Director: Bill Leatherbarrow

# LUNAR SECTION CIRCULAR

**Vol. 56 No. 5 May 2019**

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## FROM THE DIRECTOR

The evening of 11 April 2019 offered the observer an opportunity to meet up on the Moon with three of Britain's greatest selenographers – or, at least, with the craters now officially named after them. All three were reasonably near the terminator and therefore shown to good advantage. Observing them reminded me strongly of the outstanding role played by British Moon-mappers during the nineteenth and twentieth centuries, when visual telescopic observation was not yet challenged by high-resolution photography or spacecraft imagery.

*Crater Goodacre (image by Bill Leatherbarrow)*

Two of the individuals in question – Walter Goodacre and H. P. Wilkins – served lengthy terms as Director of the BAA Lunar Section during the first half of the twentieth century. The crater named after Goodacre is easily located since it is attached to the northern rim of the larger formation Gemma Frisius. Both Goodacre (46 km diameter) and Gemma Frisius (88 km) are ancient and much-degraded formations, but they stand out because of their position in the southern highlands just to the north of the fine crater Maurolycus.

Goodacre was the longest-serving Director of our Section, which he oversaw from the death of Elger in 1896 through until 1938. Elger is also commemorated on the Moon by a smallish (21 km) crater on the southern shore of the Palus Epidemiarum, not far from the striking Ramsden rille system. However, crater Elger was still in darkness on the evening of 11 April. Both Elger and Goodacre produced very fine maps of the lunar surface that were among the best in their day. Goodacre's map, 77 inches in diameter, was published in 1910 and later reproduced in his privately published book *The Moon* in 1931.

*Crater Wilkins (image by Bill Leatherbarrow)*

H. P. Wilkins was Lunar Section Director for ten years from 1946 and was responsible for reinvigorating the Section after World War 2. He produced several maps, the most famous being a 300-inch behemoth that contained too much fine detail for its own good. Crater Wilkins (57 km diameter) is, like Goodacre crater, a much degraded formation in the southern highlands, located just south of Rupes Altai and the large crater Sacrobosco. It is recognisable by a keyhole-shaped multiple crater on its western flank.

*Crater Saunder (image by Bill Leatherbarrow)*

Our third selenographer visible on the evening of 11 April was not a Director of our Section but, along with Mary Blagg, Samuel A. Saunder made a notable contribution to lunar mapping and nomenclature in the early decades of the twentieth century. Together they produced a *Collated List of Lunar Formations* for the Lunar Nomenclature Committee of the International Association of Academies in 1913. Crater Saunder (45 km diameter) is located not far from the apparent centre of the lunar disk as seen from Earth, just to the east of the giant ruined crater Hipparchus. Mary Blagg is also commemorated by a small crater on the Sinus Medii, south-west of the Triesnecker rille system, but this was not visible on the evening in question.

Other notable selenographers from the same golden age of British selenography whose craters were not visible on 11 April include the cartographer Edmund Neison and the Scotsman Thomas Logie MacDonald, who was BAA Lunar Section Director in the period between Goodacre and Wilkins. It is surely just a matter of time before another of our past Directors, Ewen Whitaker, is similarly honoured.

*Bill Leatherbarrow*

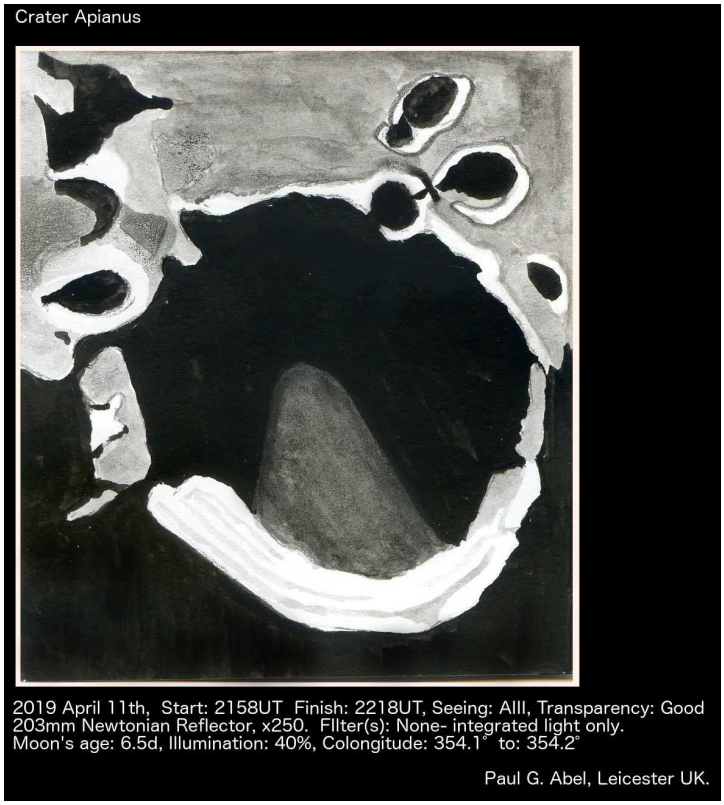
**OBSERVATIONS RECEIVED**

Images or drawings have been received from the following observers: Paul Abel, Leo Aerts (Belgium), Maurice Collins (New Zealand), Chris Dole, Dave Finnigan, Rik Hill (USA), Rui Lourenco (Portugal), Rod Lyon, Mark Radice, Bob Stuart, and the Director.

A selection is presented below.

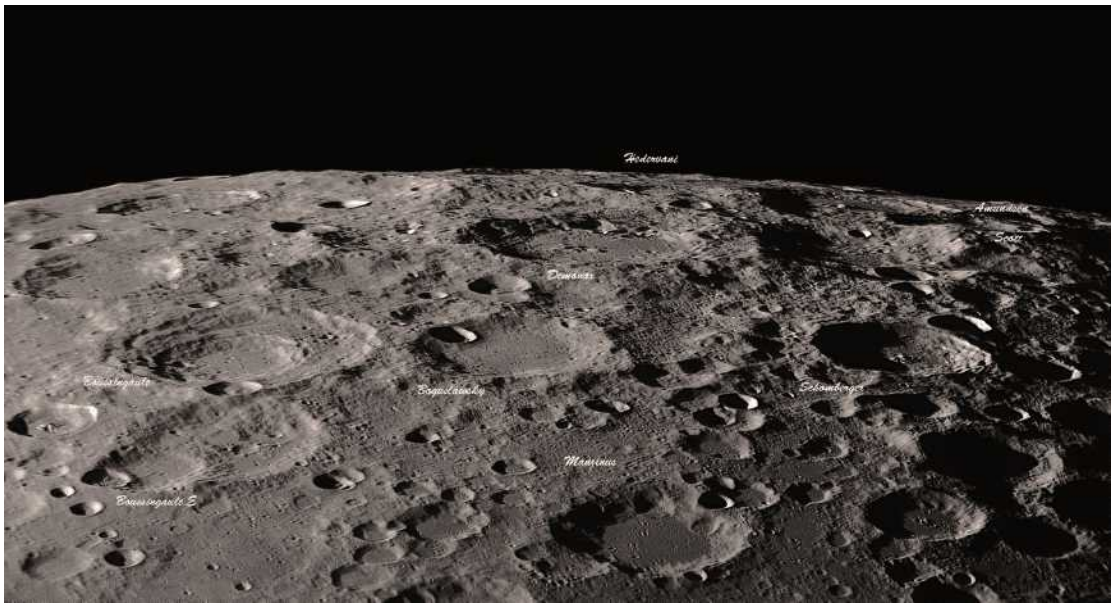
**Rui Lourenco** has sent in this fine wide-field view of the area around Plato, captured on 14 March 2019 at 23.34 UT using a C11 SCT.

**Paul Abel** continues to keep the tradition of visual observation alive with this study of the crater Apianus.

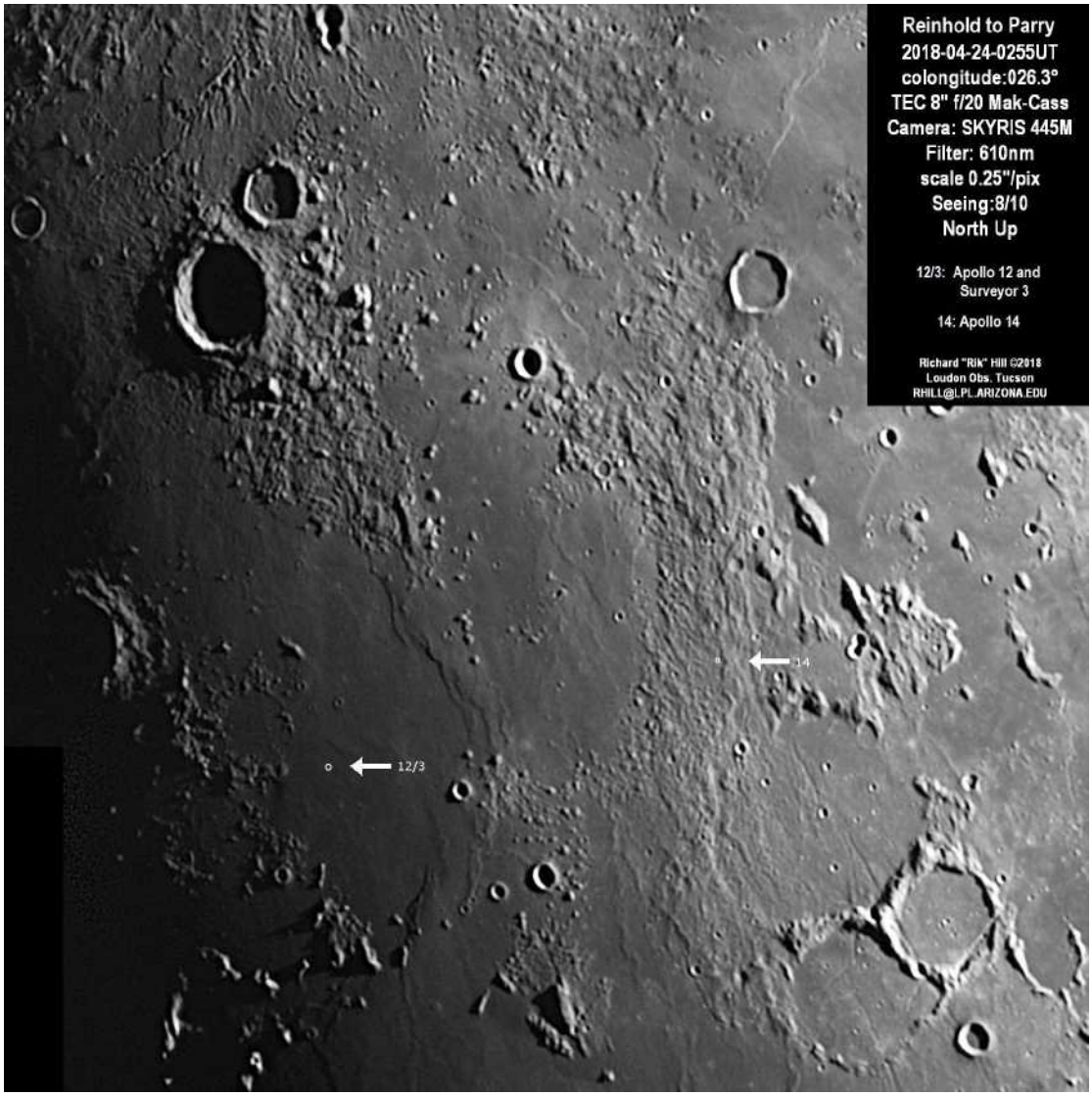


**Chris Dole** is a new contributor to the LSC and we welcome this study of sunrise over Prom. Laplace, captured on 14 February 2019 at 22.41 UT using a 180mm Mak-Cass.

