



*Painting of an instrument of Jean Dominique Cassini for observation of the comet of 1652. On the walls of the town where he was born, Perinaldo (Liguria, Italy). The text is Tool designed for distance measurement for the observation of the comet of 1652*

# THE COMET'S TALE

## Comet Section – British Astronomical Association

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[britastro.org/comet](http://britastro.org/comet)



*C/2022 E3(ZTF). 2023 Jan 24, 03:32. Esprit 100ED Pro, ASI294MC. 5x120s. Mazin Younis*

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## 1 From the Director:

**Nick James**

Time flies and the northern hemisphere summer has arrived again so it must be time for a new edition of the Comet's Tale. My thanks to the editor, Janice McClean, who has done a splendid job of pulling together all of your material and turning it into the publication that you are reading now. My thanks also to Denis Buczynski for the work that he does in getting people to write for us. I know how much effort is involved in writing articles, so many thanks to all of our contributors. If you are reading this and think that you would like to submit an article please get in touch. You have a year until the next Comet's Tale comes out but that time will be gone before you know it!

It is almost time for our section meeting, the first since the 2019 event that we held in York. This time we have another fantastic venue. In conjunction with the Flamsteed Astronomy Society the meeting will be taking place at the National Maritime Museum in the heart of the Maritime Greenwich World Heritage Site and only a short walk from the Royal Observatory, MPC code 000, where precision astronomy and timekeeping began. The meeting will take place on Saturday, July 8<sup>th</sup> and I hope to see many of you there. To register please visit the website:

<https://britastro.org/event/comet-section-meeting-3>



*National Maritime Museum, Greenwich, UK*

One of the speakers at this meeting will be Helen Usher. Helen is a part-time PhD student at the Open University, looking at how amateur astronomers and schools can effectively contribute to comet missions and observing campaigns. She leads the Comet Chasers project which has linked schools in South Wales and beyond with amateur and professional astronomers to give kids a taste of what doing real cometary science is like. They have access to large (2.0-m, 1.0-m and 0.4m) telescopes in the LCO network through the Faulkes Telescope Project. Schools have been involved in observing comet 67P/Churyumov-Gerasimenko to complement observations made by the Rosetta spacecraft, and newly discovered main belt comets linked to the LOOK Project. They are now doing a lot of work on the unusual Centaur comet 29P/Schwassmann-Wachmann and are contributing to the section's Mission 29P project.



*The Stefanik Observatory, Prague*

Helen was also involved in the organisation of the Pro-Am Comet Workshop which took place at the Stefanik Observatory in the beautiful city of Prague last summer. This meeting was sponsored by Europlanet, the BAA, Planetum Prague, and the Czech cometary community SMPH and it was well

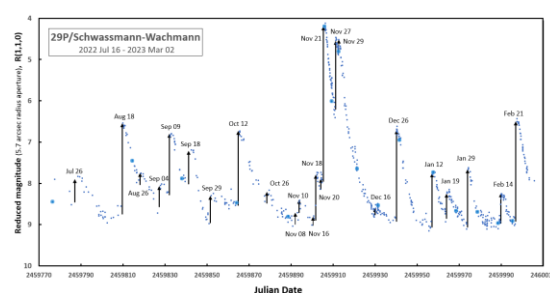
attended by professional and amateur astronomers from across Europe and further afield. One of the outcomes of this meeting was a suggestion that amateurs should use Sloan  $r'$  and  $g'$  filters when doing photometry on comets. A subsequent RAS grant application was successful in securing funding and a number of observers have now been equipped with suitable filters. We are currently in the process of devising a procedure that can be used to process these filtered images using available photometric catalogues and which will be suitable for most amateurs to use. I hope that we will have time to discuss this at the July 8<sup>th</sup> meeting.

I mentioned 29P and this has been an exciting year with the comet high in the sky for those of us in the northern hemisphere. 29P is a large (approx. 60km diameter) Centaur comet in a roughly circular orbit around 6 au from the Sun. It can fade to 17<sup>th</sup> magnitude but has frequent outbursts ranging from small (a few tenths of a magnitude) to very large (more than five magnitudes). Observers submit their photometry and images to Richard Miles who runs the Mission 29P project for the section. Richard probably knows this comet better than anyone else on the planet and, with his help, our observations are being turned into real science. 29P has now disappeared into the evening twilight and won't be observable over the summer but it will emerge into the morning sky in the autumn and we will be able to start following it again. The lightcurve of the comet is fascinating as you can see from the picture below.

In addition to the photometry, precision astrometry by Richard and others has improved our knowledge of the comet's orbit so that it is now possible to accurately predict stellar occultations. Five of these have been observed leading to improvements in our knowledge of the

position, size and shape of the nucleus. The most recent occultation track passed over north west Europe and Malcolm Jennings in South London recorded the first ever positive observation of a cometary occultation from the UK. Richard has also set up a mailing list for observers of this comet. For more details see:

[https://britastro.org/section\\_information/comet-section-overview/mission-29p-2](https://britastro.org/section_information/comet-section-overview/mission-29p-2)



**29P\_2022-23\_reducedmag-8.**

We had a reasonably bright comet at the start of the year. C/2022 E3 (ZTF) was discovered by the Zwicky Transient Facility (ZTF) on 2022 March 2 using the 1.2-m, f/2.4 Schmidt at Mount Palomar and, at the time of discovery, it was 4.3 au from the Sun and a 17<sup>th</sup> magnitude object in Aquila. It was quickly determined that the comet would make a close approach to the Earth in 2023 February and it looked as if it would be a nice, possibly naked-eye comet at the time.

Throughout 2022 the comet brightened slowly and by early 2023 January it was a naked-eye object from dark sites and a fine visual object in binoculars. The ion tail was very active throughout 2022 December and 2023 January and several disconnection events were observed. In late January the comet was moving rapidly across the sky under the pole and showed a lot of detail to visual observers. The Earth crossed the comet's orbital plane on the morning of 2023 January 23 at 02h UT and images taken around January 23 show an almost three-dimensional effect as we see the recently released dust in front of the



spherical, green coma and the older dust behind it.

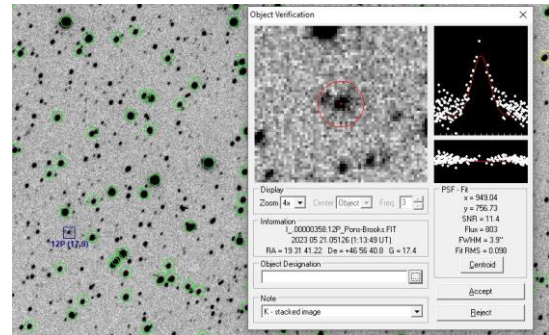


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Gravitational perturbations during its pass through the inner Solar System have changed the orbital eccentricity to slightly greater than one on the outbound path so it looks as if this was the comet's last visit to the solar neighbourhood and we won't see it again but it was a nice object for a while and we have around 850 images of it in our archive. An initial report on this comet appeared in the 2023 February Journal of the BAA.

At present there aren't any bright comets around but there are a few interesting objects visible from the northern hemisphere. C/2019 T4 (ATLAS) has been around for a while but it is now around magnitude 13 and C/2023 E1 (ZTF) is showing a nice extended coma and is also around 13<sup>th</sup> magnitude.

In terms of prospects for the coming year, the brightest reliable comet in 2024 is likely to be 12P/Pons-Brooks. Currently, this comet is high in the sky in the morning for northern observers and I recorded it as an unremarkable 17<sup>th</sup> magnitude object on May 20. It should become a naked-eye object next April.



12p

One discovery that raised a lot of interest earlier in the year was C/2023 A3 (Tsuchinshan-ATLAS). This may become a bright object in October next year but it is far too early to tell. The comet was detected by the ATLAS 0.5-m, f/2 Schmidt at Southerland, South Africa on Feb 22. At the time it was an 18<sup>th</sup> magnitude, apparently asteroidal object in Serpens.

The MPC linked it to a previous object that had been reported by the Purple Mountain Observatory XuYi station in China on 2023 January 9 hence the name Tsuchinshan-ATLAS. At discovery it was 7.5 au from the Sun but it will come to a perihelion distance of only 0.39 au in late 2024 September. This close perihelion distance means that it could become quite bright. It will spend 2023 moving slowly through Serpens, Virgo and Libra staying within a few degrees of the celestial equator.

Around perihelion, even if it is bright, it will be at small solar elongations and so will only be visible in a bright sky. The best prospects, if it survives, are after perihelion as it emerges into the evening twilight in 2024 October but it has a long journey ahead of it and, being a comet, it is unlikely to do what we expect. My latest observation of it on May 20<sup>th</sup> shows it as a star-like object of magnitude 16.7. With the current MPC magnitude parameters it might reach negative magnitudes in 2024 September but the elongation will be very small. In reality we don't really know what it will do since it has only been under





# **BAA Comet Section Meeting National Maritime Museum, Greenwich Saturday, July 8th, 2023**

**Join us for a day of comet-related astronomy at this fantastic venue. Our speakers include Prof. Alan Fitzsimmons, Mark Kidger, John Mason, Richard Miles, Helen Usher, Thomas Lehmann, Robin Leadbeater and Jonathan Shanklin. The meeting will include a planetarium show.**



**This meeting has been arranged in conjunction with the Flamsteed Astronomy Society and the NMM and it is open to members and non-members. Just visit the website to register.**

**[britastro.org/event/comet-section-meeting-3](https://britastro.org/event/comet-section-meeting-3)**

## 2 Q&A with Michael S.P. Kelley, Comet Scientist with the ZTF Survey Team

### Denis Buczynski



**Michael Kelley**

In November 2022 I contacted Michael Kelley to ask him about aspects of his involvement in observing comets as part of the ZTF (Zwicky Transient Facility). His fascinating answer promoted me to ask him further questions for reproduction in *The Comet's Tale*, to which he kindly agreed.

*You say that you have your own software to examine all known comets, does that mean that you measure every comet that ZTF captures on a nightly basis using your own software. Do you report these results and where? Also, is there an online image archive of these cometary detections and photometry results? We are very interested in your operations and procedures.*

I have software that finds comets by ephemeris position and I am tracking approximately all known comets that can be easily observed (those with high ephemeris errors or very faint apparent magnitudes will not be in my list). My software is primarily designed for outburst discovery, and we described our first working version at a conference a few years ago:

[http://www.aspbbooks.org/a/volumes/article\\_details/?paper\\_id=39288](http://www.aspbbooks.org/a/volumes/article_details/?paper_id=39288)

When I need to report precise photometry or astrometry, I usually analyse the data on a case-by-case basis, either to re-measure the results or to verify the pipeline's output. The ZTF surveys are split between public and proprietary projects. The ZTF project provides immediate access to the public data through the ZTF transient alert stream. The alert stream is designed for point sources, so any asteroid that doesn't move too much in a 30s exposure should be there, and some of the alert stream brokers support moving target searches (although, I'm not very familiar with them). Archival data are made available by periodic data releases, currently every two months. Anyone can use the IRSA tool to search for their favourite moving targets: <https://irsa.ipac.caltech.edu/applications/ztf/>

With some limitations, members of the ZTF Partnership can immediately examine public survey data for the purposes of solar system science (and can always examine the proprietary ZTF Partnership data). The main limitations are that discoveries should be promptly reported, and that science analysis is not allowed on the public data unless those data have



otherwise been made public, e.g., via the MPC, telegrams, or data releases. This enables ZTF's NEO discovery projects, and my outburst discovery project. I strive to promptly report every 1-mag or larger outburst, but I usually look for confirmation before sending out the telegram.

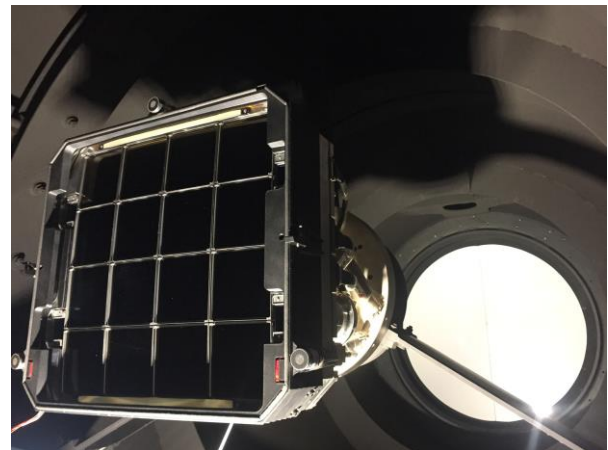


*Oschin Telescope*

I have collected a large amount of cometary photometry under this project. Because I am working with nominally proprietary data, I do need to follow ZTF Partnership publication procedures, even after that data becomes public. This means I cannot share my data until they are formally published. We are working to review the full data set so that we can make that happen. It is a really great data set and I am eager to share the data, but there is still a lot of work to do.

*You are a comet scientist (Principal Research Scientist University of Maryland Department of Astronomy) who works with the ZTF survey. Can you give us quick insight into how the ZTF survey operates in the discovery and identification of comets?*

The ZTF is a wide-field time-domain observing system using the 1.2-m Samuel Oschin Schmidt telescope at Palomar Observatory. ZTF's camera has sixteen 6k x 6k CCDs (576 megapixels), and fills the telescope's prime focus field-of-view for the first time since photographic plates were used (Bellm et al. 2019, PASP 131, 018002). With 30-s exposure times, the system can observe 3760 deg<sup>2</sup> per hour to a 5-sigma point source r-band limit of 20.5 mag. The observation scheduler robotically executes several concurrent surveys, and our Twilight Survey is particularly tuned for the discovery of low-solar elongation solar system objects, using 11% of ZTF's total observing time.



*ZTF Camera*

There are two independent components to the discovery of comets: ZMODE and Tails. ZMODE (ZTF's Moving Object Discovery Engine) is a more typical tracklet-based moving object detection algorithm matching ZTF's capabilities (Masci et al. 2019, PASP 131, 018003). ZMODE tends to perform better with point sources and short streaks, so machine learning techniques are used to enhance ZTF's

discovery capabilities with two programs: DeepStreaks and Tails. DeepStreaks is designed for fast moving near-Earth asteroids and Tails for comets. Both are deep-learning-based systems, capable of detecting objects in single images and near-real time. After an observation is made, Tails is given a data set that consists of the image being tested, the static sky reference image, and the difference of the two. Tails has a 99% positive recovery rate, and a 0.01% false-positive rate (Duev et al. 2021, AJ 161, 218). On 2020 October 7, Tails identified a possible cometary object that ultimately proved to be a new discovery and what we think is the first "AI"-assisted comet discovery: C/2020 T2 (Palomar).

*How long will the funding last for ZTF survey to be operating into the future. Will new technology overtake and replace the current operation? Will we still be seeing new ZTF comets being discovered in 20 years or so?*

Operations are currently funded through to 2023 September 30 and additional funding requests have been made. But beyond extending the present-day surveys, other plans are being considered that could dramatically change ZTF operations by changing cadence and filter selection. At this early stage, the project leadership seems interested in considering any scientifically transformative approach appropriate for the telescope.

*What sparked your interest into the research of comets, and were you an amateur astronomer before you became a comet scientist in your professional academic career?*

My dad was an amateur astronomer and we frequented our local astronomy club, the Quad Cities Astronomical Society (Iowa/Illinois, USA). We would attend star parties with his homemade refractor and later a commercial 6" Newtonian (easier to

travel with!). Besides the usual Galactic and extra-galactic targets, I recall many solar system events: my first sightings of Mercury and Neptune, Voyager 2's flyby of Neptune, the annular solar eclipse of 1994, comet Halley, comet Shoemaker-Levy 9's impact scars on Jupiter, and, of course, comets Hale-Bopp and Hyakutake. In high school, I even ordered a CD-ROM from NASA with data from Voyager 2's flyby of Jupiter. All this led me to consider an undergraduate degree in astronomy.

*Which areas of the ZTF survey are you personally involved on a regular basis.*

I am a co-lead of the ZTF Solar System Working Group. Members of our group are studying comets, asteroids (near-Earth and main-belt), and Centaurs. My role is to facilitate communication within our group and between our group and the rest of the ZTF Partnership.

*Outbursting comets seem to feature heavily in your personal webpage. I understand that you have developed your own software to identify and follow up the development of these objects. Can you explain what that involves?*

I have a cometary outburst discovery program with ZTF. ZTF's transient pipeline is tuned for point sources and so only a few cometary objects end up in the telescope's transient alert stream. In order to find cometary outbursts, I wrote a program I call ZChecker. ZChecker finds possible observations of a targeted list of comets, downloads the data from ZTF's archive, and processes them. The result is photometry, a combined image of the target for that night, and a temporally filtered image showing the differences in morphology from observations taken in the last two weeks. Outbursts show up in both the photometry (as a brightening of the comet) and the morphology (as additional material in the image). We look for new

outbursts on a daily basis, and report any significant events after confirmation. Currently, we have found about 170 outbursts. About 70 of those are from 29P/Schwassmann-Wachmann. Most comets just show one or two outbursts in the data set.

*Are there opportunities for amateur astronomers i.e. citizen science to be involved in the ZTF comet programmes?*

Absolutely. In the past, I've received great help from amateurs who have discovered outbursts before we have with ZTF. ZTF's cadence is about 1 every 2 to 4 days, depending on location in the sky, and it doesn't cover solar elongations between 55 and 90 degrees very well. Aside from discovery, outbursts evolve on hour timescales. So, if ZTF only observes a comet every few days, then we can end up with a large uncertainty in the onset time, which has consequences on our ability to derive the dust dynamics. Having additional photometry from other sources, whether in outburst or not, helps reduce that uncertainty. I recommend anyone interested to watch the comets that are closest to Earth. Based on our analysis, they are the ones where outbursts are most likely to be seen.



*21p-ztf-r-20180725 . The image is 0.8x0.5 deg across. North is approximately up and east to the left.*

*The ZTF survey telescope is limited in coverage at low altitudes and in areas close the twilight sky in the evening and morning,*

*does this give an opportunity for comet imagers to monitor comets (outbursting and disintegrating) and even discover new comets?*

It does. As I mentioned above, ZTF has limited coverage between 55 and 90 degrees solar elongation, and our Twilight Survey approximately covers 35 to 50 degrees, so that leaves another gap interior to 35 degrees, within which some amateur observations are still possible. The ZTF scheduler does prefer lower airmasses, too. Only about 4% of the data is taken at airmasses  $> 2.2$ . Of course, we have our limitations in Declination, and I think we are only observing north of  $-31$  degrees.

*The BAA Comet Section runs a monitoring programme on comet 29P (MISSION 29P) coordinated by Dr Richard Miles. Does the ZTF survey pick up the multiple outbursts of this comet that we observe? If so is there a database of these outburst observations?*

We have identified about 70 outbursts of this comet, so MISSION 29P has a much more extensive list, being able to observe over a broader set of sky conditions and with a higher temporal resolution. I plan to publish our full outburst study, which includes the 29P events, within the next year.

*Does the ZTF survey specifically make follow up observations of disintegrating comets?*

That is an interesting use case, but not one that we have tried. Generally, we wait for the survey to automatically observe any particular objects of interest and save targeted observations for other telescopes. There may be a disintegrated comet or two in ZTF's public archive, if anyone wants to go hunting for them. One challenge with this project is the short integration time. I've looked for known dust trails with ZTF, but the images are too shallow.

*Some of the new comets that have been picked up in the major surveys that are operated today have comets that are named after the researcher that discovered them rather than the survey, can you explain the procedure. Also have you had/or want a comet named Kelley? Would this be important to you personally or would you consider it a by-product of your academic career?*

I'm not familiar with the process, but only one of the ZTF discoveries were named after the discoverer, and in that case, there was more data than just ZTF contributing to the discovery. It is not something that I've put special effort into, but a comet Kelley would certainly be exciting!

Website of the ZTF Samuel Oschin Schmidt telescope.

<https://sites.astro.caltech.edu/palomar/media/oschinmedia.html>



***Denis Buczynski***  
***Comet Section Secretary***



### 3 Comet 153P/Ikeya-Zhang

Neil Norman



[153p 20020404 Gerald Rhemann - The encounter with Galaxy M31](#)

Japanese amateur astronomer Kaoru Ikeya of Mori Shuchi Shizuoka, Japan, was observing a part of the sky in Cetus on 2002 February 1 as part of his routine search for comets. This is a hobby he has indulged in since 1963, when he made his first discovery aged just 20 with his homemade 25-cm reflector (using a power of x39).



