Director: Bill Leatherbarrow

LUNAR SECTION CIRCULAR

Vol. 56 Nos 8-9 August - September 2019

FROM THE DIRECTOR

Because of travel and other commitments over the summer that impinge upon the normal LSC production schedule, this issue covers the two months of August and September. Moreover, in the Director's absence it has been prepared by Tony Cook and I am very grateful to Tony for taking on this extra work. We apologise for any inconvenience caused, particularly to those whose submissions do not appear in this issue because of the revised schedule. Fortunately, these temporary arrangements coincide with the northern hemisphere summer months, when observational activity is minimal.

Normal arrangements should resume for the October issue, so please continue to submit observations and other material in the usual way.

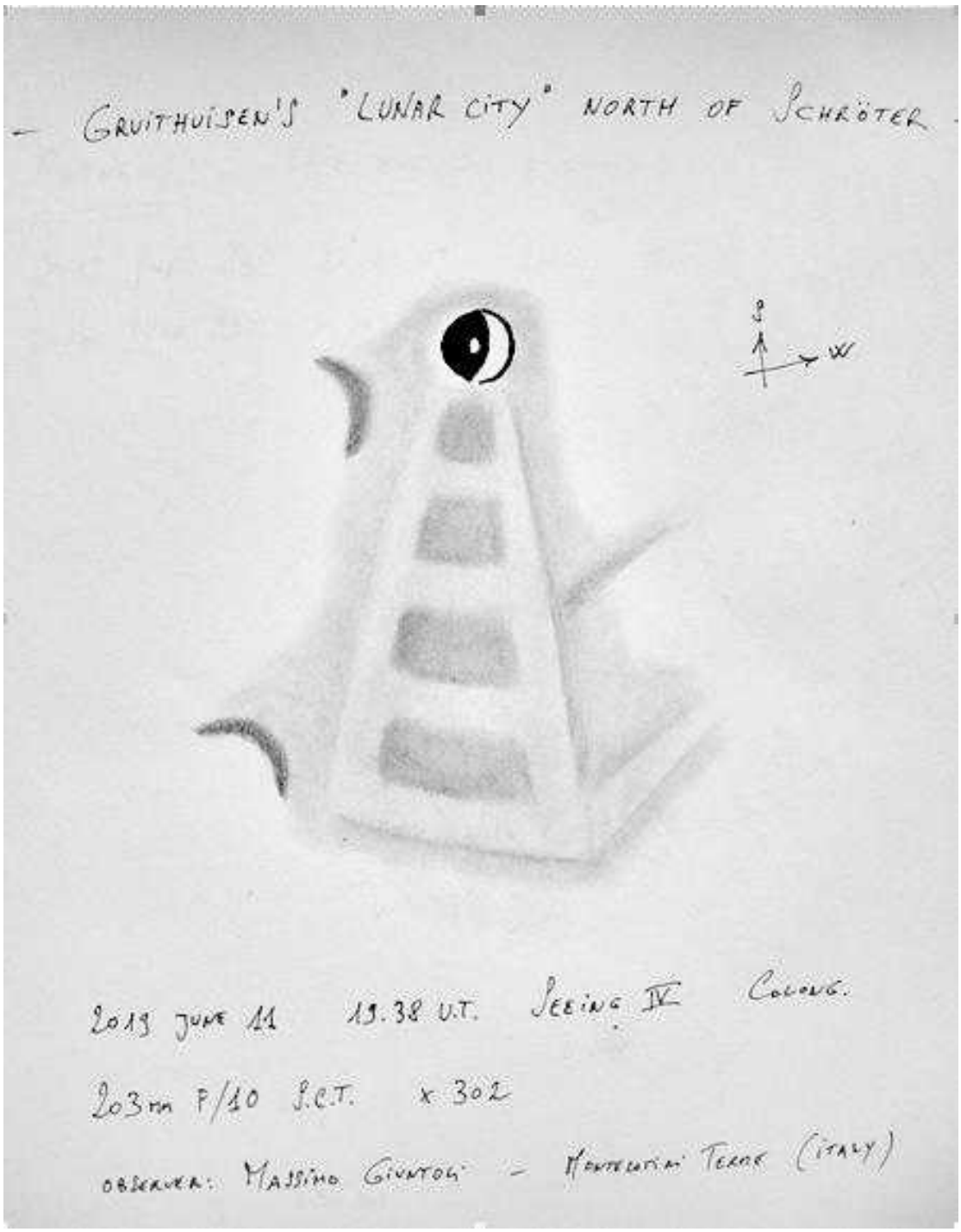
In the meantime, I wish you all a relaxing and enjoyable summer.

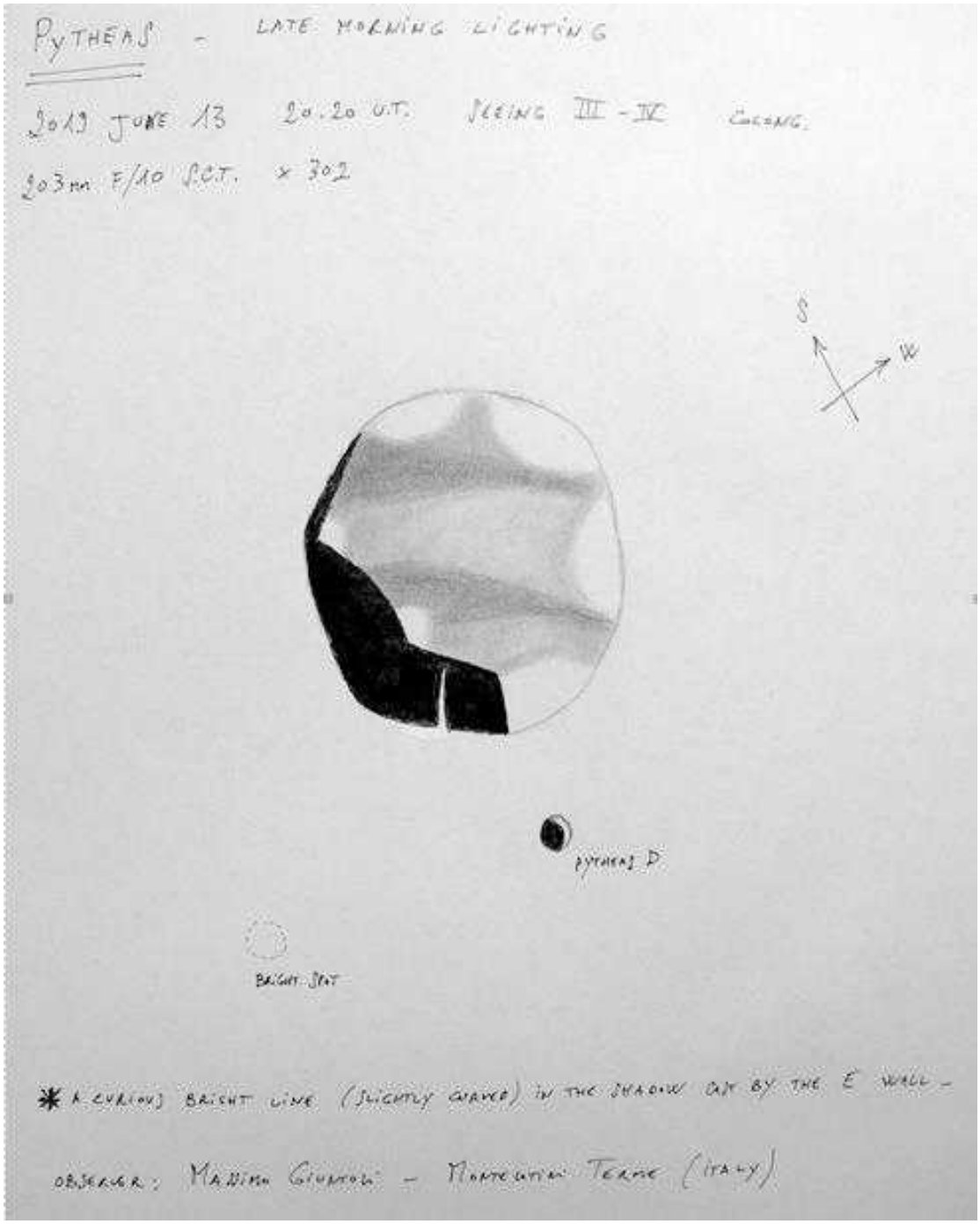
Bill Leatherbarrow

REGULAR OBSERVATIONS RECEIVED

Observations have been submitted by the following observers: Leo Aerts (Belgium), Massimo Giuntoli (Italy), Rik Hill (USA), Rod Lyon (UK), David Scanlon (UK), Bob Stuart (UK). We have had additional observations forwarded for the partial lunar eclipse from Tony Cook, Tim Haymes, Richard McKim, Damian Peach, Julien Quirin, David Scanlon, and Trevor Smith,

Massimo Giuntoli has sent in drawings of Gruithuisen's fabled 'lunar city' (see *The Moon: Occasional Papers of the BAA Lunar Section*, vol 4, 2017 – available via the Section website) and the banded crater Pytheas, made on 11 June 2019 and 13 June 2019, respectively. The colongitude value of the former was 18.9 and the latter 43.5.



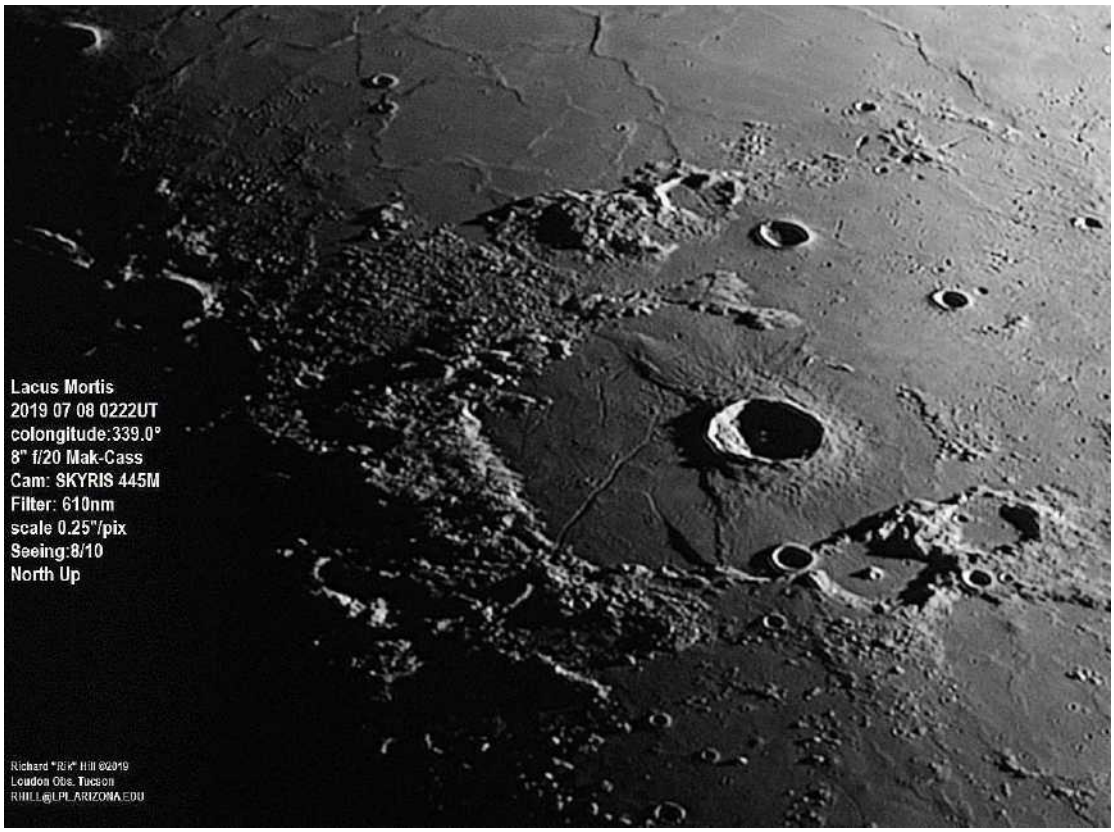

PYTHEAS - LATE MORNING LIGHTING
2013 JUNE 13 20.20 U.T. SEEING III - IV CLOUDS.
203mm F/10 S.C.T. x 302
S
W
PYTHEAS D
BRIGHT SPOT
* A CURIOUS BRIGHT LINE (SLIGHTLY CURVED) IN THE SHADOW CAST BY THE E WALL -
OBSERVER: MASSIMO GIUNTOLI - MONTECATINI TERME (ITALY)

Rik Hill has submitted several images and below we see a couple of his excellent examples:

'Just below and right of center is the 26km diameter crater Ramsden named for the famous 18th century instrument maker Jesse Ramsden who invented the Ramsden eyepiece which was a good advancement at the time he developed it, but in comparison to our contemporary eyepieces has fallen into disuse. It sits in the western reaches of Palus Epidemiarum surrounded by a system of rimae, known appropriately enough as Rimae Ramsden. Above it are two roughly equal sized 49km craters, Campanus left and Mercator to the right. Below them we can see half of Capuanus (61km) with the interesting mountains reaching west, out from the crater into the Palus. In the very upper right corner of the image you can catch sight of the mild swelling of Dome Kies Pi with the little pit in the summit. The Lunar Domes Atlas cites the diameter of this pit as 3.6km but it seems smaller in the LROC QuickMap images.

