Director: Bill Leatherbarrow

LUNAR SECTION CIRCULAR

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FROM THE DIRECTOR

Total Lunar Eclipse 26th May 2021, 11h 14m UT, 150mm OG
(Peter Anderson, Australia)

The light summer months in the northern hemisphere and the generally low elevation of the Moon mean that we have received fewer observations for this month. However, there was a fine total eclipse of the Moon on 26 May 2021. Unfortunately this was not visible from Europe, but I have received reports and images from Peter Anderson, Maurice Collins and Mark Lonsdale in Australasia. Europe did get to see a partial solar eclipse on 10 June, but most UK observers experienced troublesome cloud interruptions. However, many fine images have been posted on the BAA Members' Pages.

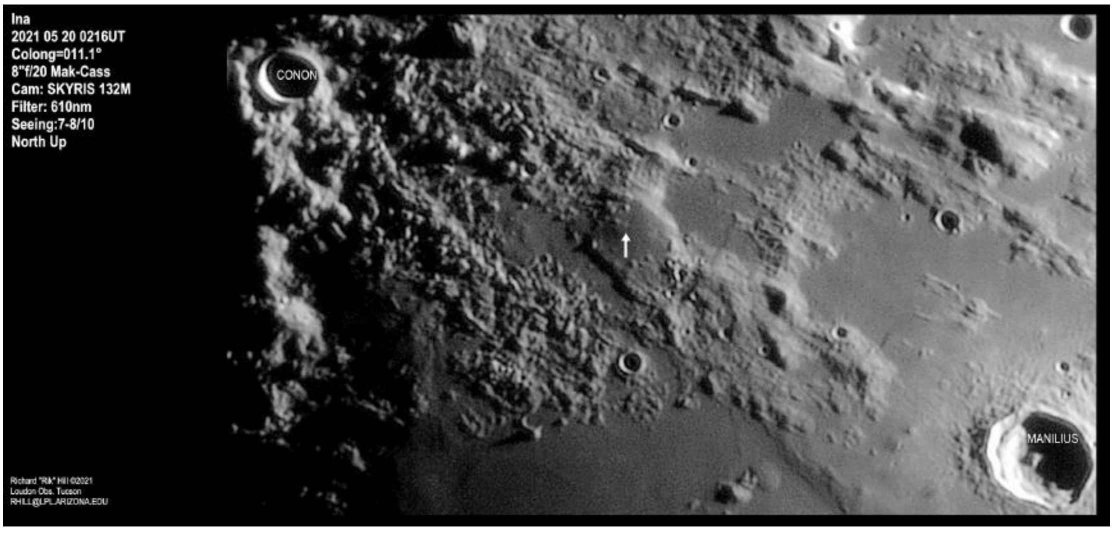
I am delighted to announce that at its May meeting BAA Council recommended the joint award of the Merlin Medal and Gift to those stalwarts of the Lunar Section, Raffaello Lena and Barry Fitz-Gerald, in recognition of their contributions to lunar geology and the work of the Section. I am sure that members will wish to join me in congratulating Raf and Barry on this achievement. A further joint contribution from them may be found later in this issue.

Bill Leatherbarrow

OBSERVATIONS RECEIVED

Observations, including lunar eclipse images, have been received from the following: Leo Aerts (Belgium), Peter Anderson (Australia), Maurice Collins (New Zealand), Clyde Foster (South Africa), Rik Hill (USA), Raf Lena (Italy), Rod Lyon, Luigi Morrone (Italy), Alexander Vandenbohede (Belgium), and the Director.

LITTLE INA Rik Hill



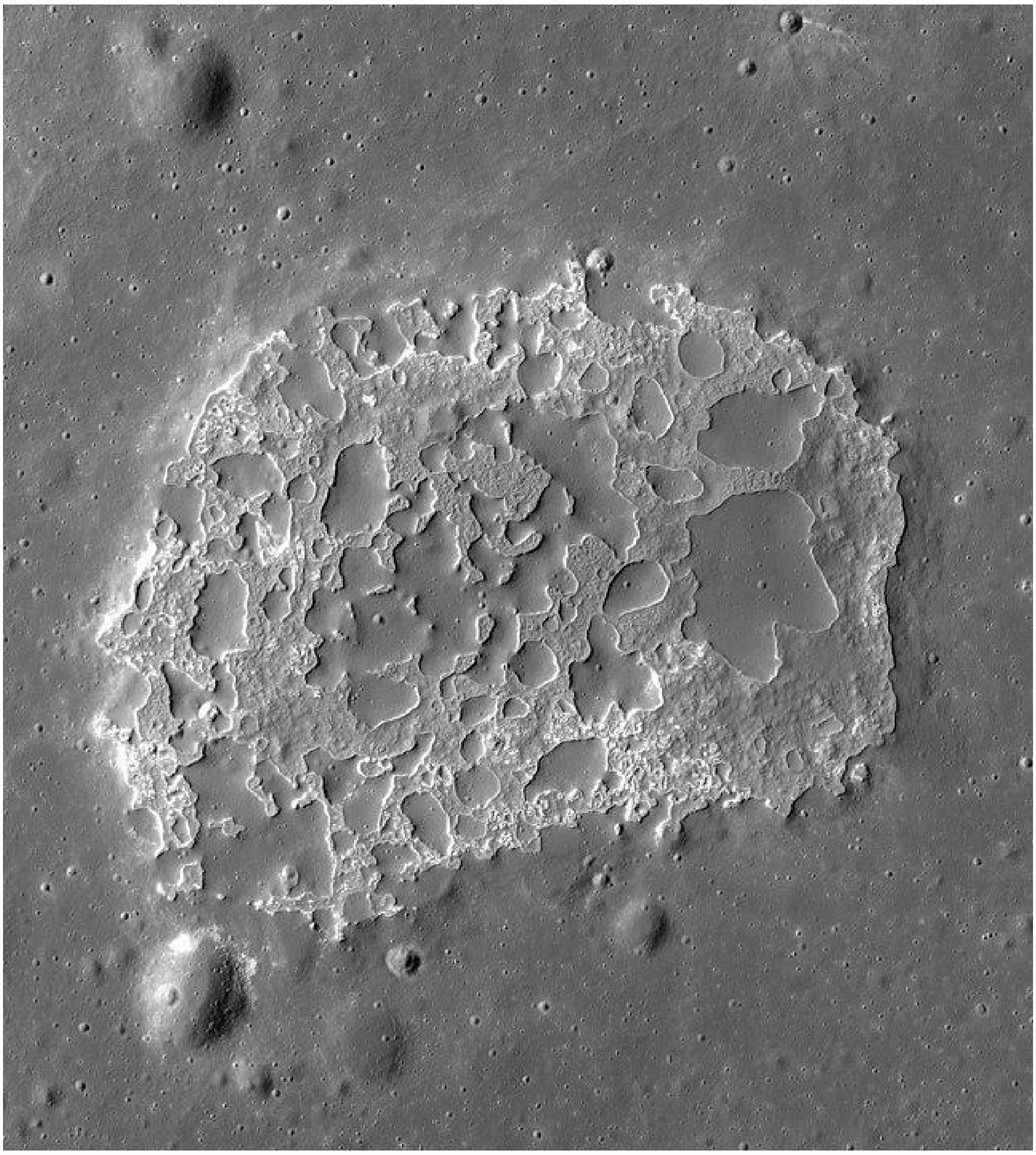
Before he died, I was at the home of Ewen Whitaker and he challenged me to find the lunar feature Ina. He showed me a spacecraft image but never told me the size, just that it was 'very small'. This year I gave it a go, hunted down the location of it and was doubtful I could really see the 'D'-shaped volcanic feature. It's only 1.9x2.9km in size on a plateau in the middle of Lacus Felicitatis. It took a while but I did manage to find it as a smudge on my image which is pretty much all you're going to see in an 8" aperture telescope. It shows up very well on the LROC Quick Map as a sideways 'D'. There is nothing else exactly like it on the Moon and its slightly blue tint would make the use of filters to find it possibly helpful, which I will try in the future. Several larger craters are labelled in this image for easy reference.

Happy hunting!

Note from the Director:

Rik is right to say that there is nothing exactly like Ina elsewhere on the Moon, but there are a few similar features. They are known as irregular mare patches (IMPs) and appear to be volcanic in origin. We still have much to learn about them. Ina is one of the more difficult features listed in Chuck Wood's 'Lunar 100' - a well-known set of challenges for the telescopic observer.

A Lunar Reconnaissance Orbiter image of INA is reproduced below, courtesy of NASA.

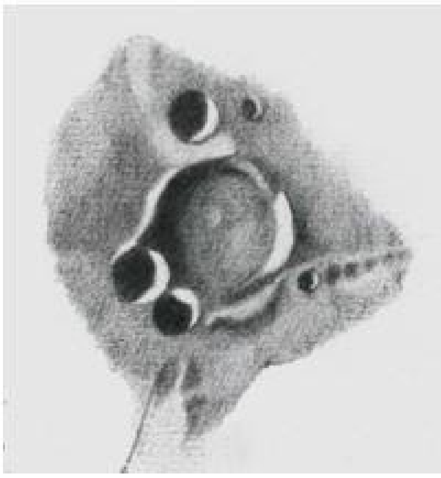


WEBB'S FURROW – revisited Nigel Longshaw

It is often instructive and sometimes imperative to revisit certain areas of the lunar surface to obtain a better understanding or interpretation of a doubtful topographical feature or hitherto strange appearance which defied interpretation at the time of the initial observation.

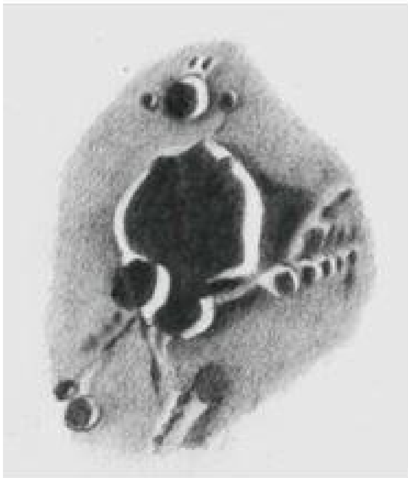
Even selenographers of the past soon realized that the changing aspects of illumination and libration can often present different appearances, and in many cases, it becomes difficult to reconcile one observation with another simply because of these differences.

I was recently able to revisit the crater Müller to make further observations of the feature known in the past as 'Webb's Furrow' (see *J. Br. Astron. Assoc*. **122**, 3, 2012). I first observed the region on 2008 October 8 when the interior of Müller was ostensibly free from shadow. Then, 'Webb's Furrow' appeared as a shaded linear feature along the south-western wall of Müller. More recently, on 2021 April 19, sunlight had not yet reached the interior of Müller and the western wall was brightly illuminated. The southern end of the crater wall appeared to continue in an easterly direction, parallel with a ridge to the south, both enclosing an area of dark shadow. Both features appearing to form the southern and northern 'banks' of 'Webb's Furrow'.



Muller 2008 October 8, 100mm Achromat

X160, seeing conditions III.



Muller 2021 April 19, 100mm Achromat

X185, seeing conditions II.

On the occasion of April 19 however the crater chain which extends west of Müller, along the alignment of 'Webb's Furrow', was resolved in greater detail than I was able to make out in 2008. I counted around four, possibly five, craterlets, however these features are at the limit of resolution of the 100mm achromat I was using at the time, even given seeing conditions were good, but not at their best. It would seem, as suggested by one selenographer in the past, that this crater chain, when visible, can be used as a means to assess the seeing conditions on a particular evening.

Several observers contributed observations to the Committee for Mapping the Surface of the Moon, appointed by the British Association for the Advancement of Science, under the guidance of W.R. Birt (1804-1881). Of the crater chain to the west of Müller Birt writes, 'On Sept. 22, 1864,…three were recorded, with a possible fourth. B&M [Beer and Mädler], give six and say in Der Mond, p. 346, "a row of six craters". 1865, Jan. 5, four are quoted by Mr. Freeman of Mentone, with two very small ones'. In 1866, Feb. 22 Birt found five.

Observing on December 7, 1864, T.W. Webb recorded, 'There are but four, or at most five craters in their [B&M's] row of six'. Further Webb writes 'I could readily count them but for the great agitation of the air; the S.W. one [now S.E.]…is the largest; they decrease somewhat towards Ptolemaeus'. Further he writes, '…the direction …is carried on by a furrow through the wall, and visible on its interior slope to the two subcraters on the S.W. side of [Müller]'. Hence this feature became known as 'Webbs Furrow'.

Due to the apparent discrepancies in the record of these small features, in the report to the Moon Mapping Committee of the B.A.A.S., 1868, Mr. Slack, suggested that the, 'crater row …should be regarded as a "test object" of the state of the earth's atmosphere, particularly with regard to definition; for example, if the craters, some of which are difficult, come out sharply and well defined, and can be seen distinctly and without tremor, the earth's atmosphere is in a good state for observation'. The suggestion was, by this method of first ascertaining the quality of the seeing, that if '…any neighboring objects are indistinct, hazy, and ill-defined, it may be inferred that such indistinctness is not occasioned by the state of the earth's atmosphere but is dependent on some other agency'.

Clearly the latter reason for observing the 'crater row' is reminiscent of the period in which the original report was written. Despite this the 'crater row' does still present a difficult feature to resolve fully in small to medium aperture telescopes, when the seeing conditions are anything but nearing perfect, and remains a good test of the state of the atmosphere and instrument.

