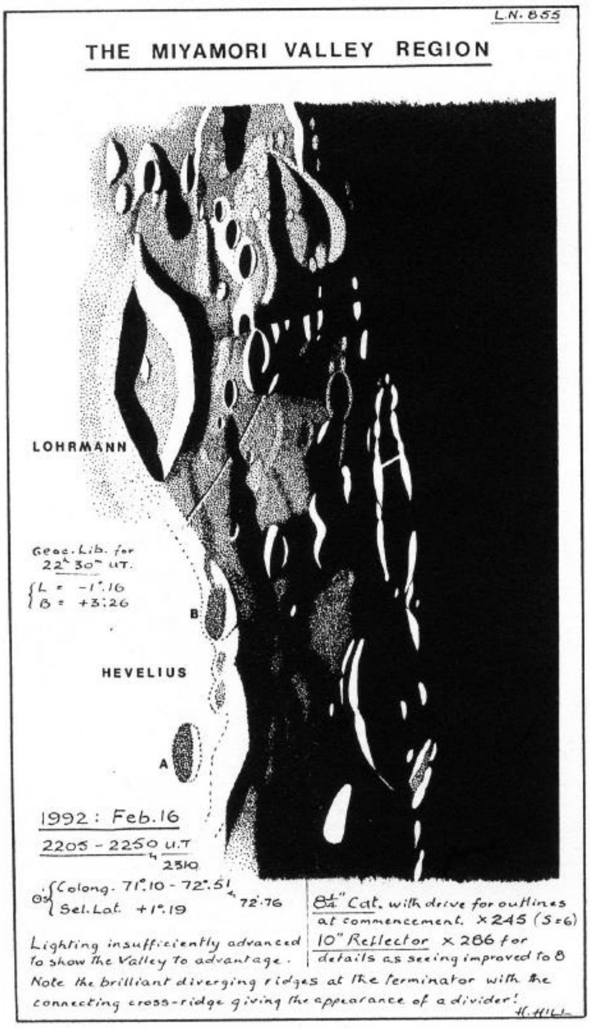
Director: Bill Leatherbarrow

LUNAR SECTION CIRCULAR

Vol. 58 No. 2 February 2021

FROM THE DIRECTOR

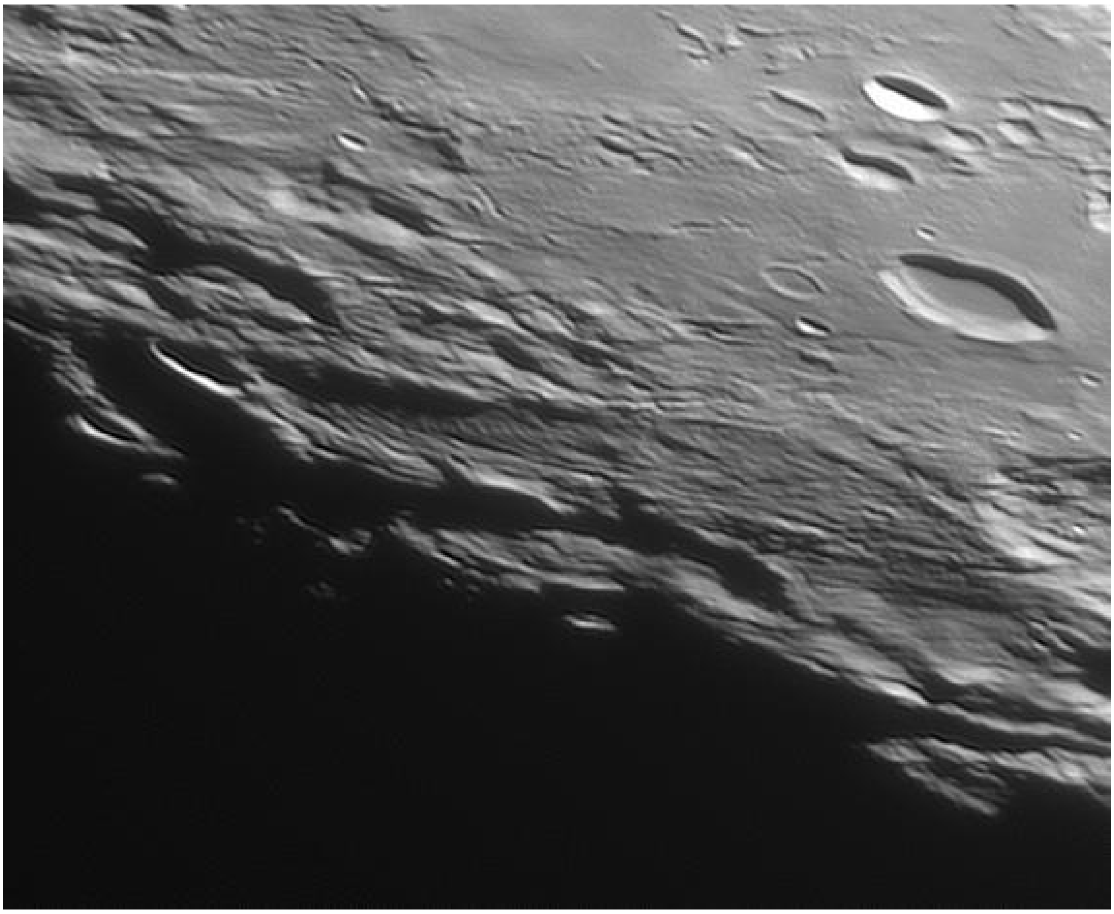


We need to be careful when we speak of valleys on the Moon, for they are not always what they seem. Whereas some are comparable to terrestrial geological structures – the Alpine Valley, for instance, is the sort of rift valley or graben familiar to terrestrial geologists – others have quite alien origins. The Rheita Valley is not a 'valley' at all in the sense that we understand the term; it is a crater chain made up of secondary impacts as huge blocks of material were thrown out from the formation of the Nectaris Basin.

Other putative valleys turn out to be illusory in the sense that their appearance is produced by factors such as incident lighting or severe foreshortening, particularly if they lie near the lunar limb. Harold Hill's fine drawing of the unofficially named Miyamori valley, which runs from the western wall of the crater Lohrmann towards the eastern wall of Riccioli, is a case in point. Hill's drawing (which has south up) shows it as a clearly defined linear feature, plunged in shadow. However, my image of 28 December 2020, taken under higher illumination, shows no convincing evidence of a valley structure. Instead, the linear appearance seems to be the result of a chance alignment of surface ridges, and the same is true when the area is examined on spacecraft imagery.

The Miyamori 'valley', 28 December 2020, 22-43 UT (Bill Leatherbarrow)

Also on the evening of 28 December I observed another 'ghost' valley, this one associated with the crater Inghirami. Vallis Inghirami runs north from Inghirami itself, hugging the western limb. It is recognisable by its spearhead shape, but it is never an easy telescopic object even when the libration is favourable. Its floor is draped with the same sort of rippled herring-bone patterning that can be seen within Inghirami itself.

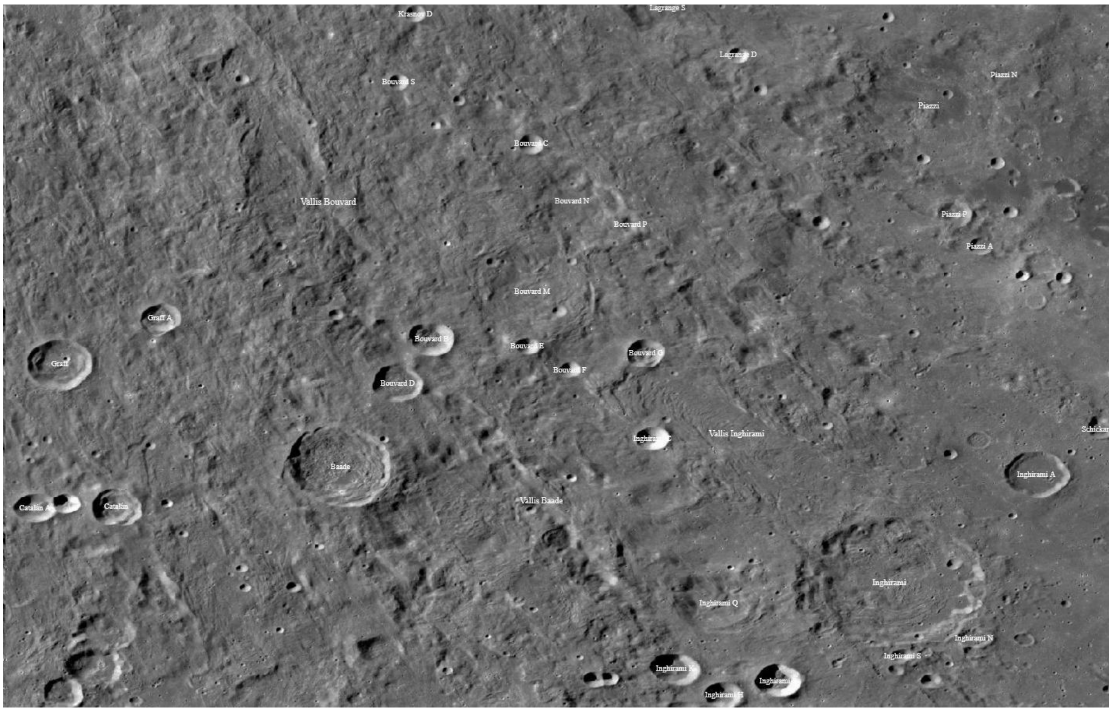


Vallis Inghirami, imaged by Bill Leatherbarrow on 6 April 2020, 22-15 UT. Part of crater Inghirami can be seen at the right edge of the image.

There appears to be a similar valley-like feature, Vallis Baade, running parallel and to the south-west of Vallis Inghirami for around 160km. There is another even larger 'valley' further to the north, between the southwest limb and the crater Piazzi. This is the Vallis Bouvard; it is about 40km wide and some 280km in length. Tellingly, it runs in the same direction as the Inghirami and Baade valleys. All are radial to the Orientale Basin, as is the rille running from Inghirami along the length of the Vallis Inghirami. This, along with the herring-bone patterning draping Vallis Inghirami, suggests that all these features are not 'valleys' in a conventional terrestrial sense, but rather secondary impact scars from the formation of the Orientale Basin.

These difficult areas are well worth exploring telescopically and I would welcome good drawings and images. They will be well presented under favourable libration on the evenings of 25 and 26 February.

