

Halley's Comet as depicted by the 14th Century Florentine artist Giotto di Bondone 1267? – 133.7 “The adoration of the Magi”, Scrovegni Chapel in Padua, Italy, around 1301-5.

THE COMET'S TALE

Comet Section – British Astronomical Association

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britastro.org/comet



Comet C/2016 R2 2017 Dec 14 Damian Peach

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1 From the Director – Nick James

I hope you enjoy reading this issue of Comet's Tale. Many thanks to Janice McClean for editing this issue and to Denis Buczynski for soliciting contributions. Thanks also to the section committee for supporting me, and particularly to our former Director, Jonathan Shanklin, who continues to perform detailed analyses of cometary activity.

Unfortunately, the powers of the BAA Comet Section Director do not stretch to summoning bright comets on demand and comet observers have recently had to make do with rather faint objects. That is not to say that we haven't had things of interest to observe. The amazing dynamic tail of C/2016 R2 and the outburst of 174P are two key aspects that come to mind. Both of these objects are recorded in the section image archive here <http://www.britastro.org/cometobs/> along with many other objects.

There are always plenty of faint comets to observe but there will be at least three comets this year which we hope will become bright enough to be seen with the naked-eye from a dark site. C/2017 S3 (PanSTARRS) comes to perihelion on 2018 August 15 at only 0.20au from the Sun and may reach 4th magnitude although it will be a difficult object low in the morning twilight from the UK.

Periodic comet 21P/Giacobini-Zinner will be at its best in September when it might be a naked eye object. This comet starts the summer as a 13th magnitude object moving north in Cygnus. By early August it should have reached 8th magnitude as it

moves through Cassiopeia and at the end of the month it may attain naked eye visibility as it enters Auriga. Throughout September it should maintain 6th magnitude as it moves rapidly southwards, crossing directly over the open cluster M35 in Gemini on September 15. From the UK the comet will be lost in the dawn sky in late October as it fades rapidly and moves away from the Sun and the Earth.

Periodic comet 46P/Wirtanen is at its best in December and it should be a naked-eye object high in the sky in Taurus. The comet should become visible from the UK in small instruments in late November as it starts to move rapidly northwards. The return in 2018 is almost as good as it can be with the comet passing 11 million km from the Earth on December 16, just 4 days after perihelion. On that date it will be high up in Taurus not far from the Pleiades, possibly at magnitude 3.5, but moving rapidly relative to the stars at 0.2 degrees per hour.

Since the last Tale we have lost two important comet observers. Former Director of the section, Mike Hendrie, died in February and there is short note on his significant contribution to cometary astronomy in this issue.



Thomas Bopp 1949-2018

Thomas Bopp, the co-discoverer of probably the largest comet nucleus to enter the inner Solar System in recent history,

C/1995 01 Hale-Bopp, died at the start of the year. Anyone who saw that comet hanging in the sky for months on end will not forget it.

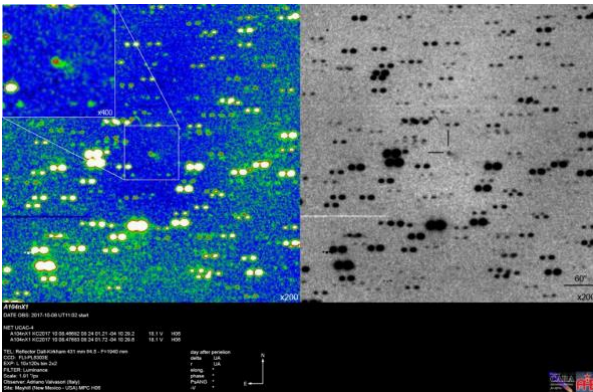
Finally, I know that it is a long way away but we are planning a section meeting in York on Saturday, 2019 May 18. Please put that date in your diary and if you would like to speak at the meeting please let me know. The BAA is also planning to hold its 2019 Autumn meeting in Armagh on the weekend of 2019 September 7/8, a location with close ties to cometary astronomy.

I wish you all the very best for clear skies over the northern summer with plenty of comet observing opportunities.



Nick James Section Director

2 Comet C/2017 T1 Heinze – A long time coming then a short-lived presence - Denis Buczynski



C/2017 T1 on 20171008 (A Valvasori) only six days after discovery

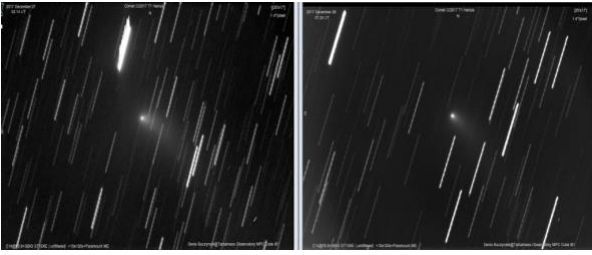
This comet was discovered on 2017 October 2 by Ari Heinze working at the University of Hawaii on the ATLAS programme. It was an 18th magnitude object in Hydra at the time. It was soon designated by the MPC as being a near

parabolic comet with a perihelion distance of 0.58 AU occurring on 2018 February 21.



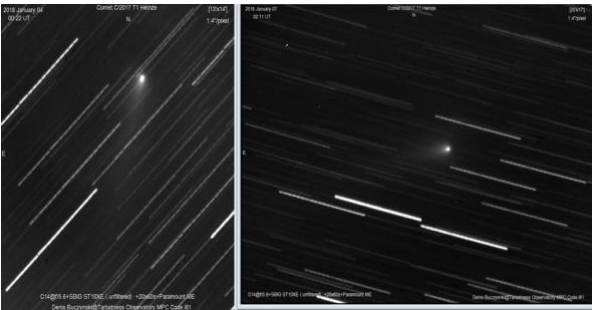
C/2017 T1 on 20171214-19 (D Buczynski)

It had an inclination of almost 97 degrees and a rapid southerly descent was seen through northern skies as the comet tracked towards perihelion during the autumn months of 2017.



C/2017 T1 on 20171227-29 (D Buczynski)

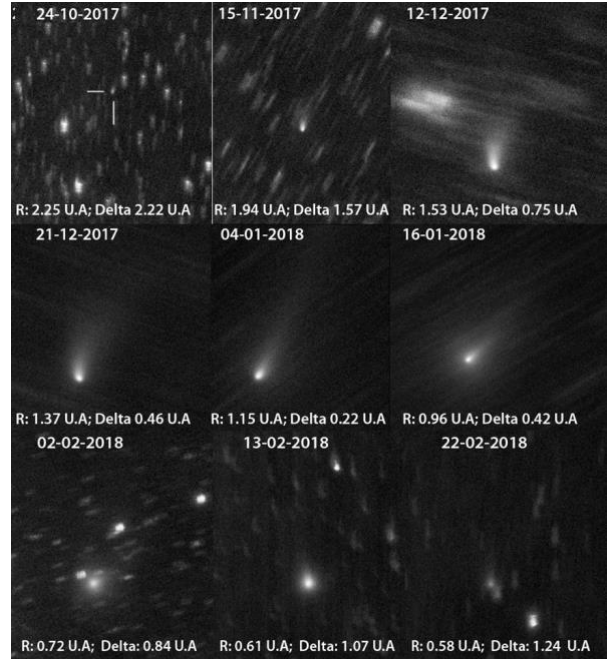
It passed closest to the earth on 2018 January 4 at 0.22 AU.



C/2017 T1 on 20180104-07 (D Buczynski) taken at closet to Earth distance



C/2017 T1 on 20180111_2135_ (D Buczynski)



C/2017 T1 On 20171024-20180228 (D Romeu)

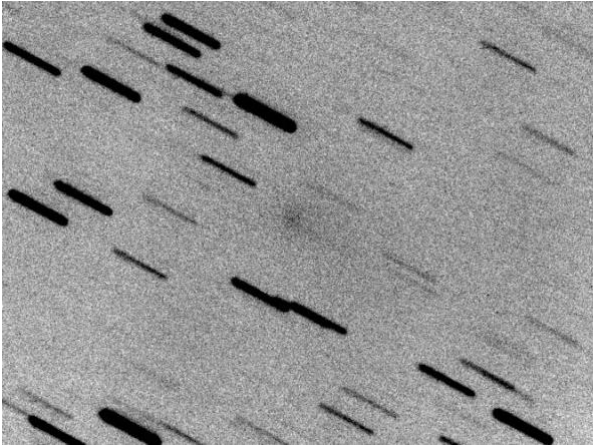
Photometry showed that the comet was small and its absolute magnitude was near the Bortle limit, meaning that survival after perihelion was not expected. Images taken during the apparition showed that this was the case and the comet seemed to have disintegrated when last imaged.



C/2017 T1 on 20180223 (A Diepvens) taken close to perihelion

As the comet approached Earth its daily motion increased and the position angle of that motion changed rapidly as the comet swung by Earth. As the comet receded from Earth its apparent size decreased.

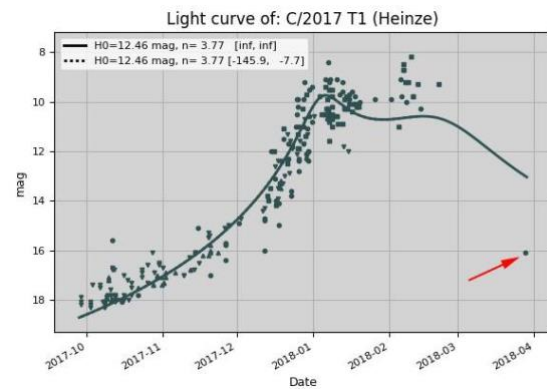
Disintegration is evident in the last image taken by the FRAM group on 2018 March 28.



C/2017 T1 on 20180328 probably disintegrated, FRAM (MPC 147), 0.3-m SCT f/10 + CCD M11 G2-1600, 31x60s.

A record of images from discovery to disintegration can be seen in the BAA Comet Archive at this link:

<http://www.britastro.org/cometobs/2017t1/index.html>



C/2017 T1 light curve 201710 - 201804 M Mašek



Denis Buczynski Secretary

3 'Oumuamua; Interstellar Interloper – Neil Norman

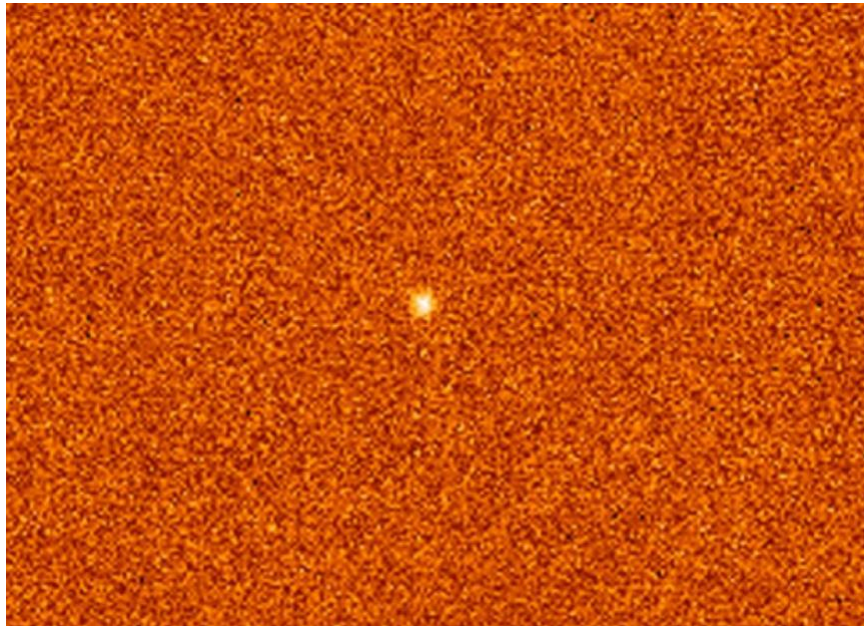


Image of 'Oumuamua. Credit Hubble Space Telescope

On the morning of October 25th, 2017, my good friend and comet discoverer, Cristovao Jacques of the SONEAR Observatory in Brazil, alerted me to an object that was mentioned in the Minor Planet Centre's Possible Comet Confirmation Page (PCCP) and that it was showing an abnormal eccentricity value. The object had the provisional designation of P10Ee5v which indicated that it was an object discovered by the PanSTARRS team based on the Hawaiian island of Haleakala. Their job is to locate all potential Earth threatening asteroids that could cause imminent or future impact risks.

The object in question was showing a large eccentricity value of 1.2, much higher than had ever been previously seen in the Solar System. Because of its orbit, it was initially thought to be a comet, by its discoverer

Robert Weryk, who first saw it on October 19th when it was just 33 million km or 0.22 AU's from Earth and some 40 days past perihelion. On October 25th it was officially designated C/2017 U1 (PanSTARRS), even though no cometary activity had been detected. But as each day passed there were no signs of this object becoming a comet. This meant that the object would now have to be classed as an asteroid and so a new designation was assigned, A/2017 U1.

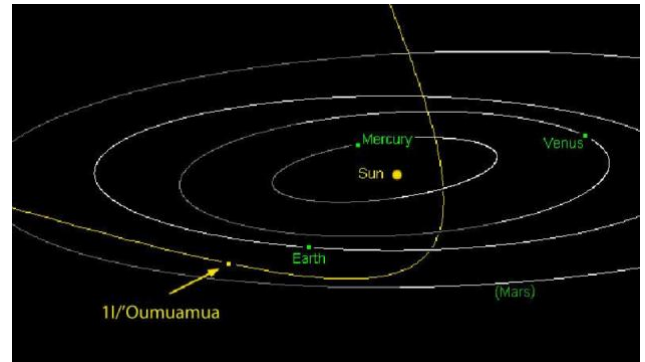
One problem remained though, the eccentricity of the orbit didn't decrease at all, even with further observations, and this could only mean one thing. A/2017 U1 was the Holy Grail for those astronomers who had always believed that one day we would see an object from interstellar space infiltrate our Solar System. With this now

being confirmed, a whole new designation would be required and so the International Astronomical Union decided to give it the new designation on November 6th of 11/2017 U1 ('Oumuamua). The name was given by the team that had discovered it, and as they are based in Hawaii they chose a word from the local dialect, 'Oumuamua meaning 'scout'.

Now that we knew we had an interstellar object the world turned its telescopes towards it as it was receding away from the Sun at an astonishing speed. With an absolute magnitude of 22, it was obvious that it was small in size, roughly some 230x35 metres and was also very dark. The lightcurve also indicated that the object was rapidly tumbling through space rather than slowly rotating; this would indicate that it had suffered a collision at some point in the very distant past.

