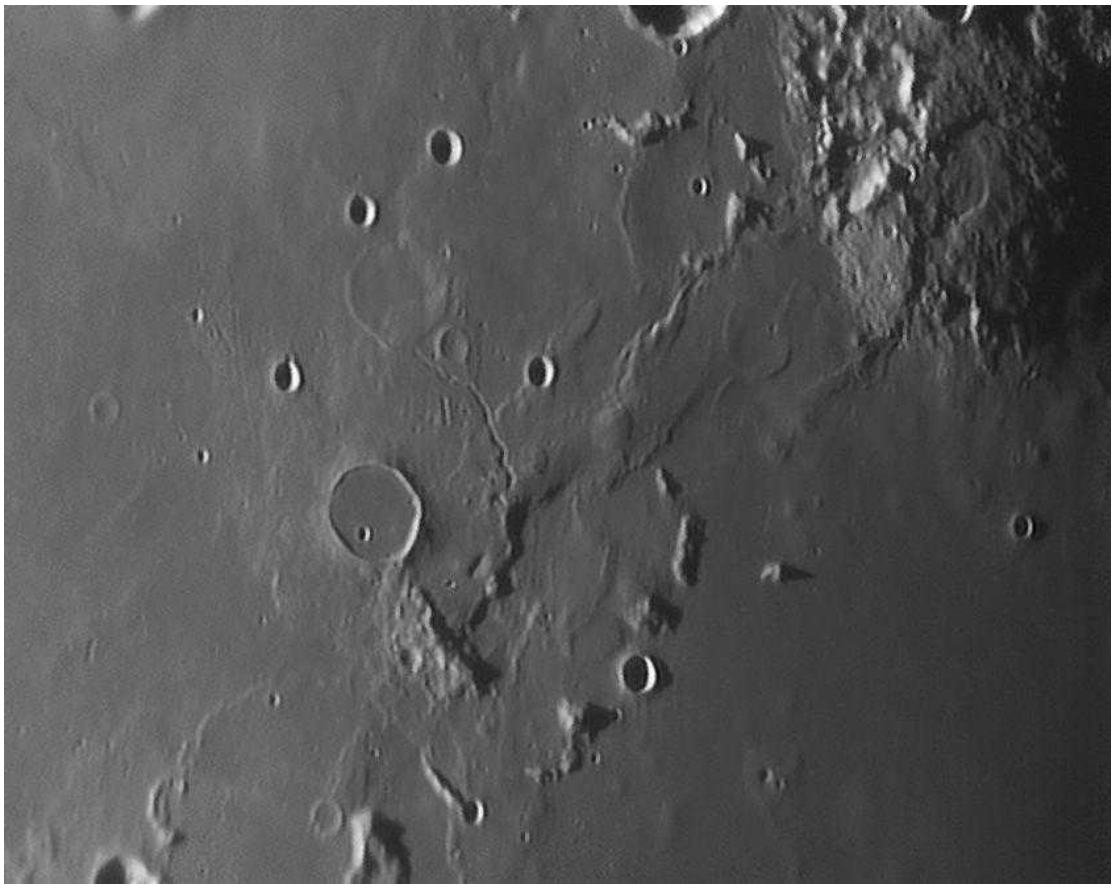
Director: Bill Leatherbarrow

LUNAR SECTION CIRCULAR

Vol. 57 No. 12 December 2020

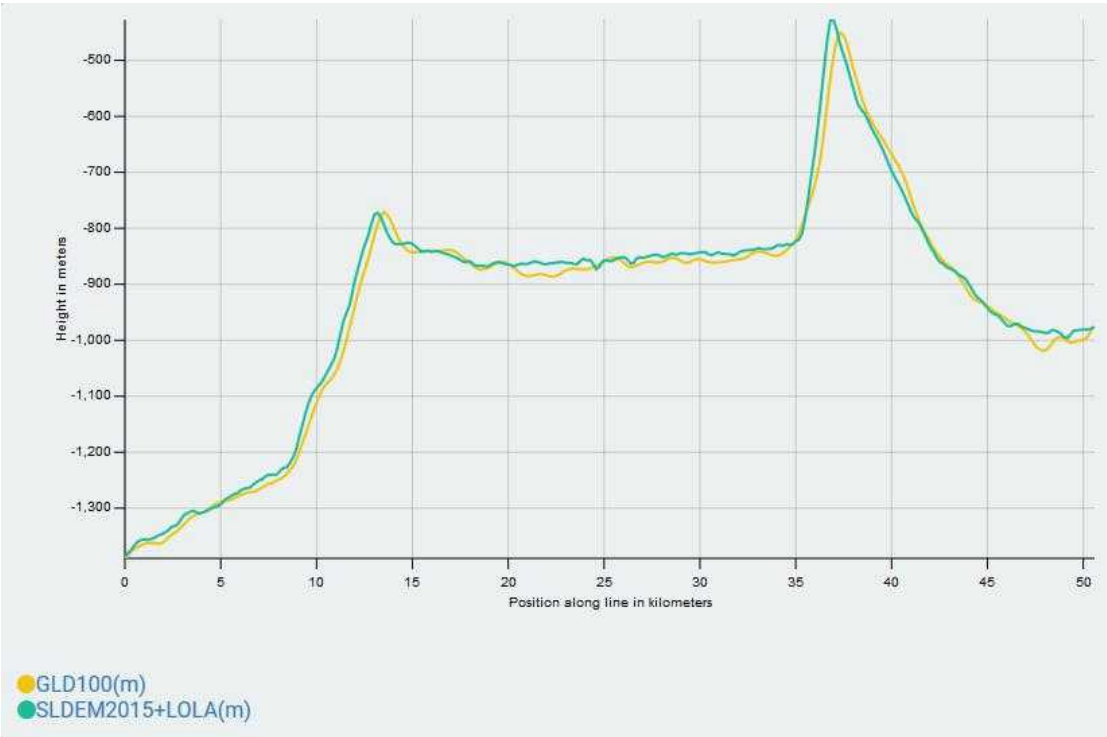
FROM THE DIRECTOR



Jansen and environs, 29 September 2018, 04.04 UT (image by Bill Leatherbarrow)

In his regular contributions to the LSC Raf Lena has consistently pointed out the value of telescopic observations made under low-angle illumination for revealing the presence of domes whose low elevation means that they do not always show up on images from spacecraft. Moreover, a recent contribution by KC Pau has shown how similar telescopic imagery can detect shallow rilles that also elude spacecraft imagery taken under a higher sun (LSC, 57:9, October 2020).

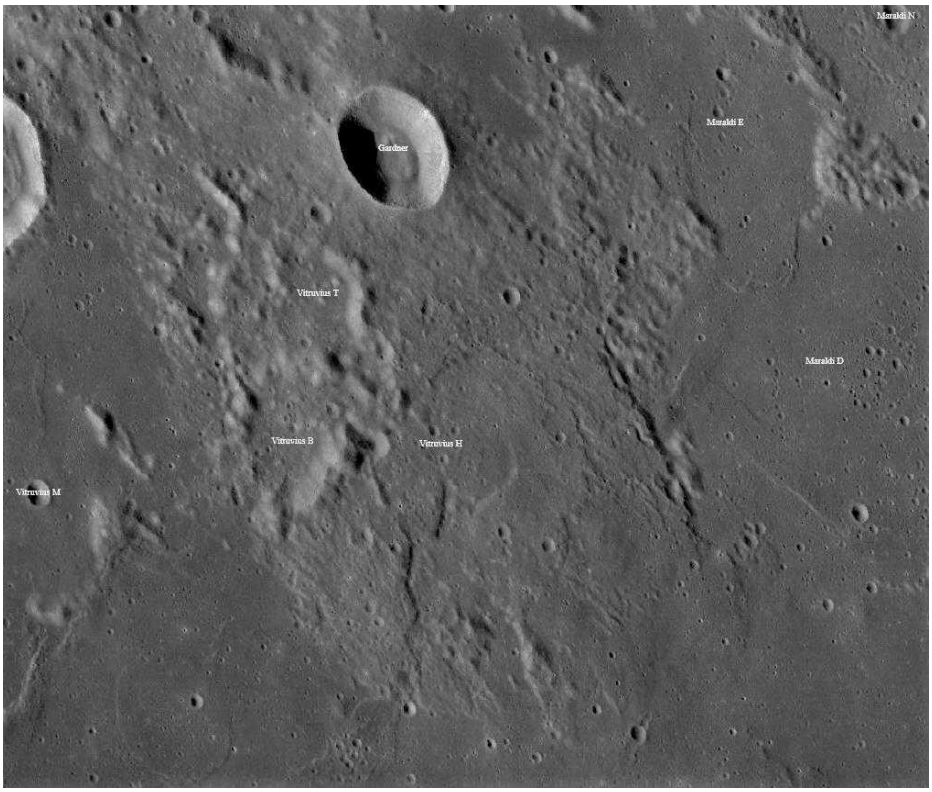
These endorsements of the continuing value of earth-based observation lead me to suggest an observing programme for both imagers and visual observers over the coming months, while the Moon is high is the sky for northern observers. It would be good to see further telescopic images (under both low morning and evening illumination) of the area around the small (23km) flooded crater Jansen, located to the east of Plinius on the Mare Tranquillitatis. This is one of the most geologically interesting areas of the lunar surface, despite its lack of 'showpiece' formations. Jansen itself is clearly a lava-flooded crater, but this is not a simple case of its walls having been breached by the surrounding mare lavas. A west-east elevation profile shows that the floor of Jansen is significantly higher than the surrounding mare, suggesting that it was flooded from below, rather like the 'plateau' Wargentin near the Moon's southwest limb.



Elevation profile (W – E) of Jansen (NASA/QuickMap)

Notice the presence of further pancake-like flooded rings in the same vicinity, as well as numerous conventional domes, the latter particularly to the east of Jansen. The ring to the north of Jansen (Jansen R) has a similar elevation profile to that of Jansen itself and it lies at the northern end of the Rima Jansen. This is a sinuous rille marking out the course of lava that must once have flowed from its origin at the rille's higher southern end, a caldera perched upon a wrinkle ridge that is part of the Dorsa Barlow system. This looks likely to have been the source of the lavas that infilled Jansen R.

But perhaps the most interesting feature of this region is the presence of a huge upswelling at the northern end of Dorsa Barlow. Despite being some 70 km across, it was overlooked by many observers who assiduously charted the many much smaller domes in the area. It has, however, received more attention in recent years. Perhaps this earlier neglect is because, unlike the smaller domes, its surface is rough and could be mistaken for normal highland terrain. However, spacecraft imagery and elevation profiles betray its dome-like structure and the presence of what looks like a rimless summit caldera confirms its volcanic origin. Chuck Wood has termed this 'the Gardner Megadome' after the 18km crater that sits at its northern edge.



The Gardner 'Megadome' (NASA/QuickMap)

Raf Lena and his colleagues have considered this area in the past (see, for example, the BAA *Journal*, 125:2, April 2015) and there is a good recent image by Dave Finnigan in the LSC for September 2020, but I do feel that there are further opportunities here for the diligent observer. We just need some clear skies!

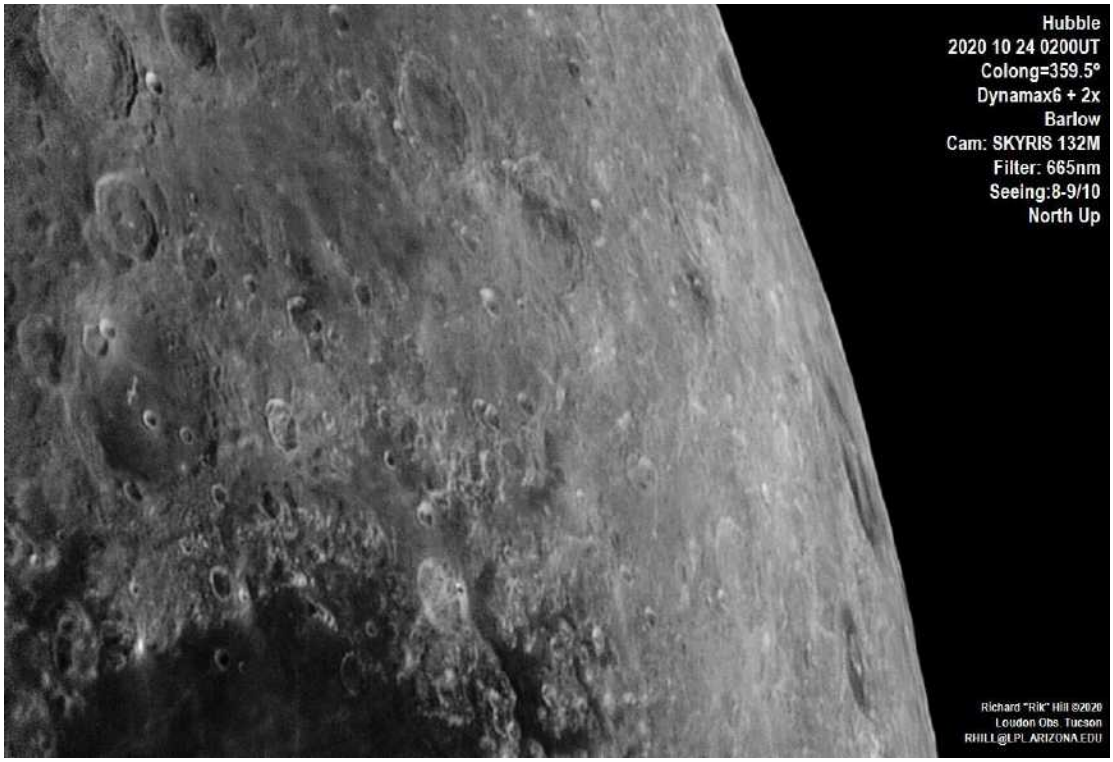
With all good wishes for Christmas and New Year!

Bill Leatherbarrow

OBSERVATIONS RECEIVED

Images and/or reports have been received from the following observers: Leo Aerts (Belgium), Maurice Collins (New Zealand), Daryl Dobbs, Chris Dole, Dave Finnigan,

Mark Green, Rik Hill (USA), Luigi Morrone (Italy), KC Pau (Hong Kong), Bob Stuart, Alexander Vandenbohede (Belgium), Ivan Walton, George Whiston, and the Director. A selection from these is featured below.