Bill Leatherbarrow



The Inghirami, Baade and Bouvard 'valleys' (NASA/QuickMap)

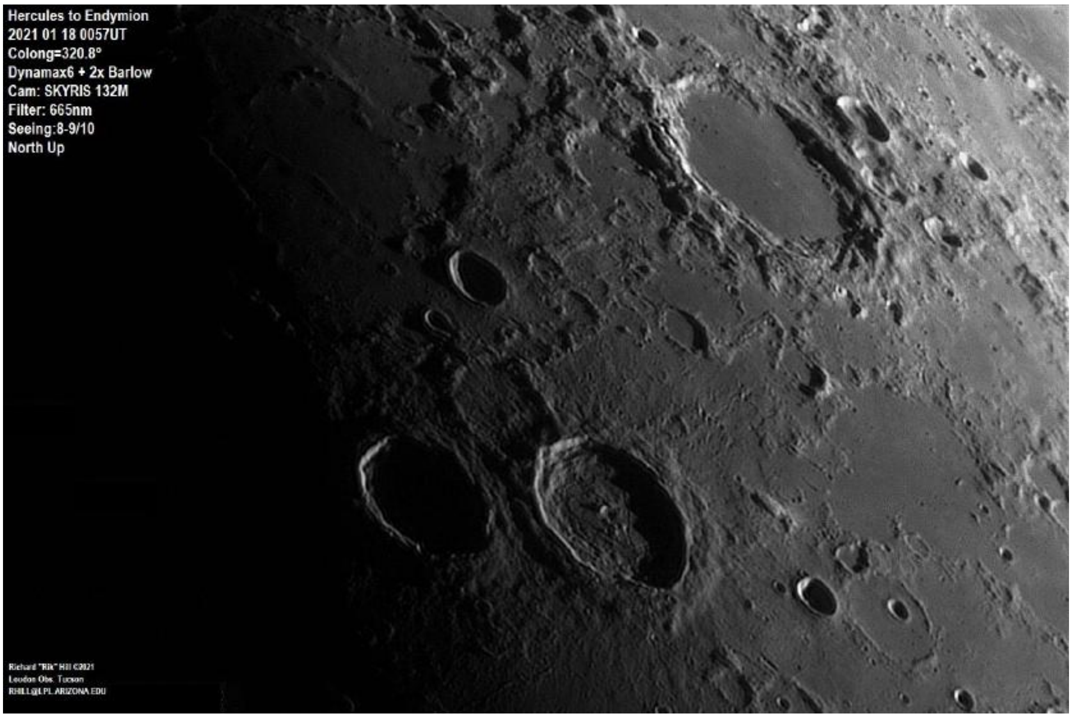
OBSERVATIONS RECEIVED

Images or drawings have been received this month from the following observers:

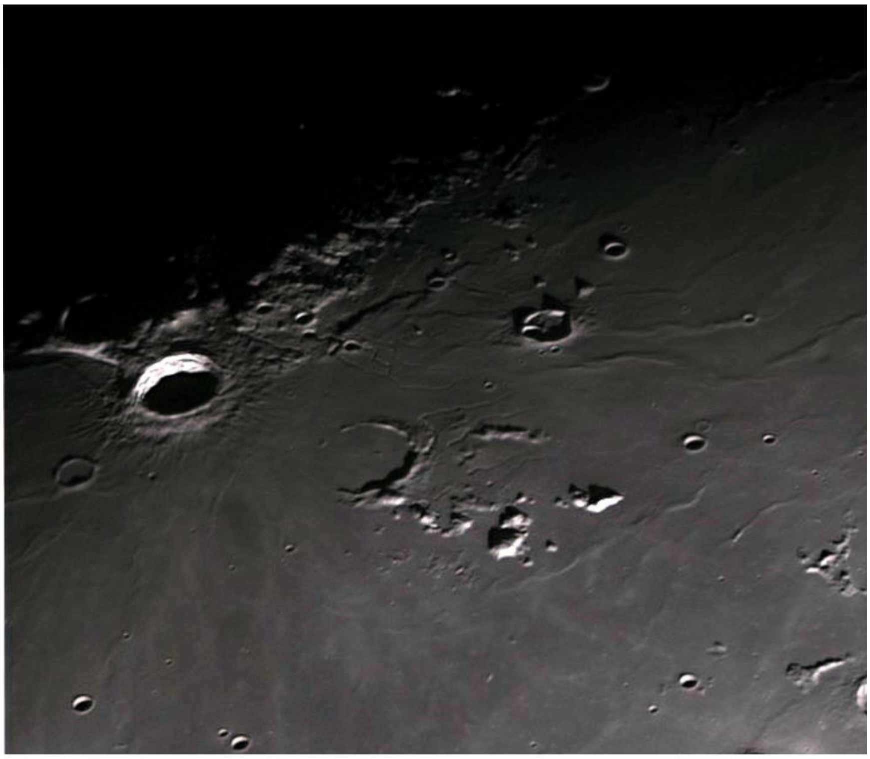
Paul Abel, Maurice Collins (New Zealand), Rob Davies, Daryl Dobbs, Chris Dole, Rik Hill (USA), Rod Lyon, Luigi Morrone (Italy), Bob Stuart, Alex Vincent, and the Director.

Rik Hill has submitted the following account of the area between Atlas/Hercules and Endymion under morning illumination:

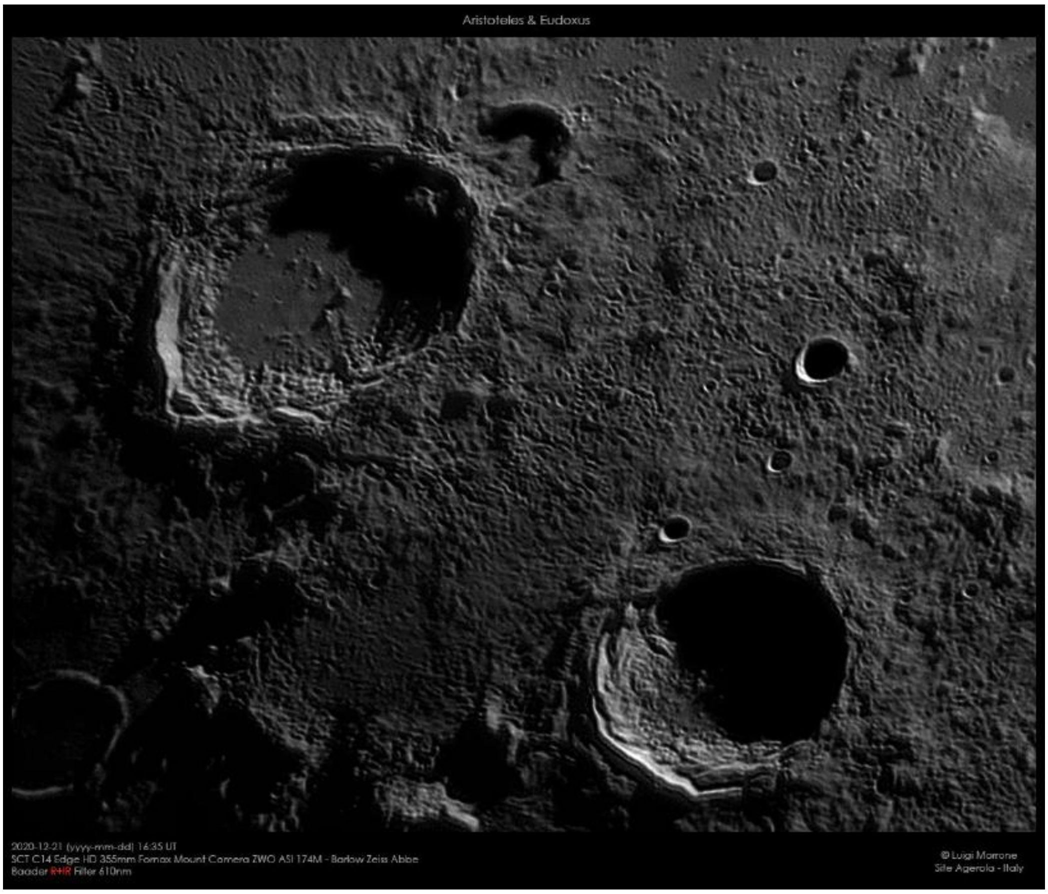
'The Moon is just a thin crescent in the bright twilight sky as this trio of craters creep out from the lunar night. The large one on the right is Endymion (129km dia.) an ancient walled plain that was formed about 4 billion years ago (b.y.). It's accompanied by the younger Atlas (90km) below center with its contained system of Rimae Atlas a mere 3.2-3.8 b.y. old. It has an impressive ejecta blanket to the east and south where the material was piled up outside the crater wall. Atlas is followed by the shadow-filled Hercules (71km) to the west, the youngest of the trio at 1.1-3.2 b.y. old. Above Atlas is a very young crater Keldysh (34km) and between them the totally ruined crater Atlas E. It's obviously older than Atlas since the ejecta from the Atlas impact is splattered across the whole width of Atlas E. To the east (right) of Atlas is a large flat area. This is the northern portion of Lacus Temporis. Just below the Lacus is a flat-floored crater with low walls, Chevallier (54km) with a smaller, younger crater on its floor, Chevallier B (13km) and another relatively young crater, Chevallier A (22km) just outside its northwestern wall. Notice that just below Chevallier B is a grouping of 1-2km craterlets, measured on LROC Quick Map and clearly seen here.'

