



From the Director:



ChatGPT Logo

Many of you may have heard some interesting claims about the use of OpenAI's [ChatGPT](#). It is a lot more sophisticated than the Google search engine, Wikipedia, or voice devices like Alexa, in that it comes up with a well filtered short essay or paragraph, tuned to your needs. It is not quite like the fictional Artificial Intelligence of the HAL9000 computer on 2001 A Space Odyssey, but perhaps more like Data from Star Trek's Next Generation in terms of its output. ChatGPT is certainly raising eyebrows in Universities in that it may make it more difficult to tell if coursework was written by students, or by Artificial Intelligence. It can even write short sections of computer programs. On the plus side though it is a good way to improve one's English, and grammar and students are finding it excellent to tune their job applications, and likewise researchers are using it to improve the style of their research applications.

In case you were wondering what use this is to the Lunar Section or amateur astronomers, I thought that I would demonstrate by asking this question: "Please write me 600 words on geological evidence for shallow quakes on the lunar surface, in the style of TV Astronomer Patrick Moore" :

Paragraph 1 : *"Good evening, viewers. Tonight we'll be exploring the fascinating topic of shallow quakes on the lunar surface, and the geological evidence that supports their existence."*

Paragraph 2 : *"First, let's talk about what we mean by shallow quakes. These are seismic events that occur relatively close to the surface of a planetary body, as opposed to deeper quakes that occur within the planet's interior. On the Moon, these shallow quakes have been a subject of study for decades, ever since the Apollo missions first brought seismometers to the lunar surface."*

Paragraph 3 : *"One of the key pieces of evidence for shallow quakes on the Moon comes from the analysis of moonquakes recorded by the Apollo seismometers. In total, there were 28 shallow moonquakes recorded during the Apollo missions, with magnitudes ranging from 2.0 to 5.5 on the Richter scale. These quakes were all relatively shallow, with their epicenters located within a few kilometers of the lunar surface."*

Paragraph 4 : *"But what could be causing these shallow quakes? One possibility is that they are caused by the thermal stresses that occur as the Moon's surface goes through its day-night cycle. During the lunar day, the surface can heat up to over 100 degrees Celsius, while during the night it can cool down to nearly -200 degrees Celsius. This rapid temperature change can cause the rocks on the surface to expand and contract, putting stress on the crust and potentially leading to shallow quakes."*

Paragraph 5 : *“Another possible cause of shallow quakes on the Moon is the ongoing process of lunar cooling and contraction. As the Moon cools, its interior contracts, which can cause the crust to fracture and create shallow quakes. This process is thought to be ongoing, as recent studies have suggested that the Moon is still cooling and contracting today, over four billion years after it first formed.”*

Paragraph 6 : *“But what does the geological evidence tell us about these shallow quakes? One piece of evidence comes from the analysis of lunar rock samples brought back by the Apollo missions. These rocks show evidence of being fractured and faulted, with some rocks even showing signs of having been melted and then rapidly cooled. These types of features are consistent with the kinds of stresses that would be caused by shallow quakes on the lunar surface.”*

Paragraph 7 : *“In addition, recent studies of the lunar surface using high-resolution images from spacecraft like the Lunar Reconnaissance Orbiter have revealed a number of intriguing features that may be related to shallow quakes. These include graben, or long, narrow depressions that form as the crust is pulled apart, and scarps, or steep slopes that form as the crust is compressed. These features are thought to be caused by the same kinds of stresses that lead to shallow quakes, and their presence suggests that such quakes may be more common on the Moon than previously thought.”*

Paragraph 8 : *“So, in conclusion, the geological evidence supports the idea that shallow quakes are a real phenomenon on the lunar surface. While the exact cause of these quakes is still a subject of debate, they are likely related to the ongoing processes of thermal stress and lunar cooling and contraction. The study of these shallow quakes is an important part of understanding the geological history of the Moon, and may also have implications for our understanding of other planetary bodies in our solar system. Thank you for joining me tonight, and keep looking up!”*

The only Patrick Moore style I can see above is perhaps in the first couple of paragraphs, and the very last sentence of the final paragraph is more reminiscent of the catch phrase from Jack Horkheimer’s (1938-2010) US series: Star Hustler. In terms of accuracy, paragraph 2 is right, as we did not know about shallow quakes until the Apollo missions. Paragraph 3 is spot on! Paragraph 4 highlights thermal stresses, and indeed there were very weak thermal quakes detected close to the Apollo Seismometers but these were primary due to surface rocks expanding/contracting and cracking with the huge day/night temperature swings on the Moon. However the regolith layer pretty much cancels out thermal stress below a few metres of the surface and so would probably not account for the shallow quake epicentres of a few km beneath the surface.

Paragraph 5 is correct to talk about contraction from cooling, but should clarify that cooling is over billions of years and horizontal stresses and strains that result can also vary regionally. The last sentence in this paragraph probably ought to refer to thrust faults and lobate scarps, some of which are still thought to be active. In paragraph 6, there are some Apollo returned rocks that exhibit melting and cooling, but there are many other explanations other than shallow quakes. I think that paragraph 7 is trying to talk about fresh downhill deposits of boulders seen on the sides of graben and especially wrinkle ridges, that might indicate recent shallow quake activity? Finally paragraph 8 is a typical ChatGPT conclusion if you ask it to write an essay.

So to conclude, it has done a fair job, but has missed out a few key things that I have highlighted above – I would give it 5-6 out of 10. Beware that OpenAI warn users that occasionally ChatGPT results can be inaccurate. ChatGPT, and similar AI assistants will definitely find niche uses and improve significantly over time. Anyway you might want to give it a go, and explore, as it will give mostly accurate answers to any questions you have ever wanted to ask about the Moon. Some of the answers maybe quite thought provoking. But please remember that you will need to register first <https://chat.openai.com/chat> in order to use ChatGPT.

And finally, Congratulations to Barry Fitzgerald and Raffaello Lena for their paper on "Lunar volcanic complex north-west of Lichtenberg" published in the February BAA Journal.

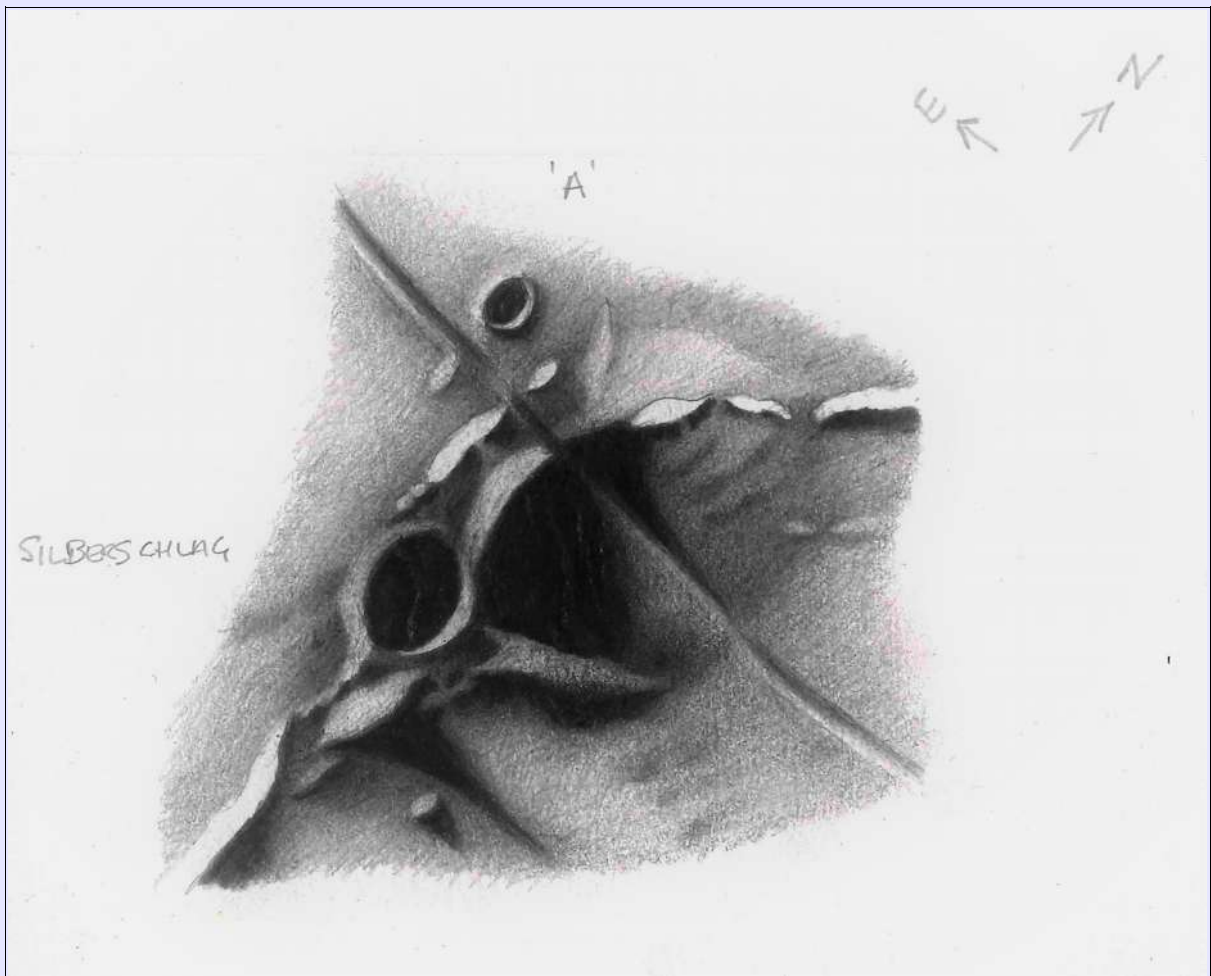
Tony Cook.

Correspondence Received.

Silberschlag and the Ariadaeus Rille

By Nigel Longshaw.

I was interested in the drawing and observing notes by Dr. Paul Abel published in the February 2023 Circular. I have observed this region on a number of occasions under similar lighting but in the past concentrated on the area immediately surrounding Silberschlag. I attach a drawing for comparison made on 2019 December 3rd when seeing was average and lighting was slightly more advanced than at the time of Dr. Abel's observation. Using a power of x160 on my 100mm achromat, with colongitude values 352.7 to 353.2 degrees, I got the impression that the continuation of the rille to the north west of Silberschlag ran along slightly higher ground. There appear to be some unusual shadow effects at this colongitude I wonder if this might have contributed to the possible sighting of the rille 'inside' the shadow as described by Dr. Abel?



I trust members are familiar with the observations of Harold Hill in the first section of 'The Portfolio' where he attempted to ascertain if the Ariadaeus rille was traceable through the ridge which runs north of Silberschlag. This requires observations to be made under sunset conditions and therefore in the early hours of the morning. Whilst Hill indicates he was unable to record the rille on the western facing slope of the ridge with any certainty, both Dr. Able and myself record the passage of the rille up the eastern facing slope of the ridge north of Silberschlag.

I have however observed the region under colongitude 350.2 degrees and did not record the passage of the rille up the eastern face of the ridge. So, it would appear that factors other than simply colongitude values may influence the visibility of the rille on the eastern and western slopes of the ridge north of Silberschlag.

Note: See image by Dave Finnegan of Rima Ariadaeus in this LSC.

Gassendi and Johann Krieger's Lunar drawings.

By Leo Aerts.

I very recently compared Johann Krieger's lunar drawings with present lunar digital imaging results. I did my best to mimic my results as good as possible with the Johann Krieger's drawings. I have about 20 examples of it. Herewith one example include of the lunar crater Gassendi. It shows how very accurate Johann Krieger was in his lunar observations.



Weather Forecasts (by an insider!).

By Trevor Pitt

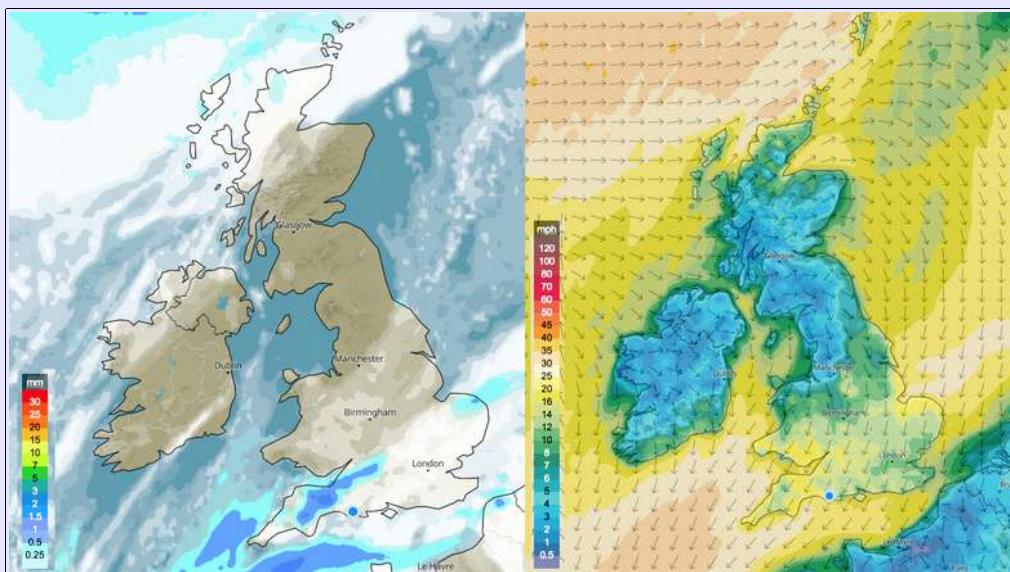
I like your rant at the weather forecasts at the start of the circular. As a former commercial meteorologist, I do sympathise and have found conditions at odds with the forecasts on many occasions. This was especially so when the source observational data from aircraft was lost in Covid times. Most of the weather apps that people see on Mobiles use the same data source. The GFS from the US is the prime source as its freely available. Clearoutside downloads most of the GFS data, but uses a second model for some items that they cannot get hold of (not sure what those items are though).

The various computer and mobile Apps are all programmed by different developers and often have different solutions to the same data. What, for example, is the amount of rain over a one hour period that will generate a rain drop in the app display? 1mm in the hour, 0.5 mm in the hour, 2mm in the hour are all possible. Some apps will therefore predict rain and others may not. It often strikes me as odd when Clearoutside predicts rain and there is no cloud at the same time. However, you seem to have observed that phenomena with the snow??.

Meteoblue is an exception, it seems to use the European (German) Icon model and its own nested models for one of its sources of data, one of those models is nested to the east of Wales where to the east of the line the ICOND2 produces a higher resolution nest than the model to the west of the line. Obviously there will be a difference from inside to outside the nest, but not sure what these are other than the model grid is set at a higher resolution with slightly different physics. Meteoblue do give three days advice for observing, but its not a

traffic light forecast like Clearoutside and takes a little interpretation, if you want longer, you do have to pay a monthly subscription.

Personally I use Clearoutside for initial planning of the conditions through the week, then look at Sat24.com / Meteoblue to see if the models are behaving on the afternoon/evening of the observing day and the likely seeing. Another good app is Rain Alarm for PC or mobile. That should prevent you from getting caught with expensive equipment out side in rain / snow.

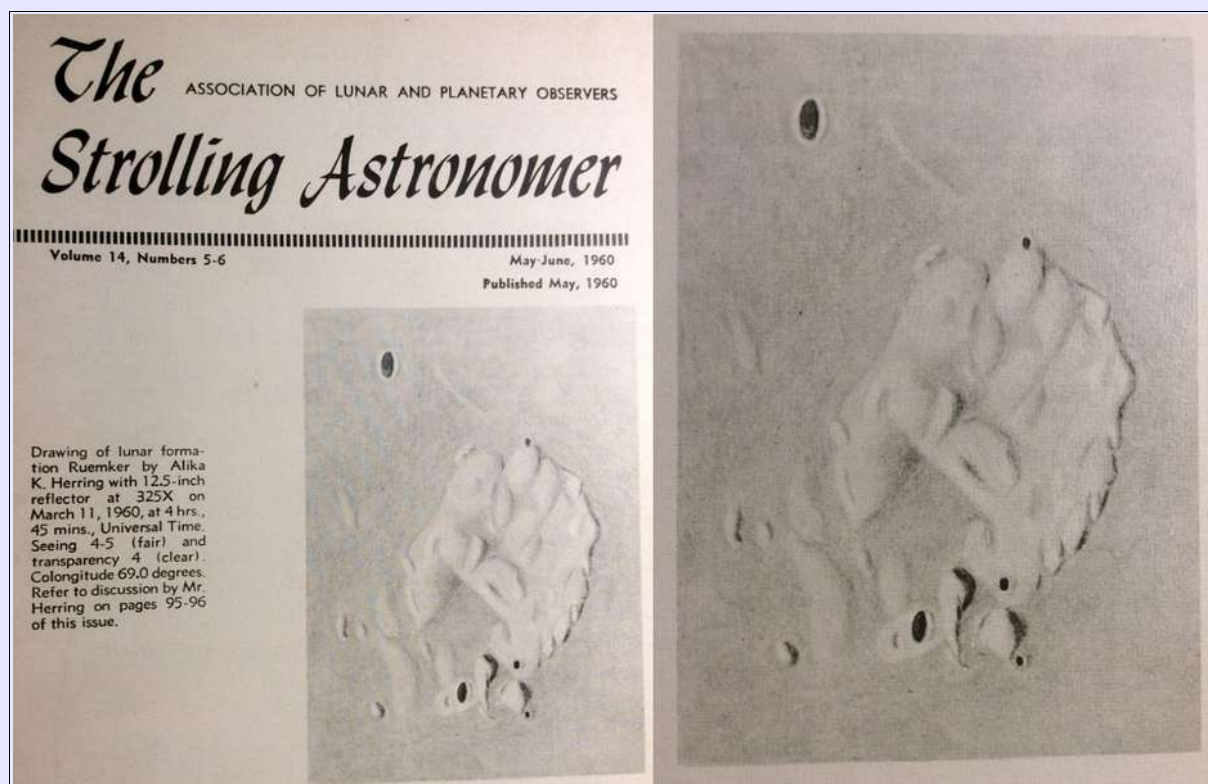


Screenshots from metoblue (<https://www.meteoblue.com>) showing Clouds and Precipitation (left) and wind (right).