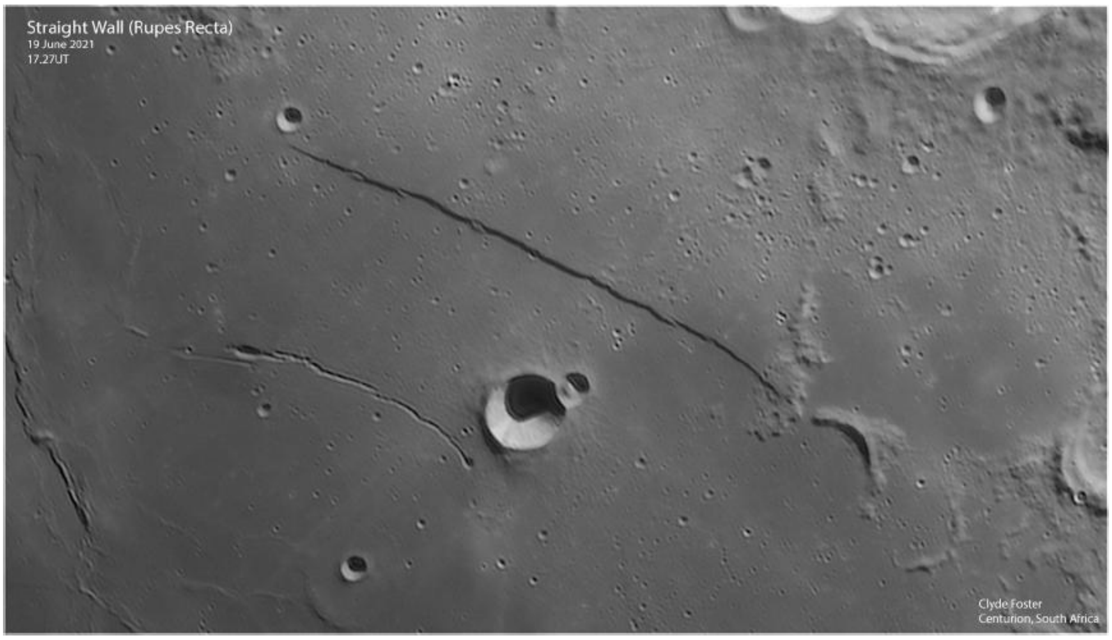
IMAGES GALLERY

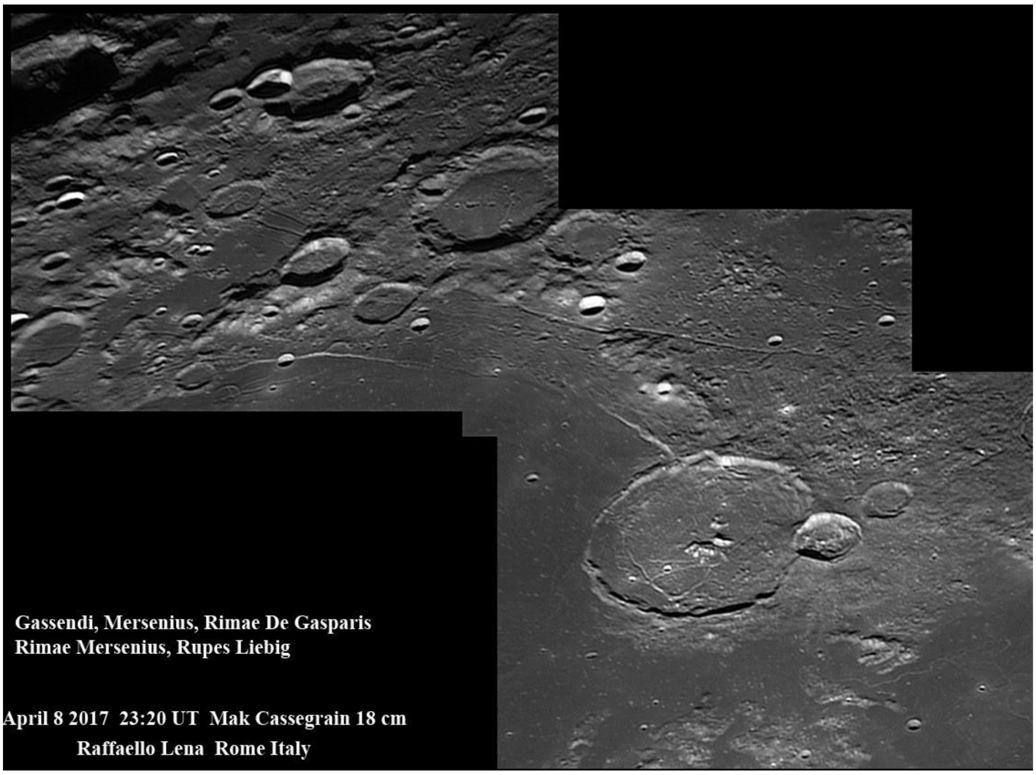
Alexander Vandenbohede is best known for his excellent images, often rectified, of the Moon's libration zones, and he has recently submitted some fine captures of the Orientale Basin. This month we feature two studies of features more prominently situated on the lunar disc – the ancient formation Deslandres and the spectacular Sirsalis Rille.

Deslandres

Rimae Sirsalis

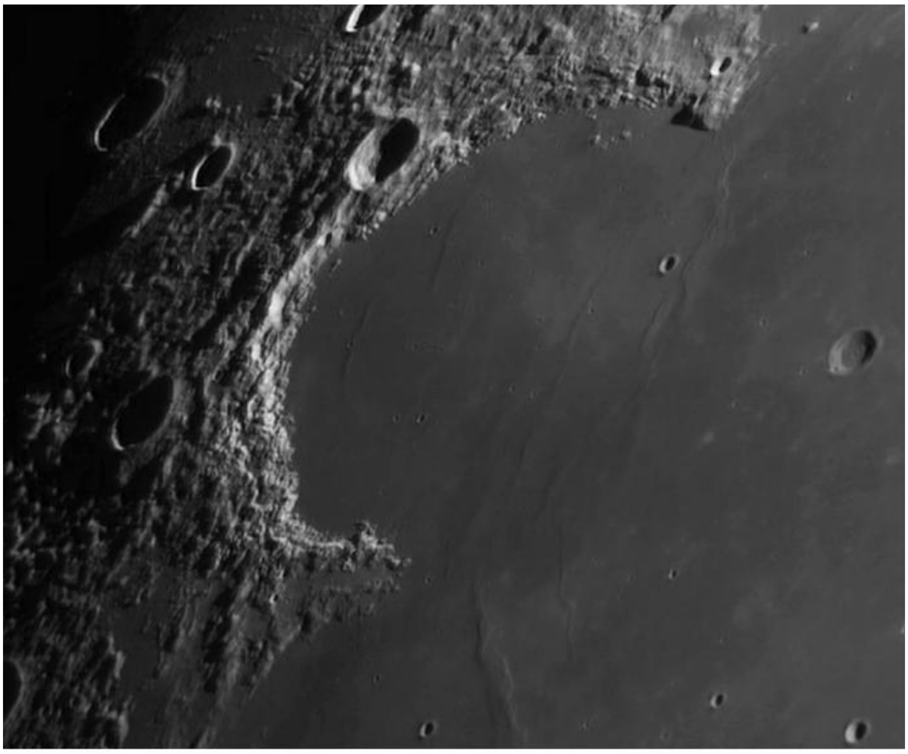

15-day Moon
2021 May 27
0907-0914UT
ETX-90 & QHY5III462C
Maurice Collins
Palmerston North, NZ


Straight Wall (Rupes Recta)
19 June 2021
17.27UT
Clyde Foster
Centurion, South Africa

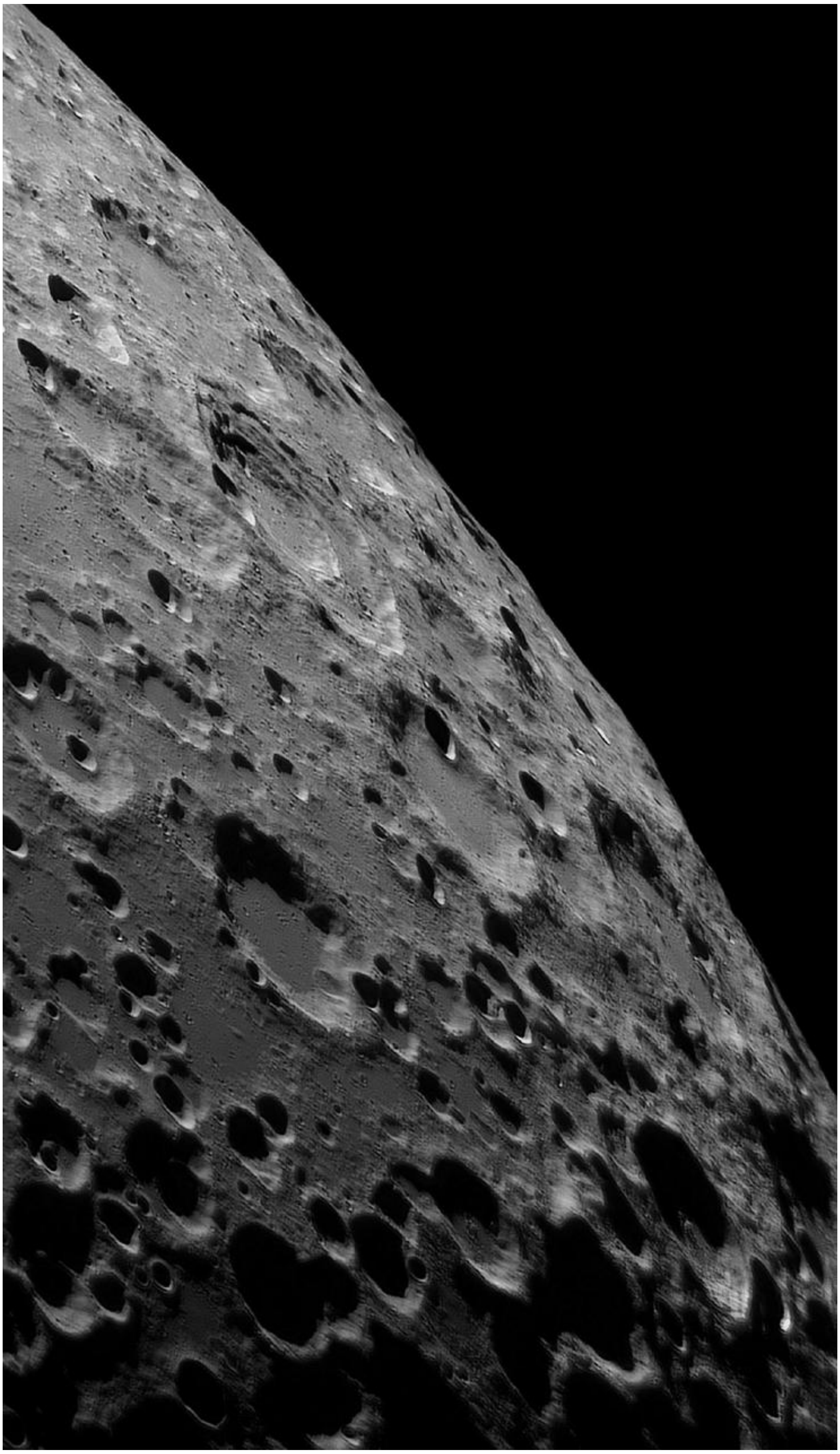


Gassendi, Mersenius, Rimae De Gasparis
Rimae Mersenius, Rupes Liebig

April 8 2017 23:20 UT Mak Cassegrain 18 cm
Raffaello Lena Rome Italy

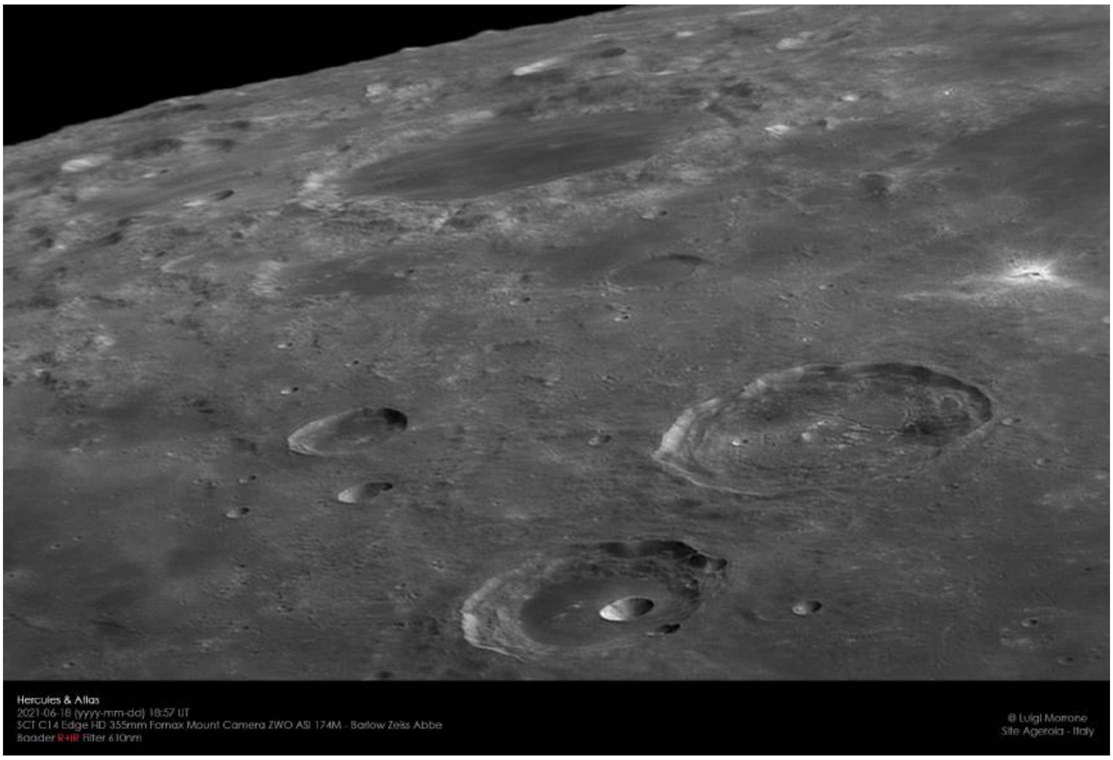


Sinus Iridum & Montes Jura 2021.05.22 - 20.10 UT
300mm Meade LX90, ASI 224MC Camera with Pro Planet 742nm
I-R Pass Filter. 1,000/4,000 Frames. Seeing: 7/10 with slight haze and
a little turbulence. Rod Lyon



Boussingault, 18 May 2021, 17-57 UT, C14 (Leo Aerts)


Archimedes
2021-06-18 (yyyy-mm-dd) 19:03 UT
SCT C14 Edge HD 355mm Fornax Mount Camera ZWO ASI 174M - Barlow Zeiss Abbe
Baader R+IR Filter 610nm
© Luigi Morrone
Site Agerola - Italy


Hercules & Atlas
2021-06-18 (yyyy-mm-dd) 18:57 UT
SCT C14 Edge HD 355mm Fornax Mount Camera ZWO ASI 174M - Barlow Zeiss Abbe
Baader R+IR Filter 610nm
© Luigi Morrone
Site Agerola - Italy

LUNAR DOMES (part XLIX): Dome north of Rhaeticus L

Raffaello Lena and Barry Fitz-Gerald

General overview

The examined dome is located to the north of Rhaeticus L in a bay along the southern shore of Sinus Medii, and within an area of low albedo, possibly pyroclastic deposits or with lavas of different composition (Fig. 1). These surface deposits overlie older volcanic deposits of an even lower albedo which have been exposed in the ejecta of two nearby Dark Halo Craters (DHCs).