At perihelion on 2017 September 9th, 'Oumuamua was just 0.25 AU's from the Sun, but interestingly enough was not visible in STEREO HI-1A images, indicating a maximum brightness of ~13.5 magnitude at this time. By the end of October, the magnitude was down to 23.

It is true to say that we may never know the exact origin of 'Oumuamua, but what we have learned during its fleeting visit is that it came from the general direction of the Solar apex which lies in the direction of the star Vega. The Solar apex is the direction of the Sun's movement relative to the local stars and is the direction that one would expect such objects to originate from. Its velocity through space was 26km/s.



Orbit of 'Oumuamua courtesy of Nasa./JPL

The speed of 'Oumuamua can be appreciated with the reference point below .

Distance in AU	Date	Velocity in km/s
2300	1605	26.34
1000	1839	26.35
100	2000	26.67
10	2016	29.5
1	09082017	49.67
Perihelion	09092017	87.71
1	10102017	49.67
10	2019	29.51
100	2034	26.36
1000	2196	26.36
2300	2430	26.32

'Oumuamua came into the Solar System at a very highly inclined angle, some 123 degrees above the plane of the ecliptic and due to the Sun's immense gravitational pull on it, it reached a maximum speed of 87 km/s at perihelion. It is now moving away in the direction of the constellation of Pegasus at an angle of 66 degrees from the direction of approach.

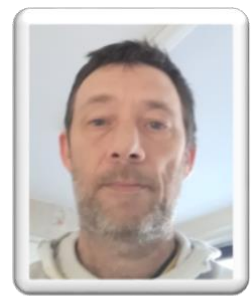
On 2017 October 14th, 'Oumuamua passed just 0.1616n AU or 24 million km from Earth and passed over the ecliptic two days later on the 16th. By November 1st it had

passed above the orbit of Mars and continues to pass the other planets: Jupiter in May 2018, Saturn in January 2019, and Neptune in 2022 respectively. As to the composition of 'Oumuamua, a spectrum was obtained on October 25th by the William Herschel telescope and the results indicated a featureless object that was reddish in colour, much as our very own Kuiper belt objects appear. Further observations from the Hale telescope showed it to resemble a comet nuclei or Trojan asteroid in brightness. The greatest surprise was the apparent shape of 'Oumuamua. It is very elongated with a ratio of 5:1 meaning it looks like a cigar shape or, dare one say, spacecraft shape, in fact this was even suggested and radio signals were bounced off it to make sure it wasn't a member of an alien fleet!



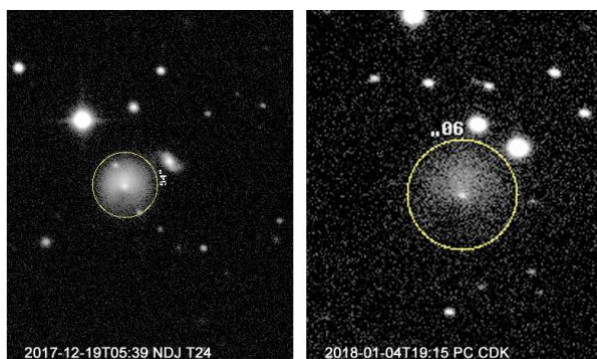
*Artists Impression of 'Oumuamua courtesy
Wikipedia By Original: ESO/M.
KornmesserDerivative:
Bartmann/spaceengine.org -
<https://www.eso.org/public/images/eso1706a/>,
CC BY*

It is estimated that around 1,000 objects of interstellar origin may be within our Solar System today but they are very elusive objects being small in size and moving extremely fast means it is amazing luck that we caught the first one. Who knows, in years to come we may be able to get a space mission to one of these objects. Imagine the scientific data to be found.



Neil Norman FRAS

4 The 2017 Outburst of Comet 174/P Echeclus – Nick James



Images by the Nick James and Peter Carson at the same scale showing the shape and expansion of the coma.

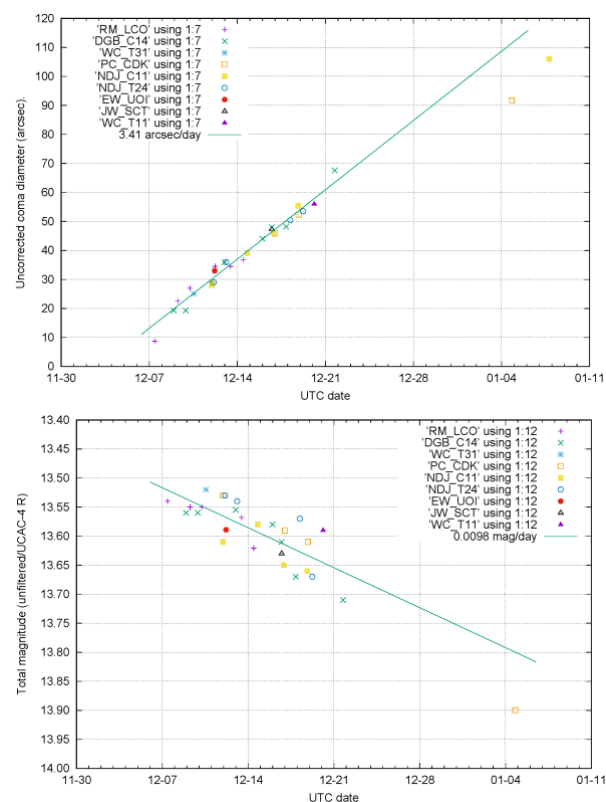
Comet 174P/Echeclus was discovered in 2000 by Spacewatch. Also known as minor planet 60558, it moves in an orbit which has a perihelion of 5.8 AU, an aphelion of 15.5 AU and a period of 34.9 years. It is a member of the class of objects known as Centaurs. This is a group of objects with orbits which have a semi major axis between Jupiter and Neptune and they are thought to be icy objects in transition between the Edgeworth-Kuiper Belt and the Jupiter Family of Comets. Echeclus last came to perihelion in 2015 April and it is currently moving outwards.

At the start of 2017 December it was 7.3 au from the sun and around mag 17. The comet has experienced a number of significant outbursts in the past (2005 December, 2011 May and 2016 August) and a number of observers keep it under near continuous observation looking for new ones.

On 2017 December 8 Brian Skiff reported that images he had taken on the previous day showed the comet to be at least 4

magnitudes brighter than expected. Jean-Francois Soulier and Richard Miles also reported the outburst using 0.20m and 2.0m telescopes respectively. At first the object was stellar but shortly after the outburst it began to show a distinct coma which was detectable in moderate aperture instruments.

I have performed a preliminary analysis of images submitted to the Comet Section.



Plots of the coma diameter and the total magnitude following the outburst. Obtained using the standard method.

These show the coma diameter expanding linearly at around 3.4 arcsec/day. At the comet's current distance of 6.6au this corresponds to an expansion velocity of 95 m/s. By December 22 the coma was

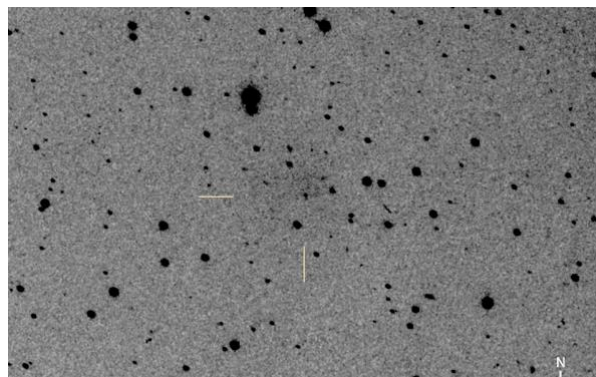
around 70 arcsec across corresponding to a diameter of 335,000 km at the comet.

The total magnitude since the outburst has been remarkably stable fading from 13.50 just after the outburst at a linear rate of 0.011 mag/day (unfiltered, UCAC-4 R mags). The constant total magnitude would be expected for a comet where the light was mainly from dust reflection and the quantity of dust was essentially constant so as the coma expands the total reflecting area remains the same.

Images of the comet are available in the Section's online archive:

<http://www.britastro.org/cometobs/174p/index.html>

The most recent image at time of writing is by Alfons Diepvens taken on 2018 February 17.



An image taken by Alfons Diepvens on 2018 February 17 showing that the coma is still faintly visible to the north of the comet.

This appears to show a very faint outer coma to the north. This unusual object is definitely worth keeping under observation whenever possible.

Nick James Director

5 Naked Eye Comet or Aurora? – Denis Buczynski



The sight of a naked eye comet with long tail projecting up from the horizon is a special view, one not experienced too many times during a lifetime and unforgettable to most. However, to obtain a similar view of an astronomical phenomena we may not have to wait lifetime. The recent discovery by amateurs of a form of the Aurora (acronym STEVE – Strong Thermal Emission Velocity Enhancement) can have the same scale and diffuse appearance that long tail comets can have. The sightings of these auroral forms are becoming more common. The attached pictures show these similar appearances.

The above picture is a combination of two images; one of STEVE taken by Gordon Mackie in Caithness Scotland and the other the view of C/2011 W3 Lovejoy at its post perihelion best taken from Australia.



The second picture is one of my own taken of STEVE from Tarbatness Highland Scotland in 2016. Make you own judgment about the similarity of appearances. More information about STEVE can be obtained at these links:

[Mystery of Purple Lights in Sky Solved With Citizen Scientists' Help](#)

<http://advances.sciencemag.org/.../advances/4/3/eaag0030.full.pdf>

If these links do not work, try copying and pasting them into your browser.



Denis Buczynski Secretary

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6 Spot the Similarity - C/1908 R1 Morehouse, C/1961 R1 Humason, C/2016 R2 PanSTARRS – Denis Buczynski

These three comets are observed to have formed plasma (ion or gas) tails at distances greater than 2.0 AU from the Sun. It is usual that such types of tails form at distances of *less* than 1.5 AU from the Sun. When studied spectroscopically these

comets have also been found to have strong emissions of CO⁺ and N₂⁺, and the blue colour of their ion tails is due to the presence of CO⁺. The tails have also been observed to have many contortions and disconnection events due to their

interaction with the solar wind, even at such large solar distances. Many similarities can be seen in the tails of these

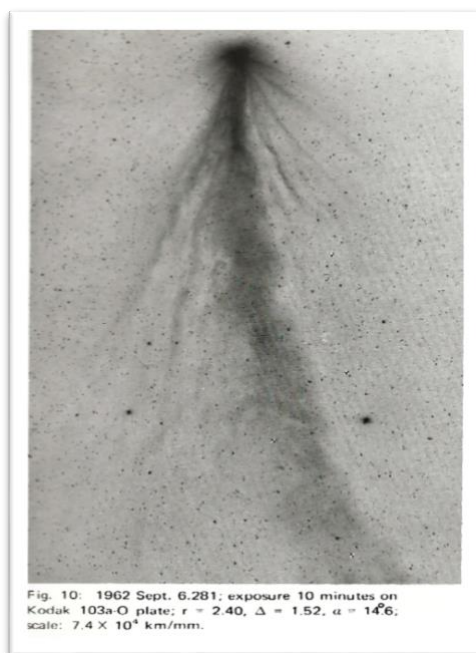
comets, such as successive envelopes and corkscrew like effects.

Some comparative images are shown here:



Left - C/1962 R1 Humason 1962 July 10(Roemer USNO)

Right C/2016 R2 PanSTARRS 2018 Jan 20 (Hemmerich)



Left C/1962 R1 Humason 1962 Sept 6 (Kearns and Rudnicki Palomar)

Right C/2016R2 PanSTARRS 2018 Feb 04 (Rhemann)



Left C/1908 R1 Morehouse 1908 Nov 22 (Davidson, Edney and Melotte RGO)

Right C/2018 R2 PanSTARRS 2018 Feb 13 (Mrozek)



Left C/1908 R1 Morehouse 1908 Nov 19 (Davidson, Edney and Melotte RGO)

Right C/2018 R2 PanSTARRS 2018 Jan 19 (Jaeger)

An animated gif (by Michael Jaeger) showing tail motions can be seen at this link:

http://www.britastro.org/cometobs/2016r2/2016r2_2018019_mjaeger.html

Some further reading material related to these comets can be found at these links:

https://en.wikipedia.org/wiki/Comet_Morehouse

https://en.wikipedia.org/wiki/Comet_Humason

Title: The Spectrum of Comet Humason (1961e).

Authors: Greenstein, J. L.

Journal: Astrophysical Journal, vol. 136, p.688

Bibliographic Code: 1962ApJ...136..688G

<http://adsabs.harvard.edu/full/1962ApJ...136..688G>

Title: The Spectrum of Comet Morehouse

Authors: Fowler, A.

Journal: Astrophysical Journal, vol. 35, p.85

Bibliographic Code: 1912ApJ....35...85F

<http://adsabs.harvard.edu/full/1912ApJ....35...85F>

Strong CO+ and N+2 Emission in Comet C/2016 R2 (Pan-STARRS)

Anita L. Cochran, Adam J. McKay

<https://arxiv.org/pdf/1801.01199.pdf>

Some Statistical Properties of Comets with Plasma Tails

Authors: Antrack, D., Biermann, L., & Lüst, R.

Journal: Annual Review of Astronomy and Astrophysics, vol. 2, p.327

Bibliographic Code: 1964ARA&A...2..327A

<http://adsabs.harvard.edu/full/1964ARA%26A...2..327A>

Denis Buczynski Secretary Comet Section

7 New imager in the Comet Section – David Swan



2017-10-26 20:24. C/2017 O1 ASASSN, Tynemouth, UK

Scope: 200mm SCT at f/6.3 Camera: ASI178MM Filter: Baader UV/IR cut

Software: Firecapture and DeepSkyStacker Exposure: 20 x 5s

I joined the BAA only very recently (Spring 2017) but have been interested in astronomy as long as I can remember. As a child I asked for lots of books on the subject, and my parents bought me my first 'proper' telescope - a 3.5 inch Mak-Cas - when I was about 14 or 15. The family moved to Northumberland in 1997, and I have a very clear memory of being wowed by Hale-Bopp in the western sky. Now I have a PhD in immunology and carry out research at university.

In the evenings and at weekends, so far as the weather allows, I'll be out observing. The fickleness of our weather does the job of ensuring that this hobby does not become all consuming. Several friends have commented on how strange it is that I do one science at work and another (as an amateur) at home! It seems an obvious thing to say here, but it is the dynamic nature of comets that makes them so fascinating to observe.

