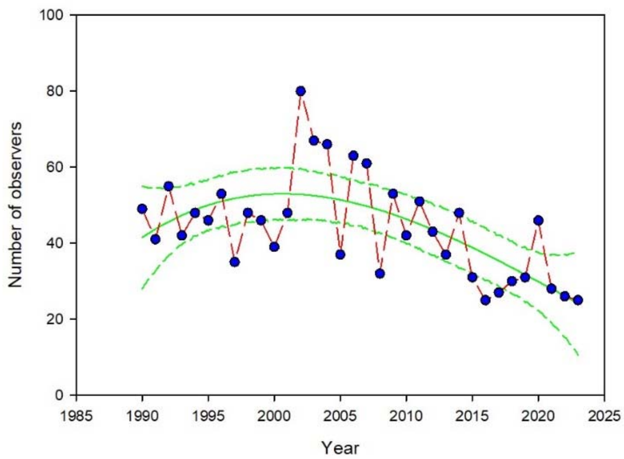

Figure 3 - The number of visual observers each year listed in "The comets of" series. The curve is a 3rd order polynomial with 95% confidence limits.

The number of observers contributing each year (Figure 3) can also be extracted from the reports, though practice has varied over the years between listing all contributors and only listing those who are BAA members or affiliates, eg through TA. What this seems to show is a steady decline in the number of observers this century. This is likely to be correct, however it may be that fewer casual observers now contribute drawings or descriptions.

Our observers are clearly becoming more prolific in terms of the number of comets that they observe. This does now rather depend on whether the observer conducts visual or VEM observations. The visual observer is generally limited to those comets that get brighter than around 12th magnitude, whereas today well-equipped amateurs can image comets of 20th or fainter magnitude. I used to regularly observe with the

Northumberland refractor (300mm) at the Cambridge Observatories (Figure 5), sometimes cycling there in the early morning. This telescope could on occasion reach 13th magnitude, but today light pollution has become much worse, trees have grown taller around the dome and I am less enthusiastic about cycling in the early hours! Perhaps the time has come when I should take up scheduled electronic observing, however my preference is to continue observing the brighter comets with my 20x80 binoculars at a convenient time of the evening.

Using my own observations allows a slightly longer perspective on the number of comets visible in a year for a typical dedicated visual observer. My first positive observation was in 1973 and since then my primary instruments have been variously: 8x40B, 7x50B, 11x80B, 20x80B, 90mm R, 25x100B, 150mm L, 200mm R (the Thorrowgood refractor), 200mm T, 300mm R (the Northumberland refractor) and 330mm L. I have mostly observed from England, but have observed comets from other locations including Antarctica, the Atlantic, a Pacific island, the Falkland Islands, Brazil, Tasmania and New Zealand. On average I have observed seven comets a year (Figure 4), and for consistency with the previous two graphs I have plotted a 3rd order polynomial. This suggests that my most prolific observing period was at the end of last century, which is perhaps when the appeal of early morning cycling began to wane. It may however indicate that there was a real peak in the number of comets visible around that time, which could explain the peak in COBS observations. A speculative prediction from the curve might be that my last comet observations will be in 2027!

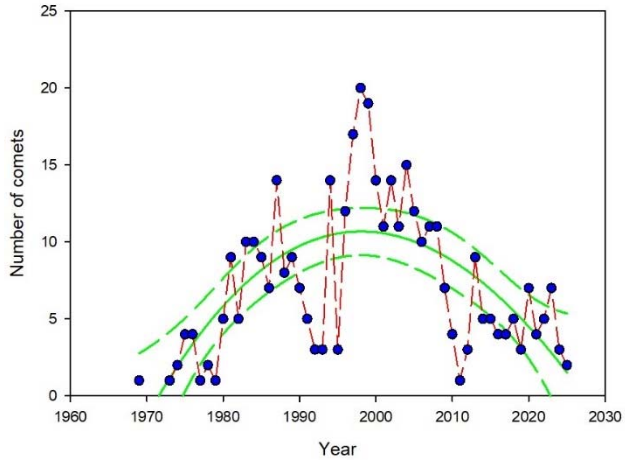

Figure 4 - The number of comets observed or attempted each year by Jonathan Shanklin. Fragmented comets with two separate condensations are counted separately. The curve is a 3rd order polynomial with 95% confidence limits. The data is less well fitted by an average of 7.2 comets being visible each year.

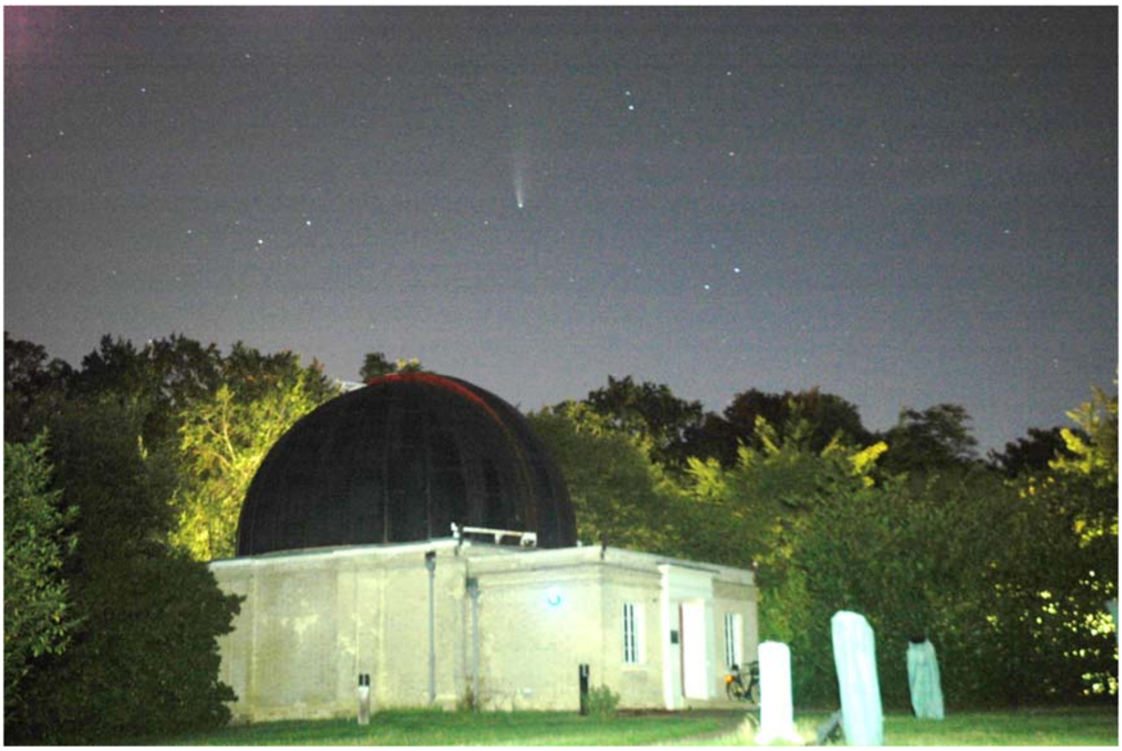

Figure 5 – C/2020 F3 (NEOWISE) above the Northumberland dome in 2020 July

SOME NOTABLE DISINTEGRATING COMETS

Denis Buczynski (buczynski8166@btinternet.com)

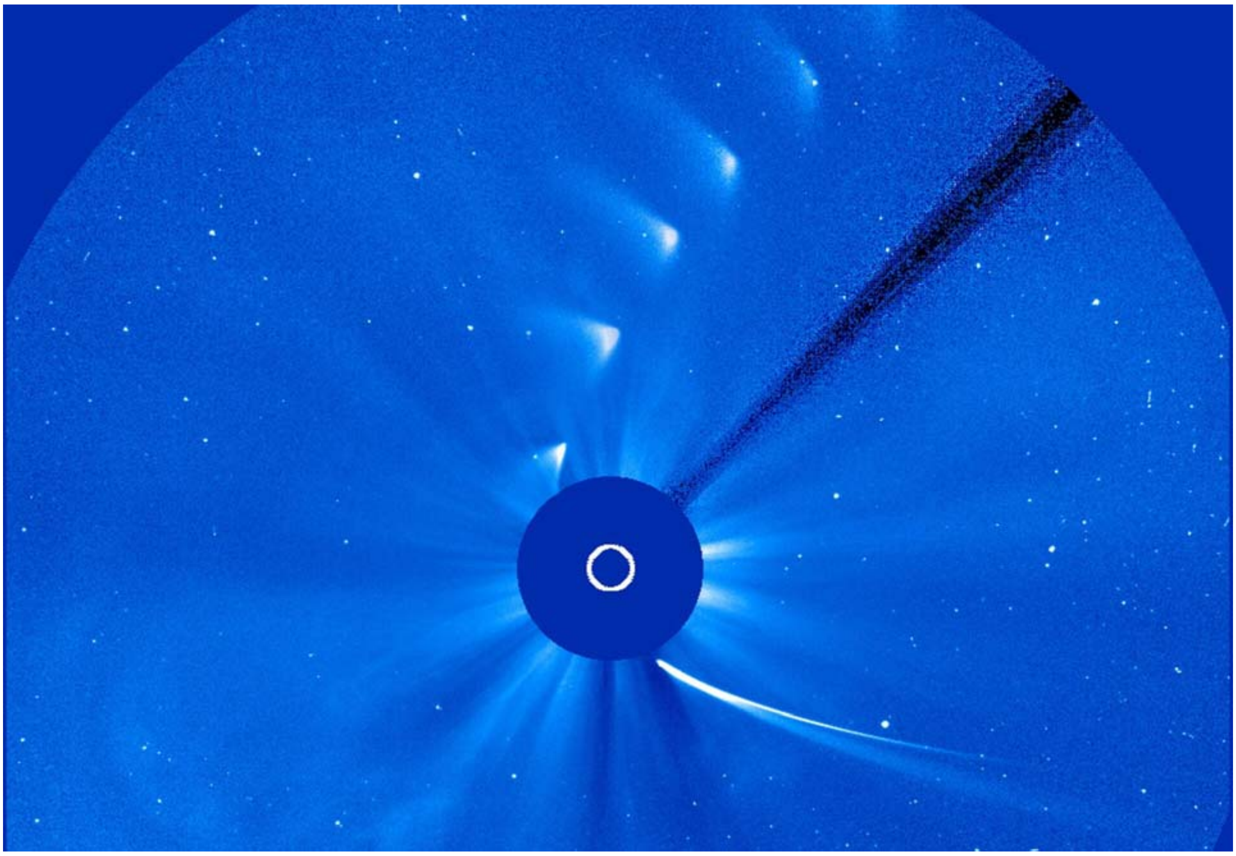

Figure 1 - C/2020 S1 (ISON) disintigrates at perihelion. This image is a montage spanning three days from 2013 November 28–30. ESA/NASA - SOHO/LASCO