Above and slightly left (west) of Ramsden is a younger crater Dunthorne (17km); to the east of it, almost forming an equilateral triangle with these two craters, is the small double-walled crater Marth (7km). Use your high powers and enjoy the view of this crater in any telescope larger than 4" aperture. It looks like a little military fort sitting on the plain. Due west of Dunthorne and Ramsden is a large crater, near the terminator, with a small central peak. This is Vitello (43km) whose central peak is

very interesting, sitting on an elevated plateau left when the lavas that filled this crater slumped during cooling. It is unfortunately in shadow here. North and east of Vitello there is the isolated large mountain in Mare Humorum, Promontorium Kelvin and the ridge running from southeast of Vitello to east of P. Kelvin known as Rupes Kelvin. West of Ramsden is a nice little valley about 20km wide connecting M.Humorum and the Palus. It leads to the south end of a system of rimae that go north out of this image. These are the Rimae Hippalus that lead to the crater Hippalus outside the bounds of this image. The rimae are concentric to M. Humorum and are thought to have been formed during the cooling of the mare when the lava cooled and contracted.'



Sometimes unfavorable circumstances give you a fresh look at old features on the Moon. Such was the case for Lacus Mortis on this night when the libration was about as unfavorable as could be. Experienced lunar observers will immediately notice the foreshortening of this 155km diameter hexagonal lake with Burg (41km diameter) not quite in the middle. In this image the central peak of Burg is just starting to catch the first rays of morning light. The hexagonal shape is most notable on the west (left) side of the lake while the east side is more ruined by flooding lavas. The craters on the south shore of the lake are Plana (46km) on the left with a small central peak and Mason (44km) which are likewise notably foreshortened. Notice the interesting "V" shaped shadow on the floor of Plana. You can see the notch in the mountains that created this pattern by letting the sunlight through its valley. South of these two craters is a small bit of Lacus Somniorum. Notice the dome-like swelling below Mason. Even on the LROC Quick Map this appears much like a dome.

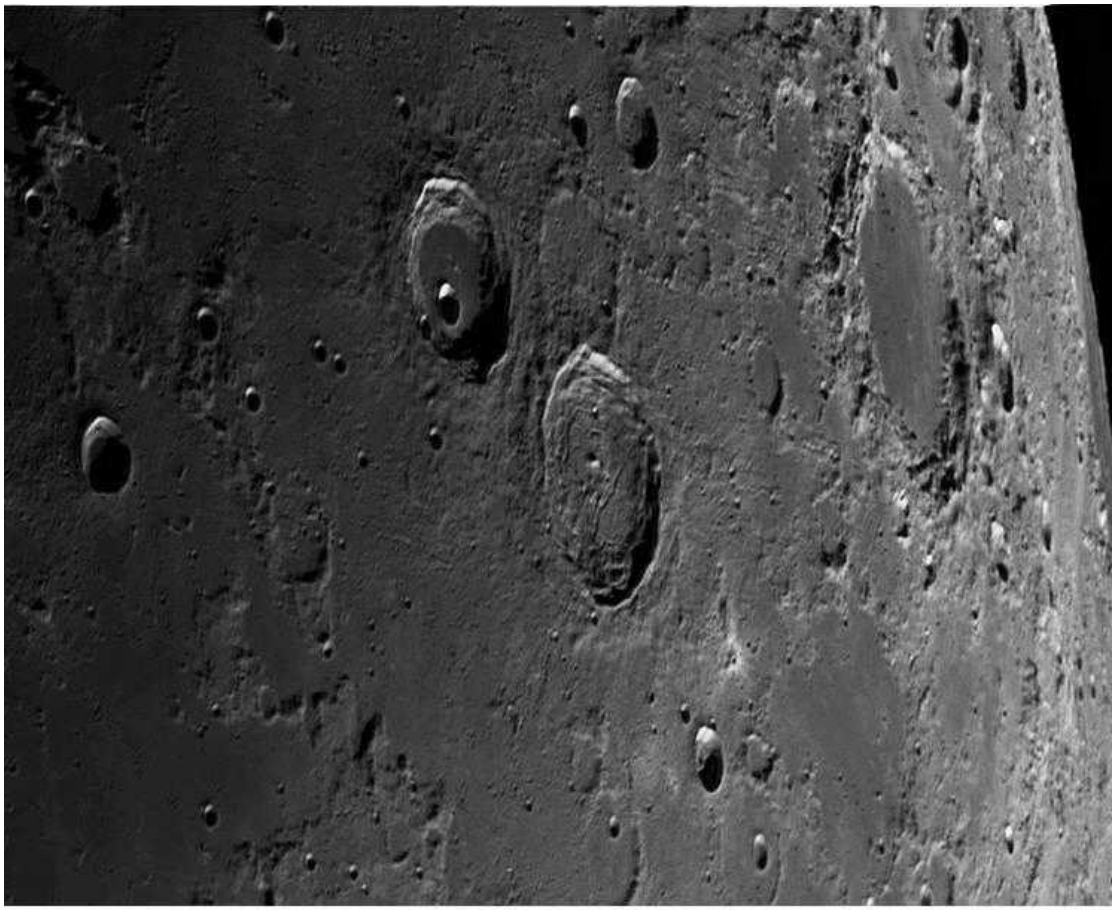
The floor of L. Mortis has a fabulous collection of rimae of different origins. On the bottom, about 40km west (left) of Plana is one rima casting a significant shadow. This

is a give away that it is a fault with vertical displacement, higher on the east side. Above it is one long rille or rima that runs from the southwest corner of the hexagonal walls to a mound north of Burg. In Wood's 21st Century Atlas of the Moon this is dubbed Burg Rille. And above this is a fragmentary rille of a different structure that is a line of small craterlets similar to Rima Hyginus but not as fresh. Careful examination will reveal other rimae in this area.

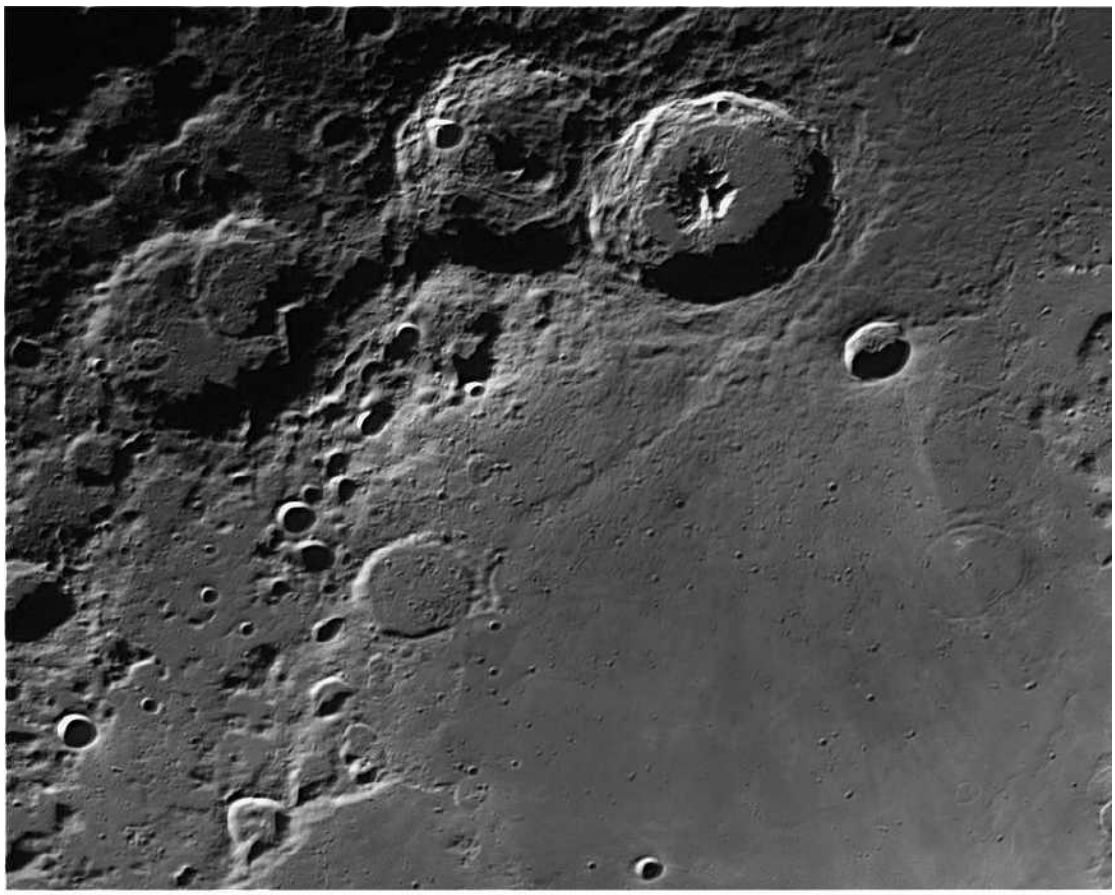
Before leaving this wonderful area note the crater directly above Burg. This is Baily (41km) and it too sports a fine unnamed rima on its floor. Above this are the many snake-like dorsa of a small portion of Mare Frigoris.

This is image was made from a single 1800 frame AVI stacked with AVIStack2 and further processed with GIMP and IrfanView.

Rod Lyon has captured a series of images during June, including the following two of Atlas/Hercules and the Theophilus trio:



Endymion, Atlas & Hercules 2019.08.06 - 20.52 UT
300mm Meade LX90, ASI 224MC Camera, with Pro Planet 742nm I-R Pass Filter. 1,600/4,000 Frames.
Seeing: 7/10, with some turbulence.