I do as much visual observing of comets as possible - it is easy enough to switch out the camera for the star diagonal and an eyepiece - but so many more comets are within reach with modern cameras. And, of course, sharing the captured images is so easy with the internet.

At the moment my equipment comprises an alt-az goto mount, 200mm SCT with f/6.3 reducer, and ASI178MM camera. I stack 5s or 10s exposures to improve signal to noise ratio, and of course stacking software deals with the field rotation. This is practical for me, as I don't have a fixed observing spot. I have good visibility of the northern sky from my backyard, but I have to move around the village to access the other parts of the sky in relative darkness. The good news is that being on the north-east coast of England, the sky to the north and east is quite dark. Because I am still a relative novice, I can't offer much help to others via the BAA. I guess the only thing I can do is contribute observations and try to enthuse as many people as possible in my local area about astronomy.



David Swan

8 My Night at the Telescope – Peter Carson

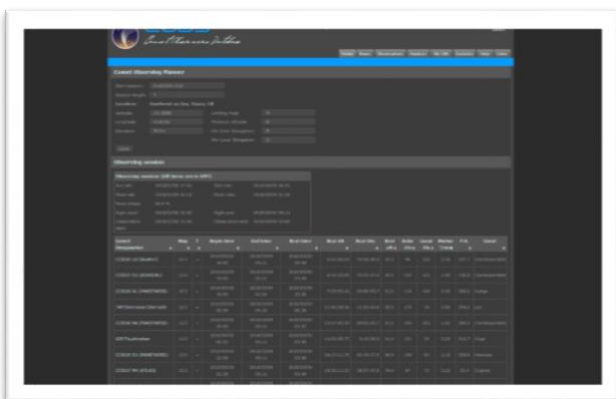
The weather forecast for the night ahead is promising many hours of clear sky. The Moon is virtually new so shouldn't interfere; the air flow is from the dryer north so the transparency is good. It looks

like it will be a great night for comet imaging and what's more I've got the day off work tomorrow. How often does that happen? Virtually never! That's why we all have to make the most of every short

interval of clear sky that presents itself, even if the conditions are not ideal.

To be more effective I keep an up to date list of observable comets. The order of comets on my list is graded based on a mixture of observing importance and increasing right ascension i.e. west to east. I'm therefore pre-armed with my "to do" list even if my decision to go out to my observatory is made at the last minute.

The starting point for my comet list is usually a visit to the COBS website. See <https://cobs.si> COBS or Comet OBServation Database; the worldwide repository for observed comet photometry. It contains a number of other useful resources including an observing planner, see below.



COBS - Comet OBServation database

Log into the COBS website and on its homepage you can specify your observing start time and duration, limiting magnitude and limiting observing altitude and the website will present you with list of observable comets especially the important periodic comets, tailor made to your specific criteria. I then modify the order of the list having considered topical issues such as comets that may have or are likely to outburst, ones that are the talk of the

BAA comet discussion email group or other social media sites etc.

The BAA comet section website <https://britastro.org/comet> and BAA handbook are also good alternative starting points as they contain information on likely observing candidates. Jonathan Shanklin maintains an up to date list of bright comets and other discovery information on the BAA Comet Section Observations and Analysis page, see <https://www.ast.cam.ac.uk/~jds>. Lastly a quick trawl through the latest Minor Planet Centre MPEC's at <https://www.minorplanetcenter.net/mpec/RecentMPECs.html> will highlight the latest comet discoveries requiring follow up astrometry to improve their orbital data.

Sometimes you get the benefit of advance notice of an impending observing session. In those circumstances I endeavour to open up my observatory an hour or so before I intend to start imaging so the equipment can cool down to the ambient air temperature. I find this is especially important if the sun has been on the observatory in the late afternoon.

My camera is difficult to focus precisely and can go out of focus if the telescope is not near the ambient air temperature. Quite often the unpredictable British weather creates observing opportunities that appear without notice. In these cases, I just "go with the flow". When at the telescope I use Planetarium software (Software Bisque SkyX) to control the go to operation of my mount. The software uses the Minor Planet Centre comet orbital data to calculate the go to coordinates for comets. See

<https://www.minorplanetcenter.net/iau/E>

phemerides/SoftwareEls.html for more info.

My observatory is close to my house and is hard wired to the internet so the latest comet orbital elements can be quickly downloaded when I start up my observatory PC. Keeping the orbital elements up to date improves the mount slewing accuracy especially if the comet is fast moving and recently discovered. If my observing session is planned and there is sufficient time available I try to time my observations to coincide with my best local sky conditions. After midnight usually produces the darkest available local sky after neighbours have retired to bed and the streetlights have dimmed. I have some particularly troublesome local sources of light pollution such as the ritual Friday and Saturday night high intensity xenon sky beam projectors used to advertise a seafront amusement park. My south east sky can look a bit like the opening credits of a Fox Searchlight motion picture, before the Lion roars... or is the Lion from a different movie company? Fortunately the serious degrading effects of the searchlights stop around 11pm when they are switched off.

I image with a 315mm Dall-Kirkham Cassegrain reflector which has a focal reducer in its light path giving a final focal ratio of f5.3. I find this gives a satisfying compromise between image scale and imaging speed. I avoid removing or rotating my CCD camera so my flat field calibration images can be repeatedly reused, sometimes for several months. I've also got a library of dark and bias frames for different camera temperatures. It's this sort of practice that makes the imaging processing much less tedious. It's also

really useful to invest some time setting up your image capture software so it records the instrument used, mount data, time and image information on the FITS image header. This way you never need to make any separate notes of your nights observations and you don't end up with a pile of image files that made sense on the night but make no sense the morning afterwards! FITS header image data is also automatically used by other software such as Astrometrica for astrometry.

There are many brands of image acquisition software all of which have various useful features. I use Maxin DL. It has a "sequence" function which enables a semi-automatic capture function, but only for a single target. This function is useful on cold nights as it allows you to leave the telescope and camera to drive themselves for a period long enough to boil a kettle and make a coffee. The sequence function also allows a bit of space to plan and consider revisions to the target list that might be required if, for instance, the weather looks like it might worsen.

I like to review each image as they are downloaded from the camera to monitor background sky brightness, saturation levels and focus. I trim these settings "live" to ensure I get the best image possible in the circumstances. I find making a focus judgement by just viewing the images on the observatory monitor can be very misleading. What looked good on the night can be disappointingly out of focus when critically examined. Therefore, I use a tool in my capture software to measure the FWHM of non-saturated stars and take action if they go out of a range I know my setup can achieve.

More recently I have invested in some auto focusing software called FocusMax. This has proved very effective focusing the telescope much better than any other method I've tried, particularly when the seeing is poor. FocusMax also has an automatic star selection routine and go to slew function. Whilst this is not strictly necessary for a manned telescope it does make me smile when the telescope goes off and does its own thing. Whilst out in the observatory watching each sub frame appear on the PC monitor it sometimes becomes apparent which tiny fuzzy patch is the comet as its movement across the sky is revealed from frame to frame. More exciting is watching the tenuous tail of a brighter comet change from exposure to exposure. Comet 2013US10 Catalina showed a distinctive tail disconnection event moving away from the coma visible on sub frames at the telescope over a period of just 4 x 120 second exposures. See

<http://www.astromania.co.uk/2015.12.21%202013US10%20animation.gif>

Witnessing this type of event in real time is what comet observing is all about for me! To get a reasonable signal to noise ratio in my images using my 315mm reflector I generally take 2 minute sub frames and

stack around 7 or 8 to end up with the equivalent of a 14 to 16 minute single exposure. I find this approach enables tenuous tail detail and coma structure to start to become visible in many comets so it is a practical compromise between time and quality. Allowing for image download and telescope slewing time around three comet targets per hour can be achieved. A 5 hour observing session can therefore produce 15 sets of comet image data.

Having got my night's haul of images securely saved to a memory stick the image processing and measuring can start. But that's a whole different story and a task for the nights when it's cloudy.



Peter Carson CCD imaging advisor

9 Comet Magnitudes – Roger Dymock

At last year's Comet Section meeting Professor Alan Fitzsimmons asked the question as to whether or not the colour of

a comet influenced its magnitude as measured using Astrometrica. Acting under his advice I investigated this

possibility and would like to thank him for his assistance.

Photometry

A beta version of Astrometrica, Version 4.10.2.433, was used for this analysis.

An astrometric reduction was performed on an image of comet 81P/Wild obtained with the SSON 0.61m telescope. A sample of the data is shown in Table 1.

Astrometrica	RA	05 39 16.421	05 39 16.881	05 39 17.161
	Dec	+19 19 28.2	+19 22 48.4	+19 16 59.1
	R	15.28	14.70	12.27
	dR	-0.03	-0.01	-0.08
	Derived R	15.31	14.71	12.35
	Calc R	15.32	14.71	12.35
UCAC4	B	16.58	16.26	13.29
	V	15.75	15.29	12.71
	r'	15.54	14.94	12.54
	B-V	0.82	0.97	0.58
	V-R	0.44	0.58	0.36
	V-r'	0.22	0.34	0.17

Table 1. Astrometric reduction data (Sample)

RA and Dec, R and dR are the coordinates, and R magnitudes of stars measured by Astrometrica. Derived R is the R mag used by Astrometrica and equals $(R - dR)$. Calc R is the R magnitude calculated manually from the equation $R = r' - 0.108(B - V) - 0.132$ and was used to check the value of the Derived R (Astrometrica uses the same equation). Values of r' , B and V were obtained from the UCAC4 catalogue. The derivation of this equation is the subject of a recently submitted paper by Richard Miles and Roger Dymock.

Analysis

$(V - R)$ was plotted against dR – Figure 1 and $(B - V)$ against dR – Figure 2. A paper by David Jewitt ‘Colour Systematics of Comets and Related Bodies’ (<https://arxiv.org/pdf/1510.07069.pdf>) lists $(V - R)$ values for Long Period and Jupiter Family/Short Period comets of 0.46 to 0.47 +/- 0.02. Inserting these values in the equation shown in Figure 1 gives a dR of < 0.01. Similarly $(B - V)$ values are given as 0.74 to 0.78 +/- 0.02 and inserting these values in the equation shown in Figure 2 gives a dR of < 0.01.