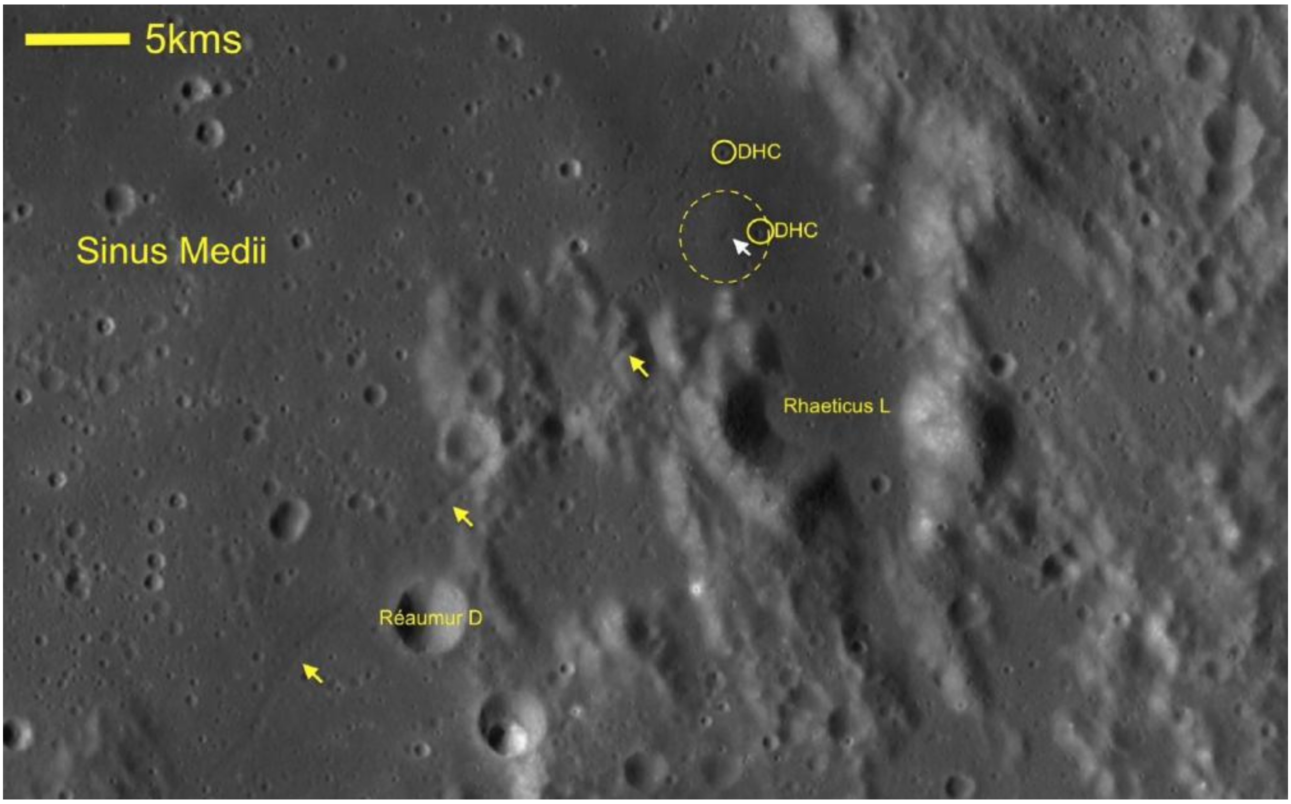


Figure 1: Location of the dome (yellow dashed circle) to the north of Rhaeticus L. The long axis of the rectangular summit crater or vent (white arrow) lines up with an indistinct graben that can be traced to the west (yellow arrows). Two Dark Halo Craters (DHCs) have excavated low albedo volcanic material from beneath the surface nearby.

The dome examined in the current study, which we name Rhaeticus1 (Rh1), has a summit crater or vent which is strongly rectangular in shape (Fig. 2) measuring some 800m by 400m and a depth of between 40m and 50m.

The long axis of the vent lines up with a partially infilled graben which can be traced to the west, passing just to the north of Réaumur D before becoming indistinct amongst the light plains to the north of Rima Oppolzer. There is a suggestion of an extension of this graben to the east, but it is very indistinct. The correspondence between the orientation of the vent and that of the graben indicates that the dome has formed as a result of effusive volcanic activity associated with a small section of this graben, and that this relationship accounts for the strangely geometric shape of the vent.

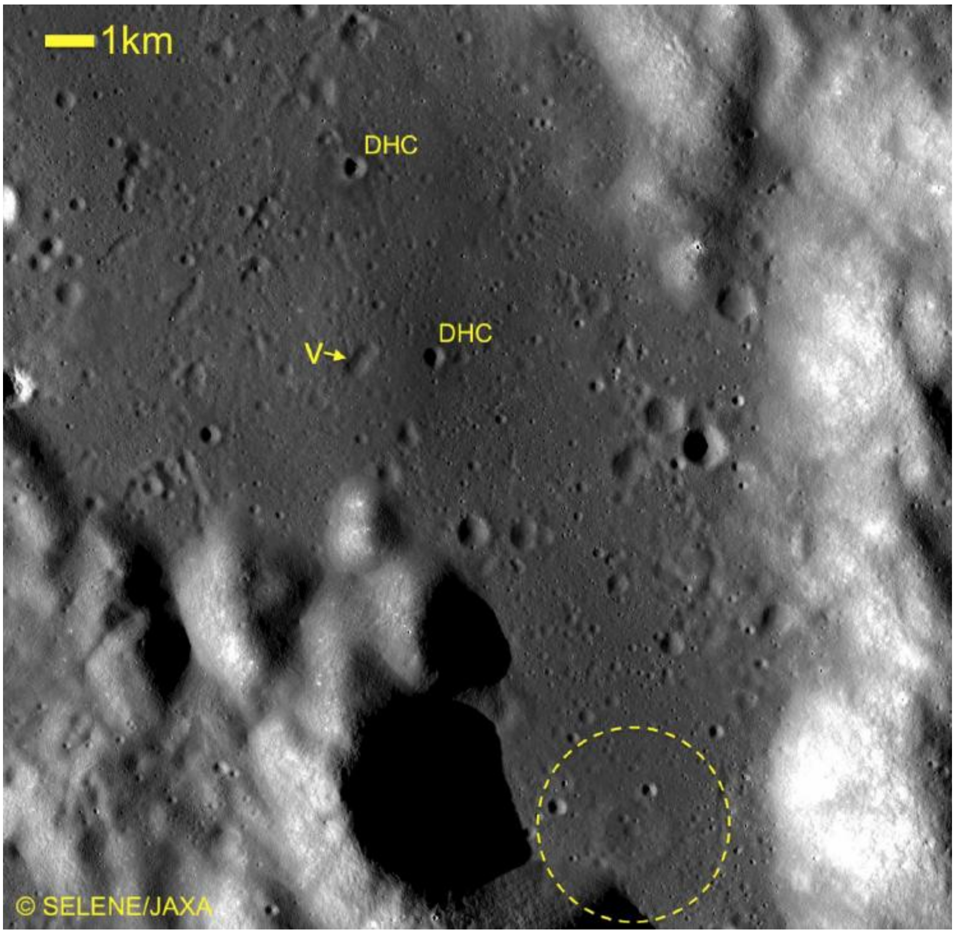


Figure 2: Detailed evening view from SELENE of the dome north of Rhaeticus L showing the rectangular summit vent (V) and dark halo craters (DHC) that have exposed older low albedo material in their ejecta. The yellow circle indicates an anomalous crater like structure on the southern floor of Rhaeticus L.

Ground-based observations

The region near the crater Rhaeticus, including the examined dome, is located to the south of Triesnecker (Fig. 3). The image was taken by Viladrich on September 9, 2020 at 04:14 UT using a 355 mm Schmidt Cassegrain telescope. This image was also used to derive the 3D reconstruction of the dome using shape from shading (SfS) approach applied to terrestrial telescopic images, as described below.

Morphology

The surface of the dome appears to be relatively lacking in any features that could be interpreted as volcanic in origin. The vent itself also appears featureless in high incidence illumination but under low incidence illumination a number of immature Irregular Mare Patches (iIMPs) are visible around the vent rim, particularly those parallel to the vent long axis (Fig. 4).

Immature Irregular Mare patches possibly represent the early stages in the formation of 'regular' IMPs, and are only readily detectable in LRO-NAC images taken under low incidence illumination. This may be a result of less vigorous outgassing compared to that which produces more conspicuous examples of IMPs. The vent axis corresponds to the orientation of the underlying graben, and more significantly the fractures on either side. The presence of these iIMPs is consistent therefore with the release of volcanic gas via the graben fractures and their surface expression on the dome summit.

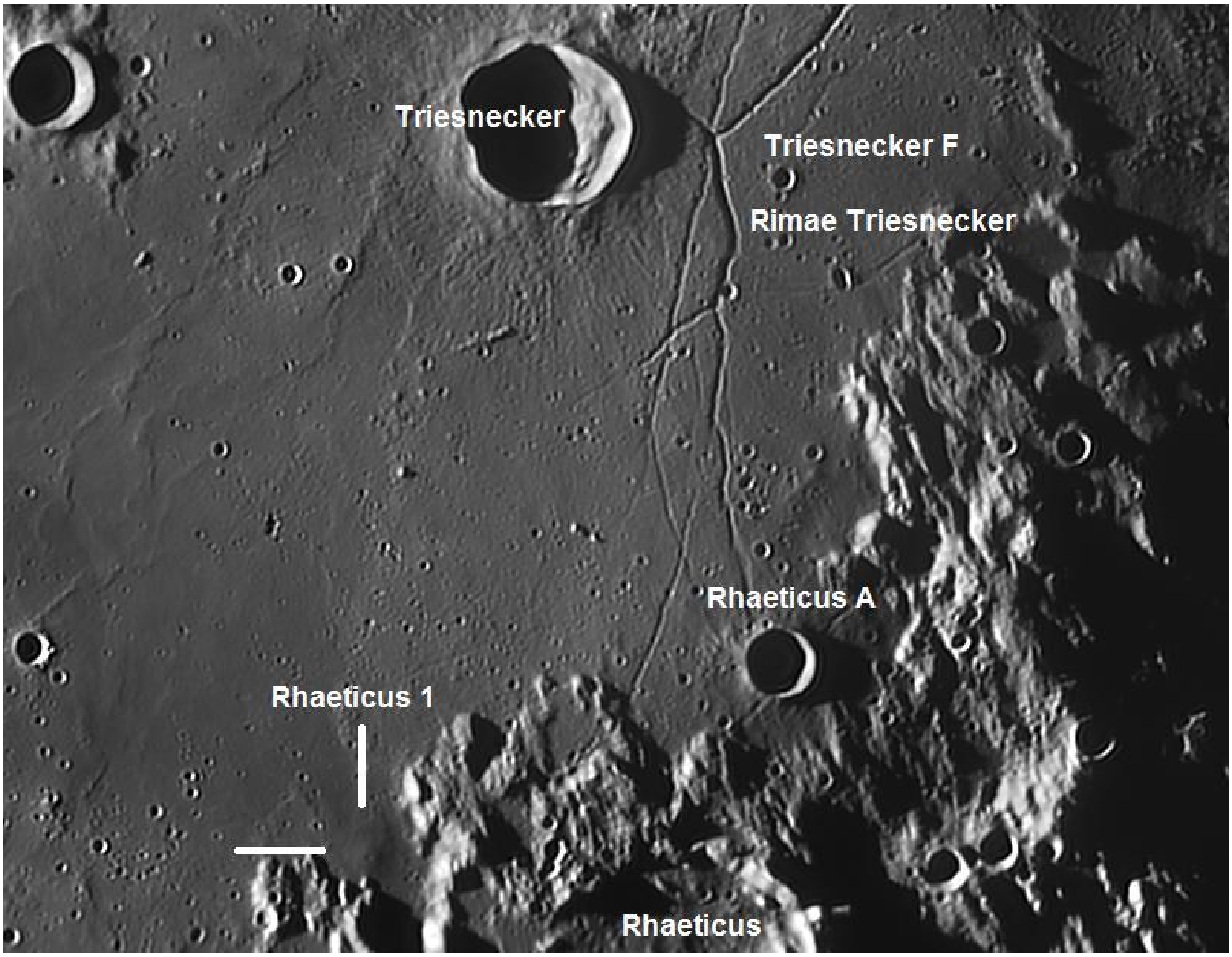


Figure 3: Image of the examined lunar region made by C. Viladrich on September 9, 2020 at 04:14 UT using a 355 mm Schmidt Cassegrain telescope. Crop of the original image. The dome is marked with white lines.