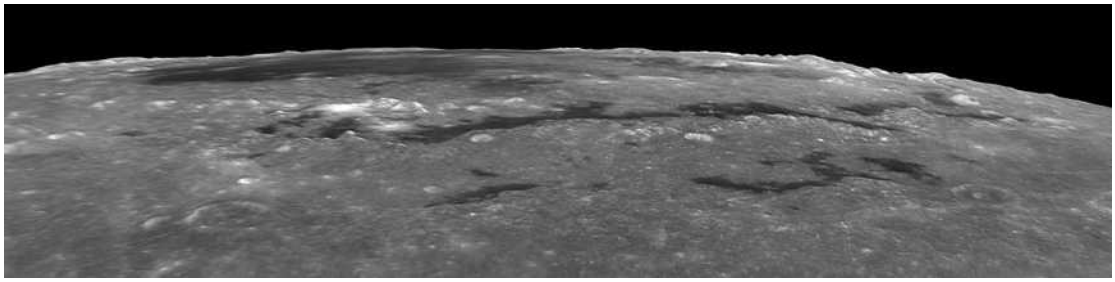


Rik Hill comments on the above image as follows:

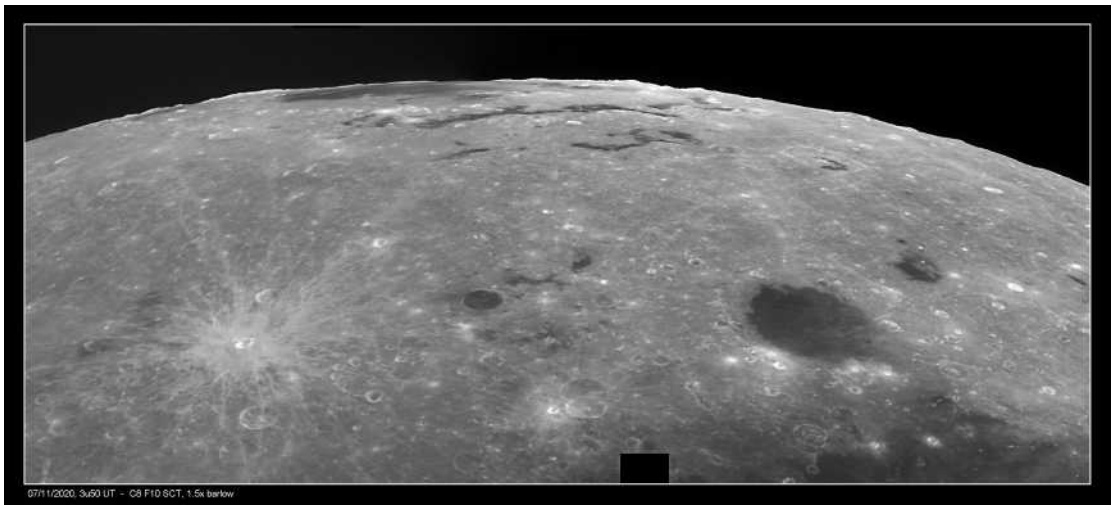
'Seven days into this particular lunation, we had a favorable libration just at the northern edge of the limb on this image. It allowed for a very good view of a couple of craters not usually seen so well. The large dark area in the lower left is the north shore of Mare Crisium and Mare Anguis, the dark meandering patch on the right side of Crisium. Notice just above Crisium is the large crater Cleomedes (129km dia.) and above that is Burckhardt (57km). Then at the top edge of the image is the well-defined Geminus (88km) with its nicely terraced walls. Moving towards the limb you see another fairly well defined crater, Berosus (77km) and to the lower right another similar sized crater with a curious dark stripe across its floor, Hahn (87km). It appears from Lunar Orbiter images and the *Gazetteer of Planetary Nomenclature: 1:1 Million-Scale Maps of the Moon* that most of the northeast half of the floor of this crater is simply a darker material than the southwestern half.

On the limb, straight across right from Crisium is a dark floored crater. This is Hubble (83km) not often seen this well with its longitude of 87°. This crater is named after Edwin P. Hubble, as is the famous telescope and minor planet (2069) Hubble. Below it is another dark floored crater, Cannon (60km). Further in towards Crisium is the outline of the crater Plutarch (70km) which is usually a near-limb feature for this region!'

KC Pau has submitted a very striking image of Mare Orientale, writing as follows: 'I enclose a new photo of Mare Orientale at longitude libration of -7º15 taken on 6 November 2020 at 21h42m UT with my 10" Newtonian + 20mm eyepiece projection + QHYCCD 290M + 400 frames stacked. I was lucky this time as the weather was fine and the Moon was nearly overhead in the sky at my latitude in Hong Kong. However, the seeing was moderate at high resolution so that the photo was not very sharp to show finest detail. The dark Mare Orientale is well-displayed as well as the Montes Rook and Montes Cordillera.'



Alex Vandenbohede captured the same region on 7 November 2020.



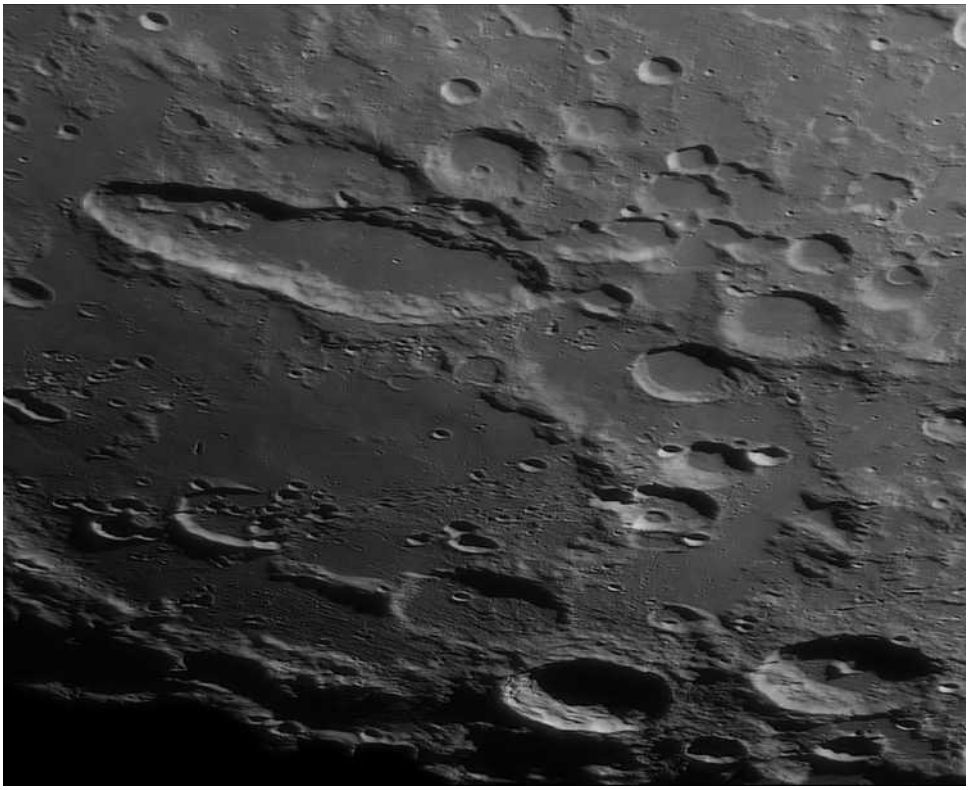
IMAGES GALLERY

Area of Apollo 16 landing site near Descartes (Alex Vandenbohede)

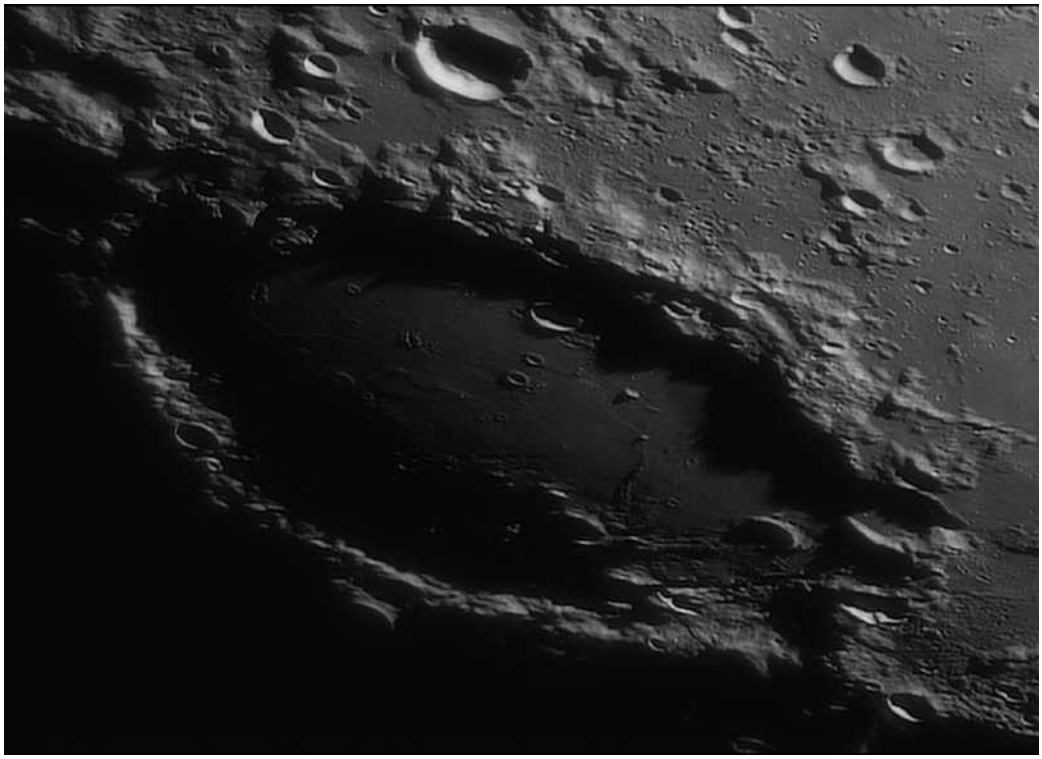
Sunset over Mare Crisium, 02 Nov 2020, 20:30 UT, 0.57m Newtonian & ZWO ASI174MM camera at prime focus (Ivan Walton)

Aristoteles, 23 October 2020, 07.56 UT, C8 SCT (Maurice Collins)

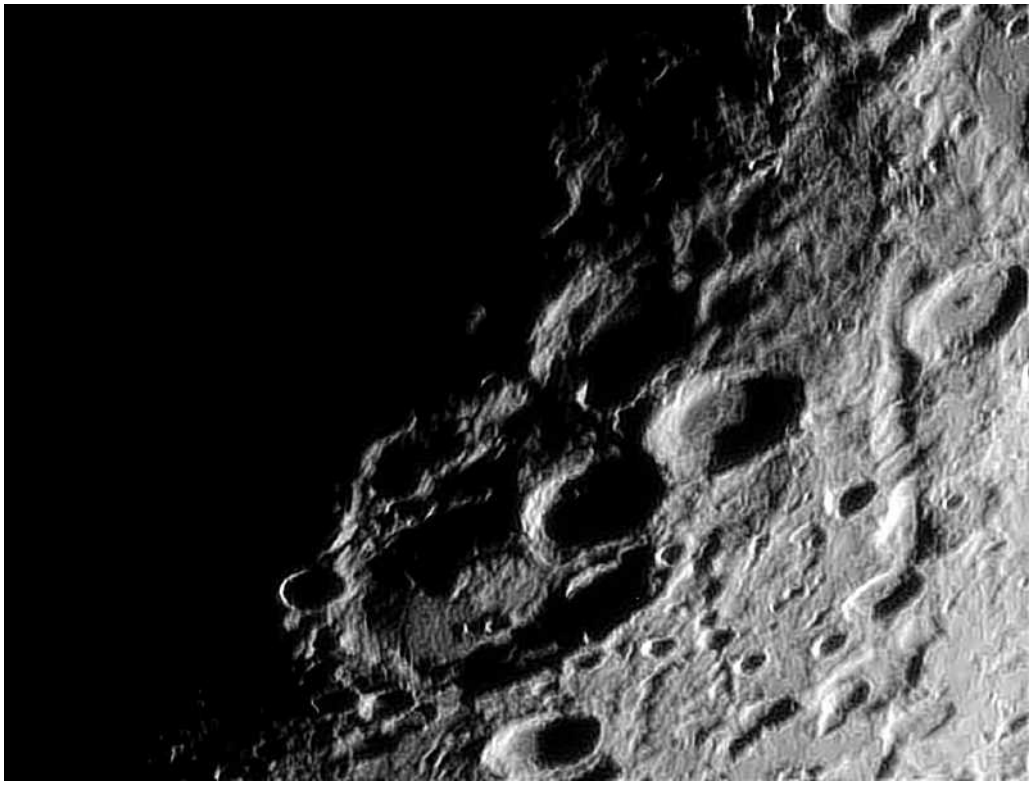
Luigi Morrone has submitted several images from earlier this year. Two, depicting the Schiller-Zucchius Basin and the great crater Schickard, are featured on the following page. They have been reoriented and/or flipped by the editor to match the conventions of this Circular.



Schiller-Zucchius Basin, 4 May 2020, 19.37UT, C14 SCT

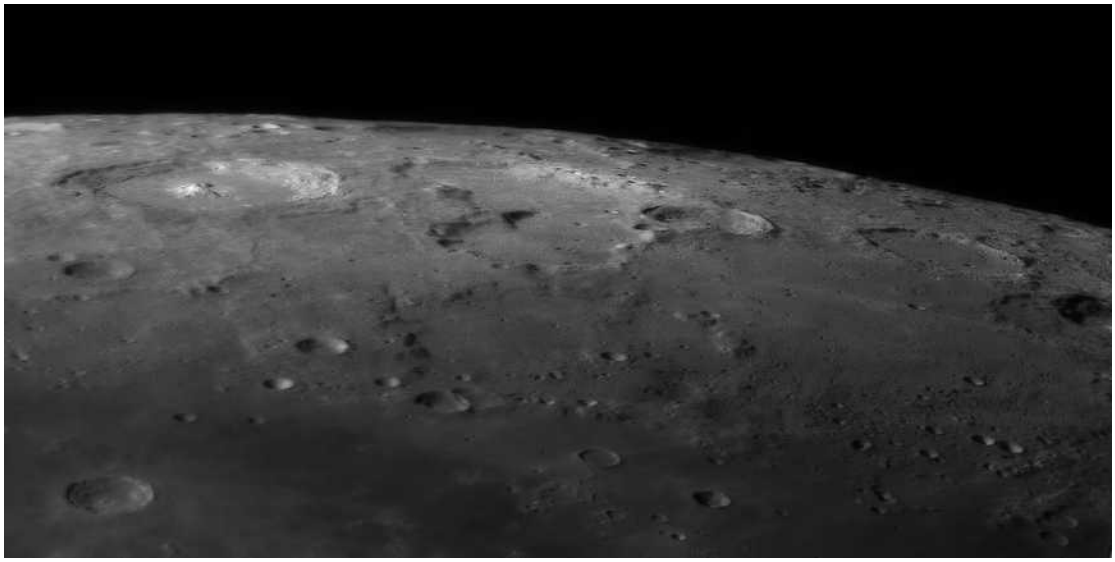


Schickard, 4 May 2020, 20.09UT, C14 SCT



Janssen, 21 September 2020, 18.32UT, C11 SCT (George Whiston)

Clavius, Moretus and South Polar Regions, 7 November 2020, 03.53UT, C14 SCT (Leo Aerts)



Pythagoras and North Polar Regions, 7 November 2020 (Leo Aerts)

LUNAR DOMES (part XLII). Observing Crisium 1: Is an inflation of the upper surface layers associated with the formation of the wrinkle ridges?

Raffaello Lena

In a previous note a possible dome, provisionally termed *Crisium 1* (Cr1), has been described. It is detectable in the image taken by Tedorescu on October 3, 2020 at 23:02 UT (LS Circular, November 2020).

A campaign to encourage lunar observers to image Cr1 under waning moon phase was organized and started on November 1, 2020. This was done completely via the internet, specifically through the use of e-mails and astronomical forums. The goal of this project was to image Cr1 under low solar illumination angle and to describe the relationship between Cr1 and the nearby topography of the Mare Crisium.