**Leo Aerts** has submitted an outstanding image of the extreme southern libration zones. This is a reworked close-up of the southern moon limb originally taken on June 20th 2018. The Moon was rather low in the sky but seeing was excellent. Focal plane image with C14, IR filter and webcam ASI 290MM. South is up in this image.




**Rik Hill** has sent in some very fine images accompanied by his usual commentaries. The first recalls some important moments in the history of the Apollo lunar program.



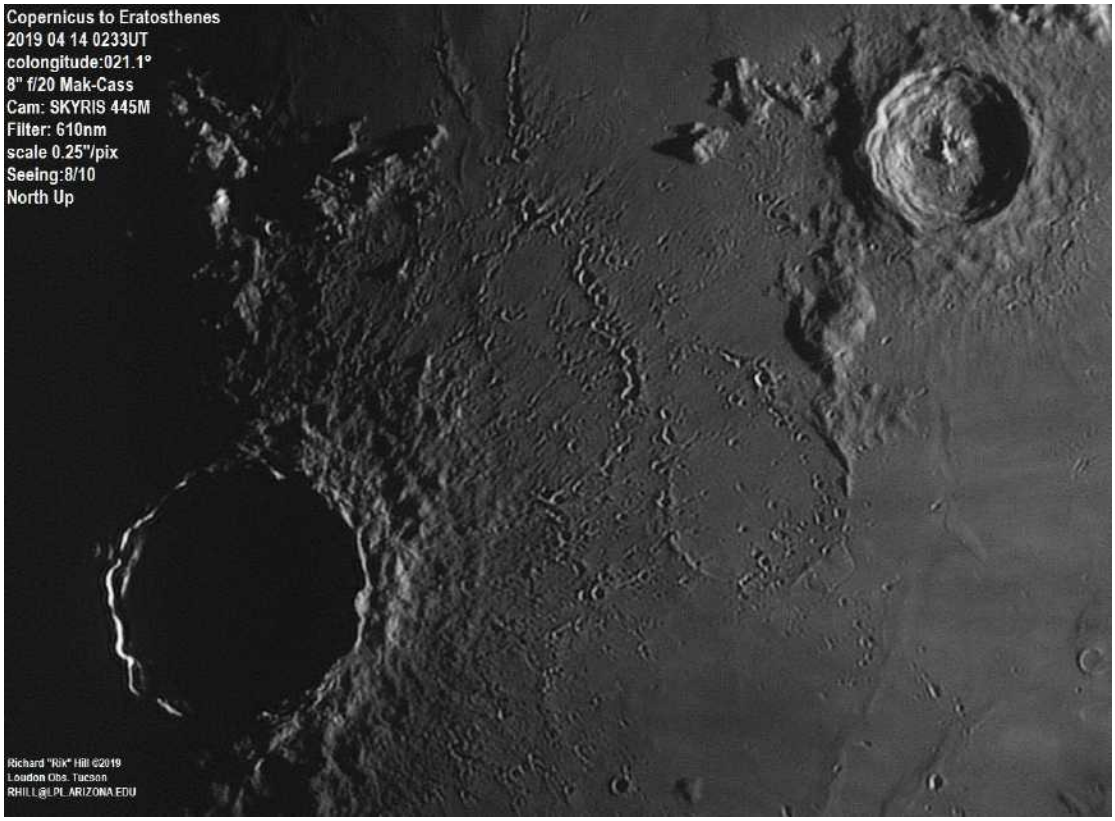

Rik writes as follows:

'South of Copernicus there is a lot to look for and see. The big crater in the upper left is Reinhold (49km dia.) and below it deep in shadow is Lansberg (41km). Just east of Lansberg is the landing site for my favorite moon mission, Apollo 12, which landed 360m from Surveyor 3, which itself landed two and a half years earlier. I followed the Surveyor program for its short life and was thrilled at this close landing. This took on greater meaning when I found many years later that Ewen Whitaker, a friend who lived about a mile from me in the 1980s and also worked at Lunar & Planetary Lab. (University of Arizona) was the person who figured out the precise location of Surveyor 3 and thus the landing site of Apollo 12 near it (see: https://www.researchgate.net/publication/281244327_A_Pinpoint_on_the_Ocean_of_Storms_Finding_the_Target_for_Apollo_12_with_Ewen_A_Whitaker)

In the lower right corner is an important trio of craters. The largest, almost a ghost crater, is Fra Mauro (99km). Below right is the best defined of the three craters, Parry (49km) and next to it on the left is Bonpland (61km). Note the beautiful system of Rimae Parry that cut across the bottom of that crater and they along one side up across Fra Mauro. There's another small rima cutting over the north wall of Bonpland too.

North of Fra Mauro, in the eject debris from the Imbrium and Copernicus impacts is the landing site for Apollo 14, noted by the arrow. This was originally the site intended for the ill-fated Apollo 13 but was moved to Apollo 14 which was scheduled for Taurus-Littrow (which site was assigned to Apollo 17). The distance between Apollo 12 and Apollo 14 landing sites is 181km or a little under the distance from Memphis to Nashville or London to Bristol, a mere afternoon's drive, if you ignore the 350,000 km commute!'

A further submission by Rik presents a view of sunrise over Copernicus that brings out the complex system of secondary cratering around the ghost crater Stadius.




Rik comments:

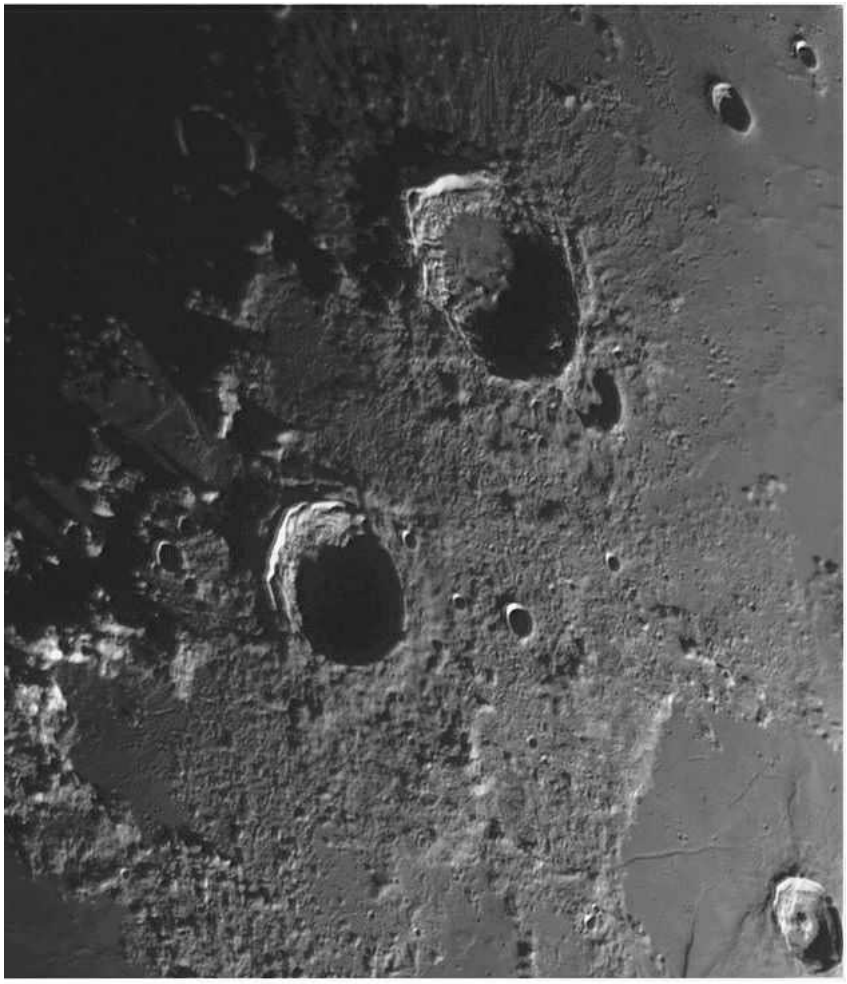
'Some people ask, why image the moon, hasn't it been done already? It depends on how you mean that. Has every square meter been imaged? Yes. At all lightings and librations? NO! This image is a good example of that. This scene made me gasp when it slewed into view. What drama! Here we have the mighty Copernicus (95km diameter) on the left just catching the first rays of morning light. I've always enjoyed that one peak on the eastern rim that juts up higher than the rest of the rim. Note the wonderful hummocky terrain immediately surrounding the eastern wall with the ejecta splash reaching further out to the secondary craters created from low velocity ejecta thrown out of the grand impact crater. The larger members of these secondaries are named subordinate to the main crater of Copernicus. Such impact ejecta form craters that can take on a variety of shapes as these do.

In the upper right corner is another superb crater, Eratosthenes (60km) with its well terraced inner slopes and a collar of hummocky terrain. There is a small chain of the

Copernican secondary craters that curls around Eratosthenes ***on top*** of the the hummocky terrain. This tells us that in relative terms, the Copernicus impact took place more recently than the Eratosthenes impact. These were the kind of things that were used to establish relative ages for many lunar features before the Apollo sample returns that gave us absolute ages that could be used to date features more accurately.

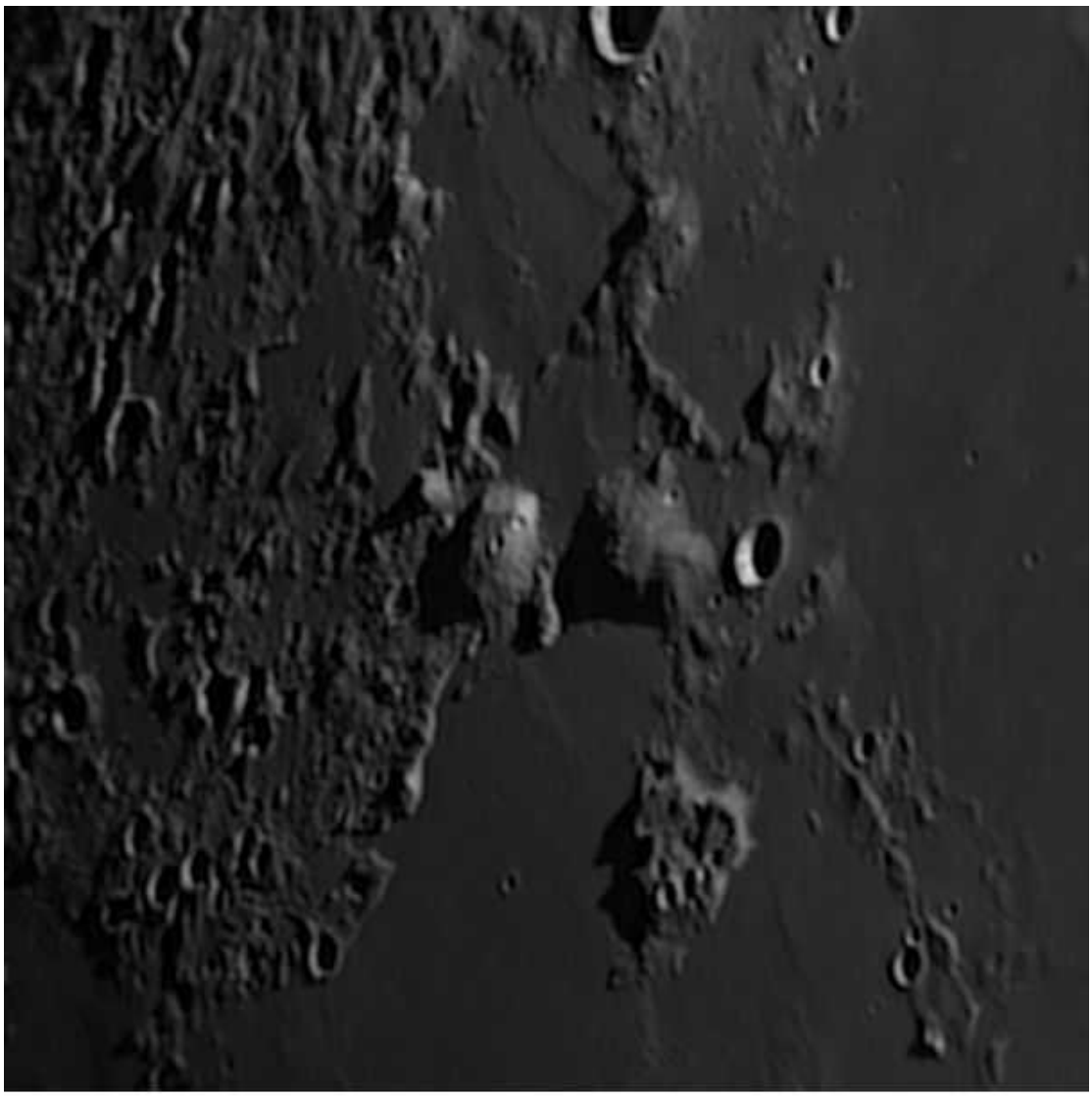
Between these two great craters is the ghost crater Stadius (71km) peppered with the Copernicus secondary cratering. I've always enjoyed the patch of mountains between Stadius and Eratosthenes and the ones to the upper left of the latter crater. What a great sunrise!