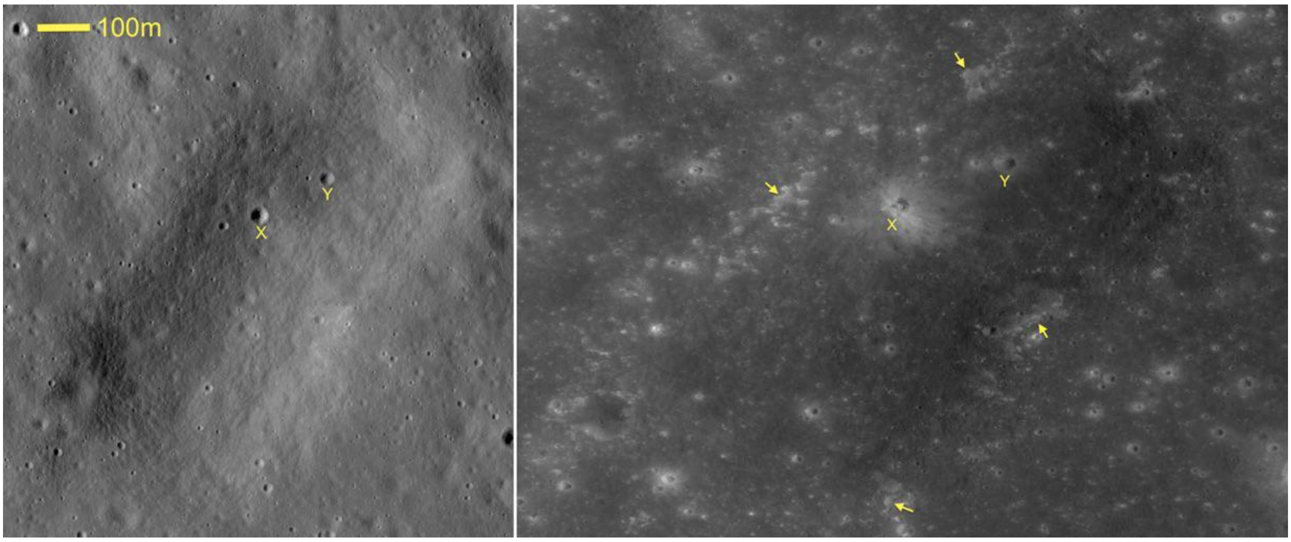


Figure 4: Left NAC image of the summit vent under high incidence illumination and right under low incidence illumination which reveals several patches of iIMPs (yellow arrows) particularly along the sides parallel to the vent long axis. Craters labelled X and Y in both images to allow correct orientation as each image is taken from a different viewing angle.

A further small field of iIMPs is located on the surface of the southern flank of the dome where it abuts the broken rim of Rhaeticus L, and in a small impact crater south of the main vent. These are only visible in low incidence illumination imagery, and their presence indicates that outgassing occurred over a wider area around this dome and not just at the summit vent.

The bay within which this dome is located is connected to Sinus Medii to the north by a channel some 9kms wide and 30m to 40m deep. This is visible as a low albedo strip running through the lighter more highly cratered light plains forming the southern shore of the Sinus.

This channel is conspicuous in the Quickmap Kagyuya FeO abundance mosaic overlay (Fig. 5) due to the elevated signature of the iron rich basalts compared to the light plains deposits either side. This would suggest that vents within this bay were the source of at least some of the basalts filling Sinus Medii, with the outflow from the bay being of sufficient volume and duration to produce an incised channel.

The level of the bay is some 140m above the level of Sinus Medii providing a gradient down which erupting lavas could flow northwards.

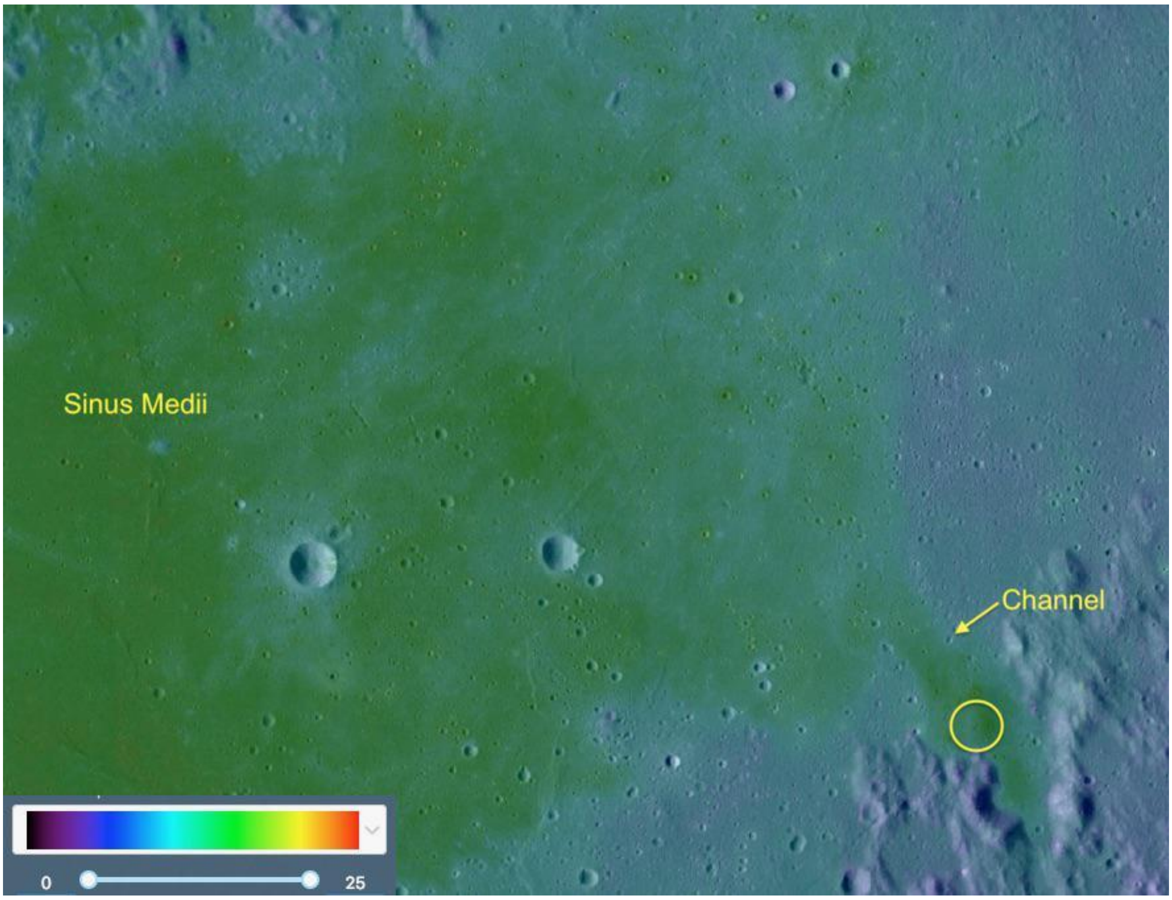


Figure 5: Quickmap Kagyuya FeO abundance mosaic overlay showing the dome location and the lava filled channel running north out of the bay and into Sinus Medii. The green indicates iron rich basalts.

Morphometric properties

The dome termed Rh1 is located at 3.29º E and 0.45º N, with a diameter of 5.5km ± 0.3km. The height is determined 80m ± 10m, yielding an average flank slope of 1.7° ± 0.1°. The dome edifice volume is determined to be 0.9km³ assuming a parabolic shape.

We have used ACT-REACT Quick Map tool with the LOLA DEM dataset to obtain the cross-sectional profiles for the examined dome (Fig. 6).

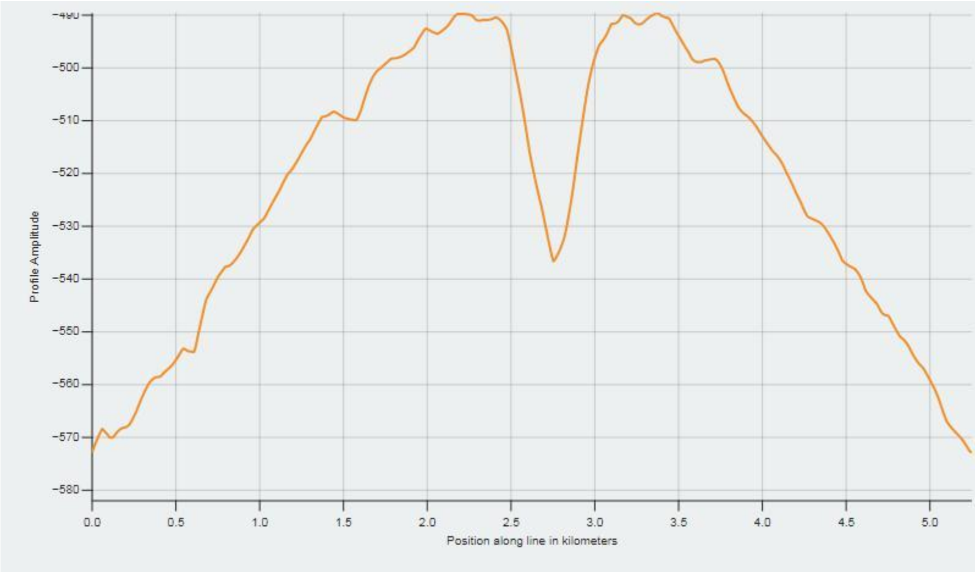


Figure 6: Cross sectional profile of Rhaeticus1 in E-W direction.

The corresponding 3D reconstructions based on GLD 100 dataset (Fig. 7) displays the central vent described above.

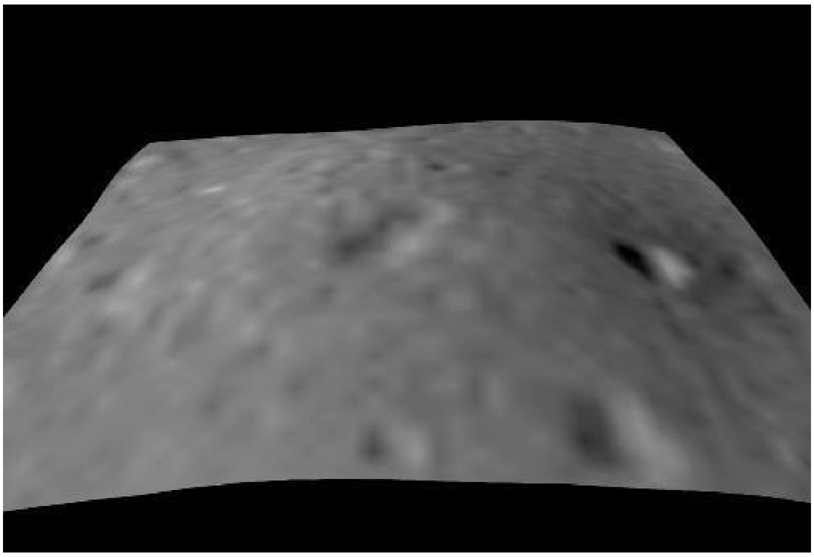


Figure 7: 3D reconstruction of Rhaeticus1, vertical axis is 7 times exaggerated.

The telescopic image shown in Fig. 3 was also used to derive an elevation map of the examined dome, obtaining a three-dimensional (3D) reconstruction. A well-known image-based method for 3D surface reconstruction is shape from shading (SfS). This technique makes use of the fact that surface parts inclined towards the light source appear brighter than surface parts inclined away from it. The SfS approach aims to derive the orientation of the surface at each image location by using a model of the reflectance properties of the surface and knowledge about the illumination conditions, finally leading to an elevation value for each image pixel (Horn, 1989; Lena et al., 2013).

The height h of a dome is obtained by measuring the altitude difference in the reconstructed 3D profile between the dome summit and the surrounding surface, considering the curvature of the lunar surface. The height of Rh1 amounts to 90m ± 10m, using the terrestrial telescopic image shown in Fig. 3. The average flank slope was determined according to: slope = arctan $2h/D$, with D the diameter in km.

The uncertainty results in a relative standard error of the dome height h of ±10 percent, which is independent of the height value itself. The dome diameter D can be measured at an accuracy of ± 5 percent. The 3D reconstruction of the dome Rh1 is shown in Figure 8.