Herring's drawing of Mons Rumker.

By Richard McKim.

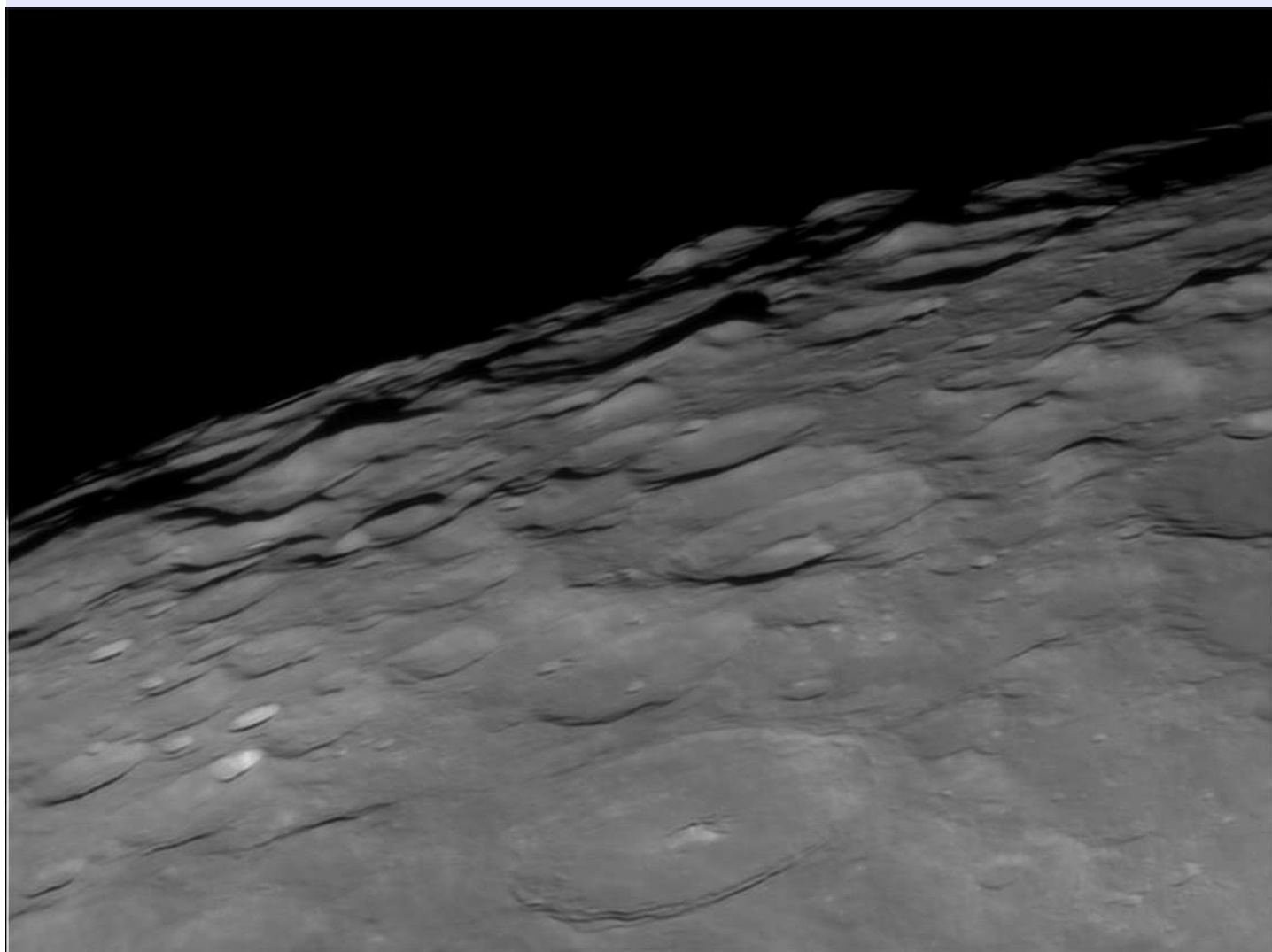
Quite by chance I have been using a particular copy of the ALPO Journal for looking up old Jupiter data and lo and behold the original drawing by Herring from the latest LSC is on the cover. See below. It shows that the copy in The Moon was not bad.



Lunar South Polar Regions.

By Bill Leatherbarrow.

I was interested in the short piece on the lunar South Polar Regions in the last LSC, along with Ewen Whitaker's chart and observations by Harold Hill and Grahame Wheatley. Hill in particular put an enormous amount of effort into charting these difficult zones that are so affected by libration, but his scores of exquisite drawings were never consolidated into a completed chart (although his working chart survives).



I took an image (above) of the area on the night of 4 February 2023 that more or less matches the area covered by Hill's drawing under nearly identical solar selenographic colongitude. Seeing was rather poor and there were strong gusty winds, but I attach it for your interest, with south up to facilitate comparison with Hill's drawing. The image shows the four mountains M1, M3, M4 and M5, although Whitaker's M2 would appear to be nothing more than a slightly elevated point on the rim of Cabeus. It also drives home just how skilful an observer Hill was.

Editor Notes:

Following the Lunar pole theme, the latest feature named by the IAU is Mons Mouton which now replaces the former name of Leibnitz β , for the plateau like area of highland visible in Bill's image half way down the left side of the frame. It is named in after NASA mathematician and computer programmer Melba Roy Mouton. Also see:

<https://www.iau.org/news/pressreleases/detail/iau2301/>

<https://planetarynames.wr.usgs.gov/Feature/16070>

Lunar Occultations March 2023.

By Tim Haymes

Time capsule: 50 year ago: in Vol 8 No.3

- *Ken Gaynor: the Lunar Section's "World Occultation Network" (W.C.N) is progressing.
- *Groups in NSW, Australia (P. Aldous), and the Dundee AS wish to contribute.
- *Project Fade and priority stars are listed for observation.
- *ZC 536 (16 Tau) is an "occultation double" discovered by Tupman on 1897 Jul 23.

[With thanks to *Stuart Morris* for the [LSC](#) archives]

Note on 16 Tau:

The WDS gives: AB 5.4 13, pa 260, sep 89": AC 5.4, 11, pa 195, sep 218"

T. Haymes: The separations are not consistent with a fade, but a very long step – worth following up?

Is the main star a close double? Prediction by Occult4 for the UK/Europe finds the following:

2025 Apr 01 2103UT DD, CA: 39N, phase 16% (Graze over Scotland)

2025 Oct 10 0506UT (Twilight)

2025 Dec 04 0240UT

Jupiter-Moon-Venus on evening of Feb 22nd

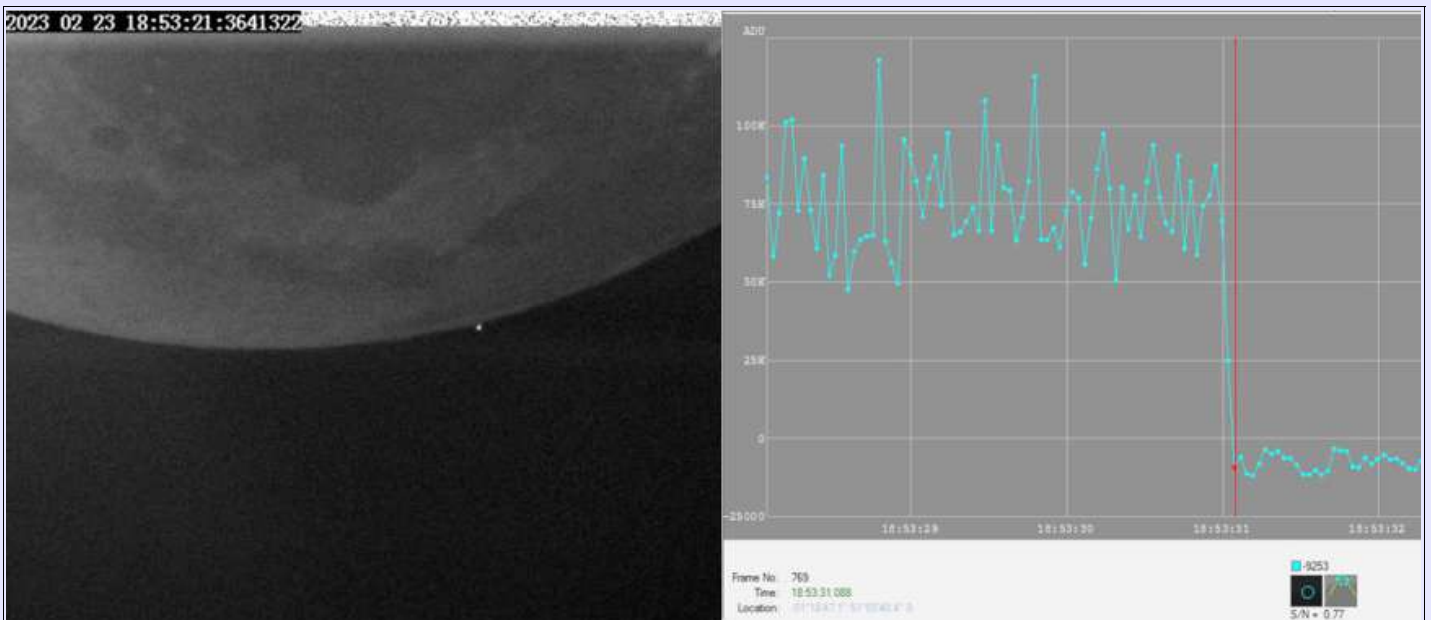
T Haymes: I viewed this delightful celestial alignment from our back garden. My Local AS was also doing some cub badges, and they were treated to a great celestial display.

SAO-109824 (G5, m 8.8) on Feb 23rd.

An occultation of this star was recorded by the *writer* on the evening of Feb 23rd. Nothing to write home about.

It was simply the first DD event reported this year at 18:53:31.088 ut (prediction 18:53:31.3)

He used a QHY174-gps camera at 0.04s exposure (= 25fps) attached to a C11 at F/6. Earthshine was prominent and the recording clear. The O-C was just 0.01 and this indicates an accurate time. D. Herald recommends the use of lunar occs to check the accuracy of the QHY-gps/SharpCap timing system.



Star at the limb 10s before being occulted

The recording in Tangra Software (H. Pavolv)

Occultation predictions for 2023 March (Times as other locations will +/- a few minutes)

Oxford: E. Longitude - 1 18 47, Latitude 51 55 40

To magnitude ca 8.5, Moon altitude >7 degrees.

yy	mmm	day	Time	P	Star	Sp	Mag	Mag	%	Elon	Sun	Moon	CA	Notes
		d	h m s		No		v	r	ill	Alt	Alt	Az	o	
23	Mar	1	18 39 48.8	D	1013cG0		7.0		73+	117	-9	61 138	84S	
23	Mar	1	21 59 13.2	d	78641 M0		8.3	7.5	74+	118		58 230	54N	
23	Mar	1	22 8 36.9	D	1028 G8		7.5	7.1	74+	118		57 233	50S	
23	Mar	2	2 15 12	D	1042cA2		6.7	6.6	75+	120		21 287	11N	
23	Mar	2	2 18 27	Gr	1042cA2		6.7	6.6	75+	120		20 **	GRAZE:	nearby
23	Mar	2	20 59 16.0	d	79495dA2		8.3	8.3	81+	129		64 180	43S	
23	Mar	3	1 29 21.2	d	1162 K2		8.2	7.6	82+	130		35 269	70N	
23	Mar	3	2 57 33.1	D	1169 K5		5.3	4.5	83+	131		21 285	45N	76 Gem
23	Mar	3	20 43 56.8	d	80165 F2		7.5	7.3	88+	140		60 151	54S	
23	Mar	5	3 5 0.8	D	1393 G7		6.5	6.0	94+	153		30 264	56N	
23	Mar	12	3 26 59.6	R	2104 K4		7.3	6.5	80-	126		20 178	60N	
23	Mar	13	2 35 12.4	R	2226 A1		7.0	6.8	71-	114		12 155	50N	
23	Mar	13	3 45 4.3	R	2234 K5		7.6	6.7	70-	114		15 171	87N	
23	Mar	24	20 8 23.6	D	93076 G5		8.7		12+	40		18 274	40S	
23	Mar	24	20 8 23.6	D X	63209		8.6	8.3	12+	40		18 274	40S	
23	Mar	25	19 28 3.7	D	76007 K0		8.6	7.9	19+	52	-10	35 260	64N	
23	Mar	25	21 27 10.0	D	525 A*		6.5	6.4	20+	53		17 282	35S	14 Tau
23	Mar	25	22 13 11.9	D	76070 A5		7.2	7.0	20+	53		11 291	39N	
23	Mar	25	22 55 50.8	D	76092 F8		7.9	7.6	20+	53		5 298	82S	
23	Mar	27	23 20 30.9	D	77229 K2		7.8	7.0	39+	77		20 288	89N	
23	Mar	27	23 43 50.3	D	77242 B1		8.2	8.2	39+	77		17 292	73N	
23	Mar	28	19 54 8.1	D	78234 A0		8.2	8.2	47+	87		58 231	63S	
23	Mar	28	20 7 27.9	D	78242 K0		8.8	8.4	47+	87		56 236	58N	
23	Mar	28	20 19 0.6	D	78241 A0		8.8	8.8	47+	87		55 239	35S	
23	Mar	28	21 28 43.1	D	78295 A3		8.8	8.6	48+	87		45 257	88N	
23	Mar	28	21 55 2.6	D	78300 B9		8.3	8.3	48+	87		41 263	26S	
23	Mar	29	21 29 4.0	D	1105 G7		6.5		57+	98		52 244	58S	Db1*
23	Mar	29	22 46 15.5	D	1108 G8		7.0	6.5	58+	99		41 262	57N	Db1*
23	Mar	29	23 26 50.8	D	79304 K2		8.1	7.3	58+	99		35 270	85N	
23	Mar	29	23 41 26.1	D	79311 A0		8.3	8.2	58+	99		32 273	70S	
23	Mar	30	21 19 15.0	D	79980 G8		7.3	6.8	67+	109		57 223	58S	
23	Mar	31	2 25 51.0	D	80089 G5		7.2	6.7	68+	111		14 291	83N	
23	Mar	31	3 3 56.4	D	1251 B9		5.9	5.9	68+	112		9 298	86S	Lambda Cnc
23	Mar	31	23 10 44.4	D	1348 G5		8.1	7.6	76+	121		47 240	64S	

See the December 2022 issue of LSC for an explanation of the table.

Detailed predictions at your location for 1 year are available upon request. Ask the Occultation Coordinator: tvh dot observatory at btinternet dot com, or the Director.

Interested in Grazes only? – Indicate your travel radius in Km and your home post code or nearest town. An aperture of 15cm will be used unless advised. More predictions will be generated by this process.

Images and Drawings Received.

Petavius.



Petavius
10 November 2022 2212UT
Celestron C11 f20 ASI224MC UV-IR filter ADC
Mark Radice RefreshingViews.com

Image by Mark Radice with details of date, time and equipment in caption.

Geological Notes: We are all pretty familiar with Petavius, but what stands out in this image is the elongate crater Palitzsch, deep in shadow and located just beyond the eastern rim. This is an odd structure, possibly made up of several overlapping craters or even a single elongate one, rather like a mini Schiller. It is however heavily eroded and partially filled in with ejecta and rim material from Petavius, so determining what it was originally is not straightforward. A number of fracture like lines are present on the southern floor of Palitzsch, and it has been referred to as a Floor Fracture Crater. The floor is slightly domed upwards and it is therefore possible that intrusion of magma from below has affected the crater floor, raising it upwards. Of course there is no shortage of volcanic activity in its larger neighbour, Petavius. Beyond Palitzsch, and almost completely in shadow is the much younger Palitzsch B. The lunar pit Palitzsch B 1 (~ 30m diam and 13m deep) is located on (or more accurately, in) the impact melt crater floor may offer potential sub-surface shelter for future lunar explorers.

Timaeus.



Image by Bob Stuart with details of time, date and equipment in caption.

Geological Notes: Timaeus is the rather unremarkable looking crater on the northern shore of Mare Frigoris opposite Plato and slightly overlapping the southern rim of the square(ish) crater W.Bond. Bob's image shows Timaeus's rather straight eastern rim, which is some 18kms long, and in plan form the crater has a distinctly polygonal look to it. This is probably a result of its proximity to the Imbrium Basin and the deep radial fractures in the crust surrounding the basin. This straight section runs fairly parallel to the linear ridges that not only form the rim of W.Bond, but which also dominate this part of the Imbrium hinterland, suggesting a deep structural control during the formation of Timaeus or its subsequent modification by rim collapse. The bright rays visible in the image are from the 51km diameter Anaxagoras.