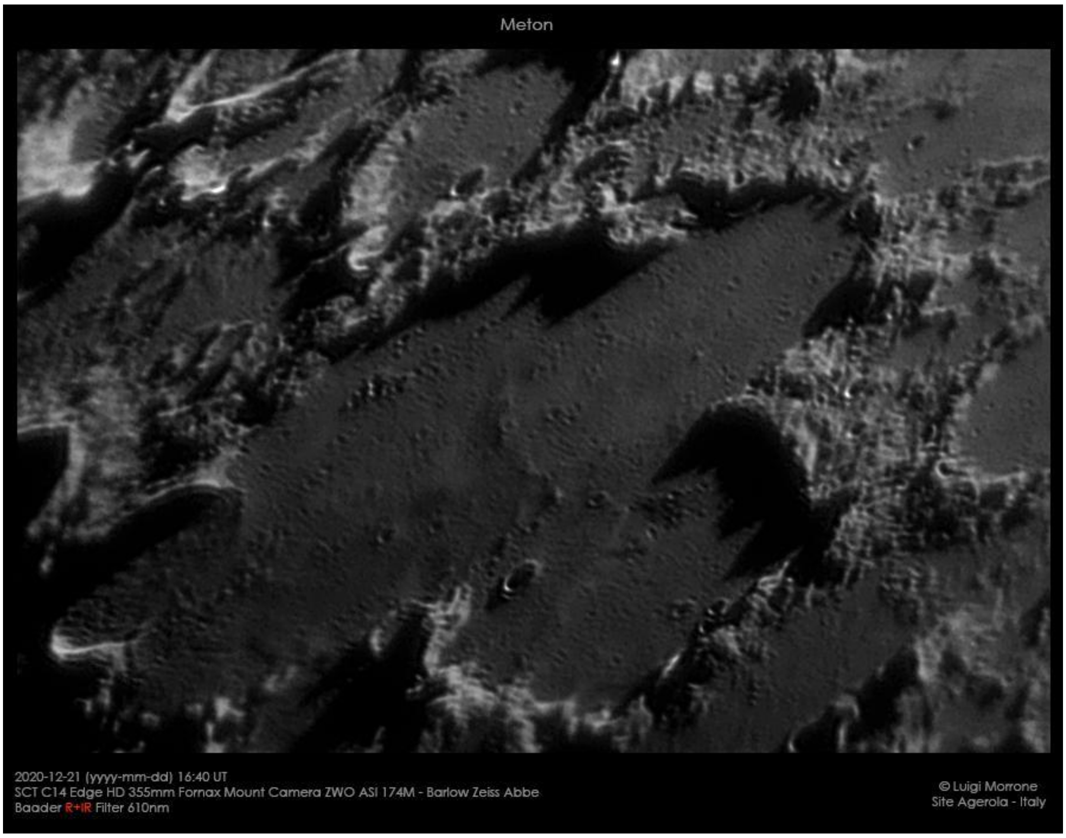


IMAGES GALLERY



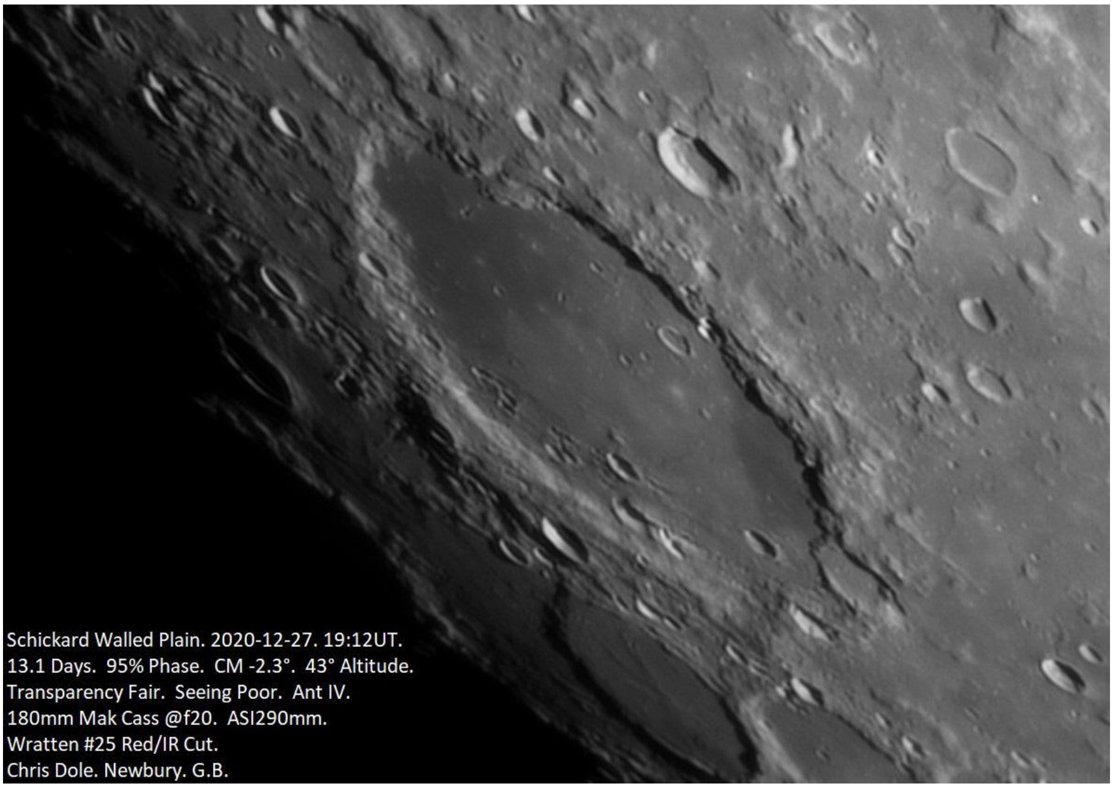
Aristarchus & Prinz at sunrise 2020.11.26 - 22.21 UT
300mm Meade LX90, ASI 224MC Camera with Pro Planet 742nm
I-R Pass Filter. 300/3,000 Frames. Seeing: 7/10. Rod Lyon


Aristoteles & Eudoxus
2020-12-21 (yyyy-mm-dd) 16:35 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


Meton
2020-12-21 (yyyy-mm-dd) 16:40 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

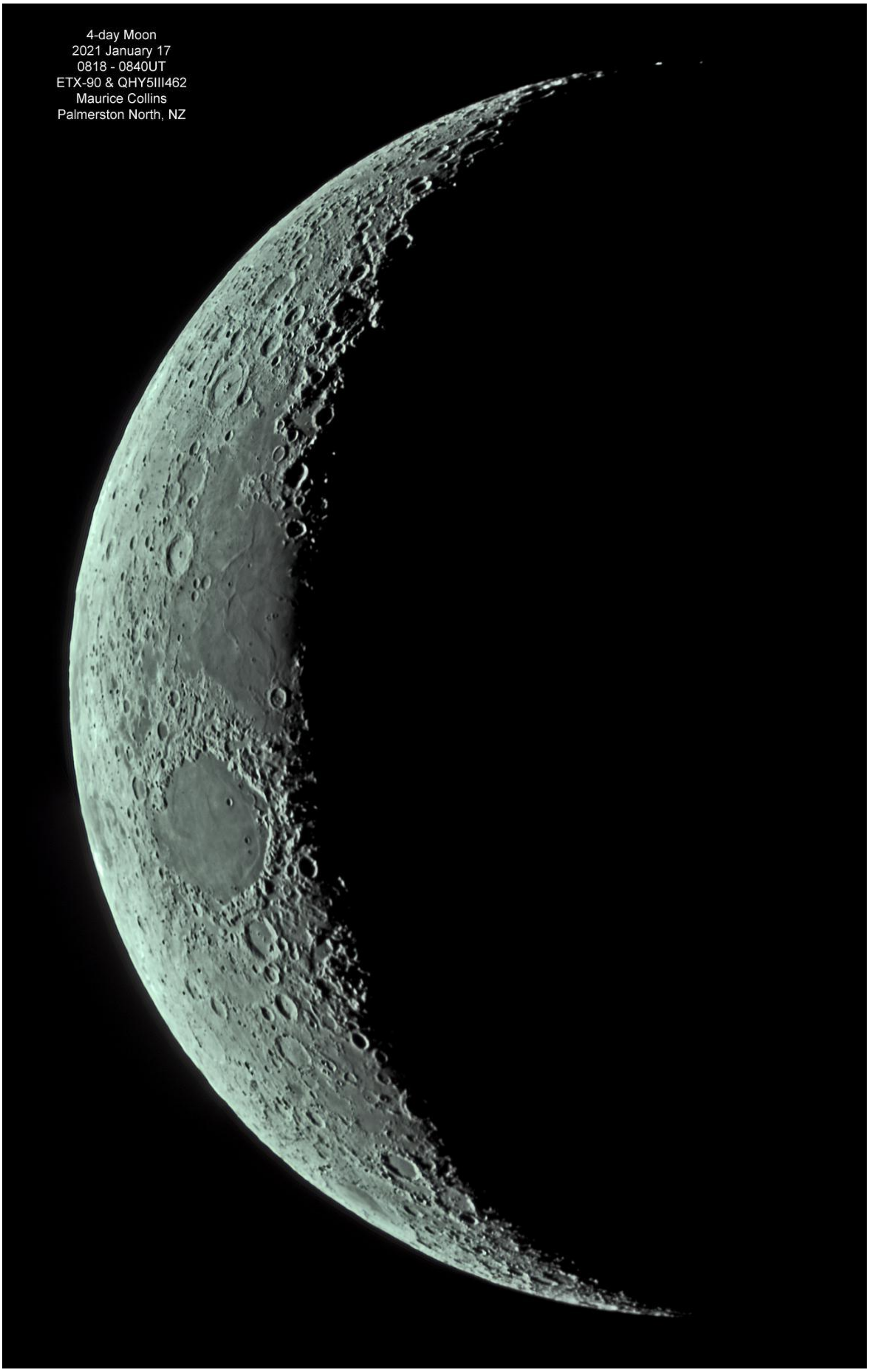
Bob Stuart
02/01/2021 00:21UT
Macrobius
25cm f6.3 Newtonian, ZWO1 174MM
3x Barlow, Baader 500nm Green filter
Seeing Pickering 4-5

Bob Stuart
02/01/2021 00:39UT
Capella
25cm f6.3 Newtonian, ZWO1 174MM
3x Barlow, Baader 500nm Green filter
Seeing Pickering 4-5

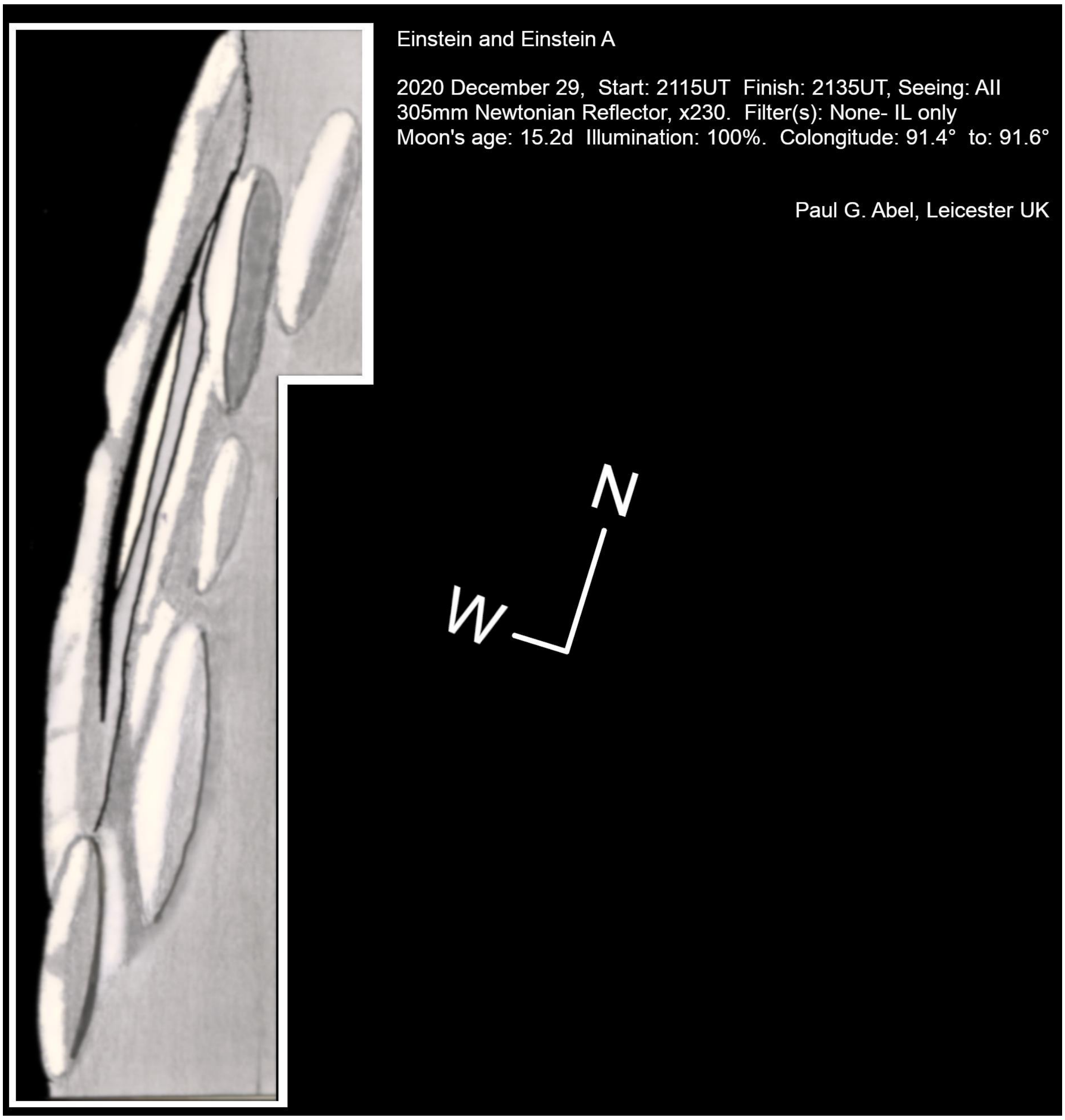

Schickard Walled Plain. 2020-12-27. 19:12UT.
13.1 Days. 95% Phase. CM -2.3°. 43° Altitude.
Transparency Fair. Seeing Poor. Ant IV.
180mm Mak Cass @f20. ASI290mm.
Wratten #25 Red/IR Cut.
Chris Dole. Newbury. G.B.


Mare Serenitatis
2020 December 20, 18:15 UT
C9.25, ASI 120 MCS
Rob Davies
Devils Bridge
Mid Wales.

Maurice Collins has submitted two lovely images of the crescent Moon, taken with his new QHY5III462 colour camera. South is up in these images taken from New Zealand:


4-day Moon
2021 January 17
0818 - 0840UT
ETX-90 & QHY5III462
Maurice Collins
Palmerston North, NZ

Of course, we continue to welcome visual observations and drawings of the Moon. On 29 December 2020 **Paul Abel** managed to capture the elusive crater Einstein on the Moon's western limb. Unfortunately the libration was not good enough to reveal much detail on the crater floor.



LUNAR DOMES (part XLIIII): Domes near Delisle and Diophantus

Raffaello Lena

Recent studies of lunar domes are based on the evaluation of their spectrophotometric and morphometric properties, rheologic parameters, and their classification based on the spectral properties and three dimensional shapes of the volcanic edifices [1-3].

The region of Delisle and the domes termed Delisle 1-2 have been examined in a previous work by Pau and the present author (https://www.hou.usra.edu/meetings/lpsc2018/pdf/1009.pdf), including their classification [4]. Delisle 1 and 2 (termed as De1 and De2) are shown in Fig. 1.