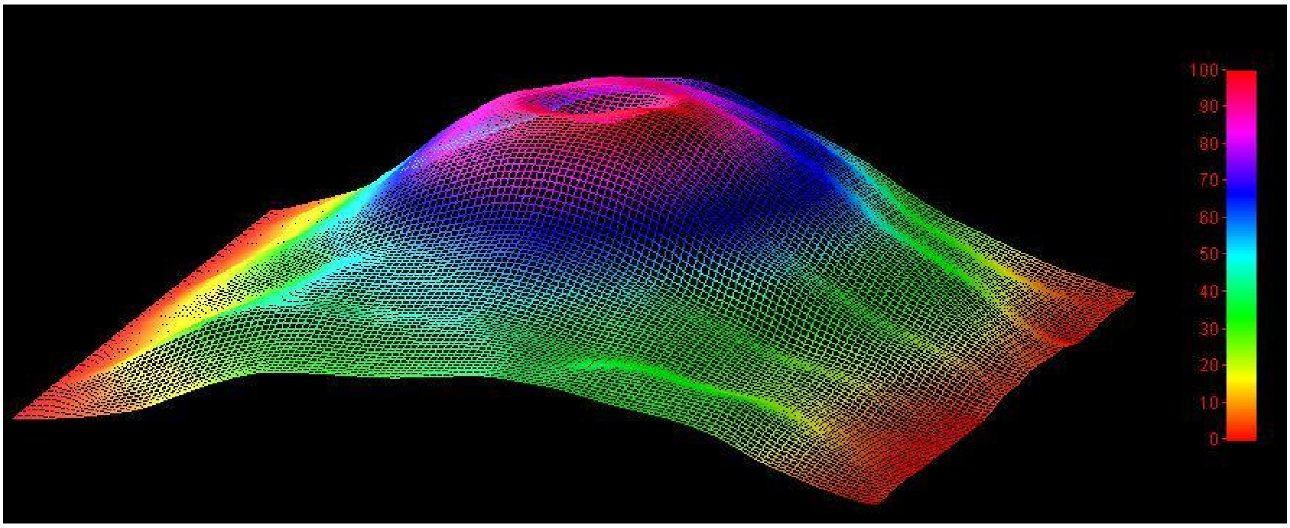


Figure 8: 3D reconstruction of Rhaeticus1, vertical axis is 30 times exaggerated.

The rheologic model yields an effusion rate of 95 $m^3 s^{-1}$ and a lava viscosity of 2.0 x 10^5 Pa s (Pascal seconds). It formed over a period of time of 0.4 years. According to the classification scheme for lunar domes (Lena et al., 2013) Rhaeticus1 belongs to class E_2.

Class E domes represent the smallest volcanic edifices formed by effusive mechanisms (diameter < 6km). In analogy to class B, the class E domes are subdivided into subclasses E_1 and E_2, denoting the steep-sided flank slope larger than 2° and the shallow edifices of this class, respectively (Lena et al., 2013).

The lava forming the dome ascended to the surface at quick speed of 4.5 x 10^{-5}m s^{-1}, through a dike of width of 21m and 97km long. Rh1 belongs to rheologic group R_1.
If we assume that the vertical extension of a dike is similar to its length, the magma which formed Rh1 originated well below the lunar crust, for which an average total thickness of 50km is given by Wieczorek et al. (2006).

Spectral data

The Clementine UVVIS spectral data indicate a low TiO_2 content with a color ratio R_{415}/R_{750} = 0.5938.

Analyses of the Diviner CF map for Rh1 reveals that it does not display the short wavelength CF position characterizes silica-rich lithologies like the Gruithuisen domes. The average CF position of Rh1 is 8.35 ± 0.05 µm; this value is not different from the average CF position of the typical basaltic *maria*, which is 8.30-8.40 µm. Hence, it displays a classic basaltic composition (Greenhagen, et al, 2010).

Spectral data have been obtained using Chandrayaan-1 Moon Mineralogy Mapper (M^3), an imaging reflectance spectrometer that can detect 85 channels between 460 and 3,000 nm. Data have been obtained through the M^3 calibration pipeline to produce reflectance with photometric and geometric corrections using image set taken during the optical period OP1B.

The spectra (Fig. 9) display a narrow trough around 1,000 nm with a minimum wavelength at 970-989 nm and an absorption band at 2,130 nm for Rh1 and 2,160 nm for the northern DHC, corresponding to a typical high-Ca pyroxene signature (Besse et al., 2014), indicating a basaltic composition. The Pyroxene is the major mafic mineral of basalt.

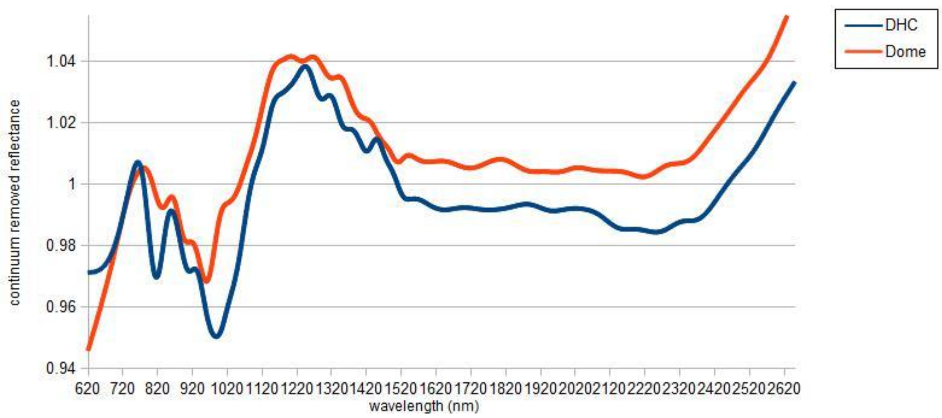


Figure 9: Chandrayaan-1 Moon Mineralogy Mapper, spectral analysis.

TiO_2 and FeO contents are estimated utilizing the Selene Multiband Imager (MI) data. MI is a high-resolution multispectral imaging instrument on board of Selene (Lemelin et al., 2016). It has five visible (VIS) bands (415 nm, 750 nm, 900 nm, 950 nm, and 1,000 nm) and four near-infrared bands (1,000 nm, 1,050 nm, 1,250 nm, and 1,550 nm). The VIS bands of MI have the same center wavelengths as those of the Clementine UV/VIS camera but have much higher spatial resolution (20 m/pixel) (Kodama et al., 2010).

The TiO_2 content of Rh1 is determined to be 2.3 wt %. The FeO content amounts to 14.1 wt %. For the northern DHC the TiO_2 and FeO content amount to 4.8 wt % and about 16 wt%, respectively.

Thus the DHCs expose basalts with higher FeO and TiO_2 content. These impacts have penetrated the upper soil and are exposing the underlying unit. According to the derived FeO and TiO_2 content, the main rock type of the examined dome is low-Ti basalt.

The presence of these subtle different Ti units indicates that the impact craters have excavated the upper soil exposing the older underlying unit with higher TiO_2 content. This relationship suggests that volcanism initially started with higher-Ti lavas evolving, in separate effusive episodes, toward lavas with lower titanium content.

A possible further vent can be seen on the southern floor of Rhaeticus L in the form of an anomalous raised crater like structure some 4kms in diameter (see Fig. 2). The height is undefined and GLD100 dataset and SLDEM 2015 display different values as shown in Fig. 10. Alternative explanations could be that this is a lunar cone or small dome. The Quickmap titanium oxide mineral overlay shows that the basalts that fill the bay and extend out into Sinus Medii appear to originate in the vicinity of this feature, which may suggest that it forms at least one of the source vents for the lavas which flowed northwards. In this scenario the feature would be considered possibly a small effusive dome having really a low height of only 30-40 m based on two topographic profiles of Fig. 10 and yielding an average slope of 1°.

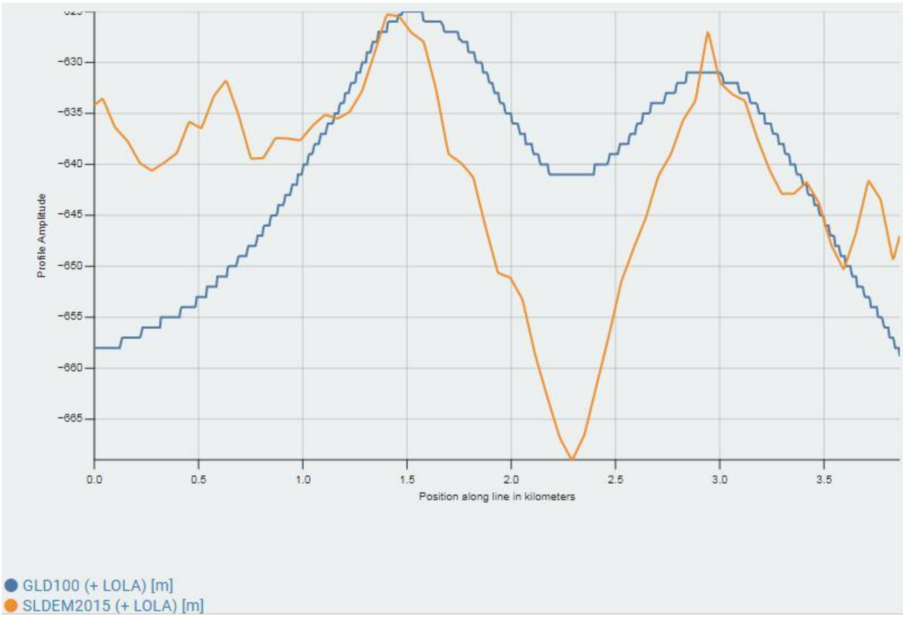


Figure 10: Topographic profile across the raised crater like structure.

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Lena, R. and Fitz-Gerald, B. 2021 BAA LSC. Lunar Domes (part XLVIII): Domes near Maskelyne region.

LUNAR LIMB PROFILE DURING THE PARTIAL SOLAR ECLIPSE, 10 JUNE 2021

***Note from Director**: Alexander Vandenbohede has put considerable effort into trying to identify irregularities in the lunar limb profile observed during the partial solar eclipse of 10 June 2021. He describes his approach and results as follows:*

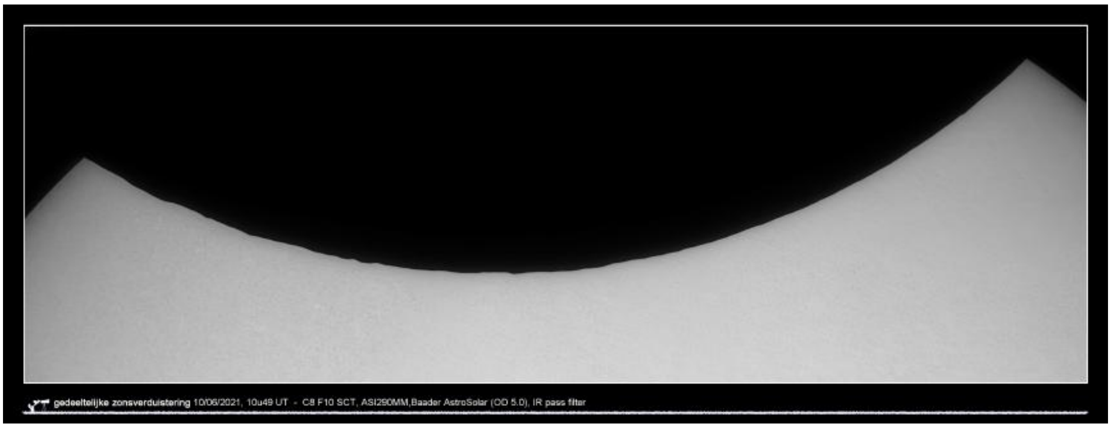
'During the partial eclipse on the 10th of June, I tried to image the lunar limb profile. With the ASI290MM, that was quite easy. The question then was: what was seen along the limb?

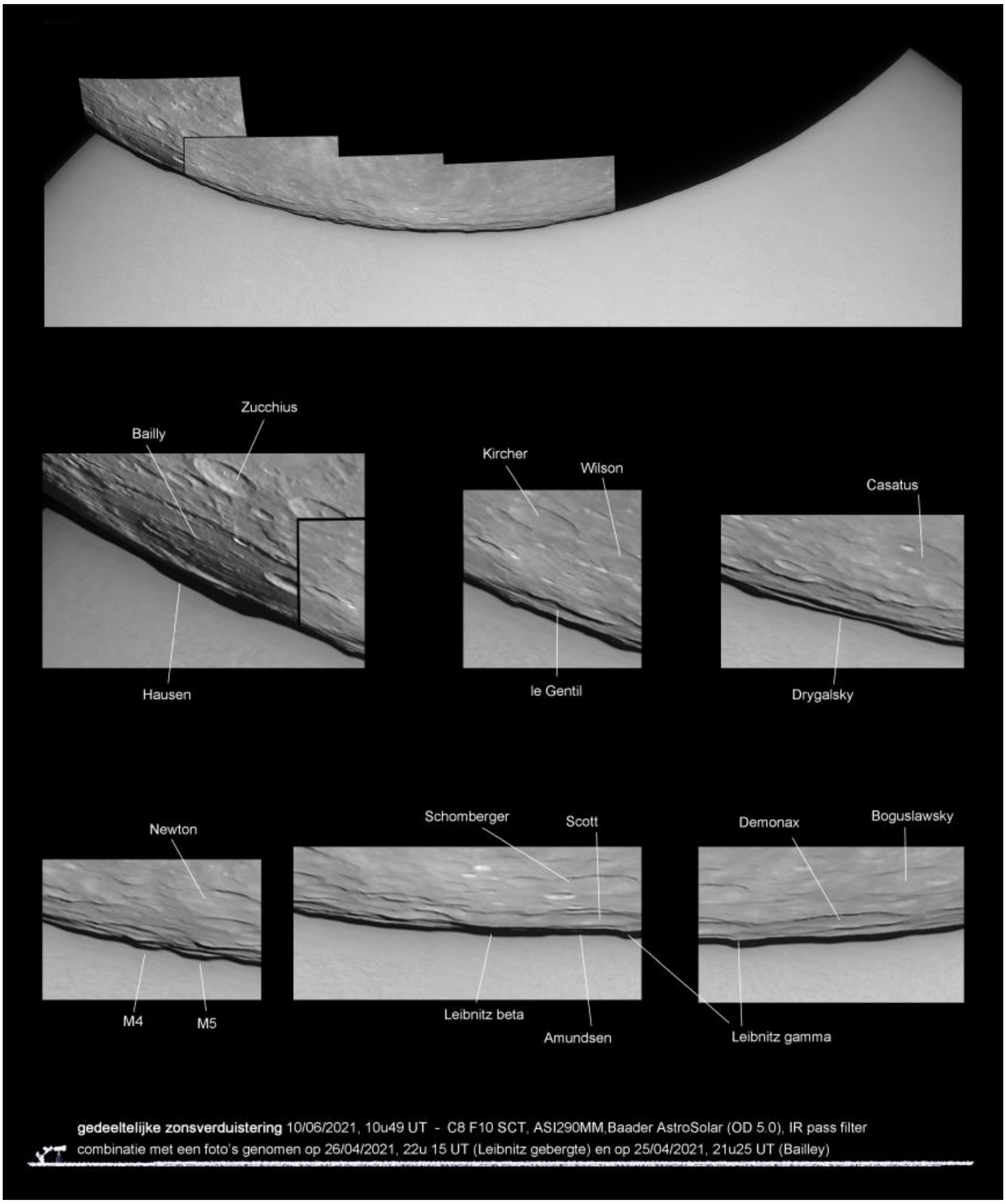
After searching for a predicted limb profile, I used an easier way. A planetarium program shows which part of the Moon was profiled against the Sun. During the second part of the eclipse, when most irregularities could be seen, this was the south pole region. So I took a past image of the south pole region, made under favorable libration conditions, and reprojected it (using LTVT) for the conditions on the 10th of June. I did the same with an image of the Bailly region. Then I compared these reprojected images with the limb profile photographed during the eclipse and there was an almost perfect match. Evidently, a number of peaks of the Leibnitz Mountains appear but also craters such as Drygalsky and Hausen can be identified.