Archimedes, Aristyllus and Autolycus.



Archimedes, Aristyllus & Autolycus 2022.08.19 - 06.17 UT

300mm Meade LX90, ASI 224MC Camera with Pro Planet 742nm I-R Pass Filter.
750/3,000 Frames. Seeing: 8/10.

Rod Lyon

Image by Rod Lyon with details of time, date and equipment in caption.

Geological Notes: The small crater just above the middle of this frame is Archimedes C, and it sits in a small embayment called Sinus Lunicus in honour of the Russian probe Luna 2 (the first man made object to land on another body) which crashed into the surface hereabouts on 14th September 1959. Rod's image also shows the north-western part of Palus Putredinis, with the illumination showing it as a shallow linear trough (~200m deep in places) roughly radial to the Imbrium Basin. This and other nearby radially orientated tectonic features such as the graben that runs up to the crater Bancroft (to the left of Archimedes) probably reflect the deep crustal fracturing that resulted from the basin forming event. There is a strong positive gravity anomaly beneath Palus Putredinis, which indicates the presence of dense volcanic rock that rose upwards through the crust along fractures and faults and probably erupted at the surface. There certainly there is plenty of evidence of volcanism in the area, not least of all Hadley Rille at the Apollo 15 landing site, which may be the source of the low titanium basalts that fill Palus Putredinis.

Gravity data seems to suggest that the 81km diameter Archimedes may have a double peak ring type of structure beneath the lavas that now flood its interior¹. This might seem a bit odd, as many craters larger than this do not have such a double ring, and you have to go up to whoppers like the 164km diameter Compton to see a well *single* defined peak ring, and by this stage they are more proto-basins as opposed to craters. You can check this out for yourself using the LRO Quickmap GRAIL Free Air Gravity overlay which reveals this odd feature². I am however no expert in interpreting this gravity data, so any more enlightened views would be most welcome!

1. P R, Kumaresan & Saravanavel, J.. (2019). Pre- Basaltic Morphological Mapping of Archimedes Crater Using Grail Data.

2. Select the hist99 or Sigma1 option in the drop down box.

Langrenus.



Image by Richard Hill with details of time date and equipment in caption.

Rik Comments: *Early in every lunation the spectacular crater Langrenus is seen on the eastern shore of Mare Fecunditatis. Here it is only a little more than 4 days past new moon and the great crater Langrenus (138km diameter) is clearly seen even in binoculars! Unfortunately it is usually overshadowed by its bigger brother Petavius (182km) to the south, with the huge rima, and often overlooked. To the west (left) of Langrenus are several large wrinkle ridges or dorsae. Dorsa Mawson is the northern branch that points to two craters on the upper edge of this image, Bilharz (44km) on the left and Atwood (31km) on the right it makes a sudden angle heading due south. Notice the shadow filled crater west of Langrenus. This is Al-Marrakushi (8km) and it is surrounded by 1-5km secondary craters formed from the Langrenus impact. Take some time to look up this region on LROC Quick Map and look at all the odd shape of these craters formed from low velocity impacts! You can see some of that if you expand this image to 100% on your browser.*

Moving east from Langrenus, heading for the limb, we see three craters in a row. The first is Barkla (40km) followed by the larger Kapteyn (48km) and the last, largest one, very foreshortened and very near the limb is La Perouse (80km). The isolated crater due south of Langrenus is a nicely terraced Lohse (43km). A small crater with a clear central peak.

On the western shore of Mare Fecunditatis is a collection of craters just coming into the sunlight. The pear-shaped crater farthest west (left) is Gutenberg (70km) with Gutenberg C (45km) being the appendage to the south. The very odd looking crater to the right of it is Goclenius (73km) with Magellan (37km) and Magellan A (19km) just below. Watch these as the sun rises on them over the course of an evening.

This image was made from portions of two 1800 frame AVIs stacked with AVIStack 2 (IDL), assembled with MS-Ice and final processed with GIMP and IrfanView.

Palus Putredinis.

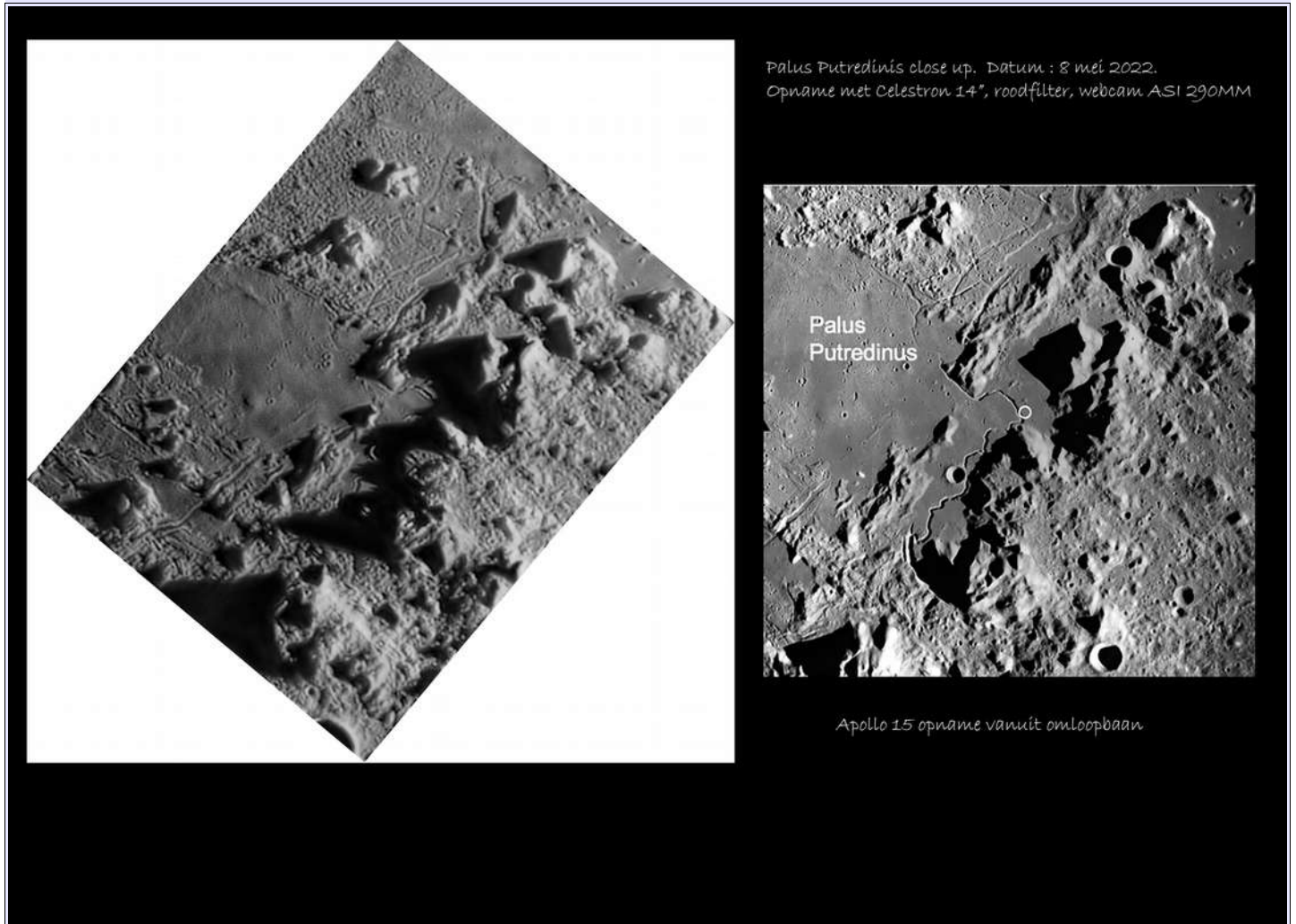


Image by Leo Aerts with a C14 SCT, red-filter and ASI 290MM webcam.

Geological Notes: Leo's image shows Palus Putredinis and the Apollo 15 landing site next to Hadley Rille. The area covered by this image contains a wide variety of geological features, with the eastern edge of the frame showing a section of the Montes Apennines which form the southern rim of the Imbrium Basin. The mare filled Palus Putredinis forms a 'bay' set within the lighter coloured and somewhat more textured Apennines Bench Formation (ABF). This Apennines Bench might look like part of the original Imbrium Basin floor but is thought to represent a volcanic deposit that *post*-dates the Imbrium Basin but *pre*-dates the lavas of Mare Imbrium and of course Palus Putredinis.

Those of you familiar with LRO-Quickmap can go to the Lunar Prospector Thorium Abundance overlay, and once enabled the whole ABF lights up, having very a very high abundance of this radioactive element. The bench also has a high abundance of those other radioactive elements, potassium (K) phosphorus (P) and rare earth elements (REE) which together constitute the 'KREEP' material that was concentrated into the last remaining dregs of the congealing magma ocean, as they are the last atoms any self respecting mineral would welcome into its crystal lattice due to various incompatibilities. The heat produced by the decay of these radioactive elements may have been responsible for the melting of source rocks containing these exotic elements, and resulting in a pre-mare volcanic episode, which we see as the ABF. The fact that the rest of Mare Imbrium is filled with non-KREEP'y lavas indicates that the source region for these basalts was different to the source region of the ABF. The ABF is fairly well endowed with volcanic features such as vents and domes that may date to this early phase of volcanism, but Hadley Rille itself is incised into the much younger lavas of Palus Putredinis and so not a result of the activity that produced the ABF.

Deslandres.

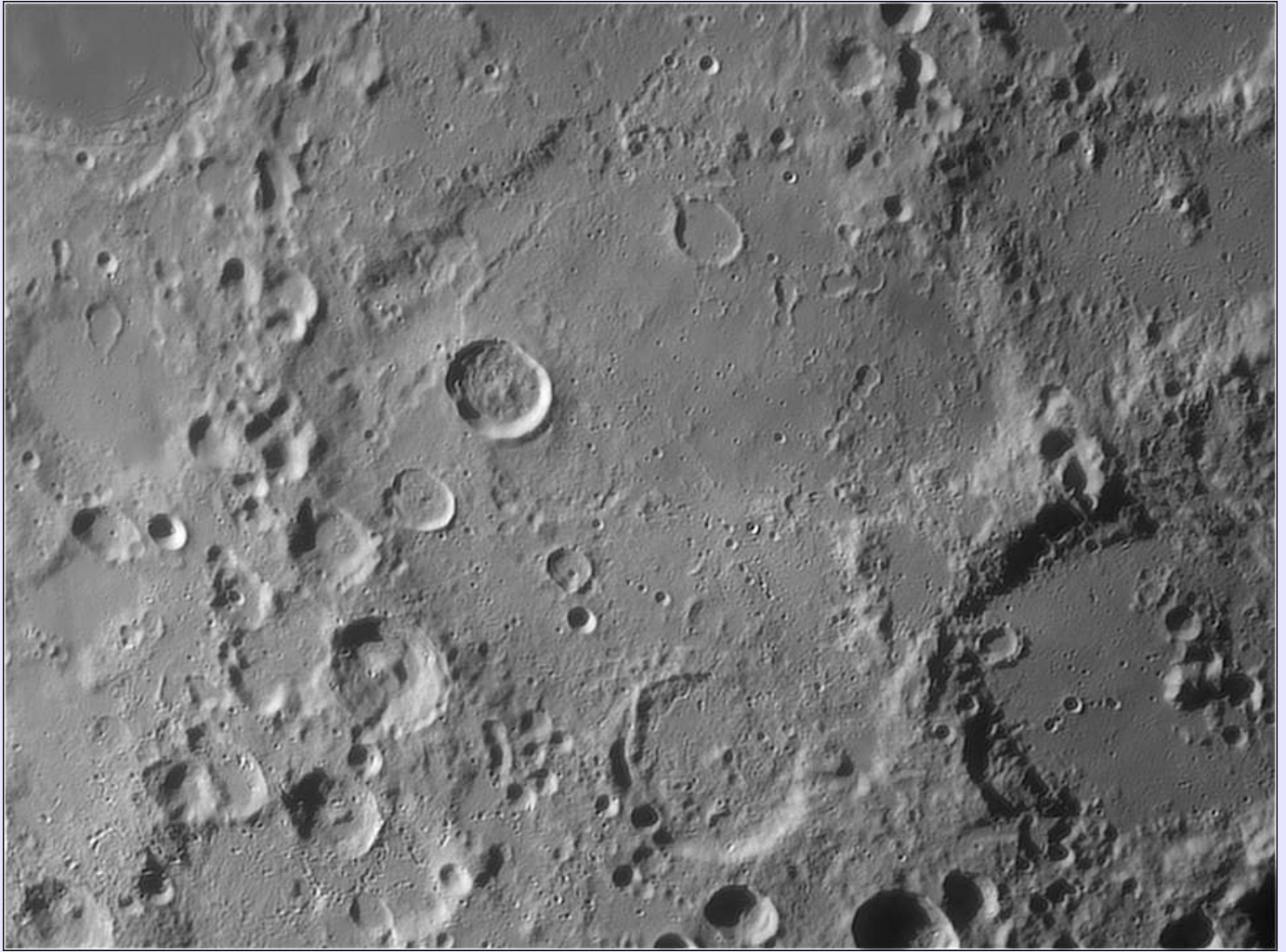


Image by Bill Leatherbarrow taken on 17th September 2022 using his OMC300 and ASI290 camera.

Geological Notes: Deslandres is a Pre-Nectarian impact basin with a diameter of some 295kms, now largely filled in with the debris and detritus from subsequent basin forming events and crater ejecta. This probably accounts for the relative dearth of impact craters within the basin, with the more ancient ones having been filled in. GRAIL gravity data shows a strong positive anomaly beneath the centre of the basin, probably reflecting a mantle uplift with dense rocks reaching towards the surface as a consequence of basin excavation. The evidence for volcanism within Deslandres is somewhat questionable, though the smooth low albedo patch up against the NE rim and some low albedo deposits within the crater Hell have been cited as possibilities, though there are no obvious vents or other structures visible.

In the rear of his 1961 book *Moon Atlas*¹, V.A. Firsoff included a nearside Selenological map that plotted "*Tectonic Grids, Crater Chains and Wrinkle Ridges*". This map shows features Firsoff believed formed part of the 'Lunar Grid', and two of the features he plotted are visible in Bill's image. If you look carefully you can see an apparent linear feature running across the frame, from the northern rim of Walther in the east, across the floor of Deslandres (just below the middle) and towards the southern rim of Gauricus in the west. Another faint linear feature can be seen to the west of Hell B, crossing the basin rim and heading just to the south of Pitatus. A further feature (not plotted on Firsoff's map) which is parallel to the previous two can be seen just north of the southern rim of Walther, cutting the western rim of that crater and passing through the extreme southern part of Lexell. These faint linear features probably only show up under extremely favourable illumination but their presence here and in other areas of the nearside has certainly got me thinking a bit harder about the hypothesised Lunar Grid, and whether it represents an ancient tectonic network that exercised control over the formation of many later lunar structures.

1. V. A. Firsoff. (1961) *Moon Atlas*. The Viking Press, New York, 1961

Rima Ariadaeus and Julius Caesar.

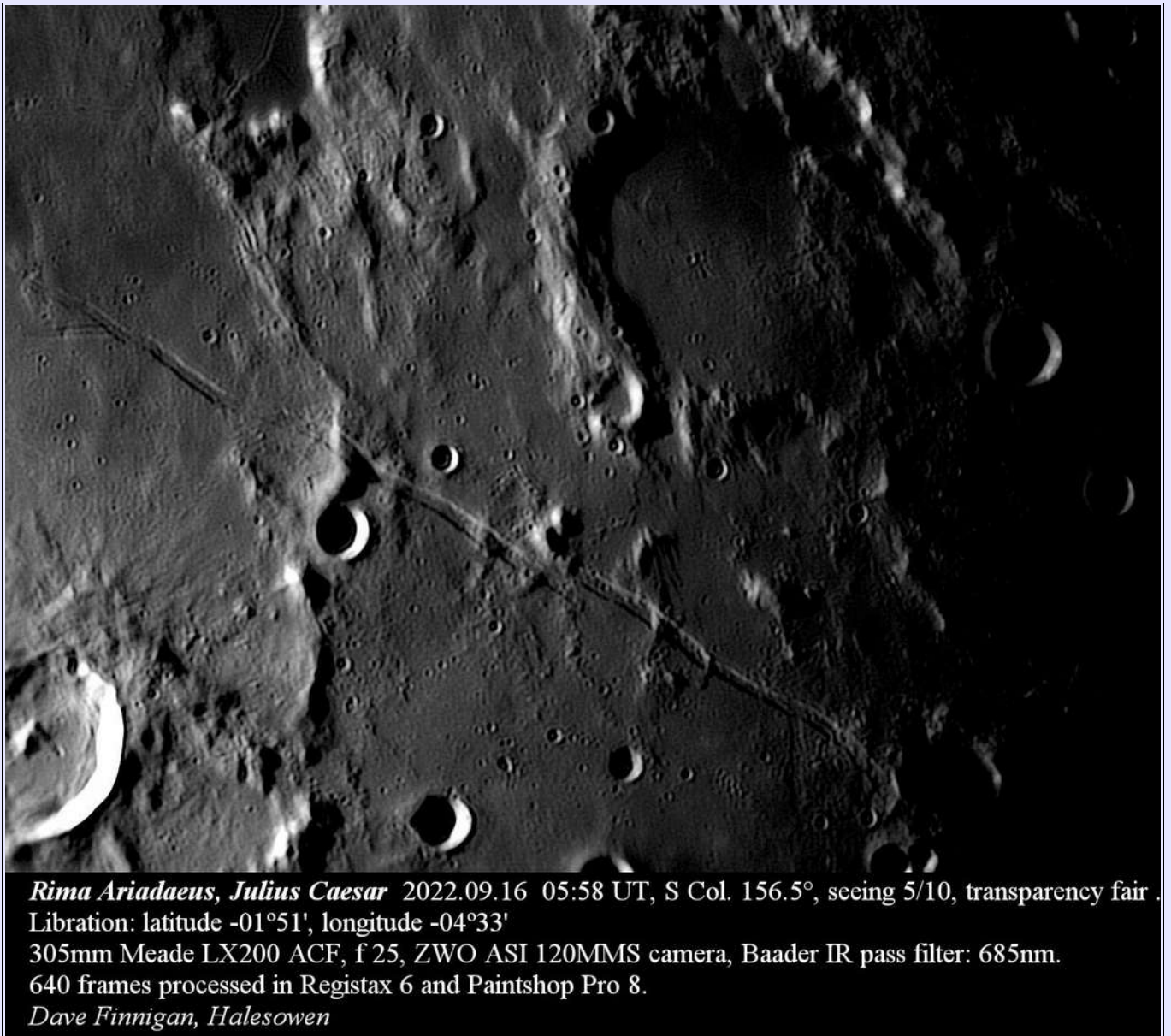


Image by Dave Finnegan with details of equipment and time/date in caption.