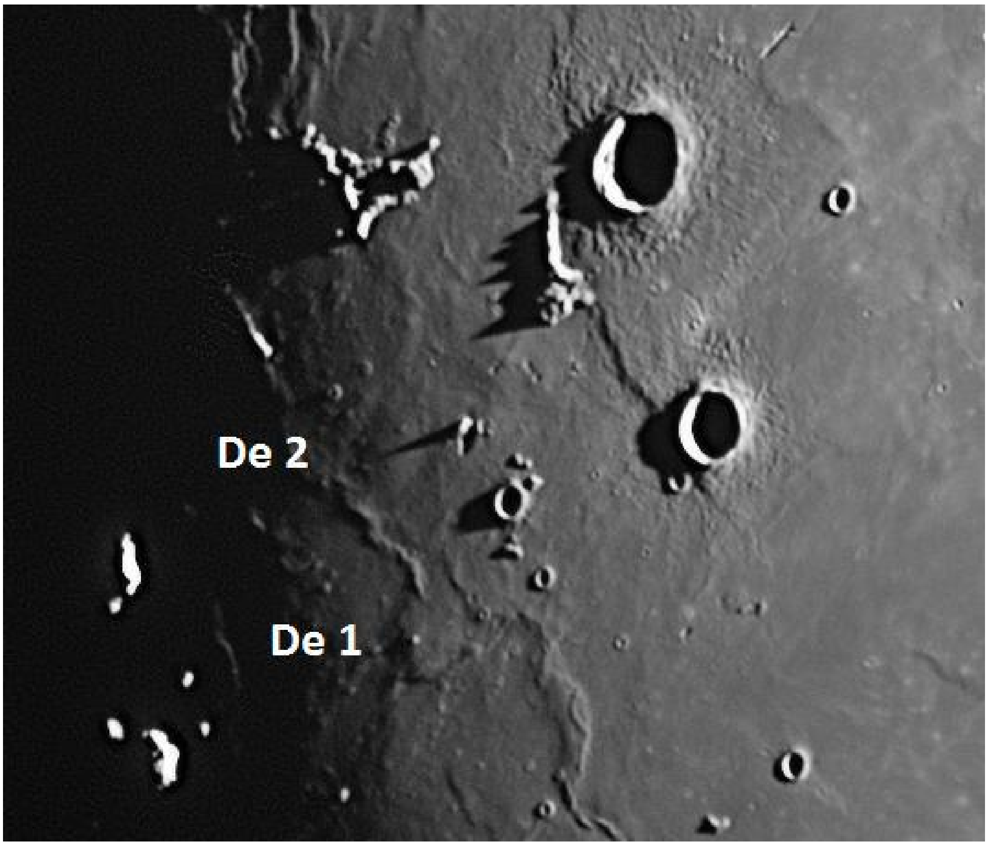


Figure 1: Delisle domes, termed De 1-2. Image acquired on January, 8, 2017 at 13:35 UT by KC Pau.

Three possible domes, described in the current note (Table 1) and termed provisionally as Delisle 3-4 (De3-4) and Diophantus 1 (Di1), are reported in Fig. 2. In the LRO WAC imagery the examined features are not prominent and thus of low height.

The image was taken by Teodorescu on August 14, 2020 at 02:12 UT, using a 355 mm Newtonian telescope and ASI 174MM camera.

Delisle is an impact crater located in the western part of the Mare Imbrium. It lies to the north of the crater Diophantus, and to the northeast of the designated Mons Delisle (Fig. 3).

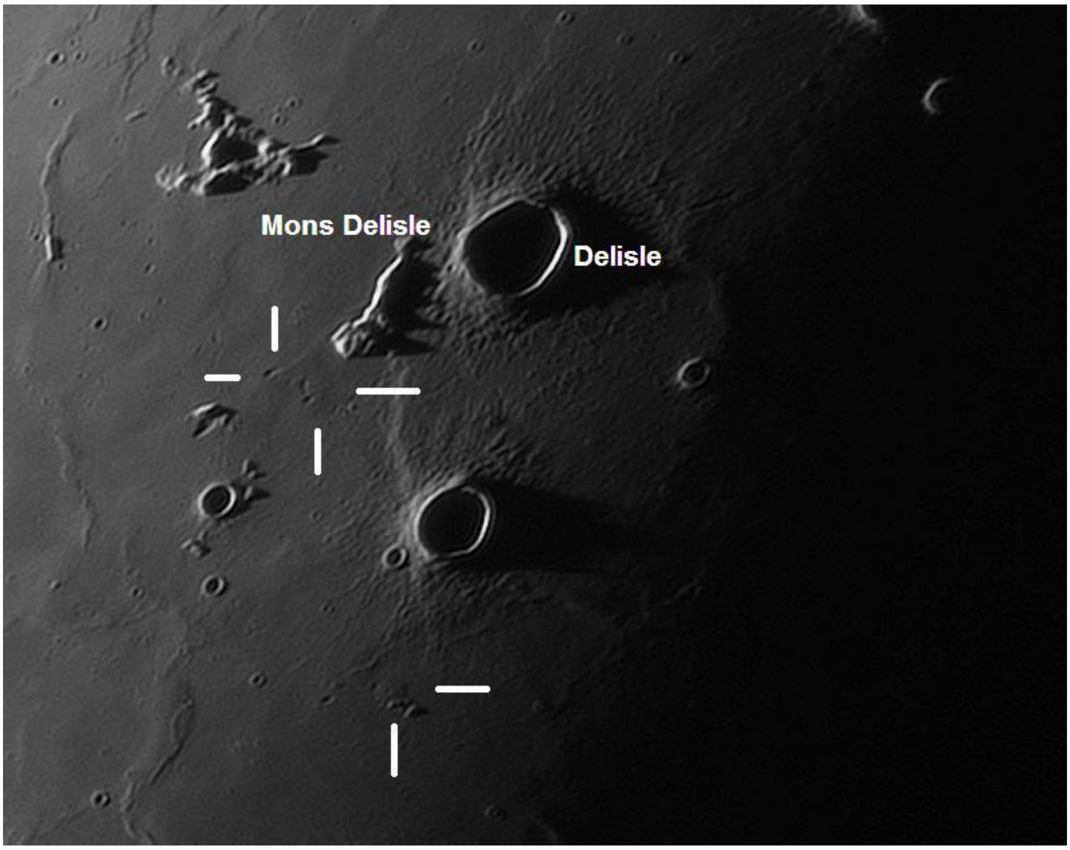


Figure 2: Telescopic CCD image made on August 14, 2020 at 02:12 UT by Teodorescu. The identified possible domes are marked with white lines.

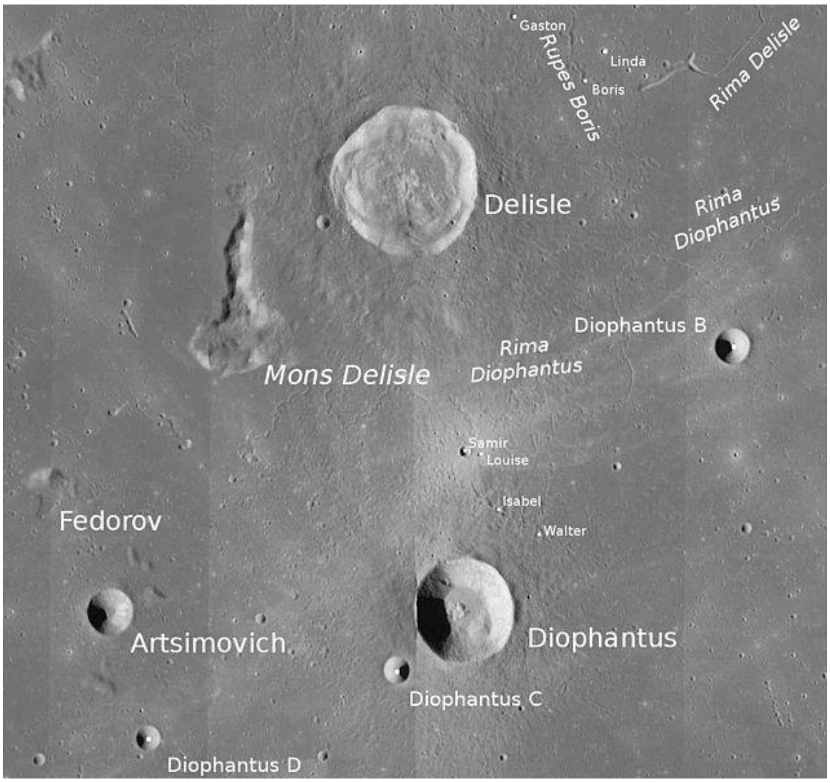


Figure 3: Delisle- Diophantus region. LROC WAC imagery.

Domes	Latitude (°)	Longitude (°)	Diameter km	h (m)	slope (°)	Volume Km^3	class
De3 (Delisle 3)	28.54	36.13	8.5	50	0.65	1.45	C_1/B_2
De4 (Delisle 4)	28.72	36.53	12	60	0.50	3.0	C_1
Di1(Diophantus 1)	26.20	34.35	8.5	50	0.67	1.5	C_1

Domes	E (m^3/s)	Te (years)	viscosity Pas	415/750
De3	370	0,13	$1.0x10^4$	0.5988
De4	730	0,12	$4.5x10^3$	0.6026
Di1	350	0,15	$1.0x10^4$	0.5982

Table 1: Morphometric and rheologic properties of the examined features.

The ACT-REACT QuickMap tool was used to access the LOLA DEM dataset, allowing us to obtain their cross-sectional profiles.

Fig. 4 displays the topographic profile of De3 and De4, while the profile of Di1 is reported in Fig. 5 below.

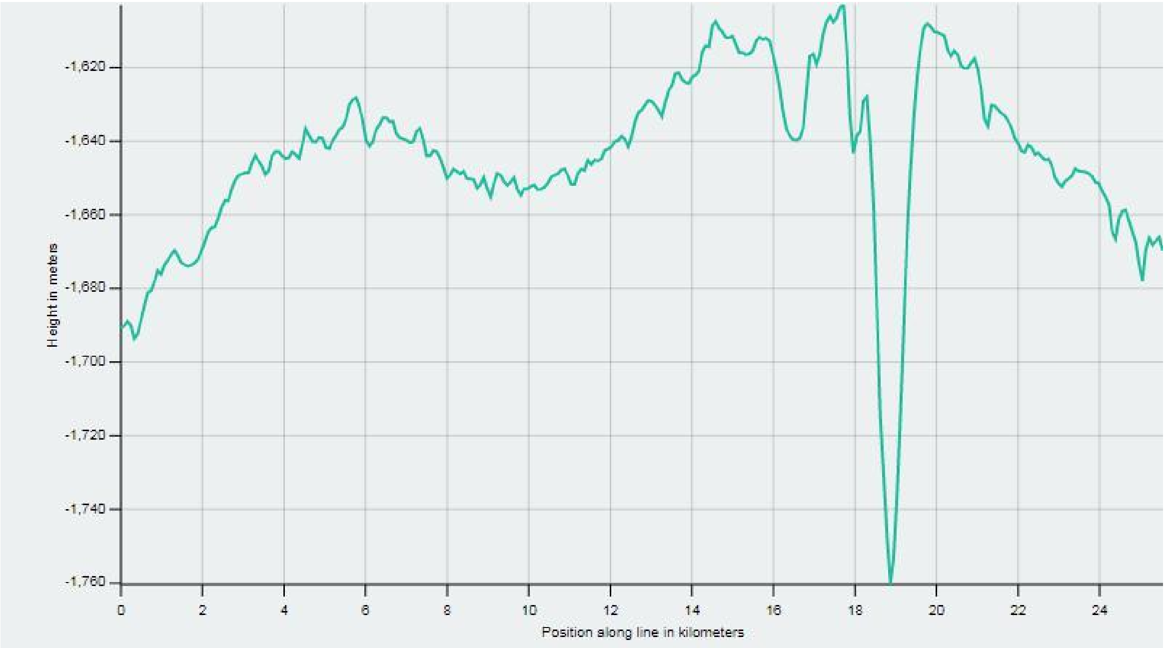


Figure 4: Profile in E-W direction of De3 (left) and De4 (right) based on LOLA DEM (see Table 1).