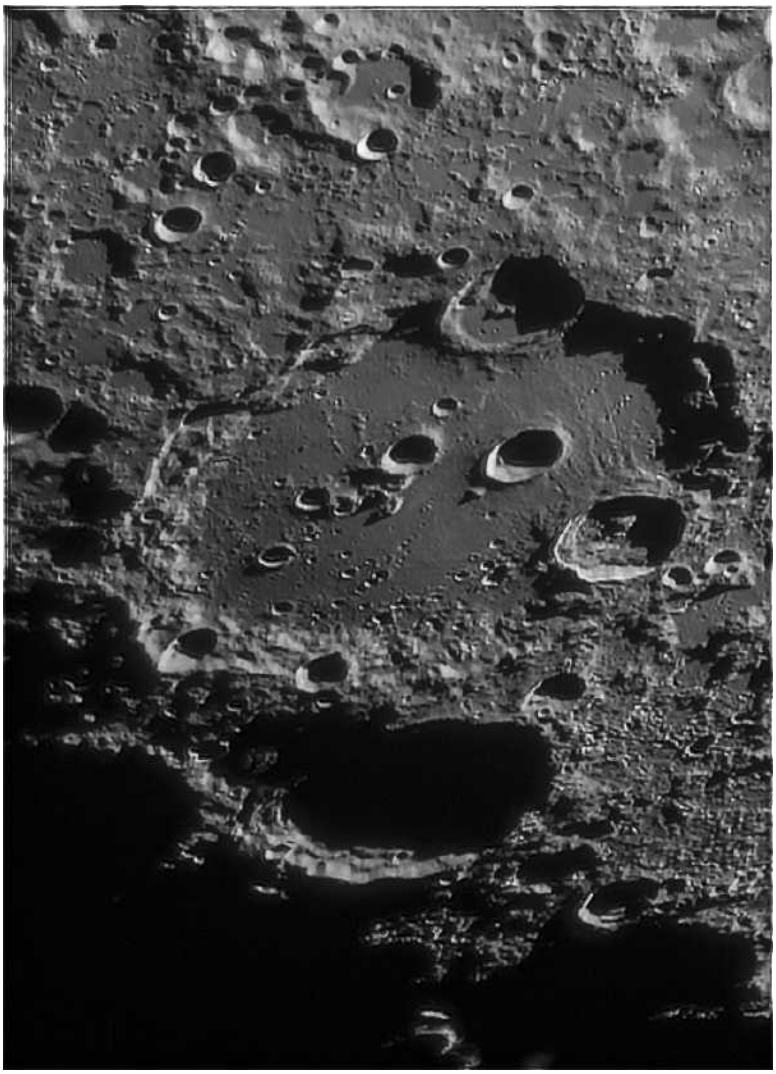
Theophilus, Cyrillus & Catherina 2019.06.08 - 20.43 UT
300mm Meade LX90, ASI 224MC Camera, with Pro Planet 742nm I-R Pass Filter. 1,200/3,000 Frames.
Seeing: 7/10 with slight turbulence.

David Scanlon to commemorate the Apollo 11 landing, took a nice colour image of Mare Tranquilitatis on 2019 Jul 21.

Bob Stuart has sent in several images that he has taken recently, or reprocessed.

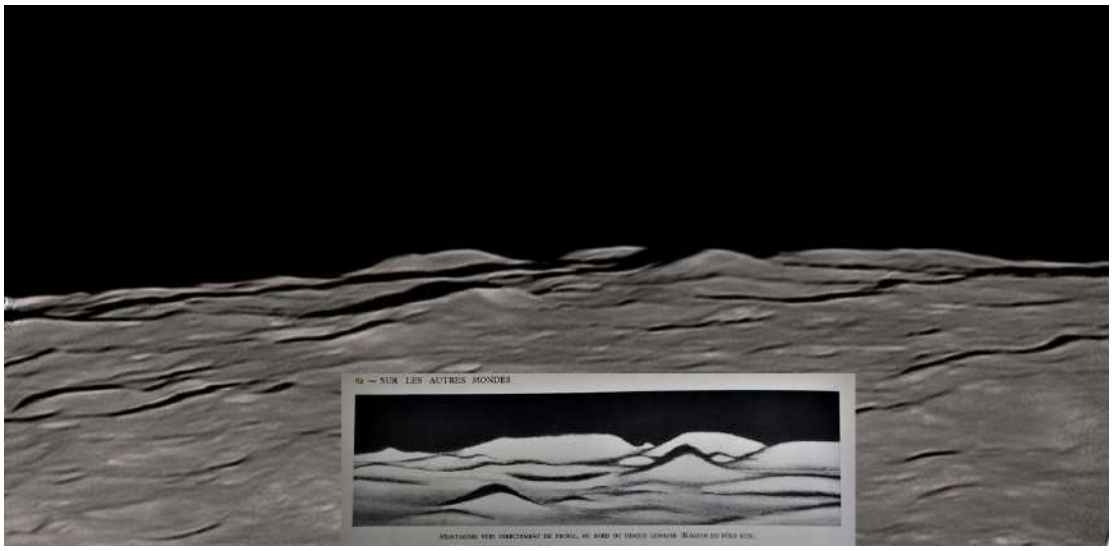
This covers the NE limb of the Moon and includes Gauss, Messala, Geminus and Cleomedes as well as the top most part of Mare Crisium. It was taken by Bob Stuart

on 2019 Jul 05 UT 20:08. A 20cm f5 Newtonian was used with: ZWOI 174MM & 3x Powermate and Astronomik ProPlanet IR filter. Stacked the best 5% of 5000 frames AS3! and wavelets Registax. Seeing about Pickering 6-7.



Bob Stuart took the above image of Clavius back in 2019 May 13 UT 20:37, but has now applied the “shake reduction” feature from Photoshop CC, during reprocessing of the observations and obtained a remarkable improvement in detail.

Leo Aerts has sent in some amazing resolution observations. Following on from the images of the Leibnitz mountains in last month's LSC, Leo has forwarded examples of some of his imagery from a few years ago:



A Leo Aerts image of the Leibnitz Mts, taken on 2017 Mar 12 compared to a sketch by Lucian Rudaux, made in 1930.

A close-up view of the Leibnitz mountains, taken by Leo Aerts image on 2016 Oct 23.

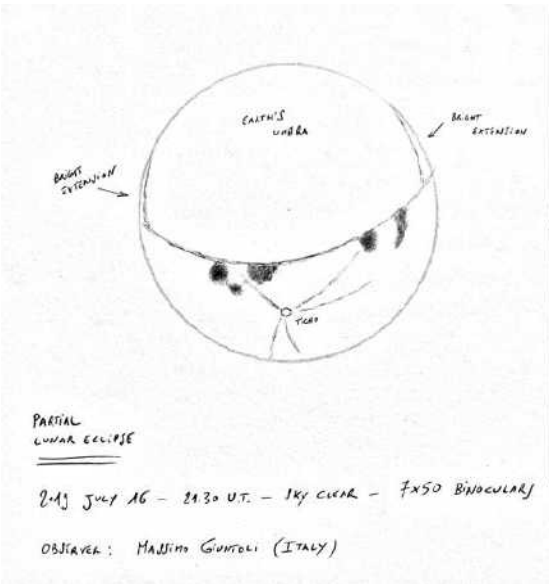
THE PARTIAL LUNAR ECLIPSE OF 2019 JUL 16

The following visual reports and digital images have been sent in:

From Trevor Smith: "The partial lunar eclipse of July 16th was just seen with the naked eye for a couple of minutes before it sank back into the clouds. In desperation I quickly wheeled out my 4-inch f 13 refractor and set it up in anticipation of a brief respite from the clouds. Twenty minutes later I was rewarded with a small gap in the clouds. Given this brief opportunity I pointed the 4-inch at the darkened lunar disc. I saw what must have been a record even for me, on the Antoniadi scale of 1 to 5, I

think I must be the first person to record a 6.The seeing was worse than appalling and I gave the tripod a good kick and put the telescope back in the garage. “

From Richard McKim, observing from the northern Czech Republic (Mnichovo Hradišt?): “The U1 time could be nicely determined, as I was located far to the east of Greenwich resulting in a much earlier moonrise at 18.59 UT. I could watch the moon from 19.47 UT onwards and I timed my first impression of umbral entry (flattening of the limb) with 10x50 binoculars as being at 20h02m02s UT. According to observations up to mid totality with the 10x50s and a 70 mm OG x27 there were always clear marial details visible in the umbra. There was no special colour effect except for the usual copper tint, and I would say that in terms of darkness it was an average or very slightly lighter than average eclipse. Generally, one sees the umbral details only so well with a total eclipse, when the eye is not dazzled by the uneclipsed part, so I think it may really have been a little lighter”.



An image by Peter Carson - taken from Leigh on sea Essex, UK taken with a Canon 60Da & a 60mm f/6 refractor

At 21:30, close to maximum eclipse, we can compare a visual drawing by Massimo Guintoli, made from Italy, with an image taken by Peter Carson of the UK. Massimo’s sketch is really interesting as it shows a couple of “apparent extensions” of the lighter penumbral part of the eclipse into the darker umbra at either side of the Moon. This effect was also caught in Peter’s image and it turns out that this is caused by the narrow strip of bright highland on the SW limb of the Moon and a thicker area of highland in the vicinity of Mare Crisium on the NE limb of the Moon.

Tony Cook captured this view of the eclipse from Newtown, Mid Wales, UK at 22:13 UT using a Lumix DMC-TZ80 compact camera f/6.4 ISO 1600 1/125sec exposure. Taken through thin cloud.

David Scanlon captured this image from the Isle of Man, UK at UT 21:53, showing nice detail in Tycho's rays in the lighter penumbral part of the shadow, using a Canon EOS 4500 with a 400mm telephoto, at f/5.6, taken with a 1/100s exposure and ISO 1600. Some low cloud present during the observation.

At 22:04 UT, Tim Haymes, Maidenhead, UK managed to capture this colourful umbral image under difficult observing conditions, using a 300mm telephoto on a Canon 70D camera.

Damian Peach, although affected by some thin high cloud, managed to take a picturesque view from Selsey, UK by combining exposures.

Julien Quirin, imaging from near Strasbourg, France, took a picture of the eclipsed Moon rising over some fields.

LUNAR DOMES (part XXX): the Arago region, a volcanic construct termed A11

Raffaello Lena

In this contribution I provide an analysis of another volcanic construct located to the south-east of Arago crater, where ten known domes, including the domes Arago α (termed A2) and Arago β (termed A3), are located (Fig. 1). Arago is a well-known crater located in the western part of Mare Tranquillitatis. Mare Tranquillitatis is situated on the site of an ancient pre-Nectarian impact basin [1-2]. As reported in [3] the older lavas in Mare Tranquillitatis are characterized by a lower Titanium content (reddish in colour ratio), while the youngest lavas erupted in the region are blue (higher Titanium content). A small volcanic feature near Arago is situated at longitude 22.04° E and latitude 5.40° N with a base diameter of 2.3km (Fig. 2). It is reported as a dome in the USGS geologic map I-510 [4] (Fig. 2) and has formed in basalts of relatively high TiO_2 abundance [1-2].

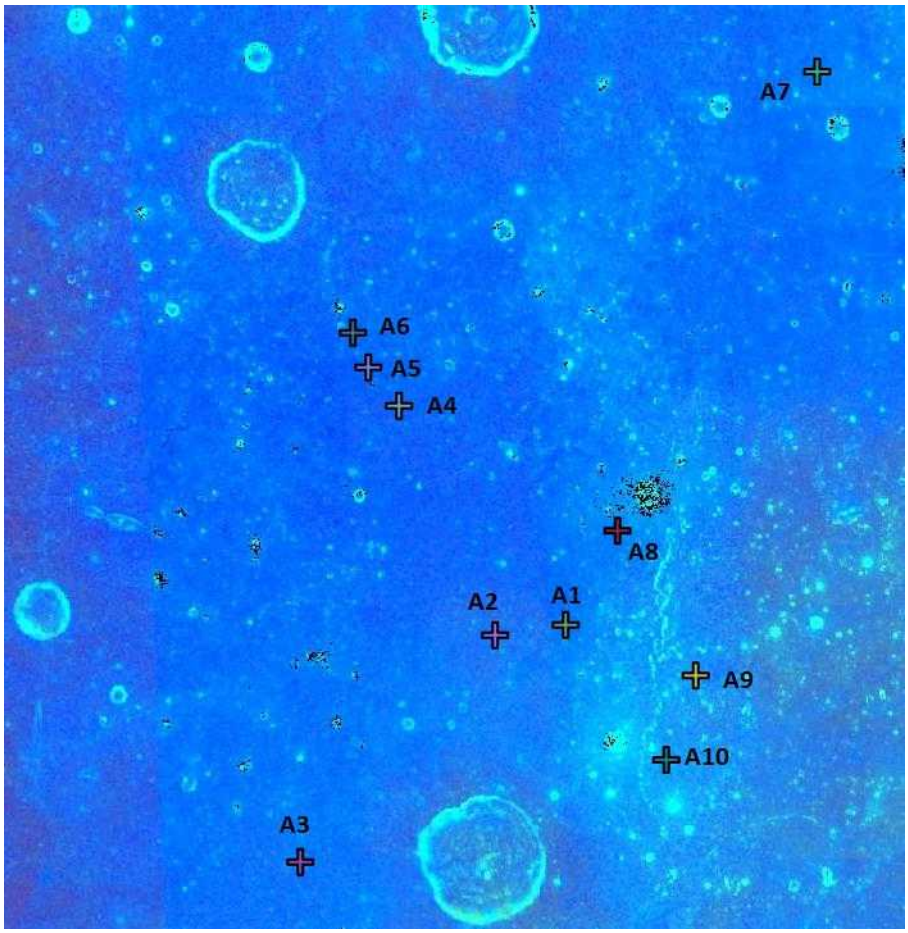


Figure 1. Clementine color ratio imagery of the Arago region including lunar domes. The domes A1-A10 are described in a previous LS circular by the author [5].