Geological Notes: The length of Rima Ariadaeus varies according to various sources, but a length of around 220 to 250kms is a reasonable estimate, and depth of 500m also seems about right. Dave's image shows an apparent fork in the graben at the western extremity of the frame, this is where the graben cuts across a faint eastern branch of another older graben, Rima Hyginus. This has left the floor of this part of Rima Hyginus perched on the side of Rima Ariadaeus as a 'hanging valley'. The en-echelon offset in Rima Ariadaeus shows up nicely in the centre of the frame, there has not been any sideways movement here, and offsets of this kind are not unusual in terrestrial fault swarms where the crust is subject to tensional forces and faults approach each other from opposite directions. The origin of these tensional forces could be due to either volcanism in the form of uplift or tectonic as the crust adjusts following the formation of impact basins. Which one is responsible for Rima Ariadaeus is not clear, but maybe the abundant evidence for volcanic activity associated with the nearby Rima Hyginus may be a pointer towards the involvement of volcanism. Upwards pressure caused by the ascent of magma along vertical dikes is thought to be responsible for some graben, and at one or two locations along the length of the rima there is evidence in the mineral data to hint at the eruption of volcanic material. At its eastern end Rima Ariadaeus is submerged by the lavas of Mare Tranquillitatis, but can just about be traced as a shallow trench in the mare surface just to the north and east of the crater Ariadaeus.

Note: See article by Nigel Longshaw in this article.

Promontorium Kelvin.



Image by Les Fry with details of time/date and equipment in caption.

Geological Notes: Promontorium Kelvin is the bit sticking out into Mare Humorum just to the north of the triple grabens of Rimae Hippalus. It appears to be of highland composition and therefore possibly part of the Humorum Basin rim, but there is evidence of low albedo, iron rich deposits over its elevated surface, which might hint at some volcanic activity. This includes a small (800m diameter) rimless pit which *may* be a vent, but the evidence for this is inconclusive. The mare filled Palus Epidemiarum can be seen to the lower right with the flooded crater Capuanus at its southern edge. You can make out a small dome on the southern floor of Capuanus, it is about 7kms in diameter but only 100m high, so not exactly a magnificent edifice, and has a rather square profile summit vent. This dome and two others on the crater floor were described by Raf Lena and others¹, with this being the most prominent of the three. The network of graben that make up Rima Ramsden can be seen in Les's image, these appear to be a result of the fact that Palus Epidemiarum bulges upwards slightly, most likely as a result of magmatic intrusion below the surface. This uplift was probably a factor in the formation of the concentric crater Marth which can be seen approximately half way between Ramsden and the mare flooded Mercator on the eastern shore of the palus.

1. Lena, Rafael, Evans, R. Lammed, S. Phillips, Jim & Wöhler, C.. (2011). Effusive Lunar Domes in Capuanus Crater: Morphometry and Mode of Emplacement.

Note: See 'From the Archive' article later in this LSC.

Marius.

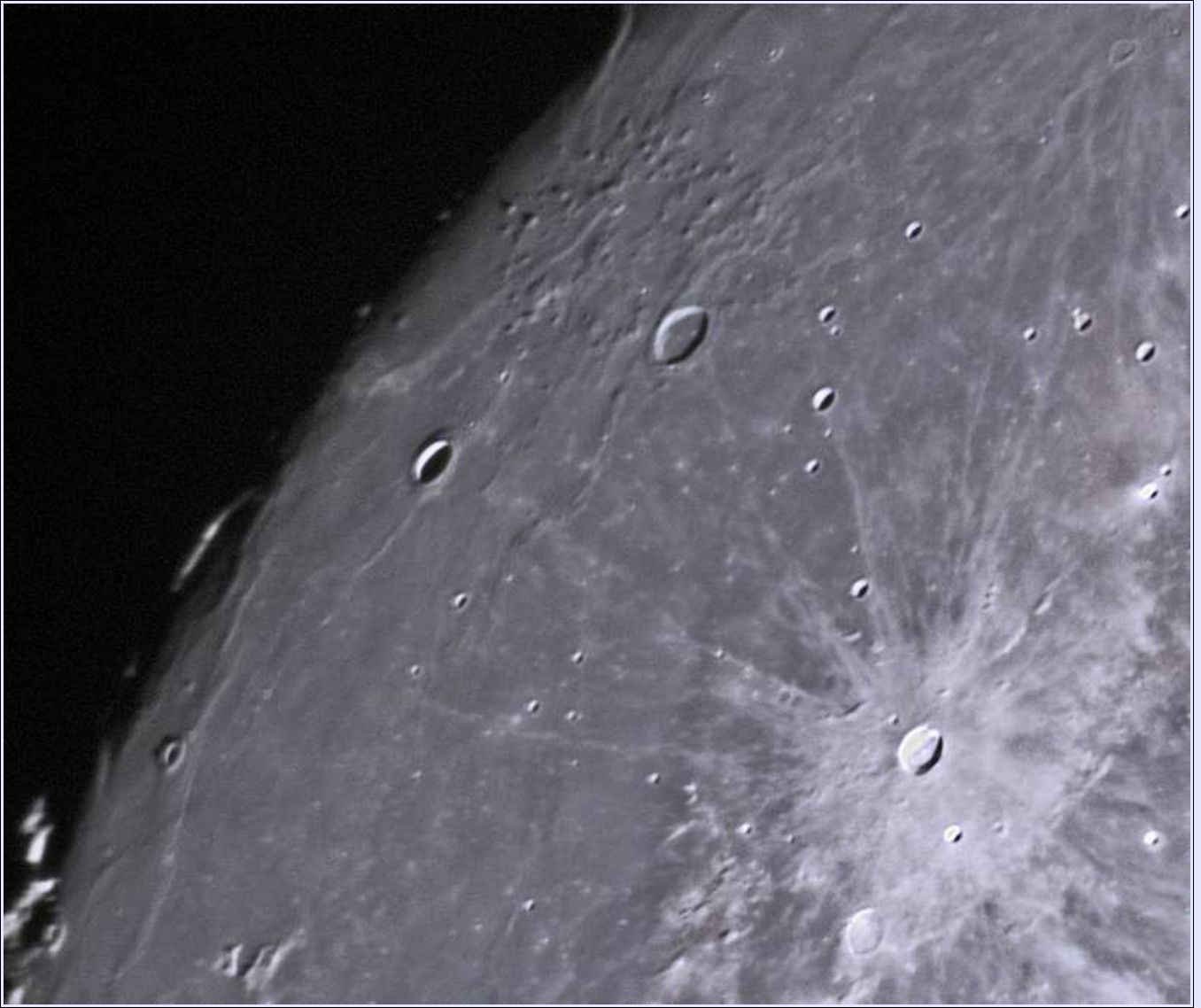


Image by Maurice Collins taken with a Celestron C8 SCT on 8th September 2022

Geological Notes: This view westwards over Oceanus Procellarum includes Kepler in the foreground and the Marius Hills plateau volcanic area in the background towards the terminator. This area contains over 300 domes and cones and a number of sinuous rilles of volcanic origin. The plateau is some 100-200m higher than the surrounding mare, and is, or was above a plume or plumes of lava that ascended from deep within the crust, carrying gas rich magma which erupted via many individual vents. Many of the volcanic structures resemble terrestrial cinder cones which are formed from the accumulation of rapidly quenched glassy ash, erupted as fire fountains such as those that occur on Hawaii or Iceland. Analysis has revealed that many of the cones in the Marius Hills are similarly glass rich and therefore likely to have been produced in similar eruptions. The sinuous rille Rima Marius can just be glimpsed snaking away along the northern edge of the plateau. Interestingly it does not emerge from a cone or dome but from a bowl like depression in the mare surface that may have formed as a magma reservoir beneath drained away, and the overlying surface subsided downwards into the emptying chamber.

The rays of Kepler reach out to the west towards the Marius plateau, but appear in the east to be truncated by a line of hills that run northwards from the crater Encke. This configuration is suggestive of a low angle impact from the bottom right hand corner of the frame, whilst the height of Kepler's rim, 200m lower in the SE as compared to the NW would support this idea. The bright ray running down into the bottom right of the frame is not from Kepler but is in fact a 'cardioid ray' from Copernicus, indicating that this prominent crater was formed by another low angle impact, this time from the south.

Beyond Nearch.

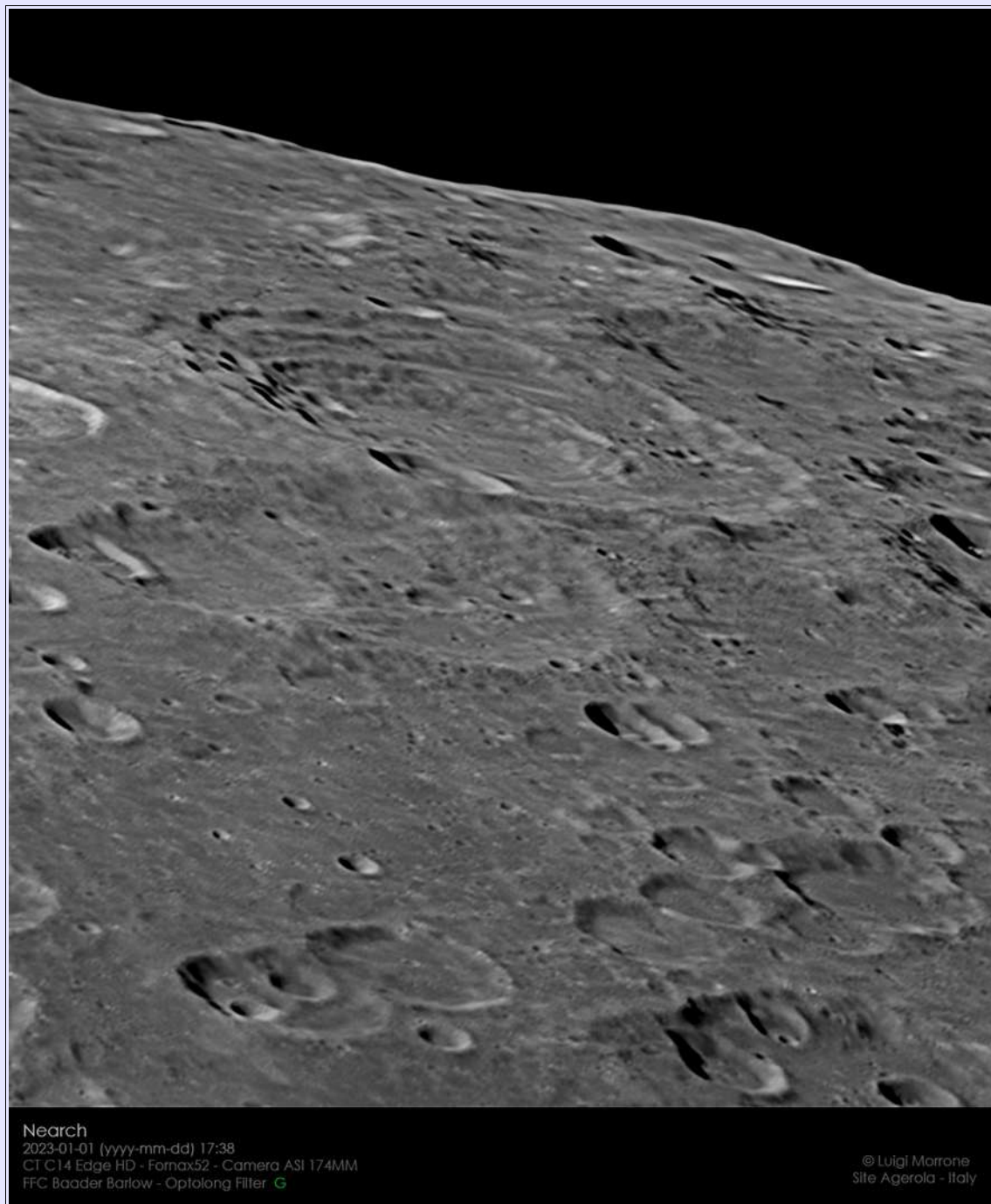


Image by Luigi Morrone with details of date/time and equipment in image.

Geological Notes: This image by Luigi shows the rugged southern highlands to the south of Nearch, with Nearch B and C in the foreground and just left of centre. The large crater occupying the middle of the frame is Boussingault (127km diam.) with the younger Boussingault A (75km diam.) set within it, and the much younger Boussingault K (27km diam.) perched on its northern rim. The highly degraded Mutus-Vlacq basin located to the NW of the area in the picture was proposed on the basis of gravity data, but there is not much in the way of topography to suggest its presence. The smooth(ish) plain above Nearch B and C in this image exhibits a reduced crustal thickness, a positive Bouguer gravity gradient and a degraded partial arc forming its south-western border. Might this indicate the presence of a large buried crater? The plain forms a bowl some 1500m lower than the surrounding terrain, and as noted above is fairly smooth with a dearth of mid size craters. If this is an ancient infilled crater, might the lack of craters here suggest that any older ones, dating from the Nectarian period for instance are now buried by later deposits that accumulated in the depression? There certainly are indications of partially filled craters around the margins of this area which would support the suggestion. This evidence is sketch at best, so please have a look and see what you think.

A feature in the Diophantus-Delisle area and observations by Bill Leatherbarrow and Paul Abel.
By Barry Fitz-Gerald.

The drawing in Fig.1 by Paul Abel is of the area around Diophantus-Delisle and includes an unusual ray like feature he spotted, the nature of which he was uncertain of. A little later Bill Leatherbarrow produced the two images shown in Fig.2 to try and elucidate the nature of what was Paul had observed. As you can see in the comments made by Paul, the ray like feature appears to come from a small crater between Delisle and Diophantus, and heads towards a large crater. The smaller crater was identified by Bill as possibly being Louise (based on Rukl's map¹) and the larger crater as Diophantus B. Paul was sure that the feature was a crater ray, but Bill's image appears to show some hummocky detail which appears to follow the line of the ray, leading to the suggestion that it might be a line of craterlets, possibly a secondary crater chain. Bill also pointed out that Harold Hill's drawing on page 72 of his 'Portfolio' covers this area and this drawing shows the 'ray' quite clearly in the position noted in the above observations². Whatever the nature of this feature, its fine structure is clearly at the limit of telescopic resolution, and a definitive answer requires some serious magnification courtesy of LRO Quickmap and SELENE images.

