



# **LUNAR SECTION CIRCULAR**

**Vol. 58 No. 1 January 2021**

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## **FROM THE DIRECTOR**

This is the time of year when I normally complain in the LSC about poor seeing conditions and the paucity of observing opportunities in the year just past, as well as hoping for clearer skies in the New Year.

This year we have much more than usual to regret in 2020 and hopefully much more to look forward to in 2021. The past year has taken a toll on all of us, for some much greater than others. I do hope that all of you have managed to negotiate 2020 without too much distress.

As I write these words, things look dark indeed with Christmas celebrations limited and optimism muted by rising COVID infections. Yet, despite everything, yesterday evening I was still able to get a splendid view of the close conjunction of Jupiter and Saturn (albeit through trees!) with my 80mm refractor and then to see the crescent Moon at low power, crisply delineated in the eyepiece and with an almost three-dimensional appearance. Such moments remind me that we are lucky to have had astronomy as a diversion and occasional refuge from the horrors of 2020. To see the Moon as a globe, as well as the two greatest planets in the solar system in the same field of view, complete with their own moons, provides some perspective and reminds us that there are other worlds out there.

I wish you all the very best for 2021, along with the hope that the roll-out of vaccines will make the world that we inhabit a better one to contemplate in the near future.

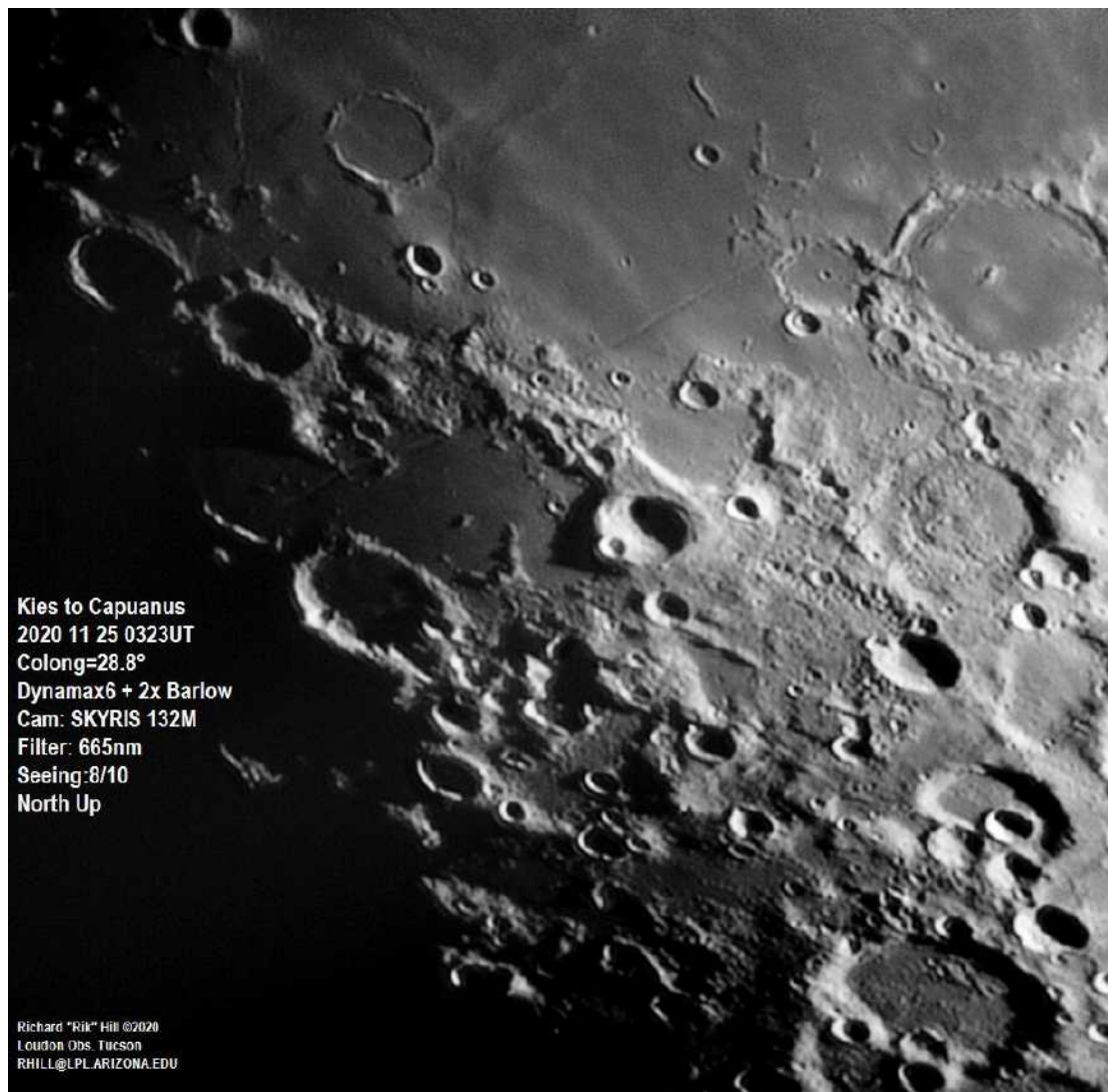
Meanwhile, keep looking up. And – I nearly forgot to add – clear skies!

*Bill Leatherbarrow*

## OBSERVATIONS RECEIVED

It has been another lean month weather-wise for British and European observers. Observations have been received from the following: Maurice Collins (New Zealand), Rob Davies, Daryl Dobbs, Rik Hill (USA), Ken Kennedy, Rod Lyon, Davide Pistrutto (Italy), Trevor Smith, and the Director.

**Rik Hill** has sent in the following image and comments on the Mare Nubium domes:

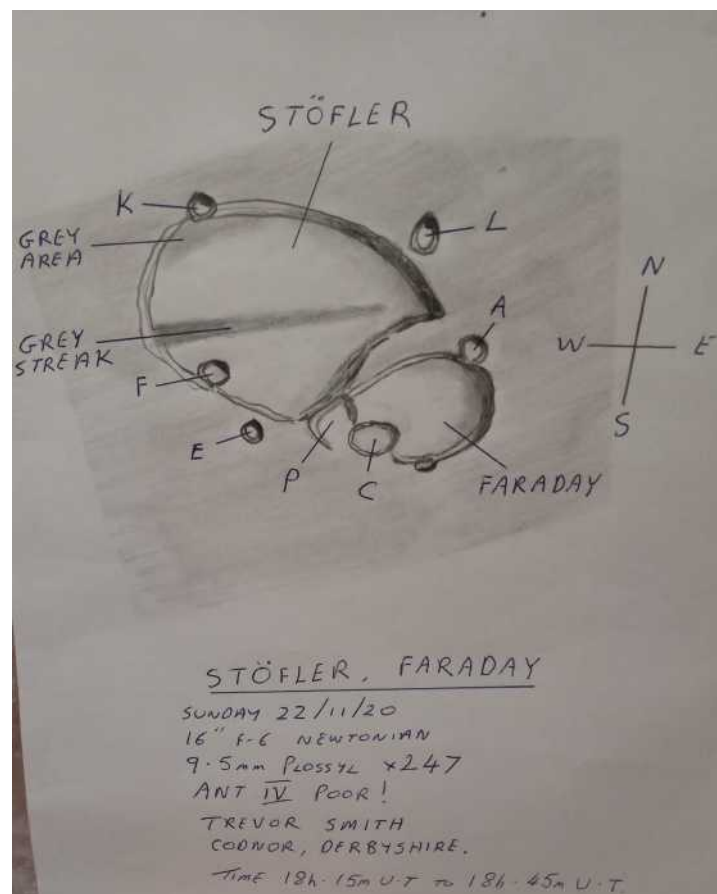


‘When the Moon is not quite 10 days old you can get a good look at a few of the more obvious domes in the Mare Nubium area south of Bullialdus. The first key is to locate Kies, the 46km diameter crater at the top of this image with the little tail pointing down. Notice the mild swelling just to the left of the crater. This is Dome Kies Pi or K1. It's 10km in diameter with a little 2km craterlet at the summit, just barely visible here. Going further to the left there are two small clusters of mountains. Just above the farther one is another mild swelling, K3. A third dome is just off the end of the

tail of Kies but I never have gotten a good image of it. It may be just too low a feature. Below Kies you see a graben-like rima, Rima Hesiodus that runs some 309 km from Hesiodus just south of its eastern (right) terminus, the crater with a small central crater (and the nice double walled crater, Hesiodus A just below it) all the way across Palus Epidemiarum north of another crater, Capuanus (61km). On the floor of this crater you can see 3 domes, C1, C2 and C3 as you may have guessed. There are other low swellings around this image near the terminator in this image but I have no guide for any identification beyond these.

In the upper right of this image, adjacent to Hesiodus is the large crater Pitatus (or "Potatoes" as we used to joke). Across from this, on the right side are the twin craters Campanus above and Mercator below both 49km dia. Then in the lower left is the crater Wilhelm (111km). It is a very busy area with lots to see, like that strange straight mountain range in the middle of the image with the small plain below it. You can easily spend a whole evening here!'

**Trevor Smith** sketched Stöfler on the evening of 22 November 2020, noting a grey streak across the crater floor.



Trevor writes:

'Sunday, 22/11/20 was calm and fairly clear for a change. First views showed that the seeing was poor as usual! Ant IV. The crater Stöfler immediately caught my attention as it lay just to the east of the terminator and looked very prominent with its large flat

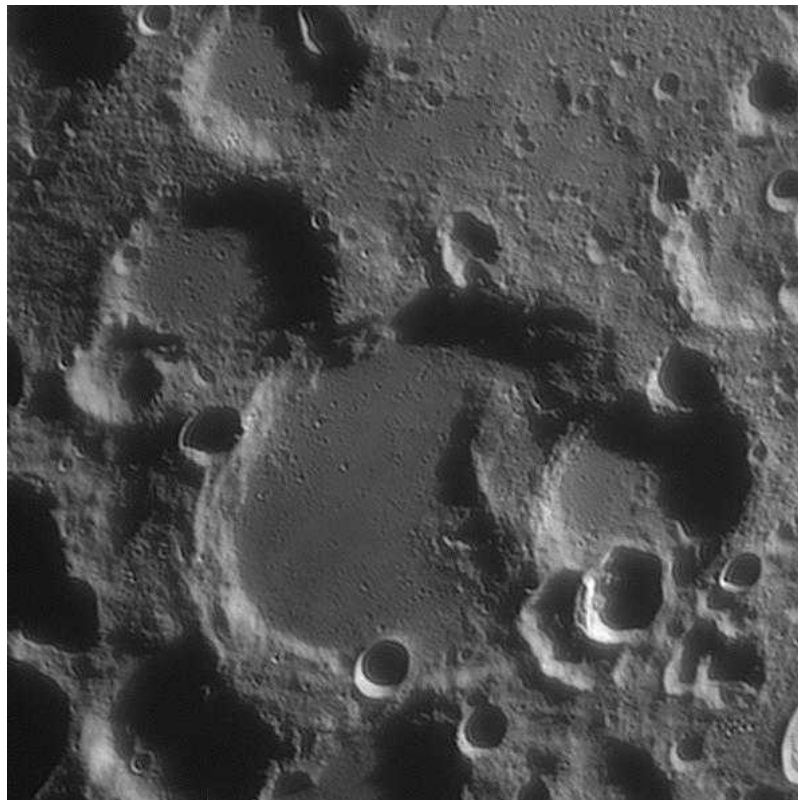
floor almost devoid of detail under these poor conditions. What struck me as unusual was the long slightly tapering grey band stretching across almost the whole of the floor from west to east. This band looked very similar to one of Jupiter's equatorial belts. This band was very easy to see and did not look like a shadow from Stöfler's West rim. It was also much lighter in tone than a shadow.