**Rod Lyon** had some good seeing on the early evening of 11 April 2019 for the following study of Aristoteles and Eudoxus.



Aristoteles & Eudoxus 2019.04.11 - 17.40 UT
300mm Meade LX90, ASI 224MC Camera,
Pro Planet 742nm I-R Pass Filter,
1,200/3,000 Frames. Seeing: 8/10

**Mark Radice** had a fine view of the atypical highland domes near Gruithuisen on the evening of 17 March 2019. These are unusually rounded for volcanic domes, suggesting low effusion rates of high viscosity lavas. No doubt our 'dome-master' Raf Lena will comment in due course!

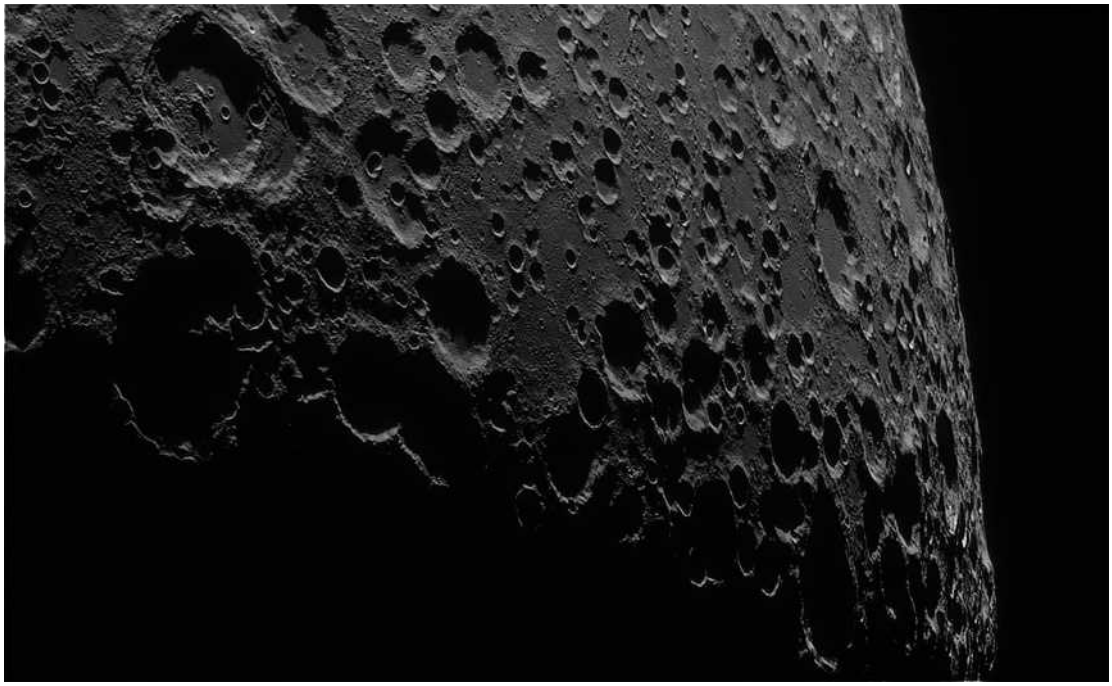


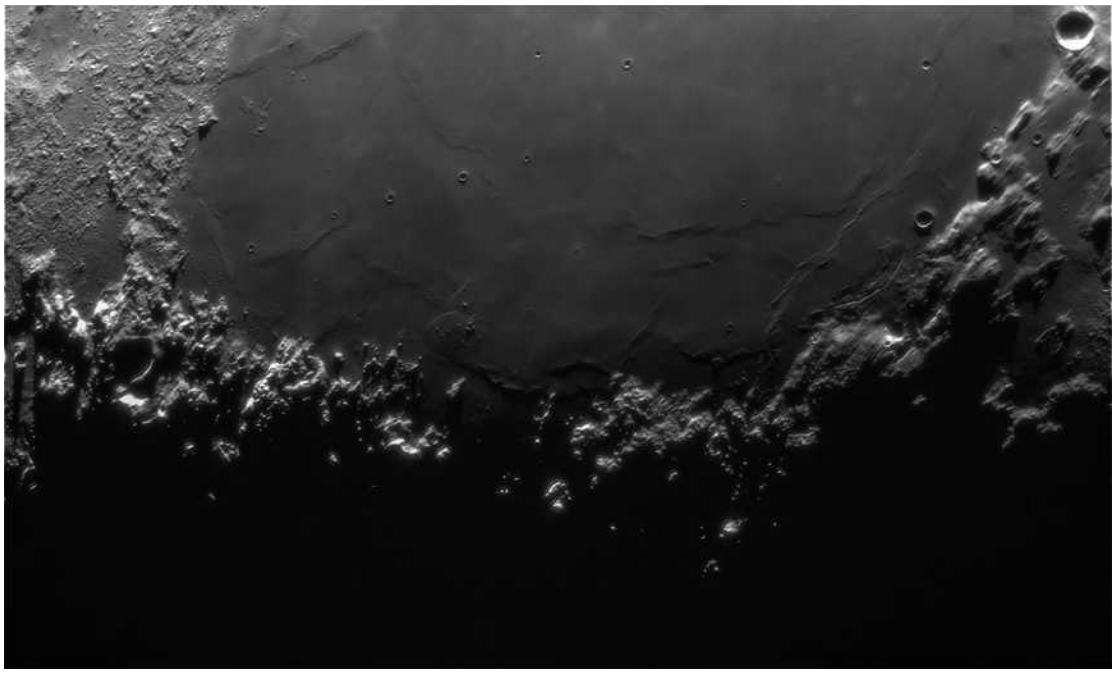
**Mons Gruithuisen Gamma and Delta**
17 March 2019 2120Z
C11 f18 ASI224MC 685nm IR filter
RefreshingViews.com Mark Radice

**Dave Finnigan** secured a fine capture of the Messier/Messier A pairing that shows considerable detail in the multiple west wall of the latter. That multiple wall is almost certainly the explanation for the apparent changes in the shape of that crater reported by many observers in the past – observers who did not have the benefit of modern high-resolution imaging.

*Messier, Messier A* 2019.04.10 18:55 UT, S Col. 339.8°, seeing 5/10, transparency good.
Libration: latitude +03º34', longitude -06º05'
305mm Meade LX200 ACF, f 25, ZWO ASI 120MMS camera, Baader IR pass filter: 685nm.
640 frames processed in Registax 6 and Paintshop Pro 8.
*Dave Finnigan, Halesowen*

**Bob Stuart** used an 8-inch Newtonian reflector to capture the following excellent images during an evening of good seeing on 11 April 2019. The first, taken at 19.57 UT, shows the southern highlands around Maurolycus. The second (20.19 UT) captures the elusive 'Valentine Dome' on the Mare Serenitatis.





**LETTER**

*John Duchek (USA) writes:*

I am catching up on my reading and noted T. Smith's letter in the February issue. I wrote an article recently for the December 2018 issue of *Reflector* magazine about taking photos of the Moon after sun-up. My article is on page 25.*

I recently bought a 9.25" Celestron SCT OTA, and it came with insulation wrapped around it. The former owner stated that it gave him better images with that.

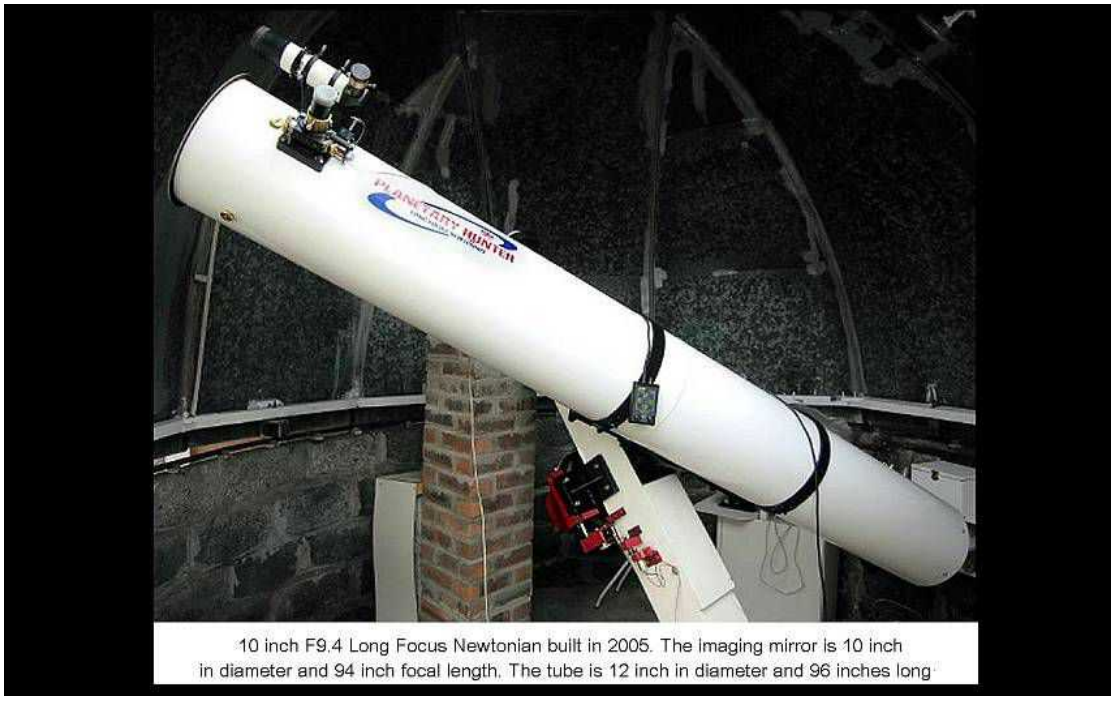
Since people get good images in summer and winter, the temperature itself doesn't seem to be the issue. The issue should be whether the scope is at equilibrium and how long that takes in changing temperatures after sunset. As my article suggests, pre-dawn good images turn bad at sunrise due to differential heating of the tube. By wrapping the two scopes I have tried this with, I got good images after sunrise by stopping the differential heating. This might well explain Trevor's observation that he sometimes got good observing in right after set up before cooling commenced.