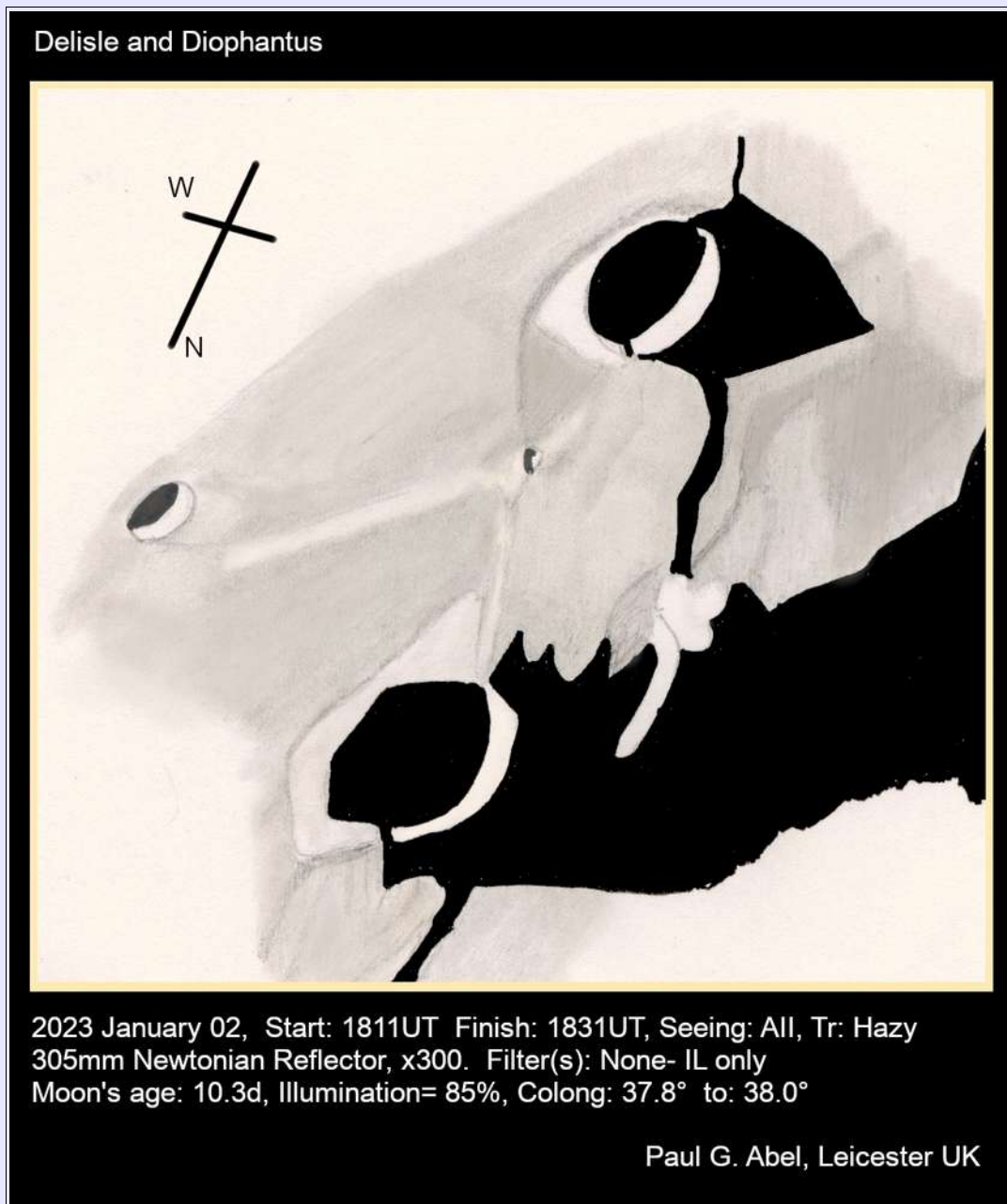


Fig.1 Drawing of the Diophantus-Delisle area by Paul Abel. He commented “Attached is a drawing I made of the craters Delisle and Diophantus (at Bill's suggestion). Both craters were close to the terminator and so their floors were filled with shadow. There were a number of interesting features, the Mons Delisle could be seen and a shadow connecting the mountains Diophantus. There was also a something similar to a bright ray heading from a tiny crater between Delisle and Diophantus towards another larger crater. Certainly a very interesting region!” North is DOWN in this drawing.

Fig.3 is a SELENE image of the area between Diophantus-Delisle, and as you can see there are in fact two small craters present, the 1.8km diameter Samir and the smaller 600m diameter Louise. There is therefore something of a discrepancy in what crater Rukl calls Louise, as the one depicted in his drawing is probably the larger Samir. Nomenclature apart, what is plain from this SELENE image is that the pair are at the centre of a bright ray system that shows a clear Zone of Avoidance (ZoA) to the SE with the implication that what we are dealing with here is a low angle impact from that direction. The rays are arranged in a very distinct 'butterfly wing' patterns to the NE and SW which is another diagnostic characteristic of a low angle impact. To the NE this pattern is dominated by three rays, the southernmost being the one that defines the eastern edge of the ZoA. This ray is sharp and has a well defined edge with the ZoA. The western edge of the ZoA is also defined by a comparable ray which appears to cross the northern rim of Diophantus.



Fig.2 Image taken by Bill Leatherbarrow of the Diophantus-Delisle area drawn by Paul Abel and shown in Fig.1. Bill Commented in an e-mail to Paul “My impression that what you saw might be a line of small craterlets and or hummocks was based on my images taken that evening, which appear to show a profusion of such features in the area, some of which appear to follow the line of the ray”. The ray is marked with a yellow arrow in the upper image and as you can see there is indeed a hummocky texture to the surface as noted by Bill.

The next most prominent ray is rather 'feathery', and can be seen to extend towards Diophantus B, before veering off slightly around the northern rim of that crater. The northernmost ray, which is also quite 'feathery' in appearance passes further north of Diophantus B. Fig.4, which is a SELENE/Kaguya Derived Optical Maturity

(OMAT) mosaic overlay from LRO Quickmap shows these rays with somewhat greater clarity, with the ZoA ray (a) middle ray (b) northern ray (c) and a peculiar down-range ray (d). They are colour coded in yellow which indicates a low optical maturity due to the higher proportion of fresh rocky material within them. Any red colouring indicates areas with a very low optical maturity, again corresponding to a surface with a high proportion of fresh rocky or even bouldery material such as the inner walls of the younger craters.

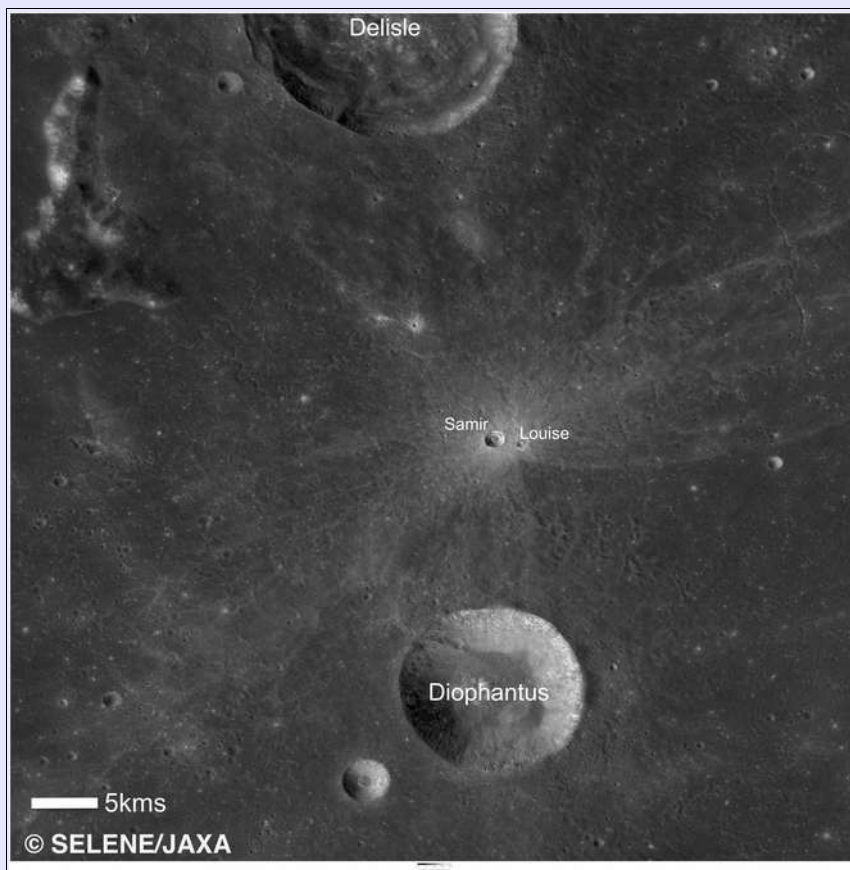


Fig.3 A SELENE image of the area between Diophantus-Delisle showing the craters Samir and Louise set within a bright 'butterfly wing' ejecta pattern. Note the prominent Zone of Avoidance, the ray forming the western edge of which crosses the northern rim of Diophantus.

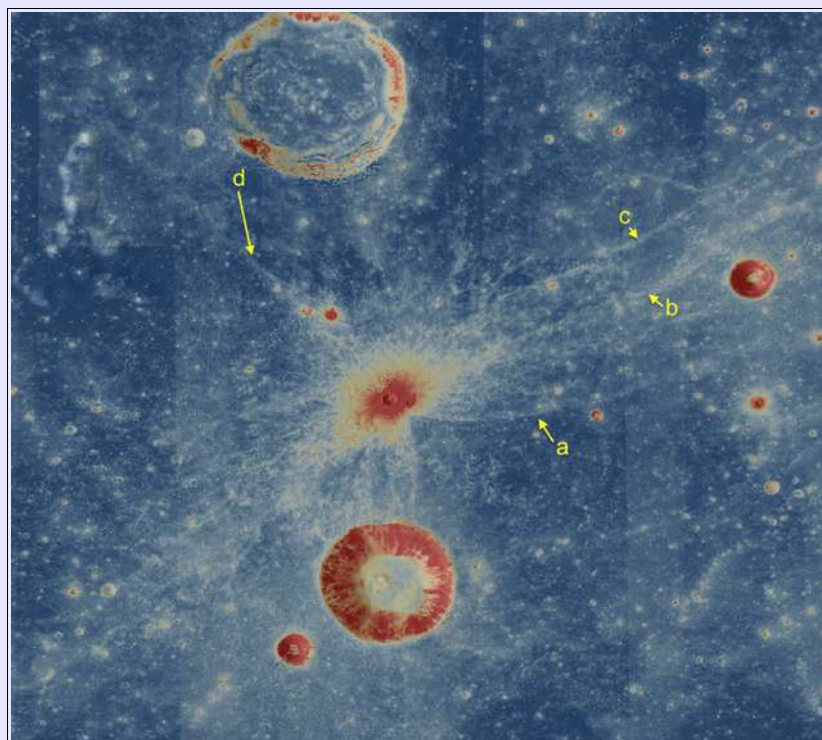


Fig.4 SELENE/Kaguya Derived Optical Maturity (OMAT) mosaic overlay from LRO Quickmap with colour rendering ranging from red through to yellow to indicate optical maturity, which also correlates with the amount of fresh rocky material exposed on the surface. As can be seen Samir and Louise appear to share a red halo of low optical maturity.

Comparing Paul's drawing and Bill's images suggests that the feature they recorded was the middle ray (b) as shown in Fig.4, which would seem to confirm its identity as a crater ray, and part of the 'butterfly pattern' ejecta from the crater Samir. But this may not be the whole story, as I have suspected for some time that this crater pair may be more than just neighbours but represents a binary impact. As can be seen both Samir and Louise are surrounded by a halo of low optical maturity rocky debris which seems to envelop both craters. This would be consistent with both impacts occurring simultaneously, but the same effect *could* be achieved by separate and unrelated impacts in the same area within a (relatively) short space of lunar time.

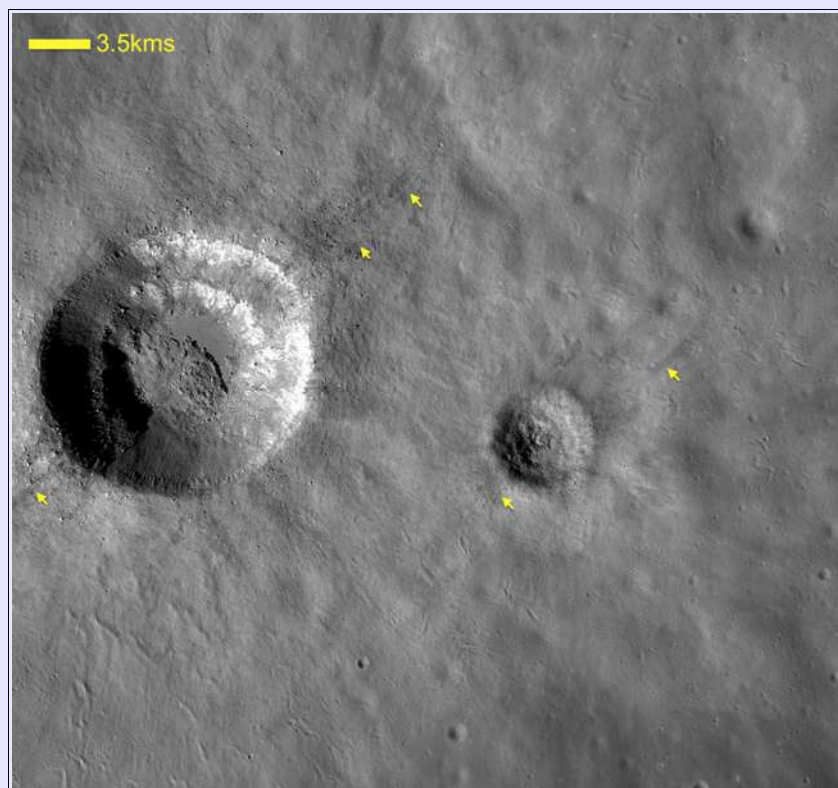


Fig.5 LROC NAC image of Samir and Louise showing impact melt rich darker deposits in the ejecta to the NE and SW of both craters (yellow arrows). Note that Samir is a 'bench crater'.

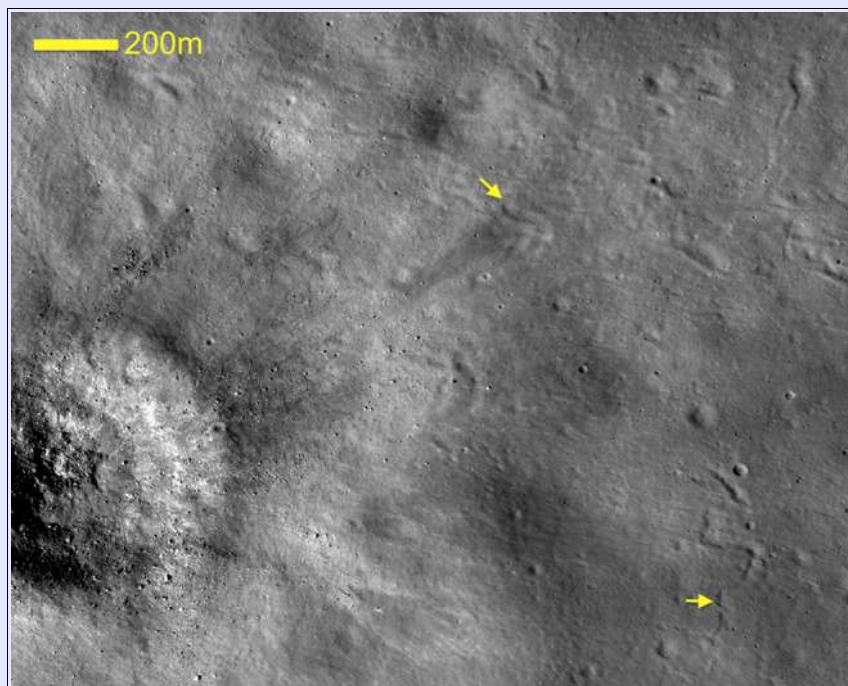


Fig.6 LRO-NAC image of the surface to the NE of Louise showing dark melt rich ejecta superimposed upon an ejecta dune/trough from Samir, showing that the ejecta from Samir came first and the ejecta from Louise second.

If we zoom in a bit on the pair courtesy of LRO we can see some evidence to support the binary impact idea however, especially in the distribution of dark impact melt deposits which are more prominent to the NE and SW of each crater. This would be consistent with this melt being ejected preferentially in the *cross-range* direction, indicating that both craters shared a similar incoming trajectory. Another observation that might add weight to the evidence is the relationship of the ejecta from each crater with the other. Fig.6 shows an area to the NE of Louise where dark, melt rich ejecta deposits from Louise can be seen superimposed on dune and trough ejecta features from Samir, indicating that the Samir ejecta arrived first and was then covered by Louise ejecta. Fig.7 shows an area just outside the eastern rim of Samir where stream of melt and boulder rich late stage ejecta from Samir appears to lie on top of a dark ray that appears to be related to Louise – so a reverse of the sequence just described.

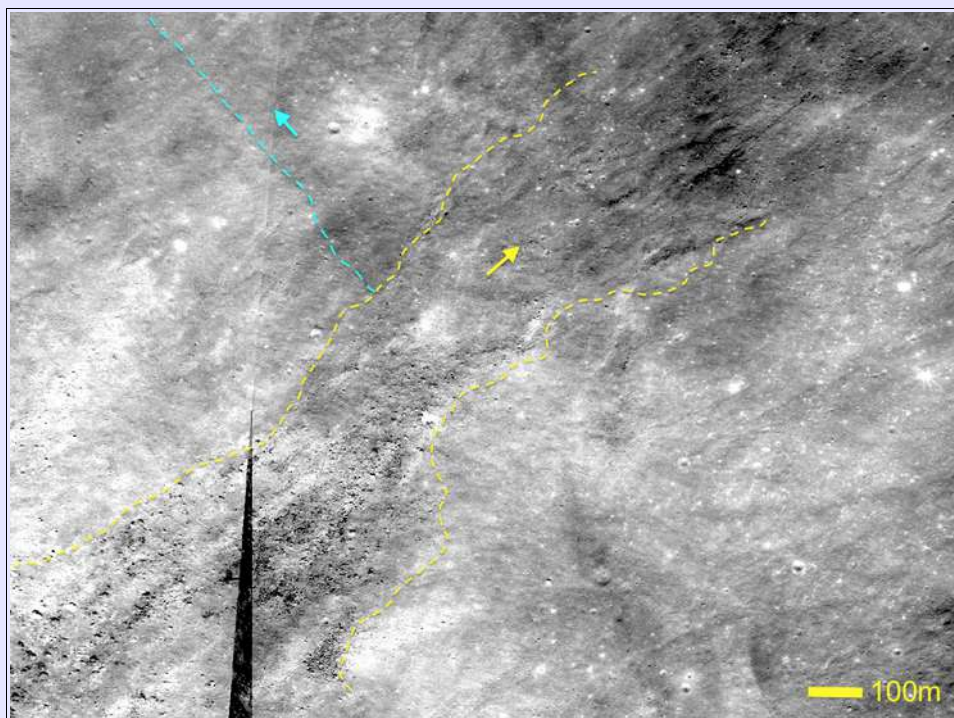


Fig.7 LRO-NAC image of an area just outside the eastern rim of Samir where boulder and melt rich ejecta (within yellow dashed line) appear to be superimposed on a dark ray (edge marked with blue dashed line) from Louise. Blue and yellow arrows show direction of each ray.