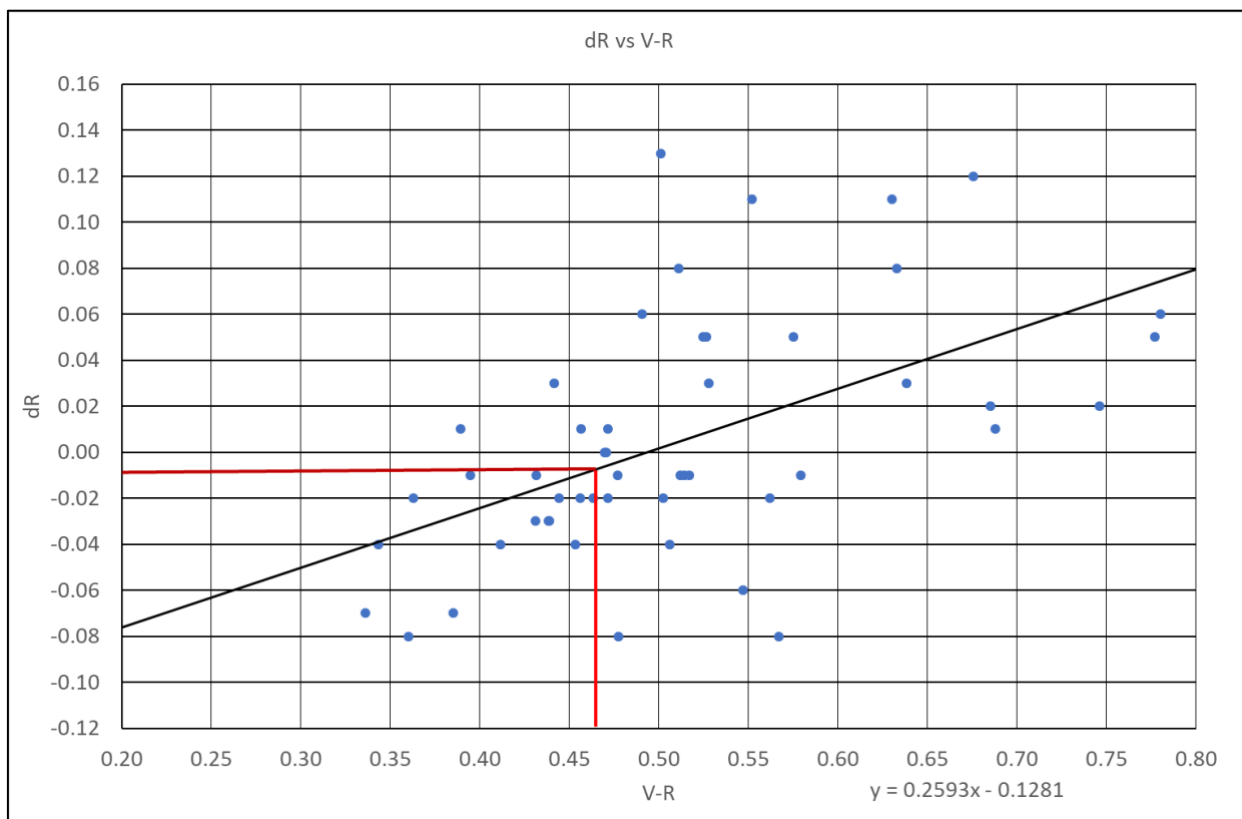


Figure 1. (V - R) vs dR

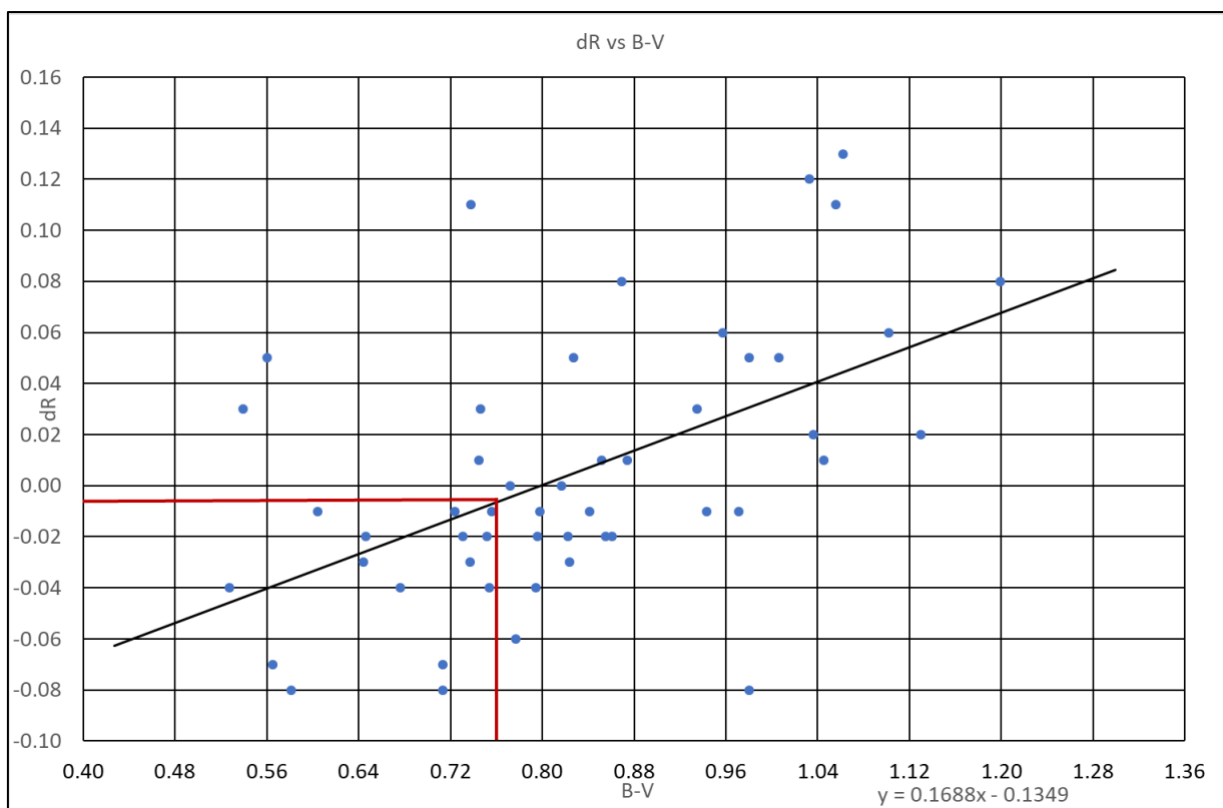


Figure 2. (V - R) vs dR

Conclusion

Comet magnitudes are usually reported to one decimal place so, for typical comets, their colour index does not significantly affect such measurements. However, as Alan pointed out, for very active or gassy comets with strong emission lines (such as the Swan bands from carbon molecules) in their spectra this may not be the case. In such cases the colour will be slightly more blue.

The results were discussed with Professor. Fitzsimmons at the RAS meeting, 'From the Outer to the Inner Solar system: The Origin and Evolution of Comets' held on 2018

February 9 and he agreed with these conclusions.



Roger Dymock

10 DSLR Comet imaging and processing - Justin Tilbrook

Introduction



My Observatory - Penwortham South Australia - Obs code D86

Comets can be difficult to image and process. This article is how I go about getting the most out of my images, and I

hope that you find this useful. The way I image is probably the same as most of those using a DSLR. It should be pointed out that I image from a dark rural site, Penwortham, South Australia, so I have the big advantage of not having to deal with light pollution which can wash out faint comet tail features.



My equipment consists of a Canon 60DA and 1100D cameras and an. 8" F/4 Newtonian astrograph - Orion mini guider and a HEQ Pro 5 mount. For operation I use an HP laptop running Windows 7 EQASCOM / EQMOD, via a shoestring cable to Guide 8 planetarium software from Project Pluto.

I'm assuming that users have a polar aligned telescope auto guider running and good focus ready to go. Also, I do not guide on the comet but in sidereal mode. You can guide on comets using EQMOD and other programs, but that's for another article.

My camera settings are as follows. I do not change white balance settings in either camera. ISO and exposure time are changed depending on sky conditions, comet brightness and relative motion of the comet. When it comes to ISO and exposure time for a given comet, I only use what is best suited to my equipment and sky conditions. Anyone imaging comets, should have good planetarium software that will allow download of current ephemerides of comets.

Steps

1. Load the comet you wish to image and click on information.

2. Check altitude above the horizon. Check magnitude.
3. Check relative motion.
4. Temperature. Very relevant to a DSLR as on a hot night lots of noise can be introduced.

All these factors will help determine where to start with settings to get the best image of the comet, e.g. C/2016 R2 PanSTARRS, Date 2018 February 11 21:33 CSDT. Elevation: 25 degrees evening sky, the comet is setting. Magnitude 13.3 from the ephemeris. Also check current CCD and visual estimates if you have access. Speed of apparent motion. 38.812" arc seconds per hour. Divide by 60 for motion per minute and 60 for motion per second. Motion per minute should be sufficient unless it is a close fast mover. So, now we have $38.812 / 60 = 0.6487$ rounded.

Multiply the exposure time you may want to use, say 5 minutes. $5 \times 0.6487 = 3.2435$ arc seconds per 5 minutes, more than acceptable considering the seeing may not even be this good.

So...

1. Comet selected
2. Elevation 25 degrees quite low, allow for sky conditions, sky glow, light pollution
3. Magnitude current estimates 11.5
4. Apparent motion and exposure time 3.2435" per 5 minutes
5. Temperature 17 degrees Celsius.
6. All these parameters will have bearing on exposure and ISO.

This is where I have no formula to find the optimum settings for all DSLR's. There are different ISO's available and balance settings, so it would be too difficult. This is where it is important to experiment with your camera and is based on experience with my equipment and the above parameters.

Test shot

I start with a 3 minute exposure at ISO 1600. This can be now adjusted up or down depending on acceptable noise levels and background washout. See below



Importing the test image into the processing software, I use Photo Shop Cs2, and doing a basic levels and stretch will tell you how much data and noise you're dealing with. See stretched test image.

Stacking and Processing

There are many different programs available for stacking and processing. I use three and they are all available for free, which is ideal if you are starting out and do not want to commit money to particular software.

Deep Sky stacker DSS

Adobe Photo Shop CS2

Olympus background subtraction tool

All work with Windows 10. Please note, I will be showing basic steps that I do in each program. You will need to experiment with your image, so make duplicates along the way so you can pick the best version in each step.

DSS Stacking images



Import your images into DSS. I use RAW converted to tiff. Select the best images. In settings, select stacking - light - median. This method seems to be the best for getting rid of artefacts like satellite trails in frames.

Select settings - register settings- star reduction threshold.

Set to around 40 % when there are plenty of stars in the field and around 10% if there are few stars, because the images will not register properly above 10% when there's few stars. I leave the median filtering for photo shop.

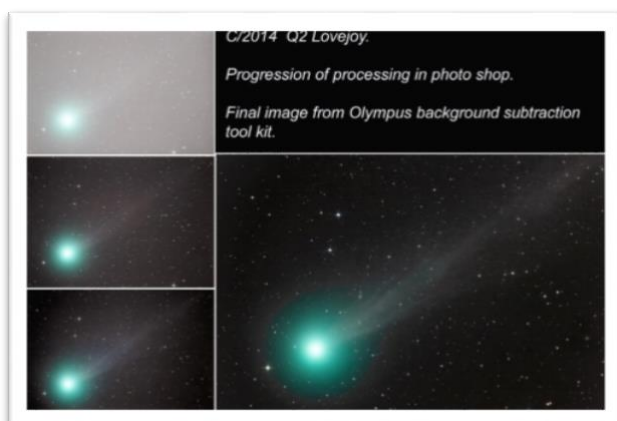
1. In settings - stacking settings - comet.
2. Select stars + comet stacking, the comet and stars will be sharp. This is my preference.
3. Go to the main menu - check all - register checked pictures.

I rarely use darks unless the image is particularly noisy. Once the images are registered, left click on the first image and a box will appear on the right, left click on the comet. A green aperture will appear when you move the cursor over the image. Place the cursor over the comet, hold down the shift key and use the scroll wheel on the mouse to zoom in on the comet. You will see a magnified box in the top left corner, once you have the comet centred, left click and it will be circled for registration. Do this for all images.

Once done select stack checked images, left click and wait, it will take some time depending on image size, number of stars in the field and number of images to stack. Good time for a coffee!

When the process is complete the autosave image will appear. This is where I leave DSS, the 32-bit autosave will be in the original image file. This is a short cut eliminating a 'save as image' which sometimes will not save a stacked comet image properly.

Processing Photo Shop Cs2



Any step can be undone by going to edit - step backwards or undo or selecting a particular point in the history window if

open. It would be wise to play around in Photoshop with any images you may have, to get used to some of the functions and where they are. This will be the most complicated part as there is quite often many iterations of your comet image before it is right. I will keep to a simple process here.

Left click file and select the autosave from your comet file.

In Image - mode - select 16 or 8bit, 16 bit is preferable for greater control. These formats will allow all the functions of Cs2 to operate.

The HDR conversion will come up, just click OK.

Click Image - adjustments - autolevels. You can choose to manually adjust if you wish. At this point make a duplicate image and save. Click Image - duplicate

Next up, image - adjustments - curves. Left click and hold in the middle of the graph, pull the curve up one square up and release the mouse, don't worry about the input output numbers. The image will be quite bright but tail features will start to stand out

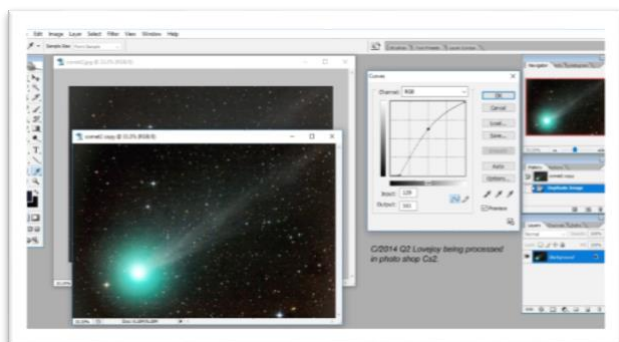
Now Image - adjustments - match colour - colour intensity. Move the slider to 130 to 150 just get a feel of the colour that may be enhanced. Click OK

In Image - adjustments - hue and saturation, click the down arrow next to master. From here you can select individual colours to enhance. In the case of C/ 2016 R2 PanSTARRS, increase the blue channel until more of the tail stands out. You may wish to increase yellows and

reds for stars too. It may pay to do autocolour again to balance the image

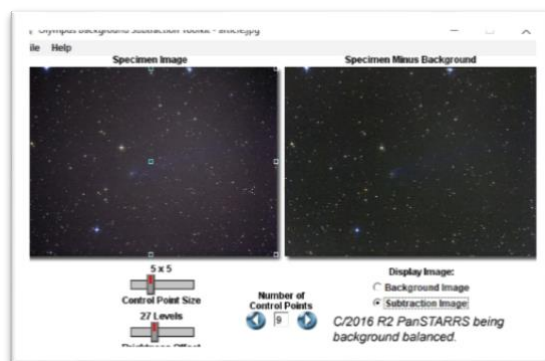
Filtering –

1. Click Filter - Noise - median, select 1 to 2-pixel radius, click OK
2. Now filter - Other - minimum, select 1 pixel. If the stars look too pinched, edit - fade minimum, move the slider until you're happy with the image
3. Save another copy of the image
4. It's now time to change the image size to 1800 x 1200 pixels in 8-bit format, png - jpg or BMP
5. Click image - mode - 8 bit. Image - image size. In width type 1800 it will auto adjust the height to your image.
6. File - save as - filename - format, click on down arrow and select jpg simplest choice, and save.



The reason for this is the next program; Olympus background subtraction tool kit will only accept certain size images. It was originally designed for microscopy. Keep PS open just minimise.

Olympus Background Subtraction Tool Kit



Select your saved jpg image, then click on subtraction image. You will notice the vignetting is now balanced out more. You may need to adjust the control point size and number of points which can be moved around. The point is to balance the image to show as much as possible of the comet and tail features. In brightness offset set to around 25 to 30

Now save the image, file - save image, it will be saved as a PSD file. Set the file destination

Open the PSD file in PS and do Image - adjustments - auto colour Save it as a jpg new file name and perhaps resize if you want. You should now have an enhanced version of the original.

This is a basic process and has worked well for C/2016 R2 PanSTARRS. Of course, there is tweaking involved as each stacked image is different. Comet processing becomes much more involved when there is a bright nucleus, coma and a faint tail. This requires learning layer masking, and that's for another time.



Colours of Comets

I hope you found this useful. It is a process that has worked for me, but I repeat I have the luxury of low light pollution and humidity here, so it may not work so well

for European skies. Good luck with all your imaging.



Justin Tilbrook

Comet Observers of the Past – Histories Contributions and Achievements

Director's Note - This section introduces historical perspectives on comet discoveries, their role in general society and in politics. I hope you enjoy it and also feel free to contribute.

11 Historical Observations in India: Prehistory – Amar A Sharma

Much regarded across the world, India embodies one of the world's oldest surviving cultural traditions and civilisations. The foundational scripture; the four canonical sacred texts of India is the Veda (Sanskrit: 'knowledge'). They are:

Rig-veda, meaning knowledge of the Hymns of Praise, for recitation

Yajur-veda, meaning knowledge of the Sacrificial formulae, for liturgy

Sama-veda, meaning knowledge of the melodies for chanting

Atharva-veda, meaning knowledge of the Magic formulas, named after a group of priests

The RigVeda is the largest text of the Vedic collection. It includes 1028 hymns and it is divided into ten books called Mandalas. The SamaVeda has verses that are almost entirely from the Rig Veda but are arranged in a different way since they are meant to be chanted. The YajurVeda contains explanatory prose commentaries on how to perform religious rituals and sacrifices. The AtharvaVeda contains charms and magical incantations and has a more folkloristic style.