New Observations (November 1-2, 2020)

Fig. 1 displays an image from this second survey taken by Maximilian Teodorescu, from Romania, on November 1, 2020 at 22:03 UT.

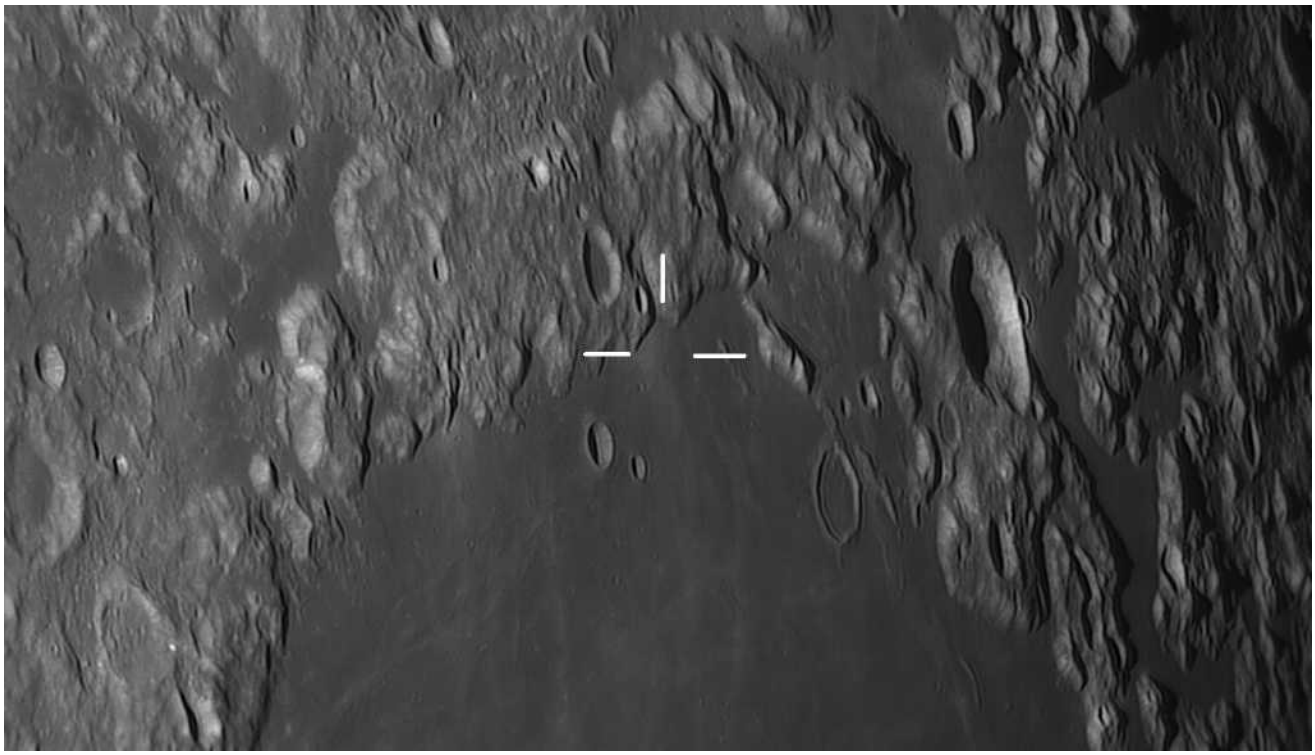


Figure 1: Image taken by Teodorescu on November 1, 2020 at 22:03 UT using a 355 mm Newtonian telescope and ASI 174MM camera.

Another image of this region was taken by Pau, from Hong Kong, on November 2, 2020 at 17:27 UT (Fig. 2). The image, taken under lower solar illumination angle, displays the wrinkle ridges around the examined region.

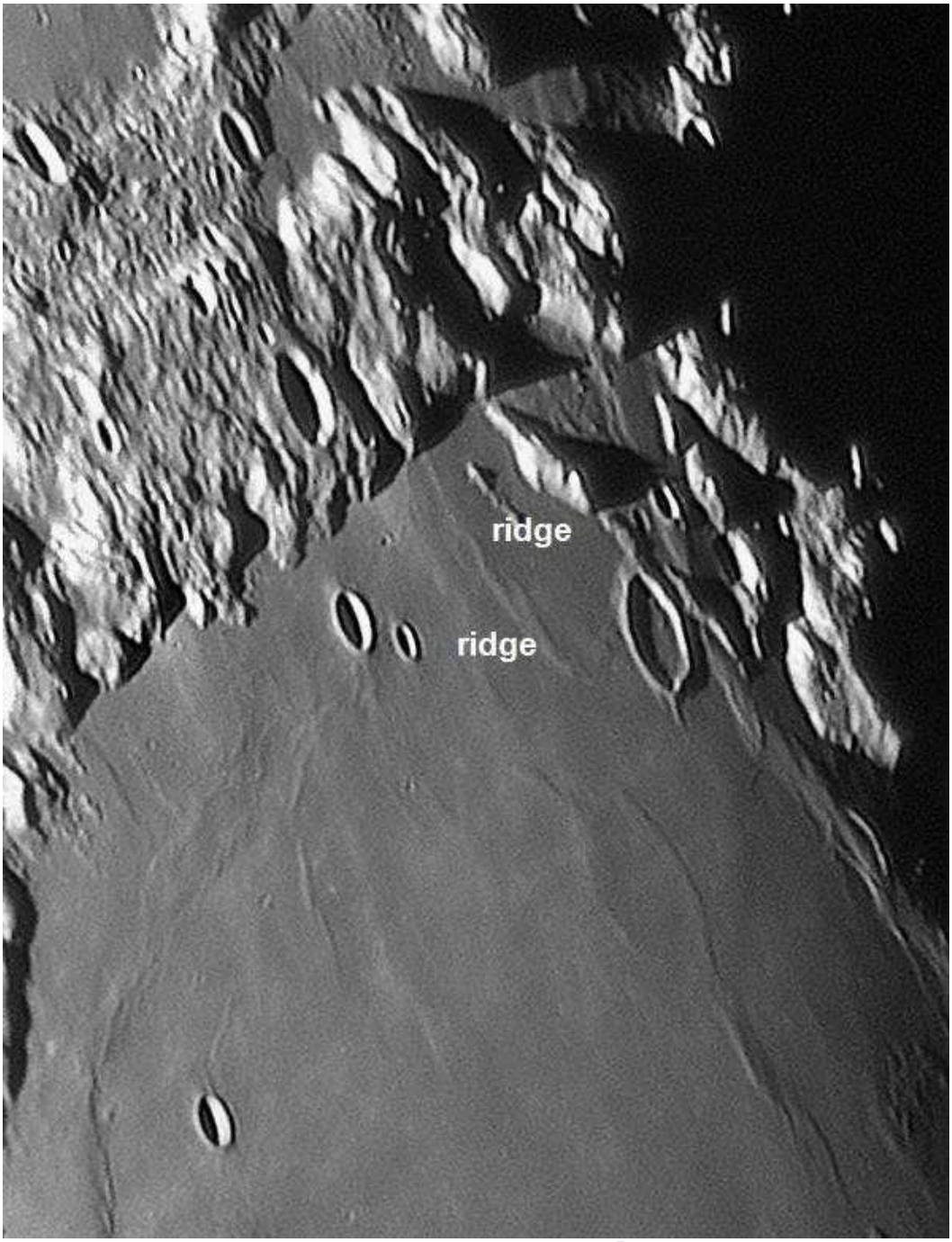


Figure 2: Image taken by Pau on November 2, 2020 at 17:27 UT using a 250 mm f/6 reflector and a QHYCCD290M camera.

Alessandro Bianconi from Italy has imaged Cr1 under lower solar illumination angle (about 3.5°) as shown in Fig. 3. The image was taken on November 2, 2020 at 22:53 UT. Note that under low solar illumination angle the dome surface is partially covered by the shadow of the nearby massif/hills located on the Crisium rim.

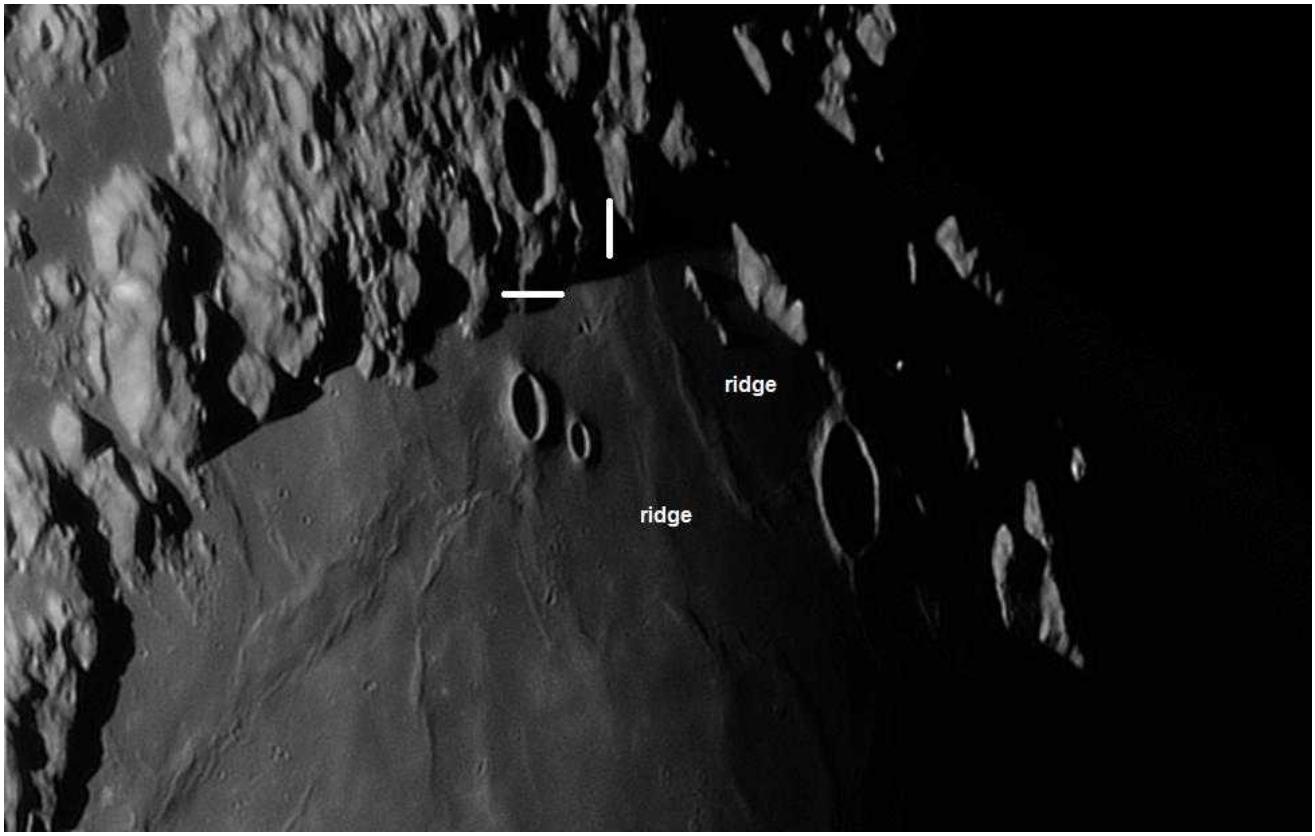


Figure 3: Image taken by Bianconi on November 2, 2020 at 22:53 UT using a C14 HD edge 10Micron GM2000HPSII and ASI174MM.

The recent telescopic images display a connection with the southern ridge when the region is imaged under grazing lighting conditions. Moreover two scarp-like features traversing the surface of Cr1 are detectable located in direction SW (see feature A in Fig. 8) and NS (see feature B in Fig. 8), respectively.

Domes and ridges

Several known lunar domes, examined in the past, are characterized by a connection with wrinkle ridge. Some examples are represented by the dome Grimaldi 1 located in Grimaldi, C16 in the Cauchy region and the dome near Turner. The following figures show these domes (Figs 4-7).

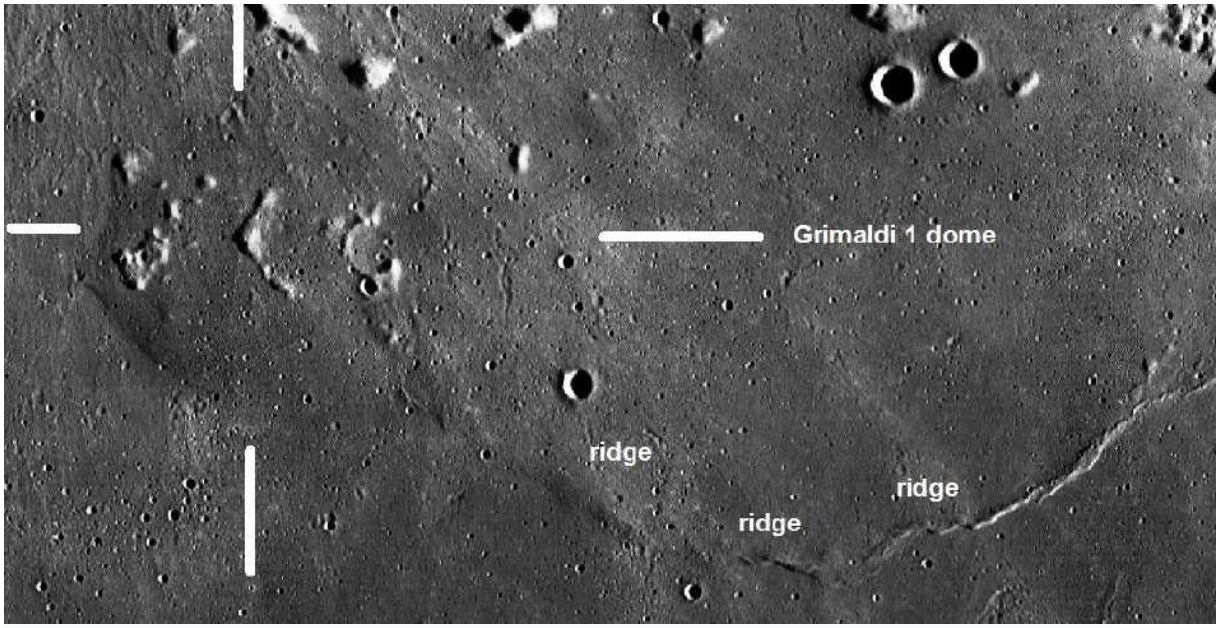


Figure 4: LRO WAC imagery. Dome Grimaldi 1.