*Kaoru Ikeya*

Thirty-nine years later he came upon a misty patch of light shining dimly at magnitude 9 and with a faint condensation and coma some 2' in diameter. Ikeya is famous for being the first person to discover the "Great" sungrazing comet C/1965 S1 (Ikeya-Seki), which became one of the brightest comets ever seen and was visible in broad daylight. Little did he know that his new comet was to be something of a record breaker itself. About an hour and a half after Ikeya's observation, Chinese amateur astronomer Daqing Zhang, Kaifeng, China, using a 20-cm reflector, also stumbled upon the new celestial visitor and he described it as magnitude 8.5 with a 3' coma.

The comet was bright and well within the grasp of even small telescopes and large binoculars. At the time of its discovery, it was also just within 1 au of the Sun and 1.2 au of the Earth and it had an elongation of some 45 degrees from the Sun.



*Daqing Zhang*

As with all comet discoveries, an orbit is calculated quickly to determine the prospects for the new object and on February 2, two orbits were independently calculated by S. Nakano (Japan) and Dr Brian Marsden (Central Bureau of Astronomical Telegrams). Both men agreed a perihelion date of March 7-8 at a distance from the Sun of 0.5 au. On February 3, the orbits were revised using more astrometry and this changed the perihelion date to 2002 March 18.

On February 3, Nakano made the claim that the comet was moving in a very similar orbital path to a comet seen in 1532 (C/1532 R1) and as the days progressed and the new positions came in, it was finally announced by Brian Marsden on February 15 that; "A parabolic orbit no longer adequately fits the observations and a revolution period of 400-500 years is likely. There is a possibility that the comet is identical with C/1532 R1, as first suggested by S. Nakano."

Yet as more and more information was gathered on the position of the comet, it became apparent that it was moving in a smaller ellipse and thus it could not be the comet seen in 1532. On February 21 Nakano announced that C/2002 C1 was moving in an orbit similar to C/1661 C1

and even produced an orbit that linked the two objects that incorporated seven observations of the comet of 1661 and 264 observations of the comet in 2002. With this analysis the comets could be linked and it was obvious that the two bodies were in fact one and the same. A period of 365.44 years was determined. Nakano revised the orbit again which resulted in a period of 367.44 years. Dr Marsden then released his updated orbit that determined the orbit to be 367.17 years. It was now clear that this comet was the record holder for the largest period for a returning comet. a record that it still holds. C/2002 C1 would be in future designated as 153P/ (Ikeya-Zhang).



*Dr Brian Marsden*

It is interesting to note that JPL Horizons gives 153P an absolute magnitude of 4 meaning that it has the potential to be bright at each return although this is dependent on the viewing geometry. The MOID (minimal orbit intersection distance) with Earth is also close at 0.33 au. This then opens up the potential brightness at favourable returns to achieve a magnitude as seen from Earth as high as  $\sim 0$ . A look through the history books for potential returns now seemed the way to go and Hasagawa and Nakano published a paper suggesting some earlier linkages although these are speculative and based on limited observational data<sup>1</sup>



As with searches for comets of antiquity Asian records are looked at because the ancient astronomers from that continent would record the appearance of these celestial wonders. A candidate prior to 1661 came in a comet seen 388 years previously in 1273.

### 877 Apparition

During this apparition the comet was observed widely in Japan and Europe and was followed from February 4 until March 17 with peak magnitude occurring around February 19 at 2.5; perihelion. It would have been February 13, +/- 3 days. The closest approach to Earth was on the 17th of February at 0.47 au.

### 1273 Apparition

On 1273 February 05 Japanese astronomers recorded a comet at 8pm in the evening in the west and it was determined at ~10 degrees in length and had a white colour. The Koreans documented the comet on February 17 in the east. The two observations would indicate that the comet would have been at perihelion on around 1273 February 05. The comet was only observed at its brightest because there were no optical aids in this period so the arc of viewing was short and close to the horizon both post sunset and pre-dawn.

On February 05 the comet was located in Pegasus and was situated 0.52 au from the Sun and 0.16AU from the Earth respectively and was of second magnitude. On February 17 the comet was located in Vulpecula and some 0.61AU from the Sun and 0.54 au from the Earth respectively and was of magnitude 2.5.

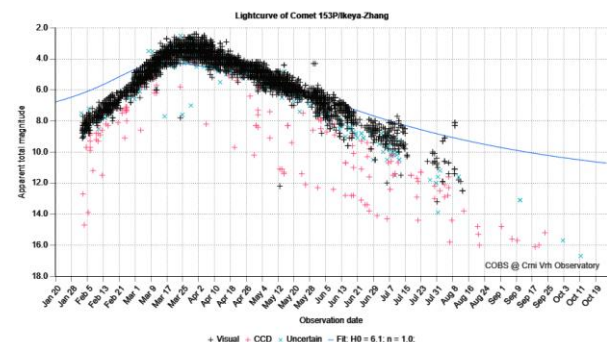
### 1661 Apparition

According to Cometography this comet was first seen by Hevelius on February 3.2 and

was seen before sunrise in the east and appeared as a "small star" with a tail of 2 degrees in length. The comet wasn't observed higher than 10 degrees above the horizon and was located near the constellations of Aquila and Delphinus.

### 2002 Apparition

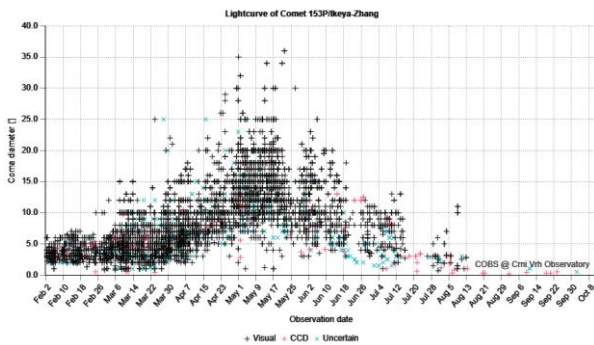
After discovery (2002 February 1) the comet brightened steadily but was hindered by a low altitude and within evening twilight. This made magnitude estimates difficult but by February 22 it was ~7. Moonlight began interfering from the 24th but by the 27th observations resumed again and the brightness was reported to be around 6 and many observers were saying the comet was visible with the naked-eye.



As March began the comet was becoming an easy object to locate and with binoculars a tail was becoming evident. Magnitude estimates indicated a brightness of 4 on March 12 and the comet was sporting a tail ~2 degrees in length. The longest reported tail lengths at this time under very favourable conditions were 4 degrees. Around this time on March 3 a tail disconnection event was widely documented and again on the 11th. During the second part of March the magnitude was around 3.5 and a tail length was between 2.5 and 4 degrees.

Into April the magnitude stayed steady at around 3.5 with coma estimate sizes ranging between 5 to 10 arcminutes in

diameter. The tail length ranged between 3 and 5 degrees in length. The comet then began to fade as the second half of April began, as it dropped to 4.5. Coma diameter estimates showed an increase in size to between 15 and 20 arcminutes and the tail had shrunk at this time to around 2 degrees.



During early May the magnitude was  $\sim 5$  with a coma diameter not decreasing and values of between 15 and 22 arcminutes were reported widely and no reported tail was observed, though a few estimates varied greatly between 0.5 and 5 degrees in length. During the second half of the month the magnitude dropped to 6 but still the coma maintained a large diameter between 13 and 18 arcminutes in diameter with perhaps 1 degree at most of tail observed. As May ended the magnitude had now dropped to  $\sim 7$  with a coma between 9 and 20 arcminutes in diameter and no tail was evident. At this time the comet was located at 1.82 au from the Sun and 0.86 au from the Earth respectively.

## 2362 Apparition

The next perihelion will occur in late 2362 or early 2364. Different sources give different dates depending on the model used. The uncertainty in the perihelion date means that it is not possible to predict the observing geometry as it passes through the inner Solar System. JPL Horizons has a perihelion in 2364 March and, depending on the circumstances, the comet could reach negative magnitudes on this return.



*Neil Norman*  
*neilnorman03@gmail.com*

1. Hasegawa, Nakano, "Orbit of periodic comet 153P/Ikeya-Zhang", MNRAS, 345, 883-888 (2003),



## Observing Comets around the World

### 4 My Astronomy Adventure

Kamila Cymorek



My adventure began with my retirement in 2019. I live in a small town south of Dortmund in Germany. I was a dentist, had my own practice and employed several people at my surgery. Then I also had a family, and of course, between running my own business and looking after a small child, I had no time for hobbies. I had always been interested in astronomy, since I was a young girl, but did not have the chance to develop my interest further, but come retirement I gained back some time, and I joined a local astronomy group.



They were a very friendly group, keen and interested to learn more and several of us began attending astronomical courses at the Zeiss Planetarium Bochum, in Bochum-Innenstadt. They have a great programme and I gained a lot of knowledge. I also began visiting other observatories to develop my practical knowledge, and not just look at pictures on a screen. I first went to the Hagen Observatory in Hagen-Wehringhausen, in the east Ruhr area. It is deep in the city forest and is all run by volunteers. It has a meteor tracking camera and a programme of observing minor planets.

The observatory and its staff, especially Norbert Mrozek, who is a well-known comet photographer, taught me a lot on how to image comets. I also like to photograph other deep sky objects, and I have a whole list of 'my' comets on my Facebook page.

I only began taking images in 2020.



***Comet C/2020 F3 Neowise 2020 July 21***

My equipment to begin with, was small and modest. The pandemic made it difficult to gain instruction but I could did get instruction from my colleagues on-line and by phone. I travel to a good dark sky site about 30 km away from my home. I go every night that the sky is clear. In fact, I will travel further if it looks like there is a clear patch of sky further away. The furthest I have travelled yet was 190 km to see C/2020 F3 (Neowise) in 2020.



***Comet C2022 E3 (ZTF) with NGC1647 2023  
February 14, 19.31MEZ Hypergraph6/420 +  
canon EOS R mod 6x1min***

This hobby makes me the happiest person on earth, it is so much fun for me, and I hope I never lose my enthusiasm.

Now I shoot with a modified DSLR and various telescopes. Then I stack and calibrate the images using Affinity Photo. I produce my comet images in two ways – comet sharp and stars tracked or stars sharp and the comet blurred. After four years I still consider myself a beginner but I will keep developing and expand my equipment.



***Kamila Cymorek  
kamila.cymorek@gmx.de***



## 5 Comets by Lake Como, Italy

Graziano Ventre



Bellagio località Scegola - Postazione Astronomica Sormano2, Bellagio Via Lattea L06 -

I'm an amateur astronomer from Bellagio, near Lake Como, Lombardy, in the north of Italy. I have built an astronomical station in the garden. The location is perfect for observing as I live above the village of Bellagio, by Scegola on the first slopes that lead to the Ghisallo pass. I have a good dark sky, almost comparable to the sky of the Sormano Observatory, which is nearby to my home. I have been a member of the Sormano Observatory since its inception (inaugurated in 1987) and I have learned a lot and gained experience in observing from my colleagues there. The partners at Sormano's helped me to qualify for a code for my home observatory.

Starting from the summer of 2017, I changed the name, from Astronomical Station Bellagio Via Lattea to Astronomical

Station Sormano2, Bellagio Via Lattea (L06).

*My observatory - L06*

With the new code I was finally able to send the first astrometric measurements of near earth objects (NEOs) but above all of



PCCP as I am very fond of comets. It is very gratifying to contribute to the confirmation of these objects found on the Minor Planet Center website in the "The Possible Comet Confirmation Page" PCCP page. With my C11 instrumentation and Orion Parsec 8300M CCD camera I can reach magnitudes of around 19. With the C11, on EQ6 pro, either from luck or from consistency of my observations, I gained enormous satisfaction in being able to submit confirmation of comet orbits which were important in identifying their perihelion, for example regarding C/2021 A1 (Leonard) my first observation of 2021 indicated it as a promising comet and we all remember the show it gave!



pccp C4AGJ62 -Postazione Astronomica Sormano2,Bellagio Via Lattea L06-07 gennaio 2021  
posa 180sec x 56 centro fu 02h16m schmidt-cassegrain 11" f.10 +ccd  
10 gennaio 2021 con MPEC 2021-A99 nominata cometa C/2021 A1 Leonard

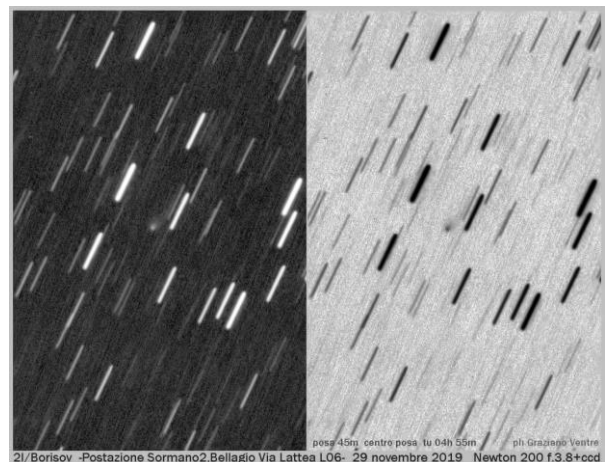


C/2021 A1 (Leonard) - Postazione Astronomica Bellagio Via Lattea L06 - 30 novembre 2021 Newton 8" f.3.8 + ccd

Another example to remember is the famous and unique interstellar 2I/Borisov, also with C11 and EQ6 pro.



In the spring of 2021 I improved the quality of my submissions by replacing the EQ6 mount with the 10 Micron GM 2000 QCI and the C11 with the C14 + very sensitive Moravian G2-1600 CCD with a quantum efficiency 80% peak. With this mount I was able to install the Vixen R200ss f.3.8 that I use for larger fields, especially useful for the already well developed comets. This instrumentation allows me to set the proper motions of the objects on the mount so I can observe and record asteroids with fast motion and of course I have also greatly improved the possibility on the PCCPs.



2I/Borisov -Postazione Sormano2,Bellagio Via Lattea L06- 29 novembre 2019 Newton 200 f.3.8+ccd

Regarding near earth asteroids I can mention 2022 QN5 which I observed with



other observers at a magnitude of around 21. All this for the passion and pleasure of getting to do some useful work for the scientific community. Of course, I didn't think I would also receive acknowledgments such as the assignment of my name to the asteroid 22500 by the astrometry associates of Sormano. Another unexpected recent surprise came to me from Mr. Denis Buczynski, secretary of the of the British Astronomical Association Comet Section, who, seeing some of my works on PCCP with images on Facebook, quoted me at the meeting of the non-professional observers in Elgin on 10 September 2022, presenting my images from Bellagio observatory, Sormano2 L06.

Why did I think of having an observatory at home while also attending an important observatory like that of Sormano? I could say that I am no longer a young age as I am a 68 year old pensioner but in reality, this is not the case at the moment, I still gladly attend the Sormano observatory and there the job opportunities are much more varied and promising. The observatory is away from home, but if you are lucky enough to have such a good sky, you have some incomparable advantages such as the possibility of working, in my case for example on PCCP and NEO, at any time, even towards dawn, quietly from the desk of home, remotely, and even with uncertain skies you often find the two or three hours with some cloudless holes where you can observe.



Furthermore, working from home, allows you to fix any hardware problems should they arise.

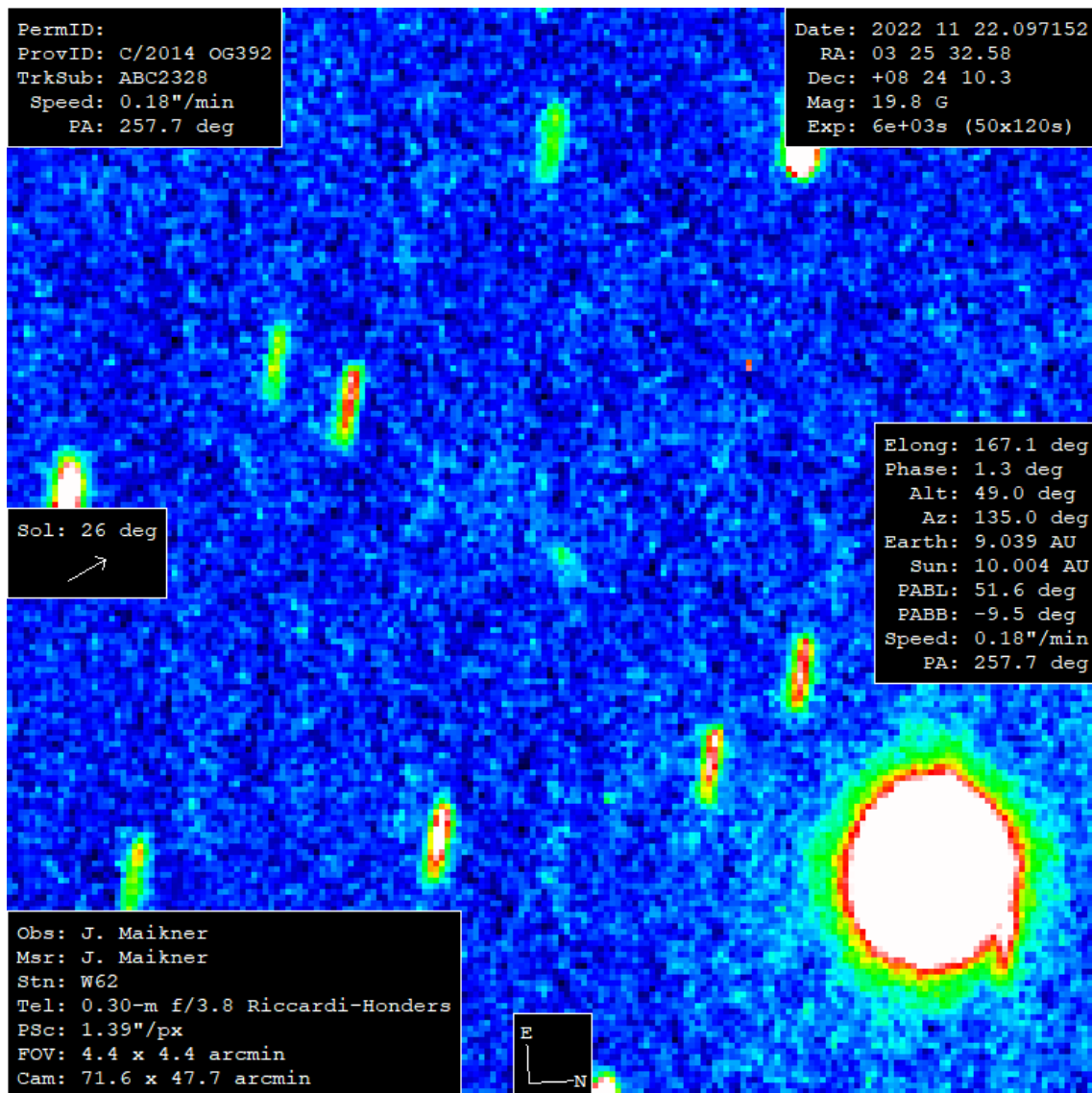
Serene skies to all, Graziano Ventre. email:



**Graziano Ventre**  
**ventregraziano@gmail.com**

## 6 Evolutionary Pathway to Chasing Faint Comets - My 50-Year Journey

John J. Maikner



*Comet C2014 John Maikner, Images taken at his home observatory in Pennsylvania USA*

As a late comer to digital imaging of comets, I have long admired the images from the great modern comet imagers such as Michael Jager, Gerald Rhemann, Francois Kugel and many more. Over the 50+ years of being an amateur astronomer and imaging faint comets, it has been a trying time. The story began with a 2-inch refractor in 1965. I managed to spot comet Ikeya-Seki (C/1965 S1) from Center City, Philadelphia. This sparked my long-time interest in astronomy and comets. I started

learning astronomy and the sky from Sky & Telescope magazine and reading books from Edmund Scientific in the 1960s. In 1970 and 1972, I managed to observe two other naked eye comets, Bennett (C/1969 Y1) and Kohoutek (C/1973 E1), respectively.

All three of these experiences had one difficulty. Each were severely hampered by the light pollution of the city. However, I managed to spot the faint comets on

multiple occasions. Later, I had the fortune to be able move out from the city and into darker skies. I was relieved to be able to observe the spectacular light show displayed by comet C/1975 V1 (West) in 1976.