I am in the process of trying to show that I can get good images out of the 9.25" immediately after going out with the insulated tube that the former owner provided. (The insulation is removable.) I am hoping to post a follow-up article with more information on the subject.

John Duchek

* Editor's note: *Reflector* magazine is published by the Astronomical League. John's article appears in volume 71, no. 1 (December 2018). It may be obtained from League sales: *leaguesales@astroleague.org*

**UNUSUAL TELESCOPE FOR SALE**




10 inch F9.4 Long Focus Newtonian built in 2005. The imaging mirror is 10 inch in diameter and 94 inch focal length. The tube is 12 inch in diameter and 96 inches long

A long-standing contributor to the work of the Lunar Section is offering for sale a 10-inch (250mm) long-focus f/9.4 Newtonian reflector. This instrument is a one-off and has been configured specially for lunar and planetary observation. The primary mirror has been figured to better than 1/10$^{th}$ wave and has a Strehl ratio of 0.993. It comes

with a complete interferometer test report from Orion Optics UK, as well as a separate star test. The optical tube assembly is being offered for sale for £400.

Prospective purchasers should make all arrangements directly with the seller, and the BAA Lunar Section can take no responsibility for subsequent negotiations. However, the Director is prepared to facilitate initial contact with the seller, so please contact him if you are interested.

**LUNAR DOMES (part XXVIII): A Bisected dome near Gassendi**
Raffaello Lena

As described in previous issues of the LSC, lunar domes are the best evidence of volcanic activity that has occurred on the Moon. Some of them are bisected by rilles, e.g. the Menelaus and Birt domes. Another effusive example bisected by a linear rille lies to the west of Gassendi at coordinates 47.58°W and 16.24°S with a diameter of 7.6±0.3km (Fig. 1). It is a difficult object to be clearly imaged. High resolution CCD imagery of elusive lunar domes is the most difficult branch of the astrophotography of the Moon. Notably, the detailed study of lunar domes is only possible based on images of the lunar surface acquired under strongly oblique illumination conditions, for their measurements and for the maximum detail. The recording of finer details will be obtained with telescopes optically of high quality, moderate or large aperture, and favorable observing sites in order to reduce the effects of the atmospheric turbulence.

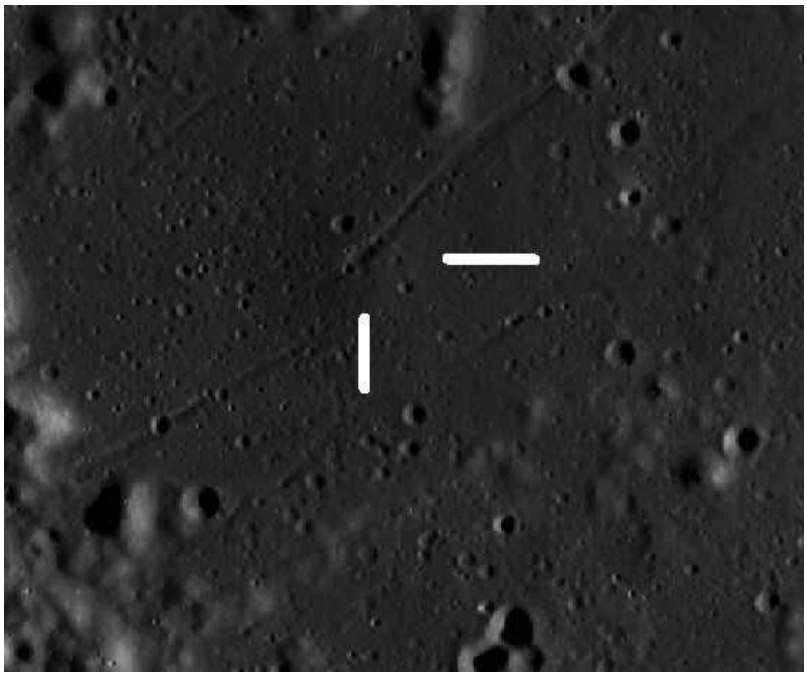


*Figure 1. WAC imagery of the bisected dome termed Gassendi 1.*

Two CCD telescopes images of the bisected dome, termed Gassendi 1 (Gas 1), are shown in Figs 2 and 3.


*Figure 2. The dome Gassendi 1. Image by Paolo Lazzarotti using a Gladius Cassegrain with aperture of 315mm and a Baader Zeiss 2x Barlow lens.*

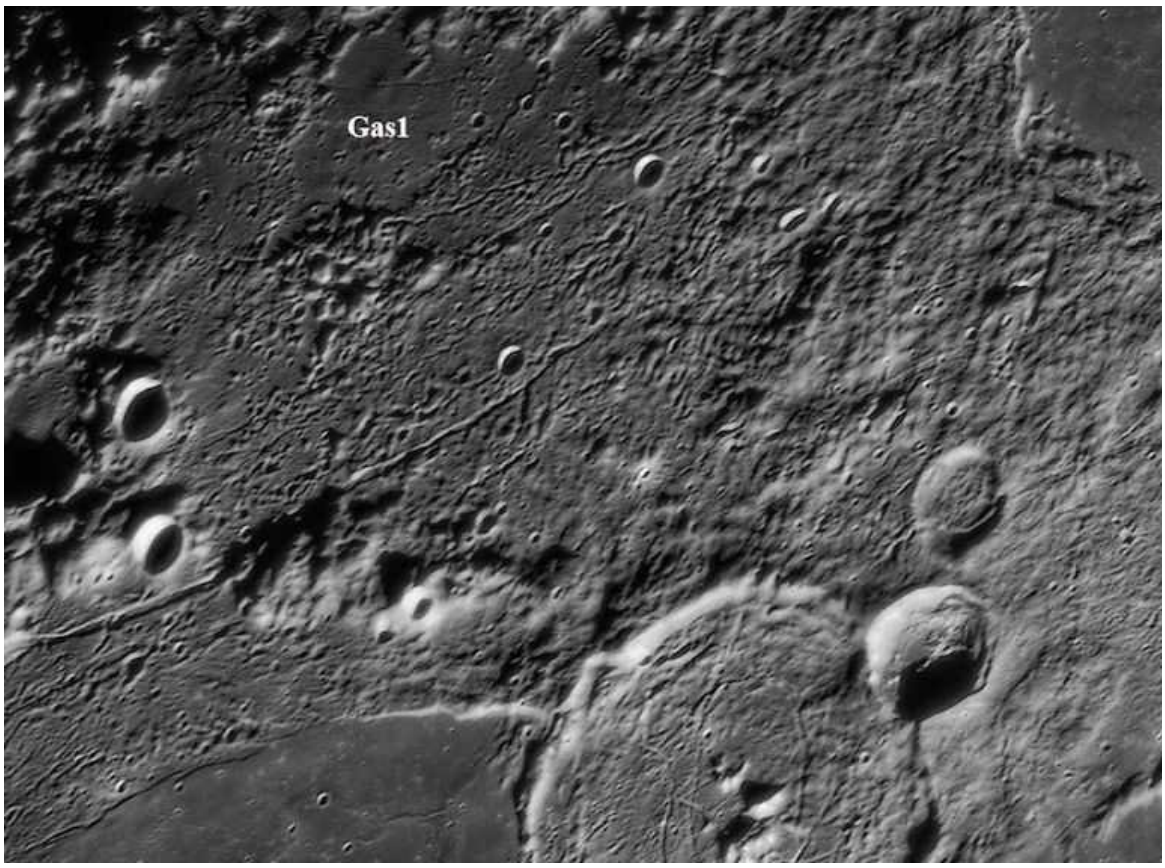



*Figure 3. The dome Gassendi 1. Image by Mike Wirths with a 400mm aperture Starmaster driven Dobsonian.*

The height of Gassendi 1 was computed generating a digital elevation model (DEM) of the dome based on telescopic CCD images. A well-known image-based method for 3D surface reconstruction is shape from shading (SfS). The SfS approach aims for deriving the orientation of the surface at each image location by using a model of the reflectance properties of the surface and knowledge about the illumination conditions, finally leading to an elevation value for each image pixel, as described in [1-2]. I have recently used the Lunar Orbiter Laser Altimeter (LOLA), a science instrument on the Lunar Reconnaissance Orbiter (LRO) spacecraft [3]. The precision of topographic data is estimated to be about 10 cm and the LOLA dataset was used as the reference for evaluating the quality of the GLD100 dataset [4]. The height of the dome is determined to 85m ± 10m yielding an average flank slope of 1.40° ± 0.1° (Fig. 4).

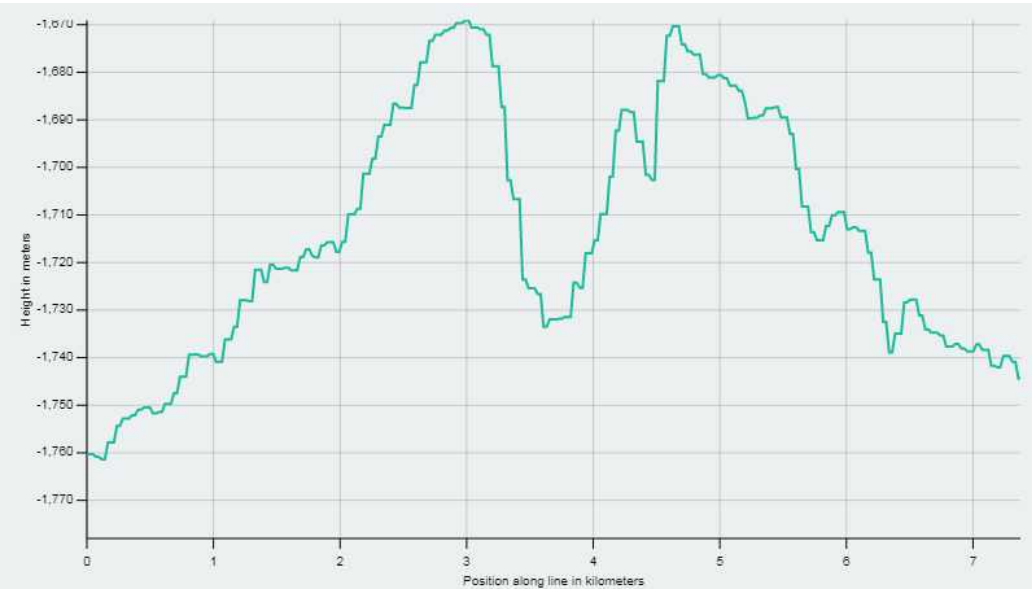



*Figure 4. LOLA DEM, cross-sectional profile in east-west direction derived for Gas 1.*

A 3D reconstruction of Gas 1, based on a WAC monochrome mosaic draped on top of the global LROC WAC-derived elevation model (GLD100), is shown in Fig. 5.