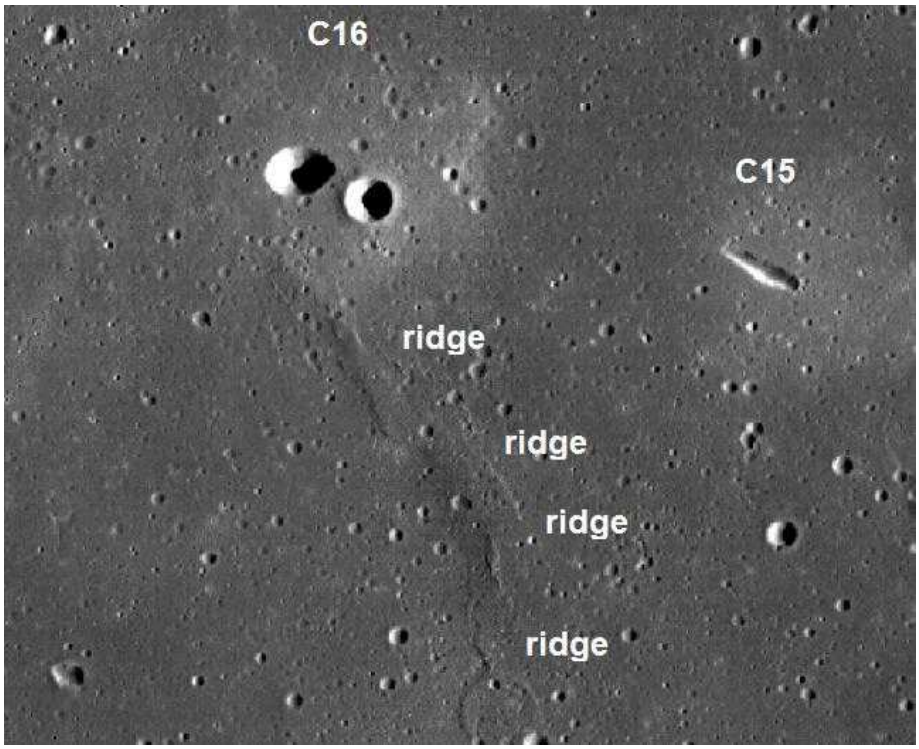


Figure 5: LRO WAC imagery, and the dome C16. The ridge is detectable also in CCD telescopic images in the lunar domes atlas (http://4.bp.blogspot.com/-qr0dWD-NPag/U7btUDmheYI/AAAAAAAAANE/ke9jfz_YUCA/s1600/Cauchyst390.jpg).

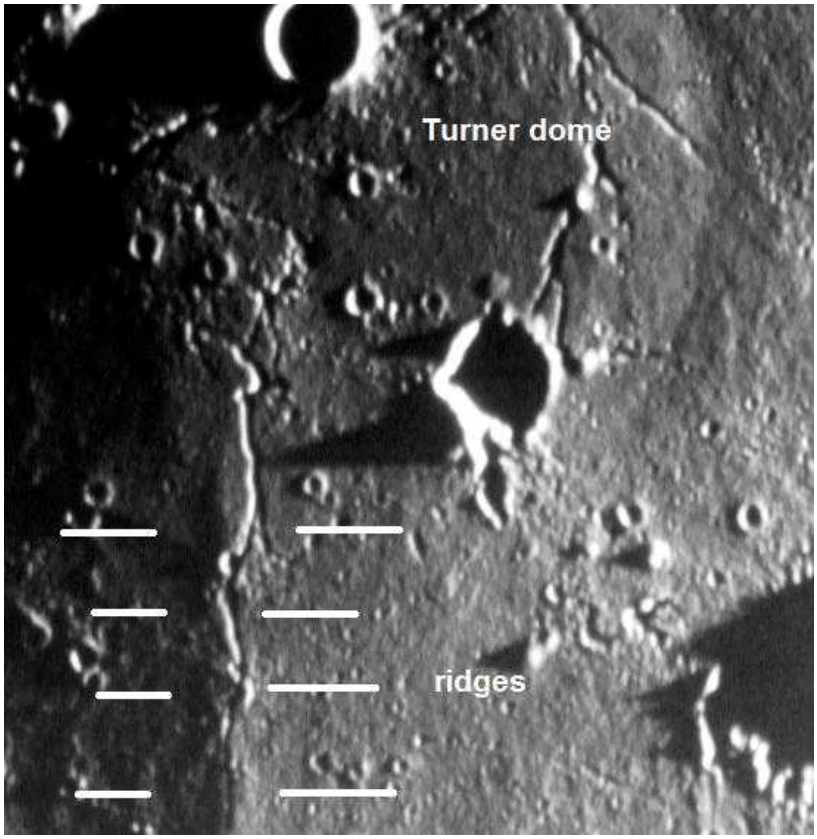


Figure 6: A dome near Turner with associated ridge. Apollo image AS12-50-7438.

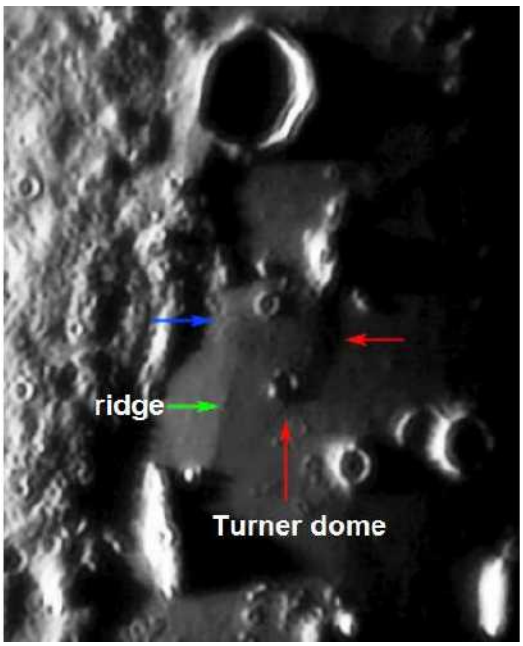


Figure 7: A dome near Turner with associated ridge. Image by the author.

Possibly the structure of Turner extends into the ridge. It would then be the manifestation of a subsurface volcanic dike with sill formation [Lena et al., 2013].

Digital elevation map LOLA DEM

The ACT-REACT QuickMap tool was used to access the LOLA DEM dataset, obtaining the cross-sectional profiles and 3D reconstruction for the examined region (Figs 8-9).

Based on WAC imagery two low scarps run up through the surface of Cr1 near the elongated crater (Figs. 8-9). The first feature, labelled as B, is 70-80m high and could be a continuation of another lobate scarp, labelled as A that approaches the dome from the SW. The scarp A is 60-70m high based on LOLA DEM measurements. There is another ridge that approaches the eastern rim of Cr1 from SE (labelled as C in Figs. 8-9).The scarp B heads off towards the N and the mountain massif that forms the border of the mare Crisium.

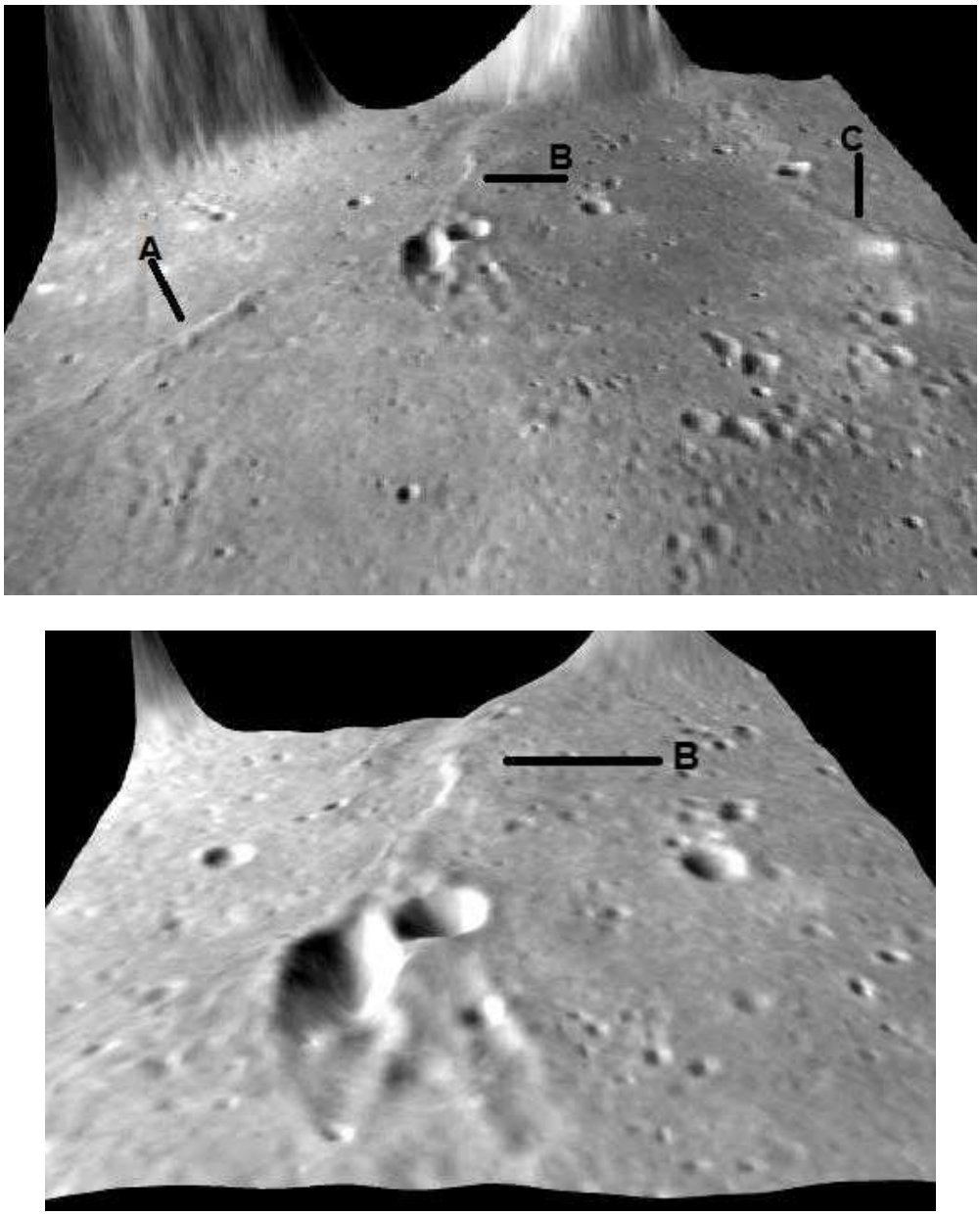


Figure 8: LRO WAC-derived surface elevation. See text for detail.

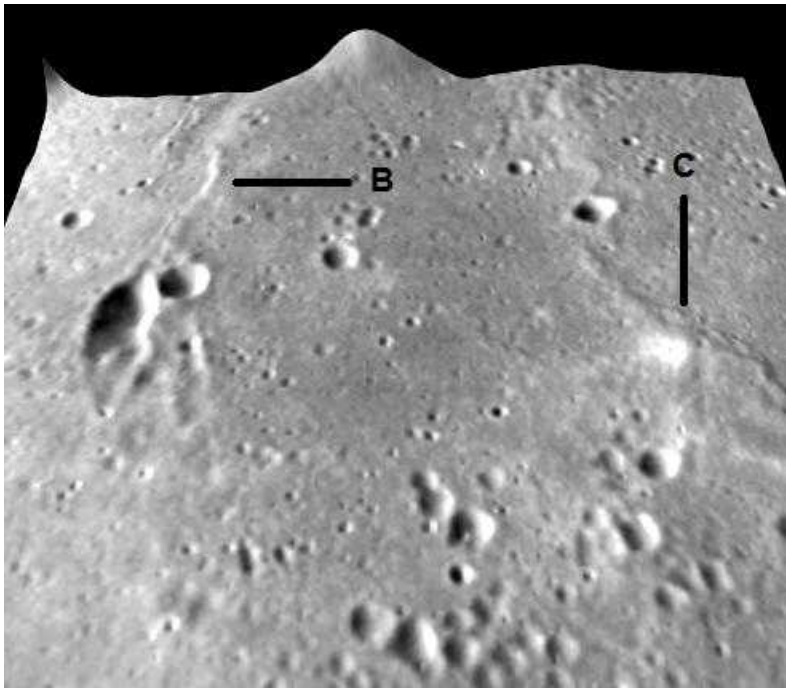


Figure 9: LRO WAC-derived surface elevation.

Along the boundary of the two lobate scarps the feature forms a west facing escarpment suggesting a low angle thrust fault, with the terrain on the eastern side overriding that on the western side (Fig. 9).

Morphometric updated data

Based on new terrestrial telescopic images and the boundary with the mentioned ridges, I have updated the morphometric data without the inclusion of the ridges (and their heights) in the corresponding measurements. This correction yields lower values of the height as shown in Figs 10 and 11. In the revised measurements the crater Cleomedes F has been used as reference point of the southern rim of Cr1.

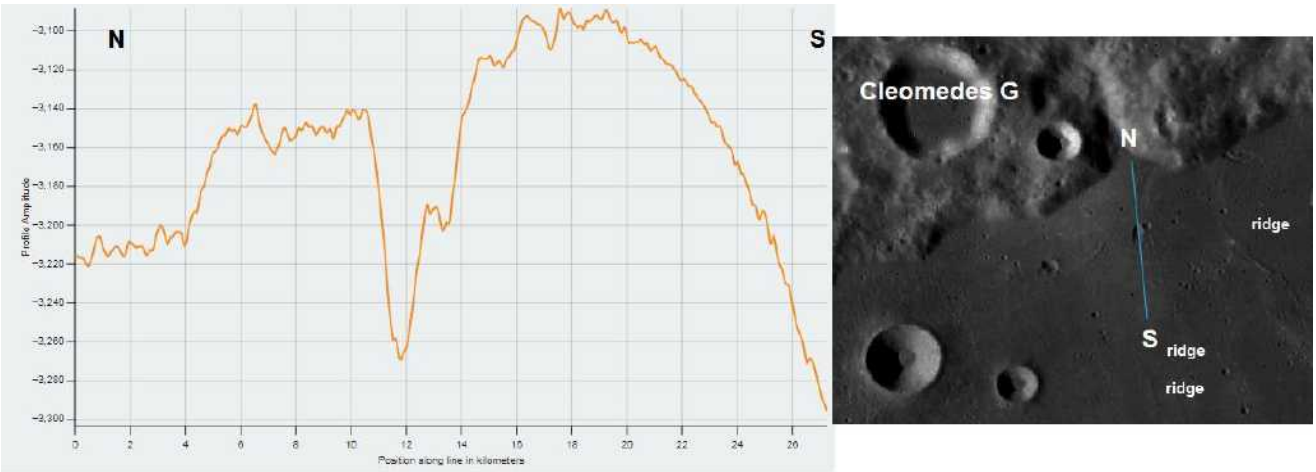


Figure 10: LRO WAC-derived surface elevation in NS direction, excluding the southern ridge to the South of Cr1, as shown in the telescopic images. The height amounts to 160m in NS direction. Note that including part of the ridge the height amount to about 230m as computed in the first preliminary report.