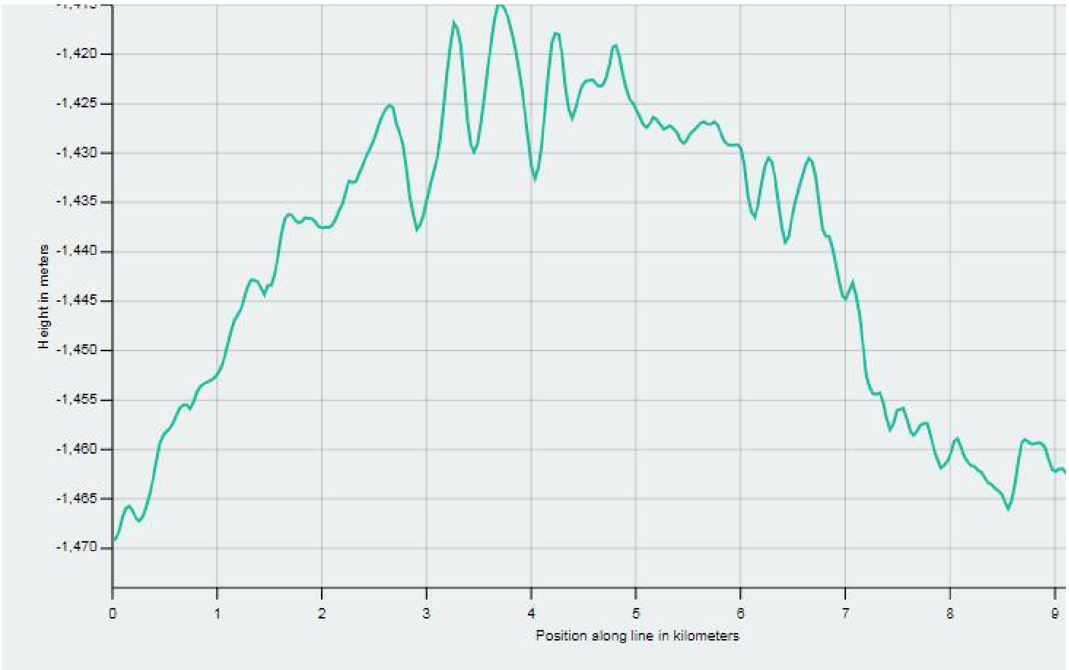


Figure 5: Profile in E-W direction of Di1based on LOLA DEM (see Table 1).

For comparison the heights of the domes De1 and De2, previously described (Fig. 1), were determined to 108 ± 10 m and 95 ± 10 m, resulting in flank slopes of 0.60° and 0.55° respectively. Similar shallow slopes are determined for De3, De4 and Di1 corresponding to 0.65°, 0.50° and 0.67° respectively.

Based on the spectral and morphometric data obtained in this study, De3 would belong to class C_1/B_2 while De4 and Di1 belong to class C_1.

Using the morphometric values listed in Table 1, we obtain high effusion rates in the range of 350 and 730 $m^3 s^{-1}$ for the De3-4 and Di1. Inferred magma viscosities amount to $4.5x10^3$ Pa s for De4 and 1.0 x 10^4 Pa s for De3 and Di1, with very short durations of the effusion process of 0.13-0.15 years.

I have obtained the spectral data using Chandrayaan-1 Moon Mineralogy Mapper (M^3) an imaging reflectance spectrometer that can detect 85 channels between 460 to 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 OP2C1. A continuum removal method that enhances the features in the 1,000 nm absorption band and more accurately shows the position of the band centre has been used. I fit a straight line between 750 and 1,500 nm to remove the continuum.

The spectra (Fig. 6) display a narrow trough around 1,000 nm with a minimum wavelength at 989 nm for Di1 and 1009 nm for De2-3. Another absorption band is present at about 2,200 nm, corresponding to a typical high-Ca pyroxene signature [5], indicating a basaltic composition.

TiO_2 and FeO contents of the examined features are estimated utilizing the Multiband Imager (MI) data. MI is a high-resolution multispectral imaging instrument on board

Selene [6]. 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).

Pyroxene is the major mafic mineral of basalt. According to the FeO and TiO_2 content derived by ACT-REACT QuickMap (~17 wt % and ~1.5-2.0 wt % in average, respectively), we can infer that the main rock type of the examined domes is low-Ti basalt.

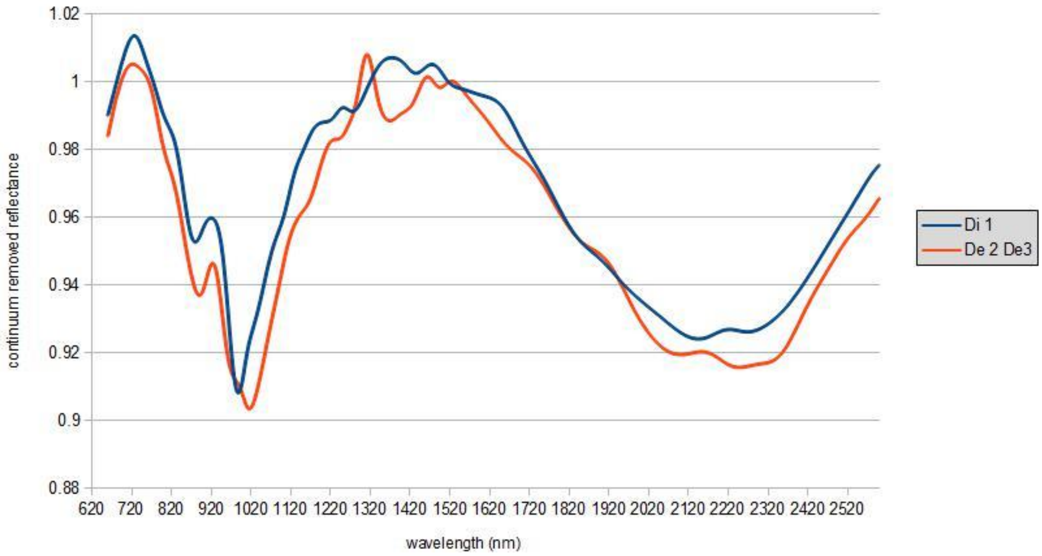


Figure 6: Chandrayaan-1 Moon Mineralogy Mapper spectra.

I encourage more high resolution imagery of this lunar region, in oblique solar illumination angle, so that we can have more data confirming the described domes and eventually further lunar domes not yet characterized in morphometric and spectral properties. Please check also your past imagery of this region and send them to me for the ongoing study (raffaello.lena59@gmail.com).

References

[1] Lena, R., 'Lunar domes', chapter in *Encyclopedia of Lunar Science*, ed. Brian Cudnik, 2015, Springer ISBN: 978-3-319-05546-6.

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

[3] Wöhler, C., Lena, R., & Phillips, J., 2007. 'Formation of lunar mare domes along crustal fractures: Rheologic conditions, dimensions of feeder dikes, and the role of magma evolution'. *Icarus*, 189 (2), 279–307.

[4] Pau, KC, and Lena, R. 'Lunar domes in Delisle region: Morphometry and mode of formation'. 49th Lunar and Planetary Science Conference 2018 (LPI Contrib. No. 2083) (https://www.hou.usra.edu/meetings/lpsc2018/pdf/1009.pdf)

[5] Besse, S., J. M. Sunshine, and L. R. Gaddis (2014), 'Volcanic glass signatures in spectroscopic survey of newly proposed lunar pyroclastic deposits', *J. Geophys. Res. Planets*, 119, doi:10.1002/2013JE004537

[6] Lemelin, M., Lucey, P.G., L.R. Gaddis, T. Hare, and M. Ohtake (2016). Global map products from the Kaguya Multiband Imager at 512 ppd: Minerals, FeO and OMAT. 47th LPSC, abs. #2994. http://www.hou.usra.edu/meetings/lpsc2016/pdf/2994.pdf

LUNAR OCCULTATIONS **February 2021** Tim Haymes

Time capsule: 50 years ago, February 1971
(With thanks to Stuart Morris for the LSC archives: https://britastro.org/downloads/10167)

- Due to a postal strike it would appear that February 1971 issue was delayed a month, and not produced.
- The Director Dr R. Maddison asks the Secretary P. Ringsdore to cover as Acting Director.

2020 Reports

T Haymes: Observations of 32 timings and 2 graze events were reported to the IOTA coordinators in 2020. It was a good year for graze attempts despite Covid-19 restrictions which were not so restrictive in my particular area at the time. Also the weather cooperated.

Graze observations made by T Haymes can be seen at his link: http://www.stargazer.me.uk/grazes/GrazeObs.htm

Observations were reported to:
Total occultation (Jan Manek) lunoccult@iota-es.de
Graze events (Mitsuru Soma) mitsuru.soma@gmail.com

Observing Possibilities (..continued from last month)

Reporting using Lunarreport

There is a small Windows application (Lunarreport.exe) which is the reporting editor of Occult4 without the analysis or prediction aspects of the full package. There is a link to Lunarreport.zip in the second bullet point at this link :
http://www.lunar-occultations.com/iota/lunarreport.htm
Or you can ask the writer for a copy via email.

It runs on W7 and W10 so I don't anticipate any problems with it.

Using Lunarreport.exe (date 2008/9): I copied the zip file to the desktop for convenience. The content was unzipped into the folder C:\Astro\Lunarreport. There are 5 files. Please note that the address file for recipients is out-of-date. Use the email addresses given earlier in this section.

The program opens with instructions. There are three pages to edit: *Header*, *Site & Names* and *Events*. When the Header and Site & Names have been entered save the report as 'BLANK.dat'. We will copy and rename the BLANK to enter Events and avoid re-entering details that don't change.

Header: Enter the information requested. Don't use the tick boxes to set defaults.

Site & Names: E. Longitude can be set to West by entering a negative longitude, e.g. -1 30 22. The format can be changed with the radio buttons. I use Google Earth (GE) with settings set to dms and enter these into the site position. When GE is opened the cursor will indicate the Long/Lat datum required, which is WGS84.

Please note that Ordnance Survey Maps should not be used to determine Long and Lat. There are conversions between datums OSGB1936 to WGS84 available on the internet if an accurate position is already available. Height above MSL in meters from OS maps can be used without any conversion.

If the MSL height of the location on GE is shown as zero, then to activate the height check Terrain in the Layers list (Bottom Left).

Continue filling in boxes. When done, the Site and Observer must be added to the lower box with [Add as new site] and [Add as new name] and saved as BLANK.dat. To continue, read the BLANK.dat. You might get a warning – e.g. if you entered 1200 as a focal length rather than 120, or the name format omitted a full stop. When updating use [Replace Selected] and save.

There is provision to enter more than one observer and telescope. Indeed, two instruments on the same mount can be defined. Each user and instrument has a different code on the report.

Events: At this point it might be advisable to now save the BLANK.dat with a new name that indicates the date and period of observation. Use the drop down boxes to describe the conditions for the observation, and the UT of the event. If you didn't note a particular condition, leave it blank.

Circumstance for some observations:

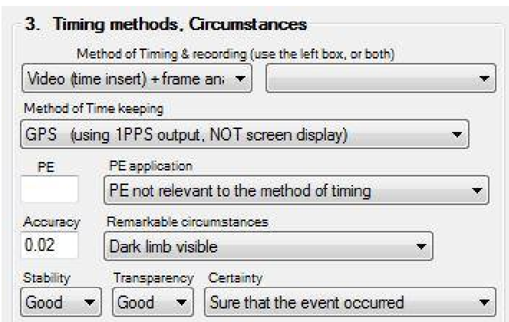


Fig. 1 Above: Video recording

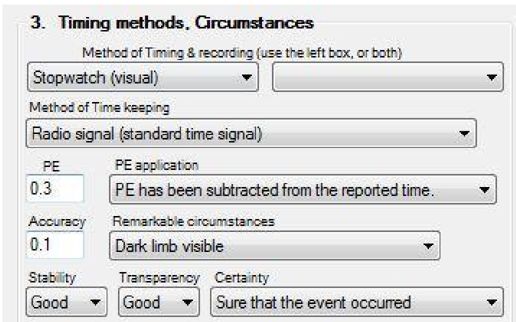


Fig. 2 Above: Visual with stopwatch

The UT from a video or CCD camera should be corrected for any fixed delays before reporting. The form will not make any time corrections for you.