### Observing and Imaging

The images of Comet West (C/1975 V1) in Sky and telescope inspired me to get into astrophotography. For the next bright comet, I transitioned from the Celestron 8 to the monster of a C14. This was just in time for Comet IRAS-Araki-Alcock (C/1983 H1) in 1983. After finding out about the new comet from Roger Tuthill, I decided to go a local club's dark site with my new C14. The night of May 9th, was my first scary night, setting up the C14 in the field. I was scared lifting the 50-pound optical assembly over my head and into the fork mount, but I was able to do it myself. That night was first light, and the first target was C/1983 H1. It was fantastic to watch the motion of the comet moving in real time. I continued to follow the comet from night to night as the comet moved Draco/Ursa Major into Cancer near M44, the Beehive Cluster, on the night of May 11<sup>th</sup> and 12<sup>th</sup>. I continued to explore the night skies with the C14 waiting for the next bright comet. The next one on the horizon was Halley's Comet (1P/Halley) in 1985 and 1986. I planned to image this comet and on Saturday, August 17, 1985, I captured the first visual observation on the hilltop during the Annual Stellafane Star Party using a 22-inch Dobsonian telescope.

In September of 1985 from the LVAAS dark site, six members of the club observed Halley's Comet using my C14 telescope. Finally, I acquired the Nikon F3 (a film camera) to image comets and other objects, and I learned to process film. With my image rig, I enjoyed my time photographing Halley's Comet from Pennsylvania. A highlight of 1986 - a group

of members from the club and I, travelled to Florida to visually observe and photograph the comet under the Everglades' dark skies.

After Halley's Comet disappeared from the inner solar system I started losing my passion due to other priorities. Unfortunately, I needed to sell everything in order buy a new house. During the time of the move, I lost all my photographs and so the only thing I have left of that time, is the memory.



*AP 180 f/7*

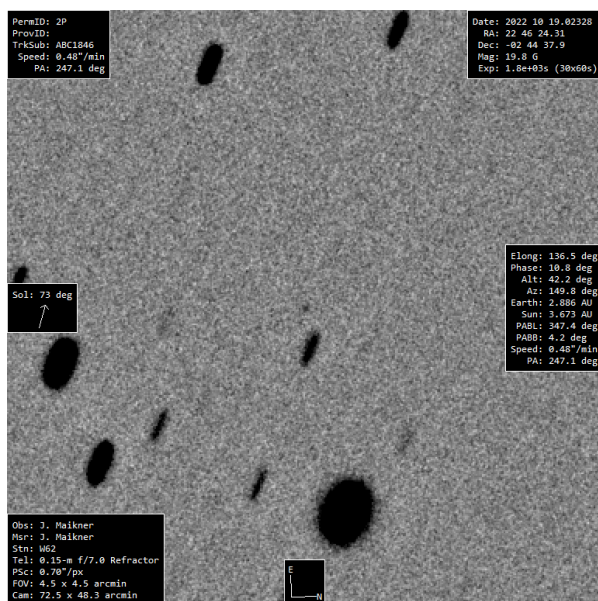
### The Passion Returns

During the next six years, I was reading about the new class of refracting telescopes by Astro-Physics and this re-sparked my interest and passion in the hobby. I needed a telescope, so I placed an order for the AP 7-inch f/7.0 refracting with a mount. This was a beast of a telescope! With the discovery of Hale Bopp (C/1995 O1) and Hyakutake (C/1996 B2), my desire

rekindled. I began observing and imaging comets with my new refractor.

By the middle of March 1996, Hyakutake showed signs of a tail, which was visible to the naked eye in the dark skies of Quakertown, Pa. In the coming nights, the tail kept on growing longer and brighter. As the comet reached its closest approach to the earth, the tail had grown from 25 to 80 degrees across the sky.

In late March of 1997, Hale Bopp exhibited 4 distinct bright bands with a very bright nucleus (-1.5 mag). The tail structure was fantastic. Using the 7-inch AP refractor, I followed comet Hale Bopp and Hyakutake until they disappeared from my night sky. After the comets were no longer visible to me, it was time to store everything into the closet. I focused on my job as a research chemist and raising my two girls.



*Comet 2P 2022 10 19*

## Software Changes

From late 1990s to early 2000, was the start of the modern electronic astronomy for an amateur. With the advent of the internet, modern computers and digital cameras changed the game for amateur astronomers. I started following the BAA

comet web page and Mr. Seiichi Yoshida's homepage. This provided insight into a family of recently comets visible and as faint as the 18 magnitudes.

In 2012 I started reading about the discovery of the possible naked-eye comet ISON (C/2012 S1). So, I pulled out my 7-inch f/7.0 AP refractor to locate and image the comet with a Canon D3, which was my first DSLR. At that time, I was using Nebulosity and PHD to image and guide the telescope. I was living in suburbs of Allentown with Bortle class 6 skies and surrounded by tall trees. Around that time, either plate solving was not available or I was not aware of plate solving software. I needed to do a crude polar alignment (I could not see Polaris due the trees) and used star hopping to locate the general area of the comet and proceeded with a 5-minute exposure in the general area of comet location.

My plan was to generate the ephemeris of the comet and print out a POSS-2 photo of the area in which the comet was located. I then compared the star pattern on the POSS-2 photo to pin down the comet location. On my image, I attempted to find the pattern in order find the comet's position. This was very time consuming and hard to do in general, but I was able to find a 16-magnitude image of comet ISON.

In 2013 I had heart problem, which required triple bypass surgery. After the surgery I had a stroke which affected my ability to walk, talk, and clearly think, which I still struggle with today. Later, I decided to find a suitable house with darker skies. I finally found a house about 25 miles north of Allentown under Bortle class 4 skies (~21.0 SQM (mag/arcsec<sup>2</sup>). I was able retire after the move. During this time, I continued to search the internet for information and to further develop my skills of locating, identifying, and imaging faint comets. I discovered plate solving and



other advances in imaging software to further help.



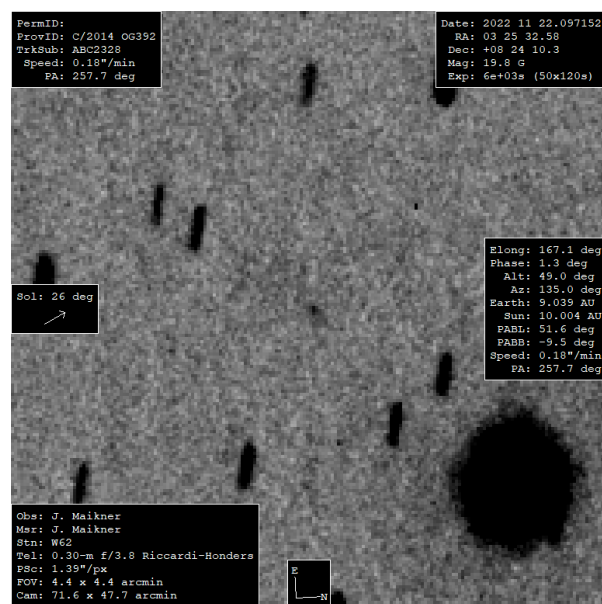
**AP 305mm**

Also, I pulled out my current imaging rig, the Astro-Physics 305 mm, Riccardi-Honders telescope with an QHY 168m CMOS camera. My skills continued to evolve while imaging the comet with a 5 - 10-minute exposure time. I was able to process using PixInsight with some success. I ran into a problem with imaging the faint, fast-moving comets; I was simply failing to find/track them. I continued developing my skill using Astrometrica but ran across a host of computer problems (MacBook and Bootcamp) with the Astrometrica software. While utilizing Facebook, I ran across Tycho-Tracker by Daniel Parrot. Tycho-Tracker looked like a similar piece of software to Astrometrica. This continues to be a is a great piece software and I finally made my decision to move to Tycho-Tracker as my primary processing software. I upgraded my camera from QHY 168m to QHY 268m to

get a wide field of view, lower read noise, and better sensitivity.

One piece of the puzzle was the difficulty of trailing images and poor residuals from the software, Find -Orb. The light bulb went off in my head and I realised my exposure time was too long. So, I started calculating the optimal exposure time to freeze the motion of the object. This technique improved images and reduced my residual results. I realised I finally had the skills to process the data. I obtained suitable results to submit to the MPC and received an observatory code (W62). Most of my learning was probably common knowledge to most, but I needed to learn the hard way. It has been a major change for me. I hope my 50-year journey can be useful to the amateur comet-chaser/imager of the future.

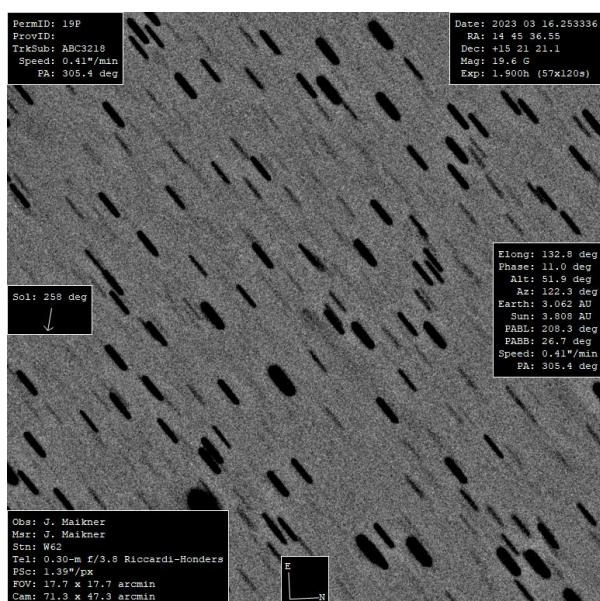
## The Faint Ones



**Comet C2014 2022 November 22**

I have imaged over 200 comets and sent over 1000 observations to the MPC over the last 2 ½ years. Currently, I am enjoying tracking down comets fainter than the 18<sup>th</sup> magnitude rather than the brighter comets. This is very strange, I know! My goal continues to be to image as many of the

fainter comets as I can with my current equipment. I also tracked down objects on the Possible Comet (A/object) Confirmation Page of MPC.



*Comet 19P 2023 March 03*

A single 120 second exposure with my 305mm telescope reaches a magnitude 19.0. With a stack 100 images at 120 second exposure, I can reach a 22.0 magnitude comet or asteroid. For a fast-moving object, it is very important to calculate the optimal exposure time to minimize trailing of the object. I have also been successful with exposures as short 0.2 seconds. On most nights, the seeing (measurement of sky condition) is 2.0 to 3.0 arc seconds FWHM. In most cases, I start my imaging when the comet is 45 degrees about the horizon and track 20 degrees pass the meridian. I have had some success imaging as low as 15 degrees above horizon.

Beside tracking down faint comets, I am also tracking down NEOs, fainter satellites of planets, and any other interesting minor planets of the solar system. It has been a long road to travel to get to this point of my life. I finally am reaching deep into space to image the family of faint comets and enjoying every minute of it.

## Workflow

This is my current workflow for comet imaging.

### Preimage preparation

Identify the comet or comets to image.

Search MPC, Dates of Last

Observation of Comets page

Search MPC, Possible Comet (and A/object) Confirmation Page

Search Mr. Seiichi Yoshida's comet waiting for first observation page.

MPC databases

Generate ephemeris from MPC or JPL. (I do not trust positional data from any planetarium program. I have been burned too many times due to poor positional accuracy or not on its true predicted position).

Generate images for predicted comet position from POSS1, POSS2 Blue light, ST Sci digitized sky survey, DR16 from Sky Server using the Sloan Digital sky survey and PanSTARRS-1 Image Access.

Determine the optimize exposure time/number of images which is based on magnitude and apparent motion of the comet.

### Equipment checks out.

Power up

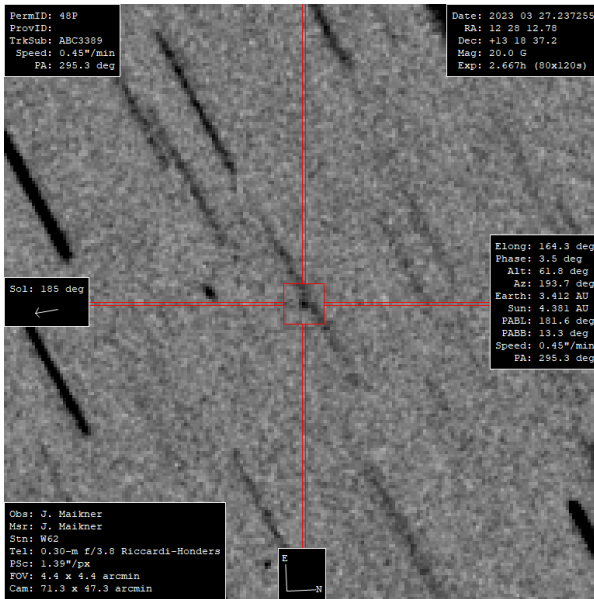
Launch software (APPC, N.I.N.A , PHD-2, Dimension 4 (software to synchronize the computer's clock) and connect hardware.

Cool the camera.

Focus telescope.

Check polar alignment (must be within 30 arcsec of the pole).

Run PHD2 guiding assistant to optimise the mount guiding parameters.



**Comet 48P 2023 March 27**

### Imaging run

Load to positional data into N.I.N.A

Start imaging.

Dithering very 5 images

Transfer a data set of 10 images to Tycho-Tracker to check the quality of images and astrometry/photometry, continue adding a set of 10 image to re-evaluate the over quality of the overall data set, or until the quality looks suitable and achieve a stable astrometry data (more data improves the quality of the astrometry), The final data set size could be as small of 10 or as large as 300 images! Of course, more data is better to a point.

Stop, move to the next comet.

### Post image processing

Process the images using PixInsight, blink routine (to remove generally artefacts) and sub frame selector (number of stars, best FWHM and other factors) to achieve highest quality of the data.

### Data reduction

Process the approved image using Tycho-Tracker. Tycho-tracker does the heavy lifting in locating, identifying, and generating astrometric/photometric measurements. The positional data is checked out in Find-Orb for residuals. Send the data to MPC.



**John Maikner**  
**maikner@yahoo.com**



## 7 Observing the Deep Sky from a Metropolis - A Passion Rediscovered in Adulthood Fabrizio Montanucci



The passion for astronomy I began to develop as a child; I remember that even before I started school I used to draw the spaceships I saw in cartoons, especially those of the series "The Jetsons" that in Italy, television began to broadcast in 1964. After all, the space race influenced every aspect of society, was a central subject not only in newspapers and television news but also in much television and film production of the time, and even in comic books. It constituted the beautiful and positive side of technological progress. The other side was, of course, the fear of nuclear conflict, which Hollywood had already been portraying for a decade in such masterpieces as Robert Wise's "The Day the Earth Stood Still" and especially Fred Wilcox's "Forbidden Planet"-a film that I would personally put on the syllabus of any high school curriculum.



*'Forbidden Planet' with thanks to MGM 'We're all part monsters in our subconscious, so we have laws and religion!'*

Then also came Kubrick's '2001: A Space Odyssey,' just a few months before Armstrong and Aldrin's moon walks, and for many the fascination was complete and irreversible. On the night of July 20-21, 1969, I had not yet turned 10, and it was the first time my father allowed me to stay up until practically dawn, with the whole family glued to a small portable television



set while we were on vacation on the coast of Rome. I think many of my generation became engineers or physicists, or at least science graduates, based on the influence of those moments and of that cultural atmosphere.

Another significant milestone for many of us was comet C/1973 E1 (Kohoutek). I thought the media had covered a lot of it only in my country, generating enormous anticipation for a passage that was supposed to be spectacularly visible to the naked eye. Instead, I discovered, in more recent times, that it was reported in practically every part of the world, or at least the Western world. All my friends and schoolmates knew that I was passionate about astronomy so virtually every day for many weeks I had to answer questions about where the comet would appear and what could be seen. Since then, as is well known, the promises of a spectacular comet were largely unfulfilled. The disappointment was deep for everyone and astronomy became a subject for specialists again. Even for me later on, things in life took a somewhat different direction, I became interested in electronics and music, which are still the focus of my professional activity, though I continued to be interested in all the discoveries in astronomy and all the astronautical missions but without any direct experience.

Then, during the summer of 1996, a friend invited me to observe first Jupiter and then Saturn through his C8, on a Polaris mount. I could neither believe it nor take my eye off the eyepiece: could one really see Jupiter's bands, Saturn's ring, and even Cassini's division with a handful of satellites, through such a relatively small and far from expensive amateur instrument? Until then I had thought these were experiences only possible with the Mount Palomar 5-metre mirror or so. The same friend, Roberto, whom I still thank,

then helped me in the selection of the equipment with which I had decided to equip myself with on that very occasion: a Celestar 8, a couple of extra eyepieces in addition to the standard one, and various accessories for photography (the focal reducer, eyepiece projector and various adapters, an off-axis guide and an old mechanical Nikon camera with a bulb setting to allow time exposure). I immediately began studying the subject and experimenting in the field, noting that from inside Rome, even on the best nights, the great Orion nebula could, at best, be barely recognisable with a (very tiring) exposure of about thirty minutes with a sensitive film (Fuji Super G-800 processed at 1250 ISO), within a field heavily vignetted and almost saturated by light pollution.



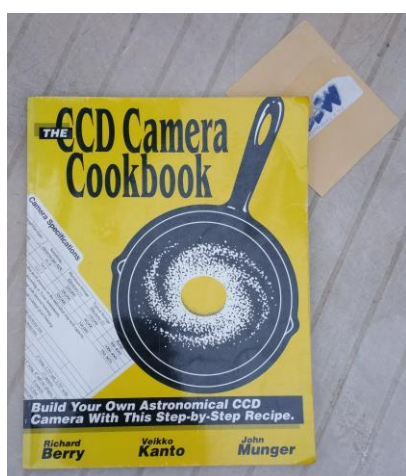
***Comet Hale-Bopp (C/1995 O1) taken March 29, 1997 from the Maremma countryside with a Rubinar 300/4.5 lens and Nikon FM in piggyback on a Celestar 8, Fuji SG800+ film processed at 1250 ISO, 12-minute exposure.***

Fortunately, we were often visiting some family members in the unlight polluted Maremma countryside 200 km north of Rome, and from there I managed not only to take some decent deep sky photos (very few, and only of the brightest subjects such as the aforementioned M42, M5 and M82) but especially some good photos of the unforgettable Hale-Bopp. Basically, I had discovered amateur astronomy just in time to capture perhaps the greatest spectacle the solar system has given us in recent

decades, or at least the greatest that it has been possible to capture with good quality through amateur equipment to date.

### **Berry, Kanto and Munger's CCD Camera Cookbook.**

In amateur astronomy magazines there was already talk of CCD cameras, and I quickly discovered that there was a DIY one in 2 versions; the now legendary Cookbook Camera by Richard Berry, Veikko Kanto and John Munger.



Having good skills in electronics I immediately bought the book and consequently found all the necessary materials, with some problems for the sensor (TC245-40), the converter (AD1674JN) and the clock driver (DS0026), which only one distributor in Italy had in its catalogue. Another friend and colleague (thankyou Matteo) helped me solve the other obstacle, which was the container.

It was enough to buy a raw aluminium cylinder, and Matteo, who had a fine numerical lathe for metals, carved it from solid, realizing a true masterpiece of mechanical precision. I applied only one structural variation; the cooling, which I made with a heatsink and a fan placed at the rear while in the original it was liquid, and added temperature control by inserting a simple transistor in the small aluminium block placed between the

Peltier cell and the sensor, measuring the voltage with a small additional circuit. The Cookbook 245 worked very well right away, as did its management software. The biggest problem was the ice that formed on the sensor if cooling was too rapid, but this could be overcome by slowly increasing the voltage supplied to the Peltier cell over a period of 30 to 40 minutes.

### **A method for deep sky imaging from a metropolis**



*C/1999 S4 (LINEAR) taken on July 21, 2000 with the Cookbook Camera and Celestar 8. Luminance 60x8 s, chroma data lost.*

With the Cookbook 245 I could finally see deep sky objects relatively clearly, within the limits of the small field covered (no more than 17.5x13' with the C8 and reducer at F/6.3). However, I quickly realised that to obtain decent results from inside Rome the usual techniques described in astronomy magazines (e.g., the 'dome' flat field) were totally insufficient; nor did my profession allow me to move when necessary to Maremma or other sites where light pollution is low.