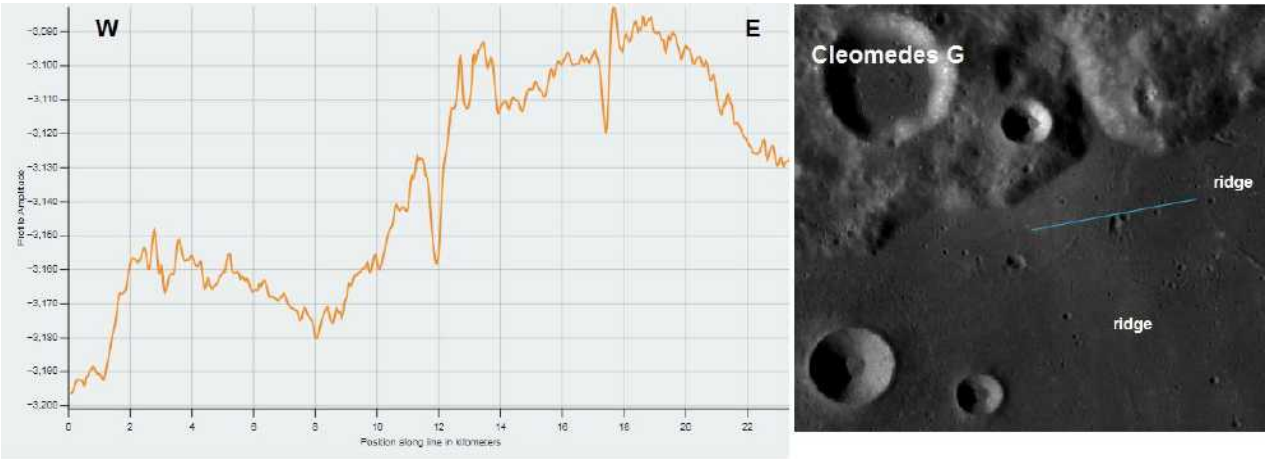


Figure 11: LRO WAC-derived surface elevation in WE direction, based on the boundary shown in the telescopic images. The height amounts to 70m in WE direction.

The outline of a dome can be described by a major axis **a** and a minor axis **b**; thus the dome diameter may be defined as the geometric mean:

$D = \sqrt{\mathbf{a\ b}}$ and its circularity as c = **b/a,** while the flank slope is defined as slope= arctan (2h/D).

The mean diameter amounts to 24.65km (a=27.0km and b=22.5km) and the circularity is determined to c= 0.83.

Possible interpretation

In the work by Head and Gifford, mare domes of class 4 are associated with mare ridges and arches [Head and Gifford, 1980].

The fact that Cr1 is located close to border of an impact basin would indicate a formation due to:

1) Magma rise through dikes guided by stress fields resulting from basin subsidence as a consequence of lava loading. The derived morphometric data are compatible with the classification of a C_1 effusive dome but, in this scenario, the origin of some lobate scarps on its summit (as described in the section *Digital elevation map LOLA DEM*) is not clear. However lobate scarps and ridges are present in some well known domes, e.g. Mons Rümker.

https://agupubs.onlinelibrary.wiley.com/reader/content/1677c5db7e8/10.1002/2016JE005247/format/pdf/OEBPS/pages/bg3.png

Or:

2) An up-arching of the central part of Cr1 as result of a next magma intrusion forming a laccolith within the crust. In this scenario, after an effusive phase, a magmatic intrusion occurred creating a west facing escarpment. Based on the circularity (c=0.83) and modelling results Cr1 does not match the properties of

putative intrusive domes regarded in previous studies. Another thing that may argue against an intrusive origin for Cr1 is the lack of any sort of extensional fractures (rilles). However it is equally possible that it is could be an intrusive dome where the low pressure did not result in the tensional features usually associated with laccoliths, but these domes of class In2 are more elongated than Cr1 (c>0.8) and characterized by smaller and slightly steeper edifices with diameters of 10–15km and flank slopes between 0.4° and 0.9°.

Or:

3) Cr1 can be interpreted as a larger extension of the southern ridge, and thus not an effusive lunar dome.

Or:

4) This complex bulge may have formed when magma, or volcanic gases, rose under a lava flow near the surface and inflated it. Thus, based on new acquired data described above, the most likely explanation could be that Cr1 is an inflation of the upper surface layers associated with the formation of the wrinkle ridges that cross the mare margins. This possible explanation is shared by my friend Barry Fitzgerald.

Conclusion

I encourage high-resolution imagery of this area during the next lunation to confirm the hypothesis of an inflation of the surface layers associated with the formation of wrinkle ridges. If any reader has further hypotheses, the debate is welcome. Cr1 is a complex feature and raises quite a lot of questions regarding interpretations of these bulges associated with ridges.

References

1) Head, J. W., Gifford, A., 1980. 'Lunar mare domes: classification and modes of origin'. *The Moon and Planets* 22, 235-257.

2) Kerr, A. D., Pollard, D. D., 1998. 'Toward more realistic formulations for the analysis of laccoliths'. *J. Structural Geology* 20(12), 1783-1793.

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

LUNAR OCCULTATIONS **December 2020** Tim Haymes

Time capsule: 50 year ago (LSC Vol.5, No.12) with thanks to *Stuart Morris* for the LSC archives. https://britastro.org/downloads/10167

- P.J. Young (Leeds) reported an RD occultation for nu Leonis on 1970 Sept 27th at 0439hr 19.2s. He used a 6" Newt. x 60, stopwatch and GPO speaking clock. The reaction delay was not given. (The observation is not the Occult4

DB. A preliminary reduction applying -0.5s PE gives a good (low) O-C residual. I used the reported location and OSGB datum – TH)

- D. Hall (Occultation Session) remarks on his unsatisfactory observations owing to poor conditions. The GPO speaking clock was also unavailable after midnight.
- A Short wave radio for DIZ Germany was being tested by Mr Hall.

Requesting Predictions for 2021

Please inform TH of your position and telescope aperture and he will email you a listing from Occult 4. Send your request to: tvh dot observatory at btinternet dot com

Report: Grazing Occultation of SAO-79805 (ZC 1195) on Nov 6th T. Haymes

I report a successful observation of this v6.8 star at cusp angle 10 degrees North. GRAZPREP software (Dr E Riedel) was used to predict the number of contacts and find a suitable position. This involved my somewhat iterative process whereby the graze was simulated at different geographical coordinates which are then displayed with Google Earth.

One can rarely find an optimum location that is accessible by car, so the idea is then to type in coordinates of a usable location (not far away) and see how many contacts are predicted. A location up a track between two fields was found that predicted 12 contacts. The location was inspected the previous day, and the ground was hard with muddy puddles and some long grass. The map shows the Occult mean limb (green) GRAZEPREP mean limb corrected for elevation, and the line of maximum contact points (yellow). The observer was at A.

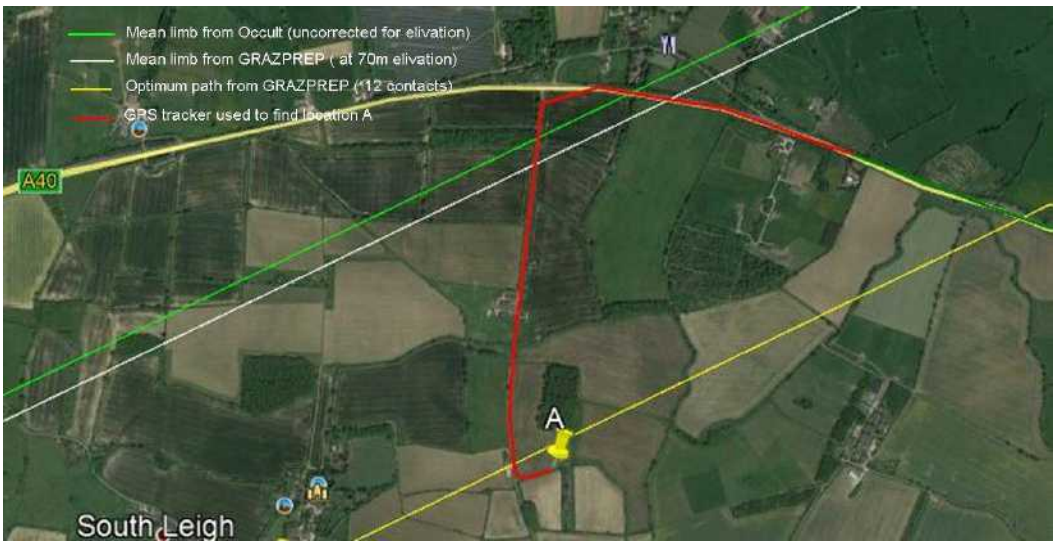


Fig 1: Location at A

The evening started off cloudy, but we proceeded to the location which was 20min drive. Here the observer would be ready to set up an 8" F/4 reflector and video

recorder. The cloud was slow moving but it looked possible that the sky might clear in time *and it did!*

When the cloud eventually cleared, **SAO-79805** could be seen on a small monitor screen. It looked 'attached' to the cusp. The star soon separated and travelled along the Earth-lit limb where the graze commenced. Although focus was not quite correct, the contacts were recorded without a problem at 25fps. The video is uploaded to Youtube: https://youtu.be/50Dh-TJXlYc

Equipment

Meade LXD55 SN8, WAT-910HX at 25fps, GPSBOXSPRITE, Sony TRV33E digital tape camcorder and a bar of milk chocolate from my wife to help keep my spirits up! There was also a dew-shield and battery. The temperature dropped to +4 C but no dew formed during the observation.

Analysis

A second star in the field (HIP 38755) was a convenient 'lock' star for TANGRA. This allowed the whole light curve of the graze to be analysed in one go, showing all the D-R events. Corrected mid-frame contact times were entered into Occult4 (Dangl correction -0.04s).

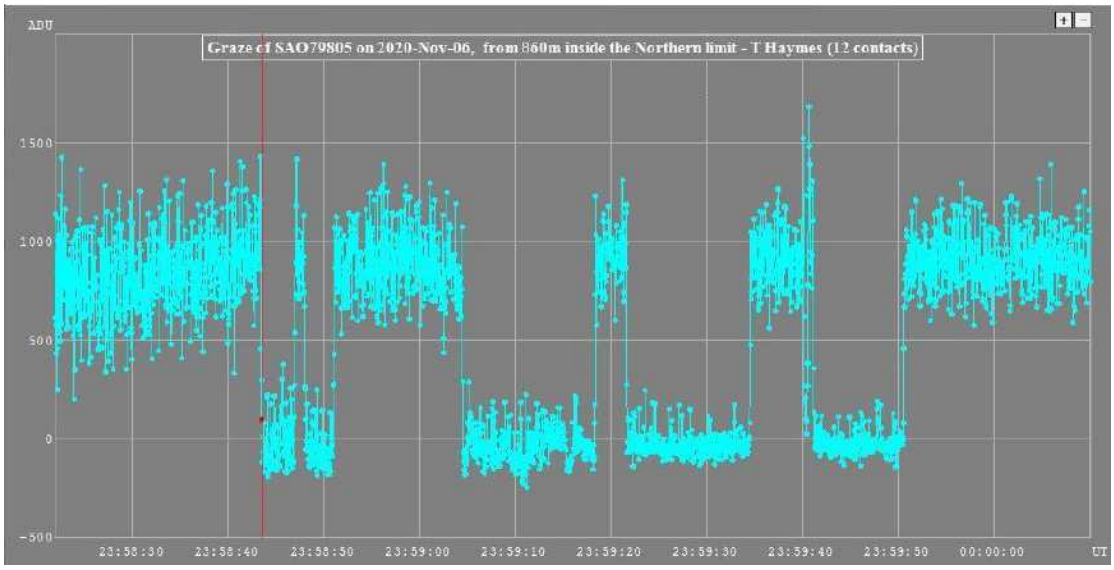


Fig 2: TANGRA light curve from the AVI imported into Windows 7

Discussion

There were some interesting features in the light curve at 2359 40s. These two closely spaced contacts were non-instantaneous (gradual) and most likely caused by diffraction effects. This prompted me to examine a small spike above base-line noise at 2359 47s. The corresponding video frames showed the star was starting to appear, but then vanished. This I have reported as a flash of duration 0.08s. When plotted on the Occult4 limb-profile the flash corresponds with a small valley. So it is a real effect!

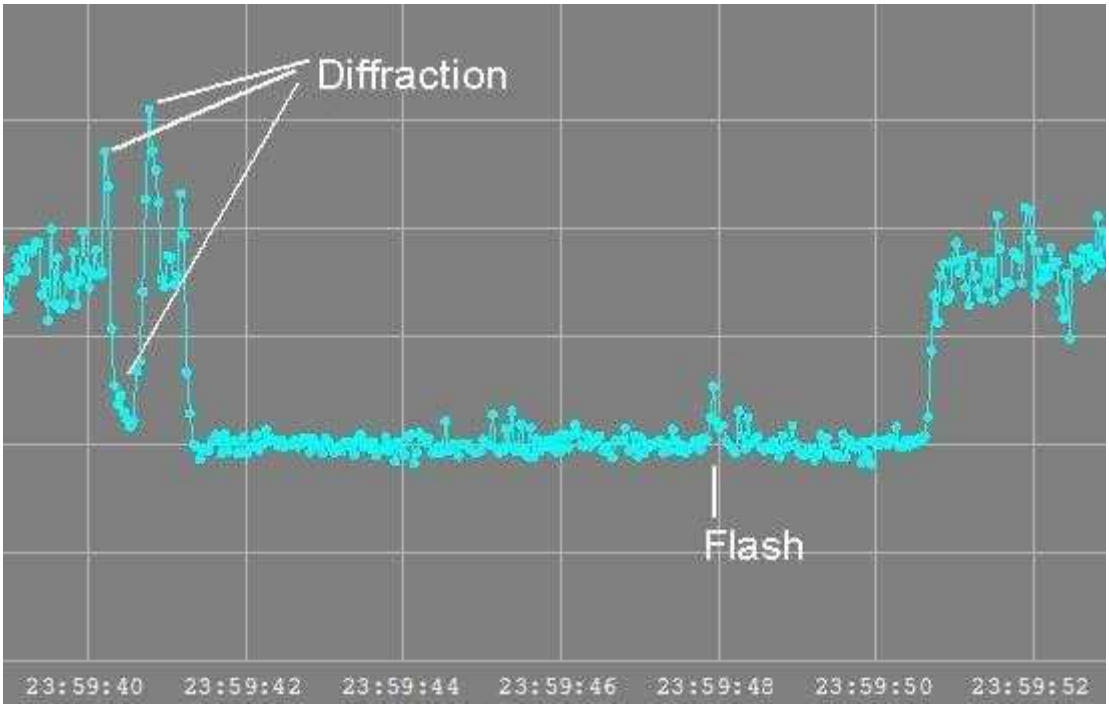


Fig 3: Fresnel diffraction and low intensity 'flash'

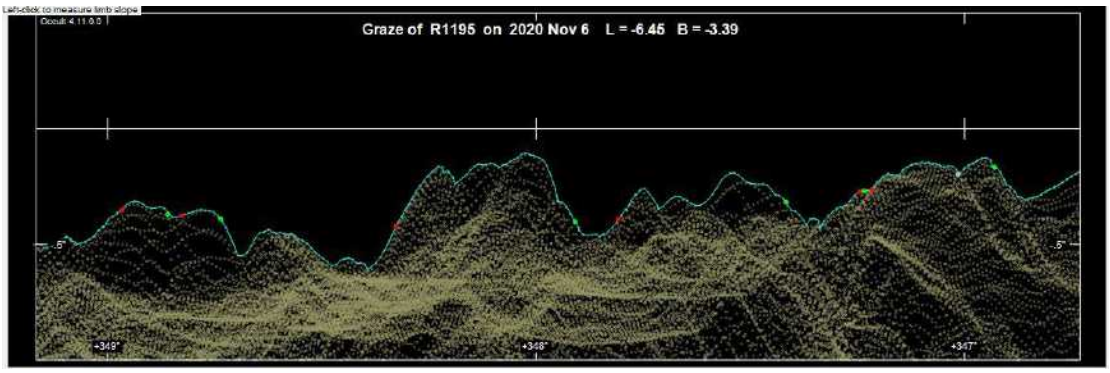


Fig. 4: 13 observations plotted in Occult4. The white spot at angle +347 is the flash

Conclusion

The lunar limb profile is from the detailed survey by LRO Lunar Orbiter Laser Altimeter [LOLA] and there is good match for observed contacts (Red=D, Green=R, White=Flash). No double star effects were noted. The time points entered in the Occult report were be fitted to the preliminary limb profile as shown.