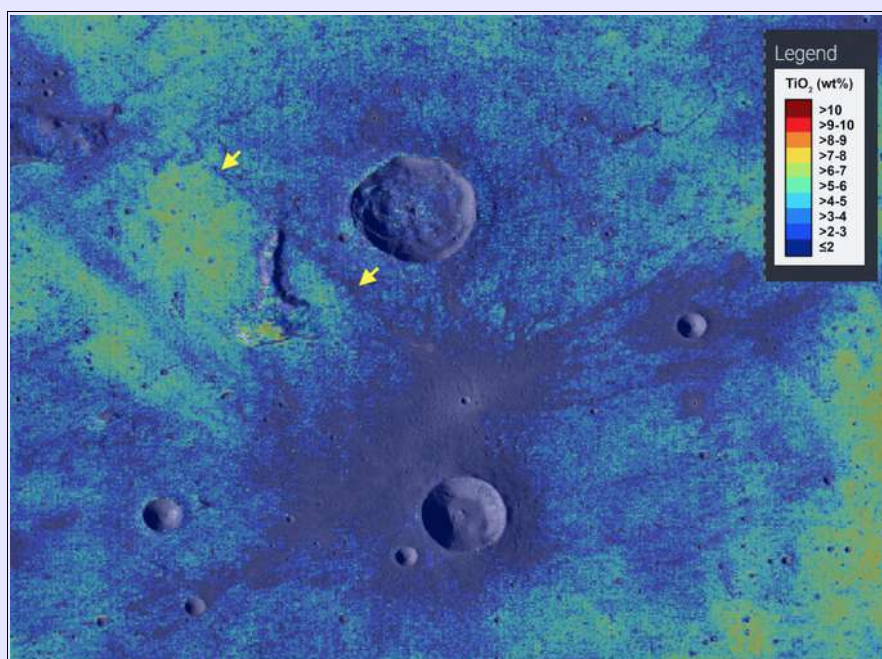


Fig.8 LRO Quickmap TiO₂ abundance overlay showing the down-range ray 'd' (yellow arrows) extending for some 85kms to the NW of the impact site of Samir and Louise. Note all the rays have the low TiO₂ signature which probably reflects the highland nature of the impact site sub surface.

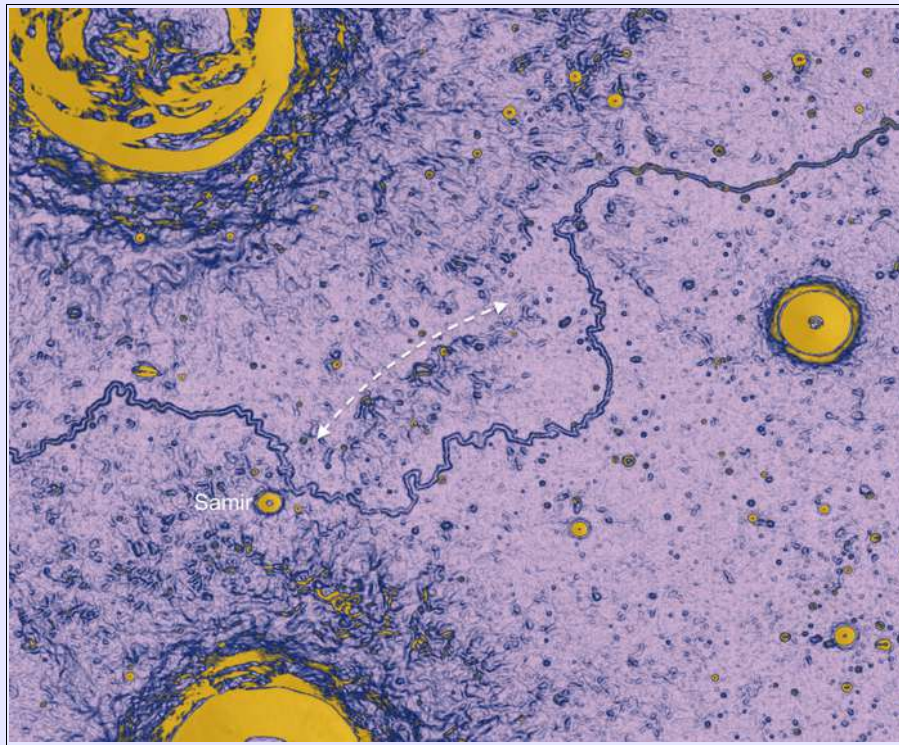


Fig.9 LRO Quickmap Terrain Slope overlay showing a line of secondary craters (white dashed arrow) corresponding to the position of ray 'b' in Fig.5. These are secondary craters from Delisle and arranged circumferentially to the crater rim.

These observations, along with a number of others strongly suggest a simultaneous origin for the two craters with their ejecta blankets having interacted as the craters were forming. This is of course just one interpretation and you might well find evidence to the contrary if you delve into the complexity of this network of rays and deposits. A few final points, as can be seen in Fig.5, Samir and to a lesser extent Louise are 'bench craters' which are thought to form where the target is composed of a fragmented regolith layer overlying a more consolidated sub surface, with the result that the excavation process encounters different target strengths as it penetrates deeper. Also the ray marked 'd' in Fig.4, which is in the down-range direction from the crater pair, can be traced in the mineral data, such as shown in Fig.8, for some 85kms to the NW, but I suspect it would be a challenging if not impossible target for earth based images. In this figure the ray is picked out as a low titanium feature lying on top of the higher titanium mare basalts – all the other rays from Samir and Louise are low titanium which probably reflects the highland nature of the sub-surface at the impact site.

What about the observation made by Bill of the hummocky terrain apparently following the line of the ray? This can be explained by looking at Fig.9 which is a LRO Quickmap Terrain Slope overlay which picks out very subtle topographic variations. What can be seen here is that there are indeed hill like features extending in a SW-NE line that appears to coincide with the position of ray 'b' in Fig.5. The relationship is however coincidental, and the hills are in fact a line of secondary craters and their intervening ridges, arranged in an arc to the SW of Delisle, which is their parent crater. The fact that the humps and troughs of the secondary craters appear to follow the path of the ray is purely coincidental.

Lastly, the area around Diophantus-Delisle has been of interest within the section for rather a long time, and Fig.10 is a drawing by P.J. Cattermole which accompanied a brief article entitled 'The Region around Delisle and Diophantus' in the September 1956 edition of 'The Moon'. As can be seen a number of suspected dome like features are recorded. It could be an interesting project to both re-observe the area with a view to re-locate any of these features and also to see what spacecraft imagery has to say about the area. The latter approach has its limitations in picking out subtle topographic features due to the limited range of illumination, but it may reveal some geological or mineralogical features that help in either confirming the reality of some of these features or ruling them out as volcanic in nature.

So, all in all, as Paul said, a very interesting area!

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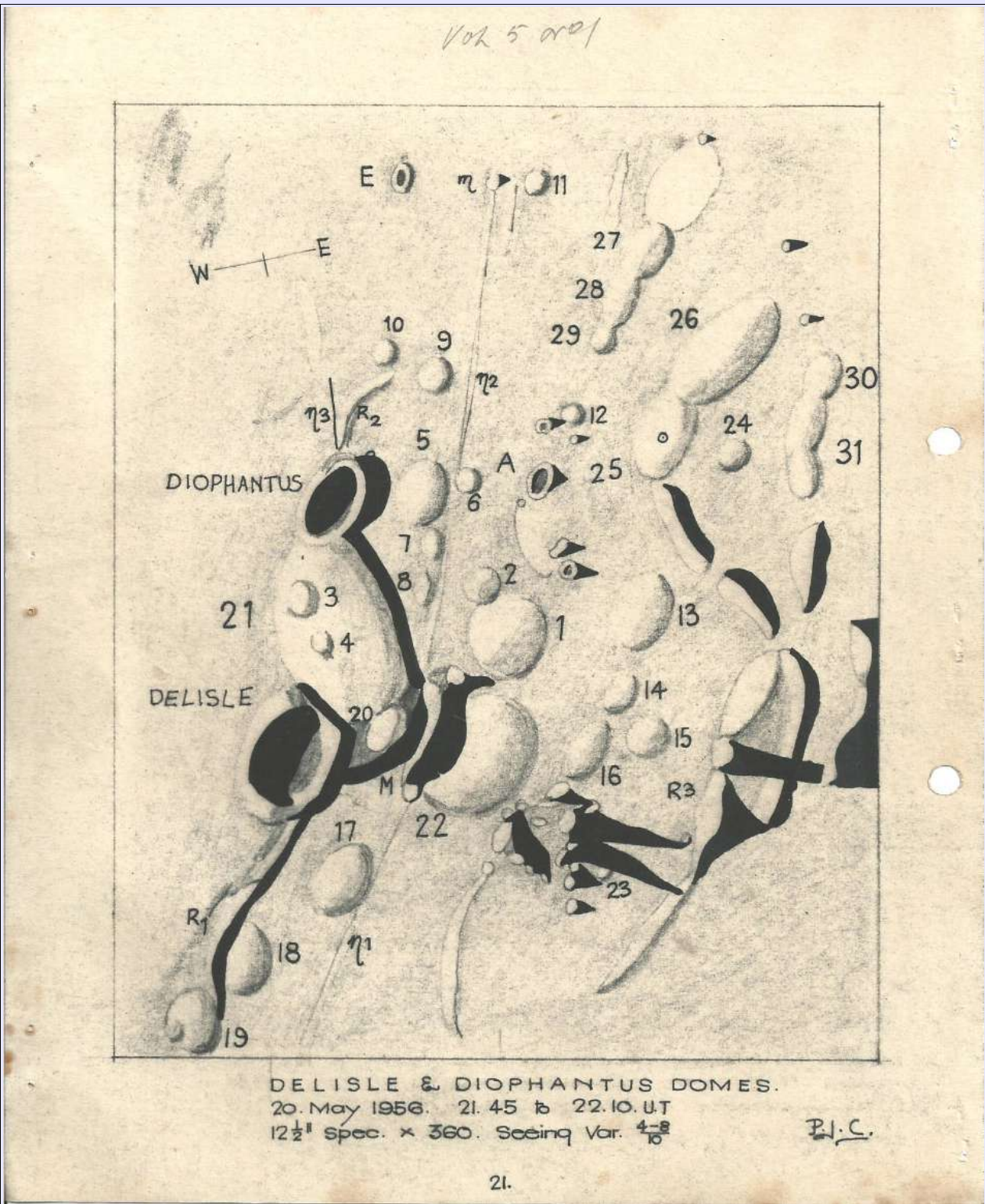


Fig.10 Drawing by P.J Cattermole taken from The Moon Vol.5 No.1 1956.

1. Antonín Růkl (1993) Atlas of the Moon. Kalmbach Publishing Co ,U.S.

2. H.Hill (2010) A Portfolio of Lunar Drawings: 1 (Practical Astronomy Handbooks, Series Number 1). Cambridge University Press

Basin and Buried Crater Project.

By Tony Cook.

I have received two communications about basins/buried craters. The first was forwarded to me by David Teske, ALPO Lunar Section coordinator, and the latter is a pretty much self-contained article by Guillermo Daniel Scheidereiter.

The Schiller-Zucchius Basin?

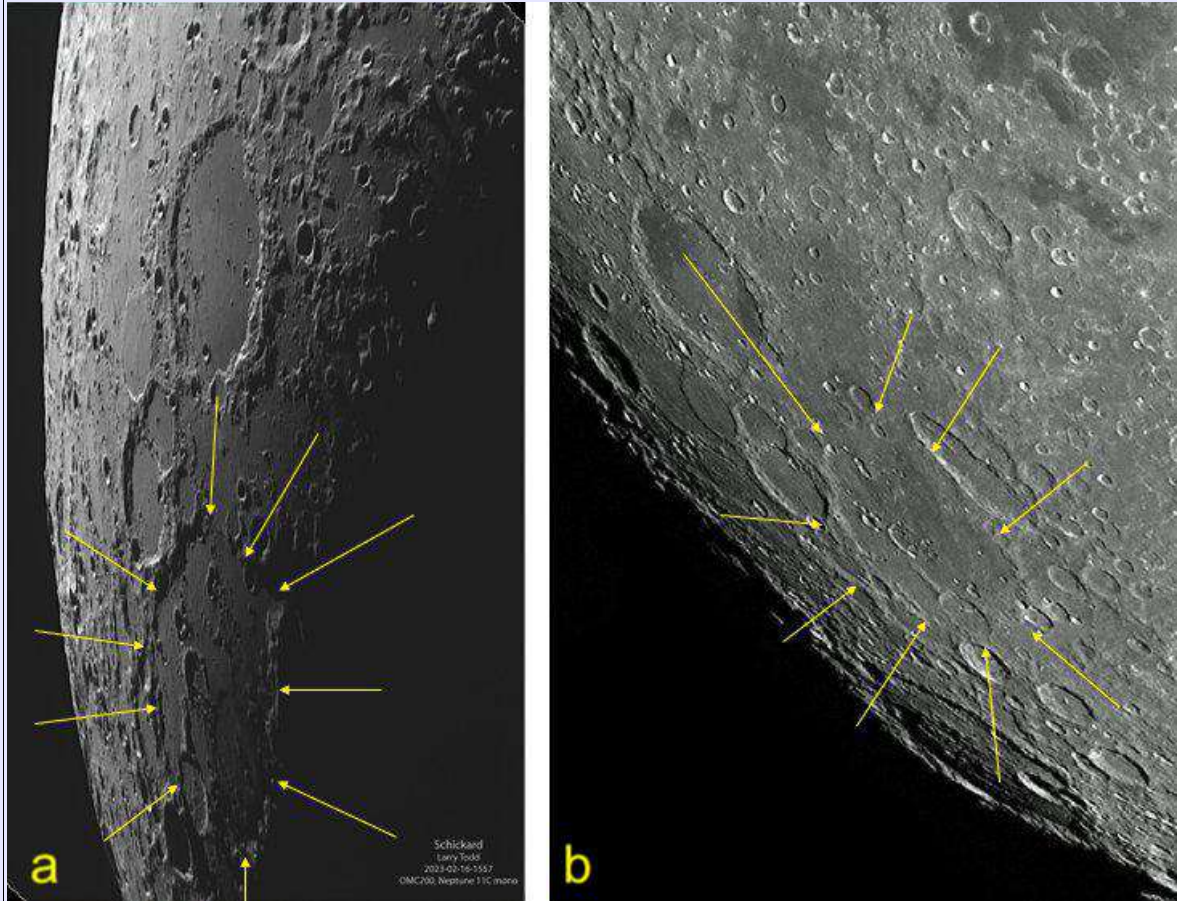


Figure 1(a and b). A basin suspected by Larry Todd and David Teske, located in the SE quadrant of the Moon. Image 'a' taken by Larry Todd (Dunedin, New Zealand) on 2023 Feb 16 UT 15:57. Image 'b' taken by David Teske (USA) on 2023 Feb 04 UT 02:46.

Larry notes that there is a basin south of Schickard, Wargentin, Nasmyth, and Phocylides (Fig 1a), and David Teske, who took another image (Fig 1b) but under different lighting suggests that it is a large, dark oval going from Phocylides to near Hainzel. I have added yellow arrows to both images following a rough overlay of the suggested basin outline that David Teske sent me in a follow up email.

The first thing I decided to do was to find the approximate location and diameter of the basin suspected by Larry and David, using the NASA LROC Quickmap tool. A slope azimuth plot helped here enormously (Fig 2). It shows more clearly the region arrowed in Fig 1.

In Larry and David images (Fig 1) the basin centre is at 45°W 55°S, and the N-S transect of the basin seems to be about 277 km in length and the E-W transect about 295 km wide. Looking in the ALPO/BAA basin database, the closest basin to this is the Schiller-Zucchius basin at 45°W 56°S and 335 km in diameter. Is this a coincidence of a newly discovered basin and the Schiller-Zucchius basin almost being on top of one another? Possibly not? I think what is happening here is that the southern edge of what we see in Fig.1a, although well defined, does not include details further south as the image is clipped here. In Fig.1b the lack of hill shaded terrain makes it difficult to really define the southern edge of the suspected basin, so it could be a larger

diameter. Likewise on the west, could the basin in Fig 1 be a little further west than the arrows?