The Star ID is an obvious descriptor, and one that could lead to a problem if not entered correctly. There is no error checking on the form. Use the BAA LS circular to identify the star or ask the writer to help with identification. Only one star ID is needed of the three possibilities, ZC, SAO or XZ.

Event type: This is generally D or R, but a graze can be reported with the same form. Then some other possibilities that could arise, e.g. ‘Flash’, and the Graze Event box needs to be ticked for all contact times. Add each observation with [Add as New Event]. Use a new form when reporting a graze occultation.

Double Star Effects: If effects are recorded, use these fields where possible. The boxes for light level and duration can be used if the effect is clear enough otherwise leave blank. Leave the WDS (Washington Double Star catalogue) box blank unless the components of the double are resolved.

Observation comments: These are not archived, but are handy for an observer who would like to add further information. I add camera type and my own reference number.

Save all edits and save the report. Add more observations later.

Reporting: It would be advisable to send the dat file to the LS coordinator – Tim Haymes. He can check for any problems. If all is fine then the observer should send the dat file to Jan Manek at the address lunoccult@iota-es.de

Next month I will introduce some of the features in Occult4.

GRAZE Occultation of 52 Geminorum on 2021 March 22, 2215UT

This is BAAH event 3, on page 44. The line is from Kent to North Wales. 52 Gem is a double star but the companion is too faint at magnitude 12 to be observable. The main component at magnitude 5.8 is predicted.

The graze occurs at the Northern limb near Cusp Angle 2 degrees. This is close to sunlit features but there are interesting features at greater distance that can cause graze phemomena. See Fig. 3, the event histogram at 1.0. 1.3, 3.5, 7.8 and 9.6 km. The most contacts occur for an observer 1.3km south of the limit, perhaps as many as 12. These occur on the depressed limb all the way to the sunlit region and so would be more difficult to pick out. A higher magnification is suggested. The contacts at 1.0 km are across two isolated peaks 1 min before central graze. There is a lot of detail in this general region to create interesting observations for the visual or video observer. If you do time any contacts, please report them to the LS coordinator.

To find a location to observe from, display the KMZ file here using Google Earth. The line is the mean limb shown on Fig. 3 at zero km. The vertical scale on the profile is km on the surface of the Earth. Then find a road or access to the limb region of interest.

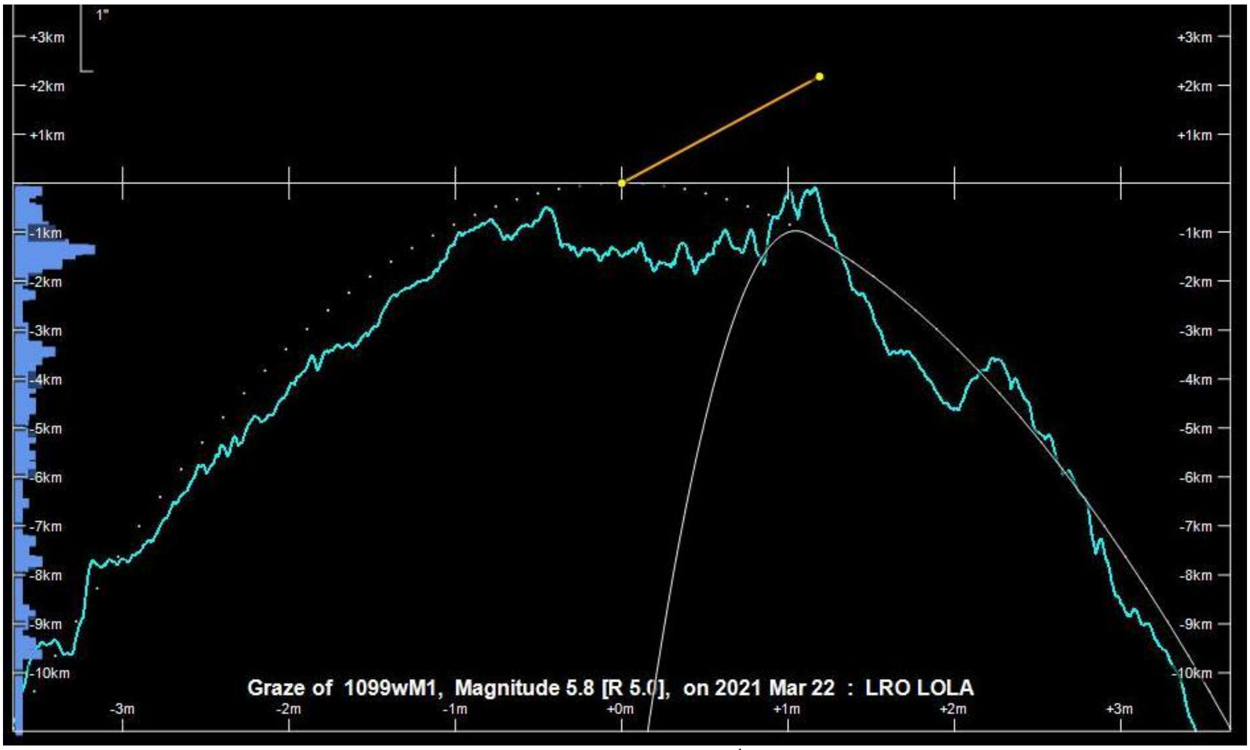


Fig. 3: Limb profile for 52 Gem at the Northern Cusp on March 22nd. The vertical scale is a projection of the Moon's limb onto the Earth.

Bright stars occulted in February 2021:

Feb 01	nu Vir	(v4.0)	DD at 0026 UT
Feb 14	30 Psc	(v5.2)	DD at 1215 UT (daylight)
Feb 17	xi Ari	(v5.5)	DD at 2030 UT
(Note: several star occulted on the evening of 17th)			
Feb 25	gamma Cnc	(v4.7)	DD at 0238 UT

Occultation prediction for Northern Oxfordshire 2021 February

E. Longitude - 1 18 00 , Latitude 51 55 00, Alt. 119m;
Some fainter predictions are omitted at Full Moon.

y	m	day d	Time h	m	s	P	Star No	Sp	Mag v	Mag r	% ill	Elon	Sun Alt	Moon Alt	Az	CA o	Notes
21	Feb	1	0	26	40.4	DB	1702	M0	4.0	3.3	87-	138		34	130	-86S	nu Vir
21	Feb	1	1	35	45.4	RD	1702	M0	4.0*	3.3	87-	137		41	150	71N	nu Vir
21	Feb	1	23	7	36.1	R	119462	G5	8.1	7.7	79-	125		13	105	69S	
21	Feb	2	0	13	36.1	R	119493	G0	9.0	8.6	79-	125		22	118	14N	
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	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	4	3	9	46.5	R	X128771		7.9	7.7	56-	97		19	143	71S	Dbl* dT 2.7sec
21	Feb	4	3	9	49.3	R	2064	F4	6.3		56-	97		19	143	71S	Comes to X128771
21	Feb	6	5	9	43.9	R	184326	A7	8.6	8.4	33-	70		11	149	42S	
21	Feb	6	6	7	35.3	R	184344	A2	8.7	8.5	33-	70		15	162	47S	
21	Feb	7	5	34	44.7	R	185287	B9	8.8	8.7	23-	57		6	143	88S	
21	Feb	14	12	15	25.6	D	3536	M3	4.4	3.5	8+	33		26	142	66N	30 Psc Dbl*
21	Feb	15	21	7	32.3	D	109576	G5	8.9	8.5	16+	47		3	268	30S	
21	Feb	15	21	10	22.4	D	109577	K5	7.7	6.9	16+	47		2	268	25S	
21	Feb	16	20	12	45.0	D	110062	G5	8.0	7.6	23+	58		21	252	42N	