Using LOLA DEM the height of A11 was determined to 120±10m yielding a steep slope of 5.9°±0.5° (Fig. 3).

For the current study I have analyzed 10 CCD images by Pujic, Phillips, Pau, Wirths, Eskildsen, Leinen, and the author. Figure 4 displays the region around Arago crater under different solar illumination angles, including some images showing Arago 11 (A11). I have many more images in our archives. Another image by Pau, under oblique solar angle, is shown in Fig. 5.

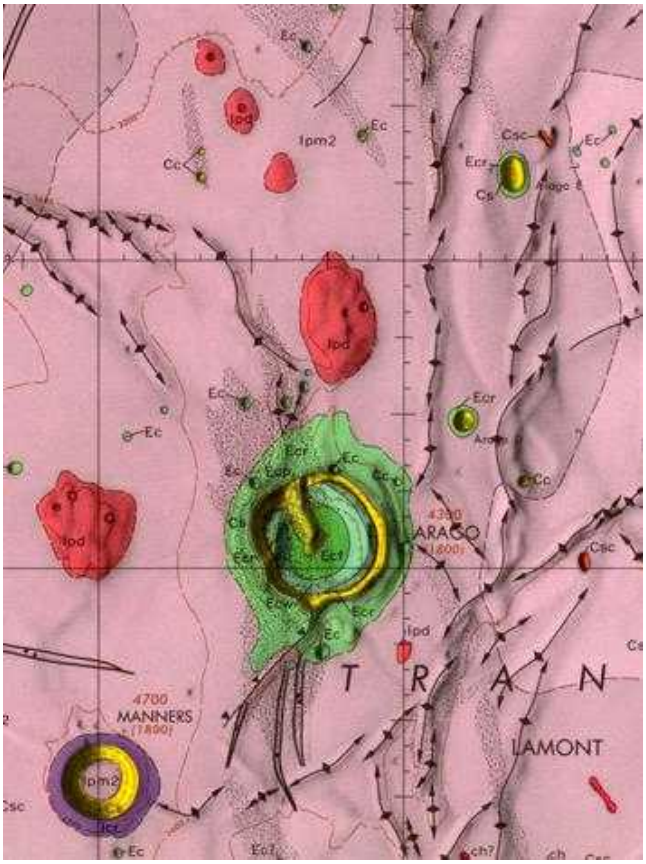


Figure 2. USGS I-510 with the examined dome termed A11, south-east of Arago.

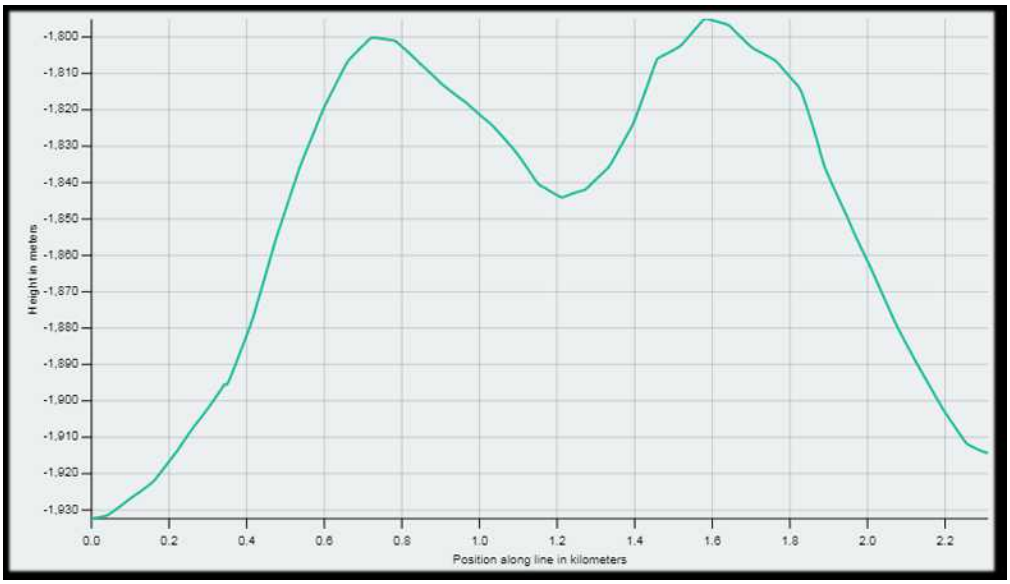


Figure 3. LOLA DEM. Cross-sectional profile in E-W direction of A11.

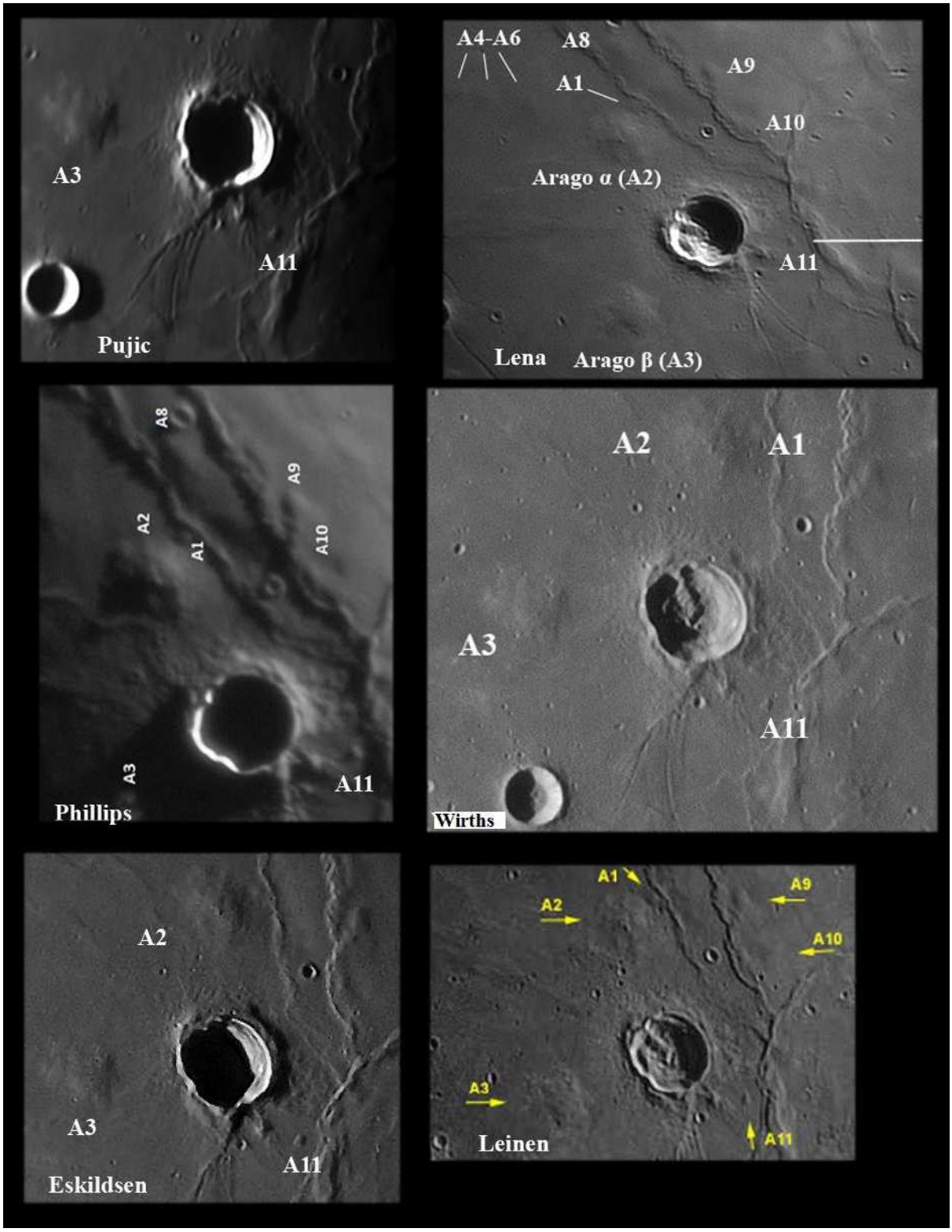


Figure 4. CCD telescopes images of the volcanic construct A11 by Pujic, Lena, Phillips, Wirths, Eskildsen, Leinen.

The examined volcanic construct, A11, is located near a basaltic irregular rise as shown in some images of Fig. 4 and in particular in the image by Pau (Fig. 5). Assuming a parabolic dome shape, the edifice volume corresponds to 0.22km³. The 3D reconstruction of A11 is shown in Fig. 6.

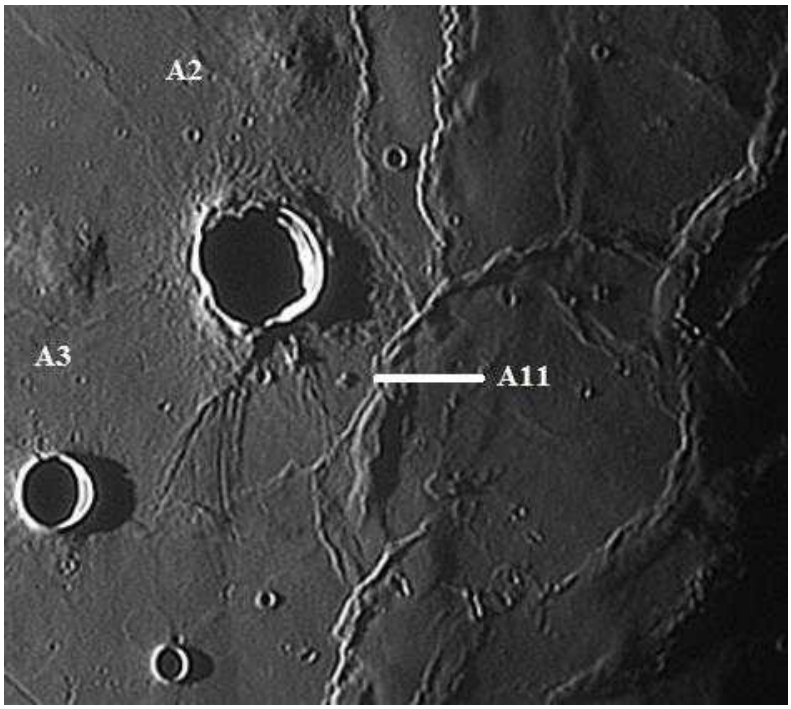


Figure 5. CCD telescope image by Pau of the dome under oblique solar illumination angle.

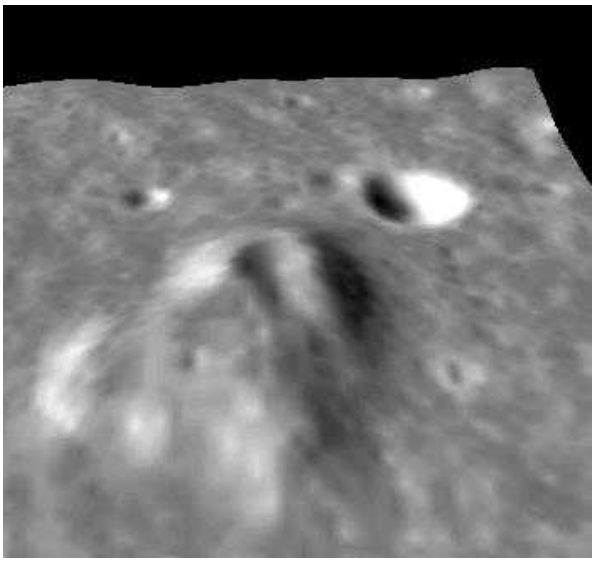


Figure 6. WAC draped on top of the global LRO WAC-derived elevation model (GLD100). The elevation of A11 corresponds to 120 m. The vertical axis is 7 times exaggerated.