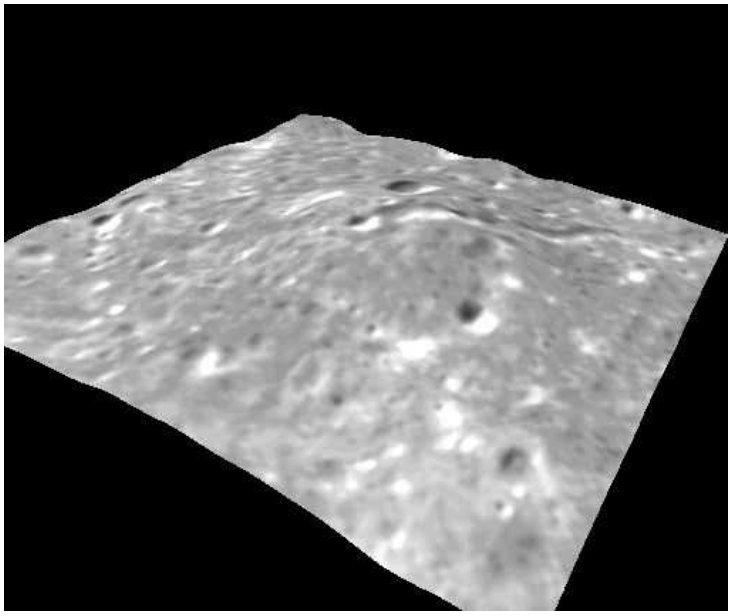


*Figure 5. WAC monochrome mosaic draped on top of the global LROC WAC-derived elevation model (GLD100). 3D reconstruction of Gas 1. The vertical axis is 7 times exaggerated.*

Based on the morphometric data the bisected dome described in this issue belongs to $C_2$ class in the lunar domes classification scheme [2]. It is a difficult and interesting object for lunar observers to improve their knowledge on volcanic domes and, of course, for lunar imagers interested in imaging it at higher possible resolution. I will be happy to receive further images of Gassendi 1.

**References**


[1] Horn, B. K. P., 1989. Height and Gradient from Shading. MIT technical report 1105A http://people.csail.mit.edu/people/bkph/AIM/AIM-1105A-TEX.pdf

[2] Lena, R., Wöhler, C., Phillips, J., Chiocchetta, M.T., 2013. *Lunar domes: Properties and Formation Processes*, Springer Praxis Books

[3] Smith et al. (2010). 'The Lunar Orbiter Laser Altimeter Investigation on the Lunar Reconnaissance Orbiter Mission'. *Space Sci. Revs*. 150, 209-241, doi:10.1007/s11214-009-9512-y

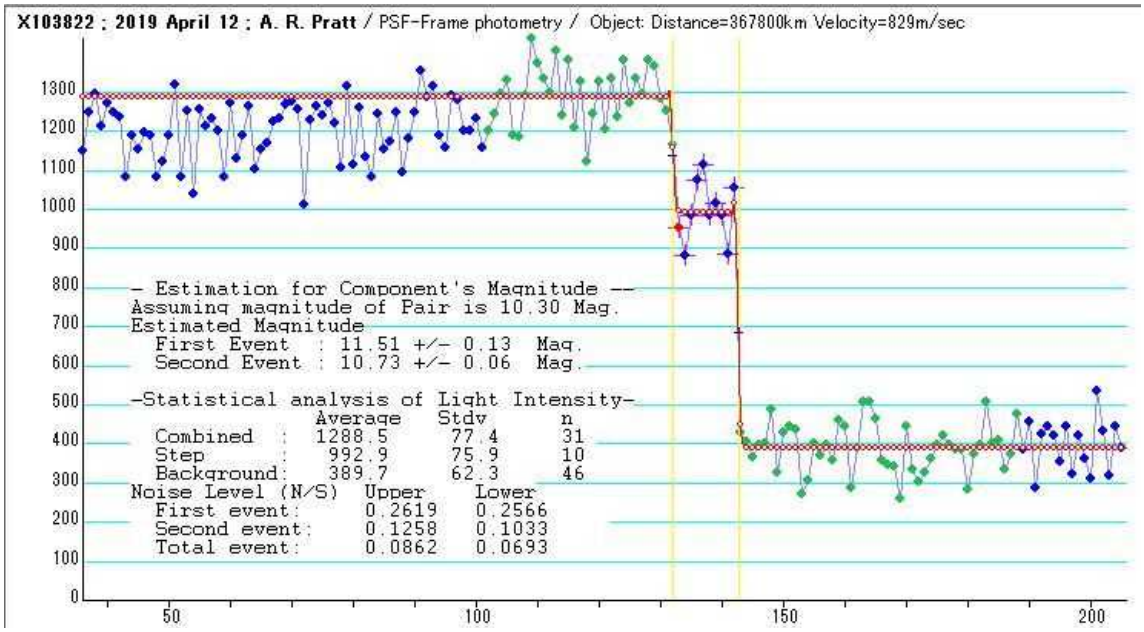
[4] Scholten, F., Oberst, J., Matz, K.-D., Roatsch, T., Wählisch, M., Speyerer, E.J., Robinson, M.S., 2012. 'GLD100: the near-global lunar 100 m raster DTM from LROC WAC stereo image data'. *J. Geophys. Res*. 117(E00H17). doi: 10.1029/2011JE003926

## Spring Observations

*Alex Pratt* (Leeds) reports two further double star occultations this month: SAO79686 on April 12th at 2143UT, and X103822 earlier the same evening at 2057UT. It appears from the light curve for X103822 this is a previously un-reported double star of component magnitudes 10.7 and 11.5. The step duration was measured at 423ms with the fainter companion being occulted first.

Congratulations to Alex on this *discovery*.

***Discovery:*** *The light curve for X103822 with C11 and WAT-910HX The star is TYC 1373-37-1. (Software: LiMovie)*




Was anyone else was observing this star on the 12th? If so, please forward your observations.

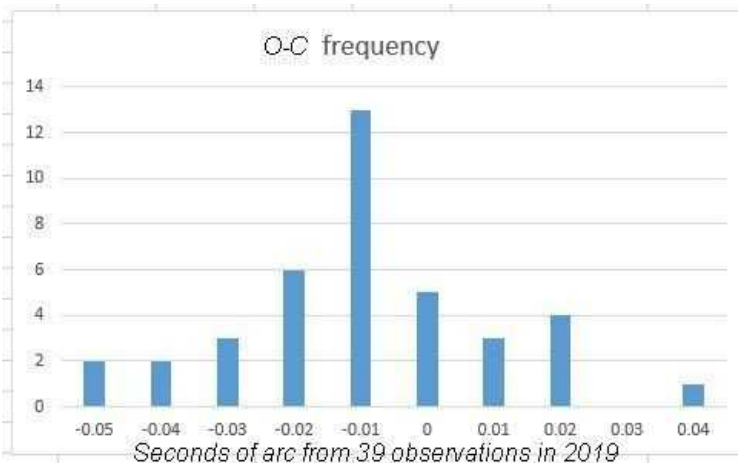
*Phil Denyer* (Hornchurch) recorded the DD of SAO 78592 on April 11th.

*Peter Tickner* (Reading) recorded the DD of SAO 98075, part of the M44 cluster.

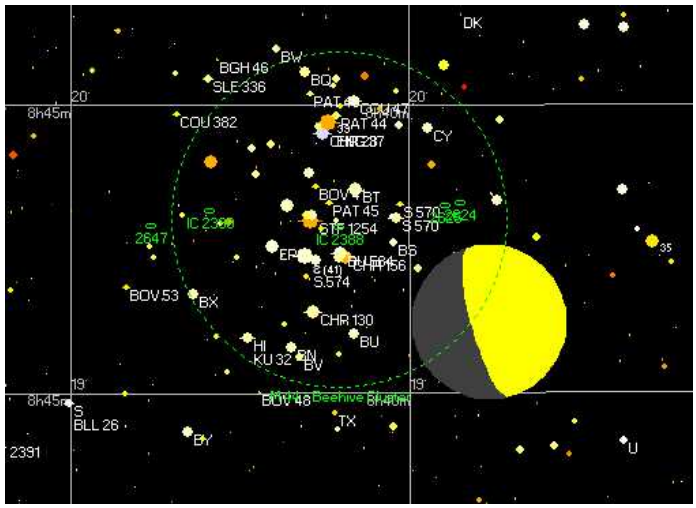
*Tim Haymes* (Maidenhead) reports he was observing on April 10th, 11th and 13th with good results and 48 disappearances were recorded with a 20cm f/4 Schmidt Newtonian. On April 13th the Moon passed through the Southern portion of the Beehive cluster and many occultations were observed, but no double star phenomena were detected. Vapour trails were a nuisance because the light reflected swamped the video. Fortunately no stars were lost in the intermittent glare. A video can be seen on You Tube of the occultations https://youtu.be/bD-4hmdg1DI

## O-C distribution

From 39 video observations in 2019, TH plotted his preliminary O-C distribution. The timing error is +/- 0.01sec on these observations so the distribution offset might represent a rounding error in the reported times. These are small figures. We have GPS, Gaia and LRO-LOLA to thank for this high precision. However the wings tell us not all is perfectly predictable.




*The Moon edging through M44 on evening of April 13th last. SkyMap pro plotted for Long 001 W, 51.5 N. The cluster occultation is not observable again in the UK until the year 2034*




**Please Note: Predicted times are in UT. Add 1 hr for BST.**

**2019 May predictions for Manchester** (Occult 4.6.1.0 by D.Herald).

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W. Longitude  002d 15', Latitude  +53 25',  Alt.  50m;
       day  Time        Ph   Star  Sp   Mag  Mag    % Elon    Sun  Moon   CA    Notes
 y   m  d  h  m   s          No         v    r      ill       Alt Alt Az