Electronic sensors, in those years only CCDs and today CMOS as well, are linear transducers and allow for numerical output. Therefore, unlike the old chemical photography, they allow us to make a differential representation of light: if I shoot an astronomical subject under light pollution conditions, then I can ask the computer to represent to me only the light that "emerges" from the light pollution. The imaged field will invariably be somewhat vignetted, but even that problem can be easily solved by getting a good flat field. This all works under low or even normal light pollution conditions, but not inside a city. In that condition the blurred imprint of a speck of dust generates not a moderate depression of the light field but a deep crater. In addition, the variation of light intensity within the imaged field is neither stable nor predictable, changing slightly depending on the altitude of the imaged subject and its location in relation to the sources of light pollution, so a hypothetical flat field that is optimal at the beginning of the shooting session may easily no longer be optimal at the end of it. There may be imbalances of only a few percentage points, but the light of the astronomical subjects we want to shoot is extremely low, usually less than the imbalance in the background. For this reason, I was driven to try to develop a method that would lead to a particularly well flattened light field, and to write software that would allow it to be implemented.

### **A dual, local and linearly balanced flat field**

The method basically consists of the following:

**1-** Acquisition, just before starting the imaging session, a footprint of the background light in an area of sky immediately adjacent to the subject you intend to image, where only stars are

present (possibly not too bright, i.e., such as to create a perceptible halo around them). If, for example, the extent of the field imaged is 20' in declination, it will suffice to shift in declination for 25-30', indifferently above or below, then shoot no less than two consecutive frames slightly shifted (always in declination) between them. Typically, the optimal number of frames is 4, with the same exposure time that will be used for the frames on the subject to be imaged, but this depends on the area of sky aimed at. The goal is not to have pixels in which a star is always present, so the higher the density of stars in the sky area aimed at the larger the number of shifted frames to be acquired will have to be.

**2-** Acquisition of the frames on the subject, shifting the pointing slightly in RA or Dec at the times when the computer loads the frames data. This should ideally be done with each frame, although keeping the same position for a few consecutive frames does not create any real problems. The aim is not to have the same pixels on the same area of sky, and in particular not to have the same pixel take up the field stars for more than half of the frames acquired.

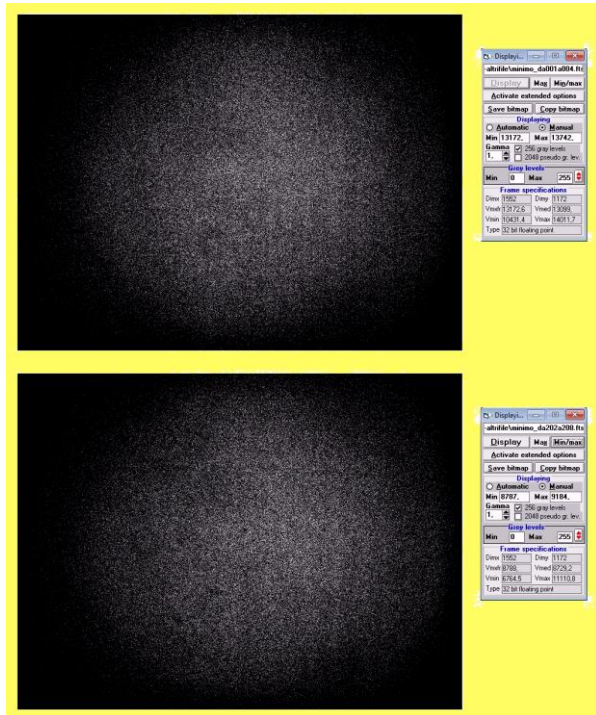
**3-** Repeat step [1] at the end of the imaging session.

**4-** Acquisition of the dark frames, if you do not already have a suitable medium dark frame.

On this raw material my software (tentative name since the late 1990s 'CCDmaxinfo', in those days only CCDs were used) performs the following functions.

**A-** it derives the footprint of the initial background light by comparing the acquired frames and constructing a frame in which each pixel is the one with the smallest value among all the acquired frames. It then does the same for the final background light.

**B-** The 2 frames thus obtained represent an exact fingerprint of the initial and final background light as acquired by the optical and electronic camera system, but they are very noisy and it is not convenient to use them directly as a flat field.

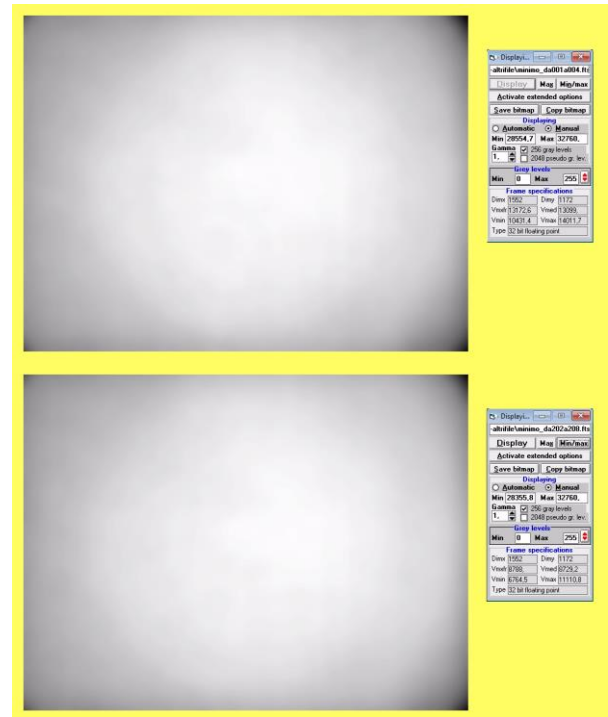


*Frames obtained by taking the minimum value for each pixel from a small group of frames acquired at the beginning and end of the imaging session, shifting the pointing slightly so as to eliminate stars.*

**C-** A flat field is used to correct 'slow' brightness variations, basically those due to vignetting of the optical system. To leave only those, it is then sufficient to operate an appropriate low-pass filtering on the frames of the minimum values just obtained. Actually, the low-pass filtering has to be preceded by a median filtering (the standard radius I use is 17 pixels) because some pixels or small groups of pixels might randomly turn out to be always illuminated by a star, which would alter the mean value in their surroundings.

**D-** At this point we have two optimal flat fields, one for the first frames and one for the last frames. However, if the sky background has not changed drastically

over the course of the shot, the optimal flat field for each frame of the session will be a linear combination of the first and last.

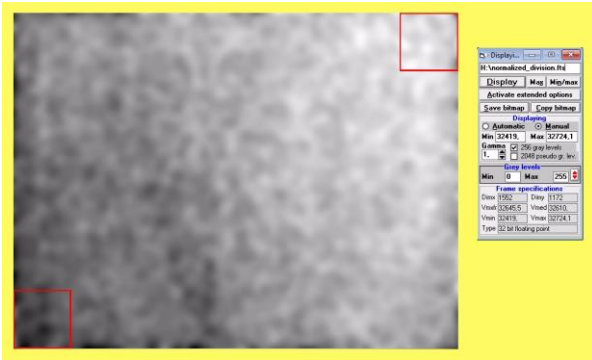


*Result of median ( $r=17$  pixels) and low-pass (simple average over a 9-pixel radius, repeated 100 times) filtering operations on the previous frames. A normalization of the maximum value to 32760 A.D.U. was also performed.*

In operational terms, if the sky is very stable, the two flat fields can be taken even one hour apart. If the sky is not very stable, it is better not to exceed half an hour. If the session is to be very long, it is good to get intermediate flats. This is the reason why, in my images, the streaks of the stars occasionally break up.

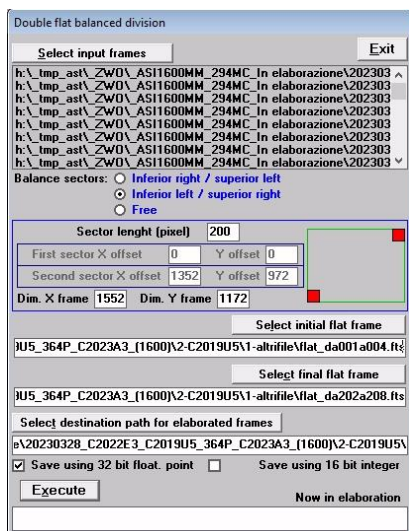
**E-** At this point I do a normalised division of the two flat fields. In the result I will be able to detect in which areas the unbalance of the bright background is maximum.





**Result of a normalised division between the previous frames, display extremes equal to the extremes of the values obtained. In this case, the shooting conditions were near-optimal in terms of stability, and over the session the background brightness distribution changed by less than one percent, but this alone would be enough to greatly affect the final result. The red squares are the sectors chosen for balanced division by double flat fields.**

This information is needed to set up another function of the software, the balanced division by double flat field, where you can define two squares of arbitrary width and position within the frame area.



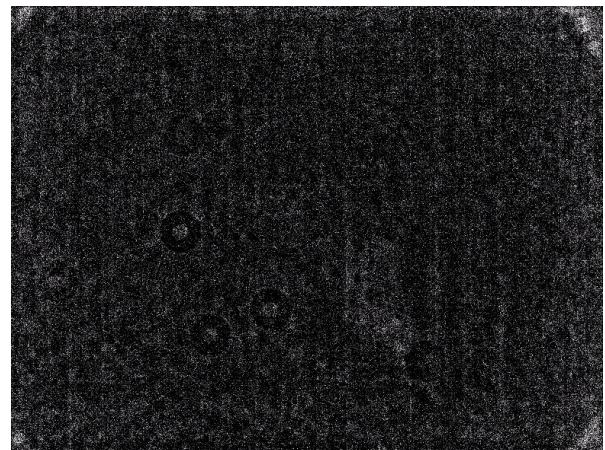
**The section of the software that performs balanced division by double flat field.**

For each frame acquired, the software will search for the balancing coefficients that obtain the most similar statistical distribution of pixel values contained in the two squares. In practice, for each square, and for each balancing coefficient, the

software looks for the distribution of values, then low-pass filters the resulting Gaussian and detects the maximum value. There are two loops, a coarse first with 10 steps and a precision second with another 10 steps.

At this point the frames are usually very well flattened. One might then consider assembling them and obtaining the final result. However, this would still lead to poor results; there are still some operations to be done to get something good.

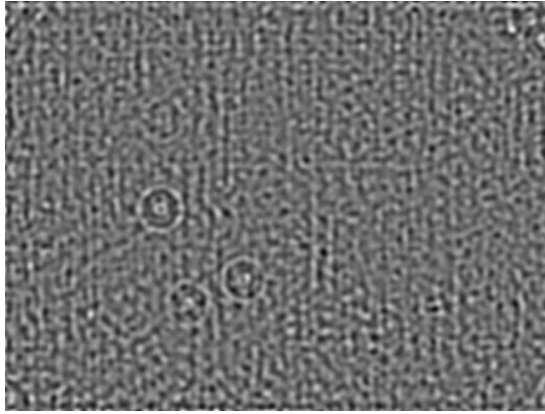
**F-** The frames were acquired by continuously shifting the pointing, albeit not by much and not by a pre-determined amount. This allows for two advantages: local alterations in light intensity, particularly due to imperfections in the optical path, are somewhat averaged out, and also, by obtaining the median of the frames, the imprint of the same imperfections emerges.



**If the frames are acquired by continuously and slightly shifting the pointing then, by obtaining the median of the sequence, the stars disappear, the imaged subject generates a diffuse and blurry signal, and the imprints of the impurities in the optical path emerge.**

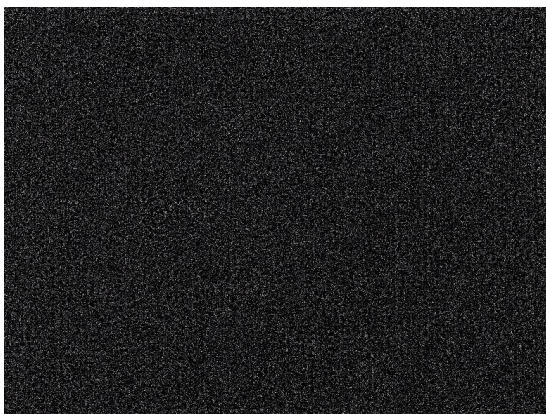
**G-** The median frame (see above) can be used in 2 ways to improve image quality. The imprints of the impurities produce, from the point of view of frequency in the 2-dimensional image plane, medium-

frequency signals, while the subject to be imaged produces a diffuse, low-frequency signal. It is then possible to apply appropriate bandpass filtering to isolate the impurities and obtain a secondary flat field that corrects only those, as below.



***A first way to improve the final result using the median frame is to perform appropriate bandpass filtering on it, which basically isolates artefacts due to dust.***

The median frame will also contain an approximation of the differential sensitivity of the pixels, confined to the upper part of the spectral content. By applying a drastic high-pass filtration, therefore, a tertiary flat field can be obtained to compensate a little for the differential sensitivity of the pixels and reduce the noise slightly.



***A further way is to subject the median frame to drastic high-pass filtering. The signal that remains is statistically quite related to the differential sensitivity of the pixels and can compensate for it to a small extent.***

**H-** By dividing the acquired frames by the 2 secondary flat fields just obtained, we have cleaned up as much of the information contained in the imaging session as possible. However, the frames were acquired by continuously shifting the pointing. As a result, only the central part of the final frame resulting from compositing the individuals will be fully illuminated, while we will have many small sectors covered only partially, and by different frames.

At this point, an algorithm generates a three-dimensional matrix representing the coverage levels of each sector, then hierarchically realigns the sectors with lower partial coverage by referencing the sectors that have higher coverage, starting of course with those with full coverage. In practice, the sectors with partial coverage are progressively realigned numerically starting from the centre and progressing toward the periphery (this is the reason why, in my images, the S/N ratio tends to go down going from the centre to the periphery of the image).

The software is written in Visual Basic with calculation engine in DLLs written in C, but there are many calculations to be done and they increase exponentially with the number of frames acquired (and therefore sectors only partially covered). Up to a few tens of acquired frames the sectors to be realigned are of the order of a few thousand at most and a modern PC of good performance achieves the final result at most in a few tens of seconds, but for example in the case of the figure below in each colour the sectors were about 160000 and the realignment time was about 15 hours (Intel Core i5 10400 4 GHz).

**I-** Actually between step (G) and step (H) there is another, simple but fundamental one. In frames acquired by imaging in heavy light pollution, the photons that accumulate on the sensor are mostly due to

the pollution itself. Suppose, for example, that we have an average frame value of 10000 A.D.U. (Analog to Digital Units): the light of the subject being imaged will probably be discernible, for example, by displaying between 10000 and 10300 A.D.U., a small number of photons among all those that have loaded the sensor. We have corrected the flatness of the illuminated field to the maximum, but some small random imbalance always remains. As a result, if we do not remove the signal component due to light pollution, the realignment algorithm for partial-coverage sectors will introduce errors proportional to the level of pollution itself. It is basically a matter of sharply increasing the ratio of the amount of useful signal to the light background, which we have now maximally flattened. To do this, all we need to do is to subtract from each pixel a value almost equal to all the light pollution (without cancelling it out because this can create other problems). In the example given just above, we will be able, for example, to subtract a value equal to 9800 (the average value of each frame will then become equal to that of useful light plus 200).

**L-** Another element not described before, because it is worth mentioning later: light pollution usually changes, sometimes by a large margin, over the course of the imaging session (think for example of a subject that starts low on the horizon and then rises). To obtain a valid median frame (step [F]) it is necessary to first align all frames to the same average value (which can be the global average value). This can be done additively or multiplicatively, both of which have minor disadvantages that are easily guessed. I set the software to do this additively.

**M-** At this point, if everything has gone right, we have a good quality image, but some small background level imbalance can always remain. To describe exactly

how to compensate for this would take more space, so I think it is best to summarise by saying that we need to eliminate the stars and perform as best as possible an interpolation of the frame between extremes outside the subject to be imaged, then again perform strong low-pass filtering to have an additional, and final, corrective flat field.



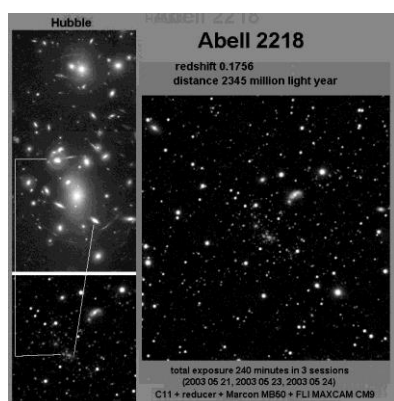
*Sometimes the brightness of cometary nuclei clashes with the need to raise the sensor gain sufficiently, and consequently the exposure time must be reduced and the number of frames acquired must be raised in parallel. In this case, 283 frames of 20 seconds were acquired. Since the realignment time of the partial-coverage sectors increases exponentially with them, about 15 hours of processing were required to complete the image reconstruction even on the outer edges.*

The method just described is laborious; it still requires working on the imaged material for up to several hours, although CCDmaxinfo includes various batch procedures for standard operations, and in the case of colour shots the time almost triples. It also has limitations: it cannot be applied if the subject to be imaged overlaps a nebula, because it assumes that the background of the sky is uniform, and it cannot be applied if the subject to be imaged fills most of the sensor area, because one could not find the 2 sectors that are needed to do the balanced division by double flats. In that case, where possible, you need to shift the pointing and acquire a local flat field, then capture a sequence of frames short enough to be sure that the footprint of the background light does not change much.



Also consider that light pollution, even making all the corrections described above, still worsens the signal-to-noise ratio. Shooting in differential mode, as CCDs and CMOS allow, would, in abstract theory, allow one to shoot the deep sky even in daylight, but it is obvious that the higher the background light the greater is, for example, the noise introduced by differential pixel sensitivity, for which it is difficult to fully compensate.

There are also conflicting requirements: on the one hand, sensors generally allow for a better signal-to-noise ratio by increasing the gain of their amplification; on the other hand, increasing the gain in the presence of light pollution quickly leads to the dynamic limits of the sensor being reached, so one is forced to take many short shots (usually no more than a single minute). Using a C11 from Rome, to get the same S/N ratio that I get from the Maremma countryside (maximum SQM at zenith around 19.4) with my old C8, I have to increase exposure time by at least a factor of 3-4. On the other hand, taking very long shots with many frames enables the creation of short animations, for which I have written specific code.

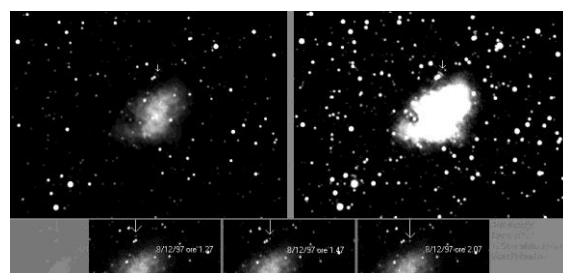


***The most distant subject that I have imaged to date, Abell 2218, with the Hubble shot inserted to find the correspondence of the various components. The idea was to see if it was possible to get a vague trace of the gravitational lensing effect that this huge cluster of galaxies produces.***

In any case, the possibility of observing objects even billions of light-years distant simply by stepping out on the terrace of the house at the end of a day's work, of seeing comets moving slowly in real time against the background of the deep sky, and other astronomical spectacles that are no less fascinating, generates a profound gratification that compensates for fatigue, lost sleep and invested resources.

### **The possibility of observations of scientific significance**

By observing the sky often, it becomes statistically likely to run into unanticipated phenomena. I believe it has happened to many and in my case at least four times. On the night of December 8, 1997, I accidentally imaged with CB245 the asteroid 1997XK10, previously observed but then lost and therefore not catalogued, as it transited over M1 (see below).

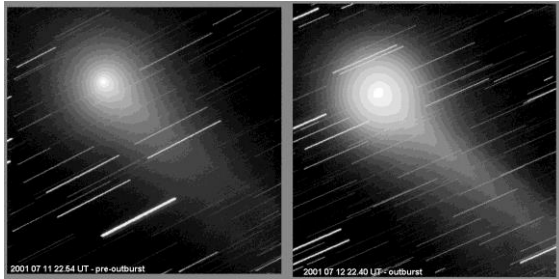


***Transit of asteroid 1997XK10 (later 16847 Sanpolaamosciano) in front of M1, December 8, 1998, 0.27-1.27 UT. Twelve 120 s guided poses with a Celestar 8 and Cookbook 245.***

I was a beginner and did not understand the nature of the object, so I would not have issued any observing alerts, but fortunately on the same night they were also filming M1 from the San Polo observatory in Mosciano (in Italy, near Scandicci) and they recognised it as an as-yet-unknown asteroid and later were able to name it (16847 Sanpolaamosciano).