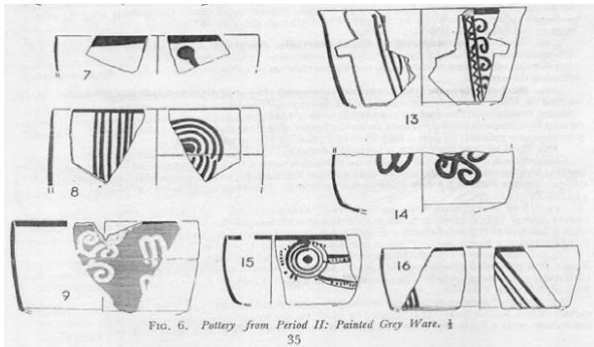


FIG. 6. Pottery from Period II: Painted Grey Ware. 35

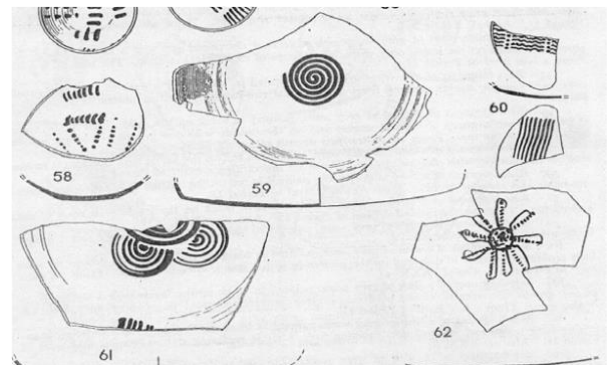
Excavations at the Mahabharata sites of Hastinapura and Ahichhatra. Pottery dated to 1100-1200 BCE exhibits typical Comet motifs

The Veda is not written, it is 'Apaurusheya' (Sanskrit: 'not by man' or 'impersonal'). It is in fact, not a book at all. It is a body of sacred revelations which were handed down as a 'Sruti' (Sanskrit: 'that which is heard') delivered in a verbal manner from Guru to disciples. They were originally transmitted orally, over many generations, before eventually being committed to writing. When writing was invented or more widely used, that is when these Mantras or chants would have been written down in the form we see today.

Around 1500 BCR a large group of nomadic cattle herders, the Aryans, migrated into the region from Central Asia. The Aryans crossed the Hindu Kush mountains and came in contact with the Indus Valley Civilisation of northwest India (and Pakistan). These Indo-Aryans of ancient India observed stars and constellations for ascertaining auspicious times in order to conduct sacrificial rites ordained by the Veda – and inadvertently observed comets too.

For the seers of antiquity, the night sky and its attendants were sacred. In Rigveda (circa 1700–1500 BCE) and Atharva Veda (circa 1150 BCE), there are references to 'dhumaketu' and 'ketu', which stand for Comets (Sanskrit: 'smoke banner'). The word dhumaketu appears seven times in Rigveda, and Atharvaveda contains a hymn about "Sapta Rishi (Sanskrit: Seven Sages , Big Dipper, part of Ursa Major) being veiled by a dhumaketu".

Now the following citations in this article predate the commonly accepted oldest cometary observations of 613 BCE by the Chinese in historical light, largely because these relate to the lesser known insights of the Vedic texts. These references were always there, only not known in mainstream knowledge and discussion.



as previous

A late Rigveda verse speaks of an “Indian fig tree whose aerial roots are held up in the sky by the god Varuna, Guardian of Cosmic Law. The fuzzy nature of a comet’s tail led them to conjure up invisible aerial roots of a tree on the Polestar which tied up the stars and the planets to keep them from falling to Earth.

The seer Garga, one of the important Sages of ancient Indian astrology, had a penchant for observing comets and made a list of 77 comets that were characterised by a dark, reddish hue, as mentioned in Varahamihira’s ‘Brihat Samhita’ of AD 550. Besides this, the aforementioned text described in detail the motion of a comet named ‘Chala Ketu’ (Sanskrit: ‘moving comet’), underscoring its rise in the west and its increase in size as it moved north, touching Ursa Major or Sapta Rishi (Sanskrit: ‘Big Dipper’ asterism). The treatise Brihat Samhita also delineated the characteristics of one thousand comets, and later added nine more.

Sage Parashara (circa 1000–700 BCE) listed 101 comets, describing features of 26 of them, which were likely to have been directly observed by him. Morbid names like skull, bone, marrow, among others, were attached to some of the comets classified by Sage Parashara in the death group of comets. As per internal evidence in the text, the Samhita (text) of Parashara should have started around 1400 BCE.

Even Atharvaveda associates comets with death since they look like the smoke rising from funeral pyre. This Veda text has a prayer for peace to the shaking Earth hit by meteorites and to Sun, Moon, planets, and Death named Dhumaketu.

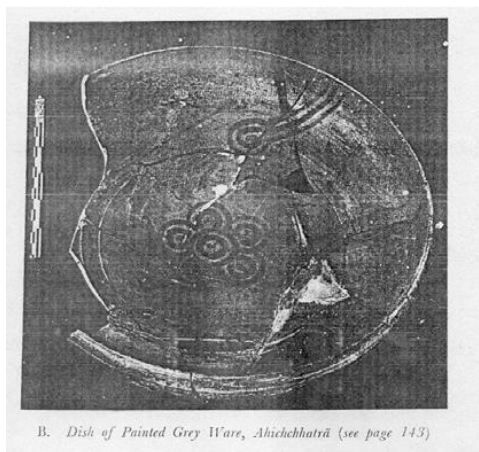


The author’s Observatory in Bangalore

The King Ballal Sena (circa AD 1100–1200) of Mithila and Banga, had compiled cometary records from the seers Parashara, Vriddha Garga, Garga, Atharva, Varahamihira, and Asitadevala in his book ‘Adbhuta Sagara’ (Sanskrit: ‘Ocean of Wonders’ started in 1169 AD). Ketu-*adhbhuta* (Comet-wonder) is the 8th chapter in *Adbhuta Sagara*.

The other authors quoted here increase the total number of objects to 1000 and add new groups such as Jupiterian (65), Saturnian (60) etc. Association of comets with planets might have had an observational basis but the numbers appear to be arbitrary. Whether the mentioned objects were comets is also unclear. None of these authors gives the era of appearance or the time interval between any two of the comets. It appears that while discussing the comet *Dhuma Ketu*, Sage Vriddha Garga observes that it has a starry nature and that it ejects a jet of smoke in a direction away from the Sun before setting.

The Jain (Jainism) seer Bhadrabahu¹ (around 322 BCE), placed by some historians as a contemporary of Alexander the Great, reckoned that comets are hundreds in number, each with a different period. According to one source, Bhadrabahu composed his Samhita only about one or two centuries before the Arab astronomer Al-Biruni (AD 973–1048).



B. Dish of Painted Grey Ware, *Ahichchhatra* (see page 143)

as previous

The great Indian epic Mahabharata recounts one episode of King Nahusha representing a comet that crossed Ursa Major from the north and kept increasing in size as it moved southward towards Canopus. As the comet moved southward, its tail gradually elongated, finally making contact with Canopus. Interestingly, this episode is synonymous to the Comet C/1853 G1, discovered on April 5, 1853, which became brighter as it moved from north (discovery position south of Rho Aquilae Delphini) to the southern hemisphere (last observed on June 11,

1853), its tail growing from about 4° to about 10° pointing towards Canopus.

From whatever that has been presented above, it appears that Parashara and Vriddha Garga were preoccupied with comets rather than planets. This is in contrast to later Indian astronomers such as Aryabhata, Varahamihira, Brahmagupta who remained silent about even the few comets they might have observed in their lifetime.

We may surmise that in ancient India comets should have been observed with some care, much before the systematic observation of planets started. The rudimentary nature of planet data given in Parasara's Samhita supports this inference. However, the only way we can explore this issue further is with reference to Vedic literature, which is not astronomical in the modern sense, but would have had a strong correlation with the then visible sky. This was a preview of what has been mentioned. As one goes into the rich ancient Indian texts and manuscripts, one will find an abundance of delightful historical and engaging references to the celestial objects that one wonders about even today: comets.



Amar Sharma Nikaya Observatory, Bangalore

¹ Bhadrabahu I, who died in 298 BCE, India, was a Jain monk often associated with one of Jainism's two principal sects, the Digambara (Sanskrit: 'Sky-clad' i.e., naked) one of the two principal sects of Jainism, whose male ascetics shun all property and

remain unclothed. The other sect is Shwetambara, Sanskrit: 'White-robed,' or 'White-clad' where the monks wear simple white garments.

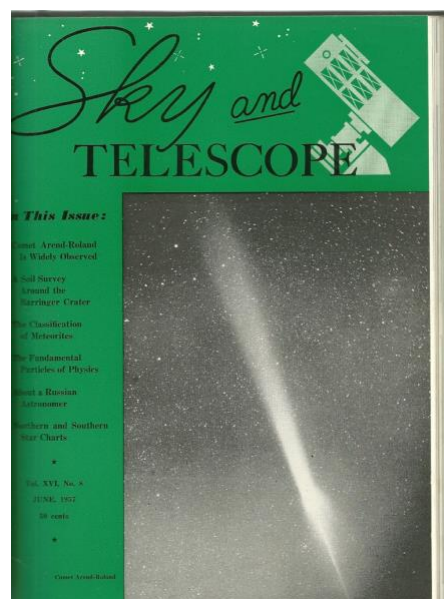
12 Alan McClure, an appreciation – Denis Buczynski



Alan demonstrating his equatorial and comet guiding technique

When I first became interested in astronomy in 1975 I tried to read all the popular literature available in my local library and anywhere else that I could find information. I saw my first copy of *Sky and Telescope* in the foyer of Jodrell Bank Radio Observatory in Cheshire. I was hooked and subscribed to S&T immediately. I was stunned to find a bound series (1955-64) of the magazine in a second-hand bookshop in Lancaster (my home town). I arranged with the book seller to purchase them by instalments.

The 13 volumes were priced at £60 (a large amount of money then). My interest in astronomy had been initiated by the media hype surrounding the upcoming apparition of Comet Kohoutek 1973 E1 and so I scoured the pages of those 13 volumes of S&T for any information about comets in them.



I was excited to find that there had been bright comets visible in the near past (1957) and that amateurs had photographed them. That became my ambition, to succeed at comet photography. No better example could be found than the excellent photographs taken by the American amateur astronomer Alan McClure. His photographs of comets were by far the best taken by any amateur that I could find.

Vol. XVI, No. 8	CONTENTS	JUNE, 1957
<p>COVER: Comet Arend-Roland, as it appeared from an altitude of about 7,000 feet in the mountains east of Los Angeles, California, on the evening of April 24th. The picture was taken by Alan McClure, a member of the Los Angeles Astronomical Society, with an Aero-Xenar lens of 320 millimeters focal length, aperture 80 millimeters. The camera was set on a small equatorial mounting with electric clock drive and slow motions, guided through a 3-inch refractor. The exposure was for 10 minutes, from 7:47 to 7:57 p.m. Pacific standard time. The enlargement from the 4-by-5-inch negative (emulsion Kodak 103a-E) is nearly 2½ times in this reproduction. (See page 364.)</p>		

I noticed that he seemed to be using equipment that was more commonly found in the hands of professional astronomers at international observatories. He made great efforts to locate and transport his equipment to suitable dark sky sites. At these sites he would set up and precisely polar align his hugely complicated equatorial mount and large camera lenses.



Alan's Transportable Observatory on Mount Pinos California, Stony Ridge Observatory Website²

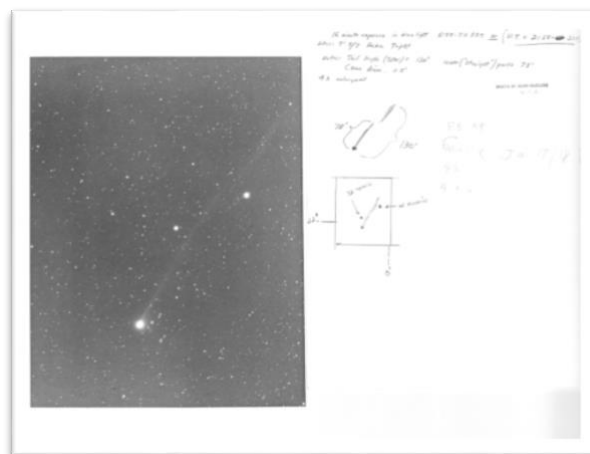
This painstaking work was essential for offset comet guiding. His results also stood out because he used specialist photographic emulsions that were specifically designed for use in astronomical photography (Kodak 103a series). This meant that he could make long exposures on films and plates without reciprocity failure becoming a limiting factor. He also selected the spectral response of the emulsions he used in order to match the colour of the comet being photographed.



C/1957 P1 1957-08-13 Alan McClure

He realised that a comet with a dust tail (which reflects sunlight) is red in colour, and he photographed them using 103aE a red sensitive emulsion. A comet with a blue ion tail would be imaged using 103Ao, a blue sensitive emulsion. His results were outstanding and were acknowledged and appreciated by fellow comet photographers and were used by professional astronomers researching comet morphologies. He was an inspiration to me and I set about finding comet photographers in the UK who also used similar techniques. I was lucky that through the BAA Comet Section I met and worked alongside Dr R.L Waterfield and Harold Ridley. Both men knew of Alan McClure and admired his work.

As a result of digitally archiving comet photographs which had been submitted to the BAA Comet Section in years gone by I discovered some comet photographs by Alan in our collection.



Comet 2P Encke (submitted to the BAA Comet Section)

This led me to think that a retrospective for The Comet's Tale would be appropriate. In looking for further information about Alan

² Courtesy of SRO Member, and current chair of the SRO Telescope Restoration Committee, John E Rogers who also attributes his early

interest to Alan. John obtained it from an auction of Alan's estate. Note the George Carroll mount.

McClure I came across the website of the Stony Ridge Observatory. This had a webpage dedicated to Alan which tells something of his life story in these words, "The well-known amateur astronomer and comet photographer, Alan McClure (1929-2005) was a member of Stony Ridge Observatory for a short time, serving on the SRO Executive Committee as an Expediter during the planning and construction phases between 1957 and 1959.

Alan's comet photography has been widely published in scientific papers and texts, and on magazine covers (Sky & Telescope). A number of his photographs were also published in the 3-volume classic Burnham's Celestial Handbook.



C/1956 R1-Arend-Roland-1957-04-2

Link to Stony Ridge Observatory Website:

<http://stony-ridge.org/AlanMcClure.html>

Orphaned at the age of seventeen, Alan inherited a sizable family fortune that allowed the teenager to not worry about the need of getting a job for the rest of his life.



Alan McClure courtesy of SRO Website

He took that opportunity to inspire a generation of devotees in astrophotography world-wide, including a number of us old-timers at Stony Ridge Observatory. After his death in 2005, Alan's entire remaining estate, which included his Pasadena condominium, was donated to the International Dark-Sky Association (IDA)." On June 2 2015 in an M.P.C. 943 the IAU named asteroid 32703 Alanmaclure after him.

M.P.C. 94392 2015 JUNE 2

(327030) Alanmaclure = 2004 RR₂₈₉

Discovered 2004 Sept. 12 at Stony Ridge.

Alan McClure (1929-2005) was an exceptional amateur astronomer who built a reputation of taking stunning photographic images of comets that graced the pages and covers of astronomy magazines and other publications during the 1950s-70s, inspiring a generation of astrophotographers.