Recently we have been able to observe disintegration processes in some comets. Some have been bright enough to allow us to image and record these events. Disintegration of cometary nuclei is not unusual. As comets approach perihelion they are subject to huge tidal forces and their fragile nature means that although some survive perihelion passage, others are ripped apart, sometimes catastrophically, never to be seen again. Some are seen to fragment and then to continue their passage through the Solar System.

In the past few years, we have seen many examples of fragmenting comets. Sometimes we have anticipated seeing a spectacularly bright comet at its perihelion passage, as with C/2021 S1 (ISON), but were left observing only a ghostly remnant as this comet disintegrated, whilst we watched it in the SOHO coronagraph images.

A famous fragmenting comet frequently described in historical comet literature is Comet 3D/Biela. It was discovered on 1772 March 8, by the French astronomers Jacques Leibax Montaigne and Charles Messier. Its designation as a 6.6 year short-period comet of the Jupiter family was not confirmed until orbital calculations were made by Wilhelm von Biela in 1826. Prior to that date there had been numerous attempts to classify its orbital period (by notable astronomers such as Carl Friedrich Gauss and Friedrich Bessel) and also any possible links to previously designated comets. Biela's discovery of this comet at its return in 1826 allowed him to positively identify his discovery as being the same as a comet that appeared in the year 1772 and a comet discovered by Jean-Louis Pons in 1805. The comet was then named after him, the third known comet to be recognised as a returning periodic comet after 1P/Halley and 2P/Encke.

Biela's comet was observed at the next return in 1832. The return in 1845 saw the splitting of the nucleus into two distinct cometary forms, both with coma and tails. These were first seen by the astronomer John Russell Hind in January 1846. It seems that the comet's brightness peaked at around magnitude 5.5 in early March, when it was visible to the naked-eye. This value would probably have been derived from the brightness of both components added together.

By August 1846, the separation between components A and B had widened to approximately 2.5 arc minutes, with both nuclei remaining visible despite component B fading to about 1.5 magnitudes fainter than A by mid-March. The general consensus suggests that component A was twice as bright as B. On that basis A could have been about magnitude 6 and B about magnitude 7. At the 1852 return the comet was observed again and both components were detectable, with component B being much the fainter. The comet was last seen by Struve at Pulkova in September 1846. It has not been observed since then.

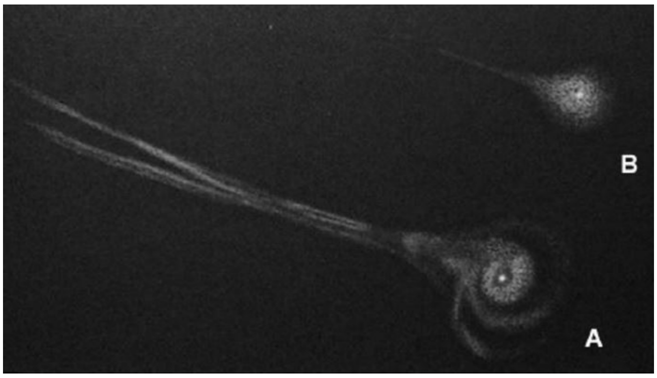

Figure 2 - Comet 3D/Biela 1846 February drawing by E.Weiss (Vienna) as reproduced in Bilderatlas der Sternwerit 1888

Subsequent searches, right through to the present date, have failed to reveal any trace of the comet nuclei, and total disintegration must be considered. The comet did leave traces of material after its demise and this material was well seen as strong meteor display (originally called the Bielids but now named as the Andromedids) on November 27 1872.

Two other notable theories with which Biela's comet were associated came from a discussion about the 19th century idea of "luminiferous ether" and also the possibility of interaction of material associated with Comet 3D/Biela to the Carrington Solar flare of 1859. This was discussed as late as 2025 at the 2025 EPSC-DPS Joint Meeting in Helsinki. Both of these links are well beyond the scope of this article to describe.

We may have seen a comet that resembled 3D/Biela during the latter months of 2025. The periodic comet 240P/NEAT also split into two separate components, each showing distinct comas and tails. Both components have been seen drifting apart and the fainter B component becoming gradually fainter. This is similar to observations during the later apparitions of 3D/Biela. Comet 240P/NEAT has an orbital period of around 7 years and is also a member of the Jupiter family of comets. It will be interesting to observe this comet at future apparitions and see if it suffers the same fate as 3D/Biela.

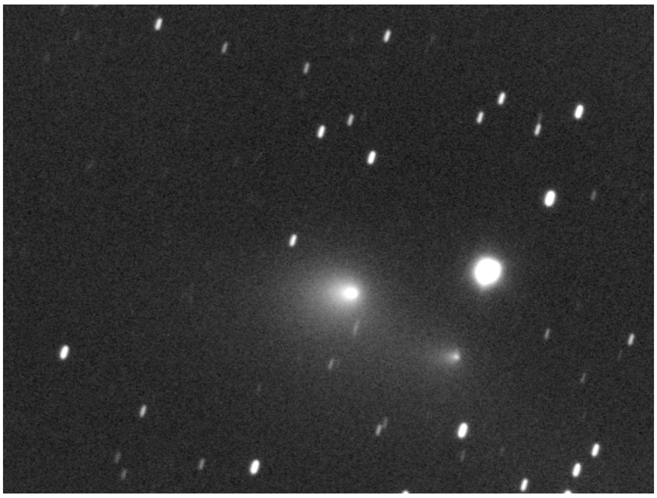

Figure 3 - Comets 240P and 240P-B NEAT on 2025 December 22. Denis Buczynski. I81.

Jonathan Shanklin commented: "3D/Biela in 1846 March was 0.9 au from the Sun and 0.4 au from Earth. 240P is currently at perihelion 2.1 au from the Sun and 1.2 au from the Earth. Intrinsically 240P has a brighter absolute magnitude, possibly 5 magnitudes brighter, so if you swapped the orbits 240P would be quite spectacular!"

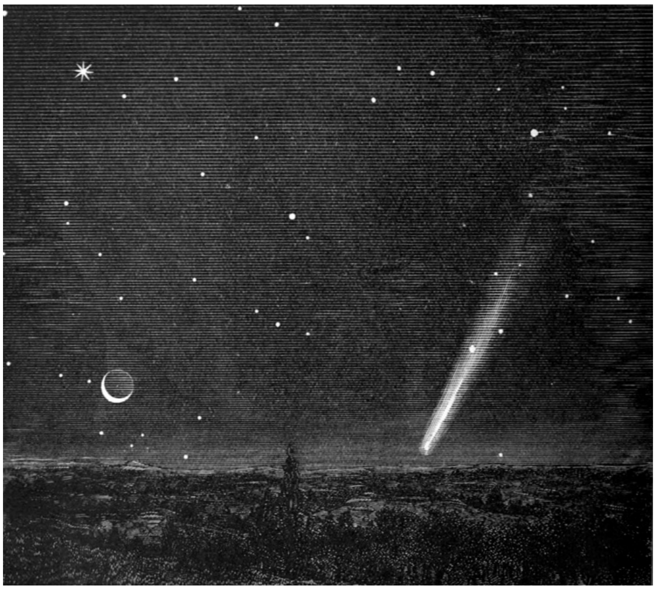

Figure 4 - The Great Comet of 1882 and the crescent moon on the morning of 1882 October 9 as recorded on an engraving by French astronomer Camille Flammarion.

Another fragmenting comet extensively observed at the time which was well documented, was the Great September Comet of 1882.This comet was truly a "comet like no other". Its perihelion passage was eventful and spectacular. There are plenty of descriptions in the literature and the chronicling of the observations makes fascinating reading. I recommend the authoritative account written by Gary Kronk in his Cometography series Vol 2 pages 503-516.

Comet C/1882 R1 was a Kreutz sungrazer. It was discovered close to perihelion at 0.007 au as a Southern Hemisphere naked eye object on September 1 by numerous people in several countries. One description noted that the comet "was as bright as Venus with a brilliant tail". Observers in South Africa, Australia and Brazil followed the comet until it was at perihelion on September 17 and it was visible in broad daylight for many days. At perihelion passage the comet was also closest to the Earth at 0.99 au and was predicted first to transit the face of the Sun, then second to be occulted by the Sun. These events were observed in detail. As the comet approached the solar limb prior to transit it was seen by W.L. Elkin at the Royal Observatory SA who said that "the silvery light of the comet presented a striking contrast to the reddish-yellow of the Sun. I actually observed it to disappear among the undulations of the Sun's limb" At that point the comet could have been as bright as magnitude -17. After perihelion the comet remained a bright naked eye object throughout September with a straight tail of around 12 degrees length.