What I recognised instead right away was an outburst of comet C/2001 A2 LINEAR, the fourth of those that were detected during the period of observations of this

object, on the nights of July 11-12, 2001: the overall brightness almost doubled and the coma became perfectly circular, with distinct reinforcement of the tail and the possibility of detecting numerous rapidly evolving streams within it.



***Images of the comet C/2001 A2 LINEAR outburst that occurred between July 11 and 12, 2001.***

Less than a year later, on 2002 March 11, another shot puzzled me. I did not understand why the tail structures of comet C/2002 C1 Ikeya-Zhang (later renamed 153P) appeared so undefined, whereas they were sharply defined in the shots of the previous days. The animation obtained from the frames sequence,

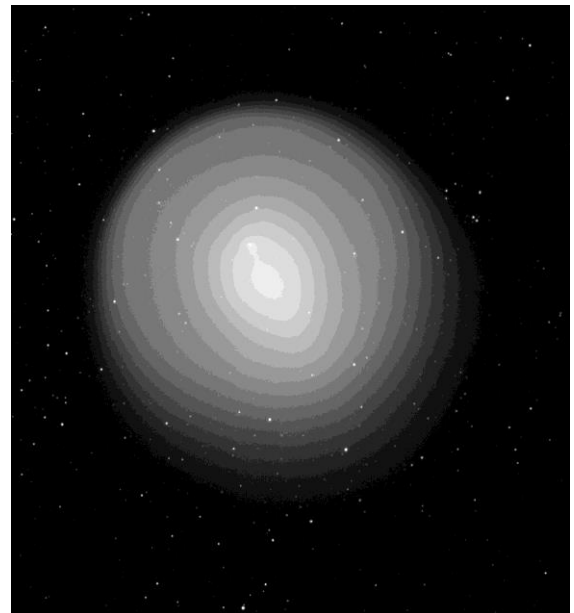
([http://www.astropress.it/filmati/C2002C1\\_20020311\\_gamma075\\_singoliframe\\_fmotanucci.zip](http://www.astropress.it/filmati/C2002C1_20020311_gamma075_singoliframe_fmotanucci.zip)),

clarified the mystery: the comet, already very active in itself, had encountered the expansion front of an ICME, and the tail showed very rapid disconnection phenomena.

Geraint H. Jones (Jet Propulsion Laboratory) and John C. Brandt (Department of Physics and Astronomy, University of New Mexico) noticed this and also used my images for a paper on the subject that was published in Geophysical Research Letters (Vol.31, Oct. 28, 2004, "The interaction of comet 153P/Ikeya-Zhang with interplanetary coronal mass ejections: Identification of fast ICME signatures"). The fourth phenomenon was the first in chronological order but was a visual observation. On the night of Sept. 6-

7, 1997, I was imaging M57 from the Maremma countryside with the Celestar 8 and off-axis guide when, around midnight, the sky literally lit up brightly for a few seconds-between 2 and 4, I couldn't be more precise, and in absolute silence. I was just in time to look up to see a bright trail through the foliage of some trees, heading north, which dissipated in a few moments. It was a bolide that practically lit up all of central Italy and of which a report was written that can be found (in Italian) at this link:

[https://www.academia.edu/34589488/Il\\_meteoroido\\_del\\_Trasimeno\\_6\\_7\\_Settembre\\_1997\\_Report\\_di\\_osservazioni\\_in\\_visuale\\_e\\_in\\_radio](https://www.academia.edu/34589488/Il_meteoroido_del_Trasimeno_6_7_Settembre_1997_Report_di_osservazioni_in_visuale_e_in_radio)

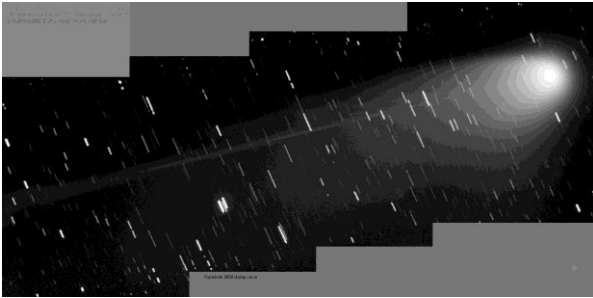


***November 7, 2007 image of the long-lasting outburst of comet 17P (Holmes). 48x20 seconds with a C11 at direct focus.***

### **A few final considerations**

The typical SQM in the area of Rome where I live, on the best nights, is of the order of ~17.5 around the zenith, moreover I do not have a fixed location and all the software I use to make my shots consists of an old release of Paint Shop Pro, the excellent Fitswork (only to debayering colour shots) and the already mentioned CCDmaxinfo. Bearing in mind that already today the

majority of the world's population lives in urban areas, there are certainly many potential astronomy enthusiasts who do not know that with today's hardware and software technologies they could, with a moderate investment, peer into the deep sky and do serious research even from the terrace of their apartment building.



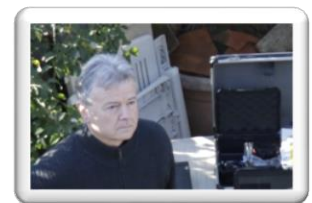
***Comet C/2001 Q4 (NEAT), taken on May 17, 2004, 150 frames of 20 s in 5 shifted groups. By preemptively constructing a basic mosaic with a few individual frames such that stars are in the correct position over the entire area covered by the observation, CCDmaxinfo can automatically bind all frames by correctly realigning the levels of those with partial coverage.***

Regarding CCDmaxinfo, initially it was to become something commercial but I never found the time to complete it and, in the meantime, Microsoft has basically abandoned that development platform (Visual Studio) even though the applications developed with it are always fully compatible with the latest versions of Windows. If some programming experts would like to work on it, extend it and improve it, I would have no problem providing them with the source code for free.



***Comet C/2002 F1 (Utsunomiya) appeared fleetingly in late April and early May 2004. The sky conditions were excellent for Rome but the comet was very low on the horizon, however the described procedure allowed to remove (with a lot of work and patience...) almost all artefacts.***

Finally, an invitation and a dedication. The invitation, addressed to all those who image comets and the deep sky, is to always accompany the images with as much detail as possible of the imaging session, always with the purpose of facilitating others-especially younger ones, but for me too - to get better and better results. The dedication is to a friend who is no longer with us, Giovanni Sostero, a great theoretical and practical expert on comets, with whom I collaborated for a number of years for the comet section of the Italian astronomy magazine "Le Stelle" and whose shots are still widely present in the BAA archive.



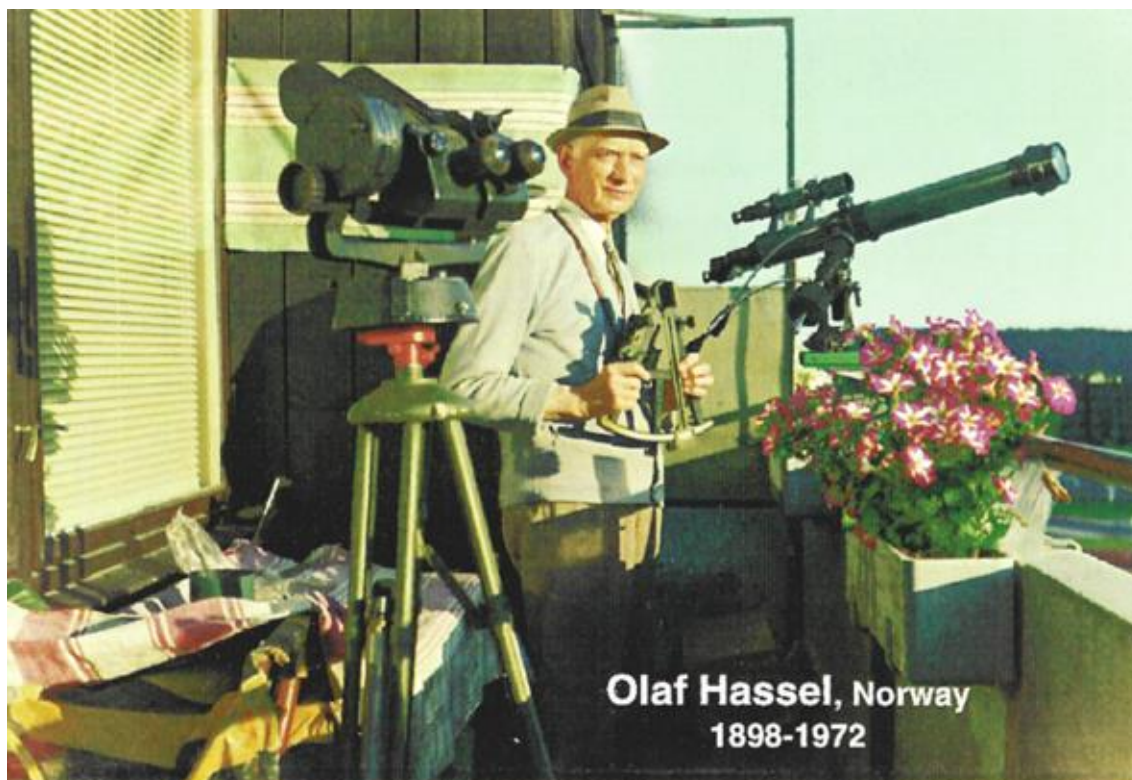
***Fabrizio Montanucci  
f.montanucci@mclink.it***



# Comet Observers of the Past – Histories Contributions and Achievements

8 **Olaf Hassel, Norwegian Comet and Nova Discoverer**

**Denis Buczynski**



In 1939 Olaf Hassel discovered a bright naked eye 3<sup>rd</sup> magnitude comet. In 1960 he discovered a bright 5<sup>th</sup> magnitude nova in Hercules. This amateur astronomer was a remarkable man, self-taught in astronomy and mathematics and he was born totally deaf. I want to relate some of his achievements in astronomy as he independently discovered another nova and two more comets. His life story is well documented elsewhere <sup>1</sup> but he may not be

well known to today's English-speaking comet enthusiasts.

Olaf Hassel was born in 1898 May 12 on a rural farm near Kongsberg in southern Norway. Between 1907 and 1915 he attended a deaf school in Oslo 40 miles distant from his home. A small book containing a star map purchased from a school friend sparked a life-long interest in astronomy. In his teenage years he began to learn and recognise the constellations.

<sup>1</sup> In writing this article (all mistakes are mine) I have relied heavily on information written in a leaflet by Rune Anda for the 3<sup>rd</sup> Conference on Deaf History which took place in Trondheim September 1997.

Anda, Rune (1997). Olaf Hassel: The deaf-born Norwegian farm-boy with a world reputation amongst astronomers [PDF Document]. Retrieved from <http://www.andata.no/hassel/OlafHassel-engelsk.htm>.

On 1918 June 10 he saw a bright star he did not recognise, situated in Aquila; it was actually a nova. It turned out that this was the famous bright Nova Aquila 1918 (V603 Aquilae) originally discovered on June 6 by Zygmunt Laskowski and confirmed on June 8 by Grace Cook an English astronomer. Hassel was convinced he would have discovered the nova had it not been for the bright summer twilight. Previously in 1919 he independently discovered a comet and alerted astronomers in Oslo, but learned that it was a comet discovery that was credited to the American astronomer Rev Joel Metcalf.

Hassel continued careful scrutiny of the night sky and was surprised when on 1920 August 24 he saw a bright nova in Cygnus. He realised that, as a star, this object must have been discovered some days earlier. It turned out that this star was Nova Cygni 1920 (V476 Cygni), which had indeed been discovered by the famous comet and nova discoverer William Denning in England on August 20.

On 1921 April 26 he independently discovered a small tailless comet in Aquila, but again this was a comet that had been discovered a few weeks earlier by William Reid in Cape Town South Africa. A contemporary of Hassel's, Sigurd Einbu, wrote that Hassel had discovered this comet using a telescope he made himself, constructed from spectacle lenses. His regular correspondence with astronomers in Oslo led to him taking their advice to learn mathematics so as to be able to make astronomical calculations. He commenced a correspondence course in mathematics and was able to complete his studies in a couple of years.



*Northern lights photographer Olaf Hassel, on the platform of Meteorological Institute, April 1960.*

Around 1920 he began making observations and sketches of the displays of Aurora Borealis and sending these to Professor Carl Størmer, a well-known professor of mathematics at the University of Oslo. They were very favourably received due to their accuracy. Hassel was eventually offered a small honorary bursary to continue making observations. He devised and constructed a plate camera that allowed him to slide the lens to six different positions so as to record six individual exposures on one photographic plate. One night in January he observed the Aurora from 7pm to 7am taking 395 images of a huge display. All of the developing and logging of the photographic plates were made by him before being sent to Oslo.

His collaboration with Professor Størmer led him to become interested in measuring the areas, volumes and depths of the lakes in Sweden. He measured depths using a plumb over 900 times and said that the greatest depth he found was over 404 metres and that it took over 7 minutes to turn the crank of the heaviest plummet up from the bottom!

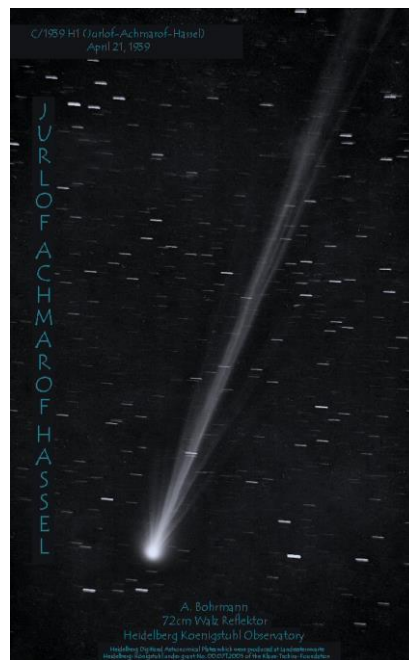
In 1937 Olaf Hassel met his future wife Marie Iverson after meeting her at a church sermon for the deaf. They married after the end of WW2.

Then in 1939 April 16, in the evening sky through broken cloud, he discovered a bright naked eye 3<sup>rd</sup> magnitude comet. He first saw only the tail in his prismatic telescope. Using a larger telescope, he was able to see the comet head. In the bright April sky, the comet was difficult to see with the naked eye. He immediately informed astronomers in Oslo, but they were clouded out and they doubted his discovery report. The next day he was able to contact his friend the astronomer Sigurd Einbu, who then contacted the Observatory in Kobehavn. They also said that they had not received other reports. That evening Einbu saw the comet himself, immersed within the Aurora and he telephoned Oslo to confirm the comet discovery. After two more days the Oslo Observatory sent out a telegram announcing the discovery to the rest of the world's observatories. On the third day Hassel received, in the post, a statement from the Kobehavn Observatory that the comet should be named Comet Hassel 1939d (now designated C/1939 H1). It then transpired that two Russian observers had seen the comet on April 15, one day before Hassel's observation. So, the comet was renamed Comet Jurlof-Achmorof-Hassel.



***Olaf Hassel***

The discovery made front page news in Sweden and Hassel received many letters of congratulations from around the world. His deafness seemed to add to the interest. Coincidentally one of the co-discoverers, Achmarof, was a teacher of deaf children in Russia. On 1939 May 11 Olaf Hassel was invited to a meeting of the Norwegian Astronomical Society to give an account of his discovery.



***Comet C/1939 H1 Jurlof-Achmorof-Hassel 1939 April 21 by A.Bohrmann<sup>2</sup>***

In 1941 Hassel received an unexpected telegram inviting him to work as an assistant with the Meteorological Institute. This meant a move to Oslo. He spent 30 years at the Institute eventually becoming head clerk. During his tenure he prepared material concerning climate variations all over the world. The Norwegian Antarctic expedition of 1956-57 asked Hassel to spend a month classifying the types of Aurora they had acquired on pictures during the expedition. During his time at the Institution he was asked on several

<sup>2</sup> Comet C/1939 H1 (Jurlof-Achmarof-Hassel)  
April 21, 1939  
A. Bohrmann  
72cm Walz Reflector  
Heidelberg Koenigstuhl Observatory

This image made use of the Heidelberg Digitized Astronomical Plates which were produced at Landessternwarte Heidelberg-Königstuhl under grant No. 00.071.2005 of the Klaus-Tschira-Foundation.



occasions to give evidence of the details of sunrise and sunset, moonlight and tides for legal prosecutions used in trials for traffic accidents etc.

In 1960, on March 7 at the age of 61, Olaf Hassel made another discovery. This time it was a 5<sup>th</sup> magnitude nova in the constellation boundary between Hercules and Aquila. Designated Nova Hercules 1960 (V446 Her). The nova eventually brightened to magnitude 2.8. His account of the discovery can be seen here in his own words:

*«On March 7, 1960 my wife woke up before me. As she from the bed looked out of the window and noticed that it was a clear starry sky, she woke me up at 05.20, ten minutes earlier than usual. The stars would soon disappear in the dawn of the morning. After a short consideration I run out of the bed, and hurried up to the roofwindow in the attic. There I directed my prism telescope towards the somewhat light South-East sky - and then suddenly I stared stiffly at one point, without noticing the other stars in the sky. I had a terrific score! It was a strange lightweak star which I had never seen before. With the naked eye, the star could not be seen in the twilight, but it were not in my star maps. Was it a quite new star?*

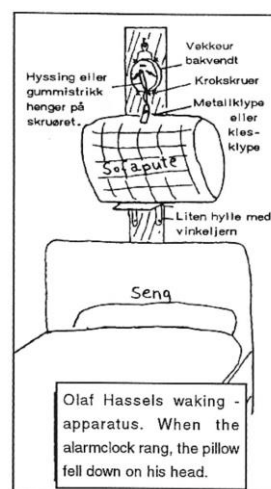
*After breakfast I hurried to the same Oslo astronomer who I had contacted in connection with the comet-discovery - and this time he immediately believed me. He telegraphed at once to København. It was a new star or nova.»*

The nova was well observed around the world and classification spectra were taken at Kitt Peak Observatory. The bright hydrogen emission from the nova gave a distinctly red colour to the star when seen visually in telescopes. He was awarded an AAVSO plaque for this discovery and this was presented to him at the American Embassy in Norway with his wife and colleagues there to watch. The National TV filmed the event and it was broadcast the following next day.



These achievements and discoveries in astronomy were made using visual techniques and small telescopes and binoculars. His deafness prompted him to use inventive methods to observe and communicate. One rather extreme example of this was his method of waking (he could not hear an alarm clock) to make observations during early morning hours. His brother Alfred described this as follows:

Inventive he has also been. Of lack of technical aids, he devised his own method of wakening, as the illustration to the right shows. When the alarm clock rang, a soft pillow would fall down on his head...



Olaf Hassel died on 15<sup>th</sup> August 1972 aged 74, a year before a planned trip to West Africa to watch a Total Solar Eclipse. His

friend and author on astronomy, Johnny Skorve, said this of Olaf Hassel:

*Astronomy author Johnny Skorve wrote among other things: - Hassel has again shown that in spite of the great technological development within astronomy, not least when it comes to photographic surveyance of the starry sky, that the persisting observer behind the ocular is not so easily beaten by the modern and fancy.*

In 1969 he had been awarded the distinction of being named a Member of Honour by the Norwegian Astronomical Society. During his life he spoke passionately about issues related to the deaf community and was recognised world-wide for his life's work.



**Denis Buczynski**  
**Secretary**



*Victor Daimaca 1892 - 1969*

Victor Daimaca was born on August 22, 1892, the son of Dumitru and Maria Daimaca. His parents were small traders in Turnu Severin, a city in Mehedinti county, Oltenia, Romania. They owned an imposing two-story house on the north bank of the Danube.