21	Feb	17	18	42	2.3	D		352	K0	7.1*	6.5	31+	68	42	222	57S	
21	Feb	17	19	18	50.3	D		354	B7	5.5*	5.5	31+	68	38	233	67N	xi Arietis
21	Feb	17	19	45	25.8	D		92942	B9	7.6*	7.6	32+	68	34	240	68S	
21	Feb	17	20	6	19.1	D		92948	G0	7.3*	7.1	32+	68	32	245	84S	
21	Feb	17	20	30	49.6	D		360	F0	6.7*	6.5	32+	69	28	250	51S	VW Arietis
21	Feb	17	20	31	45.5	D		92953	F0	8.3	8.1	32+	69	28	250	55S	
21	Feb	17	21	27	54.0	D		92964	K0	8.6	7.9	32+	69	20	262	60N	Dbl*
21	Feb	17	22	40	48.0	D		369	G5	8.6	8.1	32+	69	9	276	85S	
21	Feb	18	19	37	3.3	D	X	64814		8.9	8.4	41+	79	44	229	57S	
21	Feb	18	23	18	56.6	D		93371	K0	8.5	7.9	42+	81	13	278	82S	
21	Feb	18	23	33	21.9	D		93369	G5	8.8	8.4	42+	81	11	281	19N	
21	Feb	19	19	5	37.6	D		585	F5	8.5	8.2	50+	90	55	206	22N	
21	Feb	20	0	17	5.8	D		605	F2	7.5	7.3	52+	92	14	283	84S	
21	Feb	20	20	35	31.2	D		76776	A0	7.8	7.8	60+	101	54	224	48N	
21	Feb	20	23	33	59.2	D		76830	A3	8.0	7.8	61+	103	30	268	44N	
21	Feb	20	23	37	15.8	D		76837	K0	8.5	7.9	61+	103	29	269	59S	
21	Feb	21	22	29	20.5	D		77526	A0	8.0		70+	113	48	244	68S	
21	Feb	21	23	16	15.6	D		77558	K2	8.4	7.6	70+	114	41	256	83N	
21	Feb	21	23	54	44.1	D		77586	B9	8.3	8.3	70+	114	36	264	74S	
21	Feb	22	1	12	52.3	D		77636	A0	8.5*	8.4	71+	114	24	279	72N	
21	Feb	22	2	12	4.7	D		77666	K2	8.8	8.2	71+	115	15	289	26S	
21	Feb	22	18	49	8.4	D		78522	K5	8.4	7.6	78+	124	57	135	77N	
21	Feb	22	20	14	31.0	D		1015	A3	6.5		78+	124	63	171	85S	
21	Feb	22	20	26	42.6	D		78550	F5	9.0	8.8	78+	124	63	178	28S	
21	Feb	22	20	57	47.3	D		1019	A5	6.8	6.6	78+	124	62	192	48S	
21	Feb	22	21	12	20.3	D		78582	A0	8.8	8.7	78+	124	62	199	72S	
21	Feb	22	21	28	36.2	D		1023	F8	6.4	6.2	78+	125	61	206	87S	Dbl* dT 0.04s
21	Feb	22	22	27	2.4	D		78634	A0	8.5	8.4	79+	125	56	229	77N	
21	Feb	23	0	3	9.8	D		78686	A2	8.8	8.7	79+	125	43	255	88N	
21	Feb	23	0	47	41.5	D		78706	K2	7.0	6.1	79+	126	36	265	49N	
21	Feb	23	2	10	43.5	D		1041	F8	8.4	8.2	80+	126	24	280	77S	
21	Feb	23	3	9	38.2	D		78786	F5	8.5		80+	127	15	290	36S	Dbl* dT 0.36s
21	Feb	23	19	1	32.6	D		79470	K0	7.6	7.1	86+	136	51	122	46S	
21	Feb	23	19	23	45.9	D		79477	K2	7.8	7.2	86+	136	54	129	30S	
21	Feb	23	20	9	45.4	D		79505	M1	8.8	7.9	86+	136	59	145	79S	
21	Feb	23	20	40	22.7	D		79523	M5	7.7	6.8	86+	136	61	158	59N	
21	Feb	23	21	0	55.6	D		79524	F5	8.0	7.7	86+	136	62	168	39S	
21	Feb	23	22	7	19.2	D		79549	K0	8.4	7.7	86+	137	61	199	46S	
21	Feb	23	22	42	24.1	D		79561	G5	8.3	7.8	86+	137	59	214	40S	
21	Feb	23	23	7	5.8	D		79574	K0	8.8	8.2	87+	137	56	223	37S	
21	Feb	23	23	18	32.5	D		1157	A2	6.2	6.2	87+	137	55	228	27N	
21	Feb	24	0	43	33.9	D		79620	A3	8.1	8.0	87+	138	44	251	39N	
21	Feb	24	1	21	18.1	D		79644	A0	8.6	8.6	87+	138	39	260	78N	
21	Feb	24	2	41	10.9	D		79679	B9	7.7	7.7	87+	138	27	275	75S	
21	Feb	24	3	4	7.6	D		79688	K0	7.5	7.0	88+	139	23	279	68N	
21	Feb	24	3	6	58.3	D		79690	F5	8.9	8.7	88+	139	23	280	56N	
21	Feb	24	23	5	44.9	D		1285	G0	8.4	8.1	93+	149	59	200	50N	
21	Feb	24	23	27	50.5	D		80293	K0	8.6	7.9	93+	149	58	209	82N	
21	Feb	25	2	38	49.2	D		1308	A1	4.7	4.7	94+	151	34	262	89N	Gamma Cnc
21	Feb	25	19	21	15.4	D		98567	A3	7.5	7.4	97+	160	35	104	63S	
21	Feb	25	20	27	6.1	D		1400	F5	8.3*		97+	161	44	120	29N	
21	Feb	25	20	48	45.1	D		98603	M2	8.9*	8.1	97+	161	47	126	61N	
21	Feb	25	23	1	16.7	D		98640	K0	8.0	7.5	97+	162	57	174	69N	
21	Feb	25	23	51	3.0	D		98646	K2	8.2	7.3	98+	162	56	195	58S	
21	Feb	26	4	36	34.8	D		98737	G5	8.4	7.9	98+	164	21	272	61N	
21	Feb	26	18	53	25.8	D		1514	A1	6.2	6.2	100+	172	20	91	45N	42 Leo
21	Feb	26	22	34	52.4	D		1535	K0	6.9	6.3	100+	173	48	145	33N	
21	Feb	27	4	12	7.7	D		1553	A0	7.8	7.8	100+	175	29	253	64S	78 Leo
21	Feb	27	22	42	1.0	R		1647	A2	6.7	6.5	99-	170	39	135	30N	
21	Feb	28	3	43	7.0	R		1669	F5	6.7*	6.5	99-	168	35	231	61S	
21	Feb	28	5	32	1.7	R		1673	K0	8.2*	7.6	99-	168	20	256	57N	
21	Feb	28	21	21	14.7	R		119272	F5	7.6*	7.3	96-	158	18	108	75N	
21	Mar	1	4	6	50.7	R		119369	A3	8.8*	8.7	95-	155	32	221	69S	
21	Mar	1	4	43	35.6	R		1781	M*	7.6*	6.8	95-	155	28	230	74S	
21	Mar	1	23	35	52.0	R		1889	F2	8.4	8.3	90-	144	23	130	81N	
21	Mar	1	23	46	36.6	R		139196	F8	8.7	8.5	90-	143	24	132	32N	
21	Mar	2	0	23	57.3	R		139205	K0	8.6	8.0	90-	143	27	142	28S	
21	Mar	2	1	28	0.2	R		139220	K2	8.4	7.9	90-	143	32	159	84N	
21	Mar	2	23	56	30.4	R		139704	K0	7.3	6.7	82-	130	14	126	53S	
21	Mar	3	0	3	58.9	R		139712	K0	8.4*	7.9	82-	130	15	128	72N	
21	Mar	3	1	50	8.6	R		158366	G5	8.0	7.5	81-	129	24	153	32S	
21	Mar	3	2	20	53.2	R		158376	F2	8.8	8.6	81-	129	26	161	44S	
21	Mar	3	2	53	52.5	R		2028	G8	6.5*	5.9	81-	129	27	170	89S	96 Vir
21	Mar	3	4	4	50.0	R		158411	M*	8.0	7.2	81-	128	27	189	54N	
21	Mar	3	4	20	29.5	R		158412	G0	8.8	8.5	81-	128	27	193	73N	
21	Mar	4	2	16	59.7	R		2151	B8	8.2	8.3	71-	115	17	148	29N	
21	Mar	4	2	24	9.9	R		159001	F5	8.1		71-	115	18	150	36N	Dbl* dT 0.07s

21 Mar	4	4	10	43.7	R	2159	K5	5.2	4.4	71-	115		22 176	51S	nu Lib
21 Mar	5	4	13	21	R	184093	A2	8.1	8.0	60-	101		16 164	4S	
21 Mar	5	4	23	5	R	184093	A2	8.1	8.0	60-	101		16 166	20S	
21 Mar	5	4	38	36.5	R	184105	K3	7.4*	6.9	60-	101		17 170	26N	
21 Mar	5	5	33	59.4	R	2307	B1	3.9*	4.0	59-	101	-11	17 183	54N	omega1 Sco
21 Mar	5	6	5	4.3	R	2310	G6	4.3*	3.9	59-	100	-6	17 191	84N	omega2 Sco
21 Mar	5	6	7	38.0	R	184137	G5	7.9*	7.2	59-	100	-6	17 191	81S	

Prediction until March 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 = Zodiacal catalogue (ZC) referred to as the Robertson catalogue (R)
5/6 digits = Smithsonian Astrophysical Observatory catalogue (SAO)
X denotes a star in the eXtended ZC/XC catalogue.
The ZC/XC/SAO nomenclature is used for Lunar work. The positions and proper motions of the stars in these catalogues are updated by Gaia.

Detailed predictions at your location for 1 year are available upon request.
Occultation Subsection Coordinator: occultations at stargazer dot me dot uk
Tim Haymes, LS Coordinator (occultations)

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: On 2020 Dec 20 UT 19:00- Trevor Smith, using 16” reflector (seeing Antoniadi III-IV) found the interior western floor and western rims of **Plinius** and **Bürg** were red, and so too was the central peak of Plinius. By 19:40UT the redness of both craters had faded a bit. Interestingly **Proclus** also had some slight redness to its western regions but not as much as Plinius or Bürg. Censorinus had no sign of any red colour, nor the central peaks of Theophilus. At 20:08 Plinius was still slightly red but Bürg no longer had any colour associated with it. Observations ceased at 20:14 due to a neighbour's house blocking the view. Occasionally we find widely separated craters exhibiting colour simultaneously (but other examined craters not) in the Cameron TLP catalog. What is the cause of this I do not know as colour was not visible significantly elsewhere apart from a small amount on Proclus. However, in terms of a physical explanation on the Moon I am left scratching my head. I think I will assign these a weight of 1 for now.

The UAI has discovered another impact flash in archive recordings of earthshine: 2018 Mar 23 UT 19:50:50 as recorded by Bruno Cantarella and Luigi Zanatta – utilizing three telescopes. The duration of the flash was 0.4 sec and it was located just north of the Montes Carpatus (21.1W, 17.1N).

Fernando Ferri (Italy) has emailed me some details about a 2012 Mar 28 UT 20:45-20:50 TLP about a bright patch seen in earthshine by a couple of Italian observers. It is always good to gain additional details about some of these historical reports. It also triggered me to check through my own observations and I found some videos of earthshine which cover part of the time (there is a gap in my recordings) but which don't show a bright patch in the vicinity of Lambert, which is where the observers indicated in a sketch. Instead, my observations do show Aristarchus as a bright patch quite well much further to the NW. So, whether the colour sensitivity of my camera (not good in blue light) or the gap in my recordings had anything to do with not detecting what these two independent observers saw, I do not know. Anyway, the weight of the report remains at 1.

News: Bob Stuart has emailed me about a new image processing package: Topaz Sharpen AI.

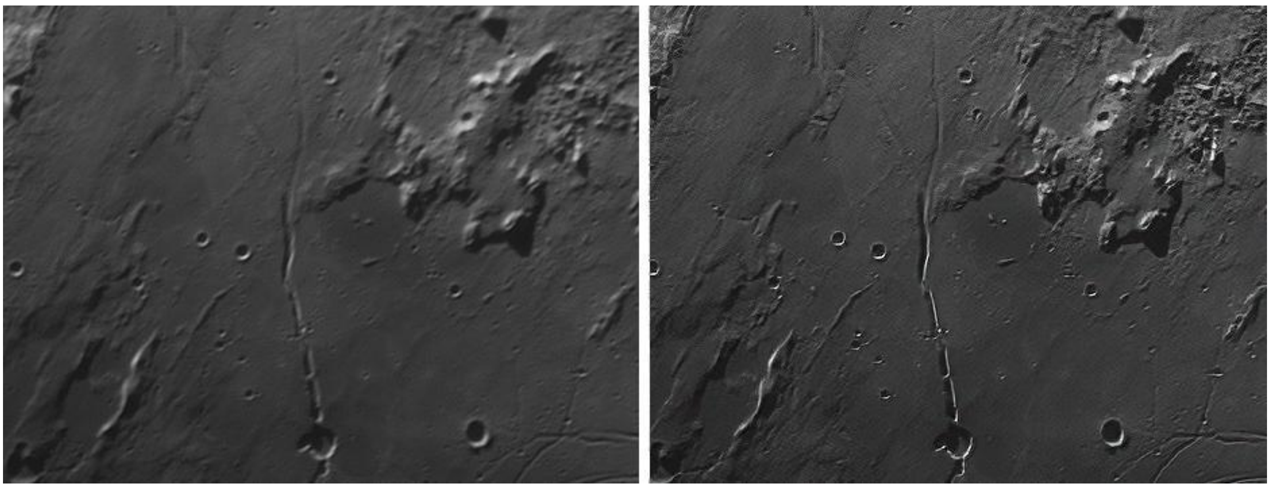


Figure 1**. North Mare Vaporum as imaged by Bob Stuart (BAA) on 2020 May 29 UT 20:18 and orientated with north towards the top.* ***(Left) *A conventional processed image.* ***(Right)*** *After feeding the video through Topaz Sharpen AI in 'Stabilise' mode.*

Fig. 1 (Right) shows a great improvement in terms of detail – however, if you look carefully, there are a few instances where small scale features have been added which weren't there originally – maybe AI has some imagination? My overall feeling is yes this is definitely worth using, but if you are going to be sending me images, please send ordinary and separate Topaz versions so that I can compare.

Recently I have been browsing through telescope seller web pages and am struck by how odd it is that most telescopes are now out of stock. It seems that the Covid-19 pandemic has sparked a massive urge for people to buy telescopes. I only hope that this translates into more people submitting observations rather than just putting their best images up on social media and not doing any analysis on them.

We have received the sad news that one of our TLP contributors from the 1970/80s Ron Livesey has passed away. He was also a past director of the BAA Aurora Section.