After checking, the completed report was emailed to Mitsuru Soma (IOTA-Japan) who is the global coordinator for grazes. He will forward the results to Dave Herald for inclusion in the relevant files of a forthcoming maintenance update.

Planning and hopefully observing a graze is very rewarding. This recreational activity of specific purpose was made in isolation the evening following the introduction of COVID-19 restrictions on Nov 5th. Astronomy tends to be a solitary pursuit.

Follow up from last month

Occultation of M35 – Nov 5th 0200UT: No reports have been received. It was cloudy here (T Haymes)

Nu Virginis –RD- on Nov 11th: This 4th magnitude M0 star was clouded out. No observation.

Reappearances in November: T. Haymes reports 5 RD events were timed by video.

Gamma Cancri on Dec.5th

The star will be occulted from Scotland. The egress (RD) is predicted for Edinburgh at 0308.9 UT, but since the phenomenon is at near grazing incidence (Southern limit) the star will enter the bright limb at about 0240UT. A graze will occur on the bright limb. This isn't listed in the *Handbook*, but can be followed by observers at or north of Londonderry (NI), Stranraer, Cockermouth, Darlington, and Whitby. Observers in more Southerly parts will see no occultation.

Occultations in December

This month the Moon passes through some dense star fields and a large number of Reappearance at the dark limb (RD) are predicted. The two lines in red denote daylight hours for kappa Virginis which is possible to observe in a good sky.

The bright DD event involving Xi Ceti on Christmas Eve should be a nice one if you are not otherwise occupied. Binocular event?