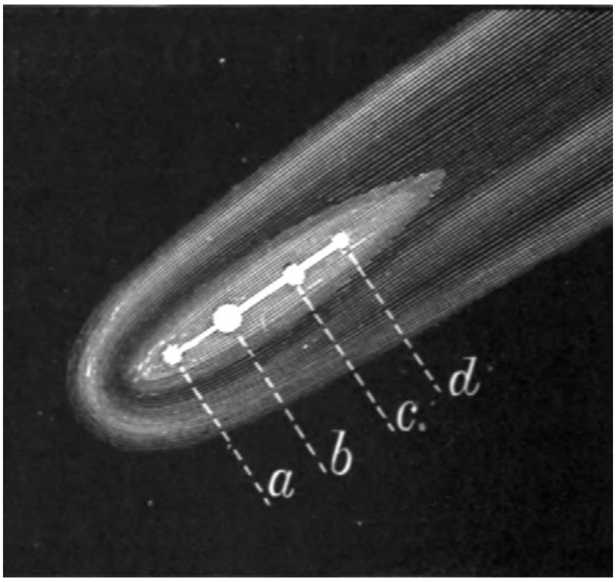

Figure 5 – Components of the Great Comet of 1882. G.F.Chambers. The Story of the Comets 1909

Attention was then directed at the comet nucleus after Edward Emerson Barnard noted that it was elongated in the direction of the tail. By October 2 observers in South Africa and Belgium saw that there were two distinct components. "They resembled two grains of rice placed end to end". Three days later Barnard reported that there were now three individual nuclei, "in a row". By the end of October observers using large aperture telescopes saw six components. Schaeberle described the view as: "like small beads strung on a thread of worsted". This comet displayed many features such as long gaseous envelopes and glows that were well separated from the main body. Indeed, Barnard said he observed six or eight objects close to one another within 6 degrees south and west of the comet's head. His note regarding this phenomenon was published as "Barnard's dream" (The Early Life of E.E. Bernard (Part II) Hardie, R. Journal: Astronomical Society of the Pacific Leaflets, Vol. 9, No. 416, p.121).

The nucleus region changed continually, sometimes looking like a bar and sometimes with many individual condensations. A sunward extension of the main tail was also seen during October. The comet remained visible to the naked eye until March 1883.The tail length was recorded as being 15 degrees long. The elliptical orbital period was calculated as being in excess of 700 years. However, despite the seeming fragmentation of this comet it did survive and then began its long journey to aphelion. It was a truly remarkable comet and was well observed by many famous and active comet observers, mainly in southern skies. Its brightness and form inspired David Gill in South Africa to experiment with photography to record it, resulting in the famous Carte Du Ceil project.

https://en.wikisource.org/wiki/Popular_Science_Monthly/Volume_22/January_1883/The_Great_Comet_of_1882

Figure 6 – C/1975 V1 (West) 1976-03-04.84UT, 1x180s, Minolta SRT101, Rokkor f=55mm F1.7, Fujichrome R100, K.Shima, Manual (hand) drive, taken at Nanto-shi, Toyama, Japan.

In 1976 the brilliant naked-eye Comet C/1975 V1 (West), was seen to fragment after its perihelion passage on February 25 1976 at 0.19 au and subsequently display a complex dust tail with prominent synchronic bands. The comet was discovered on ESO photographic survey plates taken on November 10 1975 by Richard West. After these were measured for position, an orbit was calculated by Brian Marsden at the MPC. This showed that it would be a bright comet in the morning sky in mid-March 1976. It was observed regularly photographically on its inbound journey whilst faint, then extensively by amateurs visually when it was brighter than magnitude 10. It then became bright enough to be seen by the naked eye in daylight at magnitude -3. It had an orbital period of more than 250,000 years.

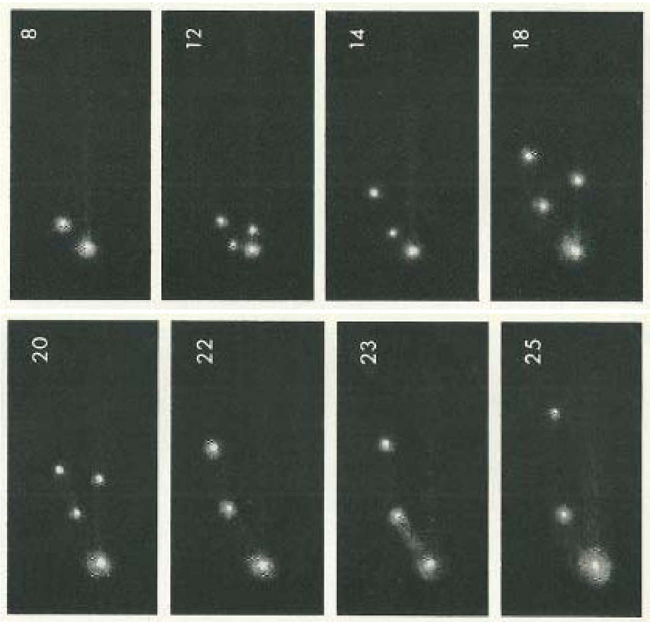

Figure 7 – C/1975 V1 visual observations by John Bortle in 1976 March 8-25. From Sekanina Sky&Telescope, 1976 June

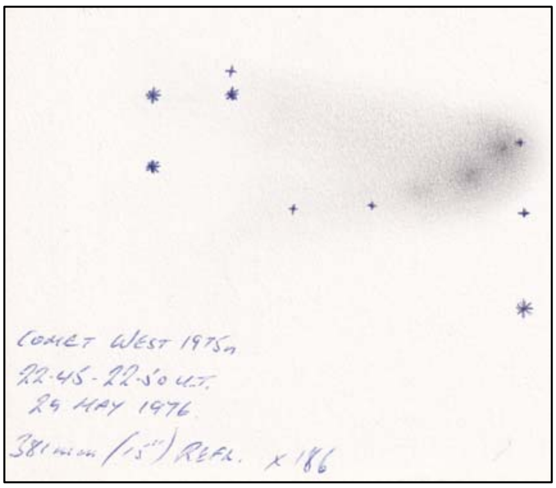

Figure 8 – C/1975 V1 visual observation of the components of the inner coma. 1976 May 24 Paul Doherty

The fragmentation of the nucleus was documented in detail, mainly by observers in the USA between 1976 March 6 to April 8. The ever-changing positions, brightness and orientations of the four components were analysed and described by the Harvard comet scientist Zdenek Sekanina in the June 1976 edition of Sky and Telescope. At that time one of the main visual observers was the experienced comet observer John Bortle of New York. Also, a series of photographic images were taken at New Mexico State University showing the evolution of the cometary fragments. The extensive dust tail was produced by the release of dust particles of various sizes during the disintegration process. This was also described by Sekanina in the same Sky and Telescope article. This comet was one of the brightest of the second half of the 20th Century.

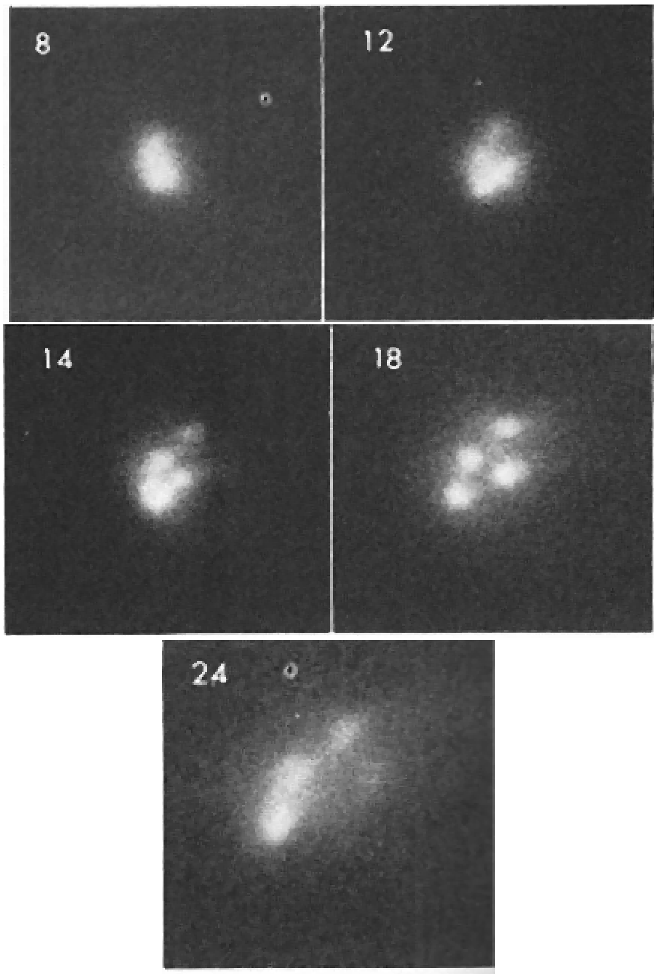

Figure 9 - C/1975 V1. Photographic series made at f/40 with the 24 inch reflector of New Mexico State University at Las Cruces between 1976 March 8-24 in yellow-green light 103aD emulsion and GG filter. Observers were Scott Murrell and Claude Knuckles. From Sekanina Sky&Telescope. 1976 June

Periodic comet 73P/Schwassmann-Wachmann was observed to be in the process of disintegration during its 1995 and 2006 apparitions. Its nucleus separated into three distinct fragments at the 1995 return then into more than 60 individual components at the 2006 return. The 2006 events were recorded in exquisite detail in images taken by the Hubble Space Telescope. Some of these fragments returned to perihelion at the 2022 apparition. Next perihelion is on 23 December 2027. It will be fascinating to see if any or all of the comet components have survived. Perhaps it will have the same fate as 3D/Beila.