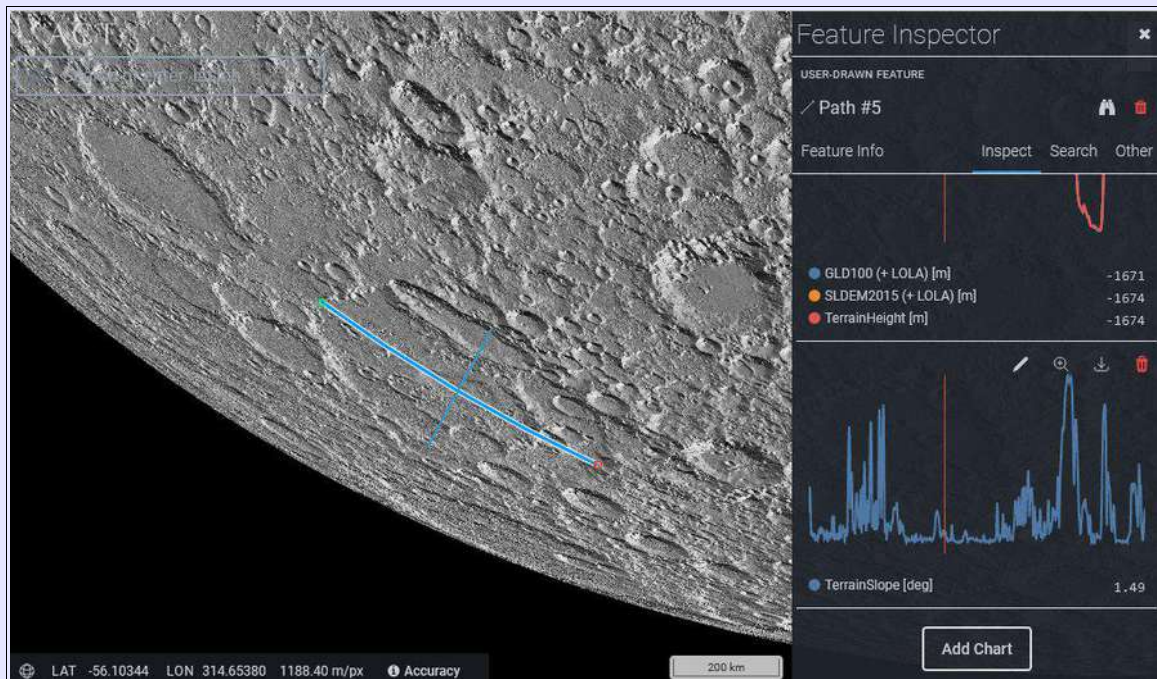


Figure 2. A N/S topographic cross-section through the Schiller-Zucchius basin using NASA's Quickmap website.

On the eastern flank of the suspected basin we have the unusual elongated Schiller crater, which is shadow filled in the left image. Suppose the basin ring were going along the eastern edge of Schiller (actually in shadow in Fig.1a), then the E-W diameter would be bigger still. Schiller even has an elongated and offset central set of peaks on its northern floor – could this alternatively be the rim of the basin? The actual diameter of the Schiller-Zucchius basin is 335 km – so I think the basin that Larry and David imaged is probably one and the same. However, I would welcome readers to prove me wrong. At least with Larry's image I can add a selenographic colongitude of 223.7° of when it is best to see the basin under evening illumination.

Proposed Basin Study by Guillermo Daniel Scheidereiter.

** Note that the measurements and analysis described below were sent in by Guillermo Daniel Scheidereiter before I had a chance to check the on-line basin catalog. So alas it turns out not to be a newly discovered basin (or proto-basin). However the article illustrates very well much of the procedure needed to establish the presence of a basin. We also have an improved estimate of the centre of the basin, the ring diameters of the primary and inner rings, and the associated errors. The Hind-Almanon basin would also provide an interesting target for lunar photographers so that we can find at what range of colongitudes it is best presented on the morning and evening terminators. Anyway Guillermo's article follows (with some edits – T.C.)....*

The Hind-Almanon Impact Basin* – an Analysis by Guillermo Daniel Scheidereiter.

In these notes, observations are made of a lunar crater/basin that has almost disappeared due to subsequent impacts after its formation. The region of interest contains a few craters such as Abulfeda, Ritchey, Andel, Burnham, amongst others.

The aim was to inspect images and determine approximately the circular contour of the suspected crater (or basin), establish coordinates of some points that possibly delimit the edge approximately, estimate the diameter and examine topographic profiles that may reveal a interior depression.

The procedures and results established according to the proposed objectives are listed below:

1) Inspection of images using computer tools

An initial inspection of images was carried out, of which two sample images are shown in Fig 3 and 4.



Figure 3: Arrow indicates the region of interest.



Figure 4 Arrow indicating the region of interest.

In addition, the area was studied using [LROC QuickMap](#) and [Virtual Moon Atlas](#).

2) Delimitation of the area of interest

To delimit the observation area, we begin by listing the main craters that are around, or even superimposed, on what is presumed to be the rim of the suspected crater/basin.

a) Major craters surrounding the area:

North: Halley, Hind, Hipparchus C, Hipparchus L.
Northwest: Albategnius.
West: Burnham.
Southwest: Argelander.
South: Airy B and edge of the Werner-Airy basin.
Southeast: Abulfeda (overlapping the edge).
East: Descartes.
Northeast: Lindsay.

b) Approximation of the contour

Based on sections 1 and 2a, a series of points were drawn that could mark the outline of the crater (or basin). For this the drawing tool of LROC QuickMap was used. The guide points were arranged in a circular pattern following the relief that suggests the shape of the supposed crater or basin. The location is imperfect and approximate (Fig 5).

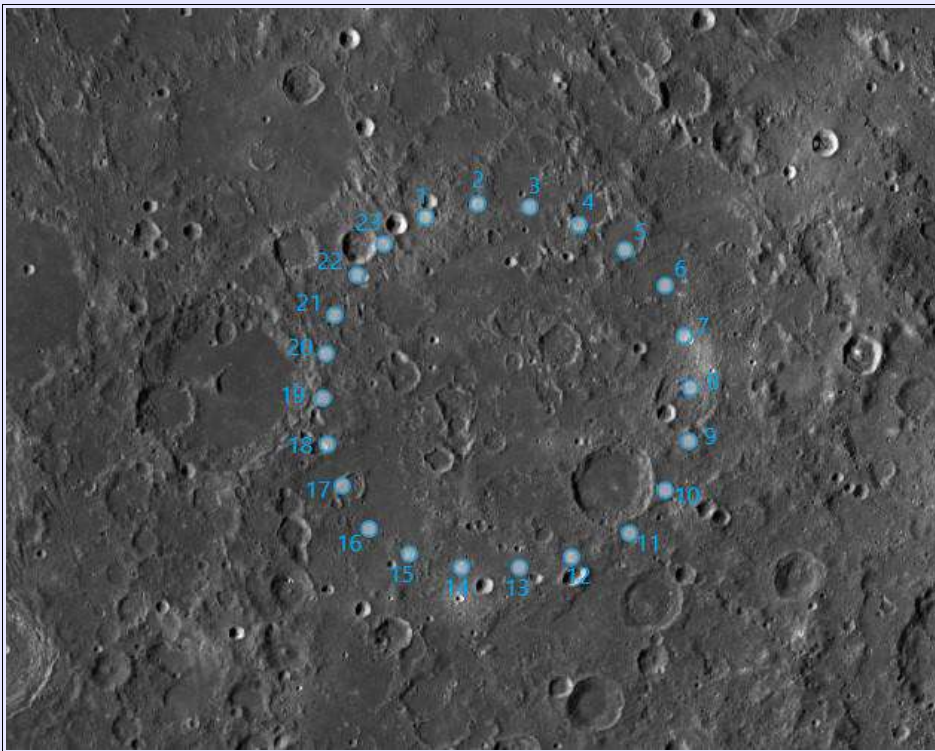


Figure 5. Contour estimation of the basin/buried crater primary ring.

Once an approximate contour of the area was established, a record of the latitude and longitude of each point was taken, which are organized in Table 1.

3) Diameter Estimation

In order to estimate the diameter of the circular area, a series of straight lines between points on the suspected rim were drawn in LROC QuickMap, and with the Feature Inspector tool a record of the distances (in kilometres) that they cover themselves on the Moon. The average of the distances was then calculated and a diameter of 281.1 ± 5.0 km was found.

Point	LAT	LON	Point	LAT	LON	Point	LAT	LON
1	-7.25332	8.92807	9	-12.81511	15.79564	17	-13.92574	7.00259
2	-6.93876	10.19746	10	-14.02471	15.26091	18	-12.87402	6.61234
3	-7.01133	11.52930	11	-15.11633	14.41209	19	-11.71291	6.48978
4	-7.42278	12.75363	12	-15.71411	12.96531	20	-10.61822	6.52720
5	-8.05282	13.94450	13	-15.98868	11.62831	21	-9.68084	6.70885
6	-8.95111	15.00726	14	-15.98776	10.13432	22	-8.69247	7.25119
7	-10.16861	15.54287	15	-15.63929	8.79550	23	-7.91286	7.90689
8	-11.46425	15.76457	16	-14.99201	7.71320	-	-	-

Table 1: Latitude and longitude for estimated points. Note that a +ve longitude means east and +ve latitude means north.

4) Topographic Profile inspection

Twenty-one profiles of the area were plotted using LROC QuickMap to see if there was evidence of a circular depression with higher edges. The fact that central peaks may be part of later formations should be taken into considerations. The diameters were numbered from smallest to largest in a clockwise direction, and lines were drawn from the numbers toward the opposite end to maintain the same order of relief in the profiles. The following figures were associated with each of the twelve drawn diameters. Each of them is a profile of the cross section established by the plotted diameter. The number in the circle is associated with the number assigned to the diameters.

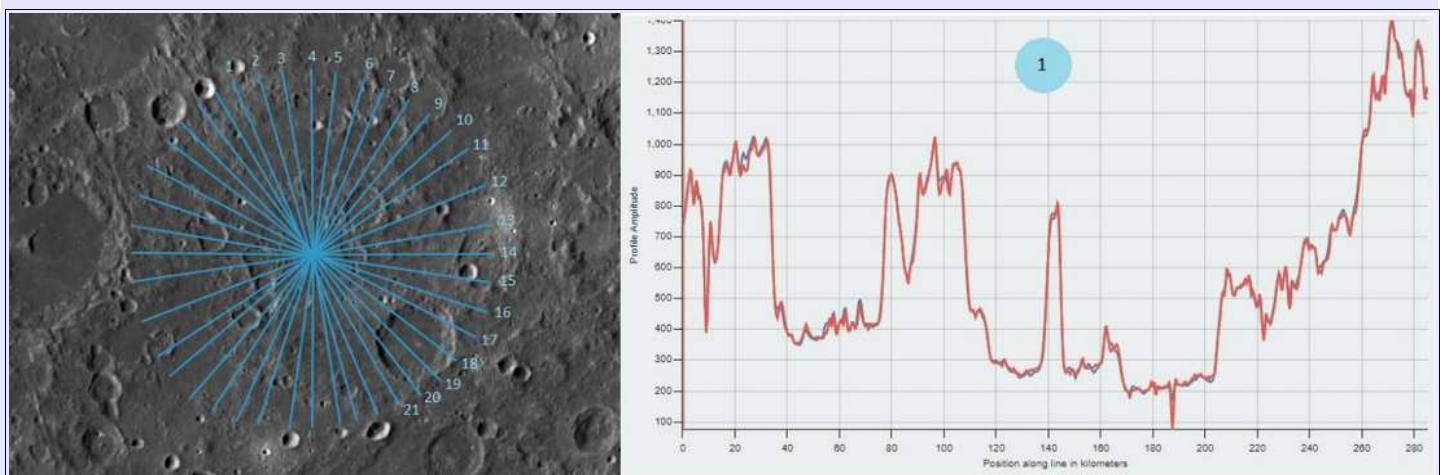


Figure 6. Diameter rate (left) and first profile (right).

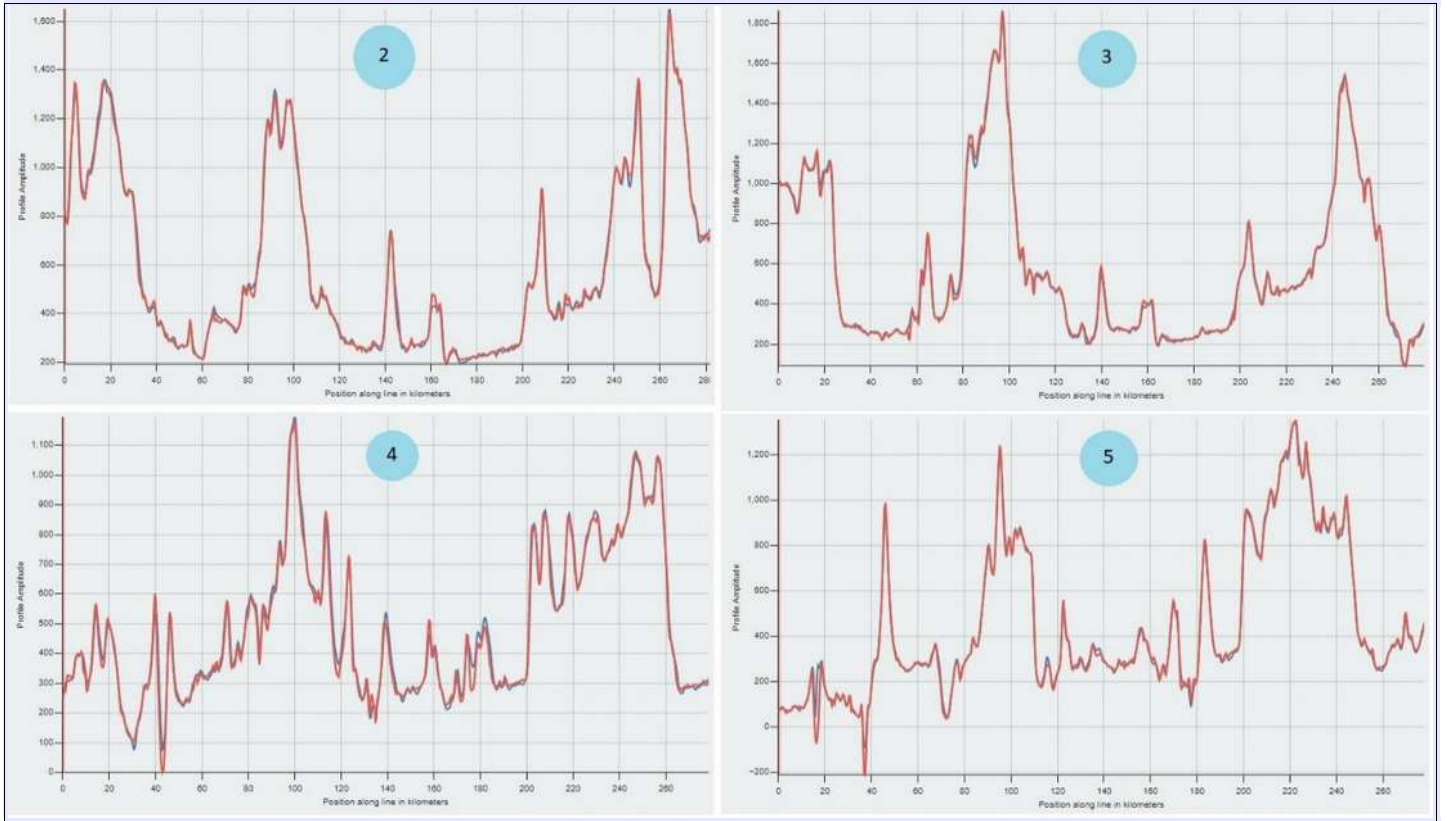


Figure 7. Four profiles following Figure 6 (numbers are associated with numbered diameters in the Fig 6 - Left), LROC QuickMap.

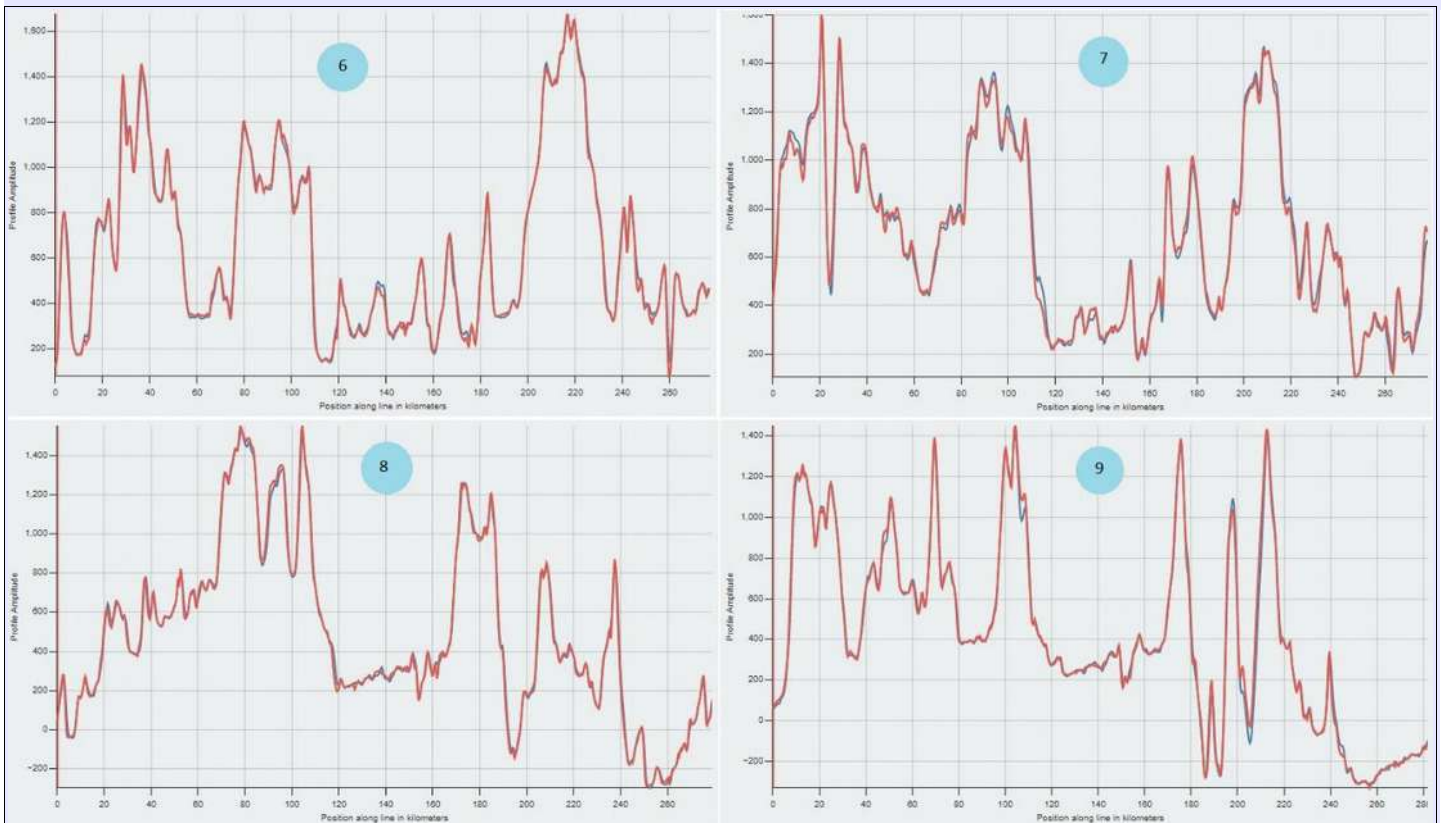


Figure 8. Intermediate profiles from six to nine (numbers are associated with numbered diameters in the Fig 6 - Left), LROC QuickMap.