Occultation prediction for OXFORD, 2020 December

E. Longitude - 1 15 27.0, Latitude 51 45 10, Alt. 65m

y	m	day d	Time h	m	s	P	Star No	Sp D	Mag v	Mag r	% Ill	Elon	Sun Alt	Moon Alt	Moon Az	CA o	Notes
20	Dec	1	19	25	44.2	R	859	B8	6.6	6.6	98-	164		21	79	76N	
20	Dec	1	20	1	11.8	R	865	B2	6.2	6.3	98-	163		27	86	58S	
20	Dec	1	22	50	24.9	R	77586	B9	8.3	8.3	98-	162		51	123	55N	
20	Dec	2	0	23	52.0	R	77636	A0	8.5*	8.4	97-	162		61	157	50N	
20	Dec	2	1	15	20.4	R	77666	K2	8.8	8.2	97-	161		62	181	36S	
20	Dec	2	4	29	3.1	R	77792	M0	7.9	7.0	97-	160		44	251	20S	
20	Dec	2	6	8	22.8	R	77851	A0	7.4	7.3	97-	160		30	271	41S	
20	Dec	2	6	13	57.0	R	77852	A0	8.2	8.2	97-	160		29	273	53S	
20	Dec	2	21	23	24.0	R	78635	A0	8.7	8.7	94-	151		32	90	25S	
20	Dec	2	23	6	57.5	R	78686	A2	8.8	8.7	94-	151		47	112	59N	
20	Dec	3	1	39	30.0	R	1041	F8	8.4	8.2	93-	150		62	167	59S	
20	Dec	3	5	13	31.5	R	1052	F8	6.8	6.5	93-	149		46	249	50S	
20	Dec	3	6	1	43.3	R	78887	K0	8.8	8.1	92-	148		39	260	39S	
20	Dec	3	6	24	48.0	R	78894	K0	8.7	8.2	92-	148		35	265	79S	
20	Dec	3	20	50	18.2	R	79524	F5	8.0	7.7	88-	140		19	75	76N	
20	Dec	3	21	45	49.7	R	79549	K0	8.4	7.7	88-	140		27	85	89N	
20	Dec	3	22	11	44.3	R	79561	G5	8.3	7.8	88-	139		31	90	78S	
20	Dec	3	22	30	21.9	R	79574	K0	8.8	8.2	88-	139		33	93	69S	
20	Dec	4	0	5	3.1	R	79620	A3	8.1	8.0	87-	139		47	114	50N	
20	Dec	4	0	5	24	R	79631	K2	8.8	8.2	87-	139		47	114	6N	
20	Dec	4	1	6	42.6	R	79644	A0	8.6	8.6	87-	138		55	132	77S	
20	Dec	4	3	14	14.1	R	79688	K0	7.5	7.0	87-	137		62	187	62S	
20	Dec	4	4	31	34.7	R	79717	S*	8.0		87-	137		57	220	81N	
20	Dec	4	5	11	36.7	R	79740	F2	8.5	8.3	86-	137		53	234	53N	Dbl*
20	Dec	4	7	10	13.9	R	79781	K2	8.8	8.2	86-	136	-7	36	263	73N	

```
20 Dec  4 23 35  3.1 R    1285 G0  8.4  8.1   80- 127     34  97  61N

20 Dec  5  0  4 21.1 R   80293 K0  8.6  7.9   80- 127     38 103  79S
20 Dec  5  2 57 52   m    1308 A1  4.7  4.7   79- 126     58 156   1S  gamma Cnc
20 Dec  5  5 19 53.8 R   80417 K0  8.7  8.2   78- 125     56 217  68N
20 Dec  5  5 45 54.5 R   80425 K0  8.6  8.0   78- 125     53 226  76N
20 Dec  5 22 21 32.0 R    1400 F5  8.3*       71- 115     13  75  40N  Dbl*
20 Dec  5 22 58 35.7 R   98603 M2  8.9* 8.1   71- 115     18  82  82N
20 Dec  6  0 53 38.7 R   98640 K0  8.0  7.5   70- 114     35 105  62S
20 Dec  6  1 54 14.0 R    1417 G5  8.9        70- 114     44 119  24N  Dbl*
20 Dec  6 22 30 32.5 R    1514 A1  6.2  6.2   61- 103      4  71  74S  42 Leo
20 Dec  6 23 22 11.3 R   99096 G5  8.6  8.4   61- 102     11  80  68S
20 Dec  7  0 17 30.1 R   99117 G0  8.5  8.0   60- 102     19  90  57N
20 Dec  7  1 21 26.0 R    1532 K0  7.6  7.0   60- 101     29 103  49N
20 Dec  7  1 50  8.3 R    1535 K0  6.9  6.3   60- 101     32 110  47S
20 Dec  7  2 41  9.8 DB   1544 M2  5.4  4.5   59- 101     39 122 -73S  46 Leo
20 Dec  7  3 51 30.9 RD   1544 M2  5.4  4.5   59- 100     47 142  79S  46 Leo
20 Dec  7  4 28  1.3 R   99179 K5  8.6  7.8   59- 100     50 155  40S
20 Dec  7  6 14 51.8 R   99202 A2  7.8  7.7   58- 100     51 195  67N
20 Dec  8  0 47 37.4 R    1638 A2  8.1  8.0   49-  89     12  90  71N  Dbl*
20 Dec  8  2 17  7.6 R    1647 A2  6.7  6.5   49-  88     25 108  43S
20 Dec  8  4 25 45.8 R  118843 G0  8.5  8.2   48-  87     41 140  89S
20 Dec  8  4 44 35.1 R  118866 K5  8.7  7.9   48-  87     43 146  30N
20 Dec  8  4 59  2.1 R    1659 K0  6.7  6.0   48-  87     43 151  58S
20 Dec  8  6 17  8.3 R  118880 K2  8.3  7.6   47-  87     47 177  82N
20 Dec  9  1 13 28.0 R    1755 A0  6.9* 6.9   38-  76      4  89  59N
20 Dec  9  3 25 18.5 R  119297 F8  8.0  7.8   37-  75     23 116  50N
20 Dec  9  4 57 40.1 R  119317 A*  8.0* 7.9   36-  74     34 139  79N
20 Dec  9  6 45 10.0 R  119349 K0  8.4  8.0   36-  73 -11 41 171  58N

20 Dec 10  3 49 45.5 R  139174 F2  7.8* 7.6   26-  61     15 114  83N
20 Dec 10  3 52  2.1 R  139172 F0  8.7* 8.5   26-  61     15 115  72S
20 Dec 10  4 28 35.7 R  139201 G5  8.7* 8.4   26-  61     20 122   7N
20 Dec 10  5  2 54.3 R  139196 F8  8.7  8.5   26-  61     23 131  31S
20 Dec 10  6 43  0.1 R  139229 K2  7.3  6.6   25-  60 -11 32 157  82S
20 Dec 11  5  3 58.2 R    2016 A0  6.7* 6.6   16-  47     12 123  47S
20 Dec 11  5 13  0.2 DB   2022 F2  5.5  5.3   16-  47     13 124 -89S  95 Vir
20 Dec 11  5 21 50.8 R  139725 G0  8.1  7.8   16-  47     15 126  68N
20 Dec 11  6 15 36.2 RD   2022 F2  5.5  5.3   16-  46     20 139  76N  95 Vir
20 Dec 11  8 49 35.1 DB   2033 K3  4.2  3.5   15-  45   5 28 178 -81S  kappa Vir
20 Dec 11  9 59 52.3 RB   2033 K3  4.2  3.5   15-  45  11 26 197  82N  kappa Vir
20 Dec 12  6 15  9.7 R  158989 A0  8.4  8.4    8-  33      9 129  74S
20 Dec 12  6 41 29   m    2151 B8  8.2  8.3    8-  32 -12 12 135   9S
20 Dec 13  7 28 20.2 R    2303 B2  4.8  4.9    2-  18  -5  7 135  31N
20 Dec 13  7 28 51.6 R    2302 B0  2.6  2.7    2-  18  -5  7 135  32N  beta Sco
      beta Sco is multiple: Aa,Ab 2.9 4.1

20 Dec 18 17 12 17.4 D  190425 K0  8.8  8.2   19+  52 -11 16 201  53S
20 Dec 18 18 29 58.9 D    3158 F5  5.7  5.5   20+  52     10 218  68S  37 Cap
20 Dec 18 18 44 49.6 D  190466 G5  8.7  8.2   20+  53      9 221  64N
20 Dec 18 18 51 45   m    3160 F7  6.7  6.5   20+  53      8 223  10S 38 Cap
20 Dec 20 16 24 37.2 D    3408 G8  7.1  6.5   37+  75  -4 25 165  48S
20 Dec 20 16 24 43.9 D X184943     7.8  7.3   37+  75  -4 25 165  48S  Dbl*
20 Dec 20 19 23 59.2 D  165594 F8  9.0  8.7   38+  76     22 212  62N
20 Dec 21 19 52 35.2 D    3536 M3  4.4  3.5   48+  88     28 211  63N  30 Psc
      30 Piscium (YY) is double: ** 5.2 5.2 0.050" 140.0, dT = -0.02sec
20 Dec 21 20  1 35.5 D  147050 G0  9.0  8.7   48+  88     27 213  86N
20 Dec 21 21  3 26.2 R    3536 M3  4.4  3.5   48+  88     21 229 -82N  30 Psc
      30 Piscium (YY) is double: ** 5.2 5.2 0.050" 140.0, dT = +0.05sec
20 Dec 21 22  0 31.4 D       5 K1  4.6  4.1   49+  88     14 241  74S  33 Psc
      33 Piscium is double: AB 5.0 7.5 0.004" 170.9, dT = 0.00sec
20 Dec 22 20 53  3   m  128955 G5  8.8  8.4   58+  99     31 218   9S
20 Dec 22 21 53 57.0 D  128965 K0  7.6  6.9   58+  99     25 233  44N
20 Dec 22 23  5 59.9 D     106 K0  6.6  5.9   59+ 100     15 249  33N
20 Dec 23 16 22 35.6 D  109873 A0  7.4  7.3   66+ 109  -4 29 127  57N
20 Dec 23 17 37 58.4 D     210 B9  6.6  6.7   66+ 109     37 146  83N  Dbl*
20 Dec 23 18 23 25.5 D  109899 K2  7.6  7.1   66+ 109     41 160  40N
20 Dec 23 18 42 36.2 D  109904 G5  8.6  8.1   67+ 109     42 166  35N
20 Dec 23 17 37 58.4 DB    210 B9  6.6  6.7   66+ 109     37 146  83N
20 Dec 23 18 57 25.5 RD    210 B9  6.6  6.7   67+ 109     42 172 -77S  Dbl*
20 Dec 23 22  1 25.4 D  109954 K2  8.5  7.7   67+ 110     33 228  53S

20 Dec 24  0 27 35.8 D  109997 K0  8.7  8.2   68+ 111     14 261  46N
20 Dec 24 17 40 17.5 D  110383 G5  8.2  7.6   75+ 120     38 133  90N
20 Dec 24 18 14  8.2 DD    322 G0  5.6  5.3   75+ 120     42 143  67N  64 Ceti
20 Dec 24 19  8 49.4 D  110404 K5  8.8  8.1   75+ 120     46 160  54N
20 Dec 24 19 31 16.2 RB    322 G0  5.6  5.3   75+ 121     46 169 -87N  64 Ceti
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20 Dec 24 19 33 18.7 DD    327 G8  4.4* 3.9   75+ 121     47 169  63N  Xi 1 Ceti
20 Dec 24 20 51  5.2 RB    327 G8  4.4* 3.9   76+ 121     46 197 -83N  Xi 1 Ceti
20 Dec 25  1 16  6.3 D  110491 G0  8.8  8.4   77+ 123     16 265  77S
20 Dec 25  1 38 57.2 D     344 G5  8.4  7.7   77+ 123     13 270  14N
20 Dec 25 17 12 42.0 D     428 A3  8.5  8.4   83+ 131 -10 33 113  44N
20 Dec 25 17 54 50.9 D   93192 K2  8.7  8.1   83+ 131     39 123  82N
20 Dec 25 18 18 29.4 D   93187 F8  8.8  8.6   83+ 131     42 130   8N
20 Dec 25 20 31  3.5 D     437 G5  7.3  6.7   83+ 132     52 174  16N
20 Dec 26  0 17 21.2 D   93261 G8  7.4* 6.9   84+ 133     34 247  27S
20 Dec 26  2  6 22.8 D   93291 K2  8.7  7.9   85+ 134     19 270  83S
20 Dec 26 22 16 49.0 D   93619 K0  8.6  7.8   90+ 143     55 199  56N
20 Dec 26 23 10 14   m   93630 G0  7.5  7.2   90+ 144     51 218   5S
20 Dec 27  4 45 54.5 D     593 F4  5.9  5.7   91+ 146      5 293  36S
20 Dec 27 16 50 45.2 D   93973 F6  7.1  6.8   94+ 153  -7 22  85  22S
20 Dec 27 17  6 21.9 D   76638 G8  8.6  8.2   94+ 153  -9 24  88  87S
20 Dec 27 21 12 40.3 D     700 B8  5.9  5.9   95+ 154     56 152  68S  HU Tau
      HU Tauri is double: ** 6.0 7.5      350.0, dT = 0.00sec
20 Dec 27 22 22 24.7 RB    700 B8  5.9  5.9   95+ 155     59 182 -51S
20 Dec 27 23 14 18.2 D   76708 K3  8.1  7.5   95+ 155     57 204  63S

20 Dec 28  2 51 28.3 D   76747 A5  8.6  8.5   96+ 156     31 266  25N
20 Dec 28  3 31 18.3 D     725 A0  7.0  7.0   96+ 157     25 273  84S
20 Dec 30 17 38 28.8 R    1092 F5  5.9  5.6  100- 172     10  63  70N  48 Gem
20 Dec 31 21  9 39.1 R   80065 F8  8.8* 8.5   97- 159     31  92  89S
21 Jan  1  1 38 28.5 R   80172 G5  8.5  8.1   96- 157     60 175  56S
21 Jan  1  4 17 39.8 R    1273 M0  8.7  7.9   96- 156     49 237  50S
21 Jan  1 22 38 15.2 R    1376 F   8.7  8.6   91- 146     34 102  59N
21 Jan  2  1 44  1.3 R   98518 G0  8.7* 8.4   91- 145     56 156  55S
21 Jan  2  3 19  2.0 R   98547 G0  8.7  8.4   90- 144     57 196  65N
21 Jan  2  4 55 18.1 R   98567 A3  7.5  7.4   90- 143     48 230  81S
21 Jan  2 22 28 50.2 R   98974 G5  8.6  8.1   84- 133     22  92  58S
21 Jan  2 22 55 43.6 R   98983 K2  8.4  8.0   84- 133     26  98  85N
21 Jan  3  1 57 12.3 R   99030 F8  8.8  8.4   83- 132     49 144  57S
21 Jan  3  4 17 29.8 DB   1514 A1  6.2  6.2   83- 131     52 196 -85N  42 Leo
21 Jan  3  5 27 33.9 RD   1514 A1  6.2  6.2   83- 131     47 222  64N  42 Leo
21 Jan  3  6 25 44.8 R   99096 G5  8.6  8.4   82- 130     40 238  44N
21 Jan  4  4 31 54.4 R    1622 K2  8.2* 7.6   74- 118     48 183  41S
21 Jan  5  0 11 31.7 R    1725 K0  7.6* 7.1   65- 107     15 100  55S  Dbl*
21 Jan  5  1 33 34.1 R  119159 G5  8.4  8.0   64- 107     26 117  29N
21 Jan  5  7 20 26.0 R  119237 K5  8.5  7.8   62- 104  -7 35 220  55S  Dbl*
Predictions up to Jan 5th
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Notes on the Double Star selection

Doubles are selected from Occult 4, where the fainter companion is brighter than mag 9.0, and the time difference(dT) is between 0.1 and 10 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. (-ve indicates bright limb)
Dbl* = A double star worth monitoring. Details are given for selected stars.
Mag(v)* = asterisk indicates a light curve is available in Occult-4
Star No:
1/2/3/4 digits = Zodiacal catalogue (ZC) 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.
The ZC/XC/SAO nomenclature is used for Lunar work. The positions and proper motions of the stars in these catalogues are updated by Gaia.

LUNAR GEOLOGICAL CHANGE DETECTION PROGRAMME – Dec 2020

Tony Cook

Introduction

In the set of observations received in the past month, these have been divided into three sections: Level 1 is a confirmation of observation received for the month in question. Every observer will have all the features observed listed here in one paragraph. Level 2 will be the display of the most relevant image/sketch, or a quote from a report, from each observer, but only if the date/UT corresponds to: similar illumination (±0.5º), similar illumination and topocentric libration report (±1.0º) for a past TLP report, or a Lunar Schedule website request. A brief description will be given of why the observation was made, but no assessment done – that will be up to the reader. Level 3 will highlight reports, using in-depth analysis, which specifically help to explain a past TLP, and may (when time permits) utilize archive repeat illumination material.

TLP reports

No Additional TLP reports have been received for October. Concerning Luigi Morrone's (UAI/BAA) candidate impact flashes reported in last month's newsletter, my PhD student, Daniel Sheward has now remeasured the coordinates of these and come up with :- flash 1 was at 37.5°W±0.3° 26.4°S±0.2°, and flash 2 was at 23.4°W±0.3°, 3.5°N±0.1°. He will also take a look at new NASA LROC images once these are released into the public domain, in order to see if there is evidence of any new impact craters.

Stöfler: On 2020 Nov 22 UT 18:15-18:45 Trevor Smith (BAA) reported seeing a long slightly tapering grey band stretching across almost the whole of the floor of Stöfler, from west to east. This band resembled Jupiter's equatorial belt in appearance (darkness), was easy to see and did not look like a shadow. The band was slightly darker at its western end. No lighter streaks were seen to the floor of Stofler or Faraday. No atmospheric spectral dispersion or obscurations were seen, though the seeing conditions were poor (Antoniadi IV). We shall put this into the Lunar Schedule website and see if it recurs.

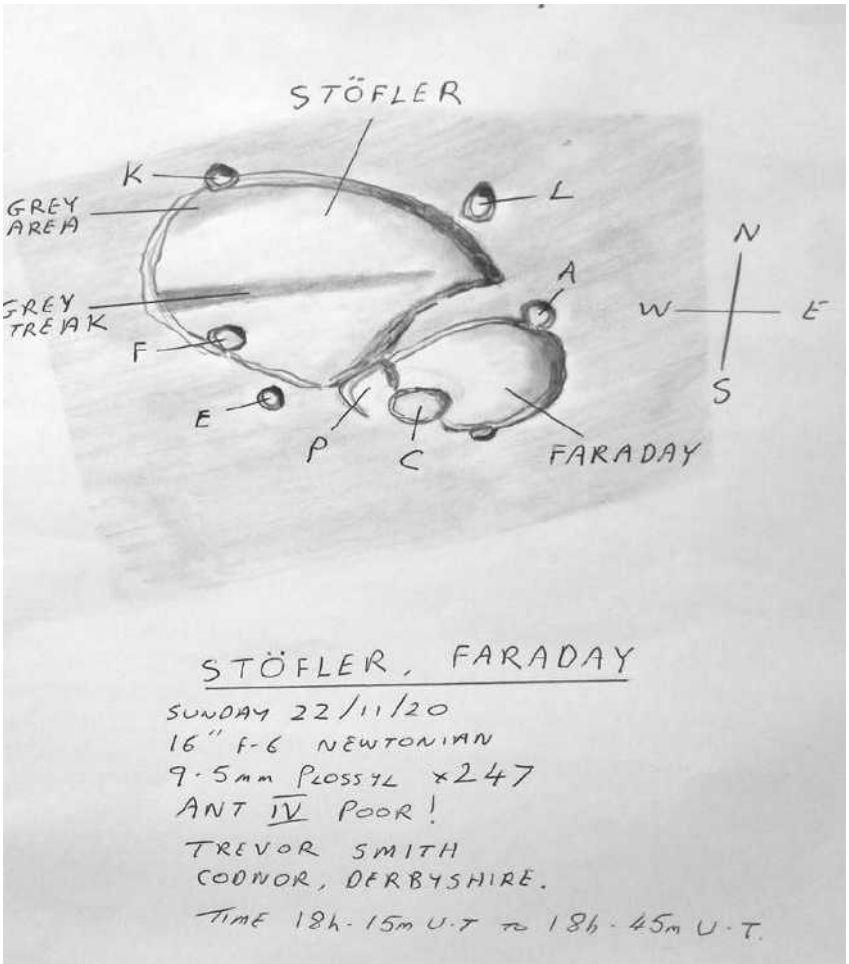

Figure 1. *Stöfler as sketched by Trevor Smith (BAA) on 2020 Nov 22 UT 18:15-18:45.*

News: I'd like to wish our readers a Happy Christmas / Happy Holidays. By the time you read this, the Chinese Chang'e 5 lander, will have hopefully landed on the Moon in the region on Mons Rümker. If you are interested, some radio amateurs have been following the telemetry from this probe: https://twitter.com/uhf_satcom. Due to pressure of work, I've only had time to put one observation into Level 3 this month.

Level 1 – All Reports received for October: Jay Albert (Lake Worth, FL, USA - ALPO) observed/imaged: Aristarchus, Gassendi, Plato and Posidonius. Alberto Anunziato (Argentina - SLA) observed: Mons Piton, Montes Teneriffe, and Theophilus. Anthony Cook (Newtown, UK – ALPO/BAA/NAS) imaged several features. Maurice Collins (New Zealand – ALPO/BAA/RASNZ) imaged Aristoteles, Atlas, and several other features. Rob Davies (BAA/NAS) imaged earthshine. Daryl Dobbs (UK - BAA) observed: Bullialdus, Jansen, Plato, and Tycho. Fernando Ferri (Italy - UAI) imaged: Tycho. Les Fry (UK – NAS) imaged: Clavius, Fra Mauro, Pytheas, and Rupes Recta. Rik Hill (Tucson, AZ, USA – ALPO/BAA0 imaged: Albategnius, Hubble, Mare Vaporum, and Tycho. Davide Pistritto (Italy – UAI) imaged: Deluc H and Mare Frigoris. Leandro Sid (Argentina – AEA) imaged: Proclus and several features. Trevor Smith (UK – BAA) observed: Gassendi, Mare Crisium, Plato and Proclus. Franco Taccogna (Italy – UAI) imaged: Deluc H, Lichtenburg, Posidonius, and Tycho. Aldo Tonon (Italy – UAI) imaged: Herodotus. Ivor Walton (Cranbrook, UK – CADSAS) imaged: Mare Serenitatis and the whole lunar disk.