Figure 10 - 73P/Schwassmann-Wachmann. Observation by Hubble Space Telescope of component B after fragmentation. 2006 April 18. NASA/ESA/H Weaver et al STSci

Speculation about inbound comet C/2019 Y4 (ATLAS) created some excitement as it seemed to have a similar orbit to the Great Comet of 1844 (C/1844 Y1) and that it may be a fragment of a common parent body. C/2019 Y4 ATLAS has an orbital period of 5500 years and came to perihelion at q=0.25 au on May 31. In March 2020 the comet experienced a huge surge in brightness from magnitude 17 to 8. This event must have been the onset of the fragmentation that was observed in April. The dust production values indicated that the process of disintegration was underway. Comet imagers were able to record the disruption of the comet nucleus and the changing aspect of the inner coma of the comet was also fascinating to monitor. Eventually the comet faded. Images from the Hubble Space Telescope showed the extent of the fragmentation of the comet. It was last observed as a remnant in late May just prior to perihelion.

Last year, on 2025 May 24, a comet was discovered by the ATLAS survey team in Chile. It was eventually designated C/2025 K1 (ATLAS) after its cometary nature was confirmed. The orbit was soon defined and it was recognised as being dynamically new and a first-time visitor to the inner Solar System from the distant Oort Cloud. With perihelion only 0.33 au from the Sun, the comet was not expected to survive perihelion passage on October 8, but it did and was recovered on 18 October 2025.

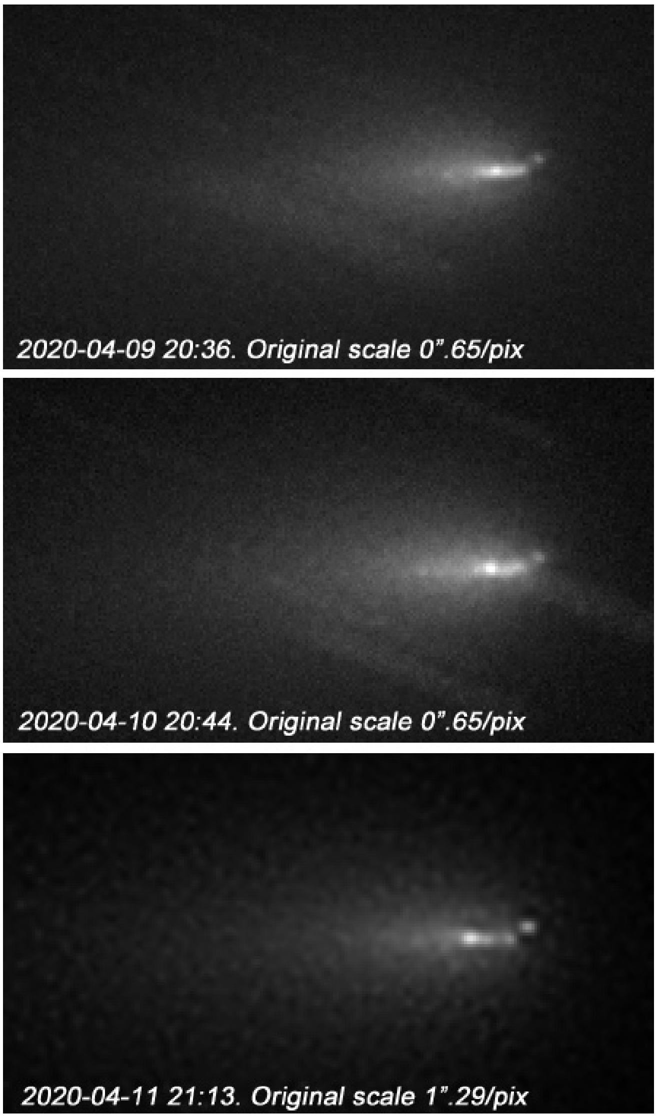

Figure 11 - C/2019 Y4 (ATLAS) inner coma region FOV 2.4 x 1.3 arc min. Nick James. 970

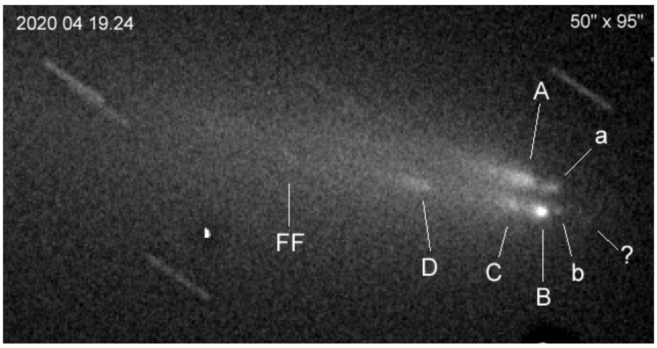

Figure 12 - C/2019 Y4 (ATLAS) 12×120s R filter 2.0 m f/10 Faulkes Telescope North (F65) Richard Miles

One of the first amateur images showing that the comet had split into two components was made by

Francois Kugel on November 10.19. There had been some outburst activity in early November and the result was an ongoing series of fragmentations. The Gemini North Telescope observed the comet and high-resolution images showed four individual components in a line within the inner coma, the brightest one being enclosed in a parabolic hood. The frontal component was ejecting jets of material forward of the comet trajectory. The comet continued to fragment further with comet observers following events closely. More components were seen in images and their ever-changing orientations and brightness were documented by Nick James using astrometry of the individual components to identify them.

Figure 13 - C/2019 Y4 (ATLAS) muliple fragments 2020 April 20 Credit: NASA, ESA, D. Jewitt (UCLA), Q. Ye (University of Maryland). NASA/ESA HST image.

During the post-perihelion fragmentation period the comet displayed a long dust tail over one degree in length as seen from earth. As the comet receded from Earth it faded and by mid-January 2026 had become a faint object. However, there were still two components which remained visible in long exposure images. Thus, the comet survived its close encounter with the Sun and began its long outward journey through the Solar System. Whether it remains intact as a cohesive body is something we will never know.

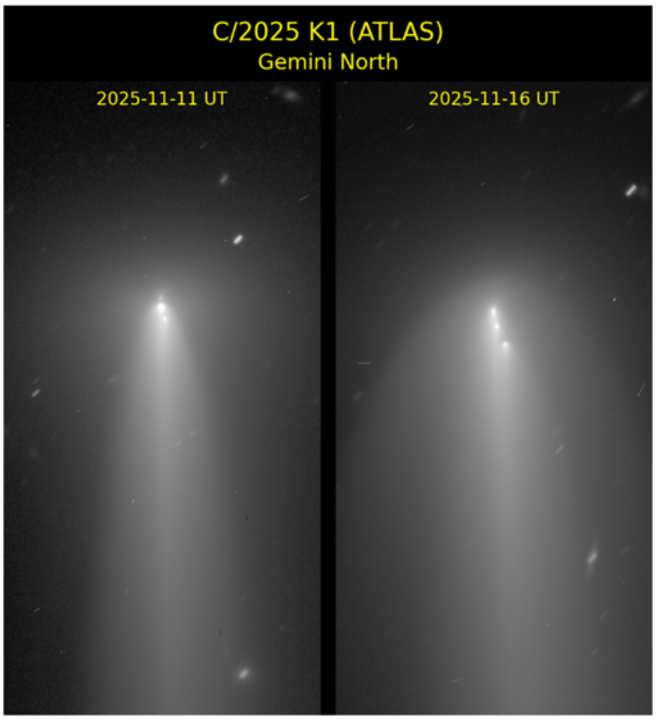

Figure 14 - C/2025 K1 (ATLAS) 2025 November 11-16 Observations by the Gemini North Telescope

Comets are fragile bodies and many of them fragment and disintegrate as they pass by the Sun. This article mentions only a few of the many comets that suffer this fate. Many more will do so in the future. Observing them falling apart and documenting the rapidly changing events within them provides us with hard physical data about their composition and also a fascinating natural spectacle of ongoing forces within them.

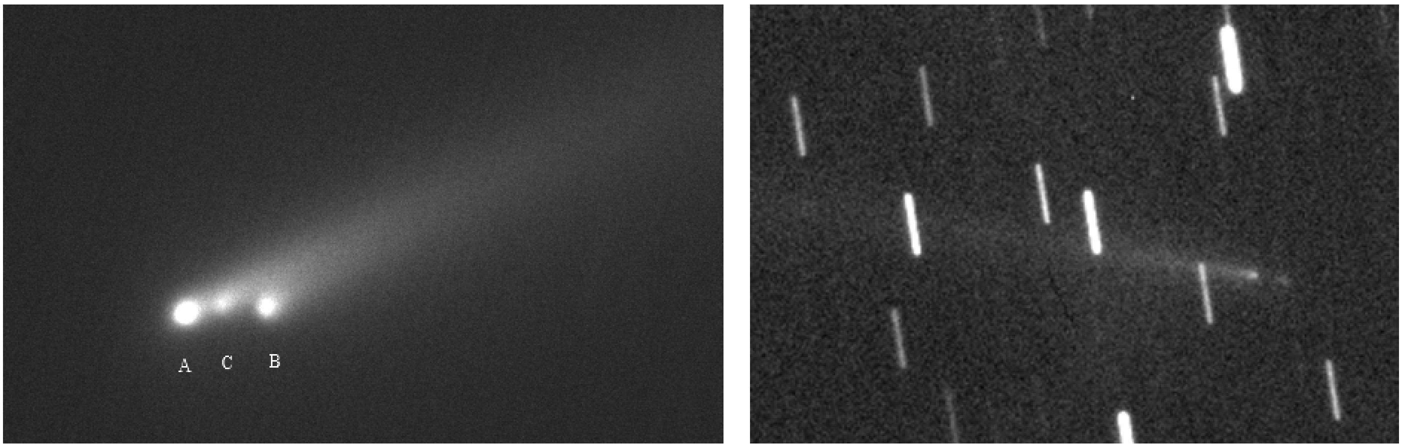

Figure 15 - C/2025 K1 (ATLAS). Left: 2025 Nov 20 showing main three components. Right: 2025 Dec 29 showing the remaining two components at a different scale. Denis Buczynski, Tarbatness. I81.