My observing report started at 18h15mUT and finished at 18h45mUT when observing had to stop due to cloud.

I had noticed some white streaks on Stöfler's floor on previous occasions but I had not seen this dark band before and wondered if this was a normal feature which I had missed on past observing sessions. The strange thing was that it was so obvious on this occasion and it was hard to believe that I had not noticed this before. The band was slightly darker at its Western end. No lighter streaks were seen to the floor of Stöfler or Faraday. No false colours or obscurations were seen.'

*Note from the Director:*

I am pretty certain that what Trevor saw was a normal albedo variation on the floor of Stofler, although it appears to have been particularly obvious under the conditions of his observation. It shows up on many other images of this crater, and can be discerned on an image taken by myself with my 300mm OMC on 29<sup>th</sup> May 2020 at 19.58 UT (see below). There might be an element of the 'zebra problem' at work here: are we seeing a dark streak on a lighter background or a light streak on a darker background. I favour the latter view in this instance, since bright rays from Tycho cross this part of the Moon (see, for example, the description in Wilkins and Moore, *The Moon*).

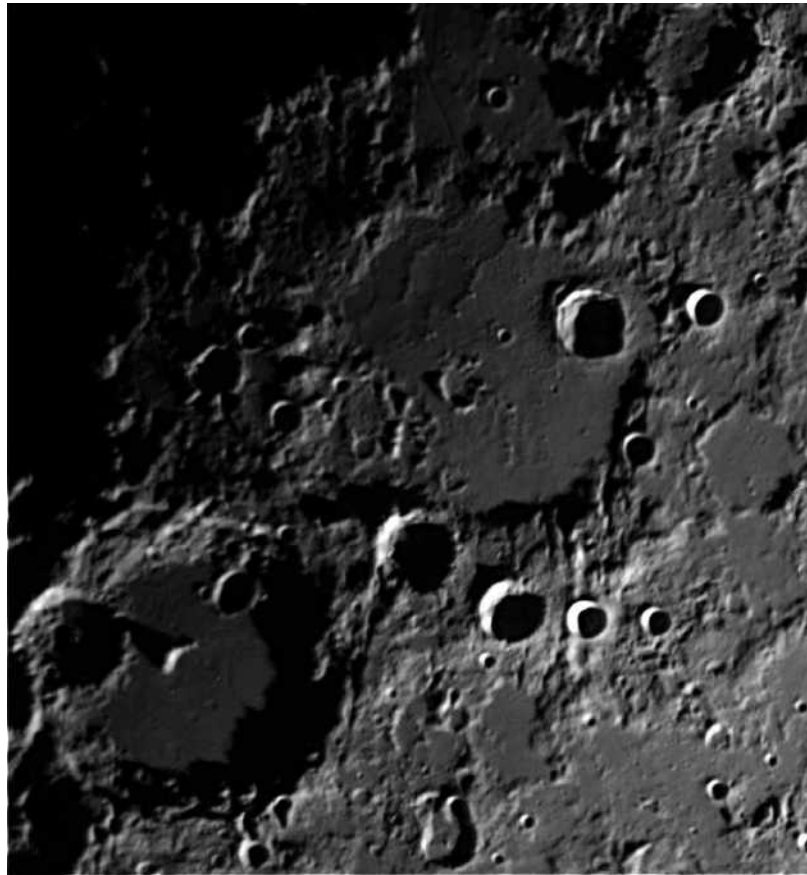


## IMAGES GALLERY

**Davide Pistritto** is a new member from Bari, Italy. He has submitted a series of excellent images taken with a C9.25 SCT. We feature two below:







Albategnius & Hipparchus 2020.11.22 - 18.26 UT  
300mm Meade LX90, ASI 224MC Camera with Pro Planet 742nm  
I-R Pass Filter. 300/3,000 Frames. Seeing: 7/10, hazy. Rod Lyon



Piccolomini & Rupes Altai 2020.11.04 - 22.55 UT  
300mm Meade LX90, ASI 224MC Camera with Pro Planet 742nm  
I-R Pass Filter. 300/3,000 Frames. Seeing: 7/10. Rod Lyon

**The Director** had a good view of Sinus Iridum on 26<sup>th</sup> November 2020 at 22.46 UT:



**Rob Davies** caught Mare Orientale under favourable libration on 6<sup>th</sup> December 2020:



**Ken Kennedy** imaged the southern highlands during daylight on 6<sup>th</sup> November 2020, writing as follows:

‘I have tried to take advantage of any clear spells which have been none too numerous. I was out at about 10am on the morning of 6th November imaging the large sunspot group when I noticed the 20.6 day old Moon still in the bright sky. I had not attempted daylight imaging of the Moon before so, after imaging the sunspot group, I added a red filter to the Altair GP-CAM and reattached it to my old Celestron C8 at f6.3 mounted on a Skywatcher AZ EQ5 mount. The initial results didn't look too promising but after some processing I was surprised to get a reasonable image of the area around Clavius and Tycho’.





## **LUNAR DOMES (part XLIII). Volcanism in Posidonius: magmatic intrusions and the dome Posidonius 1**

Raffaello Lena and Barry Fitzgerald

### **Introduction:**

Posidonius is a floor-fractured crater (FFC) that originated as a result of magmatic intrusion. The occurrence of small-scale graben in an arcuate pattern that follows the crest of a local topographic high in Posidonius, suggesting formation by uplift from a magmatic intrusion associated with FFC formation, has been recently described by French et al. (2015).

Intrusions are subsurface concentrations of magma that have locally uplifted the mare but do not erupt, a mechanism reported for terrestrial laccoliths. Laccoliths are shallow magmatic intrusions which lead to the vertical displacement of the overburden creating a characteristic dome-like topography at the surface. Laccoliths have recently been proposed to explain various geological features such as domes or floor-fractured craters on the surface of the Moon and also Mars and Mercury (Head et al., 2009).

Using LROC GLD100 dataset French et al. (2015) identify a domical feature, located near the western rim of Posidonius. If an igneous intrusion occurred near the western rim of Posidonius, as proposed by French et al. (2015), a slightly elevated terrain should be detected as an up-bowing of the soil, which could be visible in terrestrial telescopic images taken under oblique solar illumination. In this work we thus provide an analysis of the shallow domical structure, first proposed by French et al. (2015), also using modelling analysis as proposed by Lena et al. (2013) and Wöhler & Lena (2009).

### **Ground-based observations:**

The domical object (Figs 1-2) is clearly detectable only with a low solar angle, demonstrating that Posidonius must be imaged close to the terminator. It displays a curved edge showing that the centre of the structure is slightly higher than the edges. We termed the dome, located at 28.26° E and 32.02° N, as Posidonius 1 (Pos1).

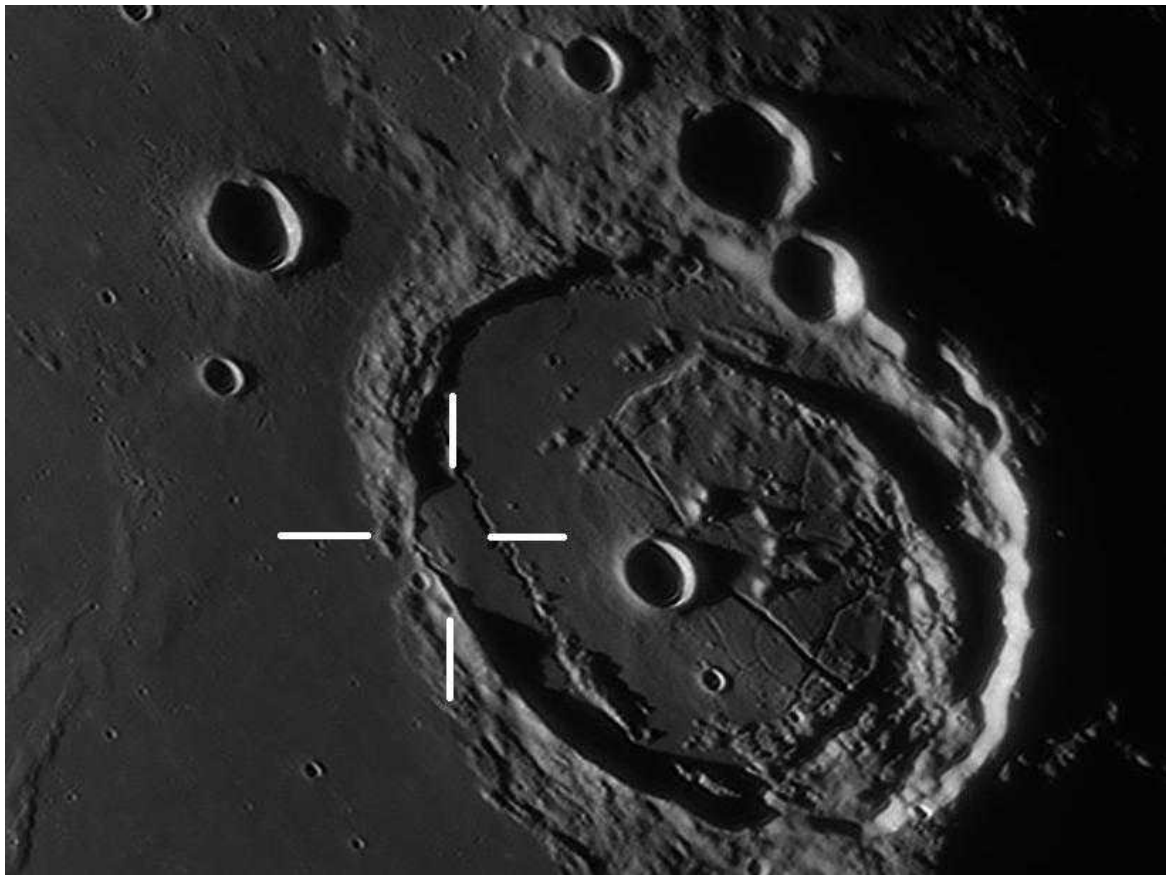
### **Morphometric properties:**

In the LOLA DEM, the elevation difference between the centre of Pos1 and the surrounding surface corresponds to  $65 \pm 10$  m (Fig. 3), which is in good agreement with the terrestrial image-based photoclinometry and shape from shading analysis (Fig. 4).