I would like to thank Stephen Singer-Brewster the Stony Ridge Observatory Webmaster for allowing me to use material and photographs from their website.

(Stephen is the discoverer of Comet 105p Singer-Brewster currently visible in our skies)

Denis Buczynski Secretary

13 Michael Hendrie – Nick James



Mike Hendrie with his 25cm reflector. Note the micrometer on the guidescope

Mike Hendrie, Director of the Comet Section from 1977 to 1987, died on February 25 at the age of 87. Mike was an excellent observer and a very well respected Director. He also made some excellent H- α observations of the Sun which he sent to me when I was Solar Editor of TA. I visited him a few times at his observatory near Colchester. Mike was director of the Comet Section at a key time which included the return of 1P/Halley and he edited the BAA Memoir on this comet which was a huge undertaking.

Mike's time as director was well documented by the section newsletter, *Istimirant Stella*, which he edited with Andy Stephens and Stan Milbourn. The complete

run of this newsletter is available online here:

<https://britastro.org/node/10769>

Mike was awarded the Association's Goodacre medal in 1990 and he made many comet observations. His last recorded visual observation was of C/2006 P1 (McNaught) in January 2007.

Comet observing in Mike's day was very different to today. Mike did most of his Halley imaging using the 25cm reflector shown here. These days we are lucky enough to have mounts that track a comet's motion or we stack short frames with appropriate offsets. In Mike's day you took a single long exposure and offset guided using a micrometer or some other means. The micrometer was rotated to the appropriate PA and then used to offset at the correct rate. If you messed up you would not know until you developed the single film frame sometime later. An example of Mike's work is this image of C/1959 Y1 Burnham (aka 1959k) taken with another comet master Harold Ridley at Reggie Waterfield's observatory in Ascot on 1960 April 27.



C/1959 Y1 Burnham taken by Hendrie and Ridley in 1960 April 27 using Waterfield's 6-inch f/4.4 Cooke Lens, at Ascot.

The following report is Mike's report from JBAA vol 70, No. 7 (1960 September):

"You should really be hearing from Dr Waterfield now, but as he has had to be away for a fortnight he has very kindly arranged for Mr Ridley and myself to observe the comet from his observatory at Ascot. Before he left he obtained a photograph of the comet on the morning of April 23, but the sky was so poor that we could barely see the comet with the naked eye. However, this 14-minute exposure did show the tail over two degrees long.

The next morning when Mr Ridley and I made two exposures of 21 and 44 minutes duration, the sky was still far from suitable for comet photography. Despite this the second plate shows the narrow tail nearly 8 degrees long and the head some 15 minutes of arc in diameter. The first slide made from

this photograph shows about five degrees of tail, the remainder being too faint for reproduction.

After two cloudy nights it was unexpectedly clear on the night of April 26-27 when we secured another three plates in varying conditions. However, the last exposure of 70 minutes duration made just before twilight intervened this morning, was taken in good conditions with a sky that was both transparent and steady. The second slide now on the screen was made from this photograph. The tail on the negative extends to the edge of the plate, more than 10 degrees, and the coma is 25 minutes of arc across. The narrow tail can be seen on the slide: it is, I think, unusually narrow. It is nearly but not perfectly straight and broadens out a little some three degrees from the head.

These photographs were all taken with Dr Waterfield's 6-inch f/4.4 Cooke lens of about 26 inches focal length using whole plates. Kodak Oa-O blue sensitive plates were used. Owing to the comet's very rapid apparent motion, the guide-star had to be shifted relative to the micrometer's cross-wires every 15 seconds, during which interval the comet had moved through 6.65 seconds of arc. This was the greatest degree of trailing permissible if sharp photographs were to be obtained. The comet was too large and ill-defined to enable guiding to be done on the comet itself.

The original negatives show signs of a central condensation elongated along a line at right angles to the axis of the tail. This cannot be seen on the slide because the head has been over-exposed to show the tail, but I believe that Mr Alcock also noticed this and has a drawing that shows the same effect."

Comet imaging was really hard work in those days and not many people had the skills necessary to do it well. Mike was one of those people.

Mike leaves a widow, Pat, who is now 90. Richard McKim and John Vetterlein have

written an obituary which appears in the JBAA.

Nick James Director

14 Editor's Whimsy – Maria Mitchell and Comet 1847/T1

"We especially need imagination in science – it is not all mathematics nor logic, but it is somewhat beauty and poetry." Maria Mitchell



Maria Mitchell, Astromomer 1818-1889

2018 is the 200th anniversary of the birth of Maria Mitchell. She was born on the island of Nantucket, Massachusetts, on 1st August 1818, fortunately to a Quaker family, whose beliefs insisted upon a quality education for both sexes. Her father, William, taught her astronomy. He was a school teacher, later a banker and

also rated chronometers for the whaling community. Her mother, Lydia Colman, had been a librarian at Siasconset on Nantucket Island. She gave birth to ten children. Her ancestors had been one of the first families to flee puritan rule in the Massachusetts Bay Colony. They adopted Quakerism as it allowed for much more freedom in personal and business dealings.



William Mitchell's schoolhouse, the grey shingled building on the right, now joined by a fireproof wing to house the Maria Mitchell Science Library. (Collection of Nantucket Maria Mitchell Association).

It was a very bookish and studious family but filled with curiosity about the natural world. It is said that William Mitchell used to hang a glass globe in the sitting room, filled with water, which he used in experiments in the polarisation of light.

Mitchell and her father did astronomical observations together as she grew up. At 12 years old, Maria helped her father calculate the position of their home by observing a solar eclipse, counting the seconds of the eclipse, and pinpointing the longitude of their house. By 14, whaling sailors trusted her to do vital navigational computations for their long sea voyages and they entrusted her to rate their chronometers on her own. After her father's retirement from teaching, she was also supported by several mentors who donated money for her studies and even helped her to acquire a telescope in one instance. The details of it are not recorded unfortunately.



Maria Mitchell studying with her father William

At only 16 she was already a teacher's assistant and then she opened her own school in 1835 (at 17 years old) and welcomed students of all colours and creeds, something unheard of at that time; the local public school was still segregated. A year later she was offered the job of

librarian at the Nantucket Atheneum and remained there for 20 years. It allowed her to continue her studies and her observations without too much interference. She learned Latin and German, advanced mathematics and celestial mechanics, a much more romantic description of what we now call astrophysics. By this time her father had become chief cashier at the Pacific National Bank, still in Nantucket.



Pacific National Bank in the 1830s

Maria continued to study and to support her siblings too, as money was always short in the family. She even helped one of her sisters purchase a piano, although music was supposedly forbidden under strict Quaker rules and she was the one to brave her father's wrath when they brought it in to the house.

"Newton rolled up the cover of a book; he put a small glass at one end, and a large brain at the other - it was enough." Maria Mitchell

On 1st October 1847, after slipping away from a party, she went to observe from the roof of the Pacific National Bank in Nantucket's Main Street. This was when she discovered and charted the orbit of what became known as "Miss Mitchell's Comet, now designated Comet 1847 T1 at 22.30 hrs. (a non-periodic comet).



The telescope, believed to be a Dolland, with which Maria Mitchell and her father made their observations at her humble Quaker home on Nantucket (Maria Mitchell Museum, photograph by Maria Popova)

Maria herself was somewhat reticent to lay claim to this discovery, fearing that because of her gender the scientific community would reject her, but her father wrote to many influential friends including William C Bond at Harvard, then Director of the observatory at Harvard College, and this set off a chain of events in which the President of the College, Edward Everett, replied pointing out that she could claim a medal from the King of Denmark.

As the comet was too faint to be observed by the naked eye, she won the gold medal, specially instituted by Frederick VI of Denmark, for discovery of 'telescopic comets'. The only previous women to have ever discovered a comet were Caroline Herschel and Maria Margarethe Kirch. She almost did not receive it because her father and William Bond did not follow the proper procedure for alerting the Danish government, but a year after her discovery it was in her possession.

"This evening at half past ten Maria discovered a telescopic comet five degrees above Polaris." William Mitchell

She was subsequently elected as a member of the American Academy of Arts and Sciences. Her fame did not turn her head, in fact she complained that she found it irritating, and she continued to work and to study at the library. In 1854, she wrote: "My visitors...have been of the average sort. Four women have been delighted to make my acquaintance—three men have thought themselves in the presence of a superior being...One woman has opened a correspondence with me and several have told me that they knew friends of mine....I have become hardened to all."

Amongst other things, the US Nautical Almanac asked her to track Venus to help navigation at sea. She began saving hard as she wanted to travel to Europe and she finally made it, landing at Liverpool in 1857, as a chaperone for the daughter of another banker. She stopped at Liverpool Observatory, then went on to London to the Greenwich Observatory, (and meeting Sir George Airy) Sir Isaac Newton's tomb, and Cambridge Observatory. Later she stayed at the Collingwood Estate, the home of Sir John Herschel. She then travelled across Europe and the highlight of her travels was a visit to the Vatican Observatory, having obtained permission from Father Secchi; he of the canali fame, and three comets himself. Rome was her favourite destination of all.

She returned to the US in 1858, and a few years later (1861) after her mother's death she and her father moved to Lynn, Massachusetts. Then in 1865, she took the role that established her as the first woman

of American Astronomy – as one of the first professors at Vassar College.



Maria Mitchell's first astronomy class.

She was also named as the Director of the observatory. This gave her access to a 12 inch telescope at the observatory, the last one manufactured by the New Yorker Henry Fitz, and in between observations managed to co-found the Association for the Advancement of Women which improved the rights of women in the US in the late 1800s. Regrettably at the same time she discovered that she was being paid less than many of her younger, much less experienced colleagues. Some things never change. However, she insisted upon, and was given a salary increase.

At Vassar College she instigated 'dome parties' and insisted that student guests write poems on scraps of paper. One survives written by Antonia Maury.

Verses to the Vassar Dome

A low-built tower and olden

Dingy but dear to the sight

And they that dwell therein are wont

To watch the stars at night.

Maria took her students on Eclipse trips; to Burlington, Iowa in 1869 and to Denver,

Colorado in 1878. She was notorious for keeping them observing well past their curfew but became good friends with many of her students over the years, setting high standards, but with a fair and open manner. One even named her daughter after her.



The Old Observatory at Vassar College

"Mitchell published the findings of her students along with her own, sometimes in Silliman's Journal, the pioneering American scientific journal established at Yale in 1818 by Benjamin Silliman, and on other occasions in the Nantucket or Poughkeepsie papers," [wrote Vassar College](#) of her work. "She constructed an apparatus for making photographs of the sun and preserved the (original) plates of the photographs in a closet in the observatory — where they were rediscovered during a house cleaning in 1997, in place, and labelled in her own handwriting. Her students used the Morse telegraphy instrument invented and given to them by Samuel F. B. Morse, a neighbour of the college and one of its original trustees."

She returned again to Europe in 1873 and this time visited the St Petersburg Pulkovo Observatory. And she discovered that in Russia many women were studying science at the St Petersburg University. On her

way back, she visited the Glasgow School for Girls. Such a contrast. On speaking to the superintendent, she was told that they learned dancing, needlework, music and drawing and that teaching Latin and mathematics to girls was “bosh, according to the superintendent. This was what prompted her to co-found and support the Association for the Advancement of Women.

Mitchell retired in 1888, suffering ill health. A nephew, an architect, built her an observatory in Lynn, Massachusetts in the hopes that she would soon be well enough to resume observing. But on 28th June 1889 she died. She is buried in Nantucket in the cemetery at Prospect Hill next to her mother and father.

An asteroid, 1455 Mitchella, discovered in 1937, was named after her, as was a lunar crater.

The Maria Mitchell Association, which continues her commitment to education, was established by various friends, former pupils, and family in 1902. Her old family house in Vestal Street was the first site of what is now an association, “dedicated not only to preserving Maria’s personal legacy, but also to educating all its visitors about the flora and fauna of Nantucket Island and the wonders of the skies which Maria dedicated so much of her life to observing.

Maria Mitchell Association staff and visitors alike bring Maria’s words to life:

“We have a hunger of the mind which asks for knowledge of all around us, and the more we gain, the more is our desire; the more we see, the more we are capable of seeing.”

With thanks to the [Maria Mitchell Association](#).



Janice McClean Editor

Refs:

American Physical Society APS News October 2006
Vol 15 number 9

Maria Mitchell Association Website -
<https://www.mariamitchell.org/>

https://en.wikipedia.org/wiki/Maria_Mitchell

<https://www.brainpickings.org/2013/10/01/october-1-1847-miss-mitchells-comet/>

<http://vcencyclopedia.vassar.edu/faculty/original-faculty/maria-mitchell1.html>

15 Comet Section Contacts

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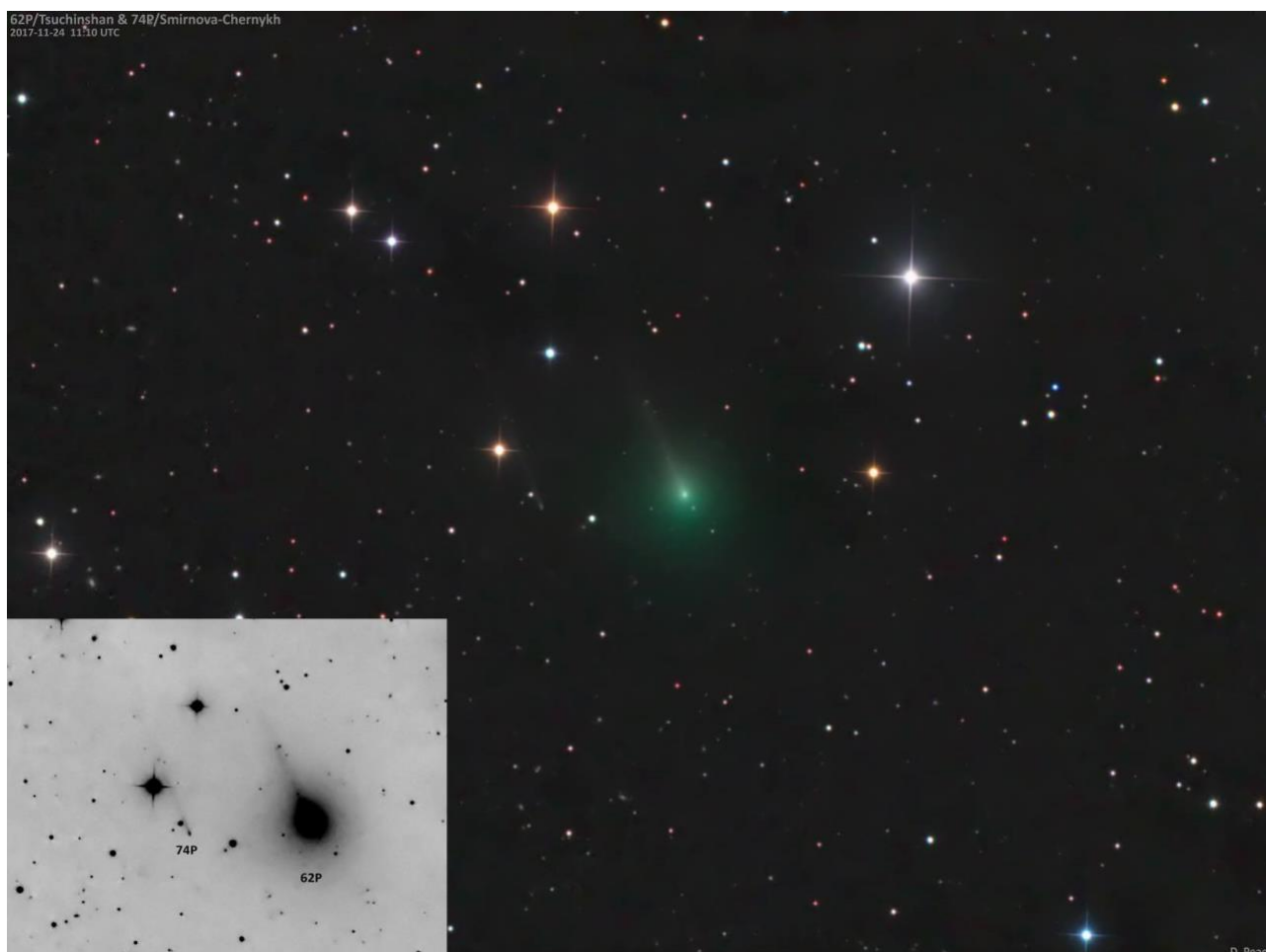
16 Picture Gallery