19 May  7 21 24 38.1 D   77199 K5  9.3  8.5    9+  36 -12  9 291  75S
19 May  7 21 27 13.0 D   77196 K0  7.3  6.5    9+  36 -12  9 292  46N
19 May  7 21 34 18.3 D   77198 A2  8.5  8.4   10+  36      8 293  35S
19 May  7 21 53 20.9 D   77209 G5  8.9  8.6   10+  36      5 297  33S
19 May  7 22 10 53.0 D   77223 K5  8.2  7.2   10+  36      3 300  71S
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| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 19 | May | 8 | 20 | 36 | 44.4 | D | | 984 | G5 | 6.5 | 6.0 | 17+ | 48 | -7 | 25 | 273 | 49N | DBL* |
| 19 | May | 8 | 20 | 56 | 46.6 | D | | 78371 | G0 | 8.4 | 8.1 | 17+ | 48 | -9 | 22 | 277 | 54N | |
| 19 | May | 8 | 21 | 17 | 52.0 | D | | 987 | G5 | 8.0 | 7.4 | 17+ | 48 | -11 | 19 | 280 | 55S | DBL* |
| 19 | May | 8 | 21 | 47 | 43.6 | D | | 78414 | A2 | 9.1 | 9.1 | 17+ | 49 | | 15 | 286 | 54N | |
| 19 | May | 8 | 21 | 54 | 50.4 | D | | 78421 | K5 | 8.6 | 7.7 | 17+ | 49 | | 14 | 287 | 54N | DBL* |
| 19 | May | 8 | 21 | 55 | 46.7 | D | X | 88620 | | 9.6 | 9.2 | 17+ | 49 | | 14 | 287 | 86S | |
| 19 | May | 8 | 22 | 0 | 56 | m | | 78406 | A0 | 7.6 | 7.6 | 17+ | 49 | | 13 | 288 | 1S | Possible Miss |
| 19 | May | 8 | 23 | 10 | 34.9 | D | | 78471 | A0 | 8.7 | 8.6 | 18+ | 50 | | 4 | 301 | 76N | |
| 19 | May | 9 | 21 | 8 | 38.4 | D | | 1125 | F6 | 6.5 | 6.3 | 26+ | 61 | -10 | 29 | 268 | 36N | DBL* |
| 19 | May | 9 | 21 | 12 | 44.7 | D | | 79396 | G5 | 9.3 | 8.8 | 26+ | 61 | -10 | 28 | 269 | 63N | |
| 19 | May | 9 | 21 | 27 | 0.5 | D | | 1129 | F5 | 5.3 | 5.0 | 26+ | 61 | -11 | 26 | 271 | 53N | 63 Gem |
| 19 | May | 9 | 21 | 27 | 10.0 | D | X | 101685 | | 9.3 | | 26+ | 61 | -11 | 26 | 271 | 53N | |
| 19 | May | 9 | 22 | 4 | 35 | m | | 79410 | G5 | 7.2 | 6.7 | 26+ | 62 | | 21 | 279 | 0N | |
| 19 | May | 9 | 23 | 16 | 43.0 | D | | 79480 | A2 | 8.1 | 8.1 | 27+ | 62 | | 10 | 291 | 89S | |
| 19 | May | 9 | 23 | 53 | 3.2 | D | | 79504 | K5 | 8.3 | 7.4 | 27+ | 63 | | 6 | 298 | 75N | DBL* |
| 19 | May | 10 | 20 | 58 | 20.2 | D | | 97805 | F0 | 9.0 | 8.9 | 36+ | 74 | -8 | 37 | 252 | 24S | |
| 19 | May | 10 | 23 | 11 | 23.0 | D | | 97883 | F8 | 7.8* | 7.5 | 37+ | 75 | | 18 | 279 | 82S | Mult * |
| 19 | May | 11 | 20 | 57 | 28.8 | D | | 98563 | | 9.2 | 8.9 | 48+ | 88 | -8 | 42 | 236 | 72N | |
| 19 | May | 11 | 21 | 47 | 59.3 | D | | 98568 | M* | 8.0 | 7.1 | 48+ | 88 | | 35 | 248 | 41S | |
| 19 | May | 11 | 22 | 1 | 37.9 | D | | 98584 | G0 | 8.9 | 8.7 | 48+ | 88 | | 34 | 252 | 79N | |
| 19 | May | 11 | 22 | 8 | 3.9 | D | | 98586 | F8 | 8.9 | 8.6 | 48+ | 88 | | 33 | 253 | 52N | |
| 19 | May | 12 | 22 | 19 | 27.7 | D | | 1524 | A2 | 8.2* | 8.0 | 60+ | 101 | | 35 | 240 | 60S | |
| 19 | May | 12 | 23 | 18 | 33.9 | D | | 99122 | G5 | 8.1* | 7.5 | 60+ | 102 | | 27 | 254 | 45S | |
| 19 | May | 12 | 23 | 34 | 4.0 | D | | 99133 | K0 | 7.8* | 7.0 | 60+ | 102 | | 25 | 257 | 51S | |
| 19 | May | 13 | 0 | 40 | 21.6 | D | | 99157 | F2 | 7.4* | | 61+ | 103 | | 15 | 270 | 39S | DBL* |
| 19 | May | 14 | 21 | 7 | 25.5 | D | | 119272 | F5 | 7.6* | 7.3 | 81+ | 128 | -8 | 40 | 185 | 32N | |
| 19 | May | 15 | 22 | 50 | 57.0 | D | | 139174 | F2 | 7.8* | 7.6 | 89+ | 142 | | 32 | 200 | 90N | |
| 19 | May | 16 | 22 | 43 | 39.6 | D | | 139675 | K0 | 8.1* | 7.6 | 95+ | 155 | | 29 | 183 | 52S | |
| 19 | May | 19 | 22 | 17 | 14.6 | R | | 2401 | F3 | 5.6 | 5.3 | 99- | 166 | | 9 | 141 | 79N | |
| 19 | May | 21 | 1 | 56 | 10.5 | R | | 2549 | F0 | 6.6 | 6.4 | 95- | 153 | | 15 | 179 | 38N | DBL* |
| 19 | May | 22 | 1 | 40 | 56.8 | R | | 2709 | F5 | 6.7* | 6.4 | 89- | 141 | | 12 | 163 | 81N | |
| 19 | Jun | 5 | 21 | 20 | 48 | m | | 1086 | G9 | 6.4 | 6.0 | 7+ | 32 | -6 | 9 | 294 | 2S | |

Prediction up to June 5th

Notes on the Double Star selection:

Doubles are selected from Occult 4, where the magnitudes of the pair are not more than 2 magnitudes different, the fainter companion is brighter than mag 9, and the time difference (dT) is between 0.1 and 5 seconds. Please report double star phenomena.

Key:

P = Phase (R or D), R = reappearance D = disappearance
M = Miss at this station, Gr = graze nearby (possible miss)
CA = Cusp angle measured from the North or South Cusp. Negative CA = bright limb
DBL* = This is a double star worth monitoring.
Mag(v)* = asterisk indicates a light curve is available in Occult-4

Star No:

2/3/4 digits = Zodiacal catalogue (ZC) but referred to as the Robertson catalogue (R)
5/6 digits = Smithsonian Astrophysical Observatory catalogue (SAO)
X denotes a star in the eXtended ZC/XC catalogue

*Detailed predictions at your location for 1 year are available upon request.*
**Occultation Subsection Coordinator**: Tim Haymes occultations@stargazer.me.uk

**LUNAR GEOLOGICAL CHANGE DETECTION PROGRAMME 2019 May**
Tony Cook

Reports have been received from the following observers for March: Jay Albert (Lake Worth, FL, USA - ALPO) observed: Alphonsus, Aristarchus, Atlas, Eratosthenes, Mutus F, Pallas, Taruntius, and the West Limb. Alberto Anunziato (Argentina – SLA) observed: Alphonsus, Eratosthenes, Furnerius, Gassendi, Plato and Torricelli B. Juan Manuel Biagi (SLA) imaged several features. Jario Andres Chavez (Columbia – LIADA) imaged Copernicus and several features. Marie Cook (Mundesley, UK – BAA) observed Aristarchus. Valerio Fontani (Italy – UAI) imaged Copernicus, Godin and several features. Rik Hill (Tucson, AZ, USA – ALPO/BAA) imaged Clavius, Gassendi, Marius and several features. Trevor Smith (Codnor, UK - BAA) observed: Alphonsus, Aristarchus, Bullialdus, Censorinus, Copernicus, Cruger, Eimmart, Encke/Kepler region, Eratosthenes, Gassendi, Lichtenberg, Mare Crisium, Mersenius, Mons Piton, Promontorium Heraclides, Promontorium Laplace, Plato, Proclus, Ross D, Theophilus, and Torricelli B. Franco Taccogna (Italy – UAI) imaged Copernicus, Godin, and several features. Aldo Tonon Aldo Tonon (Italy-UAI) imaged several features. Ivor Walton (UK - CADSAS) imaged several features.

TLP reports: No TLP were observed in March. But On 2019 Apr 10 UT 22:42:40 Marcelo Zurita (Brazil - APA/BRAMON/SAB) video-recorded Earthshine and detected a candidate impact flash, lasting 2 TV fields(?) in the approximate vicinity of Copernicus. Was anybody else observing then so that we can confirm this?

News: It was a great pity to hear that the first privately funded lunar lander, Beresheet (made by SpaceIL), did not make a survivable landing in the northern Mare Serenitatis on 2019 Apr 11. Just out of curiosity, I decided to video the landing site, at the time, through my 8” Newtonian – though not expecting to see anything as the resolution would not have been sufficient. SpaceIL had a live broadcast on the Internet so I sat outside watching this and the live video from my telescope. It was a bit difficult to understand what was going on as at least half of the commentary from SpaceIL Mission Control was in Hebrew. Fig. 1 shows the landing site around the time that they lost contact. I have examined the video carefully, and despite an impact velocity of just under 1 km/s (mostly sideways) have not seen any evidence of an impact cloud. You can compare a slightly later higher resolution image of the area (Fig. 2) taken by Bob Stuart. It probably would help if we had a more precise knowledge of the trajectory and impact site to be sure that nothing has been missed in the video. Hopefully SpaceIL will get a Beresheet II lander built and launched in the near future.

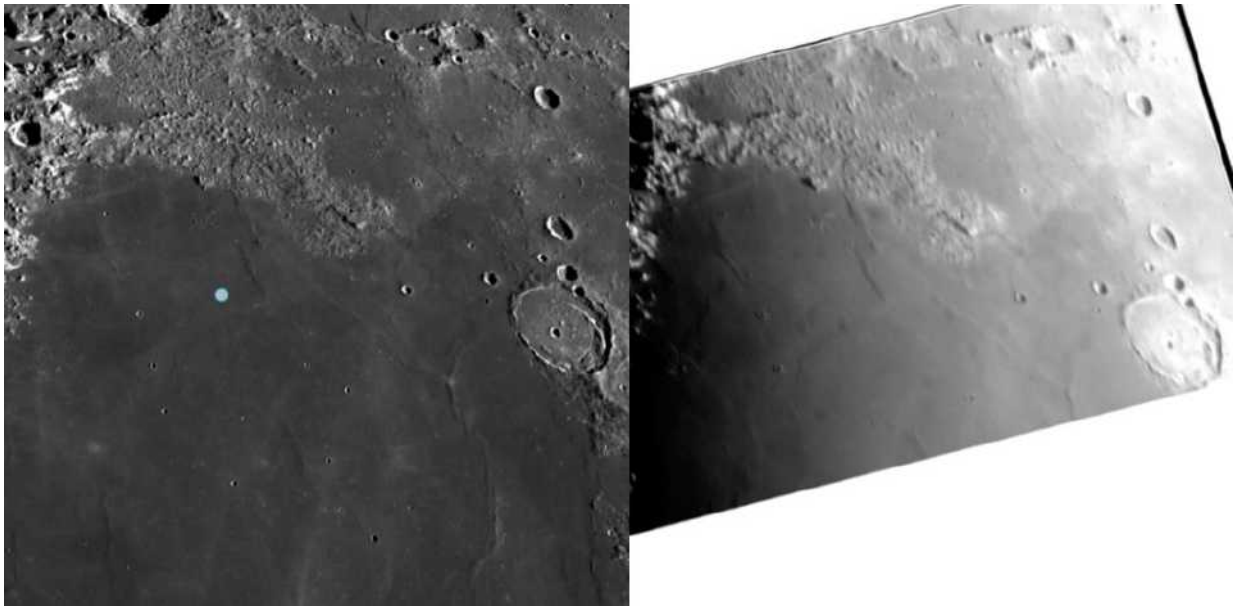

*Figure 1. Northern Mare Serenitatis. (Left) A LROC/QuickMap view with the planned landing coordinate of SpaceIL's Beresheet-I lander marked by a blue dot. (Right) A Registax'ed image of the landing site, by Anthony Cook (ALPO/BAA) made using video frames from ±5 sec either side of the loss of contact on 2019 Apr 11 UT 19:23:01 – This time came from a Tweet. Note that some of the small faint dark smudges are due to dust diffraction rings on the Watec 902H camera being used in conjunction with a 3x Barlow and a Wratten 87C near IR filter.*