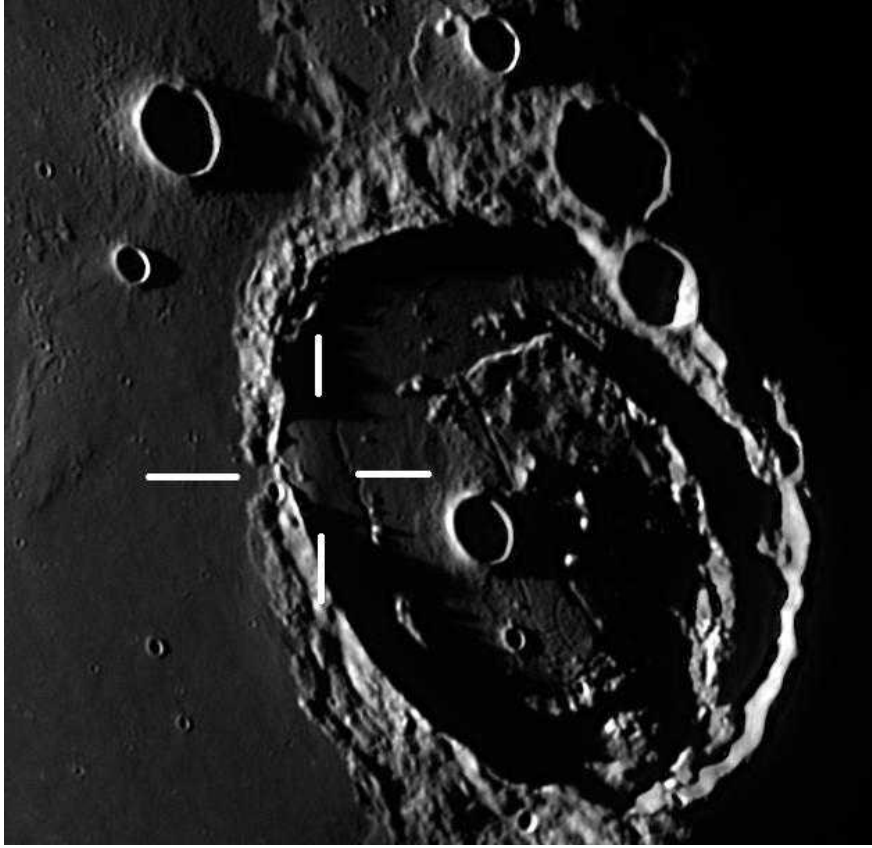
The elevation of the shallow domical structure measured on the terrestrial image of Fig. 1 is determined to  $74 \pm 10$  m (Fig. 4), its diameter amounts to  $8.0 \times 11.2$  km, resulting in an average flank slope of  $0.8^\circ \pm 0.08^\circ$ . Assuming a parabolic dome shape the edifice volume corresponds to about  $2.2 \text{ km}^3$ . It has an elongated shape with circularity (minor axis/major axis) of 0.72.

A reliable discriminative criterion in the dome classification is the circularity of the dome outline: the putative intrusive domes are elongated and with low slopes ( $< 0.9^\circ$ ). Class In1 comprises large domes with diameters above 25 km and flank slopes of  $0.2^\circ$ – $0.6^\circ$  and have linear or curvilinear rilles traversing the summit. Class In2 is made up by smaller and slightly steeper domes with diameters of 10–15 km and flank slopes between  $0.4^\circ$  and  $0.9^\circ$ . Class In3 comprises low domes with diameters of 13–20 km and flank slopes below  $0.3^\circ$  (Lena et al., 2013; Wöhler & Lena, 2009).

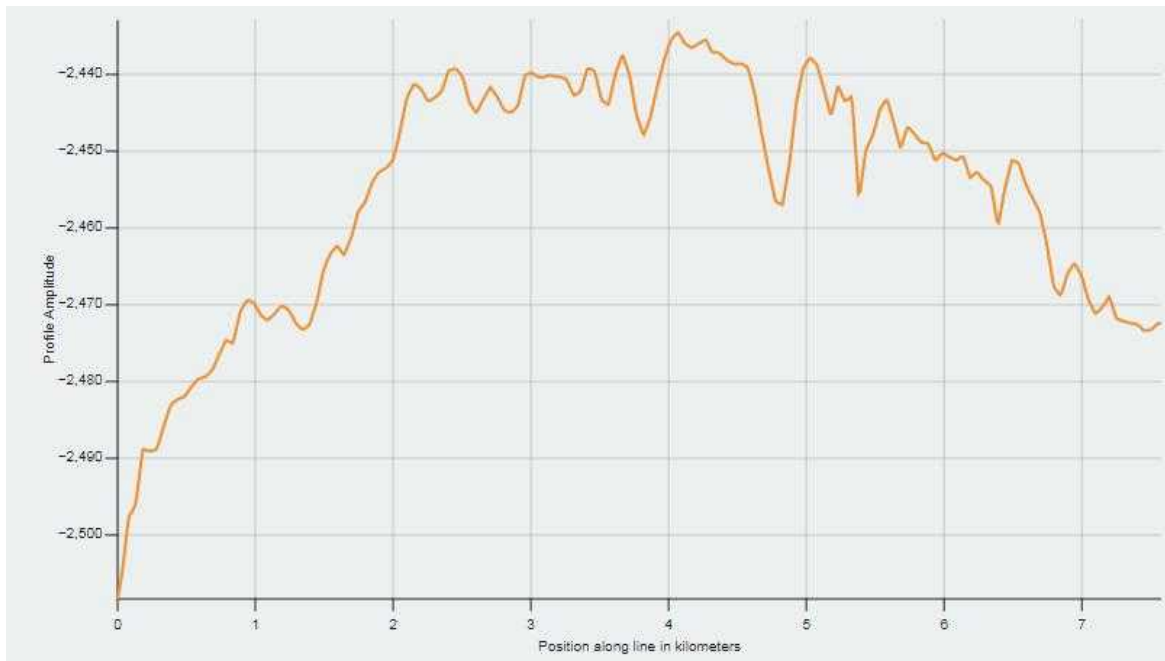
Hence the dome Pos1 matches the properties derived for a putative intrusive dome belonging to class In2 and, according to French et al. (2015), could imply an origin due to a subsurface intrusion of a magmatic body. Fig. 5 displays the diameter vs. flank slope diagram illustrating the three established morphometric classes of lunar intrusive domes as introduced in previous work by Wöhler & Lena (2009).



*Figure 1: Telescopic image taken on October 10, 2017 at 04:02 UT by M. Teodorescu. The dome, which we named Posidonium 1 (Pos1), is marked with white lines.*



*Figure 2: Telescopic CCD image taken on September 19, 2019 at 02:11 UT by C. Viladrich. The examined dome, Posidonius 1, is marked with white lines.*



*Figure 3: Topographic profile of the identified Posidonius 1 using LOLA DEM. The hills and lobate scarps are not comprised in the computation of the flat surface of Pos 1.*

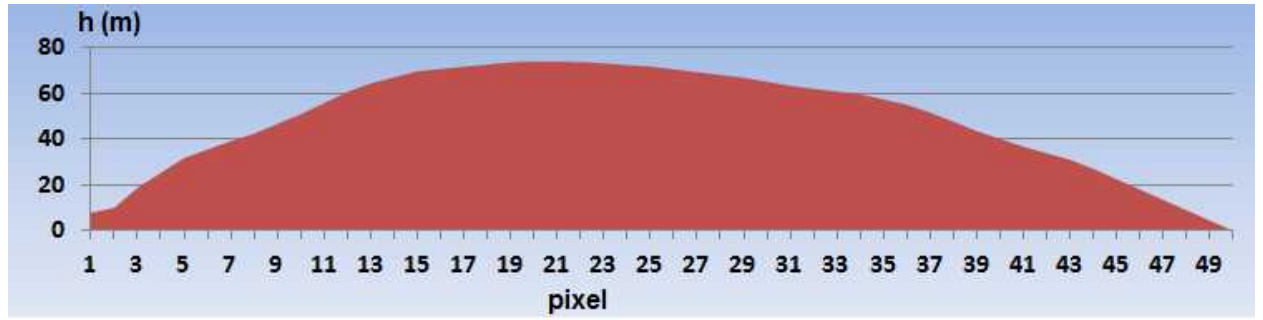


Figure 4: Cross-sectional profile of the shallow domical structure described in the text, obtained using the combined photoclinoetry and shape from shading method (Lena et al. 2013), on the image shown in Fig. 1 and regarding the central region of the feature excluding the hills located on the summit (see Figs 1-2). The vertical axis is 40 times exaggerated.

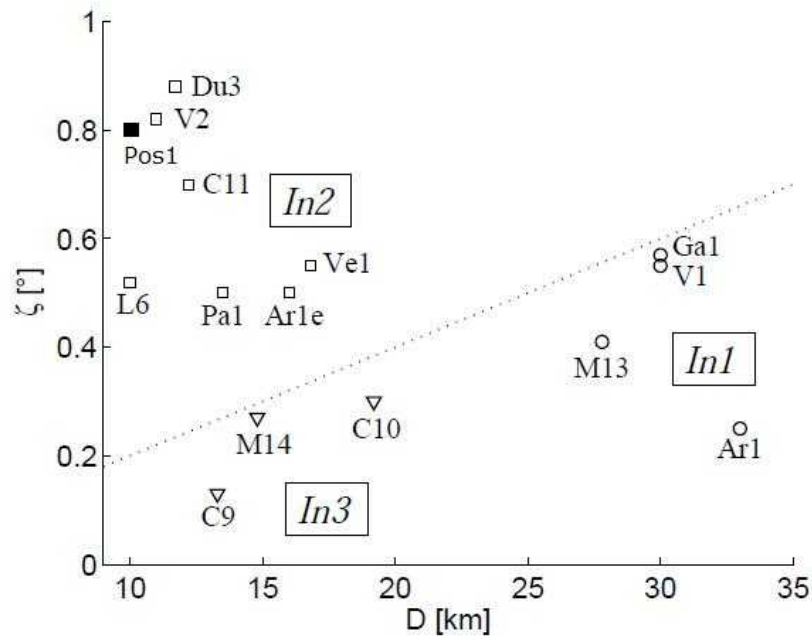


Figure 5: Diameter vs. flank slope diagram illustrating the three established morphometric classes of lunar intrusive domes. Circles, squares, and triangles denote the domes of the classes In1, In2, and In3, respectively. In black square is shown the recognized Posidonius 1 (Pos 1).