Note the presence of a lava channel running across the southern rim (Fig. 6). The central crater pit has a diameter of about 800m and is 45m deep: A NAC image of A11 is shown in Fig. 7. The Clementine UVVIS data reveal that A11 appears

spectrally blue. It has a 750 nm reflectance of R_{750} = 0.0939, a moderate value for the UVVIS colour ratio of R_{415}/R_{750} = 0.6494, indicating high TiO_2 content and a weak mafic absorption with R_{950}/R_{750} = 1.0488.

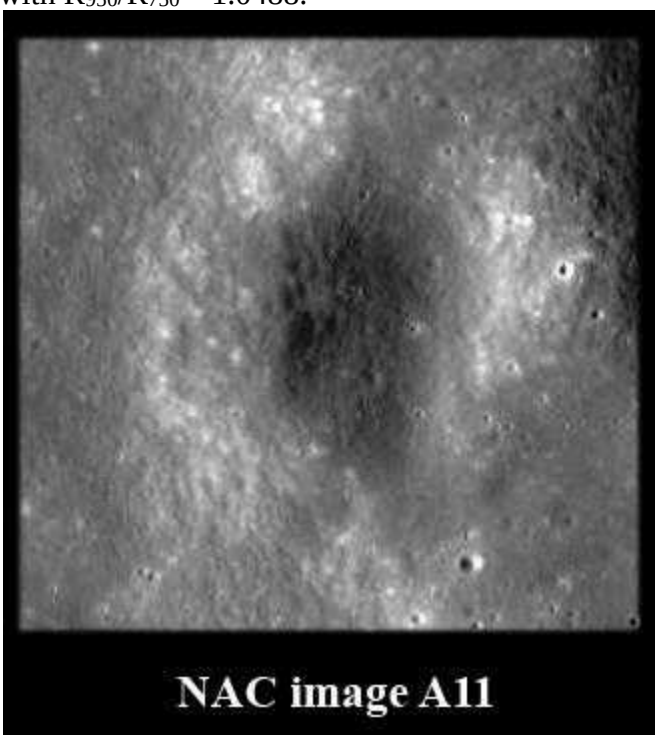


Figure 7. NAC image of A11.

Note that it is a breached volcanic feature (Figs 6-7), a characteristic shared by further lunar cones. It can be compared with the cones Isis and Osiris. Isis, located in Mare Serenitatis (18.96°N, 27.48°E), is a 1.7km diameter cone that is also C-shaped, smooth-sided, and has a gap and a lava channel. Isis is 60m in height and has a slope of 4.0°. Osiris is another similar volcanic construct ~2.3km in diameter, located southeast of Isis (18.64°N, 27.64°E). It does not have a gap in the cone wall.

Unfortunately, no spectral data from Chandrayaan-1's Moon Mineralogy Mapper (M^3) are available for a full spectral analysis of this steep volcanic construct.

Thus, it is likely A11 is a possible lunar cone or, alternatively, it could be a steep (and unusual effusive) dome in Mare Tranquillitatis belonging to class E_1 with a tendency towards class A.

References:

[1] Wilhems, D. 'The geologic history of the Moon', USGS Prof. Paper 1348, 1987.

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

[3] Rajmon, D., Spudis, P., 2001. 'Distribution and stratigraphy of basaltic units in Mare Tranquillitatis', Proc. Lun. Plan. Sci. Conf. XXXII, paper 2156.

[4] USGS Geologic Map I510 https://www.lpi.usra.edu/resources/mapcatalog/usgs/I510/72dpi.jpg

[5] Lena, R. 2017. 'Lunar Domes (part VIII): Domes in the Arago region', BAA LS Circular vol. 54, 1, January 2017, pp. 9-16.

OCCULTATION NEWS Aug-Sep 2019 Tim Haymes

Partial Umbral Eclipse July 16

The writer took a range of exposures of the partial Umbral phase for his album, but no occultations were timed. Conditions were not as clear as might be expected, with lingering cloud present but the eclipse was well presented offering some good photo opportunities. It was also a fitting tribute for the Apollo 11 50th anniversary launch.

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

2019 Aug. and Sept. predictions for Manchester (Occult4 by D. Herald).

W. Longitude 002d 15', Latitude +53 25', Alt. 50m;

y	m	day d	Time h m s	P	Star No	Sp	Mag v	r	% ill	Elon	Sun Alt	Moon Alt	Az	CA o	Notes
19	Aug	9	20 33 51.2	D	184634	G8	7.7	7.1	72+	116	-6	16	192	39N	Dbl* dT +0.46s
19	Aug	10	22 43 9.0	D	2549	F0	6.6	6.4	81+	129		10	209	27N	Dbl* dT +0.23s
19	Aug	11	22 41 37.0	D	2709	F5	6.7*	6.4	88+	140		12	197	73N	
19	Aug	11	22 44 35.0	D	2706	B8	5.8	5.8	88+	140		12	198	19S	
19	Aug	17	2 15 6.5	R	3358	K2	6.9	6.1	98-	163		24	194	83N	75 Aqu
19	Aug	17	23 16 5.8	R	3480	F5	7.2	6.9	94-	153		19	136	39S	
19	Aug	18	3 15 52.3	R	3490	F8	7.2	6.9	94-	151		27	200	87S	
19	Aug	19	2 11 29.7	R	128739	A0	7.4	7.4	89-	141		33	170	45N	
19	Aug	22	0 47 14.3	R	110646	G5	8.4	7.9	65-	108		25	109	88S	
19	Aug	23	3 41 59.6	R	93467	F8	8.7	8.3	55-	95	-11	45	139	53N	
19	Aug	24	0 57 38.1	R	93845	G8	8.3*	7.9	45-	85		19	87	51S	
19	Aug	24	1 32 22	m	93860	G8	8.5	8.1	45-	84		25	93	9N	
19	Aug	24	3 4 37.6	R	93882		8.9*	8.1	44-	84		38	113	62N	
19	Aug	24	3 32 19.1	R	93894	G0	8.9*	8.6	44-	83		41	120	44S	
19	Aug	24	3 54 9.4	R	648	G8	3.8*	3.3	44-	83	-10	44	126	81S	delta 1 Tau
19	Aug	24	4 14 58.7	R	653	A7	4.8*	4.7	44-	83	-7	46	132	35S	delta 2 Tau
19	Aug	25	2 25 27.5	R	783	G0	7.7	7.4	34-	72		27	92	69N	
19	Aug	25	2 43 32.3	R	94421	B8	8.1	7.8	34-	72		29	95	80S	
19	Aug	25	2 46 9.5	R	77064	K2	7.8*	6.9	34-	72		30	96	64N	
19	Aug	25	3 12 55.3	R	77076	A3	7.6*	7.4	34-	71		34	101	79N	
19	Aug	25	3 33 41.9	R	790	F7	6.8*	6.6	34-	71		36	106	86N	CD Tau (var)
19	Aug	25	3 35 39.2	R	94446	F5	8.7*	8.4	34-	71		37	106	57S	
19	Aug	25	4 23 50.9	R	793	G8	6.2	5.6	34-	71	-7	43	118	72S	
19	Aug	26	0 21 8.6	R	78006	F0	7.3		25-	60		3	58	88N	
19	Aug	26	1 4 38.2	R	78056	F0	8.3	8.1	25-	60		8	66	64S	
19	Aug	26	1 28 34.3	R	78074	B1	7.4	7.2	25-	59		12	70	50N	
19	Aug	26	2 28 31	m	78129	K0	7.0*	6.4	24-	59		20	80	10N	
19	Aug	26	3 31 51.4	R	78161	K0	8.9	8.3	24-	58		29	93	64N	
19	Aug	26	3 58 55.6	R	78179	A5	8.7	8.5	24-	58	-10	33	98	90N	
19	Aug	27	1 34 30.9	R	79174	G5	7.3	6.7	15-	46		5	60	10S	
19	Aug	27	3 25 23.5	R	79242	G5	8.6	8.4	15-	45		20	80	79N	
19	Aug	27	4 17 6	m	1110	F0	3.5*	3.3	15-	45	-8	27	89	10N	delta Gem
19	Aug	28	3 35 46.8	R	80101	M0	8.6	7.7	7-	32		12	72	88S	
19	Sep	2	19 58 58.3	D	1978	K0	6.6*	6.1	16+	48	-10	5	251	88S	88 Vir

Predictions up to September 5th

Delta Gem Graze on August 27th:
This is perhaps one of the best graze predictions of 2019, a bright star and crescent Moon. The track passes over Coventry, NE to SW. There is no graze at Birmingham or Manchester. (Northern Limit)

Notes on the Double Star selection.

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

Key:

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

Star No:

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

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

LUNAR GEOLOGICAL CHANGE DETECTION PROGRAMME, 2019 Aug-Sep

Tony Cook

Reports have been received from the following observers for Jun: Jay Albert (Lake Worth, FL, USA - ALPO) observed: Agrippa and Alphonsus. Alberto Anunziato (Argentina – SLA) observed Aristarchus, Kant, Mare Crisium, and Proclus. Maurice Collins (New Zealand – ALPO/BAA/RASNZ) captured some whole disk images of the Moon. Valerio Fontani (Italy – UAI) imaged: Censorinus, Plato and Tycho. Trevor Smith (Codnor, UK – BAA) observed earthshine, Hecataeus, Kant, Mare Crisium, Messier, Picard, Proclus and several other features. Franco Taccogna (Italy – UAI) imaged Plato. Aldo Tonon (Italy – UAI) imaged Censorinus, Plato, and several features.

Reports have been received from the following observers for Jul: Jay Albert (Lake Worth, FL, USA - ALPO) observed: Censorinus, Curtis, Pytheas, Plato, and Swift. Tony Cook (Newtown, UK – ALPO/BAA) imaged the partial lunar eclipse. Walter Elias (Argentina – AEA) imaged: Boussingault, Mare Nectaris, Menelaus, Proclus, Theophilus, and several features during the partial lunar eclipse. Cian Gonzalez (Argentina - AEA) imaged Picard. Facundo Gramer (Argentina – AEA) imaged Promontorium Fresnel. Avril Micaela Elias (Argentina – AEA) imaged Schmidt. Rik Hill (Tucson, AZ, USA – ALPO/BAA) imaged Atlas, Lacus Mortis and the Apollo 16 landing site area. Walter Latrónico (Argentina – AEA) imaged Aristarchus. Alan Trumper (Argentina – AEA) imaged Plato. Julien Quirin (France) imaged the lunar eclipse. Thierry Speth (France) imaged Alphonsus, Aristarchus, Eratosthenes, Montes Teneriffe, Rumker, and Tycho. Robert Stuart (Rhayader, UK – BAA) imaged: Bela, Buckhardt, De La Rue, Endymion, Furnerius, Geminus, Helmholtz, Humboldt, Lame, Langrenus, Mallet, Mare Crisium, Neumayer, Petavius, Vega, Vendelinus, and several features.

News: The launch of Chandrayaan-2, India's 2nd lunar mission, was delayed a few days until 2019 Jul 22nd. However, it is now enroute to the Moon, due to arrive in September time. It consists of an orbiter, a lander and a rover. The latter two should land on Sep 6/7. They are intended to explore the primary site midway between Simpelius and Manzius (or between Manzius C and Boguslawsky C), or if decided otherwise aim for a backup site further to the west, midway between Klaproth and Gruemberger. Keep an eye open for details of when the landing will be as its always worth monitoring such events using a telescope, just in case dust clouds get kicked up for some reason.

Kevin Kilburn (BAA) has sent in an image showing how it is possible to drape a colour image (without shadow) over a monochrome image (with shadow) in order to compare the location of colour with topography. He reminds us that a special technique for this "colour draping" was devised by Drs Phil Masding and Andrew Fearnside, some eight to nine years ago, and even took into account the difference in viewing angles (libration) between the colour and monochrome images.

Peter Anderson (Australia – BAA) has emailed me a set of PowerPoint slides which illustrate what we talked about last month, namely how atmospheric seeing can play havoc with brightness estimates of small bright mountain peaks and slopes.