HISTORICAL COMETARY OBSERVATIONS IN INDIA

Part 3: The Jesuits & cometary astronomy in India: the 1600s

Amar Sharma (amar10sharmaa@yahoo.co.in), Edited by Jonathan Shanklin

It may seem to the reader that, in the second decade of the 1600s, whilst science was getting accustomed to the dawn of rudimentary telescopic "technology", it would be far too early an era for any telescopic debut on Indian soil. However, that was not the case as it was the advent of the Jesuit missionaries.

What was an evangelistic or apostolic mission to the Far East (China, Japan, even India), was a scientific mission too – a trait of these missionaries who were astronomically inclined or disciplined. In 1582, Fr. Matteo Ricci (1552–1610), an Italian Jesuit priest, re-initiated the Society's mission to the Chinese imperial court and met with Chinese scholars.

Under the auspices of Fr. Mutio Vitelleschi (1563–1645), the sixth Superior General of the Society of Jesus (or the Jesuit Order) a group of 22 missionaries was led by Fr. Nicolas Trigault (Flemish/Dutch; 1577–1628) and Fr. Johann Schreck Terrentius (German; 1576–1630) along with Fr. Giacomo Rho (Italian; 1593–1638) and Fr. Johann Adam Schall von Bell (German; 1591– 1666) and included Fr. Wenceslas Pantaleon Kirwitzer (Bohemian; 1588–1626), who hailed from Kadaň, Bohemia (present-day Czech Republic). With pre-embarkment confrontations faced from February 1618, the fleet set sail in mid-April 1618 from Lisbon. After trials & tribulations encountered at sea at the cost of only eight Brothers surviving with a few others narrowly escaping death by the plague, the ship arrived at Goa on the Indian west coast, a colony of the Portuguese since its conquest in 1510, in early-October 1618.

1618

The first bright comet of 1618 – 1618 Q1 – was discovered at Caschau in Hungary on August 25, and two days later by Johannes Kepler at Lintz (Austria). This one holds the distinction of being the first recorded comet to be observed with a telescope on September 6 – by Kepler. It touched perihelion on August 17, which was during the Jesuits' seafaring voyage. There was no mention in their records if they noticed the comet while at sea (perhaps being scourged by the epidemic onboard).

After the group arrived at Goa, two great comets graced the morning skies of November 1618 in quick succession; the priest confreres were witness to apparitions of two comets conspicuously visible in the same quarters of the dawn sky, with tails ('trains') of 30° or 40° in length, and upwards.

Figure 1 - Hand-colored engraving of German Jesuit Johann Adam Schall von Bell

Fr. Kirwitzer was not prepared to make any observations because the two bright comets had made a sudden appearance in the early morning hours. It must have been dismal to them that, at the time, their baggage remained on the ship in unsafe condition, and no instruments or books were to hand; they were however able to access an astrolabe and a radius or cross-staff from the local Jesuit establishment(s). For a joint attempt at observations, Fr. Kirwitzer wrote to his fellow Jesuits, Fr. Jacobus Rho at Goa and Fr. Antonius Rubinus at Cochin (750 km further south).

The comet of the year 1607 was the last comet seen before the invention of the telescope. When Fr. Schreck, a student of Galileo Galilei but not of astronomy, on his European voyage in 1616, was a guest of Cardinal Federico Borromeo in Milan, the latter presented him with a Galilean telescope. This was later, reportedly, exchanged for a better one. This became the first telescope to reach China. Fr. Kirwitzer made use of a telescope, a 'tubo optico', to observe the comets of 1618, but it was not explicitly mentioned which type it was, whether the one gifted, or not.

Figure 2 - Stamps showing Johann Adam Schall von Bell from https://www.manresa-sj.org/stamps/01_Jesuits.htm

The next comet of 1618, 1618 V1, was discovered on the morning of November 11 in Sicily and also from Rome. The nucleus was lost in the twilight, but the tail was visible (during dawn hours) at Rome. On the following mornings, the tail was seen at other places in Europe, and by Kepler at Lintz on November 20. He saw this 'train' for the last time on the morning of November 29 – when he obtained his first view of the third comet. Kepler saw both comets on the same morning, though he was unable to detect the nucleus of the second comet in the strong twilight; and it may be added that Fr. Giuseppe Biancani at Parma, had similar experience. In more southern latitudes, this second comet was more favourably situated for observation, and its nucleus was observed.

Don García de Silva Figueroa (1550–1624), Ambassador of the King of Spain and Portugal to the court of Persia, observed the comet on November 11, from Isfahan, Iran. It was visible with a tail about 60° long. The Jesuits at Goa, along with de Silva Figueroa, later saw it and 1618 W1 simultaneously, and determined positions of the nucleus of 1618 V1, which was obscured by twilight in Europe, for Kepler and others.

1618 V1, was observed by Fr. Kirwitzer between November 10 & 30. Fr. Kirwitzer, Fr. Rho and Fr. Schreck Terrentius were observing from three spots in the city of Goa; viz., Collegio Rachol (the present-day Patriarchal Seminary of Rachol), Insula Ivari (the present-day Divar Island), St. Paul College (the present-day New College of St. Paul) (at Old Goa). They took up residence in a small house in Rachol where the present-day parish church is situated. A mysterious object was first noticed on the morning of November 10 and Fr. Kirwitzer rightly suspected it to be a comet. Observations were also made by Fr. Jacobus Rho, who used a cross-staff for his measurements. [*Kronk gives November 11 as the discovery date, but it is possible that Kirwitzer did observe it on November 10. Ed.*]

Clouds on November 11, 12, 13, prevented Fr. Kirwitzer from making any observations. Detailed observations began on November 14. That morning, the altitude of the comet was recorded as 11°.

He looked for a star in the head as was typical of comets, but found none. When he used the telescope, it clearly revealed a star, with a little 'smoke' in the head that appeared pale in colour. The comet's form was best described as like a palm leaf, and it stretched as a straight smoky column from the east to the midst of heaven, with the tip a little turned to the north. On November 15, Fr. Kirwitzer refers to the use of star-charts; figures published by Fr. Christopher Gruenberger, a mathematician of their Society. They were used "throughout the duration of our observations." On November 17, Fr. Kirwitzer depicted the position of the comet with respect to two nearby stars; which are not readily identifiable [*The comet was then in Crt. Ed.*]. No observations were again possible due to clouds on November 19, 20, 22, 25. On November 26, Fr. Schall von Bell joined him in observing while Fr. Rho observed it on November 27.

The comet had reached perihelion on October 27. Fr. Rubinus' first measurement of this comet from Cochin was made on November 28 when he noted a tail 40° long and a maximum width of ~3°. His last measurements were on December 18 when he noticed that the tail had increased in length from an initial 25° to 44°. The observing campaign continued until November 30. From that day, the light of the Moon obscured the comet and they could not observe it furthermore. Elsewhere (in Europe), its tail was reported to span about 60° long.

We must also refer to Fr. Cristoforo Borri (1583–1632), an Italian Jesuit. He left Lisbon in 1615, stopped over at Goa for six months, and arrived in Macao in 1617, moving to Cochin-China (the southern region of Vietnam). It is from here that he observed the two bright comets of 1618. He also refers to his observations of the two comets in a letter to Fr. Mutius Vitelleschi. The comets were also observed by the Croatian Jesuit, Fr. Ivan Vreman (1583–1621) in China, and by the Portuguese Jesuit, Fr. Emmanuel Diaz (Manuel Dias the Younger) (1574–1659) in India. Fr.

Borri refers to this communication in his 1631 work Collecta Astronomica ex Doctrina, where he speaks of the first sighting of the comet from November 9 up to December 22.

From his parallax estimations derived from triangulation calculations of the observations of the comets of 1618, Fr. Borri argued that comets were located far beyond the Moon, which immediately cast doubt on the impervious nature of the celestial spheres. The Jesuits concurred with Fr. Borri about the comet that it was undoubtedly a celestial phenomenon. In the case of 1618 Q1, Fr. Borri had received accounts of observations made by Fr. Vreman from Macao and by Fr. Diaz (Dias the Younger) from Cochin in India.

Figure 3 - Early Galilean telescope, from "The Astronomical Images in the First Chinese Treatise on the Telescope by Johann Adam Schall von Bell Revisited" by Yunli Shi

1618 W1, the Great Comet of 1618 was one of extraordinary brightness and a very long tail. It reached perihelion on 1618 November 8 at 0.40 au and perigee on December 6 at 0.36 au with maximum brightness on November 29 at 0–1 magnitude. The Spanish ambassador to the Persian court, Garcia de Silva, observed the comet on November 23 or 24, from Isfahan, Iran, a day or two before the sighting in India. "It was a diffuse object and had the colour of Venus".

1618 W1 was reported by Fr. Kirwitzer on November 24 before sunrise. Its nucleus was obvious and comparable to Venus, and it had a short tail. On the same day, Fr. Schreck Terrentius saw the comet. On the next day, November 25, before sunrise, Fr. Kirwitzer and many other Jesuits saw it clearly, and it already had a longer tail. The other star was Mercury located 14° away. The comet's magnitude was definitely much brighter than Mercury, so there was no doubt about its identity. Fr. Rho first noticed the comet on November 25 at Goa, and Fr. Rubinus at Cochin saw it first on November 26. On the same day, Fr. Rho observed the comet as a bright object with a tail ~2° long and similar to a beard.