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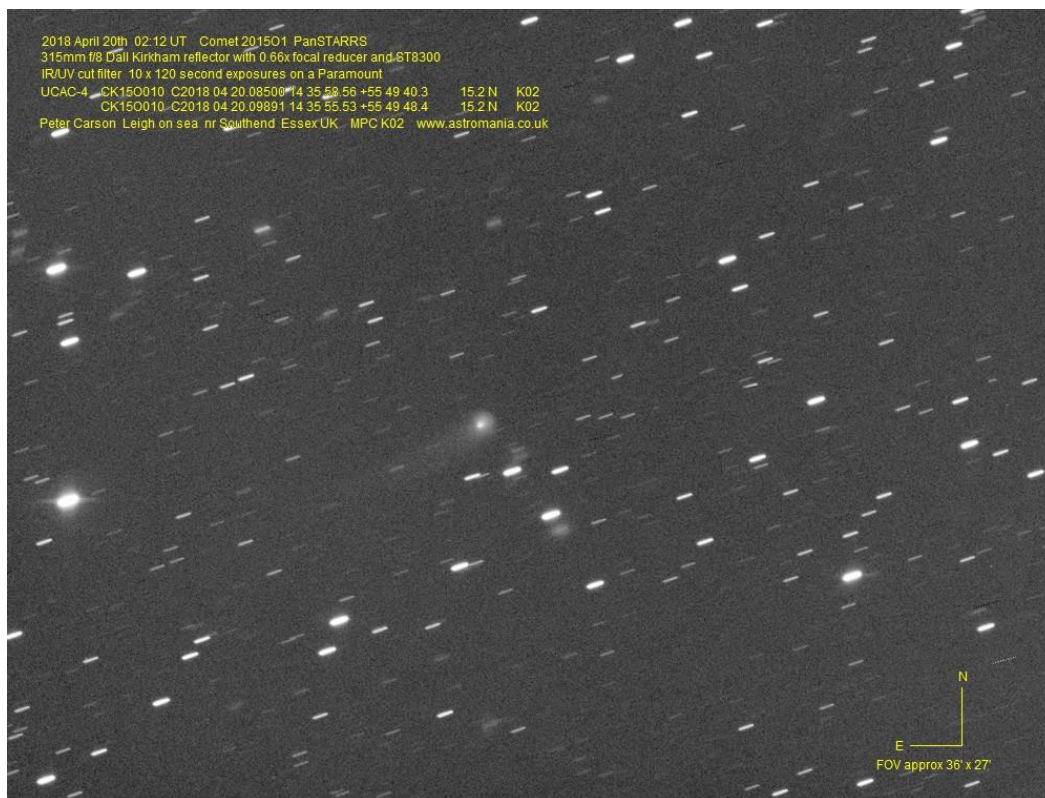
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https://www.britastro.org/cometobs/2016r2/2016r2_20171214_dpeach.html

62p 20171124 Damian Peach



C/2015o1 20180420 Peter Carson



C/2015o1 20180424 Adriano Valvasori

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 1275
 1093
 911
 728
 546
 364
 182
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10020 60121 35070

Radius km.

Generated by Waf[rho]t http://cara.uai.it

C/2015 O1 PanSTARRS
 DATE OBS: 2018/04/24UT20:04 start

TEL: Reflector Newton 400 mm mm f/5
 CCD: Moravian G2-1800
 EXP: L 45x80s bin 2x2
 FILTER: Rc
 Scale: 1.84 "/px
 Observer: Adriano Valvasori, Catia Caselli (Italy)
 Site: Montepastore (Bologna-Italy) MPC L19

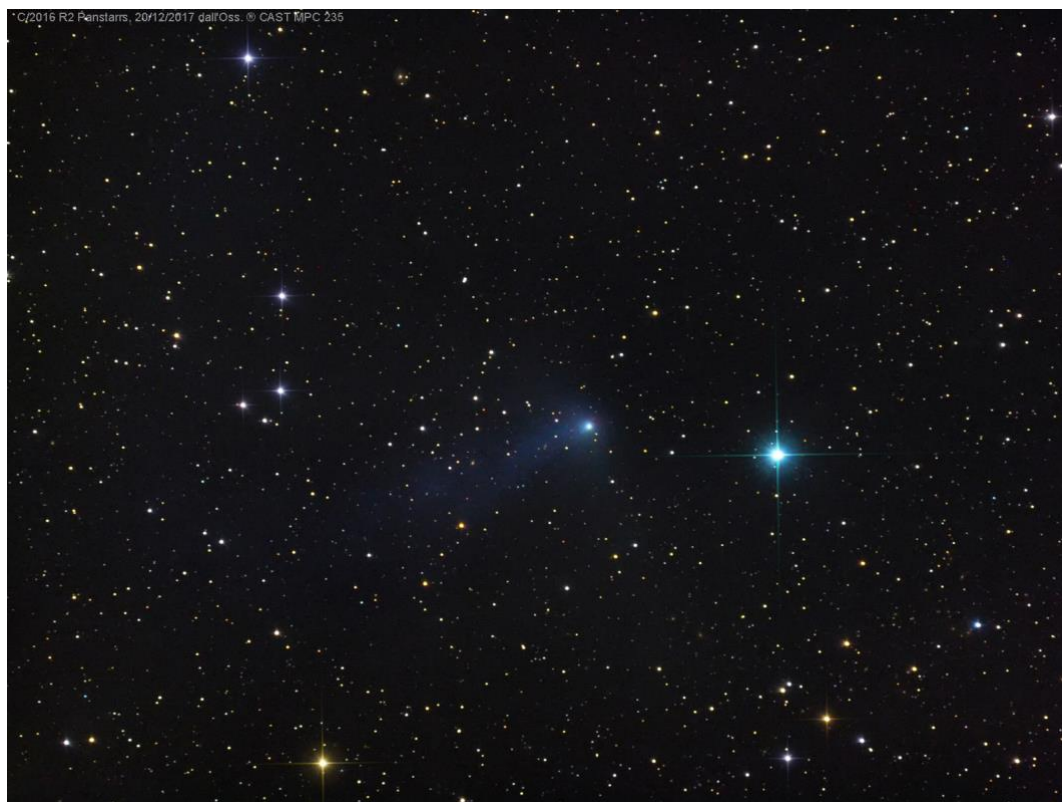
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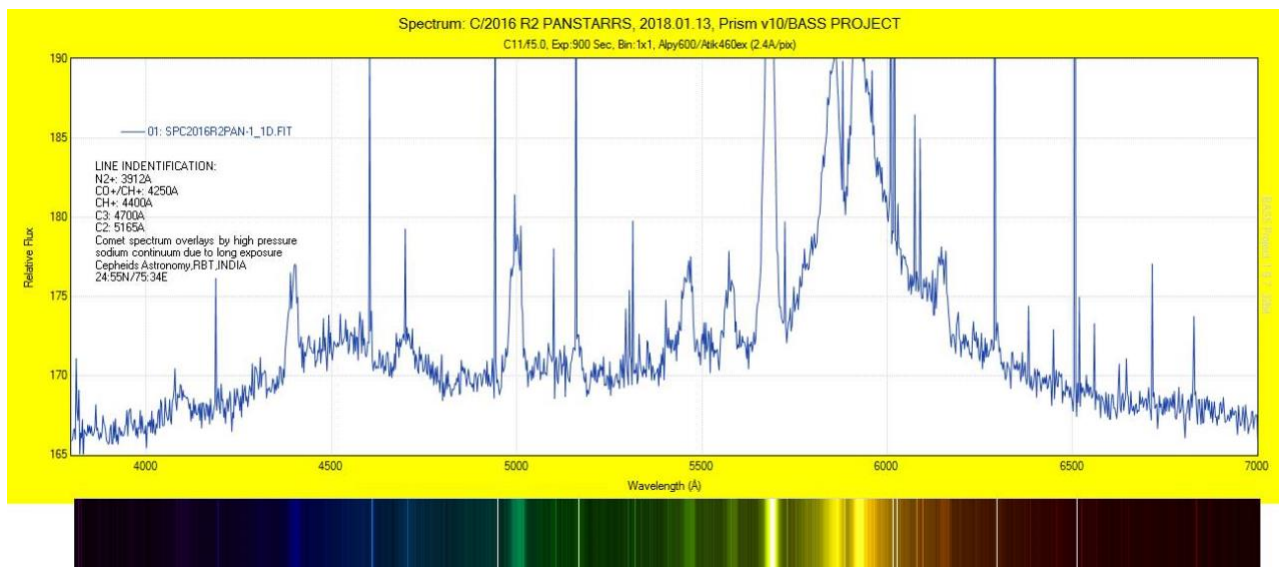
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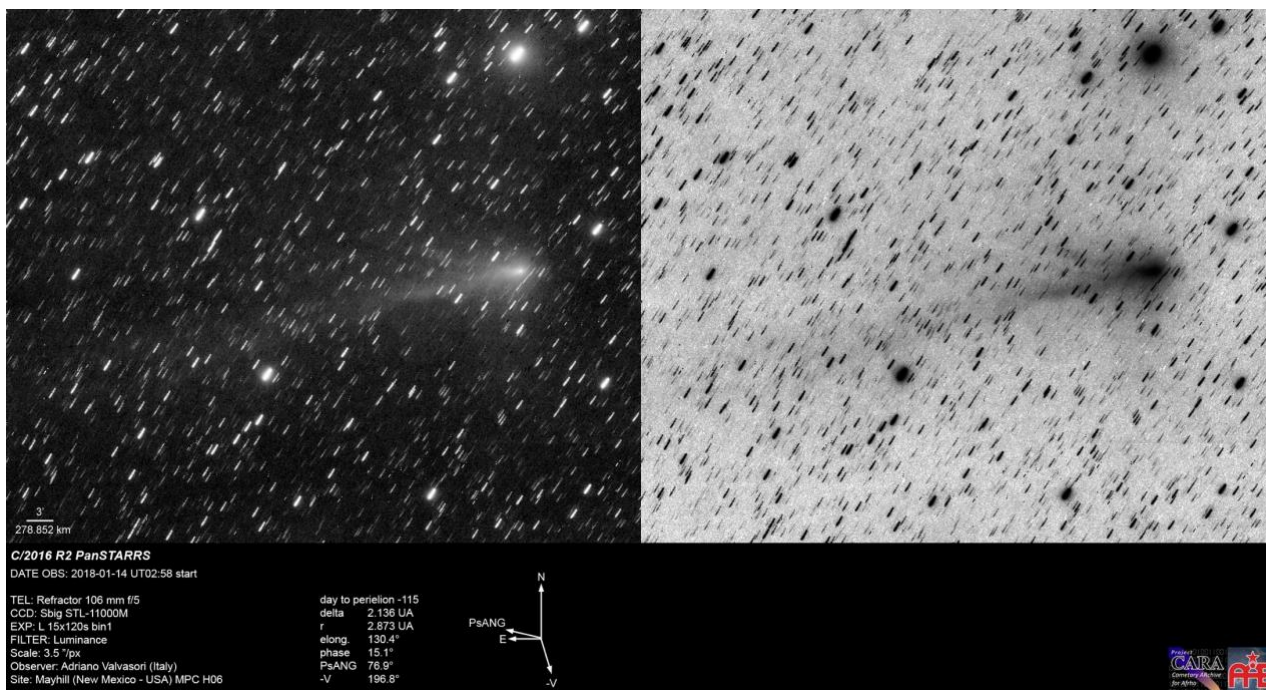
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C/2016r2 20180124 Damian Peach