Level 1 – All Reports received for December

Jay Albert (Lake Worth, FL, USA - ALPO) observed: Agrippa, Aristarchus, Grimaldi, Hyginus, Littrow, Olbers, Pythagoras, Ross D and Torricelli B. Alberto Anunziato (Argentina - SLA) observed: Aristarchus, Aristillus, Herodotus, and Vallis Schröteri. Maurice Collins (New Zealand – ALPO/BAA/RASNZ) imaged: several features. Rob Davies (Devil's Bridge, UK – BAA/NAS) imaged: Clavius, Mare Frigoris, Mare Orientale, Mare Serenitatis, Montes Alpes, Theophilus, and W. Bond. Anthony Cook (Mundesley & Newtown, UK – ALPO/BAA/NAS) videoed: several features. Daryl Dobbs (Risca, UK - BAA) observed: Littrow and Proclus. Walter Elias (Argentina – AEA) imaged: Agrippa, Alphonsus, Aristarchus, Capella, Cassini E, Delambre, Isidorus, Langrenus, Mare Crisium, Mare Nectaris, Maskelyne A, the north pole area, Petavius, Plinius, Posidonius, Ross D, the south pole area, Theophilus and several features. Les Fry (West Wales, UK – NAS) imaged: Theophilus. Leandro Sid (Argentina – AEA) imaged: Aristarchus, Aristillus, Herodotus, and several features. Trevor Smith (Codnor, UK – BAA) observed: Aristarchus, Censorinus, Copernicus, earthshine, Littrow, Mare Imbrium, Mons Piton, the north pole region, Plato, Posidonius, Prinz, Proclus, Römer, the south pole region, Tycho and several features. Bob Stuart (Rhayader, UK – BAA/NAS) imaged: Alphonsus, Archimedes, Arzachel, Cassini, Deslandres, Goldschmidt, Plato, Ptolemaeus, Rima Hadley, Thebit, Triesnecker, Vallis Alpes and W. Bond. Ivor Walton (via a Robotic telescope in Chile - BAA) imaged the Moon.

Level 2 – Example Observations Received

Proclus: On 2020 Dec 19 UT 17:00-17:25 Trevor Smith (BAA) Observed visually this crater under similar illumination to the following report:

On 1989 Feb 10 at UT 19:00? Edmonds (England) observed a "bright red coppery" colour in the north western part of Proclus crater. He checked and found that there was no colour elsewhere, though he still suspects that the effect was spurious colour. Cameron comments that usually blue is seen in the north and red in the south if due to spurious colour. The Cameron 2006 catalog ID=350 and the weight=3. The ALPO/BAA weight=2.

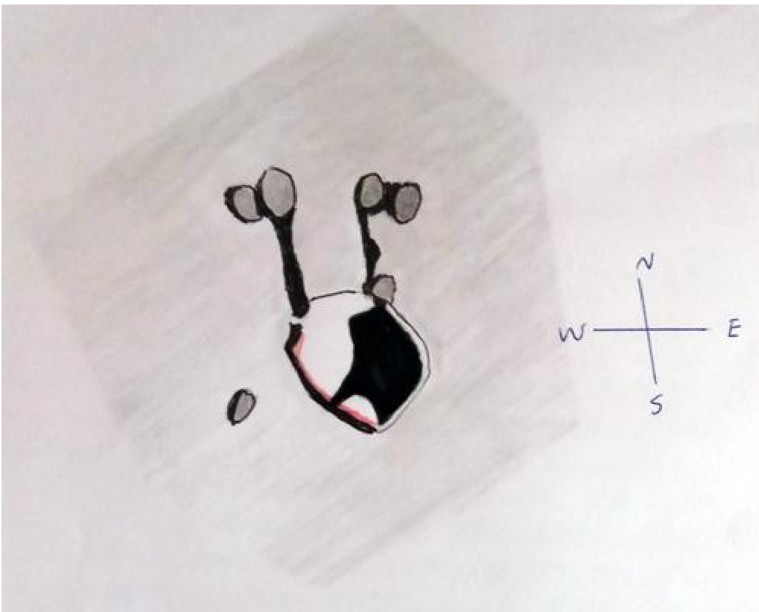


Figure 2. *Proclus as sketched by Trevor Smith (BAA) from 2020 Dec 19 UT 18:00-17:25.*

Trevor, using a 16" Newtonian reflector at x247 (Antoniadi III-IV seeing) commented that the usual pentagon interior shape to the crater was visible (Fig. 2). The inner W/SW wall was slightly reddish in the form of a thin red line that abutted the crater wall. Similar slight red colours were seen on some other craters too, He comments that this was probably the normal appearance for the crater.

Agrippa: On 2020 Dec22 UT 00:30-00:55 Jay Albert observed visually and Walter Elias (AEA) imaged 01:21-01:22 this crater under similar illumination to the following report:

Agrippa 1966 Nov 19/20 UT 23:58-00:14 Observed by Bartlett (Baltimore, MD, USA, 5" reflector x283, S=4, T=5) "Faint bluish tinge seen at base of NW wall beneath landslip" NASA catalog weight=4. NASA catalog ID #995. ALPO/BAA weight=3.

Figure 3. *Agrippa as imaged by Walter Elias on 2020 Dec 22 UT 01:21-01:22 and orientated with north towards the top.*

Alberto's colour image (Fig. 3) doesn't show a faint bluish tinge at the base of the NW wall. Jay was using an 8" Celestron NexStar (x226) under 6-7/10 seeing and magnitude 3 transparency, and found, as can be seen in Walter's image, that the west rim was brightly lit and that the floor was almost completely in shadow apart from a thin stretch of the floor at the base of the west interior wall. The east facing slope of the central peak was also bright and its peak cast a shadow that extended slightly beyond the shadow covering the floor from the E wall of the crater. There was no ‘faint, bluish tinge’ or other colour seen at the base of the NW wall at its base or elsewhere in or around the crater.

Aristillus: On 2020 Dec 27 UT 02:10 Leandro Sid (AEA) imaged this crater, and at 02:10-02:20 Albert Anunziato (SLA) observed visually under similar illumination to the following report:

Aristillus 1972 Dec 17 UT 21:50-22:20 observed by Berger (51.5N, 9E, 60mm refractor, T=2, S=3) "Diffuse bright cloud in the NE corner of the crater" - Hilbrecht and Kuveler, Earth, Moon & Planets, 30 (1984), p53-61.

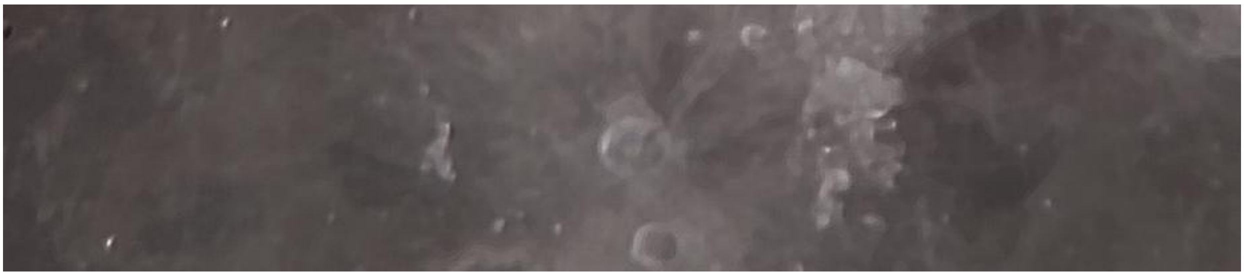


Figure 4. *Aristillus as imaged by Leandro Sid (AEA) on 2020 Dec 27 UT 02:10 and orientated with north towards the top.*

Figure 5. *A sketch of Aristillus by Alberto Anunziato (SLA) made on 2020 Dec 7UT 02:10-02:20.The image has been flipped and labels adjusted so that north is towards the top and west towards the left.*

Alberto, using a Meade EX 105at x97, made a sketch (Fig. 5) and commented that the crater had an extensive ray system that extended to the north and south and that the ray system to the north and south appeared diffuse. Perhaps the German observer from 1972, using a much smaller scope, mistook the diffuseness for a cloud effect? You can see this to some extent in Leandro’s image (Fig. 4) as well.

Level 3 - In Depth Analysis

Littrow and Proclus: On 2020 Dec 30 UT 20:50-22:00 Daryl Dobbs observed visually both craters and Trevor Smith (BAA) also observed visually: Littrow at 22:10-22:25UT and Proclus: 21:20-21:35, under similar illumination to the following reports:

Littrow 1915 Jan 31 UT 22:00? Observer: unknown (England?) "6 to 7 spots arranged like a gamma first seen on this nite. (Kuiper atlas. Rect. 14-c shows spots in form of a 7 or a cap. gamma backwards, but not l.c. gamma)". NASA catalog weight=0 (almost certainly not a TLP). NASA catalog ID #349. ALPO/BAA weight=1.

Proclus 1955 Nov 01 UTC 02:50-03:05 Observed by Bartlett (Baltimore, MD, USA, 3.5" reflector x100, S=6, T=5) "Proc. D normally 5 deg bright was vis. tonite only in blue light, whereas usually is vis. in integrated light. However, at col. 110.5 deg it was a dark spot (see #816) C.p. tonite was normal 5 deg bright but in Oct. lun. was dark". NASA catalog weight=4. NASA catalog ID #625. Note Proclus D does not refer to the crater Proclus D as defined by the IAU, but probably to a spot inside the crater that Bartlett designated D!

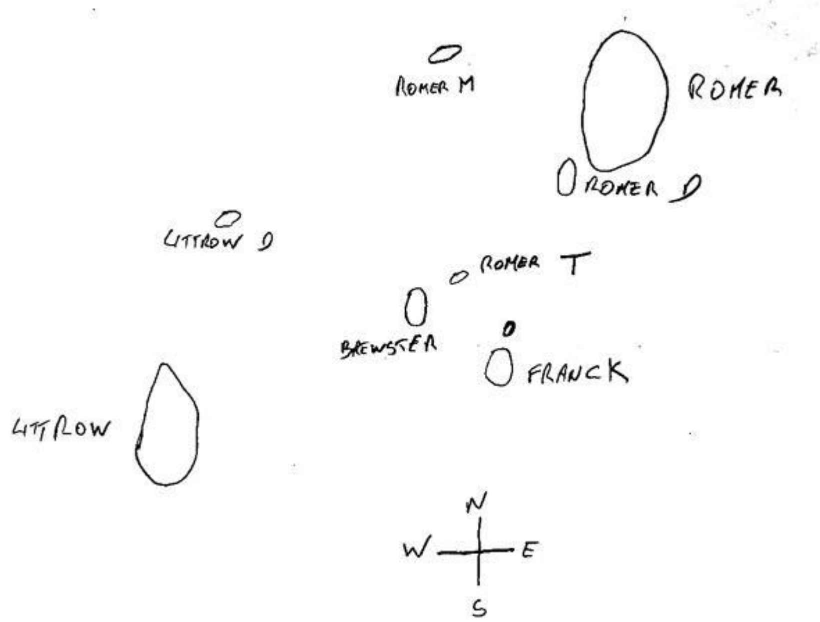


Figure 6. *Craters in the vicinity of Littrow as sketched by Daryl Dobbs on 2020 Dec 30 sometime during 20:50-22:00.*

Daryl's seeing conditions were Antoniadi II, and he was observing with a 10-inch Newtonian at x85 and x133. He had access to Wratten #12 Yellow, #23A Red, #58 Green and #80A Blue filters. For Proclus, the only part of the crater that was dark was a small shadow under the western wall on the crater floor. Daryl suspects that as the observer from 1955 was using a relatively small telescope, and low magnification, on Proclus that this shadow could easily have been misidentified as a small spot. However, when using his filters, Daryl found that the shadow under the wall wasn't at all obvious, but in blue the glare from the surface made it more pronounced. It was similarly more pronounced in yellow and green filters. Trevor, using a 16-inch reflector and much higher resolution, commented that no dark spots were seen and the crater and everything looked normal. I suspect with such a large telescope that the shadow looked like a shadow and not a spot. We shall lower the weight of the Bartlett report to 2 for now.

Daryl found Littrow (Fig. 6) to be slightly further away from the terminator with a higher sun angle. There were however a series of small craters between Littrow and Römer which Daryl thought, with a little imagination, could be perceived in the shape of the Greek letter ‘Gamma’. The base of this 'Gamma' was the crater Franck with a small unnamed crater adjacent - this smaller crater was not easy to see due to the glare from the bright lunar surface. Brewster and Römer T formed the middle of the 'Gamma' and Littrow D and Römer M the top of. All these craters had very bright ejecta blankets which make them stand out as very bright spots. Trevor Smith noted three bright spots on the floor of Littrow but did not comment about bright spots/craters elsewhere. I will lower the weight of the report from 1915 to 0 and remove it from the ALPO/BAA database.

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

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Conjunction of Moon, Jupiter and Saturn, 17 December 2020 (Alex Vincent)