### Posidonius general overview:

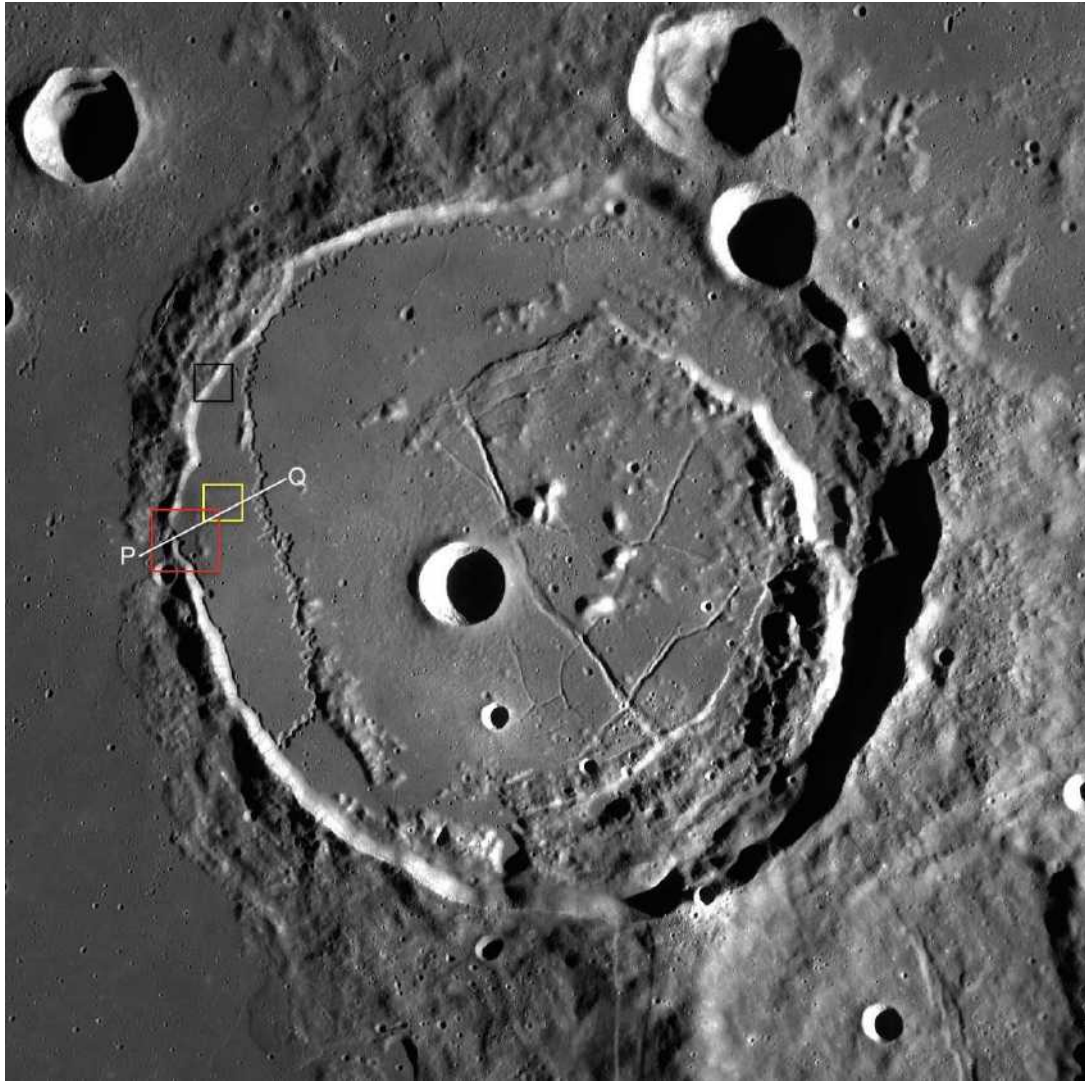
The 95 km diameter crater Posidonius, which is located on the north-eastern shore of Mare Serenitatis is a spectacular example of a Floor Fracture Crater (FFC) where a magmatic body has intruded into the shallow crust beneath pushing the crater floor upwards in a piston-like action. This upwards pressure produced the array of fractures we see on the floor of Posidonius and other FFCs whilst the presence of liquid magma beneath essentially decoupled all or part of the crater floor from the rest of the crater in a structure quaintly described as a ‘otoshibuta’ which is the Japanese term for the

lid on a stew pot (Ishihara et al., 2016). Once decoupled in this way the crater floor may actually move around within the crater, driven by movement of the underlying magma or as a response to the escape of volcanic gasses which was released as the magma depressurised during its ascent through to the crust.

In many lunar FFCs the crater floor eventually subsided as the underlying magma cooled and contracted, as can be seen in Pitatus. Additionally any 'lift' to the floor generated by gas released from the ascending magma escapes to the surface and causes a degree of deflation, and in the process gives rise to a form of volcanism or pyroclastic activity as is seen in Alphonsus. In the case of Posidonius the slab of fractured crater floor appears to have shifted towards the southwest, whilst its western edge has partially floundered beneath mare like deposits covering the western crater floor (Fig. 6).

In the case of Posidonius this was not the end of the story, and yet more magma was intruded beneath the crater forcing the surface upwards and creating a broad swelling located between the sinuous rille that crosses the crater floor to the east and the western crater rim. This swelling is visible under favourable illumination (see Figs 1-2) though in reality the heights and slopes involved are extremely subtle. This part of the crater floor consists of smooth mare-like plains forming a crescentic arc occupying much of the western floor of Posidonius. This mare-like unit is less heavily cratered than the surface of Mare Serenitatis, suggesting that it is younger. The inflation of this surface has produced swarms of small scale graben that run in a roughly north-south direction across the crater floor, roughly between where the sinuous rille apparently breaches the western crater rim and where the same rille meets the crater rim to the north (Fig. 7). The fact that this sinuous rille (which is conventionally described as having flowed from north to south before doubling back northwards up the western rim) appears to hug the eastern edge of this swelling might suggest that the lava flow that created it was active after the uplift had taken place, with the lava following the edge of the uplift.





*Figure 6: LROC WAC image of Posidonius showing the fractured crater floor which is apparently displaced towards the southwest as an “otoshibuta” structure. The areas shown in the coloured boxes are shown in detail in subsequent Fig's as is the topographic profile along line P-Q.*

A topographic profile however shows that the rille is actually located part way up the eastern flank of the swelling suggesting that the uplift occurred after the rille formed, and that its course followed the ‘pre-inflation’ slopes over the crater floor (Fig. 8).

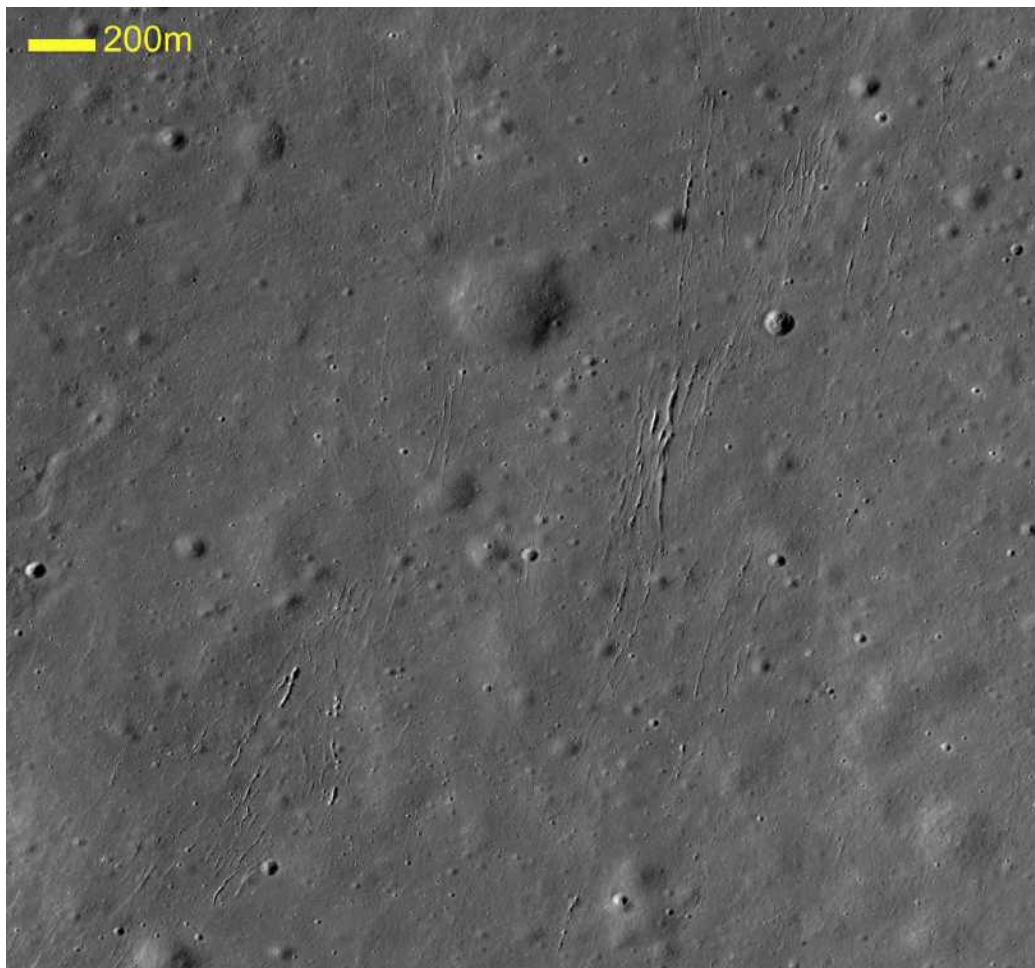


Figure 7: Detail of small scale graben on the crater floor of Posidonius and within the yellow box identified in Fig. 6. Note the lines of pits which have developed along the larger graben.



Figure 8: Topographic profile along line P-Q in Fig. 1 showing the location of the sinuous rille on the eastern flank of the uplift. Note the profile cuts through 2 meanders of the rille hence the 'W' shaped profile.

### **Modelling result and formation process:**

The laccolith model by Kerr and Pollard (1988) has been used to estimate the geophysical parameters, especially the intrusion depth and the [magma](#) pressure, which would result from the observed morphometric properties.

As introduced by Lena et al. (2013) and Wöhler & Lena (2009), intrusive domes of class In1 are characterised by uppermost basaltic layer thicknesses larger than about 0.3-0.6 km, intrusion depths of 2.3–3.5 km and magma pressures between 18 and 29 MPa. For the smaller and steeper domes of class In2 the uppermost basaltic layer is typically only 0.1-0.2km thick, the magma intruded to shallow depths between 0.4 and 1.0km while the inferred magma pressures range from 3 to 8 MPa. Class In3 domes are characterised by thicknesses of the uppermost basaltic layer of 0.4-1.2 km, intrusion depths of 1.8–2.7km and magma pressures of 15–23 MPa. The laccolith model applied to Posidonius 1 yields intrusion depth of km 0.36km, uppermost basaltic layer thicknesses of 0.205 km and maximum magma pressure in the laccolith of 2.7 MPa, thus consistent with an igneous intrusion in the range of class In2 domes and indicating that laccolith formation proceeded until the stage characterized by flexure of the overburden.

Pos 1 also has small non-volcanic hills on the surface (Figs 1-2) which are characterised by heights of not more than a hundred metres. It formed around pre-existing non-volcanic hills. A hill in the centre of the laccolith, or also laterally, should reduce the tensional stress resulting from the strong bending of the overburden due to the steeper flank slope of Pos 1 if compared with the large In1 domes, and thus preventing deep fracturing (which will be detectable as large graben in terrestrial telescopic images) and subsequent eruption of the pressurised magma (as described by Wöhler & Lena, 2009).