### **The passion for Astronomy**

Victor Daimaca attended school in Turnu Severin and he graduated from the Traian High School in 1913. His interest in the stars was awakened around the age of nine when he read the fantasy novel 'La fin du Monde' by Camille Flammarion. Published in 1893, Flammarion's book presents the extinction of mankind after the impact of a comet with the earth in the 25th century. Little Victor did not understand many things in the book, among them being the

astronomical notions. His older brother came to his aid and in a first evening of initiation, observed together, "the clear dome of the sky of Turnu Severin". Then, at the age of 14, in August of 1907, Victor observed a comet, C/1907 L2 (Daniel), for the first time. That celestial spectacle would forever galvanize his attraction to astronomy,

*"Since then, the charm of the starry nights has impressed me strongly and brought me definitively closer to the world of stars."*

He began to systematically study the sky, so that by 1908, he knew the zodiacal constellations and the bright planets. Having reached the age of high school, the young Victor formed a group with his school friends called the Urania Astronomical Society. They held talks on

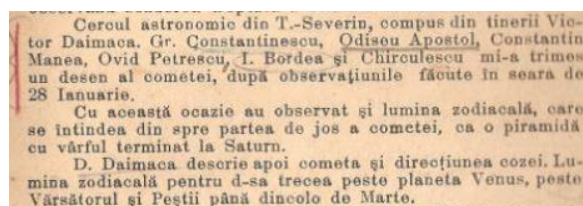


theoretical notions of astronomy and using an elementary course of Cosmography by Spiru Haret and another by Delauney. In the evening they made observations on the banks of the Danube, where there was a good clear open horizon. They sent the results to Victor Anestin in Bucharest, who published the more interesting ones in his magazine, Orion. The Orion magazine was founded in November 1907 and was dedicated to the popularisation of astronomy. Having become a declared disciple of Victor Anestin, Daimaca pursued,

*“with due attention all of his translations of Popular Astronomy, published in the Biblioteca pentru toti and Minerva collections”.*

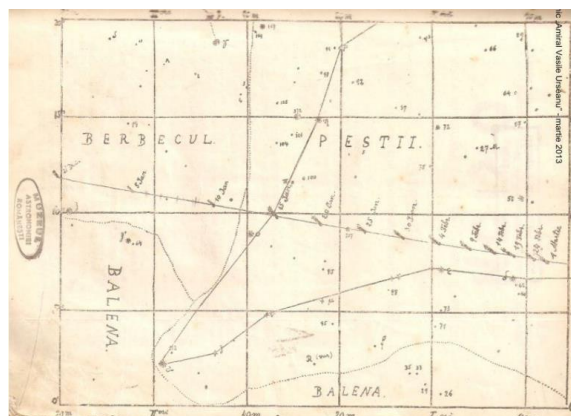
At the high school library, he found other works on the popularisation of astronomy by Camille Flammarion, namely Popular Astronomy, The Stars and the Curiosities of the Sky, and Earths of the Sky. The young amateur astronomers naturally wanted to buy a telescope. But, as happens to many they had no money, only hopes. This is how Victor Daimaca would describe, half a century later, his condition and his level of astronomical knowledge, while in high school,

*“I knew the constellations in detail, the names of the shining stars, I followed the movement of the planets visible to the naked eye, through the zodiac. In 1910 I found with binoculars the planet Uranus in the constellation Arcasul (Sagittarius) using its ephemeris, published in Flammarion's astronomical yearbook for that year. I had the opportunity to see 4 bright comets and another 3 weak ones with binoculars. They had been announced in time by Orion magazine.*



**Published observations of comet C/1910 A1 observed by Victor and six members of the Urania AS.**

*Among the faint comets, also called telescopic ones, was Halley's comet found in September 1909 on a photographic plate in Germany by Max Wolf, the director of the Heidelberg astrophysics observatory. It was approaching the Sun, increasing its brightness and developing. In the spring of 1910, it was supposed to be visible to the naked eye.*



**The path of Comet 1P/Halley Orion Magazine, November 1909**

*In March, using a drawing of the comet's positions in the sky, published in the Orion magazine, I saw it with the naked eye; it was of the 6th magnitude. It was in the constellation of Pisces, south of the square of Pegasus.*

*I immediately wrote to Victor Anestin about what had happened. They quickly announced my feat in Orion magazine and in the Universul newspaper. I think I was the only one in the country who had seen the famous comet with the naked eye... In 1911, around August, the newspapers announced that a comet discovered by Brooks in the constellation Lebada (Cygnus) had appeared in the sky (C/1911 O1). I found her with*

*binoculars, she was too small, she couldn't be seen with the naked eye. Since it was also approaching the Sun, it became bright in September, with a tail 10° long, in the constellation Dragonul (Draco). The following year, I found, according to the indications of the Orion magazine, comet Quenisset (C/1911 S2) in Serpens and comet Delavan (C/1913 Y1) in Ursa Major, both of which could only be observed with binoculars."*

For the observation of Halley's comet in 1910, a group of teachers from Turnu Severin ordered a 108mm Bardou refractor from France. However, Victor Daimaca was the one who managed to observe the comet, even with his naked eyes, thanks to his intense observation and knowledge of sky. Many of these observations were made from the attic of his parents' house where he set up an observation point: he made a hatch by temporarily removing some tiles from the southern roof, and added a table and a chair for consulting the sky maps, and a pair of Zeiss 6x binoculars.

*"In 1913 I graduated high school and with great sorrow I had to leave all these activities"*

There followed a hiatus in the astronomical activity of Daimaca, lasting almost three decades.

### **Teaching career**

After graduating from high school, military service followed, then the First World War broke out with all its misery and hardships, including financial ones. Since he could not pursue university studies immediately, Daimaca took a job as a civil servant in Bucharest at the Ministry of Education. He married, the children came and time for astronomy became harder to find. With great effort, he later graduated from the Faculty of Science in Bucharest, with a degree in Mathematics. To gain income he

taught mathematics, and gave private tuition to students. He advertised his services in ad no. 672 in the Universul newspaper of November 6, 1924:

*Analytical, descriptive geometry, algebra, mechanics, trigonometry, physics, chemistry teaches private exams, Victor Daimaca, (Str.) Burebista 2*

In 1929, he left the capital and started working as a substitute teacher at various schools in Targu Jiu, such as the Academy of Trades and the Normal School for Boys. His situation was gradually improving, and he became tenured as a mathematics teacher at the Tudor Vladimirescu High School in Targu-Jiu. On September 20, 1938, there was a fire that destroyed the local electrical plant. The street lighting and light pollution fell away and the starry sky began to be seen as an enchantment above the city immersed in the night. Then the mandatory camouflage after the outbreak of the Second World War would prolong the favourable conditions for astronomical observations.

### **The saga of the Goerz 15x60mm binoculars**

Not long after the fire, Polish prisoners of war began to appear in Targu Jiu, in the internment camp set up there for them. It was said that on the way to the camp, on the platform of the North Railway Station in Bucharest, a Polish officer offered a local man a wonderful pair of binoculars for a cup of milk. The Romanian astronomical literature, highlighted the prominent role played by these binoculars in Victor's comet discoveries. In an autobiographical note, he simply calls them 'binoculars' and recalls their magnification, which was 15x. There was a typing error and in the printed text of the note, we read, 13x magnifying binoculars. Virgil Scurtu assumed the binoculars to be of Zeiss Delfort brand; the astronomer Calin Popovici cites the binoculars as 'marine'. But the Delfort

binoculars have a magnification of 18x, not 15x, and the marine binoculars have a special appearance, very chunky due to the needed protections against the elements. They were very different from the sleek look of the binoculars seen in photographs of Victor Daimaca. Through internet searches and comparisons, this author came to the conclusion that the main binoculars used could be a C.P. Goerz 15x60mm Pernox.

Goerz 15x60mm Pernox binoculars were produced in small quantities in the years after 1920 for military use only. These binoculars are evidence of the very early violation of the treaty of Versailles by Germany, after WWI. We can only speculate that these high-quality and high-performance (therefore expensive) binoculars were produced in small quantities especially for certain German military departments or intelligence services.

It is well known that the technical ability of the Polish army was much less than that of the Wehrmacht. It seems very unlikely that the Goerz 15x60mm Pernox binoculars were part of the equipment of the Polish army. That's why the ownership of the Goerz 15x Pernox binoculars by the Polish prisoner (and the ease with which he gave it up just for a cup of milk) seems unlikely to me. I therefore assume that the binoculars were actually war booty and that's why the Polish officer strived to get rid of it before reaching the prisoner of war camp.

My research indicates that the binoculars probably changed hands several times before they reached Victor. Whatever the truth of the story is, obtaining excellent binoculars and the existence of favourable conditions for astronomical observations rekindled his astronomical passion. We find him in the spring of 1943 observing the comet, named by Daimaca, Whipple-

Fedke. Due to the difficulties caused by the war, communications were delayed and cumbersome. This was the last of the six comets discovered by Fred Whipple from Harvard, USA, but it turned out that the comet was also independently discovered by Carl Fedke from Königsberg, Kaliningrad and G.A. Tevzadze from Georgia. The correct name of that comet is C/1942 X1 (Whipple-Fedke-Tevzadze). After spectacular brightness fluctuations that brought it up to magnitude 3.5 at the end of February 1943, this comet would fall below the limit of visibility with the naked eye in April and in May, when Victor did not see it again, even with the infamous Goerz binoculars.

### **C/1943 R1 (Daimaca)**

*"Then I decided to look for new comets myself. I immediately started the nocturnal work of researching the sky. I had all the conditions to succeed. I could discover faint comets up to the 9th magnitude with binoculars. I had known the constellations for years. I had a Dien-Flammarion atlas with the stars and nebulae shown up to the same magnitude 9. The atmosphere had a rare transparency, the horizon was free, almost in all parts. The city was poorly lit at night, even at 12 o'clock at night all the electric lights went out. In the clear nights and without the light of the Moon, the sky loaded with thousands of stars was magical, just like in fairy tale. I was looking for comets among the stars from the yard of the house. My observatory was some fence post, on which I rested my binoculars."*

Success was not immediate, but eventually it came,

*"All night I was searching the sky! No comet was visible. I continued the search in the moonless nights, with the same determination. Finally, on the night of September 3, towards dawn, I pointed the binoculars towards the constellation Lynx. I*



saw a suspicious-looking star next to other stars in the field of the binoculars. The star did not have a dot like image. I looked at it carefully. It seemed to be a round, whitish, diffuse and extremely small spot. Is it a nebula? Will it be a comet? I entered the house, examined the atlas where, in the region in question, I saw represented the stars from the field of the binoculars, but not the strange little star. I knew that a comet no matter how far away is it, and no matter how small it seems, it must move among the stars. I resumed the research. The star was still in the same place. It probably had not time to move sensibly. I could not ascertain the eventual displacement because the stars had begun to be veiled by the light of dawn, the brighten up of day. I stopped the research and postponed everything for the second night. The following night, in the same part of the constellation Lynx, the stars from the last evening were in the field of the binoculars placed in the same way. The suspicious star had disappeared. Where did he go? I look to one side, I look to the other side, it was not visible. Finally, I found it moved towards Ursa Major,  $2^\circ$  away from the initial place. It was a comet! I had discovered a comet! I noted the position and the time of the discovery on the atlas.

The following night, namely on September 5, the comet had reached even further. I noted the positions occupied by the comet successively on the sky on the atlas, I estimated the diurnal movement of the star and the direction in which it moved on the celestial sphere. I made a sketch with the future positions of the comet for several nights, with the neighbouring stars where it would pass. I sent the following telegram to the Astronomical Observatory in Bucharest: 'New comet, magnitude 8 in the Lynx, on the line alpha Gemini - epsilon Ursa Major, diurnal displacement  $2^\circ$  towards omicron Ursa Major'.

The telegram sent from Targu Jiu in the morning of September 5, reached the

Observatory after 3 days. The delay was due to the interception of the telegram by the German Gestapo, who thought it was an espionage message, since in 1943 the camp for political prisoners was at Targu Jiu. Eventually convinced that the telegram had an astronomical character, they let it go.

In this interval, Victor also sent the sketch on which he had crossed the approximate equatorial coordinates of the comet, evaluated according to the atlas. The postcard with the sketch was useful to the Observatory, because it helped identify the comet with the great equatorial telescope close to the place he knew. If he had not sent the postcard, the comet would be lost, due to its rapid movement in the sky. At dawn on September 9, the Bucharest Observatory found it and described it as follows, 'the object was diffuse, of the 8th magnitude with a beginning of a tail smaller than a degree'. The comet was photographed on September 9, 10 and 11 with the Zeiss camera. The discovery and the approximate positions for the nights of September 9 and 10 were telegraphically communicated on September 10 to the Central Bureau of Astronomical Telegrams of the International Astronomical Union, from Copenhagen, which transmitted them all over the world. The comet had not been observed by anyone before and therefore received the name 'Daimaca 1943 c'. That's how he became a comet discoverer.



The notice of the discovery of his comet 1943 in *Universul* newspaper.

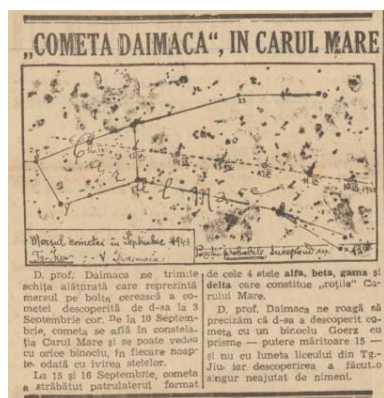
The news about the discovery of a new comet reached the public through

newspapers. From now on, the event was largely and often commented upon in pages of Romanian newspapers, journals and the international press.



**Instructions by Daimaca on how to observe his comet.**

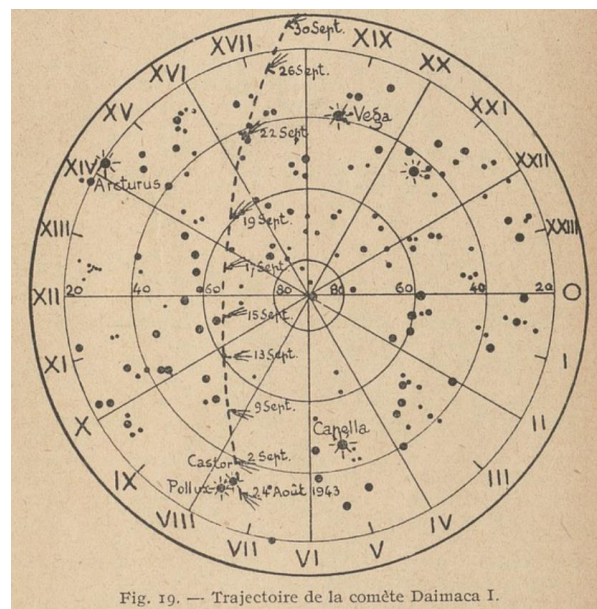
Daimaca published more instructions in the Romanian press with maps to help observers to follow his newly discovered comet.



**Further instructions on how to observe his comet in the Romanian Press**

In November, the IAU named the comet as a new object, bearing the name of Daimaca. On December 4, 1943, academician Ghe Demetrescu presented the paper of assistant-astronomer Calin Popovici which described the visual and photographic observations of the comet and the computed orbit parameters. Calin Popovici published a paper about comet Daimaca 1943 c in the third edition of the Yearbook

of the Observatory of Bucharest for 1944 and presented Comet Daimaca in the radio show, 'The Eyes of Astronomy' on February 15, Radio Romania and Radio Bucuresti stations.



**The apparent trajectory of the Comet of 1943**

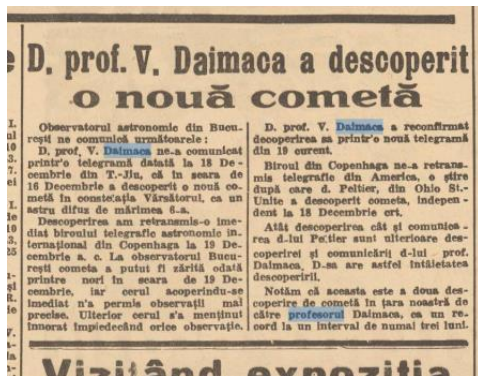
### C/1943 W1 (van Gent-Peltier-Daimaca)

Encouraged by this first success, Victor Daimaca continued to search for new comets. He writes,

*“On the evening of December 16 (1943), I found with the binoculars a comet in the southern region of the Aquarius constellation, close to the horizon, to the west. I saw her through a break in the clouds. In that region of the constellation, where the stars A1, A2 and others twinkled, there could be nothing else with a nebulous appearance than a comet. I studied the celestial atlas. Indeed, the object I saw was a comet. I immediately telegraphed my observation to the Observatory. The observatory immediately sent the news to Copenhagen, without wasting precious time, with the identification of the object. It turned out after a few days that it was comet van Gent, found at the Iohannesburg Observatory, in the Transvaal - South Africa. The comet had passed perihelion, was*

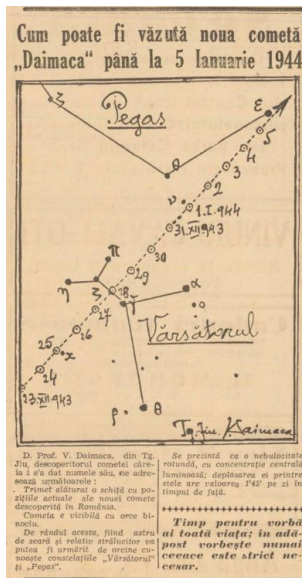


climbing among the constellations towards the northern celestial hemisphere, until it appeared above the horizon. It headed towards Pegasus. The office in Copenhagen informed our observatory that it has received the news from the United States that the American discoverer Peltier (also an amateur) had also discovered it. Our telegram arrived in Copenhagen after the American's telegram, although I had discovered it before him. The comet was named "Van Gent-Peltier-Daimaca".



Notice of the Discovery of Comet van Gent-Peltier-Daimaca 1943.

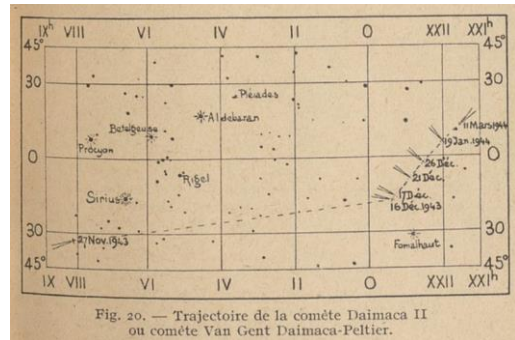
Also, for this comet, Daimaca published instructions for observers.



Instructions by Daimaca on how to observe Comet van Gent-Peltier

The magazine l'Astronomie of the Société Astronomique de France published in

Paris, on January 1, 1944 an article analysing both Daimaca comets.



## Other comets

For the above comets Victor Daimaca was recognised and certified by the IAU as a discoverer. In total, he independently identified seven comets but only C/1943 R1 and C/1943 W1 were credited as discoveries. Below I list the other comets found independently by him but which were named to other discoverers.

On March 25, 1944, Daimaca found a comet in the constellation Camelopardalis,

*"In the spring of the following year (N.A. 1944) I resumed the research. In the constellation Girafa (Camelopardalis), on March 25, 1944, I found a comet. Following my telegram, the Observatory replies that it is comet Timmers, found at the Vatican Observatory."*

It should be noted that the information above contains two errors. The object in question could not be the comet C/1946 C1 (Timmers) because that was discovered on February 2, 1946. The second error is more hidden from view; it turns out that the Observatory's answer was given after the discovery of Timmers' comet, with a delay of two years.

This is really the third comet discovered by Victor but lost due to the delay of two years waiting for a call of discovery of a new comet. Again, whilst the Gestapo had



added a delay of three days to the telegram referring to comet Daimaca 1943 c, the Marxist regime installed after WWII in Romania cut off completely any sort of communication with the outside world. No more telegrams, foreign yearbooks, magazines, alerts, phone calls or travels for the next 44 years. All had to have the approval of the political police, which took years to be obtained, if ever granted at all.

On July 30, 1945, in the constellation Libra, Victor found another new comet. Astronomer Calin Popovici from the Bucharest Observatory describes the event as follows on page 4 of the newspaper Universul of August 8, 1945.