Libration conditions during the eclipse were not the same as those when the reference pictures were taken. This means that a peak that is not profiled on the reference image will evidently not be profiled on the reprojected image. Where I indicated Leibnitz beta the limb profile shows a higher area but the reprojected image does not. However Leibnitz beta is clearly along the limb on the reprojected image but the libration is not favorable enough to clearly profile it. However, it is quite certain this area was seen along the limb during the eclipse.

The Bailly image was taken just before full moon. So it does not show the actual limb area which was still in shadow. However, the image clearly points to the area that causes the plateau seen during the eclipse. This is due to the crater Hausen and a higher area that connects with it.

During the first part of the eclipse, the southwestern limb area with the Orientale basin was profiled against the Sun. This is, however, a tougher nut to crack. The changes are quite small and subtle. There were some small slopes where the Southern part of the Montes Cordillera are expected. More to the north there where two peaks which are part of the Montes Rook (I think the Inner Montes Rook).





LUNAR OCCULTATIONS **July 2021** Tim Haymes

Time capsule: 50 years ago in the LSC July 1971 issue

[With thanks to *Stuart Morris* for the LSC archives. https://britastro.org/downloads/10167]

- Mr Daly: An Index to LSC Vol. 4 was compiled.
- P Moore writes on TLPs and how to observe them.

- No reports of Lunar Occultations.

Reports Received

It would appear that June 2021 wasn’t a good month for observing lunar occultations either (cf. 1971 June). No observations have been received and I cannot supplement this with my own. The only exception was perhaps the partial occultation of the Sun on the 10th.

First contact was clouded out so I couldn’t time it, but as the Moon encroached on the solar disk, I could see the lunar relief in places quite clearly.

The instrument was an 80mm F/5 refractor, Lunt Herschel Wedge with continuum filter, and a 12mm eyepiece.

Planetary Occulations 2022 to 2030 (UK and Europe

It seems a while since we were treated to an occultation of a planet. So I did a search with Occult-4 which I summarise below. The list includes events regardless of their ease of observation. Information is provided as a guide, since the circumstances will differ depending on the observer’s location. Those in bold type are potentially photogenic. My apologies in advance if there are transcription errors in this list from Occult-4 and SkyMap Pro which was used to obtain an indication of visibility.

* = at Long/Lat 001W/52N

Venus

Date	UT	Alt/Az*	Visibility	
2023 Nov 09	**1000**	**37/197**	**DB* 0949, RD* 1044UT**	Daylight
2024 Apr 07	1730	0/270	Ireland only?	
2025 Sep 19	**1200**	**41/228**	**DB* 1152, RD* 1311UT**	Daylight
2026 Sep 14	1000	05/120	RB* 1035UT	

Mars

Date	UT	Alt/Az	Visibility
2022 Dec 08	**0500**	**28/275**	**at Full Moon**
2024 Dec 18	1000	7/290	RD* 1016UT
2025 Feb 09	1900	43/111	S limit Graze in Lat 58/59N

Jupiter

Date	UT	Alt/Az	Visibility
2023 May 17 (Daylight)	1400	29/249	S Limit Graze in Lat 56/57N

Saturn

Date	UT	Alt/Az	Visibility
2024 Aug 21	0400	20/225	RD* ca 0418UT
2025 Jan 04	**1700**	**25/208**	**DD* ca 1722UT (6.7mag star nearby)**

Uranus

Date	UT	Alt/Az	Visibility
2022 Jul 22	0600	- / -	N Limit Graze Europe (Not UK)
2022 Sep 14	**2200**	**20/087**	**RD* ca 2220UT**

2022 Oct 12 0600	- / -	Scandinavia
2022 Dec 05 1700	20/089	Near CA 10N in the UK
2023 Jan 01 2300	42/235	S limit Graze across England

Neptune

Date	UT	Alt/Az	Visibility
2024 Jun 28	1000	10/253	Daylight
2024 Aug 21	2200	- / -	E Europe (not UK)
2025 Jan 05	1400	24/129	Daylight

Occultation predictions for North Oxfordshire in 2021 July

E. Longitude - 1 18 46 , Latitude 51 55 41, Alt. 119m; Moon Alt>5 degrees
Some fainter predictions are omitted near Full Moon.

y	m	day d	Time h	m	s	P	Star No	Sp	Mag v	Mag r	% ill	Elon	Sun Alt	Moon Alt	Moon Az	CA	Notes
21	Jul	2	2	44	41.0	R	129029	K4	7.9	7.2	48-	87	-8	21	120	33S	
21	Jul	3	0	54	36.9	R	109997	K0	8.7	8.2	39-	77		4	86	80N	
21	Jul	4	1	35	19.5	R	344	G5	8.4	7.7	29-	66		7	83	82S	
21	Jul	4	2	56	32.9	DB	354	B7	5.5	5.5	29-	65	-7	20	98	-63N	24 Ari Dbl*
21	Jul	4	3	14		R	H11194	K0	7.1		28-		-5	22	101	45S	Personal
21	Jul	5	1	59	30.1	R	93279	F5	8.8	8.6	21-	54	-12	9	77	48N	
21	Jul	6	2	27	30.5	R	93661	K5	8.2	7.2	14-	43	-10	9	71	75N	
21	Jul	6	2	47	17.3	R	93670	F5	7.8	7.5	14-	43	-8	12	75	82S	
21	Jul	7	2	52	19.8	R	76733	A2	8.3	8.2	8-	32	-8	8	66	78S	
21	Jul	13	21	58	14.5	R	99250	M0	8.7	7.9	15+	46	-11	4	285	85N	
21	Jul	14	21	27	32.4	D	1669	F5	6.7*	6.5	23+	58	-8	12	267	40S	
21	Jul	17	22	2	9.3	D	2010	F0	8.7	8.5	55+	96	-12	13	235	76N	
21	Jul	18	22	22	18.2	D	158903	G0	8.0	7.7	67+	110		11	226	82S	
21	Jul	19	22	27	20.9	D	2267	B3	5.0	5.0	77+	123		12	213	29N	lambda Lib
21	Jul	25	2	31	1.4	R	190165	K0	7.2	6.7	99-	166		14	200	42S	
21	Jul	26	0	27	23.5	R	164871	K0	8.7	8.2	95-	154		18	157	59S	
21	Jul	26	0	45	36.7	R	3242	G1	7.8	7.6	95-	154		19	162	70S	
21	Jul	27	0	2	45.9	R	3374	K3	6.1	5.4	90-	142		16	138	58S	
21	Jul	27	1	11	8.8	R	165437	K2	8.8	8.2	89-	142		22	154	69S	
21	Jul	27	3	8	41.1	R	165471	G5	8.9	8.5	89-	141	-9	26	185	85N	
21	Jul	27	3	32	15.2	R	3387	K0	8.2	7.6	89-	141	-7	26	191	81N	
21	Jul	28	3	30	37.3	R	3516	K0	8.4	7.7	81-	129	-7	32	179	47N	
21	Jul	30	0	9	2.5	R	109805	K0	7.5*	6.9	65-	107		14	103	90S	
21	Jul	30	1	42	50.9	R	198	G5	8.6*	8.3	64-	106		27	123	49S	
21	Jul	31	0	13	49.3	R	110318	G5	8.8	8.4	55-	96		13	92	34N	
21	Jul	31	2	24	39.6	R	110353	F5	7.8*	7.6	54-	95		32	119	72S	
21	Jul	31	2	42	6.0	R	315	A0	7.3*	7.3	54-	95		34	124	51S	Dbl*
21	Aug	1	0	5	56.4	R	93122	K2	8.8	8.3	45-	85		9	80	76S	
21	Aug	1	1	3	42.4	R	93135	K0	8.3*	7.6	45-	84		18	90	55N	
21	Aug	1	1	41	14.2	R	93145	K0	8.9	8.3	45-	84		23	98	77N	
21	Aug	2	1	54	45.8	R X	4678	A5	8.9	8.8	35-	73		22	89	85N	
21	Aug	3	2	1	16.5	R	76611	G5	8.6	8.2	27-	62		19	79	80N	
21	Aug	3	2	26	53.9	R	76624	K0	8.8	8.4	26-	62		22	84	32S	
21	Aug	3	3	16	50.7	R	76632	A0	8.6	8.5	26-	61	-10	30	93	37S	
21	Aug	5	1	15	19.5	R X	83542		8.5	7.9	12-	40		2	51	49S	
21	Aug	5	1	15	21.7	R	78038	G0	7.4	6.8	12-	40		2	51	21S	
21	Aug	5	1	30	28.1	R	78040	A0	8.6	8.6	12-	40		4	54	64S	
21	Aug	5	1	31	8.3	R X	8430	B8	8.8	8.8	12-	40		4	54	73S	
21	Aug	5	2	9	45.1	R	78069	B9	8.6	8.7	12-	40		9	61	57N	
21	Aug	5	2	34	2.2	R	78091	K0	8.8	8.1	12-	40		12	65	73S	
21	Aug	5	2	46	45.4	R	78100	K0	8.9	8.3	11-	40		14	67	60N	
21	Aug	5	3	14	54.4	R	78118	K0	8.5	7.8	11-	39	-11	18	72	47S	
21	Aug	6	2	37	13.9	R	79054	K8	6.9	6.1	6-	28		6	56	79S	
21	Aug	6	3	31	37.2	R	79098	K5	8.7	7.9	6-	28	-9	13	66	78N	

Notes on the Double Star selection:
Doubles are selected from Occult4, 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.** Additional predictions are available from OccultWatcher software.

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.
H denotes the HIPparchus 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. Ask the **Occultation Subsection Coordinator:** tvh dot observatory at btinternet dot com

LUNAR GEOLOGICAL CHANGE DETECTION PROGRAMME

Tony Cook

Introduction: The set of observations received in the past month has been divided into three sections: Level 1 is a confirmation of observations 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 TLP reports were received in May, but I would like to highlight an observation by Jay Albert, who noticed two very dark spots in Atlas on 2021 May 24 (See Fig. 1). Of course, this is not a TLP, as was immediately realized by Jay, but I just thought I ought to mention it to prevent less experienced observers sometime in the future wrongly assuming that there was something unusual about the appearance of the floor of Atlas. Anyway, for those who are curious, these appear to be volcanic related features in LROC images.

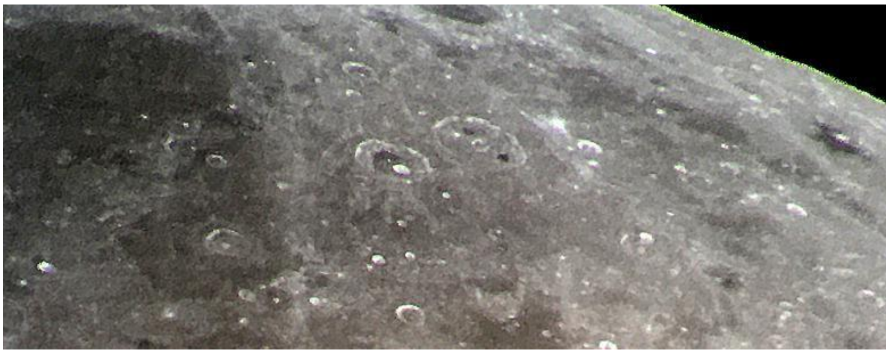


Figure 1. *Atlas and Hercules as imaged by Jay Albert on 2021 May 24 UT 02:16, taken with a camera phone placed up against the eyepiece and orientated with north towards the top.*

Level 1 – Reports received for May included: Jay Albert (Lake Worth, FL, USA - ALPO) observed: Aristarchus, Atlas, Gassendi, Herodotus, Mare Serenitatis, Piazzi Smyth, and Tycho. Maurice Collins (New Zealand – ALPO/BAA/RASNZ) imaged: the lunar eclipse and several features. Anthony Cook (Newtown, UK – ALPO/BAA) obtained video of earthshine in monochrome, and the lunar surface in thermal IR. Chris Dole (Newbury, UK – BAA) imaged: Lichtenberg. Walter Elias (Argentina – AEA) imaged: Deseilligny. Valerio Fontani (Italy – UAI) imaged: Lichtenberg. Les Fry (West Wales, UK – NAS) imaged: Aristarchus, Bettinus, Gassendi, Harpalus, and Schickard. Kris Fry (West Wales, UK – NAS) imaged the Moon. Rik Hill (Tucson, AZ, USA – ALPO/BAA) imaged: Aristotles/Eudoxus, Ina, Rimae Aridaeus, and Sulpicius Gallus. Leandro Sid (Argentina – AEA) imaged: Aristarchus, Gassendi, and Herodotus. Trevor Smith (Codnor, UK – BAA) observed: Aristarchus, Plato, Proclus, and several features. Luigi Zanatta (Italy – UAI) imaged Eudoxus.