### **Volcanism within Posidonius:**

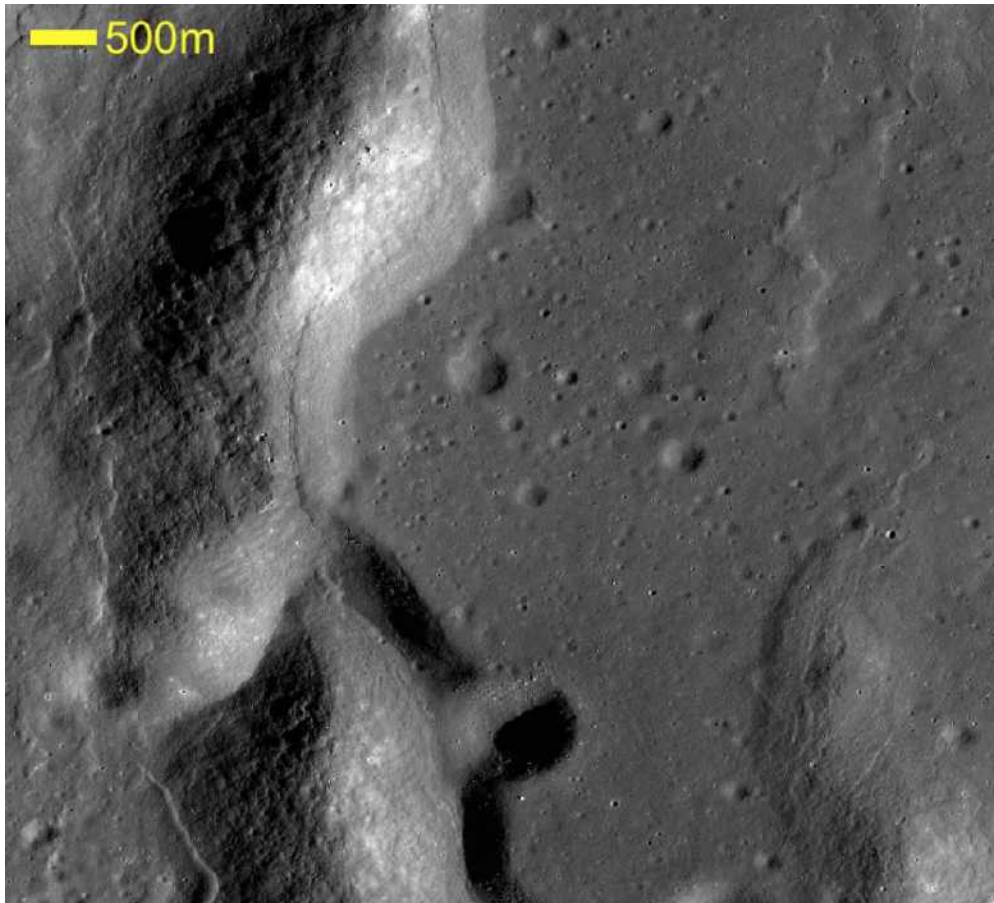
The small-scale graben along the summit of the swelling are at most a few meters wide and deep and a few hundred meters long, with some of the wider ones exhibiting strings of pits where surface regolith has collapsed downwards. As far as age goes, the graben cut through large impact craters (80 – 200m diameter) but are themselves only cut by much smaller impact craters. This suggests a maximum age of late Eratosthenian to early Copernican, and a true age considerably younger (French et al., 2015). This of course means that the intrusive volcanism that caused the uplift also occurred relatively recently in lunar terms. This activity is also clearly unrelated to the relatively ancient magmatic activity that converted Posidonius into a FFC, indicating a long history of volcanic activity in this area, which continued into what is in lunar terms the recent past. Small graben are also present on a small section of the north-eastern rim which appears to have been uplifted to form a small inconspicuous 100m high dome like structure between the crater rim and floor (Fig. 9). These graben are less conspicuous than those on the crater floor, but this is likely to be a result of infilling by mass wastage from the adjacent slopes. This feature may well be connected to the intrusive activity that gave rise to the other small graben and therefore of the same age.

The formation of the uplift discussed above also resulted in the formation of a lobate scarp along the inner side of the western rim which reaches some 50 m above the crater floor (Fig. 10). This suggests that the initial stages of the uplift resulted in extensional forces directed outwards, producing low-angle thrust faults along which the surface deformed to produce the now visible scarps. This was followed by further uplift which resulted in the formation of the small graben, some of which can be seen to cut the scarp giving confirmation of the sequence of events. This scarp can be seen to cross the channel of the sinuous rille where it apparently breaches the western rim, additional confirmation that the rille pre-dates the uplift.



*Figure 9: Detail of small scale graben on a small dome like area of uplift on the north-eastern rim of Posidonius identified in the black box in Fig. 6. Note the graben on the crater floor also.*





*Figure 10: Detail of the western rim identified by the red box in Fig.6. Note the lobate scarp which runs along the inner crater wall like a high tide mark.*

These observations show that Posidonius has been the focus of volcanic activity over a considerable period of time, with an initial intrusive FFC phase followed by a much later and unconnected intrusive phase that produced the uplift discussed above. Effusive surface activity is represented by the mare-like units which erupted onto the western floor, and the sinuous rille where a turbulent lava flow eroded down through this unit to produce the tortuous channel visible today. This prolonged activity may be related to the position of Posidonius on the edge of Mare Serenitatis and more specifically over the deep fractures that define the edge of the basin and provided ready conduits to the surface for ascending magmas.

## **Conclusion:**

The up-bowing of the soil, detected in the telescopic images, confirms the assumption reported by French et al. (2015) that an igneous intrusion occurred in this region. The presence of small-scale graben detectable only on NAC imagery are the demonstration of the ‘traces’ of the laccolith-forming intrusion of pressurized magma between rock layers of the lunar crust. Our data based on measurements carried out using LOLA DEM, photoclinometry and shape from shading analysis identify that the dome Pos1 is related to a magmatic body rising near the surface, with a low intrusion depth of 0.36km as inferred using the laccolith model by Kerr and Pollard



(1988). The laccolith model yields an uppermost basaltic layer thicknesses of 205m, in accordance with the data of French et al. (2015) that report, in their work, a maximum local mare unit thickness of 190m for the small graben groups in Posidonius.

## References

- [1] French, R. A., Bina, C. R., Robinson, M. S., Watters, T. R. ‘Small-scale lunar graben: distribution, dimensions, and formation processes.’ *Icarus* 252 (2015), 95–106. <https://doi.org/10.1016/j.icarus.2014.12.031>
- [2] Head, J. W., Murchie, S. L., Prockter, L. M., Solomon, S. C., Strom, R. G., Chapman, C. R., Watters, T. E., Blewett, D. T., Gillis-Davis, J. J., Fassett, C. I., Dickson, J. L., Hurwitz, D. M., & Ostrach, L. R., 2009. ‘Evidence for intrusive activity on Mercury from the first Messenger flyby’. *Earth and Planetary Science Letters*, 285, 251–262.
- [3] Lena, R., Wöhler, C., Phillips, J., Chiocchetta, M.T., 2013. *Lunar domes: Properties and Formation Processes*, Springer Praxis Books.
- [4] Wöhler, C., Lena, R., ‘Lunar intrusive domes: Morphometric analysis and laccolith modelling’, *Icarus*, 204, Issue 2, 2009, 381-398. <https://doi.org/10.1016/j.icarus.2009.07.031>.
- [5] Kerr, A.D., Pollard, D.D., 1998. ‘Toward more realistic formulations for the analysis of laccoliths’. *J. Struct. Geol.* 20(12), 1783–1793.
- [6] Ishihara, Y. et.al. (2016). ‘Structural and Geological Interpretation of the Posidonius Crater: Did the Posidonius Crater Floor Float on Basal Sill?’, 47th Lunar and Planetary Science Conference.

## LUNAR OCCULTATIONS

January 2021

Tim Haymes

### Time capsule: 50 years ago, January 1971 (LSC Vol. 6, No. 1)

(With thanks to *Stuart Morris* for the LSC archives at <https://britastro.org/downloads/10167>)

- The ‘Lunar Handbook’ is conceived.
- E. Symmonds – a method of focusing the Moon into an Ensign Selfix role film camera, by attaching a translucent strip to the film prior to exposure. The back of the camera is left open.
- Hot Spots (Firsoff), Lunar Fluorescence (Bartlett).

## December Reports

Observations of Xi Ceti DD (= 65 Ceti) on the evening of December 24<sup>th</sup> have been received from Alex Pratt (Leeds), Simon Kidd (Stevenage) and Tim Haymes (Oxford).

The higher frame rate recording by SK with ZWO174mm (250 fps) displays a gradual disappearance characteristic of Fresnel diffraction.

## **Observing Possibilities**

Observers have many varied and interesting projects. The Coordinator fits in occultation timings when he can, since the requirement to keep the data coming in fulfils a long history of observations from the 1600s to present time. There are active groups across Europe, Australasia and the United States.

So I encourage the reader to use whatever equipment is available to time an occultation. This could be a stop-watch and time signal, or planetary webcam with on-frame time display.

There is a small application (Lunarreport.exe) which is the reporting section of Occult4 without the analysis or prediction aspects of the full package. There is a link to Lunarreport.zip here in the second bullet point of the page:

<http://www.lunar-occultations.com/iota/lunarreport.htm>

See the following link for information on occultation phenomena

<http://www.asteroidoccultation.com/observations/>

The observer will need to input the Star ID, and this can be found in the Lunar Section Circular. If you record unlisted stars, then contact the coordinator with your long/Lat, the time of the observation and a screen shot showing the star at the limb just prior to occultation.

When enclosing an image please indicate its orientation.

## **Suggestion**

The writer suggests a basic USB3 planetary camera at 25 or 30 fps in SER recording mode, connected to a computer running D4 (by Thinking Man software: <http://www.thinkman.com/dimension4/>). This will keep the laptop clock synchronised to UT. When sync'd, it's a good idea to avoid allowing D4 to update while the recording is in progress. Then use TANGRA (Hristo Pavlov) to obtain the D or R time to report. It may be easier to advance the video forward to the event, go back 1 second, and then advance frame by frame to get the D time to report. More on analysis and reporting next month.

Occultation times with 0.04 sec accuracy (1 video frame), and with the relative motion of the moon to the star being typically about 0.3"/sec, video easily provides a relative positional accuracy of 0.01" arc.

## **Year 2021**

I look forward to receiving more reports in 2021. My tally between July and mid December 2020 has been 13 events timed. Not bad, but represents only eight days out of five months when conditions were good enough.

## Bright stars occulted in January 2021

Jan 03, 42 Leo (v6.2): RD at 0527 UT  
 Jan 16, tau Aqr (v4.1): DD daylight at 1511 UT  
 Jan 19, 35 Ceti (v6.6): DD at 1930 UT  
 Jan 21, 38 Ari (v5.2): DD at 2159 UT  
 Jan 25, M35 : DD of cluster at 2315UT  
 Jan 26, 8 Gem (v6.1): DD at 0311 UT  
 Jan 26, omega Gem (v5.2): DD at 2145 UT  
 Jan 27, 48 Gem (v5.9): DD at 0257 UT  
 Feb 01, nu Vir (v4.0): RD at 0135 UT

DD = Disappears at the Dark limb.

RD = Reappears at the Dark limb (after full Moon).