*"Professor Daimaca from Tg Jiu, who discovered 2 more comets, announced to us that on the evening of July 31 he discovered a new comet in the constellation Libra, of magnitude 7. He called us that very evening from Tg. Jiu, specifying the position of the comet at 11 p.m., namely: right ascension 15h 45 min, southern declination 14°. Professor Daimaca is a passionate researcher of the sky, he possesses a good marine binocular with which he made all the discoveries."*



**The notice of the recovery of Comet 22 P Kopff by Damiaca.**

In his memoirs, Daimaca says with restrained bitterness about the above comet,

*"I haven't had any confirmation from the Observatory. I was able to follow this comet with binoculars until September, when it reached the constellation Scutul (Scutum), under Aquila. Only after 4 years, regarding this comet, here are the few lines from the postcard that Comrade astronomer professor Calin Popovici wrote to me, dated August 1, 1949, I quote, 'Since your comet from 1945, July 30, was lost because at that time we did not have direct communications with Copenhagen and those whom I entrusted with the communication of the discovery didn't do it'. Due to unfavourable circumstances, it was lost to us! Subsequent after my discovery, a German found it and the comet was named Kopff's Comet."*

Despite my searches, I did not find any comet to be discovered in the Summer of 1945 by a German astronomer. But in that year, the periodic comet 22P/ Kopff, discovered on August 23, 1906 by August Kopff, passed at perihelion. It was recovered on February 7, 1945 by H. L. Giclas from the Lowell Observatory. The passage to perihelion took place on August 11, with the maximum brightness forecast for the month of July but of no more than magnitude 12 (G. Van Biesbroeck). The orbit of comet 22P/ Kopff was modified by Jupiter starting with the transition to perihelion of 1939.

The position of comet 22P reported on July 30 by Daimaca corresponded well with the ephemeris of the Polish astronomer F. Kepinski, cited by van Biesbroeck. In 1945, Jovian interference manifested itself again and resulted in an unexpected increase in the brightness of comet 22P up to magnitude 8.5. One of the witnesses of this phenomenon was Victor Daimaca and this is why he was able to follow this periodic comet until September. He notes further comets in his observations,

*"On September 5 1946 I found another one, it was comet Giacobini Zinner. On October 14, 1947, I found Encke's comet in the Lynx, a periodic comet like the previous one, therefore expected by astronomers."*

The rediscovery of comet Encke, (now 2P/Encke) by Daimaca was briefly described in a note published on the front page of the newspaper "Universul" on Friday, October 24, 1947.



**The notice of the recovery of Comet Encke**

*"On June 22, 1948, another comet, it was the Honda comet."*

This is the comet discovered independently on June 2, 1948 by amateur astronomer Minoru Honda from Japan and on June 4 by Italian amateur Giovanni Bernasconi. That is why the object received the name of C/1948 L1 (Honda-Bernasconi).

On July 21, 1955, Daimaca returned for a short time to Targu Jiu, and discovered the comet C/1955 N1 (Bakharev-Macfarlane-Krienke). This comet had already been named after A.M. Bakharev from the Observatory of Stalinabad/ Dushambe, Tajikistan.

Victor Daimaca discovered, through searches carried out according to the method described at comet 1943 c, a total number of eight comets: two approved comets named after him by the IAU as:

- C/1943 R1 (Daimaca)

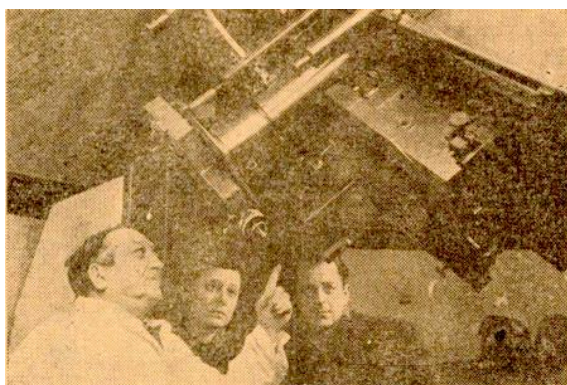
- C/1943 W1 (van Gent-Peltier-Daimaca)
- three comets attributed to other discoverers:
- the lost comet pseudo-Timmers
- Honda-Bernasconi 1948 g
- -Bakharev 1955 f
- three recoveries of periodic comets:
- 22P/ Kopf
- 21P/ Giacobini- Zinner
- 2P/ Encke

### **The research astronomer and patriarch of amateur astronomers**

In November 1946, Victor Daimaca was awarded the Donohoe Medal by the Astronomical Society of the Pacific, for the discovery of the comet C/1943 R1.



In 1950, Victor Daimaca left Targu Jiu, and moved to Bucharest. There he continued his activity as a high school teacher but also as head of sector at the Astronomical Observatory of the Academy. The move to Bucharest put an end to his search for comets. At the Observatory, Daimaca's activity focused mainly on the research of asteroids. Later the Romanian state granted him a merit pension, in recognition of his work. He was the subject the article 'The Astronomer's Work', published in the newspaper Viata Capitalei on January 29, 1954: there are mentioned the comets discovered by him, his new activity as an astronomer and the Observatory is also described.



*Victor Daimaca at the Zeiss camera, of the 15" equatorial*

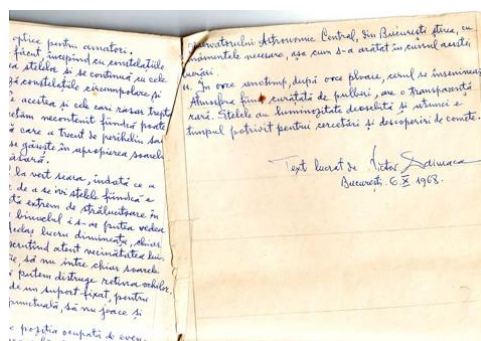
Victor Daimaca himself wrote articles on popular astronomy in the press of the time. An example is the article "The Eclipse of the Sun" which was about the eclipse of June 30, 1954, published in the newspaper Scanteia Tineretului, June 29, 1954. In the magazine Gazeta Matematica/ Math Gazette, he published periodical articles for amateurs of astronomical observations, such as The Sky in the Month of March series B, 1955, page 69. In 1965, in the magazine Ramuri published in Turnu Severin, he published an autobiographical note in which he briefly presents his evolution as an amateur astronomer and encourages others to practice astronomical observation.

Victor Daimaca maintained his ties with the community of amateur astronomers. On May 9, 1968, he attended a public conference at the Popular Observatory in Bucharest, most of the audience being amateur astronomers from the "Friends of the Cosmos" Astronomical Club. This conference, rich in biographical and astronomical details, was later published in "Andromeda", the bulletin of the Astroclub Central Bucuresti (formerly the "Friends of the Cosmos"), published as a single issue for the year 1969.



*Victor Daimaca in 1968 aged 76 with his beloved 15x60mm Goerz binoculars*

Enjoying the attention of the public, Daimaca participated in public conferences on astronomical topics. At the completion of a quarter of a century since the discovery of his first comet, he spoke about his discoveries at the Popular Observatory in Bucharest. He was congratulated by the staff of the observatory and by the members of the Astronomical Club the title, Friends of the Cosmos, according to the newspaper Informatia Bucurestiului, September 3, 1968. On October 6, 1968, Daimaca finished writing an observation guide for amateur astronomers. Unfortunately, this guide was not published but became available for sale on the Internet in 2010.



*The closing note of the unpublished observing guide*



Victor Daimaca died on May 20, 1969 and was buried on May 23, 1969, at 10 a.m., at the "Izvorul Nou" Cemetery in Sector 3-Dristor, Bucharest. In the newspaper "Romania Libera" of September 1, 1973, the note 'Daimaca Comets' appeared on the occasion of the 30th anniversary of the discovery of the two comets bearing his name. Later the 'Astronomical Circle Victor Daimaca' at the Traian High School in Turnu Severin was created. Members of the Astronomical Circle trained their colleagues on visual observing, photographing and drawing of the comet Kohoutec. Inspired by Daimaca's example, we see the amateurs of the area pursuing further the comets.

According to the newspaper "Romania Libera", 17 Oc. 1983, the philatelic circle of the 'House of Pioneers in Targu Jiu issued a philatelic envelope dedicated to the 40th anniversary of the discovery of Comet Daimaca. On the same occasion, at the Post Office no. 5 of the municipality, a special stamp was used.



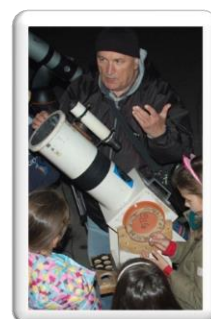
*Envelope dedicated to the 25<sup>th</sup> anniversary of the death of Victor Daimaca*

In 2010, Zenovie Carlugea published the book, 'Victor Daimaca, discoverer of

comets' at the "Scrisul Romanesc" Publishing House.

A street and an alley in Bucharest, the Capital city of Romania, bear his name. Turnu Severin, his home city and Targu Jiu, the city where he discovered the comets, also honour his memory with a street name each. In Targu Jiu is the Computer Science High School 'Victor Daimaca, an educational private institution.

Is Daimaca the first and only Romanian astronomer to discover comets? As I showed in the 2022 issue of The Comet's Tale, the answer is no. The first Romanian to discover a comet was Wolfgang Pauly, co-discoverer in 1898 of C/1898 L1 (Coddington-Pauly). This priority of Pauly does not diminish Daimaca's merits. While Pauly discovered his comet by chance, Victor Daimaca was the first Romanian astronomer to systematically search for new comets. He developed his own method and applied it with exceptional consistency and diligence. And he succeeded.



*Mircea Pteancu  
mirceapte@yahoo.com*

## 10 J.M Schaeberle's 19<sup>th</sup> Century comet discoveries: Two that were and one that was not! Denis Buczynski



*Born as Johann Martin Schäberle 1853-1924*

In the second half of the 19<sup>th</sup> Century visual comet discoveries were the norm. At that time, in the USA, there were three comet seekers, Lewis Swift, Edward Emerson Barnard and William Brooks, who were the dominant figures in this process, discovering 55 comets between them.

Also, in the USA, there were many small college and University observatories which employed full time astronomers, charged with the discovery of comets in addition to their other duties and researches. Chief amongst these were the Tuttle brothers who worked and observed at the Harvard College Observatory in the late 19<sup>th</sup> Century and regularly discovered comets

with as many as 20 comets independently discovered between them.<sup>3</sup>

Johann Martin Schäberle was born in Württemberg, Germany in 1853. His parents moved to Ann Arbor in Michigan USA in 1854, and there, with a now anglicized version of his name, Schaeberle spent most of his life. He was apprenticed to a machine shop in his teenage years and he became interested in astronomy at that time. He graduated from the University of Michigan in 1876 and he began making telescopes for his personal use. He also made many mirrors ranging from 8 to 24 inches in diameter.



*Detroit Observatory*

In 1872 Professor Watson of the Detroit Observatory (a famous discoverer of minor planets) visited Schaeberle at his home-built observatory and was impressed with the instruments the young man had built and the observations he was making. Watson provided facilities at the Detroit Observatory for Schaeberle to continue

<sup>3</sup>

1) <https://adsabs.harvard.edu/full/2012AntAs...6...74S>

making telescopes and in 1876 invited him to join the University Observatory as an instructor in astronomy.

Schaeberle used his telescopes for comet seeking and on 1880 April 17, using one of his 8 inch telescopes at his home observatory, he discovered Comet C/1880 G1 at magnitude 12 in the northern polar skies. This was the first of his comet discoveries. C/1880 G1 never became a bright comet, however it was well observed, mainly in Europe and the UK by the leading comet observers of the period. Schaeberle, amongst others, computed an orbit for the comet.

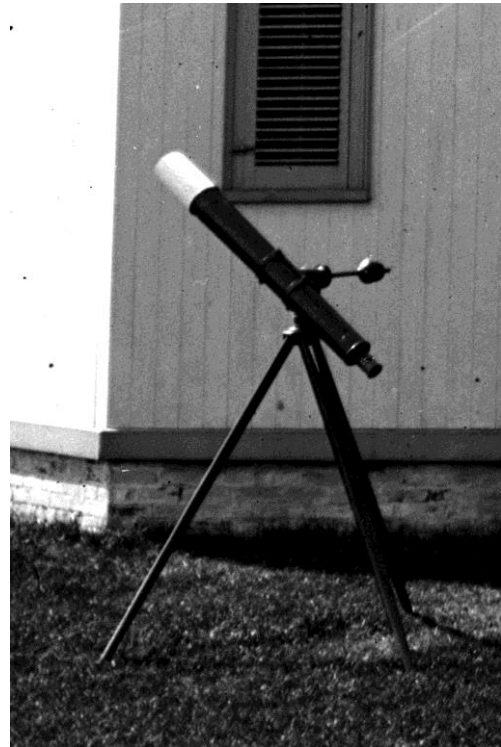
The discovery of comets was seen as feather in the cap of the University and College observatories, and brought public attention and approval. This stoked great competition by observatories and amateurs around the world to find new comets.

By 1881 Schaeberle was involved in the research at Detroit Observatory and one of his duties was to show members of the public the astronomical sights through the telescope in the small student's observatory. On the night of 1881 July 14 such a session was taking place and here is an account of that night (2003JAHH....6...69W):

following year, on July 14, he discovered the fourth comet of 1881 with the Fitz comet-seeker at Detroit Observatory. Details of the discovery are recorded in a letter written by one of his students:

With another woman student I had been working under Mr. Schaeberle's supervision in the smaller [Students'] observatory until the wee hours of the night and we were about to close up when someone suggested that a conjunction of the major planets would be visible later. We were anxious to see it and Professor Schaeberle with the patient, kindly courtesy which was characteristic of him offered to stay. While he was waiting for us he took a little portable telescope which was standing in the yard—I think they called it a "comet seeker"—and began to look around the heavens. Presently he hurried into the observatory and asked to use the telescope. We found that he had seen a comet and learned later that he received an award of several hundred dollars for the discovery. But the money didn't seem to interest him as much as the comet. (Greathouse, 1925).

Schaeberle had discovered C/1881 N1, his second comet, this time using the Observatory's Fitz comet seeker telescope. For this discovery he received a monetary award from the Warner Prize fund. This comet became bright enough to be detected by the naked eye and showed a tail in the telescope. It was very well observed in Europe, the UK, South Africa and Australia between July and October 1881.



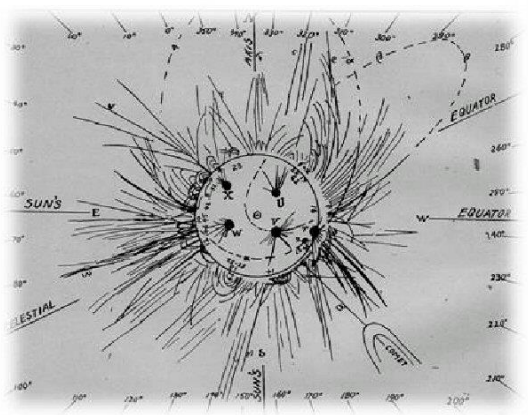
*Fitz cometseeker*

By 1886 he had risen to the post of Acting Assistant Professor at Detroit Observatory but in 1888 he left and became one of the inaugural astronomers at the newly founded Lick Observatory on Mount Hamilton in California.

At Lick, using the 36 inch refractor, he was able to employ his considerable visual observing skills and was rewarded with the discovery of the 13 magnitude companion star of white dwarf Procyon.







***Schaeberle's drawing of coronal structures***

In later years (1989) E.W. Cliver suggested that this 'comet' was actually a disconnected coronal mass ejection. He and another researcher, D.F. Webb, looked at an event that took place in 1980 April 5 and commented, "that it bore a remarkable resemblance to the 1893" comet". The consensus today is that the "Sungrazer comet" that Schaeberle discovered in 1893 was a solar related event. Thus, almost a century later his comet discovery total was reduced by one.<sup>4</sup>

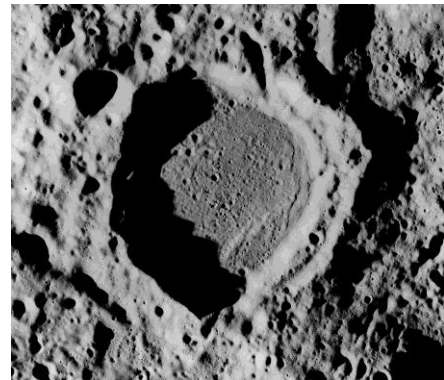


***A disconnected coronal mass ejection***

In 1897 he became Acting Director of Lick Observatory, a monumental journey for someone who started life as an amateur astronomer. He expected to be appointed full time Director in 1898 but internal politics within the Observatory and University prevented this from happening.

He left Lick and returned to Ann Arbor where he lived out the rest of his life, never accepting another formal position in astronomy. Instead, he continued to make telescopes and conduct observations based on his personal interest. He died in 1924 at the age 71 at his Ann Arbor home. Over his career he published more than 100 academic papers and was held in great regard by his contemporaries. He reached the heights as a professional astronomer but he began his astronomical career with a comet discovery.

If you want to see Schaeberle today, look at the crater named after him on the Moon.



***Crater Schaeberle***

In respect of his last "comet discovery" on those total solar eclipse plates I am reminded of that famous quotation by William Shakespeare, "all that glisters is not gold".



***Denis Buczynski  
BAA Comet Section***

<sup>4</sup>

<https://adsabs.harvard.edu/full/1989SoPh..122..319C>

<https://www.mreclipse.com/SENL/SEComets/EC18930416.htm>

## 11

## Comet Section Contacts

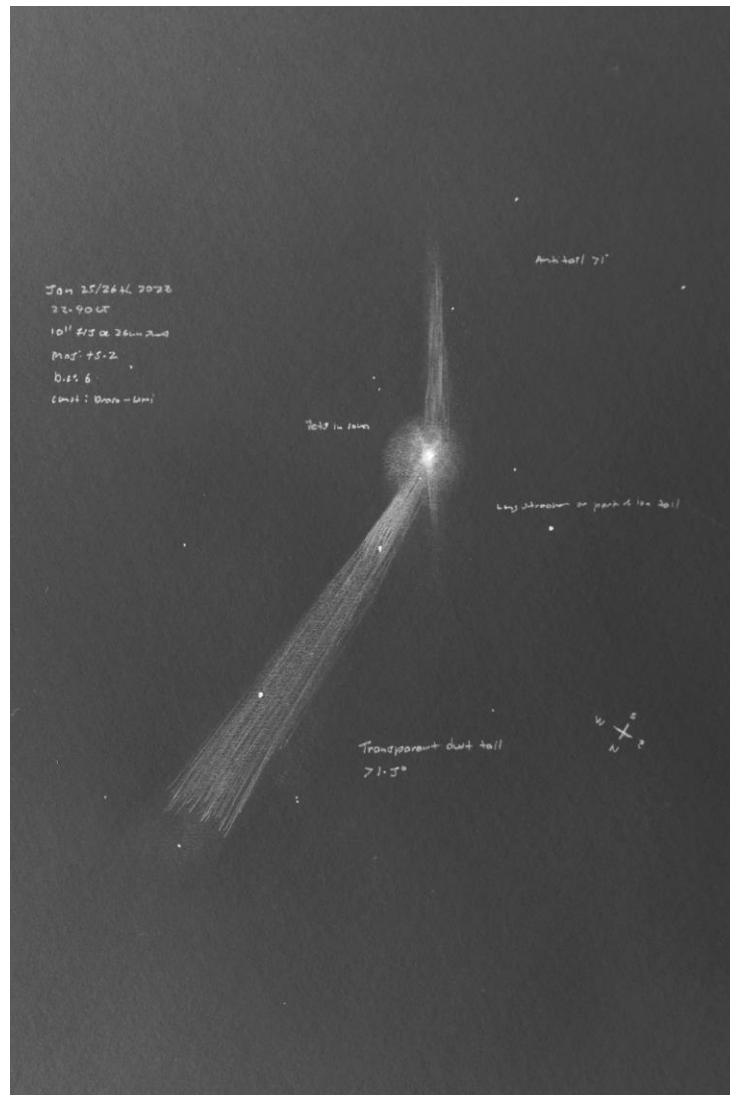
Director	Nick James, 11 Tavistock Road, CHELMSFORD, Essex. CM1 6JL England. Phone: (+44) (0)1245 354366 E-mail: <a href="mailto:ndj@nickdjames.com">ndj@nickdjames.com</a>
Visual Observations and Analysis:	Jonathan Shanklin, 11 City Road, CAMBRIDGE. CB1 1DP England. Phone: (+44) (0)1223 571250 (H) or (+44) (0)1223 221482 (W) Fax: (+44) (0)1223 221279 (W) E-Mail: <a href="mailto:jds@ast.cam.ac.uk">jds@ast.cam.ac.uk</a> or <a href="mailto:j.shanklin@bas.ac.uk">j.shanklin@bas.ac.uk</a> website: <a href="http://www.ast.cam.ac.uk/~jds/">http://www.ast.cam.ac.uk/~jds/</a>
Secretary:	Denis Buczynski, Templecroft, Tarbatness Road, Portmahomack, Near Tain, Ross-Shire IV20 1RD Scotland Phone: (+44) (0)1862 871187 E-mail: <a href="mailto:buczynski8166@btinternet.com">buczynski8166@btinternet.com</a>
TA Liaison Hampshire. (and also, Editor of <i>The Astronomer</i> magazine)	Guy Hurst, 16 Westminster Close, Kempshott Rise, BASINGSTOKE, RG22 4PP England. Phone & Fax: (+44) (0)1256 471074 E-Mail: <a href="mailto:editor@theastronomer.org">editor@theastronomer.org</a>
CCD Imaging Advisor	Peter Carson <a href="mailto:mailto:petercarson100@gmail.com">mailto:petercarson100@gmail.com</a>
Comet's Tale and Newsletter Editor	Janice McClean <a href="mailto:events@britastro.org">events@britastro.org</a>