From November 28, two sets of observations for each comet were being taken from a given location, and the comets were observed together until November 30. The Jesuits continued to make angular measurements of the comet, but from the end of December they could not observe it because of the bright Moon, and they only re-commenced their observations on 1619 January 7. On that day, Fr. Kirwitzer noted the light of the Moon somewhat diminished but the comet could not be easily observed because it was too faint. On January 8, the comet seemed to be joined to the penultimate star of the tail of Draco. Upon viewing it through the telescope, Fr. Kirwitzer found two new stars near the aforementioned star, and the comet appeared close to one of these. At this time the comet's tail was not visible in the telescope, but the 'star' in the nucleus seemed much brighter than the penultimate star in Draco's tail. It was only 0.5° away from the star ƙ-Draconis. Further observations were made with the telescope on January 10. The comet was observed until January 12.

Different estimates of tail lengths were reported from across Europe by multiple observers: from 10° on November 26, to 70° on December 9, to 104° on December 10 and to 60° on December 12. The comet was observed in China until 1619 January 4. Its last sighting was by Fr. Johann Baptist Cysat from Ingolstadt on the morning of January 22 with a telescope.

Later, his detailed observations were collated and published in a monograph in Latin titled 'Observationes Cometarvm Anni 1618. In India Orientali Factae a Societatis iesv Mathematicis in Sinese Regnum Nauigamtibus ex Itinere eo Delatis'. The treatise consists of only 24 pages and is signed 'ex–Goæ in India

Orientali 11. Febr. 1619'. This was published by Johann Theobald Schönwetter in Ursellis [Oberursel] in 1620. Although Fr. Kirwitzer's treatise contains observations and descriptions of the two comets, there is no theorizing about comets or where they belong in the Universe. Therein, recorded in detail, were what the observers saw and measured. He also reported the observers' visual impressions, sometimes gained with difficulty because of illumination by the Moon or sunlight.

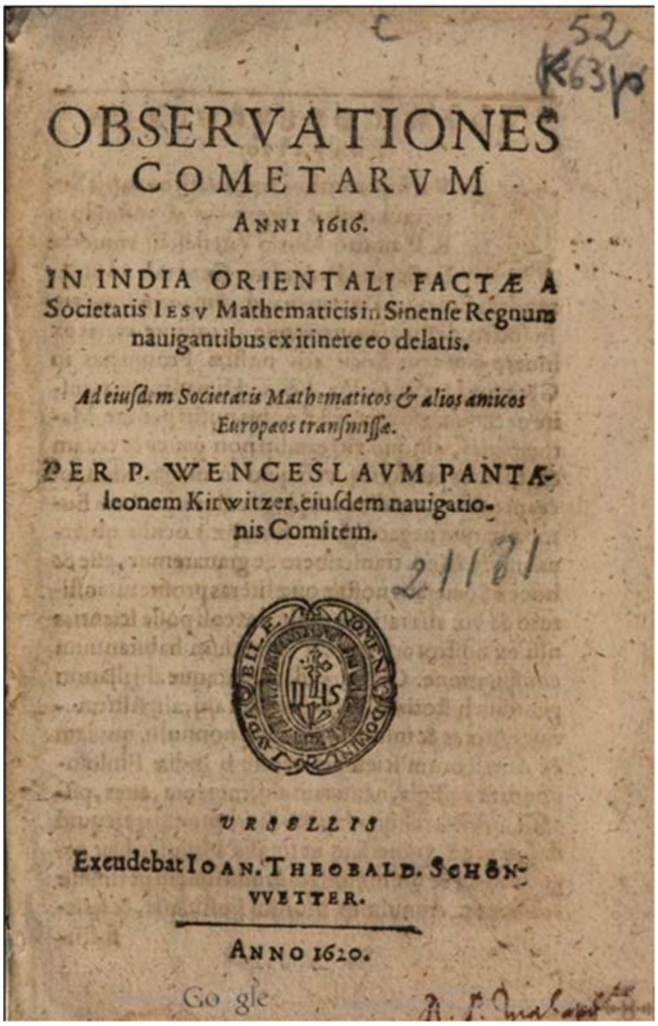
OBSERVATIONES
COMETARVM
ANNI 1616.
IN INDIA ORIENTALI FACTÆ A
Societatis IESV Mathematicis in Sinense Regnum
nauigantibus ex itinere eo delatis.
Ad eiusdem Societatis Mathematicos & alios amicos
Europeos transmissæ.
PER P. WENCESLAVM PANTALEONEM Kirwitzer, eiusdem nauigationis Comitem.
VRSELLIS
Excudebat IOAN. THEOBALD. SCHÖNWETTER.
ANNO 1620.

Figure 4 - Fr. Kirwitzer's treatise 'Observationes Cometarvm Anni 1618'

The significance of this publication is that Fr. Wenceslas Pantaleon Kirwitzer was credited as an independent discoverer of two great comets in succession, from India. Also, it was the first use of an optical device (telescope) for astronomical observations in India, dated 1618 November 10, which was within a decade of its invention. These were the first modern astronomical observations carried out in India, with Goa as the birthplace of telescopic observation in India.

These comets were also independently observed by the fourth Mughal Emperor of India, Jahāngīr (see Historical Cometary Observations in India: Part 2 – Mughal Empire 16th and 17th Century, in The Comet's Tale (2019), 38, pp 37-41), using astronomical measuring instruments as astrolabes, sundials, sunglasses, and accurate water-driven clocks (clepsydras).

1689

The Portuguese were followed by the British, the Dutch and the French to India. In 1674, François Martin, the French Governor in India, founded the city of Pondicherry on the east coast, which became the headquarters of French presence in India. The French Jesuit priests arrived in the country under rather trying circumstances from the east instead of the west.

In 1687, King Louis XIV (1638–1715) had sent, on an invitation from the King of Siam (Thailand), a team of 14 Jesuits, formally designating them 'The Mathematicians of the King'. The Jesuits arrived at Siam in 1687, in a second contingent. In May 1688, there was a revolution and coup that overthrew the King. The Jesuits could not stay over for long and were expelled. Only 3 missionaries were able to survive the ordeal, who then headed for India, and reached Pondicherry on February 1, 1689. They were Fr. Jean-Vevant Bouchet (1655–1732) and Fr. Charles Francois Dolu (–) with Fr. Jean Richaud (1633–1693). Fr. Richaud had (earlier), reportedly, observed a comet during September 7–15, 1686. From Siam, he carried a 12-foot focus telescope, courtesy of the King. And, once in India, he got down to astronomical observations.

The comet being referred here is the bright sungrazer 1689 XI. The Great Comet was not visible to Europe. On November 24, just before sunrise, Simon van der Stel from the Cape of Good Hope, South Africa, independently found this comet. "A star with a tail was seen in the south east". On November 25, "This morning about 4 o'clock the said tailed star was again seen, which soon after disappeared as the Sun rose." On December 9, "This morning at 3 o'clock the tailed star was again seen very clearly. The tail was more than 4-degrees long." And on December 24, "The tailed star no longer seen". Obviously, from earlier entries, the last observation will have been made in the dawn hours. Given these records, however, it was not officially listed as a South African discovery.

For its discovery, Fr. Richaud based at Pondicherry, is generally attributed to as a discoverer, on December 8 (or 10). He gave a detailed account of his observations from December 8–21; which was reported in Memoires de L'Academie Royale des Sciences de Paris (Volume 7). The comet passed perihelion on November 30 and entered the evening skies; it was described as a magnificent object growing a tail 'like a great sabre' around 100° long. It can be rightly assumed, therefore, that the comet did not develop its enormous tail until after perihelion. Van der Stel's observations would then have been made before it had become conspicuous and when it was still in the morning skies — a meritorious performance.

After its perihelion passage very close to the Sun at 0.06 au, it emerged again from bright twilight on December 7, when it was seen from the French East-India Company ship Jeux and other Dutch ships in the vicinity of the equator. Tail lengths in the 45°–47° range were recorded around mid-December, reaching 68° on December 14 and 60° on December 21, when the comet was located close to Centaurus. On December 21, Fr. Richaud saw the comet 1° distant from the foot of the Centaur (α-Centauri), certainly north of the star; since, on Dec. 23, it was still seen near the same. It was last seen on December 24 and was then greatly enfeebled by Moonlight. While at Pondicherry, the tail was seen in the first days of the following year. Nevertheless, by that time it had already grown faint and disappeared altogether during the commencing days of 1690 January.

However, there was an interest this comet brought about by its orbit. Its small perihelion distance coupled with the general description of its appearance, resembled that given of the Southern Comets of 1880 and 1882. This suggested the possibility of representing the path of one or other of that well known group, the 1843–1880–1892 group, or the Kreutz Sungrazer group. Subsequent orbital calculators suggest that C/1689 X1 is an unlikely Kreutz Sungrazer, though the computed orbits do not agree well with each other.

Historically, comets have been cast as the harbingers of despair. This one passed very near to the star α-Centauri. In this instance the comet was not a messenger of despair, rather a bringer of revelation. Fr. Richaud's most significant contribution was made while following the comet, wherein he (his 12-ft telescope) brought to bear upon the principal star of Centaurus. To his great surprise and delight, a prime southern star, the alpha star of Centaurus, was thereby transformed from the single star, as perceived by the naked eye, into a double star. "The two stars seemed to be practically touching each other." And, "That the brightest star at the easternmost foot (of Centaurus) was a double star as good as that at the foot of the Cross i.e. alpha Crucis." He is obviously credited as the discoverer of the binary nature of α-Centauri. However, he was not able to physically measure the separation of 7 arc-seconds between α-Cen-A and α-Cen-B with his telescope. This was the second binary star (in the whole sky) to be ever discovered; it was inaccessible to observers in the northern world. And it was also the first ever "modern" astronomical discovery from the Indian soil, on December 19, 1689.