## Occultation predictions for Northern Oxfordshire 2021 January

E. Longitude - 1 18 46, Latitude 51 55 41, Alt. 119m; Telescope dia 25cm

Predictions are omitted for Lunar phase 98+ to 98- (Full Moon).

y	m	d	h	m	s	P	Star No	Sp	Mag v	Mag r	% ill	Elon	Sun Alt	Moon Alt	CA Az	Notes
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	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	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	5	27	33.9	R	1514	A1	6.2	6.2	83-	131		47	222	64N
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
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
21	Jan	6	1	50	37.8	R	138992	M0	8.5	7.8	53-	93		17	114	80S
21	Jan	6	2	39	4.4	R	1848	K5	7.7	7.0	53-	93		23	125	89S
21	Jan	6	4	6	39.0	R	139041	G5	8.8*	8.5	52-	92		32	147	25N
21	Jan	6	4	40	44.1	R	139043	K2	8.9	8.2	52-	92		34	156	25S
21	Jan	6	7	3	27.6	R	139080	K0	7.8	7.2	51-	91	-10	34	199	77S
21	Jan	7	5	12	8.8	R	139572	K5	9.0*	8.2	40-	79		27	153	19N
21	Jan	7	6	17	42.6	R	139581	K0	7.3*	6.6	40-	78		30	171	40N
21	Jan	7	6	46	26.9	R	1985	K0	6.9	6.3	40-	78		30	179	68N
21	Jan	9	6	4	46.1	R	159427	K5	8.9*	8.2	19-	52		13	144	24N
21	Jan	15	17	57	55.7	D	164841	K0	8.1	7.6	7+	32		7	229	57S
21	Jan	16	17	27	54.5	D	165354	K2	8.1	7.4	14+	43	-9	19	215	13N
21	Jan	18	19	39	16.8	D	60	K2	6.9	6.1	30+	67		24	230	72S
21	Jan	19	19	30	44.6	D	178	F8	6.6*	6.3	40+	78		34	220	25N
21	Jan	19	20	6	49.4	D	109741	F8	8.8	8.6	40+	78		30	230	50N
21	Jan	19	21	44	21.6	D	188	F0	7.6	7.4	40+	79		18	252	82S
21	Jan	20	22	44	33.0	D	298	F2	7.1*	6.8	50+	90		19	259	90N
21	Jan	20	23	13	47.7	D	110297	K5	8.2	7.3	50+	90		14	264	53S
21	Jan	20	23	59	21.2	D	110316	F5	7.2*	6.9	50+	91		8	273	87N
21	Jan	21	20	52	14.0	D	93077	K0	8.2	7.7	59+	100		43	225	64S
21	Jan	21	21	58	13.3	D	404	A7	5.2*	5.1	59+	101		35	243	54N
21	Jan	21	23	1	7.7	D	93100	G	8.6*	8.3	60+	101		26	257	76S
21	Jan	21	23	1	13.1	D	93099	A	8.9*	8.8	60+	101		26	257	82S
21	Jan	21	23	4	21.6	D	93098	A0	7.5	7.4	60+	101		25	257	33S
21	Jan	22	17	30	29.1	D	93425	K2	7.9	7.3	67+	110	-8	48	138	69N
21	Jan	22	20	14	30.3	D	93452	F0	8.3	8.1	68+	111		53	200	89S
21	Jan	22	22	42	57.1	D	93477	F8	8.6	8.3	69+	112		38	246	25N
21	Jan	22	22	46	41.9	D	93484	F5	7.0*	6.8	69+	112		38	247	79N
21	Jan	23	18	3	0.5	D	622	F8	8.2	7.9	76+	121		50	131	40N

21	Jan	23	19	31	29.6	D	93840	F5	7.2		76+	122	57	163	79N	
21	Jan	23	19	55	38.7	D	93844	K0	7.6	6.9	76+	122	58	173	62S	
21	Jan	23	20	56	8.9	D	93856	G9	8.6	8.2	77+	122	57	199	67N	
21	Jan	23	21	2	15.7	D	93862	F5	8.5	8.2	77+	122	57	202	67S	
21	Jan	23	21	17	43.3	D	93863	A0	7.9	7.8	77+	122	56	208	67N	
21	Jan	24	18	50	33.6	D	76966	F5	8.5	8.2	84+	133	52	128	53N	Dbl*
21	Jan	24	21	22	15.9	D	77024	B8	8.1	8.0	85+	134	60	190	56S	
21	Jan	24	23	9	47.3	D	77045	G5	8.4	7.8	85+	134	52	232	84N	
21	Jan	25	1	4	20.3	D	77083	F5	8.7	8.4	85+	135	36	261	63N	
21	Jan	25	17	23	15.2	D	77792	M0	7.9	7.0	90+	144	-7	33	94	65S
21	Jan	25	19	3	13.5	D	77852	A0	8.2	8.2	91+	144	48	116	42S	
21	Jan	25	23	19	26.3	D X	8417	K5	8.6	7.9	91+	146	58	219	62N	in M35
21	Jan	25	23	28	40.9	D	78031	B2	8.2	8.2	91+	146	57	223	35N	in M35
21	Jan	25	23	33	18.7	D X	8438	B8	8.8	8.8	91+	146	57	224	68N	in M35
21	Jan	25	23	40	10.7	D X	8450	A2	8.7	8.7	91+	146	56	226	89S	in M35
21	Jan	25	23	44	40.6	D	78051	A2	7.6	7.5	91+	146	55	228	75N	in M35
21	Jan	26	01	11		D 5	Geminorum	5.8	5.3	CA 11 S	Wales, SW/S	England, IoW				
21	Jan	26	2	10	13.9	D	78121	F0	7.5	7.3	92+	147	35	265	56S	
21	Jan	26	2	13	45.9	D	78122		7.9	7.5	92+	147	35	266	47S	
21	Jan	26	3	11	23.2	D	954	G8	6.1	5.6	92+	147	26	276	59S	8 Gem
21	Jan	26	17	26	11.2	D	1052	F8	6.8	6.5	95+	155	-7	26	84	85S
21	Jan	26	20	31	17.1	D	78967	A2	8.1	8.0	96+	157	53	125	69N	
21	Jan	26	21	10	16.0	D	78989	A0	8.5	8.5	96+	157	57	138	78S	
21	Jan	26	21	35	33.9	D X	10317	K0	8.9	8.4	96+	157	60	148	67N	
21	Jan	26	21	43	29.4	D	1070	G5	5.2	4.7	96+	157	60	152	38S	omega Gem
21	Jan	26	22	5	48.4	D	79013	K2	8.8	8.3	96+	157	62	161	44N	
21	Jan	26	22	8	30.1	D	79020	F8	8.8	8.5	96+	157	62	162	86S	
21	Jan	26	22	33	52.8	D	79028	A0	8.5	8.5	96+	157	62	175	46S	
21	Jan	27	0	28	43.6	D	1080	M1	6.7	5.9	96+	158	56	225	45S	
21	Jan	27	0	31	10.4	D	79087	K0	8.8	8.3	96+	158	56	226	68N	
21	Jan	27	2	6	35.6	D	79133	F5	7.9	7.7	97+	159	44	252	57S	
21	Jan	27	2	57	51.5	D	1092	F5	5.9	5.6	97+	159	36	264	80S	48 Gem
21	Jan	27	4	35	59.1	D	79214	G5	7.9	7.4	97+	160	21	282	40S	
21	Jan	30	5	37	32.2	R	1479	F2	6.4	6.2	97-	162	30	257	50S	
21	Jan	30	21	48	11.1	R	1569	A2	6.9*	6.8	94-	152	25	101	81N	
21	Jan	31	0	16	56.1	R	99317	K0	8.1*	7.6	94-	151	44	138	84N	
21	Feb	1	1	35	45.4	R	1702	M0	4.0*	3.3	87-	137	41	150	71N	nu Vir
21	Feb	2	2	13	56.1	R	119510	F5	8.5*	8.2	78-	124	34	149	57S	
21	Feb	2	4	42	18.0	R	138923	F5	8.0	7.7	77-	123	37	194	77S	
21	Feb	2	6	59	55.4	R	138962	K2	8.3	7.8	77-	122	-7	26	231	40N
21	Feb	3	3	9	48.4	R	139388	K2	7.9*	7.2	67-	110	29	153	57S	
21	Feb	3	5	3	31.8	R	139430	B5	8.0	8.1	67-	110	32	185	28N	
21	Feb	3	6	43	49.8	R	1952	F0	8.6	8.4	66-	109	-9	27	212	70N
21	Feb	4	3	9	46.5	R	X128771		7.9	7.7	56-	97	19	143	71S	Dbl*
21	Feb	4	3	9	49.3	R	2064	F4	6.3		56-	97	19	143	71S	

Predictions up to Feb 5th to magnitude 8.9.

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 = Zodiocal 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.

*Detailed predictions at your location for 1 year are available upon request.*

**Occultation Subsection Coordinator:** occultations at stargazer dot me dot uk

## LUNAR GEOLOGICAL CHANGE DETECTION PROGRAMME Jan 2021

Tony Cook

**Introduction:** The observations received in the past month have been divided into three sections: Level 1 is a confirmation of observations received for the month: 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 a similar illumination ( $\pm 0.5^\circ$ ) or similar illumination and topocentric libration report ( $\pm 1.0^\circ$ ) for a past TLP, 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 further reports were received for November, but I will have some reports from Trevor Smith, for December, to describe in the next newsletter.

**News:** I'd like to wish our readers a rather better 2021 than the preceding year. I also would like to congratulate the Chinese Space Agency for a successful sample and return mission to the Mons Rümker area of the Moon with their Chang'e 5 lander.

**Level 1 – All Reports received for November:** Jay Albert (Lake Worth, FL, USA - ALPO) observed: Agrippa, Alphonsus, Censorinus, Manilius, Plato, Proclus and Swift. Alberto Anunziato (Argentina - SLA) observed Alphonsus and Mons Piton. Juan Manuel Biagi (Argentina – SLA) imaged several features. Massimo Alessandro Bianchi (Italy – UAI) observed/imaged Aristarchus, Copernicus and Montes Teneriffe. Maurice Collins (New Zealand – ALPO/BAA/RASNZ) imaged the Full Moon. Anthony Cook (Newtown, UK – ALPO/BAA/NAS) observed Proclus and videoed several features. Daryl Dobbs (Risca, UK - BAA) observed Aristarchus and Gassendi. Fernando Ferri (Italy - UAI) imaged the Full Moon. Valerio Fontani (Italy – UAI) imaged Montes Teneriffe and the Full Moon. Marco Di Francesco (Italy – UAI) imaged Aristarchus and Montes Teneriffe. Les Fry (UK – NAS) imaged Aristarchus, Hansteen, J. Herschel, Kepler, Mersenius, and Schickard. Rik Hill (Tucson, AZ, USA – ALPO/BAA) imaged the Kies area. Jean Marc Lechopier (France – UAI) imaged Montes Teneriffe. Davide Pistritto (Italy – UAI) imaged Aristarchus. Trevor Smith (UK – BAA) observed Aristarchus, and Atlas. Bob Stuart (Rhayader, UK – BAA/NAS) imaged Birt, Copernicus, Eratosthenes, Rupes Recta and Stadius. Franco Taccogna (Italy – UAI) imaged Aristarchus, Montes Teneriffe and Prinz. Aldo Tonon (Italy – UAI) imaged Copernicus, Mare Frigoris, and Montes Teneriffe. Gary Varney (Pembroke Pines, FL, USA – ALPO) imaged Clavius, Plato, and Sinus Iridum. Román García Verdier (Argentina – SLA) imaged several features. Ivor Walton (Cranbrook, UK – CADSAS) imaged the Moon from a robotic telescope in Chile. Luigi Zanatta (Italy – UAI) imaged Mare Frigoris.

### Level 2 – Example Observations Received

**Mare Crisium:** On 2020 Nov 01 UT 04:31 Román García Verdier (Argentina – SLA) imaged took an image of the Moon (See Fig. 1) that included this crater – under similar illumination to the following report:



*Mare Crisium 1948 Jul 21/22 UT 22:00?-01:00? Observed by Moore (England, 12" reflector) "Almost featureless except for Peirce & Picard" NASA catalog weight=3. NASA catalog ID #506. ALPO/BAA weight=2.*



**Figure 1.** *Mare Crisium as imaged by Román García Verdier (Argentina – SLA) imaged) on 2020Nov 01 UT 04:31 and orientated with north towards the top.*

**Plato:** On 2020 Nov 01 UT 04:42 Juan Manuel Biagi (SLA) took a monochrome image (See Fig. 2) of the Moon that included this crater – under similar illumination to the following report:

*On 1938 Jan 17 Barker (Chestnut, England, UK, 12.5" reflector) noticed that Plato crater had a brownish-gold veined surface, colour irregular - laid on a smooth floor. It had extended further E than on the previous night. The ALPO/BAA weight=2.*



**Figure 2.** *Plato as imaged by Juan Manuel Biagi (SLA) on 2020 Nov 01 UT 04:42 and orientated with north towards the top.*

You can certainly see the veined surface in Fig. 2, but alas the image is monochrome – but it is useful at least as a context image.