Jason Wentworth (ALPO) emailed about the possibility of using Rocket Lab's new Photon modular spacecraft, with a tiny optional; third stage, to put a home-made CubeSat into a figure of "8" orbit around the Moon – the idea being the probe takes images at the Moon and every figure of "8" pass by the Earth dumps images to the ground using a relatively small low power antenna. The figure of "8" type of orbit has been used quite successfully in the past by Apollo 8 and the Soviet Zond missions. Apart from the launch cost, the CubeSats are now down to just a few thousand pounds/dollars to purchase. I guess it won't be that many years before the Lunar Section has its own Moon mission!

TLP reports: No TLP were observed in Jun-Jul, though there was one report of a binocular sighting of a flash on the Moon, seen with binoculars on 2019 Jul 08 UT 01:35 by R.A. Jiménez (Venezuela – LIADA) - near Pickering crater. The flash was about 4th magnitude, the colour was white and the duration 1/10th sec or shorter. This was either an impact flash, sun-glint off some space junk, or possibly just the detection of a cosmic ray air-shower event by the human eye. Was anybody else observing then? Thanks to Alberto Anunziatio (SLA) for alerting me about this report.

I also received some images from Walter Elias, and other AEA observers, which appear to show some shadow (or at least shading) on sides of some lunar features, during the lunar eclipse. The effect is not present on all features – in fact less so the further away one gets from the umbral edge. Of course, during a lunar eclipse, we have effectively Full Moon (zero phase angle) illumination, which means no shadow apart from the Earth's umbra/penumbra – but nevertheless you can see some shadows mostly to the east of some features in Fig 1 Another good couple of examples can be seen in Figs 10 & 11. Although I cannot rule out over-sharpening, it is curious that the effect is directional. Walter says that "Autostackkert" was applied to 30 sec worth of video, followed by wavelet application from "Registax". Possibly what is happening here was that because image stacking was used from 30 sec worth of video, the Earth's shadow has moved several km during this time and this confuses the stacking software. However, Walter also found that the effect is visible when he processed just 3 frames? So, I would be interested to see if other observers have found similar effects during this eclipse, or past ones, where they have taken high resolution video/imagery of the surface. Please let me know what you find?

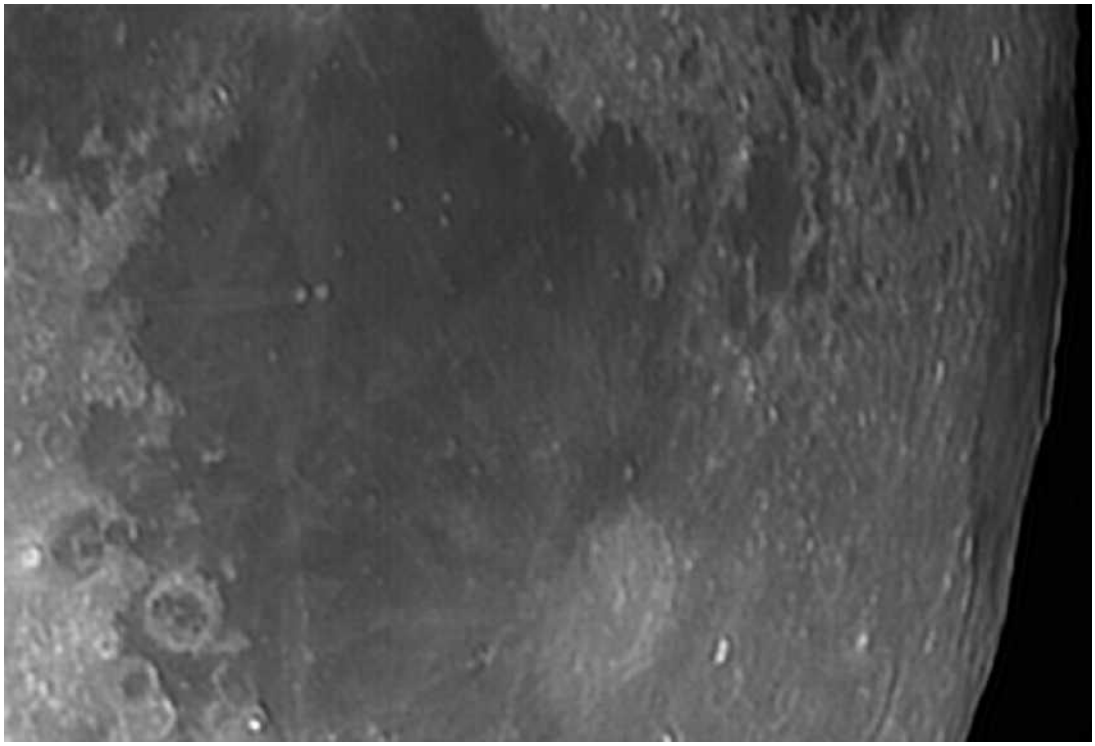


Figure 1. *Mare Fecunditatis as imaged by Walter Elias (AEA) on 2019 Jul 16 UT 23:15 Image is orientated with north towards the top.*

Lastly, again, not a TLP but K.C. Paul (Hong Kong) sent in a high-resolution image of Petavius which apparently shows a 2nd rille (Fig 2 – Centre) almost (but not exactly) parallel to the main rille. I used our archive of ALPO/BAA observations and came up with a similar illumination image (Fig 2 – Left) by Bill Leatherbarrow (BAA) and this just about shows the parallel rille. There is of course the possibility that this might be due to over processing, but you can see an intersection with the rim in the west quite clearly on K.C.'s and Bill's image. The 2nd rille is not quite parallel and if it was due to over processing it should be stronger in more contrasty areas, which it is not. K.C. also provided a raw image (not shown here) which also shows the 2nd rille quite plainly. Oddly if you look at LRO LOLA topographic data in a perspective view from the north east, looking south west, you see no obvious sign of the 2nd rille here, but instead a drop in level the floor of the crater - going from high south of the main rille to low north of the main rille. However, there are some hill crests present which might form one side of the secondary rille. Using the observations mentioned above, and another mentioned by Raffaello Lena (2019 Mar 23 UT 00:53), the secondary rille seems to appear between selenographic colongitudes of 108°-113°. Please check your past imagery and see if you have detected something here or not? I will be adding Petavius to the Lunar Schedule website to encourage more high-resolution imagery of this area so we can establish for sure if the secondary "parallel" rille is there or is an artefact of processing.

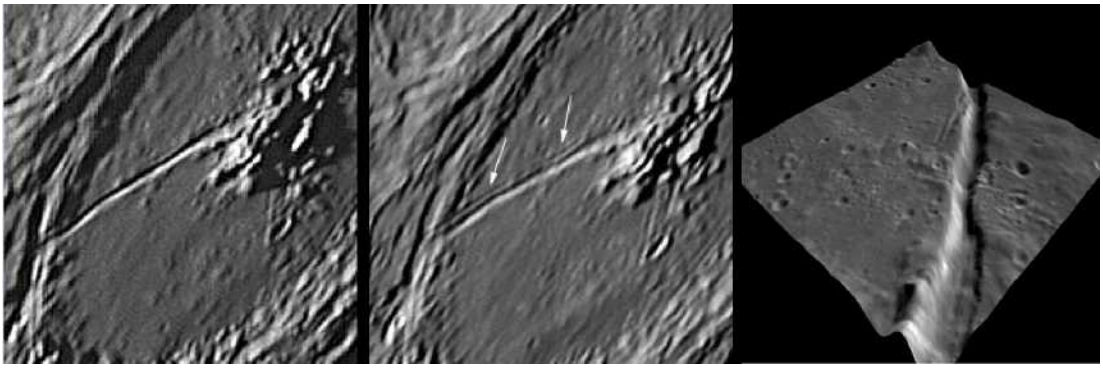


***Figure 2**. Petavius **(Left)** an image by Bill Leatherbarrow taken on 2015 Nov 28 At UT 03:29. **(Centre)** an image taken by K.C. Paul on 2019 Jul 18 UT 17:15 – the two arrows indicate the position of a possible 2nd parallel rille. **(Right)** A NASA Quickmap LRO 3D view with vertically exaggerated terrain, looking along the main rille in Petavius in the direction towards the south west.*

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

Kant: On 2019 Jun 08 UT 21:45-21:50 Alberto Anunziatio (SLA) and at UT 21:58-22:02 Trevor Smith (BAA) observed this crater visually under similar illumination conditions, to within ±0.5°, the following report:

Kant 1873 Jan 04 UT 23:00? Observed by Trouvelot (Cambridge, Mass, 8" refractor) "Luminous purplish vapors" NASA catalog weight=3. ALPO/BAA weight=3. NASA catalog ID #180.

Alberto, was using a 105 mm. Maksutov-Cassegrain (Meade EX 105) from the southern hemisphere and reported the crater as looking perfectly normal to his eyes. Trevor, using a 16" reflector (x94 & x247) under poor (Antoniadi IV) seeing conditions, examined the crater just a few minutes later, from the Earth's northern hemisphere, and noted that no luminous vapours were visible or anything else unusual! According to Patrick Moore ("The Moon", Vol 6, No. 1, p008), Kant's "vapours" were more like a mist obscuring details in the crater, but unfortunately nobody else was observing at the same time in order to be able to confirm Trouvelot's account. We have covered repeat illumination observations of this crater before in the 2012 Aug (p16) and 2018 May (p22-23) newsletters.

Readers who are unfamiliar with this French Astronomer, maybe interested to learn that Trouvelot was involved in politics in France but fled to the US when Napoleon III came to power. Apart from being an astronomer he was also interested in silk production and introduced the Gipsy Moth to the States, which then ended up becoming an invasive species. He then worked at Harvard College Observatory and the US Naval College Observatory, before returning to France to the Meudon Observatory, by which time the severe crop damage caused by the release of the Gypsy moth was beginning to become apparent. Readers interested in a more detailed history of Trouvelot would do well to read Nigel Longshaw's BAA Journal article. We shall leave the weight of this report at 3 for now as it is not apparent what might have caused this effect seen in 1873.

Alphonsus: On 2019 Jun 10 Jay Albert (ALPO) observed visually this crater under similar illumination, to within ±0.5° to the following report:

Alphonsus 1965 May 08 UT 05:47-05:59 Observed by McLaria (Huntsville, Alabama, USA, 16" reflector, S=9) "Light flashes on c.p. color detected by Trident M.B." NASA catalog weight=5. NASA catalog ID #875.

Jay was using a Celestron NexStar Evolution 8" SCT (x51, x226 & x290) with the Moon high in the sky and seeing at 7/10, however the transparency was quite poor. He found that the floor of the crater was completely in shadow, the west rim was just catching the sunlight, and the central peak were visible and bright with a fainter peak within the shadow and to the south. No flashes were seen in the central peak area or elsewhere around the crater. He did however notice that using Wratten 25 (red) and 44A (blue/green) filters that both of the visible central peaks were significantly brighter through the red filter. A visual check without filters though showed that no colour was visible. I think in view of the really poor transparency, there must have been a lot of scattered light and this affects shorter wavelengths (blue) more than longer wavelengths (red), therefore the effect was caused on our side of the atmosphere. We shall leave the weight of this report at 5 as the 1965 report was made with a Trident Moon Blink device.

Plato: On 2019 Jun 13 UAI observers imaged the crater under both similar illumination and viewing angle (to within ±1.0°) to the following reports:

Plato 1982 Jun 02 UT 22:00. Mobberley could not see the central craterlet on the floor of Plato tonight. Foley notes that he could only just see the central craterlet on nights of 2-5th Jun and it was of reduced in brightness from normal. North reported that the floor seemed nearly black, but brighter in a green filter (x144 magnification used). All three observers compared the Plato area to other areas for reference. All the above seems normal, apart from the floor being brighter in the green filter. Cameron 2006 extension catalog ID 170 and weight=5. BAA/ALPO weight=2.

We have covered repeat illumination for this feature before in the 2015 Oct (p12-13), and 2016 Oct (p18-19) newsletters. In Franco's images we can see a nice relationship between seeing conditions and the visibility of the central craterlet in Fig 3 – so the sharper the seeing, the more visible the central craterlet, though even in the sharpest of the images it is still not that prominent, in agreement with what Martin Mobberley and Peter Foley reported.