C/2016r2 20180204 José J Chambó Bris**C/2017o1 20170920 Mike Olason**

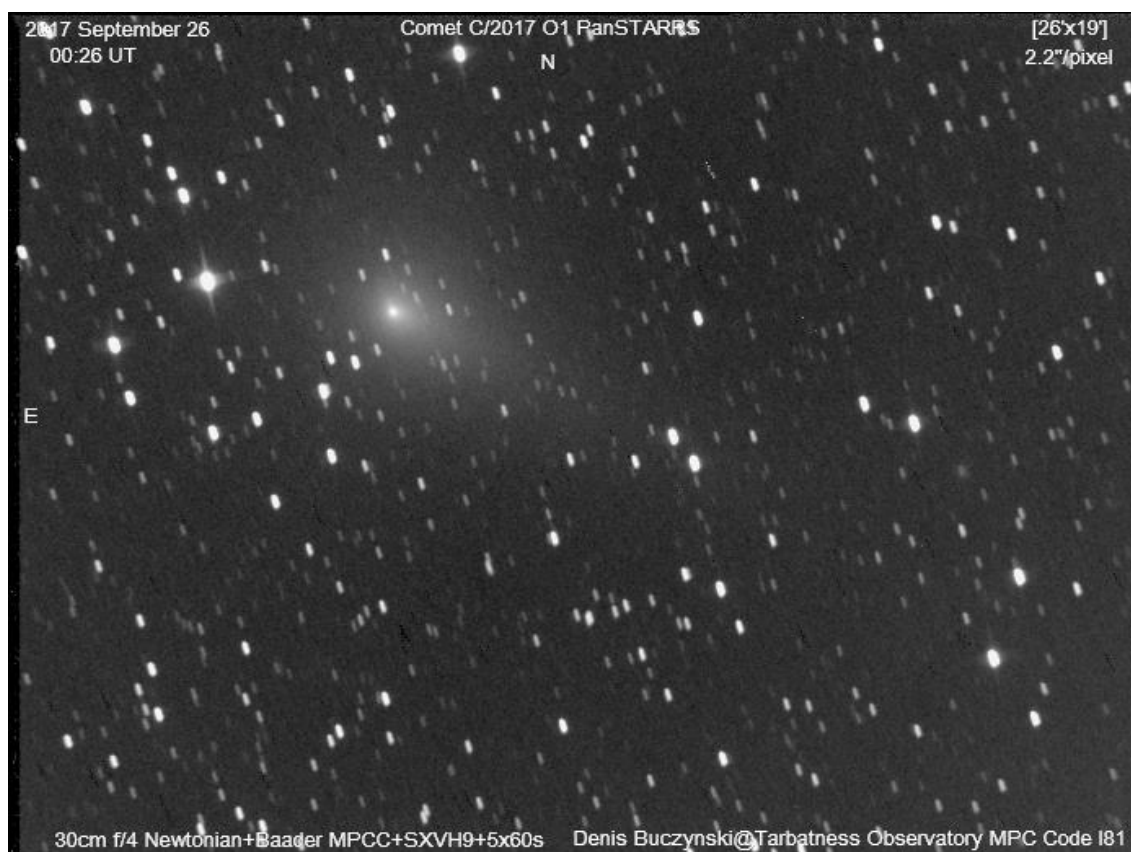
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Mike Olason, Denver Colorado

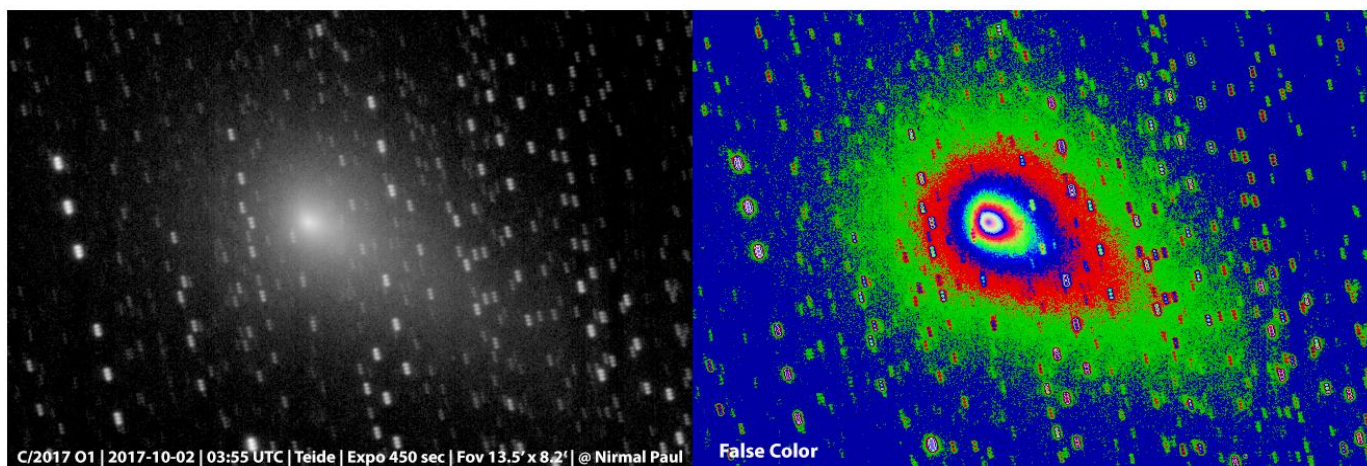
C/2017 o1 20170724 Justin Tilbrook

Object. C/2017 O1
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Time of observation. 20:04 UT
Observers Name. Tilbrook, Justin
Location of observation. Obs code D86,
Penwortham South Australia.
Telescope. 200mm F/4 newt.
Camera. Un-modded Canon 1100D
Filter. None.
Exposure time, 3 x 300 sec ISO 1600
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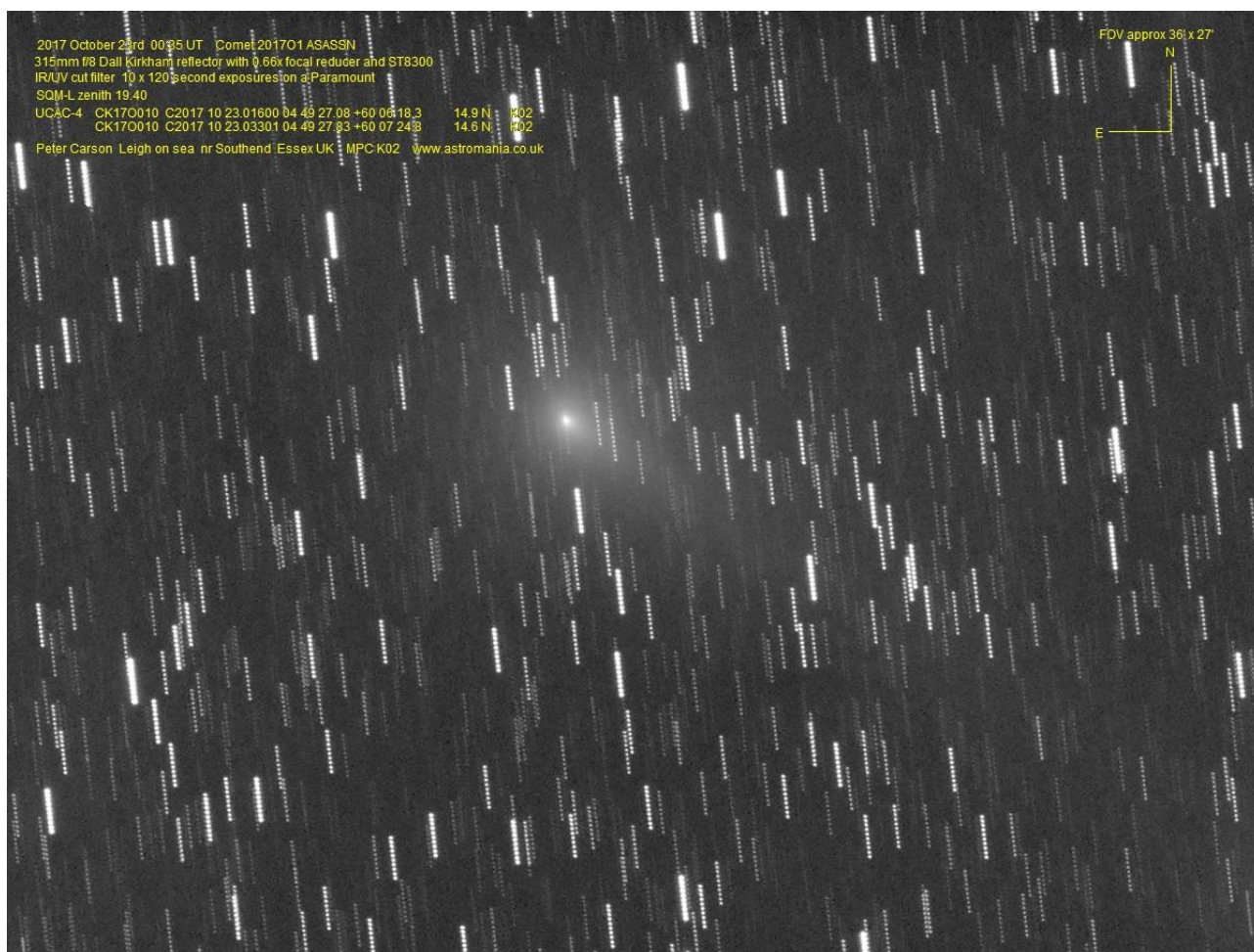


C/2017o1 20170925 José J Chambó Bris**C/2017o1 20170926 Denis Buczynski**

C/2017o1 20171002 Nirmal Paul



C/2017o1 20171023 Peter Carson



C/2017t1 20171227 Denis Buczynski**C/2016 N6 May 11 12"/4 RGB210/210/210sec L-12x120 Michael Jaeger**

C/2016 R2 2017 Dec 18 20.36 UT L-6x4min blue RGB/5/5/5 min 12"/4 asi 1600
Copyright: Michael Jaeger

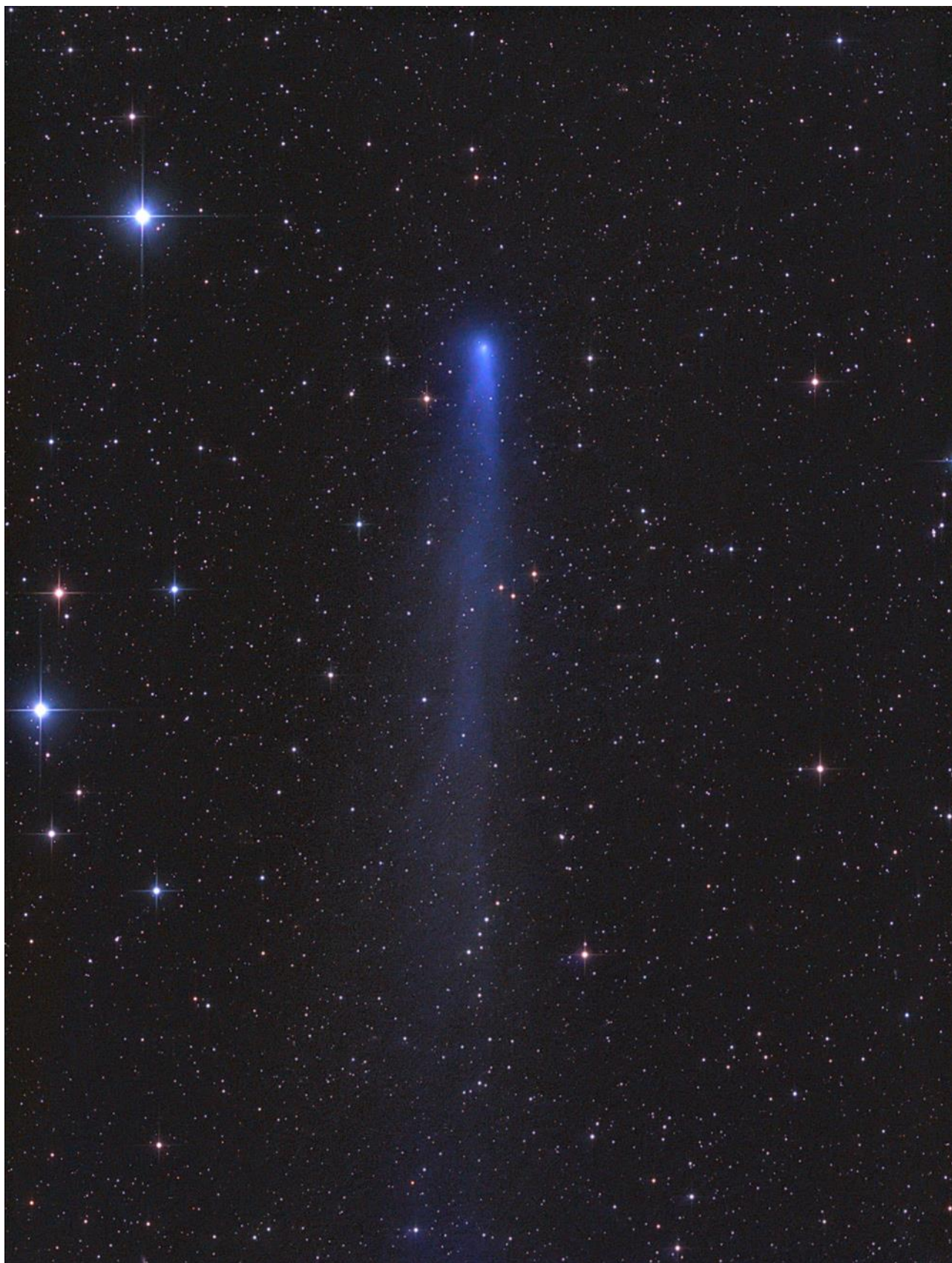


Comet C/2016 R2 Panstarrs 10 01 2018 Date: 10 01 2018 UT 20h26m Location: Farm Tivoli, Namibia SW-Africa Telescope: ASA 12" f 3.6 Camera: FLI PL 16200 Mount: ASA DDM85 Exposure time: RGB 32/12/12 min.

Copyright Gerald Rhemann



Object: Comet C/2016 R2 Panstarrs 08 03 2018 Date: 08 03 2018 UT 18h30m Location: Eichgraben, Lower Austria Telescope: ASA 12" f 3.6 Camera: ZWO ASI 16000 MMC Mount: ASA DDM85 Exposure time: BRGB 39/6/6/6 min. Copyright Gerald Rhemann



**Comet C/2016 R2 (PanSTARRS) 50 min exposure time with Hyperstar C14 and Sony A7s ISO4000 in 30 sec subframes. 2018-03-11 21h UT Tenerife 1180 m altitude.
Copyright: Fritz Hemmerich**



**Object: Comet C/2017 O1 ASASSN1 and NGC 1597 02 10 2017 Date: 02 10 2017 UT
01h52m Location: Eichgraben, Lower Austria Telescope: ASA Astrograph 12"f3.6
Camera: FLI PL 16200 Mount: ASA DDM85 Exposure time: Mosaic of 4 panels LRGB
3/4/4/4 min. each. Copyright: Gerald Rhemann**



**Comet C2017 01 ASASSN . (1) RASA 11" with ASI 1600 mono L-filter (2) Hyperstar 14"
with ATIK 490 colour L-filter ASA mount with pointing file. 2017-10-21 6:00 - 7:00h UT
Tenerife 1180 m a.s.l.
Copyright: Fritz Hemmerich**



21P 20180603 Peter Carson