**Aristarchus:** On 2020 Nov 03 UT 22:50-23:00 and 23:25-23:40 Trevor Smith observed the crater under similar illumination to the following two reports:

On 1992 May 20 at UT 11:15 D. Weier (Sun Prairie, WI, USA, naked eye and 7x50 binoculars, sky conditions excellent) noted that Aristarchus and, an area, were very bright to the eye. In binoculars the feature was quite sharp and distinct, "> anything else on the Moon". The Cameron 2006 catalog ID=447 and the weight=2. The ALPO/BAA weight=1.

Aristarchus 1979 Nov 07/08 UT 23:10-00:00 Observed by R.H. Ricketts (Lewis, Sussex, UK, 10" reflector, x300, Seeing Antoniadi II) - obscuration and colouration seen. ALPO/BAA weight=2.

For the first report Trevor notes that the crater did indeed look bright but was not excessively so. No colours were seen and the crater looked normal. For the second report Trevor saw no colouring or obscurations either.

**Alphonsus:** On 2020 Nov 23 UT 03:30-03:35 Alberto Anunziato (SLA) observed visually this crater under similar illumination to the following two reports:

1958 Nov 19 Poppendiek observed a large plume-like diffuse cloud over central peak, very large compared to central peak (@ approx 30km diameter) with intensity much different from other parts. Brightness between walls and shadowed floor. Would take 3 minutes to collapse, so continuously fed. 13-14 days later, at SS, central peak was normal. Kuiper took photos after Kozyrev's observations, but saw nothing abnormal. Drawing. Haas saw nothing in 12inch reflector at the time. Cameron 1978 catalog TLP ID=705 and weight=4. ALPO/BAA weight=2.

Alphonsus 1966 Jun 26 UT 04:30-04:40 Observed visually by D.Harris and E.Arriola (Whittier, CA, USA, 19" reflector x146, and spectrum, S=4, T=1-0) "Absorp. spectrum (visual) of c.p. band at 475+/-5nm (1st est.); 2nd est. at 485+/-5nm. Band degraded towards the viol. Band nr.Hydrogen Beta. as if abnormally broadened. No sign of anything unusual visually in central peak in white light. Absorption appeared only on C.P., not over walls. Calibration corrections put band at 491+/-4nm" NASA catalog weight=5. NASA catalog ID #948. ALPO/BAA weight=5.

Alberto, using a Meade EX 105 at x154, comments that he could not see the features reported in 1958 and 1966.

**Mare Frigoris:** On 2020 Nov 24 UT 22:14-22:41 UAI observers: Aldo Tonon (17:10-17:17UT) and Luigi Zanatta (22:14-22:41UT) imaged (See Fig. 3) this 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 3.** Mare Frigoris as imaged by UAI on 2020 Nov 24 by UAI observers and orientated with north towards the top. **(Left)** image by Aldo Tonon at 17:13 UT. **(Right)** image by Luigi Zanatta taken at 22:34 UT.

**Swift:** On 2020 Nov 25 UT 02:36-02:44 Jay Albert (ALPO) observed this crater visually under similar illumination to the following report:

*Peirce A 1927 Dec 03 UT 22:00 Observed by Wilkins (England, 15" reflector) "Invisible (date in MBM) is wrong, would be only 6h before NM. Sunrise on crater is at 3d & ? h. No interposition of dates works e.g., 13th or 1926 or Dec 26 1923. Only Dec 3 1927 is feasible as it would be just after 1st Q. & more similar to the May obs.)" NASA catalog weight=4?. NASA catalog ID #396. ALPO/BAA weight=2.*

Jay was using a Celestron NexStar Evolution 8" SCT. The sky was partly cloudy with fast-moving cumulus and moderate to stiff breezes. Transparency was second magnitude where clear and seeing was initially 5-6/10 but deteriorated to 3-4/10. Clouds covered the Moon from 02:21, as he began to observe Crisium, until 02:36. Once the clouds cleared, he could see Picard, Peirce and, with difficulty, Swift. Seeing had deteriorated to 3-4/10 due to passing clouds in the lunar vicinity and increased wind. When seeing permitted, Swift could be seen as a dim crater in one of Proclus' ejecta rays. He first saw Swift at 185x, then at 226x. He viewed Swift from 02:36 to 02:44UT.

**Plato:** On 2020 Nov 26 UT 01:50 Gary Varney imaged (See Fig. 4) this crater under similar illumination to the following two reports:

*Plato 1967 May 20 UT 01:13 K.Simmons (Jacksonville, FL, USA, 10" reflector) observed a large bright (intensity 6.5) oval area on near the central floor. According to Ricker and Kelsey (ALPO selected area coordinators) this is unusual. ALPO/BAA weight=1.*

*Plato and Plato A 1972 Jan 26 UT 18:25-18:55 Observed by Watkins and Hunt (England, 4.5" reflector x150, x225, and a 2.75" refractor) "Misty patch over A, & a misty brightness over SW wall of Plato. Hunt saw nothing unusual." NASA catalog weight=2. NASA catalog ID #1321. ALPO/BAA weight=2.*



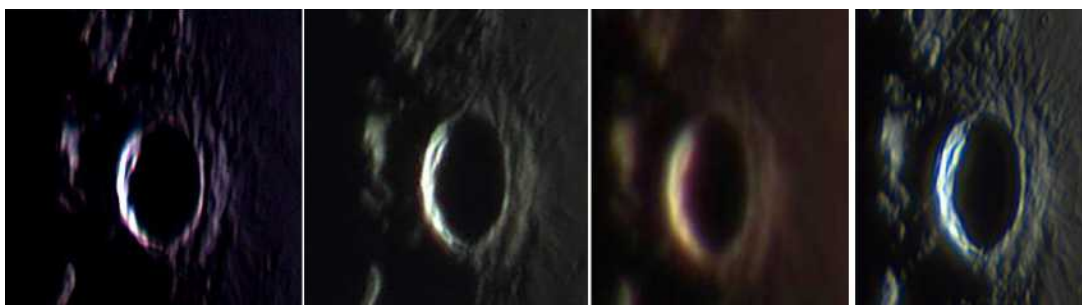
**Figure 4.** Plato as imaged by Gary Varney (ALPO) on 2020 Nov 26 UT 01:50 and orientated with north towards the top.

**Aristarchus:** On 2020 Nov 26 UAI observers: Alessandro Bianchi (17:34-17:46 UT), Marco Di Francesco (16:47-17:50UT), Davide Pistritto (17:38-17:56 UT), and Franco Taccogna (16:48-17:31 UT) imaged (Fig. 5) this crater under similar illumination to the following report:

*On 2013 Apr 22 UT 01:39-02:37 P. Zeller (Indianapolis, USA, 10" f/4 reflector, x200, seeing 6, Transparency 3 - scattered cirrus) observed visually (depicted in sketch) the two closely spaced NW wall dark bands to have a rusty-red hue. The colour of these bands did not change over the period of the observing session. Images were taken, but resolution and image S/N is not sufficient to resolve separate bands here, or to detect colour. The ALPO/BAA weight=2.*

The earlier coverage of Marco Di Francesco and Franco Taccogna (15:56-16:56 UT) also covered similar illumination to this report:

*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 colour entire length of W. wall. 3 others corroborated detail, but not colour. 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.*



**Figure 5.** Colour images of Aristarchus crater orientated with north towards the top taken on 2020 Nov 26 by UAI observers. Colour saturation has been increased to 40%. **(Far Left)** Marco Di Francesco took this image at 16:46 UT. **(Left)** Franco Taccogna took this image at 17:02 UT. **(Right)** Alessandro Bianchi took this image at 16:34 UT. **(Far Right)** Davide Pistrutto took this image at 17:38UT.

**Aristarchus:** On 2020 Nov 27 UT 18:35 Les Fry (NAS) imaged (Fig. 6) this crater under similar illumination to the following two reports:

*Herodotus 1965 Jun 11 UT 21:35-21:40 Observed by Porta, Garau (Mallorca, Baleares, 4" refractor x250) "Red glow in crater at 2140, then clouds stopped obs. After clouds, floor was abnormal rose colour" NASA catalog weight=5. NASA catalog ID #879. ALPO/BAA weight=4.*

*On 1978 Mar 21 at UT 20:57 an Unknown observer observed a TLP in Aristarchus crater. The details for this report are still being looked up in the archives. In view of the uncertain details this TLP has been given an ALPO/BAA weight of 1.*

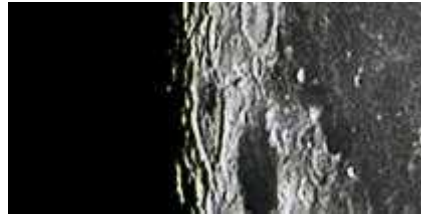


**Figure 6.** Aristarchus as imaged by Les Fry (NAS) on 2020 Nov 27 UT 18:35 and orientated with north towards the top.

**Riccioli:** On 2020 Nov 29 UT 10:03-10:06 Maurice Collins (ALPO/BAA/RASNZ) imaged the whole lunar disk, part of which (Fig. 7) contained this crater under similar illumination and topocentric libration (viewing angle) to the following report:

*Riccioli 1974 Jan 07 UT 16:30-17:00 Observed by McKay (South Downs, England, 3" refractor, x135, S=IV boiling) "Bright spot and dark patch changing in size (atmos. aberr. ?)" NASA catalog weight=1. NASA catalog ID #1385.*





**Figure 7.** Riccioloi as imaged by Maurice Collins on 2020 Nov 29 UT 10:03-10:06 in colour and orientated with north towards the top.

**Full Moon:** On 2020 Nov 29 UT UAI observers Valerio Fontani and Fernando Ferri submitted images (Fig. 8) of the Full Moon, from which relative brightness of some craters were measured (see table 1 - to compare with past measurements – covered in earlier newsletters) for the following Lunar Schedule request:

*ALPO Request: Please take images of the Full Moon, but make sure you under expose as we want to avoid bright ray craters like Aristarchus, Tycho, Proclus etc from saturating. The purpose behind this is we want to compare with images of Earthshine which are essentially zero phase illumination images, like at Full Moon. There have been reports in the past that Aristarchus varies greatly in brightness compared to other features. David Darling (a past TLP coordinator) has suggested this was simply due to libration effects, i.e., viewing angles, so we would naturally like to test this theory out. Also, if you have any past images of close to Full Moon, please send these in too if the above-mentioned craters are not saturated. Pretty much any size telescope can be used to take these images so long as we can clearly see the above craters. Obviously do not attempt this if the sky is cloudy or hazy. Observations will be presented in the "Lunar Observer" - a monthly publication of the Lunar Section of ALPO. All reports should be emailed to: a t c @ a b e r . a c . u k*



**Figure 8.** The Full Moon as imaged on 2020 Nov 29. **(Left)** Taken by Fernando Ferri at 23:35 UT with a Canon 400mm f5.6 telephoto + Kenko 1.4x convertor + Canon 70D camera. **(Right)** Taken by Valerio Fontani at 23:56 UT with a 1000mm f/10 telephoto on a Canon EOS 80D camera.