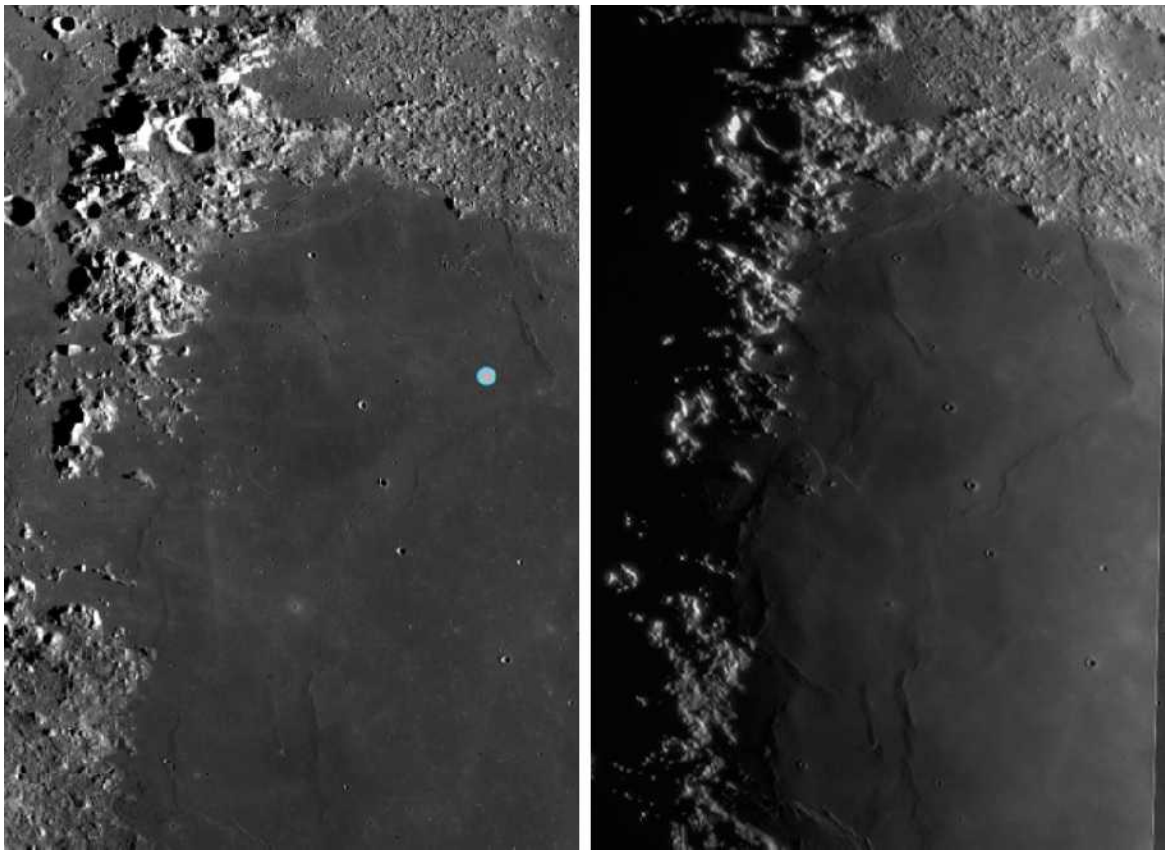

***Figure 2. The north of Mare Serenitatis, orientated with north towards the top. (Left) Quickmap view. (Right) Image by Bob Stuart (BAA) taken on 2019 Apr 11 UT 20:18.***

**Routine Reports:** Below are a selection of reports received for March that can help us to re-assess unusual past lunar observations – if not eliminate some, then at least establish the normal appearance of the surface features in question.

**Copernicus:** On 2019 Mar 15 UT 19:12 Valerio Fontani (UAI) and UT 1926-19:27 Franco Taccogna (UAI) imaged the crater under similar illumination and topocentric libration (to ±1°) to the following report:

*Copernicus: On 1995 Jul 07 at UT 04:22 R. Spellman (Los Angeles, CA, USA) noted that the floor of Copernicus was slightly darker in blue light. The ALPO/BAA weight=1. This report came from R. Spellman's web site.*

Also to within ±0.5°, in terms of similar illumination, to the following report:

*Copernicus 1969 Nov 18 UT 21:10-21:11 Observed by Hedervari(Budapest, Hungary, 3.5" refractor) "Yellowish-red stripe on inner W. wall (chrom. aberr.? Apollo 12 watch)." NASA catalog weight=2. NASA catalog ID No. 1217. ALPO/BAA weight=1.*

In order to check out these reports, we can look at the blue and red components in Franco's images, which were taken through blue (Fig. 3 – Top Left) and red (Fig. 3 – Top Right) filters. Also, a colour normalised and saturation (50%) increased version of Valerio's image (Fig. 3 - Bottom). If the floor had some blueness to it then in the red filter it will be little darker and in the saturated enhanced image, the blue colour should be present. There is no sign of any of this in Fig. 3. Therefore, what Robert Spellman saw in 1995 does not appear to be normal – though it should be said that he saw a similar effect in Godin crater – so maybe it was atmospheric related? With regard to the Hedervari observation, there is no sign of a yellow red stripe on the inner west rim, so again this is not normal, though as Cameron points out in her description it could perhaps be chromatic aberration? We shall leave the weights of both these reports at 1 for now.

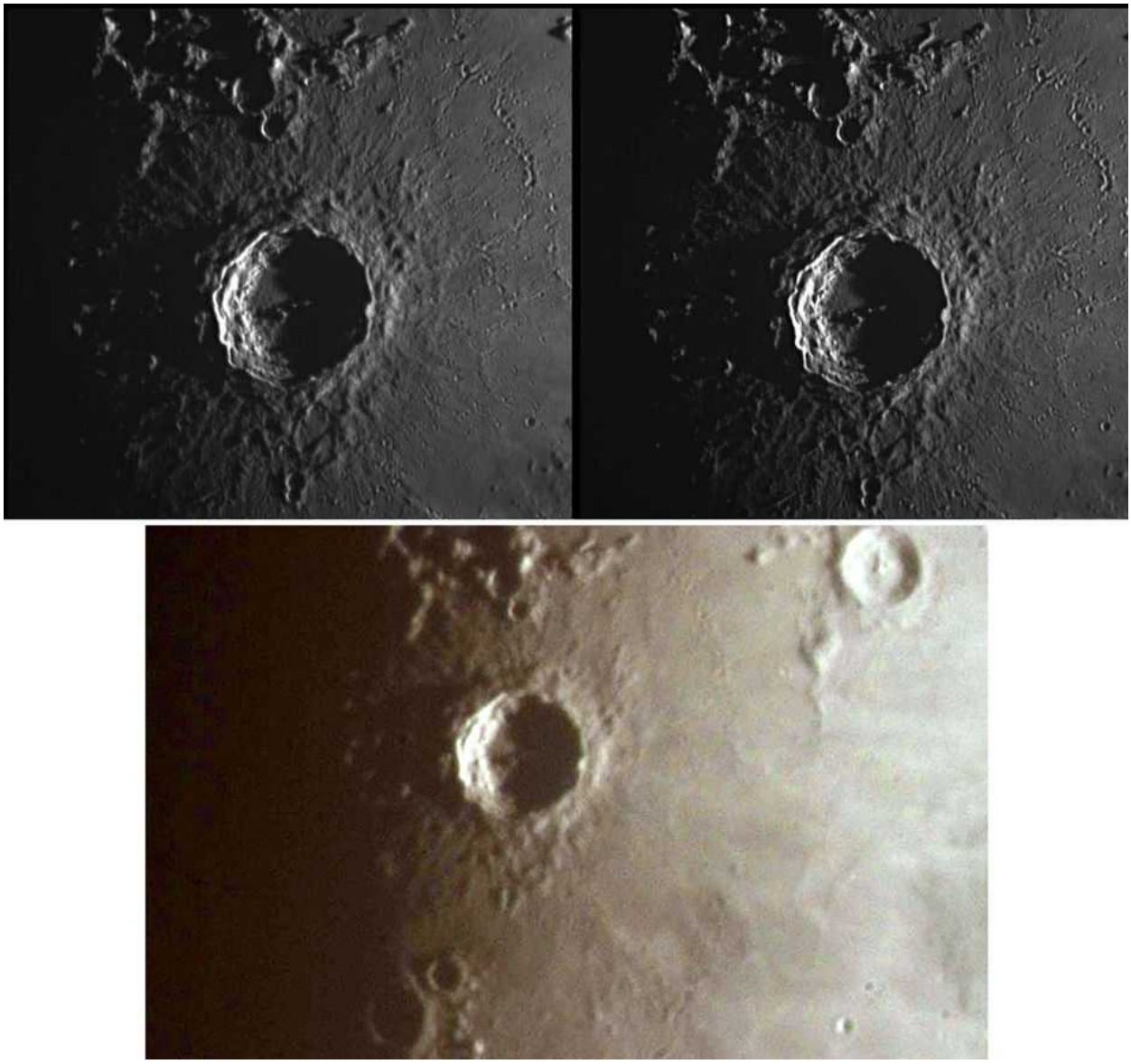

***Figure 3.*** *Copernicus orientated with north towards the top on 2019 Mar 15.* ***(Top Left)*** *A blue (#80A) filter image taken by Franco Taccogna (UAI) at 19:26UT.* ***(Top Right)*** *A red (#21) filter image taken by Franco Taccogna (UAI) at 19:27UT.* ***(Bottom)*** *A colour image by Valerio Fontani taken at 19:12 UT – this has been colour normalized and then its colour saturation increased to 50%.*

**Mons Piton:** 2019 Mar 15 UT 21:35 Trevor Smith (BAA) sketched this mountain peak 31 minutes prior to the start of the ±0.5°similar illumination window that corresponded to the following report:

*Piton 2004 Jan 30 UT 15:52 Observed by a GLR observer (Italy) "CCD image shows a point of light in the NW shadow - possibly highland starting to emerge from the shadow?" A GLR report. ALPO/BAA weight=1.*

Trevor, who was observing several features (including Mons Piton) from 21:15-22:00 using a 16" reflector (seeing Antoniadi III-IV) described the mountain (2.3 km high) as casting a black shadow westward for approximately 25 km. He could see three main illuminated parts to the mountain peak. At 21:35 (See Fig. 4) a very faint point source of white light could be seen emerging from the shadow and to its SW. The point was so faint to begin with that it came and went in the atmospheric seeing conditions – perhaps inferring the top of a local peak just starting to catch the

sunlight. By 21:45UT the point of light in the shadow could be seen for several seconds at a time in the seeing conditions. Observations ceased at 22:00 due to cloud cover. I have examined Trevor's sketch carefully and compared it to the GLR image – the latter of which I cannot show here as I was asked to keep it (and the original observer) confidential. However, it is very clear to me that what was imaged in 2004 and what Trevor saw are identical. We can therefore remove this GLR report from our database by assigning a weight of 0.

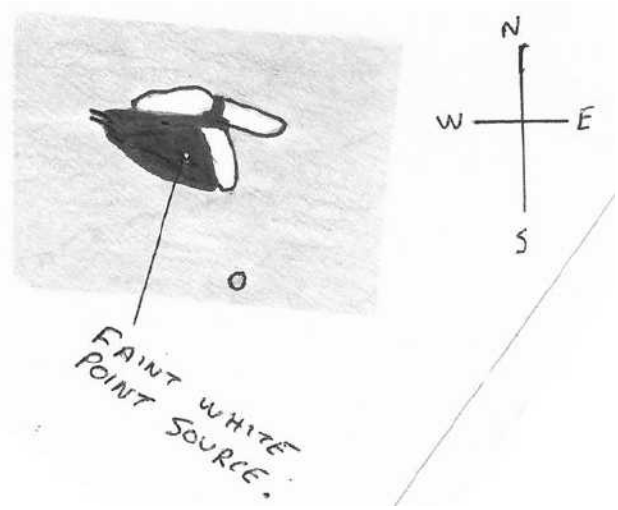


***Figure 4.*** *Mon Piton as sketched by Trevor Smith (BAA) on 2019 Mar 14 UT 21:35.*

**Eratosthenes:** On 2019 Mar 15 UT 00:45-01:00 Alberto Anunziato (SLA) and UT 00:55-01:35 Jay Albert (ALPO) observed visually this crater under similar illumination (±0.5°) to the following two TLP:

*Eratosthenes 1952 Nov 25 UT 16:30 A.P. Lenham (Swindon, UK, 3inch refractor x150, Definition Good) noted that there was faint/slightly bright detail inside the interior shadow - observer comments "presumably peaks of central mountains & W. Wall ridge, but very faint" - however this is worth checking out. ALPO/BAA weight=1.*

*On 2009 Nov 25 UT18:42-21:03 P. Abel, T. Little and C. North (Selsey, UK, 15" reflector, seeing II-III, transparency very good), all saw visually a brownish tinge on the north west rim of Eratosthenes crater. P. Abel made a sketch and T. Little took some high-resolution CCD images, some of which were through coloured filters. Checks were made for spurious colour, but none was seen elsewhere on the Moon. The eyepiece was changed but this made no difference. M.C. Cook (Mundesley) was observing with a smaller scope at the same time, but saw no colour, however observing conditions were worse. W. Leatherbarrow (Sheffield, UK) was observing with an instrument mid-way in size, and saw a brownish tinge in the NW rim area, but saw a similar colour elsewhere and put this down to spurious colour. Normally multiple observers seeing the same thing would result in a weight of 4, however as this was only observers at Selsey and some of the evidence contradicts, I am allocating an ALPO/BAA weight=3.*

Alberto comments that there were no tinges, nor bright peaks in the shadows. Jay Albert also saw no 'brownish tinge on the northwest rim'. The crater floor was in complete shadow and the central peak was not visible. The W wall and rim were intricately terraced and very bright with no colour. The ejecta blanket was very sharply detailed. Jay did however take an iPhone image at 01:28 UT (See Fig. 5), but this also shows no colour or detail in the interior shadow. We shall therefore leave the Lenham report at a weight of 1 and the Abel report at a weight of 3. If you are

interested in previous attempts at repeat illumination of the 2009 observation, take a look at past newsletters from 2012 Oct, 2016 Feb, 2017 Sep & Oct and 2017 Dec. Some of these have not been as normal in appearance as Jay and Alberto saw in March.