Summary

Thus, we see, that the 1600s, outwardly appearing nondescript in the cometary history of India, even harbouring scant cometary instances, were a playground to significant opportunities found and made by the missionary intellectuals who travelled across hazardous seas, and credibly exercised the small, newfound, telescope technology rendered in their clasp. Historical milestones were set with the 'modern firsts' the Indian soil had inherited – to add to their ancient cultural legacy of astronomy and astrology going back several millennia. This was, however, the curtain-raiser to what was to come. The Jesuit priests were the forebears to the legacy the British were to lay on the Indian soil, for two active centuries, in terms of astronomical advancements.

The next episodes will witness the immense Anglo-Indian astronomical exchanges that took place through the East India Company in the forthcoming centuries, the 1700s into the 1800s.

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THE ANTI-TAIL OF COMET C/1999 H1 (LEE)

*Luigi Sannino (*astrofililaspezia@gmail.com*)*

Comet C/1999 H1 (Lee) displayed a well-defined dust anti-tail during the post-perihelion phase of its 1999 apparition. This short historical note recalls the physical interpretation of cometary anti-tails and presents CCD observations carried out at the Monte Viseggi Observatory (La Spezia, Italy). These observations represent the first digital CCD documentation of a cometary anti-tail obtained at Monte Viseggi, using an SBIG ST-6 camera coupled to a 16-inch Ritchey–Chrétien telescope. One of the images was later published in Sky & Telescope.

Comet C/1999 H1 (Lee)

Comet C/1999 H1 (Lee) was discovered on 1999 May 9 by the amateur astronomer Steven Lee. It followed a non-periodic orbit, reaching perihelion on 1999 July 6 at a heliocentric distance of approximately 0.7 au. During the months following perihelion, the comet became accessible to northern observers and developed a conspicuous dust tail and a compact coma.

Physical nature of cometary antitails

A cometary antitail is an apparent structure composed of relatively large dust particles released from the nucleus and distributed along the comet's orbital plane. Unlike ion tails and fine dust tails, these particles are weakly affected by solar radiation pressure. When the Earth passes close to the comet's orbital plane, projection effects may cause this dust sheet to appear as a tail pointing sunward.

Such configurations are geometrically sensitive and typically short-lived. In the case of C/1999 H1 (Lee), the antitail became clearly visible during the post-perihelion phase, well separated from the primary dust tail.

CCD observations at Monte Viseggi

In 1999, comet C/1999 H1 (Lee) was observed from the Monte Viseggi Observatory, located within the Monte Viseggi Scientific Park (La Spezia, Italy). Observations were performed using a 16-inch Ritchey–Chrétien telescope equipped with an SBIG ST-6 CCD camera, one of the earliest digital detectors widely adopted by advanced amateur observatories at the time.

The CCD images documenting the antitail were obtained by Luigi Sannino, Luciano Zannoni and Paolo Pietrapiana. These observations constitute the first digital CCD record of a cometary antitail made at the Monte Viseggi Observatory, clearly revealing the morphology and orientation of the antitail relative to the main dust tail and the Sun–comet direction.

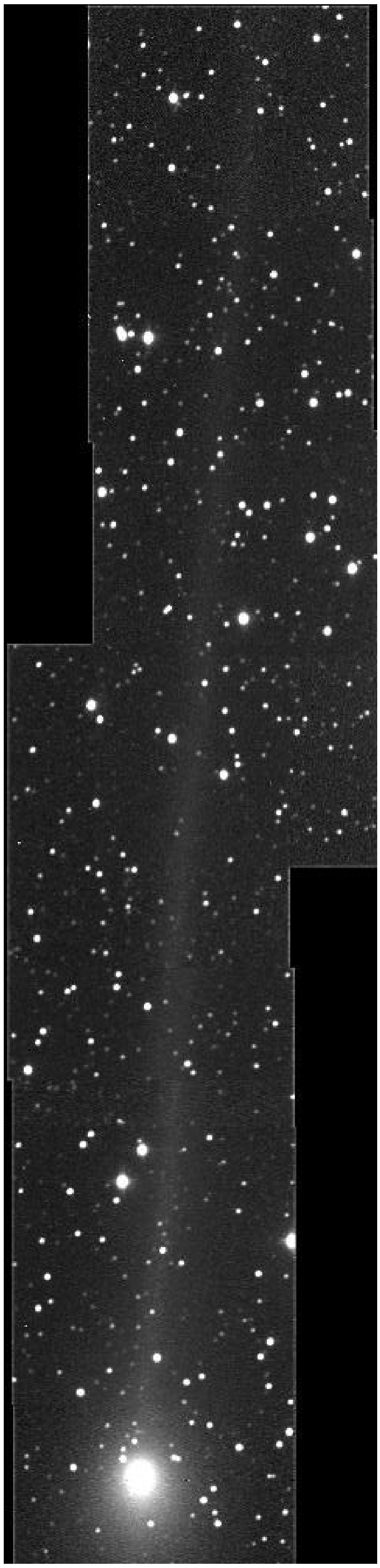

Figure 1 – The anti-tail of C/1999 H1 (Lee) taken on 1999 November 19.93.

One of the CCD images acquired at Monte Viseggi was subsequently published in Sky & Telescope (1999), providing international visibility to the observation. This publication highlighted the scientific value of early CCD imaging by amateur astronomers and its relevance for documenting transient and geometrically dependent cometary phenomena such as antitails.

The observations of comet C/1999 H1 (Lee) were carried out during a transitional period in amateur astronomy, marked by the shift from photographic emulsions to digital CCD detectors. The successful imaging of the antitail using an SBIG ST-6 camera on a medium-sized Ritchey–Chrétien telescope illustrates the growing role of amateur observatories in contributing meaningful data to cometary studies.

Conclusions

Comet C/1999 H1 (Lee) remains a noteworthy example of anti-tail visibility under favourable geometric conditions. The CCD observations obtained in 1999 at the Monte Viseggi Observatory, and later published in Sky & Telescope, represent an early digital contribution to the study of cometary dust dynamics and serve as a historical record of the evolving capabilities of amateur comet observers.

Notes

Luigi Sannino, Luciano Zannoni, Paolo Pietrapiana - Amateur astronomers and members of the Italian astronomical community, active in observational programs at the Monte Viseggi Observatory during the late 1990s, with particular interest in CCD imaging and cometary phenomena.

Monte Viseggi Observatory - Public astronomical observatory located near La Spezia, Italy, operating medium- and large-aperture telescopes and involved in public outreach and amateur research activities.

Instrumentation - Telescope: 16-inch Ritchey–Chrétien reflector, detector: SBIG ST-6 CCD camera

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SKY & TELESCOPE

ASTROLOGY AND THE STAR OF BETHLEHEM

HALOS IN THE MARTIAN SKY

THE MYSTERY OF JUPITER'S "VOLCANOES"

DECEMBER 1999

25 HOT PRODUCTS FOR STARGAZERS

Comet Lee. An easy binocular sight for much of August and September, Comet Lee was imaged by a trio of Italian amateurs: Paolo Pietrapiana, Luigi Sannino, and Luciano Zannoni. They used a 16-inch Ritchey-Chrétien Cassegrain telescope and an SBIG ST-6 CCD camera to make this six-frame mosaic.

Holtz noted, "An hour after my initial sighting, its motion was much slower and more difficult to detect, even at 200×. Needless to say, I was quite excited to have seen this spacecraft. I had a difficult time getting back to sleep."

Figure 2 – The picture appeared in the 1999 December Sky and Telescope

USING THE SEESTAR S50 FOR COMET PHOTOMETRY

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Introduction

The ZWO Seestar S50 has rapidly become one of the most widely adopted smart telescopes among amateur astronomers, particularly those working under suburban skies or facing limitations with visual observing. Although marketed primarily as a compact, easy-to-use imaging device, the Seestar has proven to be far more capable than its modest specifications suggest. Over the past two years, I have used it extensively for variable-star and comet photometry, and recently undertook a focused campaign to evaluate its performance in tracking the brightness and coma evolution of comet C/2025 R2 (SWAN).

This article presents the workflow I developed, the results obtained, and how they compare with broader datasets. It also incorporates insights from other observers who have used the Seestar for comet photometry, demonstrating that this small instrument has the potential to become a valuable contributor to amateur comet science.

Why C/2025 R2 (SWAN) was an ideal target

C/2025 R2 was well placed, reasonably bright, and passed close enough to Earth to present a large apparent coma. This combination made it an excellent test of the Seestar's optical capabilities and the photometric software used to analyse the data. Furthermore, since the coma diameter was quite large, I thought this would be a good test for the Seestar and the comet photometry software that I was using. My aim was to determine whether the Seestar could produce consistent, scientifically meaningful measurements over a sustained period, and whether its data could be reliably submitted to the ICQ and COBS and potentially used for astrometry.

Photometric technique and calibration

My workflow begins with de-bayering the Seestar's one-shot-colour images and extracting the green channel. This approach is widely used in DSLR variable star photometry and has been validated through my own variable-star work. By deriving transformation coefficients, I've found that the difference between the green channel magnitudes and standard Johnson V filter was approximately 0.02 * (B-V) and so the difference is no more than about 0.02 mag. Consequently, I have been reporting the Seestar photometry as using Johnson V even though strictly speaking, I'm not using a Johnson V filter.

For photometric analysis, I employed the Comet Photometry module in Tycho Tracker, which I found to be the most robust and consistent among the various photometry packages I tested. Tycho Tracker was reviewed in a recent edition of the Comets Tale (Tale 43, 2025 June, p45). The Seestar takes 10 or 20s exposures. With total integration times that can be set to well over an hour to capture faint comets or extended coma it generates a large number of images. Tycho Tracker handles the large volume of images very well. It also calibrates, plate-solves and aligns all images. I use the Seestar in equatorial mode.