	Aristarchu s	Censorinu s	Copernicu s	Keple r	Plat o	Proclu s	Tych o
Fontan i	177	189	159	97	67	195	170
Ferri	186	180	152	142	99	200	168

**Table 1.** Relative brightness measurements from the images in Figure 7.

The relative brightness of craters from Table 7 was found to be (from dark to bright): Plato, Kepler, Copernicus, Tycho, Aristarchus, Proclus. As we have found in the past this varies with illumination, libration, image scale, and even colour. However, we still need a large dataset of measurements in this 6-parameter space.

### Level 3 - In Depth Analysis:

**Proclus:** On 2020 Nov 05 UT 00:34 Anthony Cook (ALPO/BAA/NAS) observed the crater visually under similar illumination to the following report:

*On 1980 Aug 30? at UT 08:00? D. Louderback (South bend, WA, USA, 8" reflector x140) found the north wall to be very bright in red light (this is not normal as it is usually bright in blue - according to Cameron). The brightness was 9.7 (red) and 9 (blue no filter) compared to Eimmart's 8.7. Louderback thought that they observed an orange-yellow tinge. Cameron 2006 catalog ID=108 and weight=3. ALPO/BAA weight=2.*

Quite clearly the day is wrong so the report will be shifted by one day to 1980 Aug 31. The weight shall remain at 2 for now.

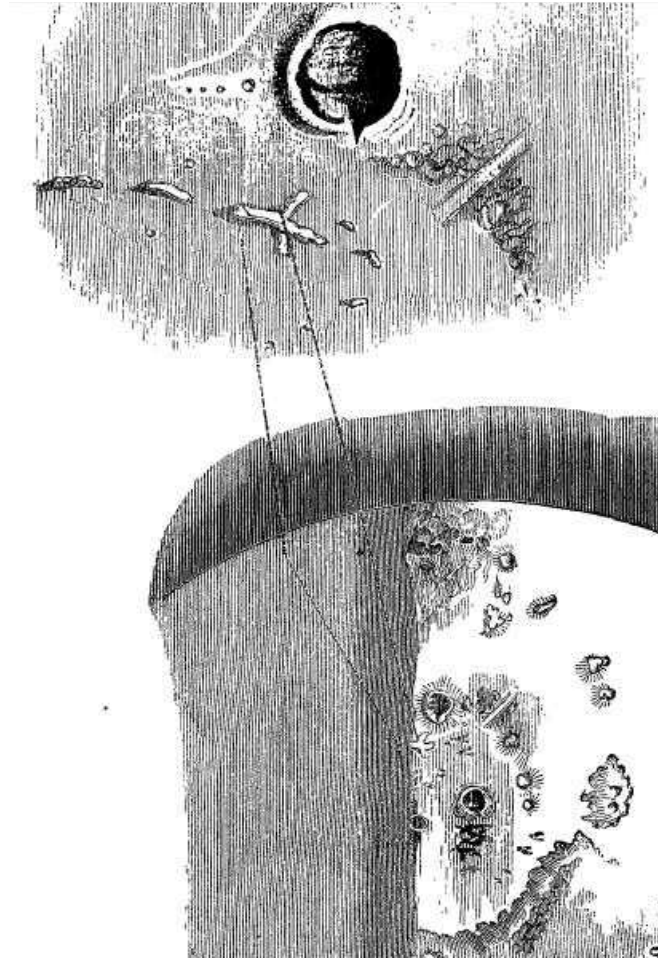
**Montes Teneriffe:** On 2020 Nov 23 UAI observers: Massimo Alessandro Bianchi observed visually, and Marco Di Francesco, Valerio Fontani, Jean Marc Lechopier, Franco Taccogna, and Aldo Tonon imaged this area under the following repeat illumination request which had a selenographic colongitude range of 10.2°-12.4°:

*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*

This actually refers to the following report from Cameron's catalog:

*"nr. Plato in Teneriffe Mountains 1854 Dec 27 UT 18:00-23:00 Observed by Hart & others (Glasgow, Scotland, 10" reflector) "2 luminous fiery spots on bright side on either side of a ridge, contrasting colour. Seemed to be 2 active volcanoes. Ridge was normal colour. Spots were yellow or flame colour. Never seen before in 40 yrs. of observing." NASA catalog weight=4. NASA catalog ID #129. ALPO/BAA weight=3."*

We have discussed this before in past newsletters e.g.: 2018 Jun, 2019 Feb, 2020 Aug and 2020 Dec. The problem has always been to try to match the sketches (Fig. 9) from the report with modern imagery:



**Figure 9.** A TLP report for Montes Teneriffe from the Royal Astronomical Society's *Monthly Notices* from 1854, Vol. 15, p. 163. The sketch has been rotated to put north at the top,

Three narrow camera view images were taken by UAI members and seem to show similar shadow patterns on the floor of Plato in Fig. 10. Two of these images are colour but show nothing unusual on the Montes Teneriffe in terms of the colour described in 1854.



**Figure 10.** Montes Teneriffe and Plato, on 2020 Nov 23 orientated approximately with north towards the top by UAI astronomers: **(Left)** A monochrome image by Marco Di Francesco taken at 16:08 UT. **(Centre)** A colour image taken by Aldo Tonon at 16:57 UT. **(Right)** A colour image taken by Franco Taccogna at 17:27 UT.

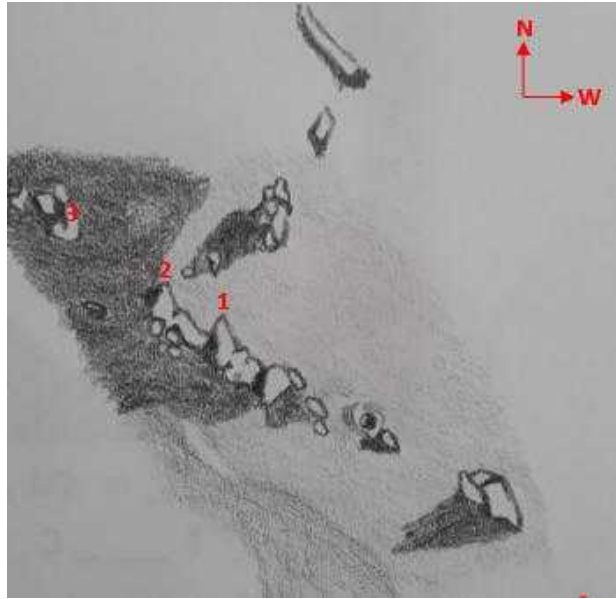
A wider-angle perspective by another couple of UAI astronomers, in Fig. 11, lets us check the accuracy of the sketch a little further to the south. Marco's image (Fig. 11 –

Right) is a little outside the lunar schedule window, but is important as it confirms the shadows on the floor of Plato are too short at this time, so sets an important upper limit on the colongitude range.



**Figure 11.** Images of NE Mare Imbrium, by UAI astronomers, orientated with north towards the top, taken on 2020 Nov 23. **(Left)** A monochrome image taken by Valerio Fontani at 16:35 UT. **(Right)** A colour image taken by Marco Di Francesco at 21:08.

Massimo Alessandro Bianchi made a visual observation and was very keen to look out for chromatic aberration and coloured scintillation effects on the sunlit peaks of Montes Teneriffe. He reports: *‘Cloudy skies, high turbulence. On the peaks highlighted I found, with decreasing intensity indicated by the numbering (See Fig. 12), a surge in the halos caused by the chromatic aberration of my instrument, more visible in its red component on the peaks 1 and 2, more balanced and diagonally along the ridge for the peak 3. The phenomenon, much more pronounced than the other features visible in the eyepiece field, was more noticeable during moments with higher turbulence, for instance after the passage of a cloud.’* This is a very important observation, something that is filtered out by stacking software used on the images in Figs 10 and 11. It seems that points ‘3’ and ‘2’ in Fig. 12 seem at least to correspond to the arrowed peaks in the 1854 top sketch in Fig. 9. I think I will lower the ALPO/BAA weight from 3 to 2. Quite clearly it would be very beneficial if we had more visual reports at these colongitudes to double check the appearance.



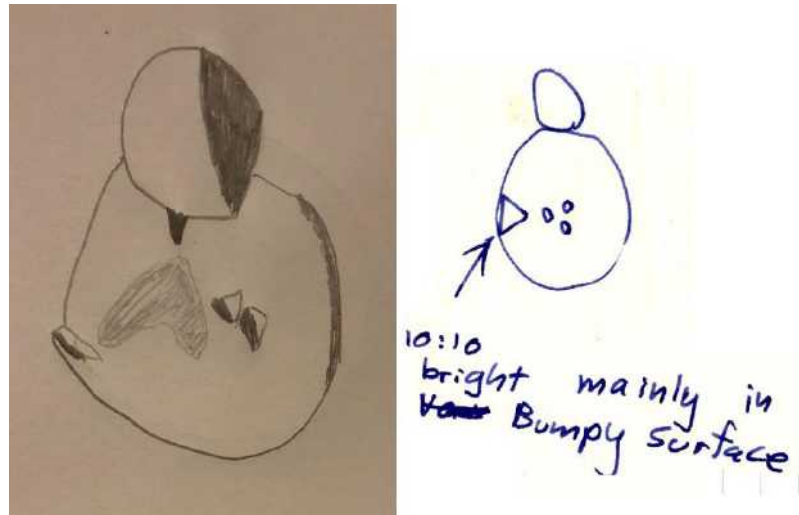
**Figure 12** A sketch made of the Montes Teneriffe by Massimo Alessandro Bianchi (UAI) on 2020 Nov 23 UT 16:36-17:40.

**Gassendi:** On 2020 Nov 26 UT 19:23-20:25 Daryl Dobbs (BAA) observed this area under similar illumination to the following report:

*On 1977 Oct 23 observing period: UT22:00-22:40 A.C. Cook (Frimley, Surrey, UK, 6" reflector, x144, 6mm Ortho eyepiece, seeing IV, red and blue filters used) saw at 22:10 a sector on the western floor to be mainly bright in the red. The surface was bumpy here. The observer at the time commented that this was probably not a TLP, but no precise explanation given. ALPO/BAA weight=1.*

Daryl had an Antoniadi seeing of II, transparency very clear, and was using a 10" Skywatcher Dobsonian, 5mm Altair Astro eyepiece with a magnification of x240, filters #12 yellow, #23a red, #58 green and #80a blue. He noticed a heart-shaped area on the floor of Gassendi slightly darker in tone to the rest of the floor as indicated by the shading on the sketch (Fig. 13 Left). This was not very obvious without filters, but very noticeable in a red filter, more so than in a blue or green or yellow. Using a blue filter, it was hardly noticeable with a view similar to the unfiltered view. The heart-shaped area reached from a shadow protruding from Gassendi A to the central peaks in one direction and to the broken terrain under the western rim. Very noticeable on the western rim was a small crater with a teardrop-shaped floor deep in shadow. If the heart-shaped area is the one reported then Daryl thought that 'it's just normal floor tone enhanced by using a red filter'. Re-reading my own report from 1977, I was pretty sure that the effect was not a TLP, so not sure why it made it into the TLP list, though the altitude was quite respectable at 37° above the local horizon. I think I will lower the weight to 0 but put it into the Lunar Schedule web site as I am curious to see if the colour can be imaged.





**Figure 13.** *Gassendi orientated with north towards the top. (Left) A sketch by Daryl Dobbs from 2020 Nov 26 UT 19:23-20:25. (Right) A sketch by Anthony Cook from 1977 Oct 23 UT 22:10.*

**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](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](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/ltip.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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