# Picture Gallery

## Copyright of all images belongs to the observer

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[C/2022 E3 2023 Jan 25 2240 UT M Mckenna](#)

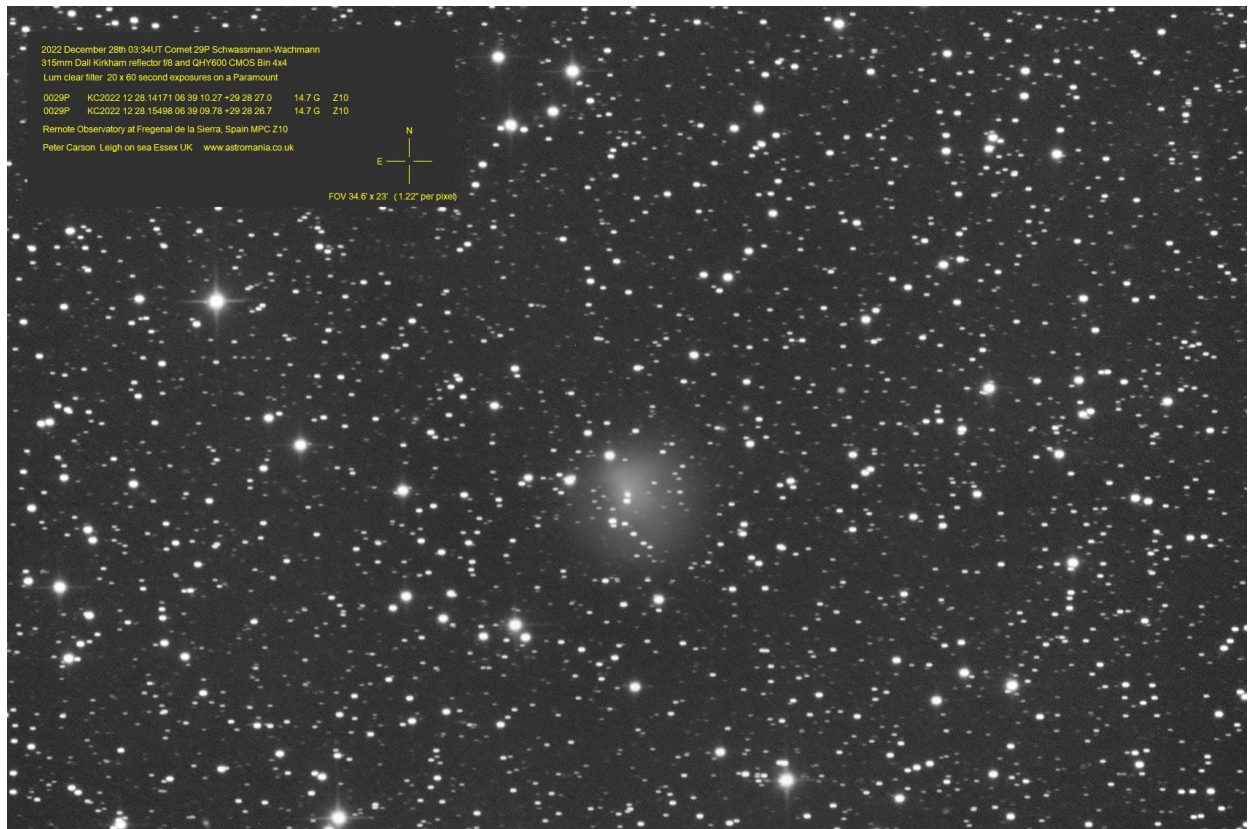
Sketch and observation of C/2022 E3 (ZTF) from 2023 Jan 25 at 22.40 UT using a 25cm f/5 reflector and 26mm 2" SWA eyepiece. Location, Cookstown, Co. Tyrone, N. Ireland.

DC: 6, mag +5.2, located between Draco and Ursa Minor.

Anti-tail 1°, transparent dust tail 1.5° or longer. Elongated streak is an isolated long streamer or else a portion of the gas tail. Jets were visible inside the coma. Observed with naked eye as an oval patch with a hint of green, tail also seen without optical aid as an elongated streak at an angle to the north, only time I've seen the tail without optical aid during entire apparition. Sketch is made from memory based on log book notes. The stars are fictitious and only added to provide an example of the scene I observed. Dust tail was enhanced close to the coma for 15 arc min's before fading into the main tail.

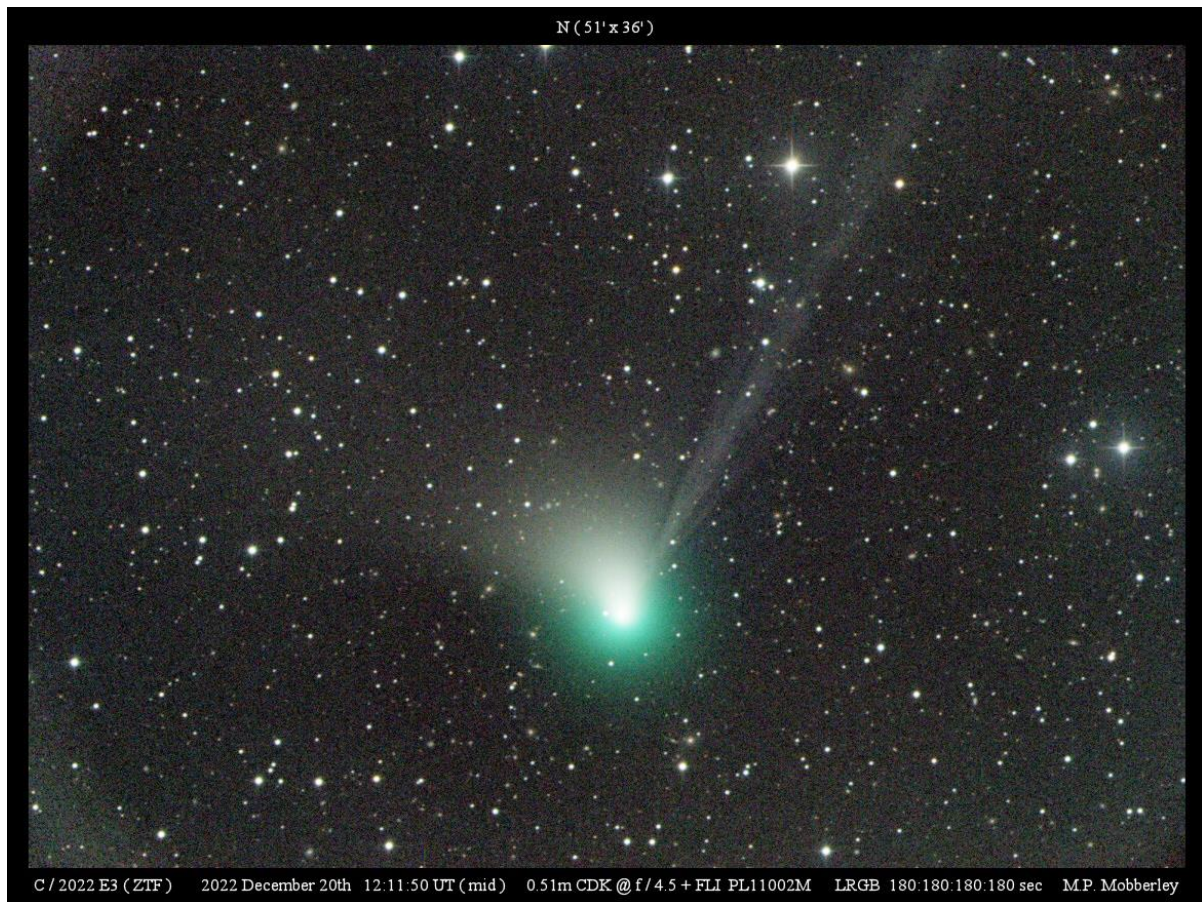


*C/2022 E3. 2023 Feb 13. 1846UT.  $2.5^{\circ} \times 1.7^{\circ}$ , N up. Tak Epsilon 160, f/3.3. Sony A7s. Denis Buczynski*



*29P. 2022 December 28 0334UT  $35 \times 23$  arcmin, N up. 0.32-m, f/8, QHY600. Peter Carson*



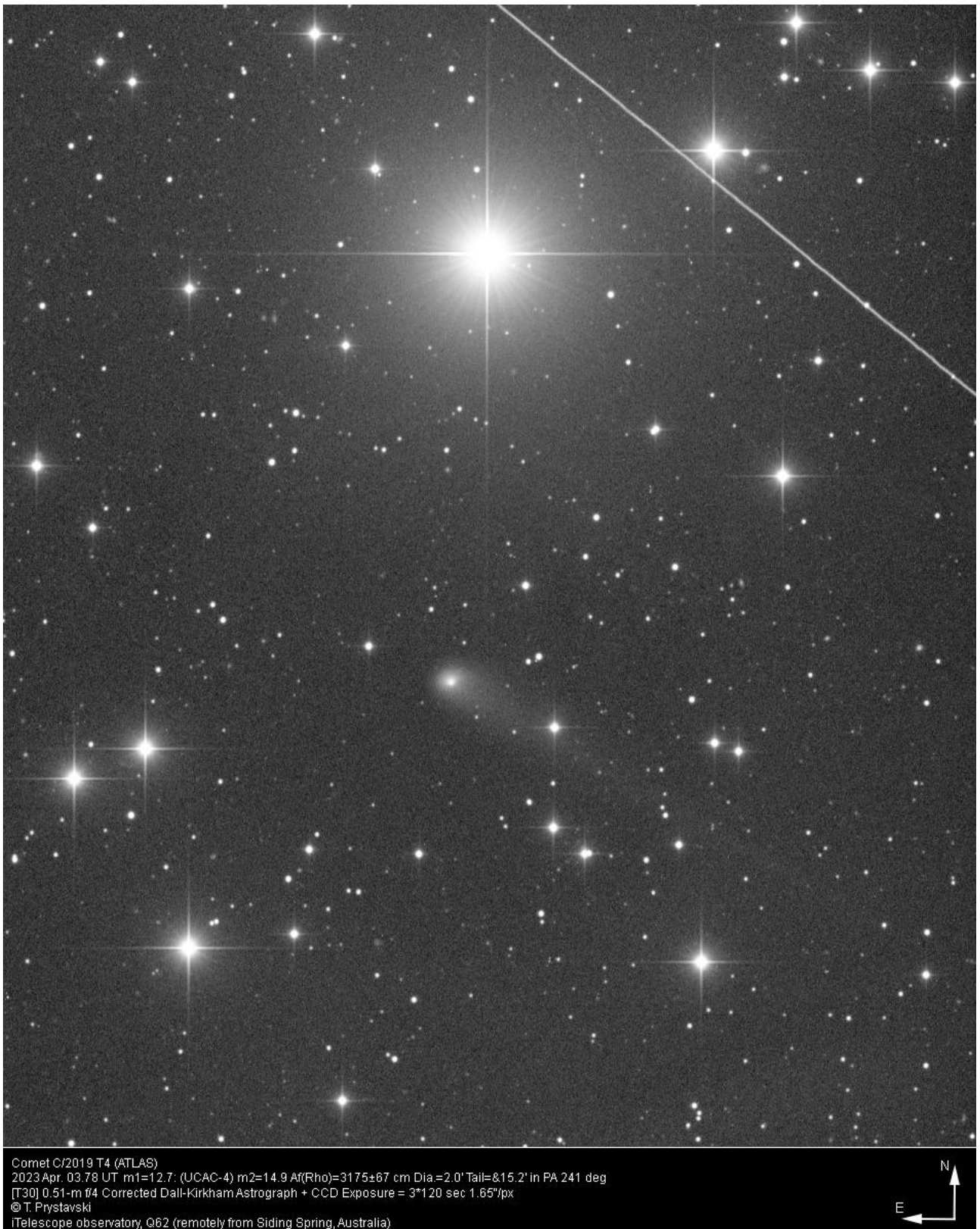


*C/2022 E3 (ZTF) 2022 December 20 1212UT. 51×36 arcmin. N up. 0.51-m CDK. Martin Mobberley*



*C/2022 A2 2022 December 25 1040UT, 65×54 arcmin, N up. 0.28-m RASA. D Bartlett*





*C/2019 T4 2023 April 3 0346UT. 26x33 arcmin, N up. 0.51-m, f/4 CDK. T Prystavski*



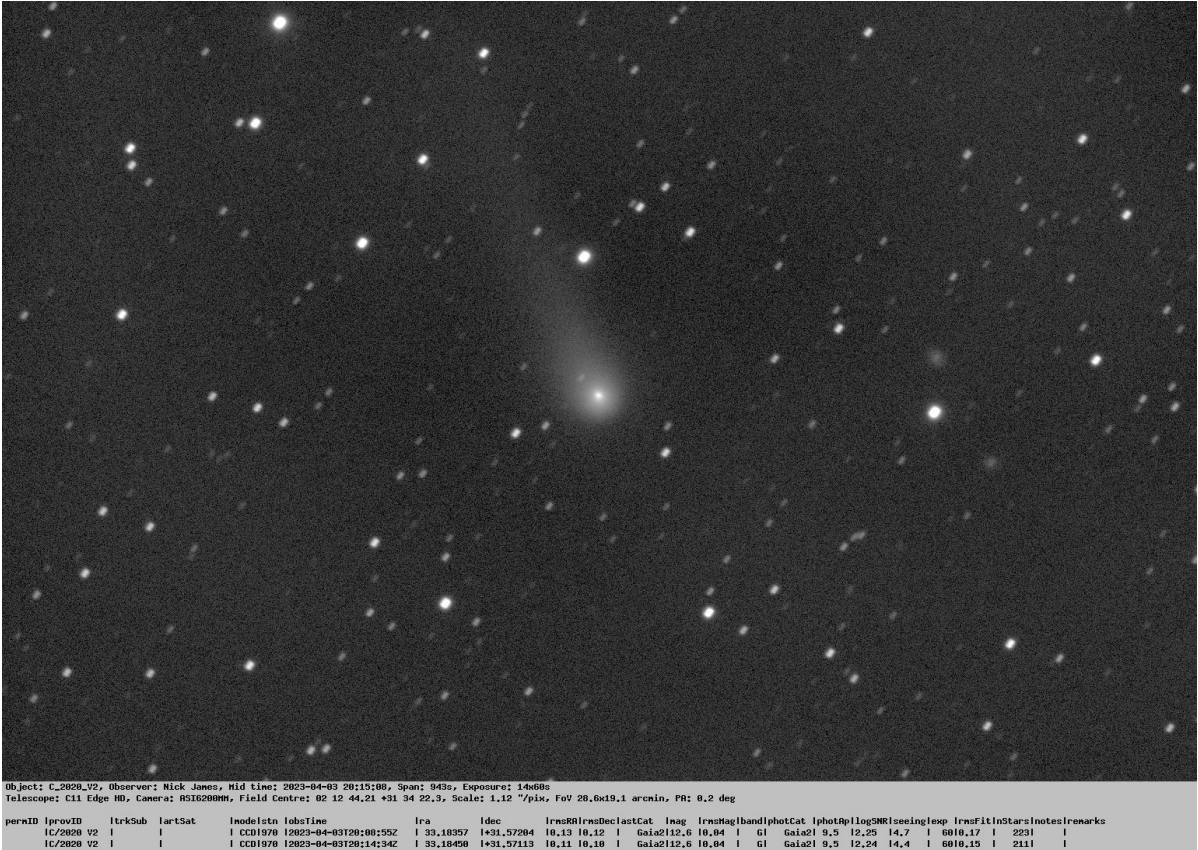


*81P/Wild 2022 December 23. 1334UT.  $1.4^{\circ} \times 1.8^{\circ}$ , N up. 0.28-m RASA, ASI2600MC. D Bartlett*



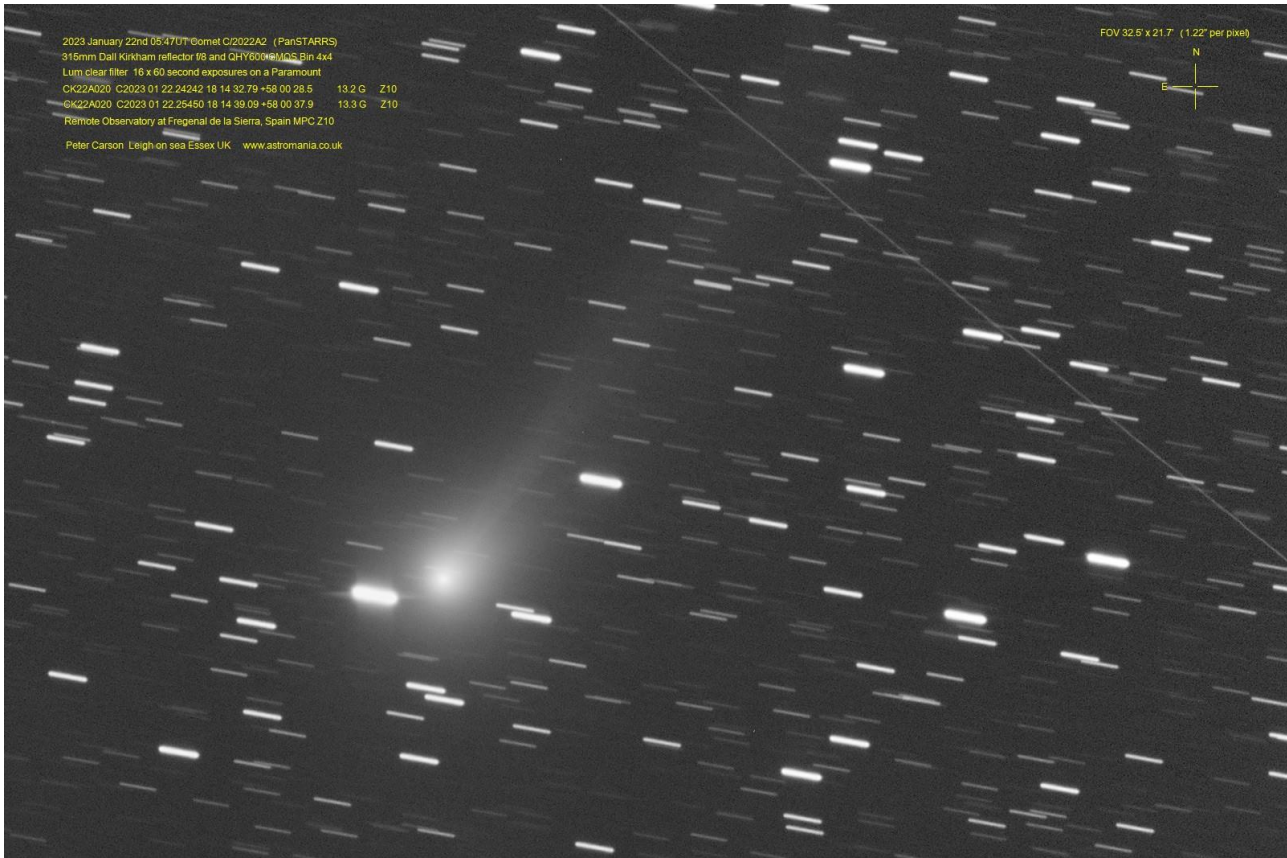


C/2022 P1 2022 Nov 30 1019UT. 56×42 arcmin, N up. 0.50-m,f/4.4 + PL09000. J Chambo



C/2020 V2 2023 April 3 2015UT. 29×19 arcmin, N up. 0.28-m f/10 SCT + IMX455. Nick James





*C/2022 A2 2023 Jan 22 0547UT. 33×22 arcmin, N up. 0.32-m f/8 DK + QHY600 Peter Carson*