Level 2 – Example Observations Received :

Mare Frigoris: On 2020 Oct 10 UT 00:21 (estimated from the supplied selenographic colongitude) Davide Pistritto (UAI) imaged this area for the following Lunar Schedule request:

UAI Request: Mare Frigoris between Plato and Fontenelle (colongitude from 23-27deg or from 185-190deg), a study of the area by Maurizio Cecchini (member of the PNdR Luna UAI) for the confirmation of a probable volcanic dome in the area. The highest possible resolution achievable, with telescopes at least of 8" aperture or larger, is needed. All images, sketches and visual reports should be e-mailed to: u a i . l u n a . l g c @ g m a i l . c o m

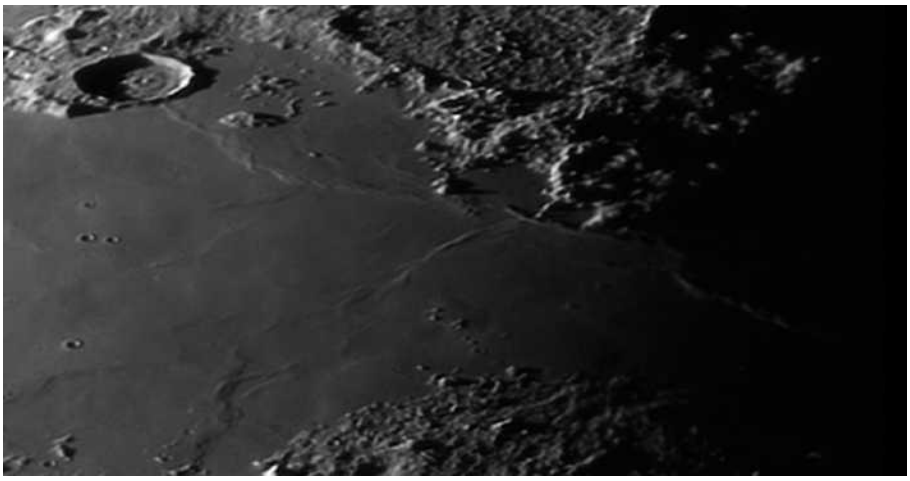

Figure 2. *Mare Frigoris as imaged by Davide Pistritto (UAI) and orientated with north towards the top.*

Davide's image (Fig. 2) is interesting as it covers this region at sunset – most of the other observations received so far have been at local lunar sunrise.

Earthshine: On 2020 Oct 15 UT 06:50 Rob Davies (BAA/NAS) imaged the Moon under the following lunar schedule request:

BAA Request: Please try to image the Moon as a very thin crescent, trying to detect Earthshine. A good telephoto lens will do on a DSLR, or a camera on a small scope. We are attempting to monitor the brightness of the edge of the earthshine limb in order to follow up a project suggested by Dr Martin Hoffmann at the 2017 EPSC Conference in Riga, Latvia. This is quite a challenging project due to the sky brightness and the low altitude of the Moon. Please be very careful around sunrise so as not to be observing once the Sun has risen. Do not bother observing if the sky conditions are hazy. Any images should be emailed to: a t c @ a b e r . a c . u k

Figure 3. *The early morning crescent Moon on 2020 Oct 15 UT 06:50 as imaged by Rob Davies (BAA/NAS) and orientated with north towards the top.* ***(Left)*** *Original Image.* ***(Right)*** *Contrast stretched and blurred to bring out detail/reduce noise in earthshine.*

Rima Hyginus: On 2020 Oct 24 UT 02:11 Rik Hill (ALPO) imaged (Fig. 4) this crater under similar illumination to the following report:

Hyginus Cleft 1966 Jul 25 UT 04:40 observed by Kelsey (Riverside, CA, USA, 8" reflector, x300) "Points at opposite ends of cleft were very brilliant in red Wratten 25 filter & very dull in blue Wratten 47 filter. Richer uncertain if real LTP." NASA catalog weight=1. NASA catalog ID #957. ALPO/BAA weight=1.

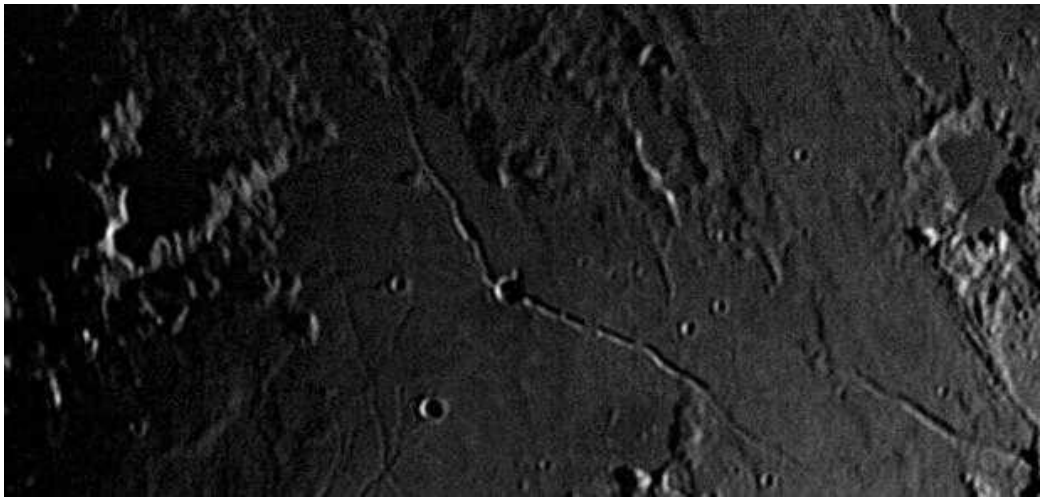

Figure 4. *Huygens and surrounds as imaged by Rik Hill (ALPO/BAA) on 2020 Oct 24 UT 02:11. Orientated with north towards the top.*

Montes Teneriffe: On 2020 Oct 25 UT 03:00-03:25 Alberto Anunziato (SLA) sketched this formation under the following Lunar Schedule request:

BAA request: please image this area as we want to compare against a sketch made in 1854 under similar illumination. However if you want to check this area visually (or with a colour camera) we would be very interested to see if you can detect some colour on the illuminated peaks of this mountain range, or elsewhere in Mare Imbrium. Features to capture in any image (mosaic), apart from Montes Teneriffe, should include: Plato, Vallis Alpes, Mons Pico and Mons Piton. Any visual descriptions, sketches or images of Earthshine should be emailed to: a t c @ a b e r . a c . u k

Alberto comments that in the sketch (Fig. 5) there were clearly a lot of shadows and bright spots, the ones marked with “X” were the brighter spots.

Figure 5. *Montes Teneriffe as sketched by Alberto Anunziato on 2020 Oct 25 UT 03:00-03:25. Orientation as indicated in the sketch.*

Tycho: On 2020 Oct 25 UT 19:18 veteran UAI observer Fernando Ferri imaged (Fig. 6) the Moon following a Lunar Schedule request:

BAA Request: Can you see any sign of "greyness" inside the shadow on the floor of Tycho? This is possibly due to scattered light off of the illuminated walls of Tycho. Minimum sized aperture telescope to use should be an 8" reflector. Any visual descriptions, sketches or slightly over exposed images should be emailed to: a t c @ a b e r . a c. u k

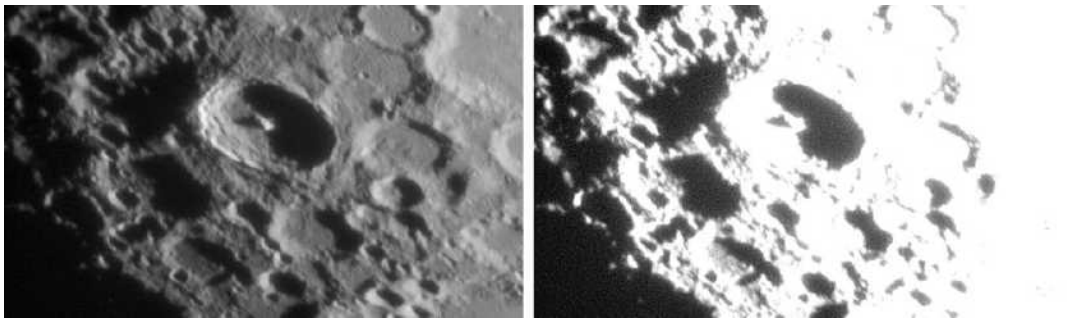

Figure 6. *Tycho as imaged by Fernando Ferri (UAI) on 2020 Oct 25 UT 19:18.* ***(Left)*** *raw image.* ***(Right)*** *Image contrast stretched to see inside the shadows.*

The Lunar Schedule request corresponds to a TLP report by Gerald North from 1995 Mar 10 UT 20:00-23:34:

Tycho observed by G. North (UK) seen to have greyness inside parts of its shadow. Confirmed by J.D. and M.C. Cook. Possibly light scattered of illuminated wall into shadow or highland starting to break through the shadow. ALPO/BAA weight=1.

Purbach: On 2020 Oct 25 UT 20:10 les Fry (NAS) imaged (Fig. 7) the area around this crater under similar illumination to the following report:

Purbach 1976 Nov 30 UT 19:40 T. Flynn (Edinburgh, UK, 29cm reflector, Wratten 25 and 44a filters) observed that the crater interior was better see through a red filter than a blue. ALPO.BAA weight=1.

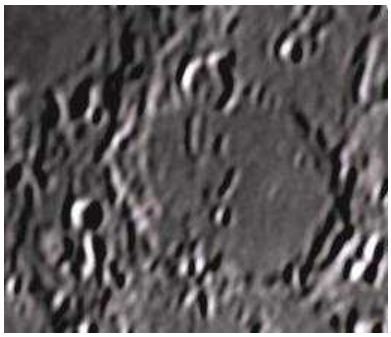

Figure 7. *Purbach from a larger image, obtained by Les Fry (NAS) on 2020 Oct 25 UT 20:10.*

Tycho: On 2020 Oct 26 UT 19:24-19:50 Daryl Dobbs (BAA) observed/sketched (Fig. 8) this crater under similar illumination top the following report:

Tycho 1998 Feb 06 UT 22:48-22:54 R. Braga (Corsica (MI), Italy, 102mm f8.8 refractor, x180, with diagonal, Wratten 23A, 80A and an OR5 filter, seeing II, Transparency good). Observer noticed that the floor darkened towards the NW (IAU), particularly with the blue Wratten 80A filter. The ALPO/BAA weight=2.

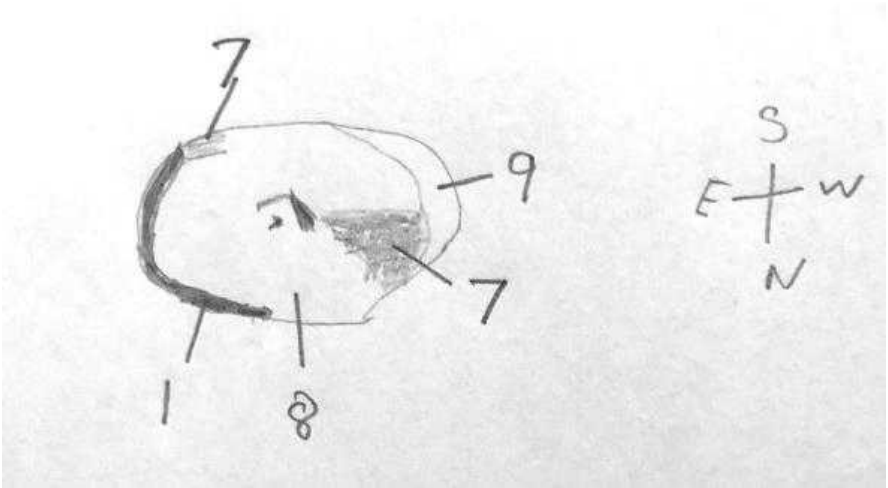

Figure 8. *Tycho as sketched by Daryl Dobbs (BAA) on 2020 Oct 26 UT 19:24-19:50. Orientation is as depicted in the image.*

Daryl comments: **'***An area of the crater floor was observed to be darker than the rest of the floor when using the blue filter, not so noticeable when using the red. Interestingly visible when using the yellow and green filter but more noticeable in blue. Still noticeable without filters. The area was from the base of the central peak reaching to the North West wall. The attached sketch gives the tones using the Elger scale. The dark area was roughly triangular with the apex touching the base of the western side of the central peak. There was also an area of similar shade on the South Eastern inner wall. If the dark feature on the floor was what the observer above seen in my opinion it looks like that normally.'*

Posidonius: On 2020 Oct 26 UT 20:20 Franco Taccogna (UAI) imaged (Fig. 9) this crater under similar illumination to the following report:

On 1997 Dec 09 at UT 18:42-19:02 P. Salimbeni (Cugliate Fabiasco, Italy, 20cm reflector) observed colour on the northern edge of the crater - 23A filter used. This is a UAI reported observation and has come from this organisation's web site. The ALPO/BAA weight=3.

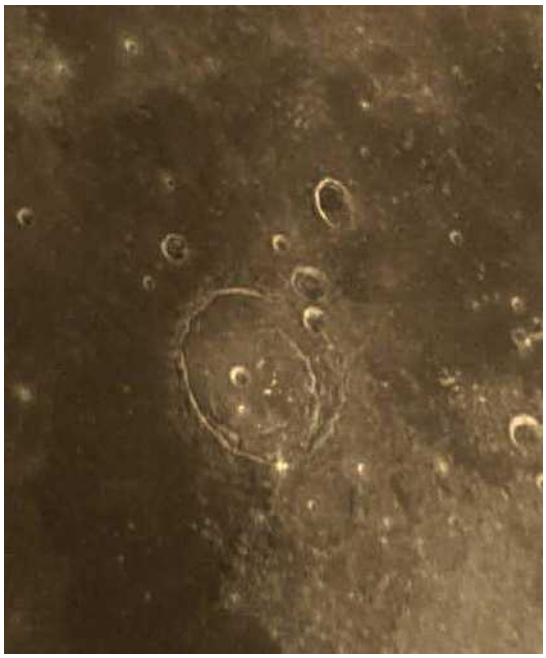

Figure 9. *Posidonius in colour as imaged by Franco Taccogna (UAI) on 2020 Oct 26 UT 20:20 and orientated with north towards the top. Colour saturation has been enhanced.*

Proclus: On 2020 Oct 26 UT 23:22 Leandro Sid (AEA) imaged (Fig. 10) this area under similar illumination to the following Patrick Moore report:

On 1984 Jul 08 at UT 20:10-22:05 P. Moore (Selsey, UK, seeing IV-V) suspected that the floor of Proclus was slightly darker than normal. The Cameron 2006 catalog ID=249 and the weight=1. The ALPO/BAA weight=1.

Figure 10. *A colour image of Proclus taken by Leandro Sid (AEA) on 2020 Oct 26 UT 23:22 with colour saturation increased to 60% and orientated with north towards the top.*

Plato: On 2020 Oct 27 UT 18:50-19:10 Trevor Smith (BAA) observed this crater under similar illumination to the following report:

On 1975 Mar 23 at UT 20:40 P.W. Foley (Kent, UK) found a brownish colour on the north west wall. This is a BAA Lunar Section report. The ALPO/BAA weight=2.

Trevor was able to confirm that the NW wall (inner and outer parts) had a brownish tinge that was not seen on other parts of the crater. Trevor was observing under poor seeing conditions (Antoniadi IV) though and was only able to glimpse one craterlet on the floor. The brownish colour seen on the NW rim had no hint of red to it, so he doubted that it was a chromatic effect. But he did see similar brownish effects on the nearby Jura Mountains on their south facing slopes, but the brown was not seen on any other features. Trevor was using a 16" reflector at x247. We may possibly remove this from the TLP database, but place it on the Lunar Schedule web site and encourage some colour imaging to see if we can confirm this 'normal appearance' of brown colour seen here.

Aristarchus: On 2020 Oct 28 UT 01:15-01:55 Jay Albert observed this crater under similar illumination to the following two reports:

Aristarchus 1966 Jul 29 UT 03:40 Observed by Simmons (Jacksonville, FL, USA, 6" reflector x192, S=7, T=4-5) and Corralitos Observatory (Organ Pass, NM, USA, 24" reflector + Moonblink) "Spot on S.wall vis. only in red filter, brightness 8deg. Slightly brighter than surrounding wall. No confirm. Says it might be part that reflected better. Not confirmed by Corralitos Obs. MB." NASA catalog ID #968. NASA catalog weight=1. ALKPO/BAA weight=1.

Aristarchus 1975 Dec 14/15 UT 17:05-00:30 Observed by Foley (Dartford, England, 12" reflector, S=II) and Moore (Sussex, UK, 15" reflector x250 S=IV) and Argent and Brumder (Sussex, UK). In early sunrise conditions, W. wall was less brilliant than usual -- matched only by Sharp, Bianchini, & Marian. Extraordinary detail could be seen on this wall. Also noted intense & distinctly blue color entire length of W. wall. 3 others corroborated detail, but not color. Moore found things normal & saw Aris. brightest at 2030-2125h tho Argent & Brumder made it < Proclus" NASA catalog weight=4. NASA catlog ID #1422. ALPO/BAA weight=1.

Jay comments that: *'The Sun was rising on Aristarchus and Herodotus was not yet visible. The spot on the S wall was best seen without filters. The spot was also seen in the red filter and, with some difficulty, in the blue filter as well. The spot was only slightly brighter than the surrounding wall, as stated in the LTP # 968 report. Contrary to the description of #1422, the W rim of Aristarchus was intensely bright. It was brighter than the W wall of Sharp and marginally brighter than the W wall of Mairan. Only the rim of Aristarchus' W wall was visible. The rest of the wall and the entire interior of the crater were in shadow. Nevertheless, what was visible of the W rim was detailed. There was no blue or other color seen inside or outside of Aristarchus. I used 226x to compare Aristarchus with Sharp and Mairan and 290x for detail on Aristarchus.'*

Herodotus: On 2020 Oct 28 UAI observers Aldo Tonon and Valerio Fontani imaged this crater under similar illumination and topocentric libration to a report:

Herodotus 2002 Sep 18 UT 22:00 Observed by Raffaello Lena (GLR, Italy). Event described was of two pseudo-peak/hill-like features, one on the southern floor of the crater, and another just slightly to the NW of the centre. on the southern floor of the crater. Lena suspects a combination of seeing effects and albedo markings on the floor. However, this effect of two spots on the floor has not been repeated again. For further information, theory, and a sketch please see Fig 5 in this web link: http://utenti.lycos.it/gibbidomine/analisi123.htm ALPO/BAA weight=2.

Figure 11. *Herodotus orientated with north towards the top.* ***(Left)*** *A sketch (from website above) by Raffaello Lena (GLR) made on 2002 Sep 18 UT 22:00.* ***(Centre)*** *an image by Valerio Fontani (UAI) taken on 2020 Oct 28 UT 18:30.* ***(Right)*** *Image taken by Aldo Tonon (UAI) on 2020 Oct 28UT 18:39.*

Although Valerio's and Aldo's images (Fig. 11 Centre and Right) are quite detailed and agree well with the accurate sketch that Raffaello (Fig. 11 Left) made, they don't seem to show up the two light spots on the floor of Herodotus, nor the two light spots on the outside SW rim. I don't propose to change the weight of this report for now.

Aristarchus: On 2020 Oct 29 Ivan Walton (CADSAS), using a robotic Telescope in Chile. managed to obtain an image (See Fig. 12) of the whole Moon that matched similar illumination to the following TLP:

On 2006 Jun 08 at UT 20:30-20:45 C.Brook (Plymouth, UK, 60mm refractor x75) found that Aristarchus was "shining exceptionally bright during daylight on a gibbous moon". The ALPO/BAA weight=1.

Figure 12. *A whole disk image of the Moon as captured by Ivan Walton (CADSAS) via a robotic telescope in Chile. Taken on 2020 Oct 29 UT 02:30 and orientated with north towards the top.*

Level 3 - In Depth Analysis:

Barrow: On 2020 Oct 23 UT 07:30-07:50 Maurice Collins (ALPO/BAA/RASNZ) imaged the whole Moon and caught the repeat illumination of the following TLP:

Barrow 1972 May 19 UT 20:17 M.Burton (UK, 13.5-inch Cassegrain reflector, x180, seeing IV-III, Transparency: Fair) noted that the E. side of the crater wall was brilliant. There was also a luminous streak across the floor

from E-W. No colour was detected using a Mon Blink device. ALPO/BAA weight=1.

Figure 13. *Barrow as imaged by Maurice Collins (ALPO/BAA/RASNZ) on 2020 Oct 23 UT 07:30-07:50 – an extract from a larger whole Moon mosaic.* ***(Left)*** *Raw image.* ***(Right)*** *Contrast stretched version.*

Fig. 13 (Left) indeed shows that the western rim is very bright – so this is normal. Fig. 13 (Right) is contrast stretched and starts to show a hint of a light streak across the shadow filled floor. I will lower the weight to 0 and remove this from the ALPO/BAA TLP database, but will include it on the Lunar Schedule web site – just to get some additional images to verify that light streak.

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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