Level 2 – Example Observations Received:
Eudoxus: On May 17 UT19:34 Luigi Zanatta (UAI) imaged this crater for the following lunar schedule request:

BAA Request: Eudoxus - please try to image the shadow filled interior of this crater. We are trying to explain an observation from Meudon Observatory in France made in 1881 for which we don't have the precise UT for. You may or may not need to over-expose the image - it is not clear from the original report whether it was faint light inside the shadow filled interior, or sunlit highland emerging from the shadow? Please send any images to: a t c @ a b e r . a c. u k .

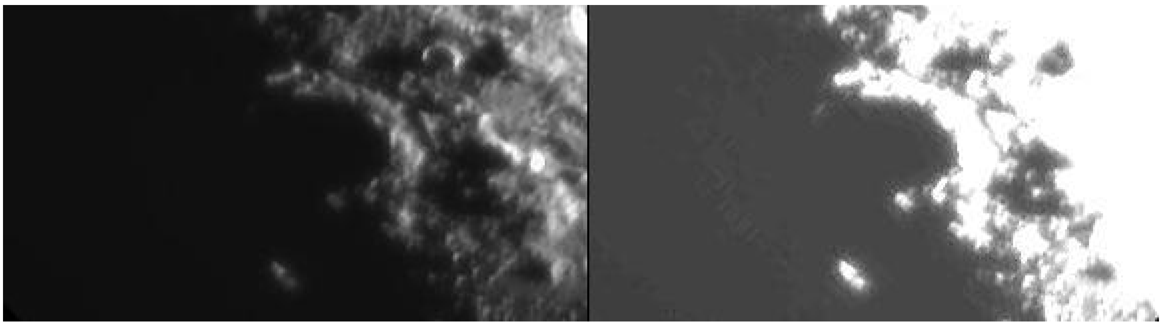


Figure 2. *Eudoxus as imaged by Luigi Zanatta on 2021 May 17 UT 19:34 and orientated with north towards the top.* ***(Left)*** *Original image.* ***(Right)*** *Contrast stretched.*

This lunar schedule request refers to 1881 May 04 – estimated time 20:00UT. Sunset at Meudon was at 19:14UT (Moon at 47° altitude) and moonset by effectively midnight, so the 20:00UT estimate does not seem unreasonable. In an email from Nigel Longshaw that I received on 5th May, he says that Trouvelot's observation refers to an observation he made on 5/4/1881 (no time given) in connection with Eudoxus where he saw a *'…bright in the shadow of the crater, a point a little elongated from N to S, exactly on the place where the western extremity of the bright line was seen in 1877'*. We have covered this observation before in the 2020 Sep, 2021 Feb, Mar, and Apr newsletters. The bright line seen in 1877 refers to a line on the northern inner rim, which was covered in Nigel Longshaw's BAA paper (*JBAA*, 117, 4 (2007)). As you can see from Luigi's image (Fig. 2), there is nothing unusual inside the shadowed area. We shall leave the weight of the original observation at 3 for now.

Deseilligny: On May 17 UT21:14 Walter Elias (AEA) imaged this crater under similar illumination to the following report:

Near Deseilligny in Mare Serenitatis (29E, 25N) 1971 Feb 01 UT 19:40-20:15 Observed by Persson (Hvidore, Denmark, 2.5" refractor, x100, S=G) "Obscur. (blurred & dark) starting between Plinius & Menelaus moving towards Posidonius. Normal after 2 min. A little crater (white spot) periodically disappeared for several secs regularly every few min. There was haze above only this spot. A tiny crater SE of it was invis. till 2015h then became clear & steady. Colour was reddish-brown. Drawing. (Apollo 14 watch)." NASA catalog weight=2. NASA catalog ID 1293. ALPO/BAA weight=1.

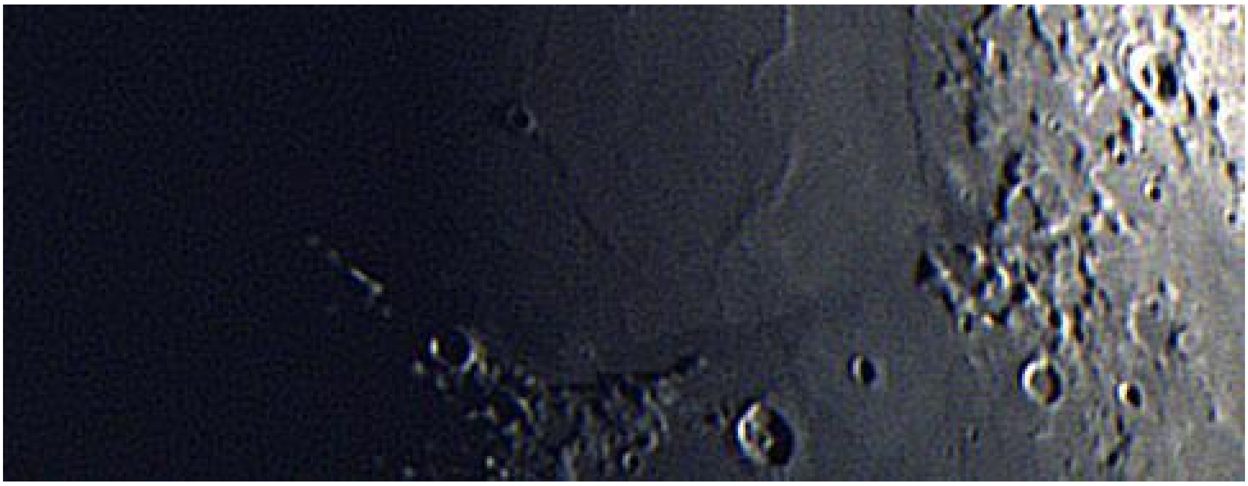


Figure 3*. Southern Mare Serenitatis, as imaged by Walter Elias (AEA) on 2021 May 25 UT 21:14 and orientated with north towards the top. The image has been colour normalized and then had its colour saturation increased to 35%.*

Deselligny is a small crater, just under 7km in diameter, and is barely visible against the image noise in the contrast stretched version of Walter's image (Fig. 3). The wrinkle ridges on the floor of Mare Serenitatis are plainly visible, however, which imply that no obscuration was present when Walter took this image. So what was observed in 1971 must have been unusual, I note however that although the seeing was good for the Danish astronomer concerned, a relatively small aperture of 2.5" was being used.

Aristarchus: On 2021 May 22 UT 22:47-23:05 Trevor Smith (BAA) observed visually the following repeat illumination/topocentric libration observation:

On 1980 Jul 23 at UT22:00 G.W. Amery (Reading, UK, 8" reflector, x144 and x207, seeing=III-V and transparency=fair) found that the interior shadow was a light grey. BAA TLP coordinator (Foley) *suggests that this was light reflecting from the illuminated walls? Cameron 2006 catalog TLP ID=102 and weight=1. ALPO/BAA weight=2.*

As Trevor's observation was both repeat illumination and repeat topocentric libration, then this made it especially useful in testing out Foley's suggestion: that the shadow was grey because of light reflecting off the craters walls and illuminating the shadowed floor, and hence why it was not jet black. The tolerance for these repeat illumination/viewing parameters was ±1.0°, and although the Sun is only 0.5°in diameter, the walls of the crater aren't anywhere near mirror like, so we can expect a bit of scatter and the tolerance to be not as precise as this.

Trevor noted that 'The crater was right on the rim of the terminator tonight and the interior shadow looked to me to be jet black and no hint of grey was seen.' He looked again at 23:45 and the shadow was still jet black, despite his seeing being IV and transparency poor. So whatever Geoff Amery saw in 1980 appears to have been unusual. I think we shall leave the ALPO/BAA weight at 2 for now will but consider raising it to 3 in future once we have more observations.

Aristarchus and Herodotus: On 2021 May 24 UT 02:30-02:55 Jay Albert observed (and took one image) and between 02:27-02:50 Leandro Sid (AEA) imaged these craters under similar illumination to the following 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.

Cobra Head 1966 May 02 UT 20:05 Observed by Sartory (England, 8.5" reflector x400) "Eng. moon blink detected red spots, seen visually also". NASA catalog weight=4 (good). NASA catalog ID #934. ALPO/BAA weight=3.

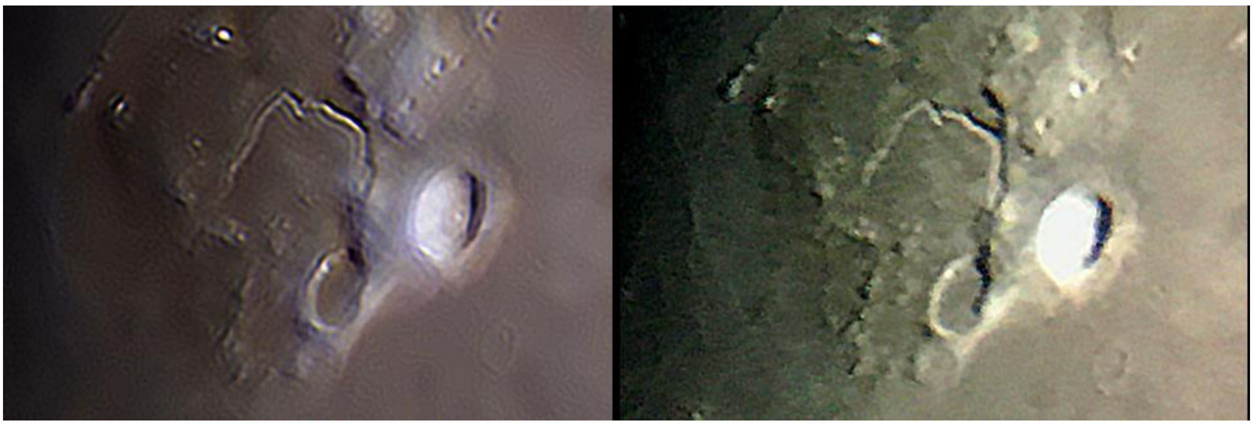


Figure 4. *Aristarchus as imaged on 2021 May 24 with colour saturation increased to 30% and orientated with north towards the top.* ***(Left)*** *Image taken by Leandro Sid (AEA) at 02:27UT.* ***(Right)*** *Camera phone image by Jay Albert (ALPO) taken at 02:51UT.*

Jay Albert observed visually and had a good view of the entire Aristarchus Plateau. He noted that Herodotus showed a flat, smooth gray floor with a sunlit W wall and black shadow along the interior E wall. There was no sign of any red, rose or any other colour seen (We have covered this before in the 2015 Jun and 2021 Jan newsletters). For the Cobra Head TLP (We have covered this before in the 2020 Mar newsletter), there was no sign of red spots, despite checking visually with Kodak Wratten 25 and 44A filters. The images that Leandro and Jay took (Fig. 4) have been colour enhanced slightly, and also show no obvious signs of colour where this was described in the original reports, although natural colours are showing up. We shall leave the weights as they are for now.

Lunar Eclipse: On 2021 May 26 UT 09:42-11:40 Maurice Collins obtained some images of the eclipse which were taken under similar illumination to the following reports:

1685-12-10 Bianchini saw a red streak seen on floor of Plato during an eclipse. The Cameron 1978 catalog assigns a TLP ID of 14 and a weight of 1. The ALPO/BAA catalog assigns a weight of 1 too.

Copernicus observed by Beccaria on 1772-10-11. Bright spot (4th magnitude) seen on eclipsed Moon and glimmering specks. Seen by nephew and niece of Beccaria. Cameron 1978 catalog weight=4. ALPO/BAA catalog weight=2.

In 1790 Oct 22/23 at UT 23:00-02:00 W. Herschel (Windsor, UK) observed during a total lunar eclipse at least 200 small, round (spots?). The Cameron 1978 catalog ID=69 and weight=4. The ALPO/BAA weight=1.

On 1889 Jul 12 at 20:52-21:00UT, Kruger of Gotha? or Kiel? Germany, using a 6" reflector (x33), saw a brilliant Aristarchus in the surrounding gloom during an eclipse. The brilliance was striking. Cameron 1978 catalog ID=263 and weight=2.

On 1910 Nov 16/17 UT 22:50-00:10 Albright (Edge(b?)aston, England, UK) observed in Stofler crater "A luminous pt. on Moon dur. ecl. (mid-ecl 0025) Others saw a meteor on moon from widely separated places". The Cameron 1978 catalog ID=333 and the weight=3. The ALPO/BAA weight=3.

On 1967 Apr 24 at UT 11:47-12:08 Osawa (Hyogo, Japan, 6" reflector, x50) observed during totality, two luminescent spots (started 20 min after beginning of totality) near Grimaldi. Location not certain because of dimness of umbral shadow and lunar features. (Bright spots in Sven Hedin?). Colour was bluish rather than yellowish and magnitude < 9. The Cameron 1978 catalog ID=1035 and weight=3. The ALPO/BAA weight=2.

On 1982 Jan 09 at UT21:37 P. Moore? (Selsey, UK) observed that Copernicus was brighter than or equal to Aristarchus. However, this was during a total eclipse of the Moon. Cameron 2006 catalog ID=162 and weight=5. ALPO/BAA weight=2.

On 1985 May 04/05 at UT19:52-00:30 during the lunar eclipse V.V. Kurchin (Volgograd, Russia, 2" reflector, x88) found that Alphonsus was abnormally bright - as were a few other features. Cameron 2006 catalog ID=270 and weight=2. ALPO/BAA weight=1.