There are a few options to control the Seestar when acquiring the images. For a long time, I used the application Seestar ALP. However recently it is now possible to control the Seestar with N.I.N.A which most would be familiar with.

Observing campaign and results

Between 2025 September 23 and December 4, I obtained 44 independent measurements of C/2025 R2 using the Seestar. The stacked exposures used were:

6-7th mag 400-800s
8-9th mag 900-1400s
10-11th mag 1200-1600s
Below that 2000-5509s

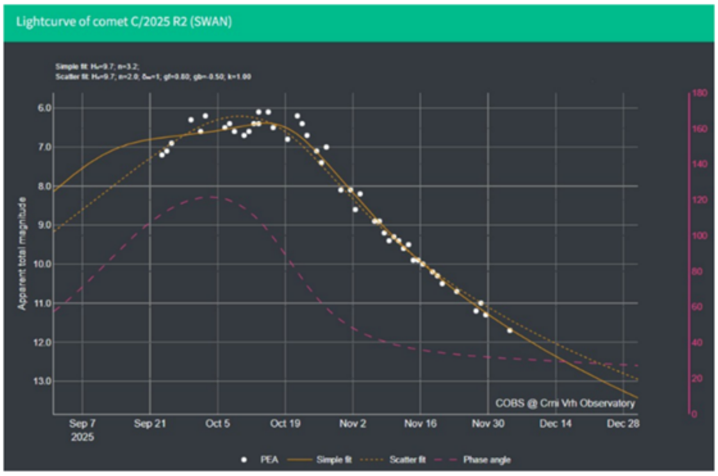

Figure 1 - My observations only

The resulting light curve was smooth and coherent, with no significant outliers as shown in Figure 1 and Figure 4. As expected, the Seestar magnitudes were consistently 0.5–0.7 magnitudes fainter than visual estimates, which is typical for CCD/CMOS photometry of extended comae. More importantly, the power-law parameters derived from my measurements closely matched those from the full COBS dataset, indicating that the Seestar was capturing the comet's true photometric evolution.

For total-magnitude comet photometry, it is essential to capture the full extent of the coma. CCD and CMOS systems often underestimate coma diameter, especially under light-polluted skies or when exposure times are too short, leading to underestimation of the total magnitude. To address this, I developed a consistent technique using Tycho Tracker and carefully selected exposure durations to maximise coma capture. The results are shown in Figure 2 and Figure 3.

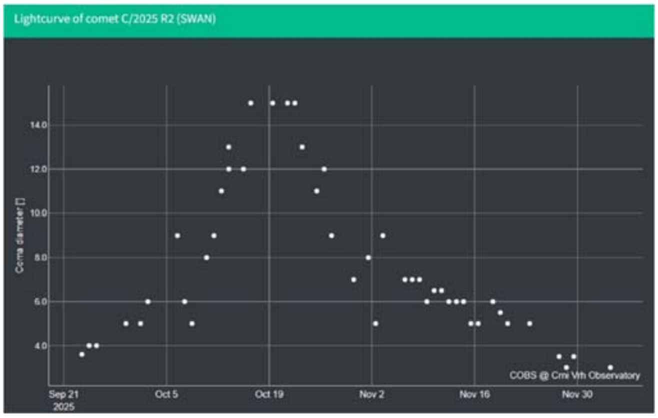

Figure 2 - Coma diameter measurements – My observations only

Astrometry

In addition to photometry, I also used the Seestar for comet astrometry. Despite its 2.4"/pixel scale, I was able to submit positional data to the Minor Planet Center with residuals typically no greater than 0.7". While comet astrometry is inherently less precise than that of stellar objects, these results demonstrate that the Seestar can contribute useful positional data when the coma is sufficiently condensed. However, it is always worth checking the residuals to ensure that the astrometry is indeed of a sufficient quality to be submitted to the MPC. The Seestar performs much better with minor planets and I have contributed a large number of astrometric positions of newly discovered near earth asteroids over the last few years.

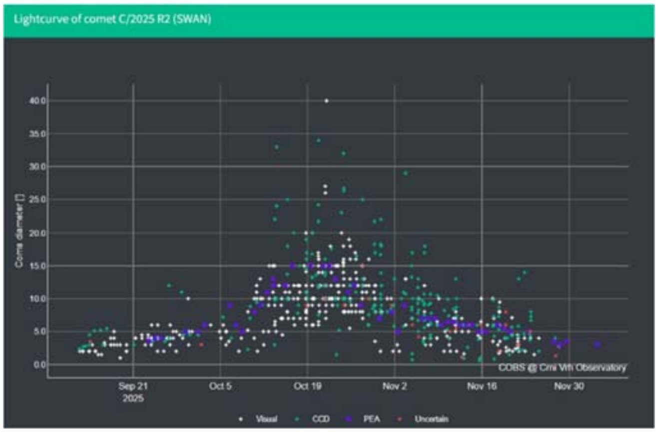

Figure 3 - Coma diameter measurements – All observations with mine in purple

Why the Seestar works surprisingly well

Although the Seestar S50 is marketed primarily as an easy-to-use imaging device, several characteristics make it unexpectedly suitable for scientific photometry. Its tracking is remarkably stable for such a compact instrument, and the plate-solved pointing ensures that fields are centred consistently.

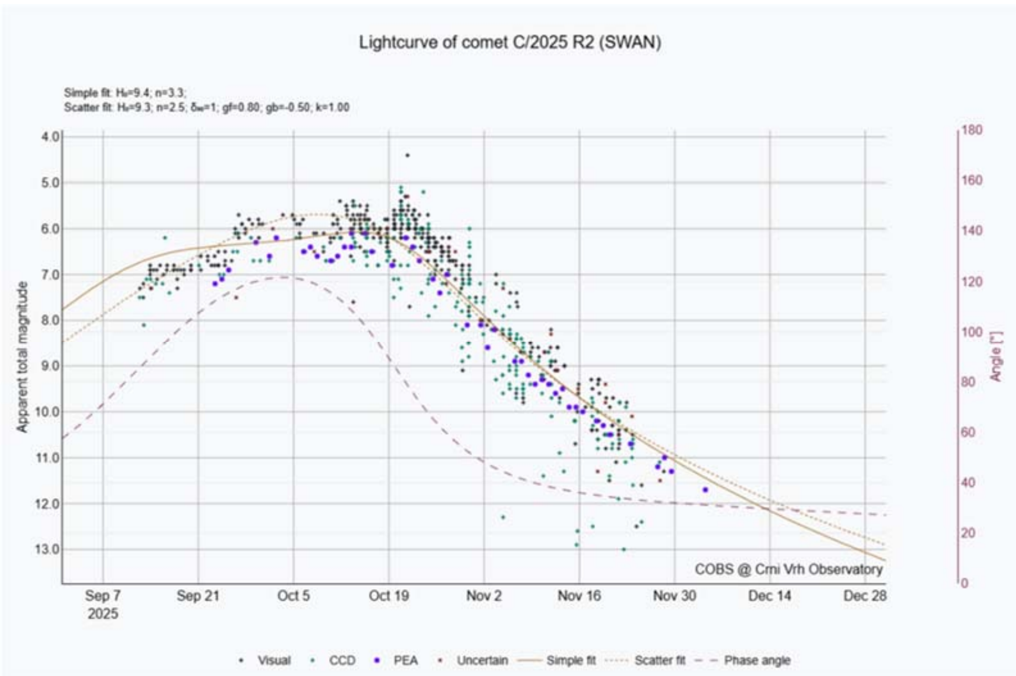

Figure 4 - C/2025 R2 – All observations with mine highlighted in purple

The one-shot colour sensor performs well, routinely reaching comets in the 14th to 15th magnitude range even under Bortle 6 skies where I operate. Calibration is also repeatable thanks to the built-in dark and flat frame library, which removes much of the variability that often complicates photometric work with small CMOS systems. Community experiments on various user forums have shown that the Seestar can deliver meaningful photometry down to around 15-16th magnitude and often fainter, even for variable stars, despite lacking standard photometric filters. The same strengths translate directly to comet work, where consistency, sensitivity, and repeatability matter more than raw aperture.

One of the most compelling aspects of the Seestar S50 is how naturally it lends itself to regular comet monitoring. Its ease of deployment means it can be set up and collecting data within minutes, making it ideal for nightly observations even when time or conditions are limited. Despite its compact size, the Seestar is capable of detecting comets in the 14th to 15th magnitude range under typical suburban skies, extending the reach of observers who might otherwise be unable to follow faint targets visually.

Its affordability also lowers the barrier to entry for scientific comet observing, enabling more amateurs to contribute meaningful data. As a result, the Seestar has the potential to broaden the community of observers capable of providing long-term, high-cadence photometric monitoring of comets. However, it must be stressed that robust and consistent image capture and photometric reduction techniques must always be maintained to ensure quality at all times.

Conclusion

This campaign has demonstrated that the Seestar S50 can produce consistent, scientifically meaningful comet photometry. Its green-channel response closely matches Johnson V, and its sensitivity allows for monitoring of comets down to magnitude 15 in light polluted skies. With careful technique, it can also measure coma diameters reliably and contribute useful astrometry.

The Seestar's ease of deployment makes it ideal for nightly monitoring, and its affordability lowers the barrier to entry for scientific comet observing. It encourages long-term light-curve contributions from a wider observer base, enabling more amateurs to participate in meaningful comet science.

For observers working under light-polluted skies or seeking a compact, reliable tool for regular monitoring, I would recommend the Seestar S50.

Figure 5. C/2025 R2 (SWAN) on 2025 September 18.39. 250×2s. 85mm FL, f/2, Canon 6D MkII. Rob McNaught. Coonabarabran, NSW.