***Figure 5**. A colour image of Eratosthenes taken by Jay Albert on an iPhone and orientated with north towards the top. Colour saturation increased to 50%.*

**Plato:** On 2019 Mar 16 UT 02:34, Jario Andres Chavez (LIADA) imaged the whole Moon under similar illumination (±0.5) to the following report:

*Plato 2005 Dec 10 UT 20:46 Observed by Brook (Plymouth, UK, 4" refractor. Conditions excellent with the Moon at a high altitude) "2 second duration white flash seen on the floor of the crater" - BAA Lunar Section Report. ALPO/BAA weight=3.*

Whilst Jario's image does not solve what Clive Brook saw (perhaps an impact flash?), at least it provides a context image (Fig. 6). We shall leave the weight at 3.

***Figure 6.** Plato on 2019 Mar 16 UT 02:34 from a larger image of the Moon by Jario Andres Chavez (LIADA).*

**Gassendi:** On 2019 Mar 18 UT 04:07 Rik Hill (ALPO/BAA) imaged the crater 26 minutes after the end of a ±0.5° similar illumination window for the following report:

*On 1990 Oct 1st at 00:44-01:24UT D Darling (Sun Praire, WI, USA) observed that Gassendi still had a blink effect when viewed through blue (Wratten 38A) and red (Wratten 25A) filters. No effect was seen on Aristarchus. Gassendi was brighter in the red filter and this was confirmed by Weier. Sketches were made and brightness measurements taken. Both observers used a 12.5" reflector x159. At 01:00UT the NW wall was 7.5, the SW wall 8.0, the S. wall 7.5, the floor 6.0, the outer E. wall 8.0, the N. floor 5.5.*

*Gassendi A W. wall was 9.5,l Aristarchus W. floor was 8.0, NW wall 8.0, shadowed floor 0.0, E. outer wall 7.0, NBP 5.5, area between Aristarchus and Herodotus 6.0, and the comet like tail: 8.2 on the E. and 8.5 on the W. The Cameron 2006 catalog extension TLP ID=412 and weight=5. The ALPO/BAA weight=4.*

***Figure 7.*** *Gassendi as imaged by Rik Hill on 2019 Mar 18 UT 04:07 with a 610 nm filter. Orientated with north towards the top.*

Although Rik's image (Fig. 7) is in monochrome, we can at least check out those visual intensity readings that Darlin and Weier give in their description. We have covered this 1990 observation before in the 2015 Sep and 2018 Jun newsletters.

**Aristarchus:** On 2019 Mar 18 UT 21:40-21:55 Marie Cook (BAA) observed this crater under similar illumination, to within ±0.5°, to the following report:

*1978 May 19 UT21:45-03:30. P. Foley of Kent, UK, using a 12" reflector, seeing=III-II, noticed that initially that the crater was pretty dull and that the floor was a slate blue-gray in colour at 22:45UT. A noticeable green spot inside the crater on the south east appeared at 22:25UT and vanished at 00:50UT. Cameron notes that one doesn't get green with spurious colour. Crater Extinction brightness measurements were made at 22:00 UT (reading=2.8) and at 23:45UT (reading=3.7). The crater dropped in brightness from 3.7 to 2.8 at 23:50UT and remained lower until 3.0 at 23:50-03:15 UT. A graph was produced and showed Proclus and Censorinus at similar brightness's, but Aristarchus variable. The Earthshine was 0.3. Cameron 2006 Extension catalog ID=31 and weight=5. ALPO/BAA weight=3.*

Observing with a 9cm aperture Questar telescope (x80 & x130, seeing Antoniadi III, transparency moderate) Marie found that the crater detail was sharp and clear. The crater brightness was normal and there was no sign of any slate blue-grey colour on the floor or elsewhere. Neither was a green spot visible. Everything appeared normal. We shall therefore leave the weight of this 1978 report at 3. We have covered this TLP before in the 2014 Nov and 2018 Jun newsletters.

**Aristarchus:** On 2019 Mar 20 UT21:50 Aldo Tonon (UAI) imaged the whole Moon under similar illumination (to within ±0.5°) to the following two reports:

*G. Amery (Reading, UK, seeing=II) saw a brilliant white rim, bands and central peak. There was also a clearly seen white glare like feature over*

*the ESE wall that had a direction opposite to the crater interior bands. Cameron states that Foley says that this is usual. High CED brightness readings obtained. M. Cook of Frimley, UK, took CED measurements at 23:35UT and recorded a brightness of > 4.9. Reported a reversal of spurious colour - Cameron suspects that this was a local effect. No spurious colour noticed by anyone else. However, the brightness of the crater was confirmed by other observers. Mosely suspected a brightness change on the inner east wall at a relative position of 8 O'clock. Cameron 2006 extension catalog ID=259 and weight=4. ALPO/BAA weight=3.*

*Aristarchus 1973 Sep 11 UT 20:48-21:06 observed by Pasternak (53deg 20'N, 7deg 30'E, 75mm reflector T=1, S=3) "reddish colours at the S of Aristarchus from 20.48-21.00 U.T., area spread to the region E of the crater at 20.57 U.T., disappeared there at 21.04U.T., no colours after 21.06 U.T." - Hilbrecht and Kuveler, Earth, Moon & Planets, 30 (1984), p53-61. ALPO/BAA weight=1.*

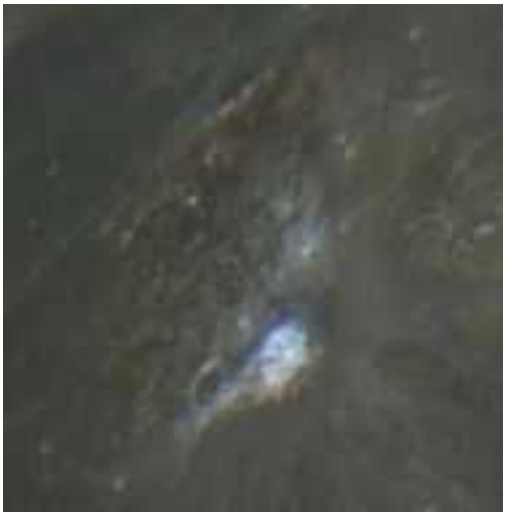

***Figure 8*** *A subsection Aristarchus of Aldo Tonon's image of the whole Moon, obtained on 2019 Mar 20 UT 21:50 and orientated with north towards the top. The colour saturation has been increased to 60%.*

Fig. 8 shows a hint of red to the south of Aristarchus which Pasternak mentions, but this does not explain the change in colour unless the 1973 report was affected by atmospheric spectral dispersion. You can certainly see the ESE glare-like feature that Amery mentions protruding outside the crater, so this is normal as Foley suggests. In terms of brightness, the absolute brightness of different craters were as follows (their brightest parts): Bright patch near Hell: 235, Censorinus: 230, Proclus: 229, Tycho: 194, Aristarchus: 192, and Copernicus: 166. Please note that as we have mentioned in the past, eye estimates, using CED devices can be affected by contrast with respect to surrounding background terrain – this could explain the difference between Marie Cooks high CED reading, and the CCD values above. We shall leave the weights of these two reports as they are for now.

**Aristarchus:** On 2019 Mar 21 UT 07:47 Ivor Walton (CADSAS) imaged the whole Moon during the following repeat illumination event:

*Aristarchus 1973 Feb 15 UT 17:07-19:31 Observed by Theiss (located at 51N 5.67E) "area 4-5 diameters of Aristarchus were coloured clearly yellow-red" 120mm reflector used. Ref Hilbrecht & Kuveler (1984) Moon and Planets Vol 30 p53-61. ALPO/BAA weight=1.*

Although the image (Fig. 9) is not in colour, we can at least see the general appearance that the Moon would have had on 1973 Feb 15. Although just past Full Moon, measurements of the brightness of craters present in the image show Aristarchus, Proclus and Tycho saturate at 255, but all are brighter than other reference craters such as Censorinus, Copernicus and Kepler. We shall leave the weight at 1 for now.

***Figure 9.*** *The lunar disk as imaged, in monochrome, by Ivor Walton (CADSAS) on 2019 Mar 21 UT 07:47.*

**Furnerius:** On 2019 Mar 23 UT 06:28 Juan Manuel Biagi (SLA) imaged a large region of the lunar disk, part of which contained Furnerius, under similar illumination (±0.5°) to the following report:

*On 1986 Feb 26 at 05:00UT a photograph was obtained by T. Kohman of Pittsburgh, PA, USA (3.5" Questar and 0.25 sec exposure) that had two bands above the limb, resembling ejecta plumes. Cameron suspects that these are probably flare from the eyepiece optics. Cameron 2006 extension catalog ID=282 and weight=0. ALPO/BAA weight=1.*

Winnie Cameron is almost certainly right about eyepiece flare, but alas we do not have a copy of Kohman's photograph to check this. Fortunately, with Juan's image (Fig. 10), we can safely say that there are no natural features in the area that would exhibit this effect. We will leave the weight at 1 for now.

***Figure 10.*** *Furnerius crater from a portion of a larger image taken by Juan Manuel Biagi (SLA) on 2019 Mar 23 UT 06:28. Orientated with north towards the top.*

**General Information:** For repeat illumination (and a few repeat libration) observations for the coming month - these can be found on the following web site: http://users.aber.ac.uk/atc/lunar_schedule.htm . Only by re-observing and submitting your observations can we fully resolve past observational puzzles. To keep yourself busy on cloudy nights, why not try 'Spot the Difference' between spacecraft imagery taken on different dates? This can be found on: http://users.aber.ac.uk/atc/tlp/spot_the_difference.htm . If in the unlikely event you do ever see a TLP, firstly read the TLP checklist on http://users.aber.ac.uk/atc/alpo/ltp.htm , and if this does not explain what you are seeing, please give me a call on my cell phone: +44 (0)798 505 5681 and I will alert other observers. Note when telephoning from outside the UK you must not use the (0). When phoning from within the UK please do not use the +44! Twitter TLP alerts can be accessed on https://twitter.com/lunarnaut .

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