Figure 3. *2019 Jun 13 monochrome red #21 filter images of Plato taken by Franco Taccogna (UAI), and orientated with north towards the top.* ***(Left)*** *19:21 UT.* ***(Centre)*** *20:08 UT.* ***(Right)*** *20:35 UT.*

So that nicely clears up the mystery over the poor visibility of the central craterlet. What about: Gerald North reporting the floor as being black visually, but brighter in a green filter? Again, we have the UAI to help us clarify what the colour ought to be like. Firstly, Franco Taccogna captured the crater through four colour filters: red #21, green, blue and near IR 685. In Fig 4 you can see Franco's images in red, green and blue light respectively, showing no obvious difference in the darkness of the floor – so it's doubtful that colour difference would be detected visually under normal circumstances. However just to check I have colour normalized, then saturation enhanced, images of the area by Aldo Tonon and Valerio Fontani, and as you can see in Fig 5 there is not the slightest hint of a green tinge to the floor that we would expect if the floor was more reflective in green light, and so therefore we can regard Gerald North's observation as unusual. In terms of the floor appearing nearly black, in Fig 5 (Left) this is not the case, but in Fig 5 (Right) where the contrast has been turned up considerably, then the floor of Plato is definitely darker than the Mare Imbrium to the south. In view if these findings, I shall amend the report of the 1982 event to a weight of 1, and note that the only oddity was the floor appearing brighter in green light. The Foley and Mobberley reports are basically just normal.

Figure 4. *2019 Jun 13 colour filter images of Plato taken by Franco Taccogna (UAI), and orientated with north towards the top.* ***(Left)*** *19:21 UT taken through a red #21 filter.* ***(Centre)*** *19:22 UT taken through a green filter.* ***(Right)*** *19:25 UT taken through a blue filter.*

Figure 5. *Images of Plato taken on 2019 Jun 13 and orientated with north towards the top. The images have been colour normalised and then had their colour saturation increased to 30%.* ***(Left)*** *Image by Aldo Tonon (UAI) taken at 19:43.* ***(Right)*** *Image by Valerio Fontani (UAI) at 20:28UT.*

Boussingault: On 2019 Jul 05 UT 22:23 Walter Elias (AEA) imaged this crater under similar illumination to the following report:

Boussingault 1856 Apr 08 UT 20:00? Observed by Schmidt (Athens, Greece, 7" refractor) "Noted weak glows in the crater he tho't prob. due to wall reflections on the floor" NASA catalog weight=0 (not very likely to be a TLP). NASA catalog ID #131. ALPO/BAA Catalog weight=1.

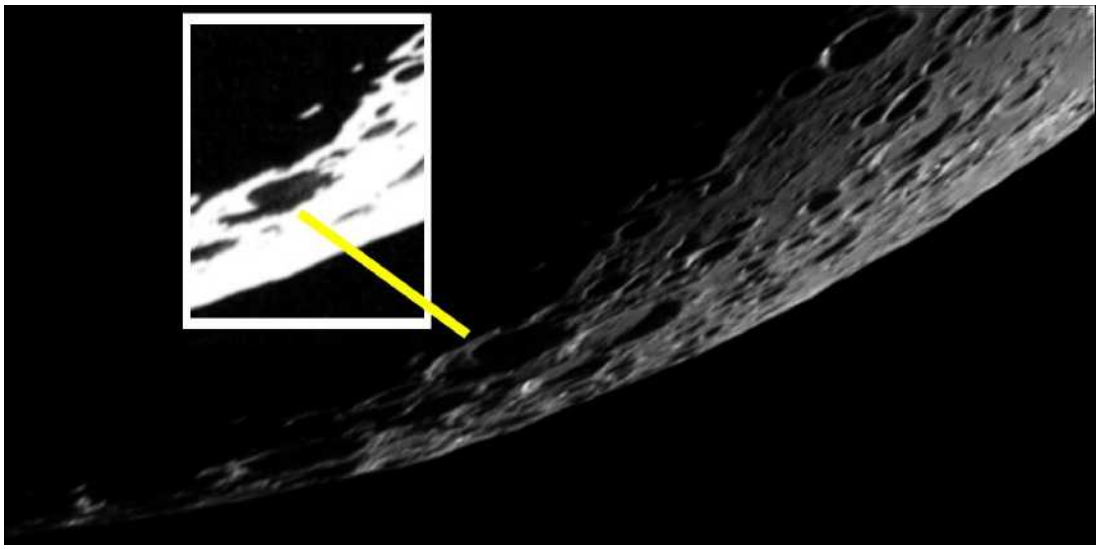


Figure 6. *The Boussingault area of the Moon as imaged by Walter Elias (AEA) on 2019 Jul 05 UT 22:23 and orientated with north towards the top. Inset shows a contrast enhanced view of the crater.*

I have enhanced the interior of the crater in the inset in Fig 6 and can see a possible illuminated area in the shadow which is either due to scattered light off the rim reaching the shadow filled floor or topography starting to break through the shadow into sunlight. I think therefore we shall reduce the ALPO/BAA weight down to 0 and remove it from the database.

Pytheas: On 2019 Jul 12 UT01:50-02:05 Jay Albert observed visually this crater under similar illumination and topocentric libration (to within ±1.0°) to the following report):

On 1982 Jul 01 at UT 02:23-02:58 Robotham (Springfield, ON, Canada, seeing=II) found that the west rim of Pytheas crater was a very bright yellow-white, indeed brighter than Proclus. At lower magnifications, Pytheas was one of the brightest spots on the Moon. The Cameron 2006 catalog ID=173 and weight=2. ALPO/BAA weight=2.

Jay found that the crater's western wall was indeed very bright with an intensely bright, white spot in the center of the west wall. Certainly, at a magnification of x51 the crater appeared visually as one of the brightest features on the Moon. This concurs with the original TLP description. Jay notes that the west wall was brighter than the west wall of Copernicus. A slight yellowish tint was noted at the crater, but also over the entire Moon due to the haze and thin clouds. Jay used magnifications of 51x and 290x on his Celestron NexStar Evolution 8" SCT. The waxing 75% lit Moon was high in the south. The sky was very hazy with thin stratus clouds almost everywhere. Transparency was initially 1st magnitude where clear, but deteriorated gradually throughout the session until only Jupiter and the Moon were visible. Seeing

was 7/10 except for image motion when clouds passed. No filters were used. I will lower the weight from 2 to 1 as only the yellow-white colour seems abnormal in the original description.

Aristarchus: On 2019 Jun 16 UT 22:58 Walter Latrónico (AEA) imaged the crater during the lunar eclipse, under similar illumination and topocentric libration (to within ±1.0°) to the following reports:

On 1978 Sep 16 at UT19:30 R. McKim (Colchester, Essex, UK, 216mm reflector and binoculars) observed that Aristarchus, in the lighter region, during the lunar eclipse, was duller than usual but no less conspicuous than expected. The Cameron 2006 catalog ID=38 and weight=5. The ALPO/BAA weight=1.

On 1982 Jan 09 at UT18:46-21:42 P. Moore, (Selsey, UK) and others found that Aristarchus and Plato changed in brightness and colour during a lunar eclipse. Aristarchus was especially bright during the lunar eclipse. Cameron 2006 catalog ID=162 and weight=5. ALPO/BAA weight=3.

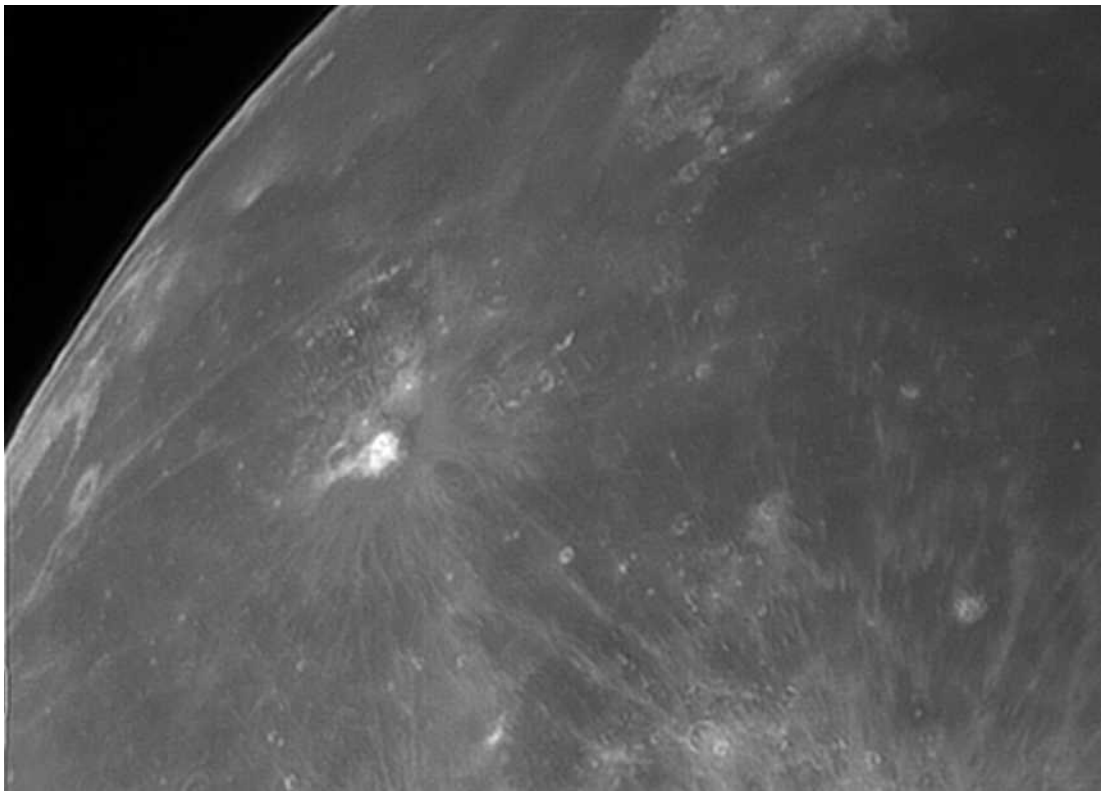


Figure 7. *Aristarchus in the penumbral part of the Moon during the Lunar Eclipse on 2019 Jul 16 UT 22:58 as imaged by Walter Latrónico (AEA). Orientated with north towards the top.*

Although Walter's image corresponds to similar illumination and viewing angle to the above two mentioned TLP reports during eclipses, only the 1978 report has some relevance as it describes Aristarchus as being in the lighter region (penumbra?) which was a similar stage in the eclipse that Walter had imaged. In terms of the brightness of Aristarchus it certainly cannot be described as duller than usual – although I would agree with the description: "no less conspicuous than expected". I am also interested in the lineated grid-like structure in the plateau area to the N/W of Aristarchus as I do not recall seeing this before. For the 1982 report there is not a lot we can add in re-

interpreting this as we would need a time sequence. I'll leave the weights of the reports at 1 & 3 respectively for now.

Schmidt: On 2019 Jul 16 UT 22:58 Avril Micaela Elias (AEA) imaged this region under similar illumination and topocentric libration (to within ±1.0°) to the following report:

On 1982 Jan 09 at UT 18:46-21:42 M. Mobberley (UK) observed that Schmidt was very bright compared to its surroundings during a total lunar eclipse. Cameron 2006 catalog ID=162 and weight=5. ALPO/BAA weight=2.