Plato. On 1989 Feb 20 at UT 16:55 G. Kolovos (Thessaloniki, Greece) photographed in one photograph (out of 3) during a lunar eclipse, some bright patches below (south?) of the crater that were not in the other photographs (UT16:56:32 or 16:58:56). Foley commented that the photographs were grainy so cannot tell for sure. The Cameron 2006 catalog ID=356 and the weight=1. The ALPO/BAA weight=1.

Figure 5. *The total lunar eclipse as imaged by Maurice Collins (ALPO/BAA?RASNZ) and orientated with north towards the top. Taken on 2021 May 26 UT 11:25, or 5 minutes after mid eclipse.*

Lunar eclipses are well renowned for TLPs. Why is a different matter. Yes, the Moon is going through the centre of the Earth's magnetotail, so for the brief duration of the eclipse, the hot charged plasma (in particular electrons) it contains slam into the surface. Unlike under normal passages through the magnetotail (±3 days either side of Full Moon), where the UV from the Sun dissipates charging, during an eclipse the UV is cut off, so dust particles can become charged, repel and levitate. So in theory you could have extremely tenuous dust layers above the surface during a lunar eclipse. Also, you can have massive temperature swings from +120°C down to -30°C in just a few minutes, so the thermal stress can potentially crack some rocks. However how these translate into TLP is a completely different matter and not at all proven yet. More likely, the darkness of the eclipse, image noise, and unfamiliarity of some observers with the surface bathed in an orange to deep red/brown colour, no doubt cause many observational misinterpretations of what they were looking at. Listed above are just some of the TLP accounts that have occurred in the past during eclipses, under similar illumination.

For the 1685 report, I see no sign of a red streak on the floor of Plato in Fig. 5. Likewise for the 1782 report, Copernicus does not look especially bright and for the 1983 Moore report, Copernicus is supposed to be brighter than Aristarchus, but in Fig. 5 this is clearly not the case. Maybe it depends upon the radial brightness gradient across the shadow and where features are with respect to this? The 1889 report refers to an extremely bright Aristarchus. Again, although it can be very bright (depending upon libration angle), this too could be affected by the radial brightness gradient in the shadow. Sir William Herschel's 1790 report has always fascinated me – some 200 round spots were seen! What I don't know is whether he ever observed a total lunar eclipse before with a telescope? Those spots could easily refer to bright ray craters, and telescopes of the time were long focal length devices, so not very good at wide field work – consequently the umbra would be very dark and only the brightest features would be seen, i.e., ray craters? Well, it's only a theory and I don't want to cast doubt on this famous British/Hanoverian astronomer's lunar observing skills. The 1910 report of a meteor on the Moon sounds intriguing – though I cannot see anything of a luminous point in Stöfler crater. For the Japanese 1967 report, I wonder if the two luminous points near Grimaldi were just ray craters? I sometimes see this in earthshine, which has a similar Full-Moon like appearance to the umbral shadow. Moving onto 1985, in Fig. 5 there is no sign of Alphonsus being very bright, but one does have to wonder about the size of the telescope that the Russian observer was using. The 1989 eclipse photo report could be from marks on the photographic material, but without the image it is difficult to tell.

Level 3 - In Depth Analysis:

Lichtenberg: On 2021 May 25 UT 22:06, 22:17, 22:28 Valeri Fontani (UAI) and Chris Dole (BAA) UT 22:27 obtained some images that were taken for the following Lunar Schedule request:

BAA Request: An important historical TLP sketch of this crater, and its surrounds, made by Richard Baum back in 1951 seems to have the wrong UT? It is very important that we establish what the UT and date of this observation actually was. In this prediction we are seeing if his UT was actually meant to be GMAT. Please email any sketches, monochrome, and especially colour images to: a t c @ a b e r . a c. u k

This refers to an observation made by Richard Baum (BAA) with a date and time of 1951 Jan 21. The following is what is described in Richard's observational note book (I hope all the words are correct, his writing was difficult to read!). Incidentally when he refers to east, he means west and vice versa – this is because in those days the coordinate system on the Moon was Classical and not the more modern IAU:

- *'Lichtenberg. 1951 January 21d. 3-in O.G.*
- *17h. 59m. 10s UT x90. Seeing 7/10. While sweeping area to the north of O. Struve a tiny spot was detected in lower reaches of telescope field, apparently W. of Lichtenberg. Optical effect?*
- *18h. 20m. 36s. UT X90 Seeing 7/10. Spot in centre of field, of a delicate rose shade and purely local. Lunar surface around the tint gray and drab-looking. Sketch made.*
- *18h. 25m U.T. X100 Seeing. 7/10. Spot has taken on a nebulous appearance, extending over a larger area.*
- *18h. 30m. 20s. U.T. Seeing 9.5/10. Really fine moment of seeing; it is fortunate indeed to have such a fine spell of seeing during a rare phenomenon, as is being watched now. In the spot no decided change has*

taken place; the extent and colour remain as before. Estimate of the position places centre at long. 66°10.'E and latitude 31°24'N. Power X100.

- *18h. 31m U.T. X100. Seeing 9.5/10. Position of centre at long. 66°8.'E and latitude 31°25'N. suspected fading, though uncertain.*
- *18h. 33m. 16s U.T. X100. Seeing 9.5/10. No change in appearance. Position of centre at long. 66°10.'E and latitude 31°23'N.*
- *18h. 37m. 20s U.T. X100. Seeing 9.5/10. Fading of spot detected; the nucleus is no longer rosy but is taking on a grayish or ashen appearance. The fainter shading surrounding the nucleus is very difficult to detect. Centre estimated as at long. 66°12.'E and latitude 31°25'N.*
- *18h. 38m. 20s U.T. X100. Seeing less than 8. Conditions deteriorating, clouds forming. Spot barely visible, no longer a bright glowing red but shot through with an ashen gray pallet.*
- *18h. 38m. 29s. X100. Seeing <5. The region visible, area grayish in colour, no trace at all of the nucleus.*
- *20h. U.T. X90. Seeing 6. Suspicion of area? A closer study reveals no trace which can be recognized as belonging to the red glow of an hour or so ago.*
- *20h. 15m. U.T. X90., & X100. Seeing 6>. Definitely no trace of area.*
- *Observation closed.'*

So, what we can see from this is that he definitely states UT and not GMAT. Now let's compare his sketch with some repeat illumination observations if indeed it was in UT. In Fig. 6. you can see immediately that there is too much shadow in the repeat illumination observations to correspond to what Richard drew.

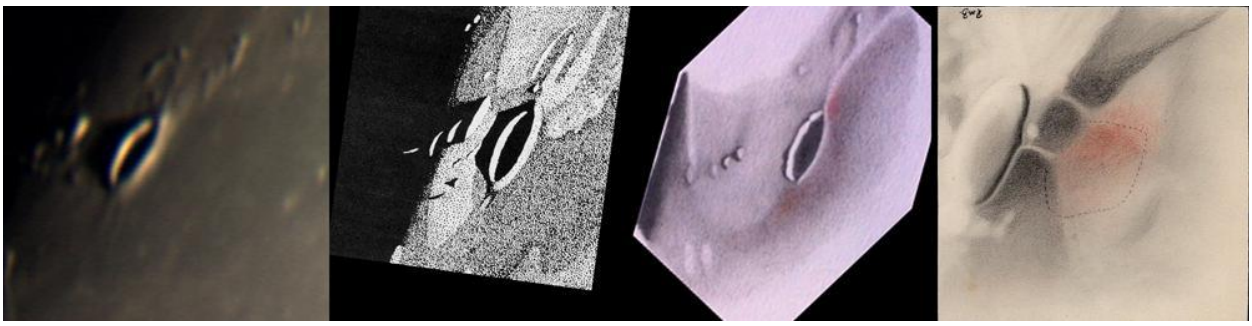


Figure 6. *Observations of Lichtenberg, orientated with north towards the top.* ***(Far Left)*** *Image by Brendan Shaw (BAA) taken on 2004 May 03 UT 00:16-00:17.* ***(Left)*** *A sketch by Harold Hill (BAA) made on 1988 Mar 01 UT 22L:30-23:10.* ***(Right)*** *A sketch made by Nigel Longshaw made on 2020 Apr 06 UT 22:00-22:25.* ***(Far Right)*** *A sketch by Richard Baum made on 1951 Jan 21 UT 18:21(?).*

So now let us test the theory to see if he was using GMAT mistakenly as UT. (See Fig. 7). GMAT is 12h behind UT as it starts at noon on the Greenwich Meridian. As you can see the images by Chris Dole (BAA) and Luigi Fontani (UAI) have a much better resemblance of the shadow inside the crater, but there is no dark fan like area to the east of Lichtenberg.

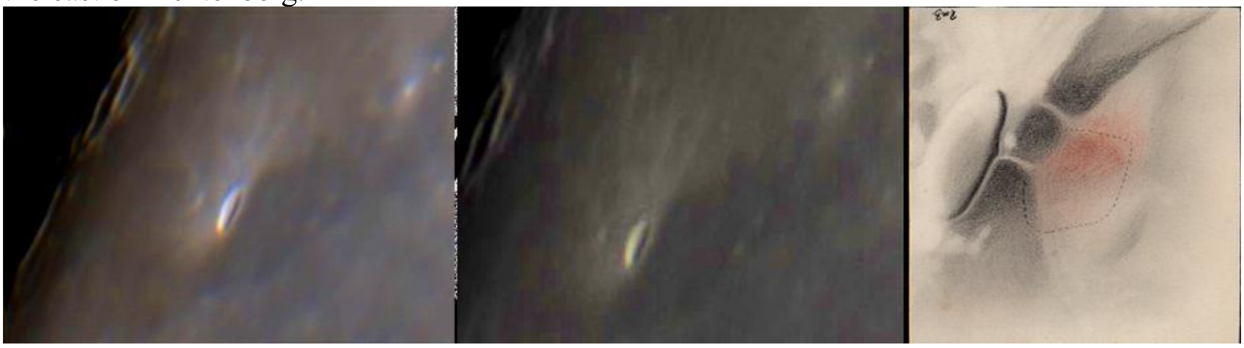


Figure 7. *Observations of Lichtenberg, orientated with north towards the top.* ***(Far Left)*** *Image by Chris Dole (BAA) taken on 2021 May 25 UT 22:27 with colour saturation increased to 65%.* ***(Centre)*** *Image by Valerio Fontani (UAI) taken on 2021 May 25 UT 22:28 with colour saturation increased to 65%.* ***(Right)*** *A sketch by Richard Baum made on 1951 Jan 21 GMAT 18:21(?).*

So, let's do one further experiment, suppose Richard got the date wrong and it was in fact 1951 Jan 22 UT 18:21. Fig. 8 shows a repeat illumination image for this scenario. It is just possible that the interior shadow drawn by Richard corresponds to the barely visible thin shadow in Valerio's image, but again the dark fan-like feature is not visible in the modern-day image.

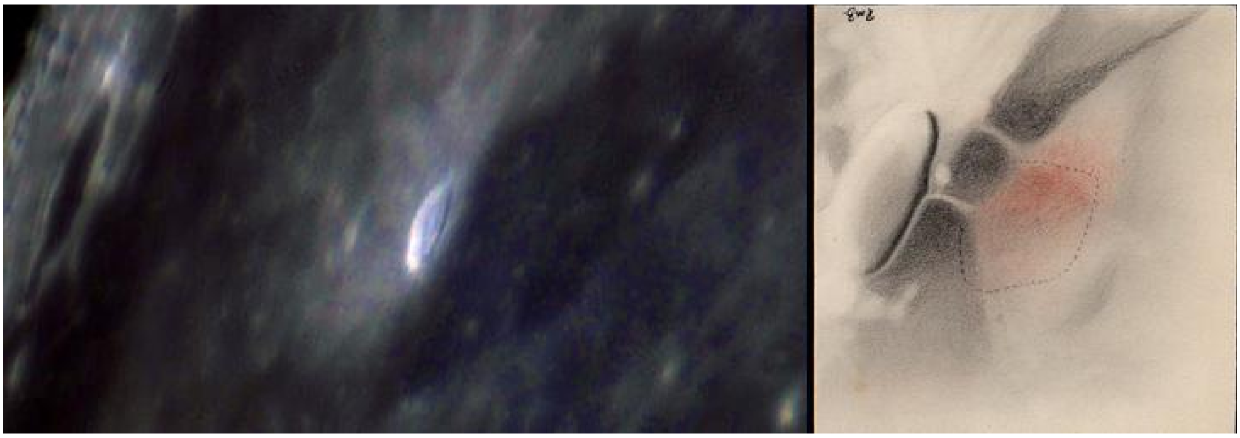


Figure 8. *Observations of Lichtenberg, orientated with north towards the top.* ***(Left)*** *Image by Valerio Fontani (UAI) taken on 2021 Feb 26 UT 22:29 with colour saturation increased to 65%.* ***(Right)*** *A sketch by Richard Baum made on 1951 Jan 22(?) UT 18:21.*

So, is it possible to come to some sort of conclusion? The sketch by Richard Baum does not correspond to 1951 Jan 21 UT 18:51 as the shadow is wrong. It may be that he used GMAT by mistake, although if you look into the Moon's altitude, the Moon would have been at 17° above the horizon (and falling), which is a bit on the low side! 2021 Jan 22 UT 18:21 is perhaps more reasonable in order to get the shadow right. However, none of the dates have the general appearance of Lichtenberg, agreeing with what Richard drew. In terms of red tints, it is noted in some of the coloured images, atmospheric spectral dispersion can add rose coloured tints, but not in the right place, Nigel Longshaw saw some colour too, but this was again not where Richard saw it. One last thing to consider – maybe Richard mistakenly drew another crater without realizing it – personally I doubt this as he was a very skilled observer. We shall leave the weight of this TLP at 3 for now.

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 in this way 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? If you would like your observations to be considered for mention in the next newsletter, then they should be submitted by 17:00UT on the 24th of July, covering observations for June. Please send observations in, even if older than this as they are still very useful for future repeat illumination studies. 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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