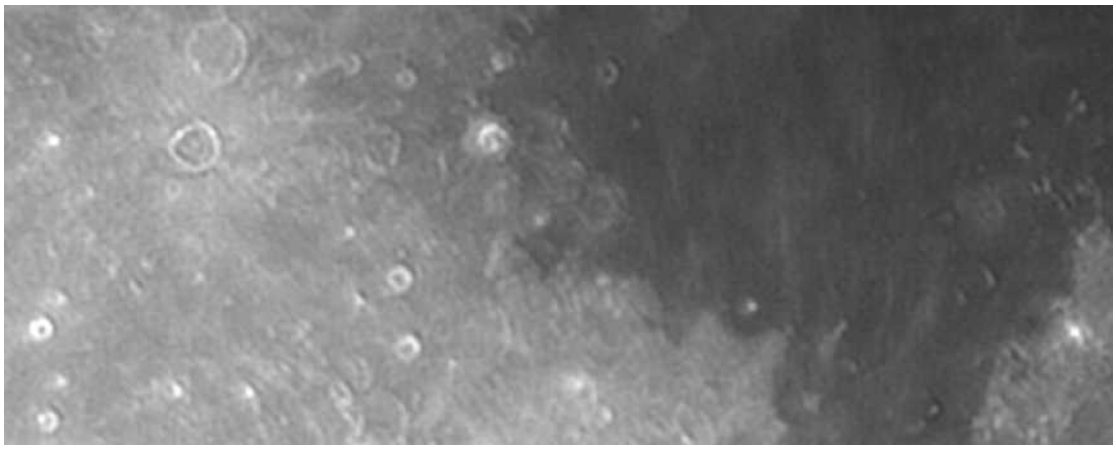


Figure 8. *The small 11 km diameter Schmidt crater at the centre of the image, taken by Avril Micaela Elias (AEA) on 2019 Jul 16 UT 22:58 in the penumbral shadow of the eclipse. Image orientated with north towards the top.*

From looking at Fig 8, it is quite clear that Schmidt is pretty indistinct compared to its surrounds, although is out of the umbral phase of the eclipse at this point. I have checked Martin Mobberley's photos that we have in the archive and none of these show Schmidt as being very bright – only Dionysius and that appeared as bright as normal. Martin does not discuss Schmidt in his observing report from the next day. There is though a mention of the report on p4 of the 1982 Mar BAA Lunar Section Circular, where he states that both Schmidt and Censorinus were very bright relative to their surrounding at 18:08 during the eclipse. I shall leave the weight at 2 for now as Avril's image differs to the Mobberley description.

Promontorium Fresnel: On 2019 Jul 16 UT 23:08 Facundo Gramer (AEA) imaged this region under similar illumination and topocentric libration (to within ±1.0°) to the following report:

On 1982 Jan 09 at UT 18:46-21:42 some unknown British observers saw a glow near Promontorium Fresnel during a lunar eclipse. The Cameron 2006 catalog ID=162 and weight=5. The ALPO/BAA weight=2.

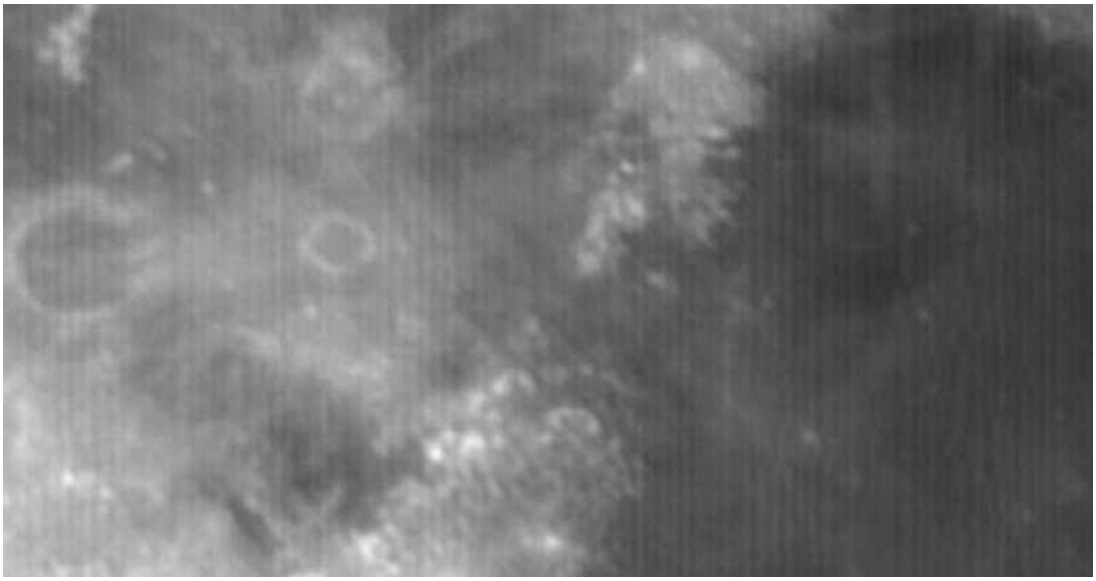


Figure 9*. Promontorium Fresnel located just below the centre of the image taken by Facundo Gramer (AEA) on 2019 Jul 16 UT 23:08 and orientated with north towards the top. Stripes in the image are an imaging artefact.*

A quick look through the BAA Lunar Section Circular (1982 Mar edition – p3), reveals that the unknown observer t was Andy Hollis, of Northwitch, UK, who described a glow near Promontorium Fresnel, but no time is quoted. Clearly there is no glow appearance in Fig 9, so we shall leave the weight at 2 for now.

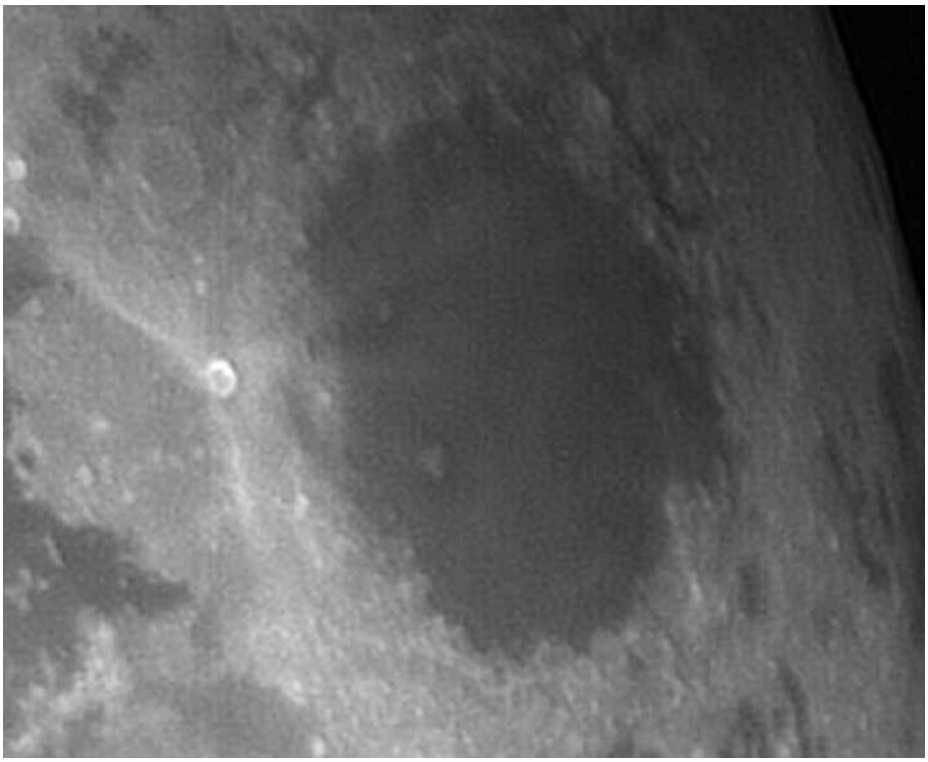


Figure 10. *Image of Mare Crisium, taken on 2019 Jul 16 UT 23:02 by Cian Gonzalez (AEA) and orientated with north towards the top.*

Picard: On 2019 Jul 16 UT 23:02 Cian Gonzalez (AEA) imaged this crater under similar illumination and topocentric libration (to within ±1°) to the following report:

On 1927 Dec 08 at 20:00 Bogdanovich (Russia) Picard: "Crater, after coming out of shadow after ech. was unusually hazy. next FM it was back to normal". The Cameron 1978 catalog ID= and weight=3. The ALPO/BAA weight=2.

Figure 10 certainly shows Picard as a bit hazy in appearance, though whether this was more so than normal is uncertain. Bogdanovich mentions that it was back to normal at the next Full Moon. I think we shall lower the weight to 1 for now. Incidentally Fig 10 shows the shadow on the east side of some features effect mentioned earlier in this newsletter.

Plato: On 2019 Jul 16 UT 23:06 Alan Trumper (AEA) imaged this crater under similar illumination and topocentric libration (to within ±1°) to a Patrick Moore report from 1982:

On 1982 Jan 09 at UT21:37 P. Moore (Selsey, UK) observed that Plato underwent brightness and colour changes, during a total lunar eclipse. At 20:07UT Madej observed a "slight anomaly in Plato". Cameron 2006 catalog ID=162 and weight=5. ALPO/BAA weight=3.

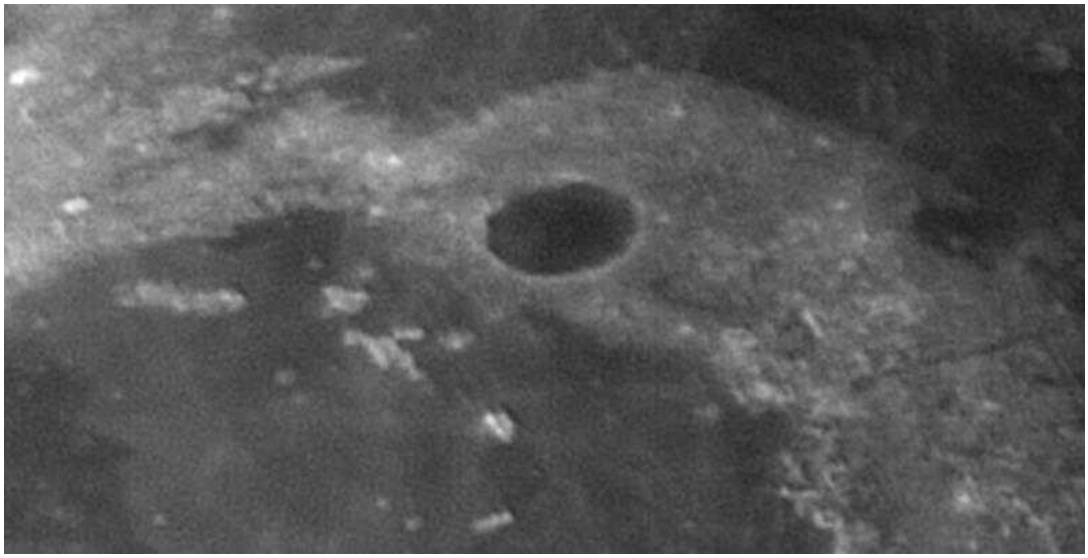


Figure 11. *Image of Mare Plato, taken on 2019 Jul 16 UT 23:02 by Cian Gonzalez (AEA) and orientated with north towards the top.*

Although we cannot see from Alan's image whether brightness or colour variations took place on this eclipse, at least we have a general appearance of what Plato should normally look like in the penumbra – for future reference. Again, we can see shadow effects on the NE corners of some high topography which might be related to image stacking artefacts as the penumbral shadow moves across the lunar surface. We shall keep the weight at 3 for now.

Copernicus: On 2019 Jul 21 UT David Scanlon (Isle of Man, UK – BAA) imaged the Moon under similar illumination and topocentric libration (to within ±1°) to the following report from the Soviet Union:

On 1977 Oct 31 UT 05:03 V.M. Chernov (Soviet Union) observed that Copernicus was brighter than normal i.e. brighter than Kepler. It was though slightly less bright than it had been on during the Oct 28th TLP. The ALPO/BAA weight=1.

Now being under effectively the same illumination and viewing angles we should in theory expect to see the same result again in Dave's image in Fig 12. Indeed, Copernicus looks visually to be brighter than Kepler, but to be sure I took some digital number readings direct from Dave's image and this gives: Kepler=206, Copernicus=209. So on view of the fact that Copernicus is brighter then Kepler, and Chernov's "normal" is not quantitatively defined, we can probably remove this TLP from the catalog by assigning a weight of 0.

***Figure 12**. An image of the whole Moon taken by David Scanlon (BAA) on 2019 Jul 21 UT 00:46 using a Meade 8" scope. Orientated with north just slightly to the left of top.*

General Information: For repeat illumination (and a few repeat libration) observations for the coming month - these can be found on the following web site: http://users.aber.ac.uk/atc/lunar_schedule.htm . By re-observing and submitting your observations, only 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? 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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