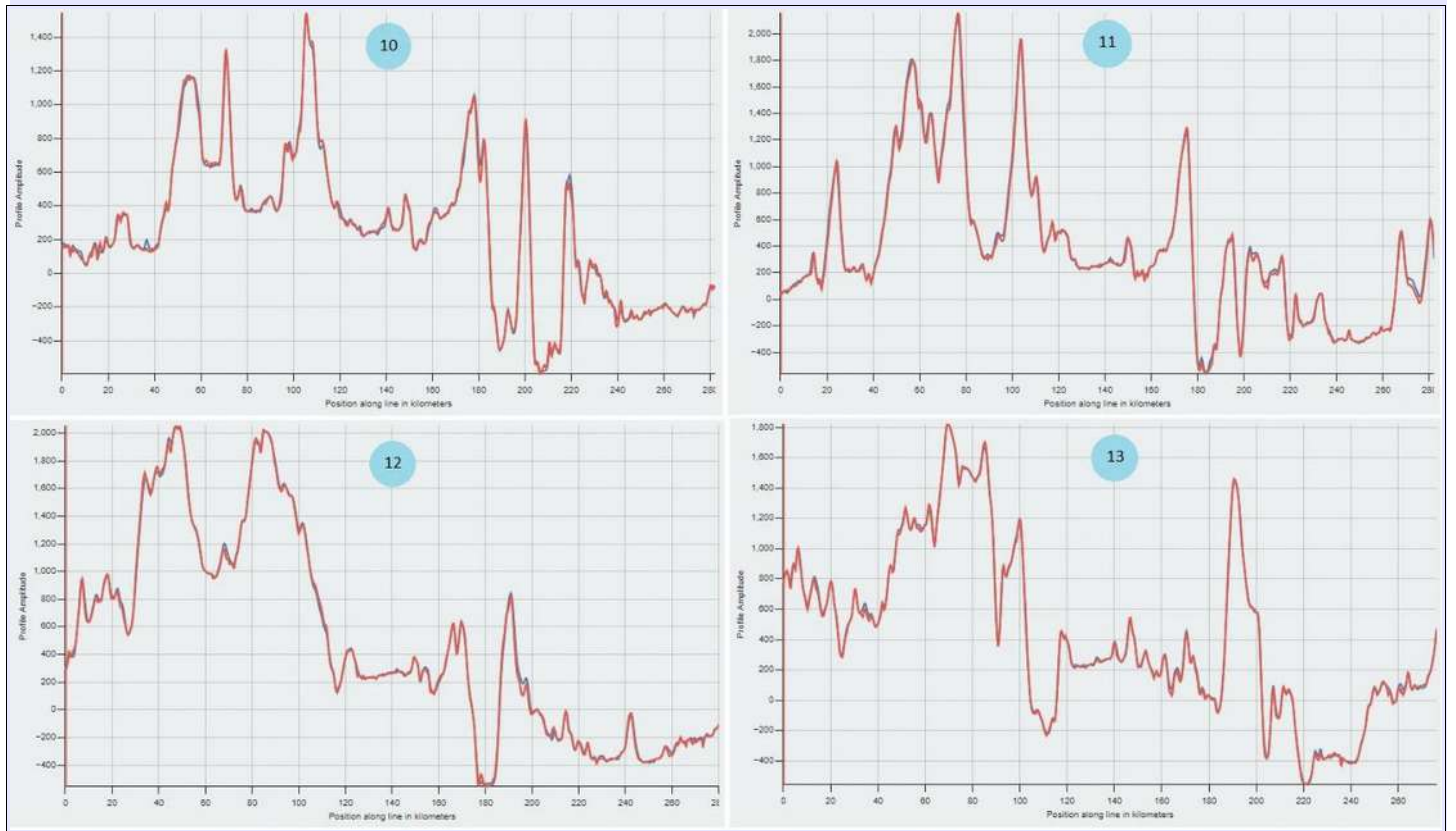


Figure 9. Intermediate profiles from ten to thirteen (numbers are associated with numbered diameters in the Fig 6 - Left), LROC QuickMap.

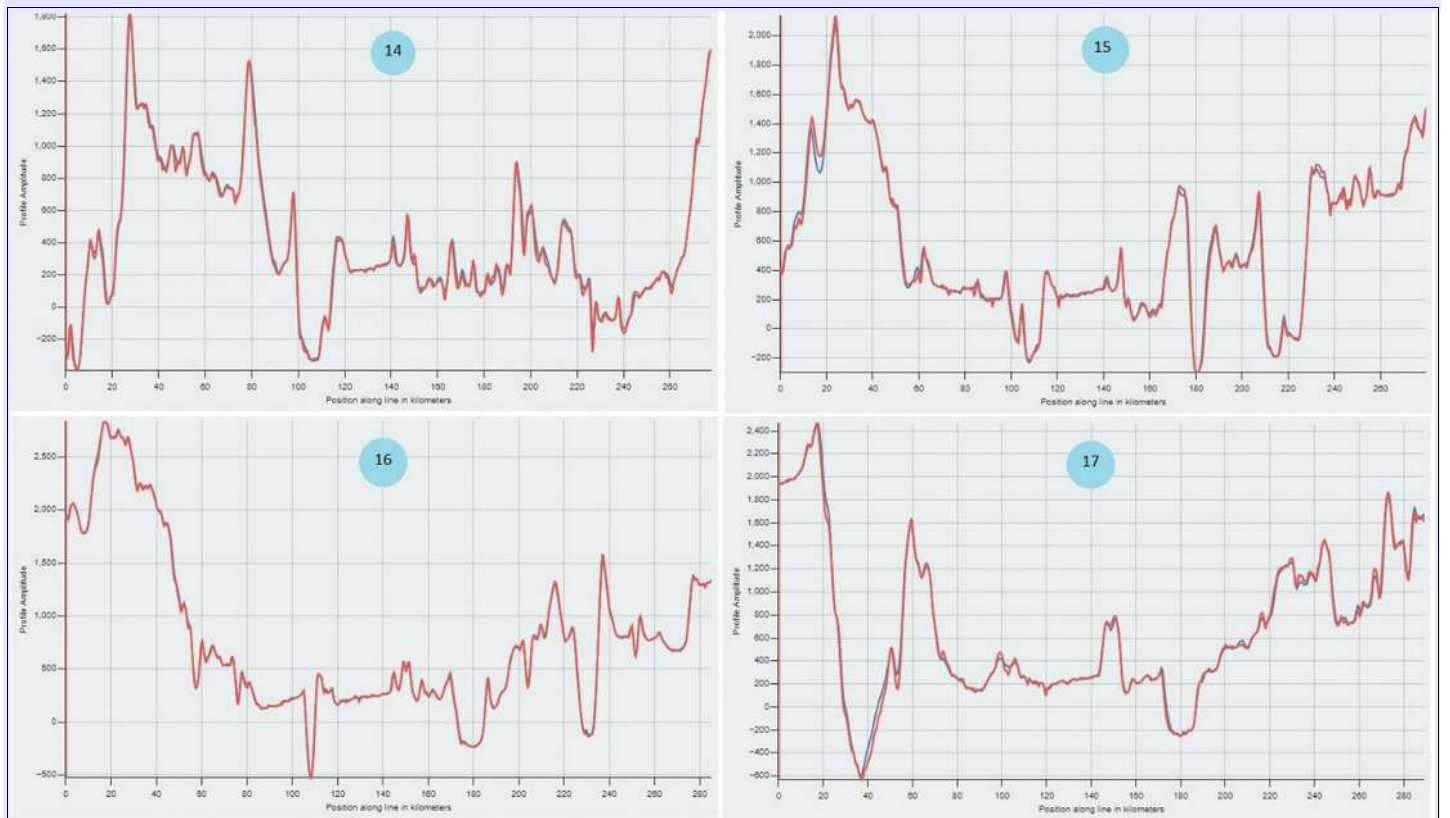


Figure 10. Intermediate profiles from fourteen to seventeen (numbers are associated with numbered diameters in the Fig 6 - Left), LROC QuickMap.



Figure 11. Last four profiles (numbers are associated with numbered diameters in the Fig 6 - Left), LROC QuickMap.

5) Concentric region observation

The image of the area shown by LROC QuickMap (Fig 6 – Left) and the inspected photographs (Figs 3 and 4) allows us to infer a darker concentric shape, with a crescent-like appearance, inside the delimited contour in Fig 12.

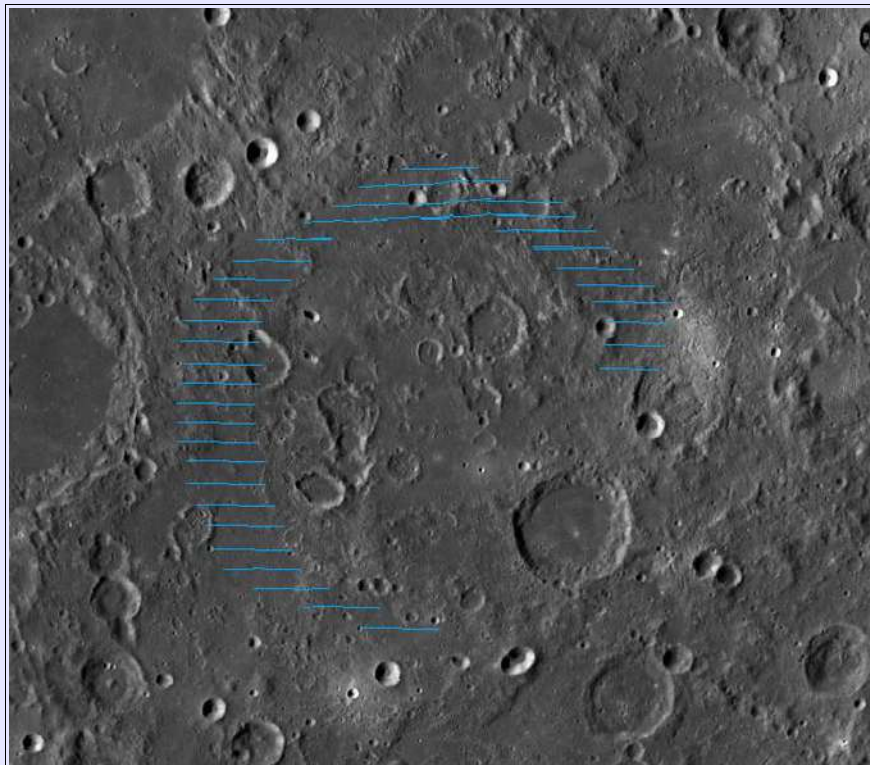


Figure 12. Shading depicting a probable concentric region.

Examination of some profiles seems to support this idea, suggesting a depression in the terrain. The following image illustrates the assumption. The interior between the yellow segments corresponds to the part of the profile associated to the right also between yellow vertical lines.

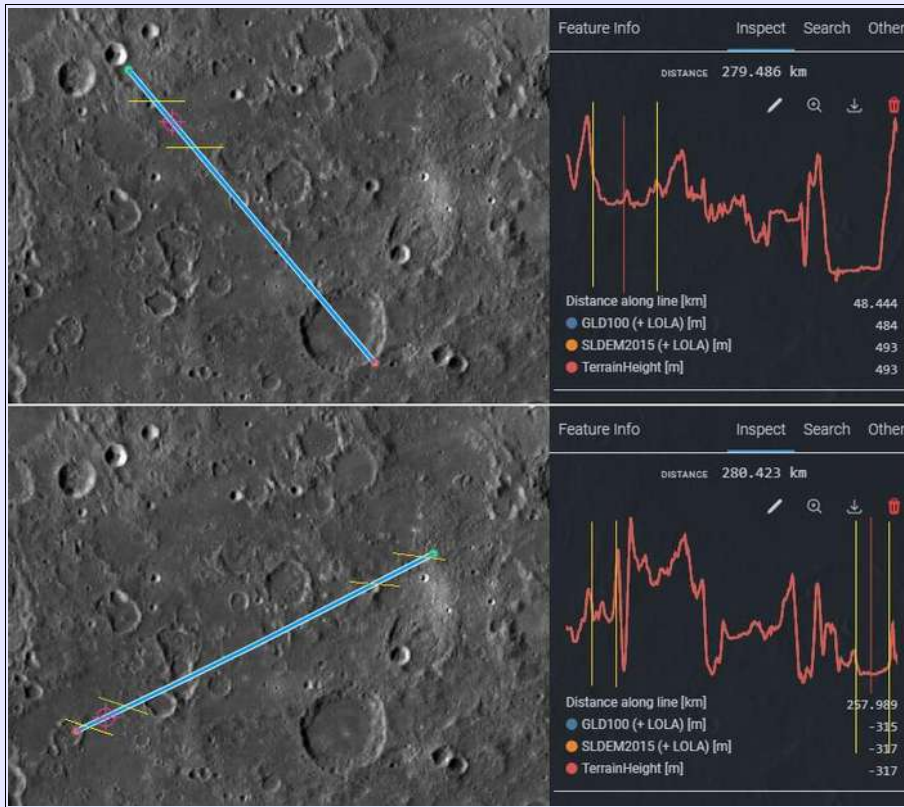


Figure 13. Two profiles that probably support the idea of concentric rings.

The circular area that is inferred measures about 177.6 ± 6.4 km in diameter and Fig 14 illustrates the interior area.

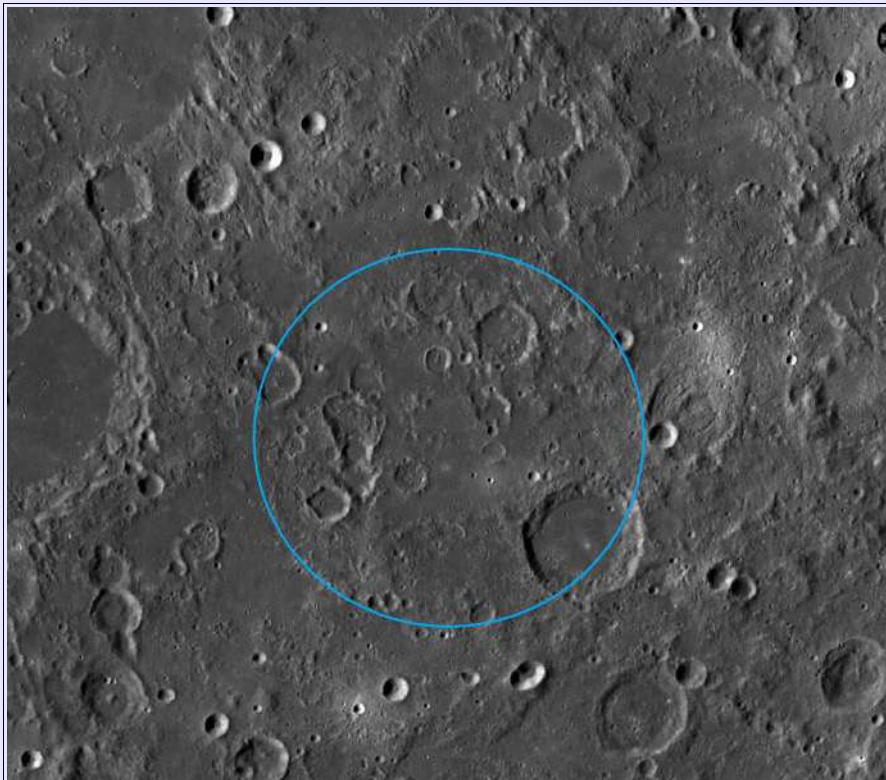


Figure 14. Probable inner circular region.

6) Final comments

The inspected images suggest a highly degraded circular area, with almost erased topographic contours, on which subsequent craters were overlaid. The points drawn, to roughly delimit the outline of the candidate crater/basin have negative latitude coordinates, which places the region toward the Moon's southern nearside hemisphere. Using LROC, a diameter of about 281 km was estimated, the traced profiles do not conclusively favour of a crater or a basin. However, the profiles determined by the lines that join diametrically opposite points in the southeast-northwest direction of the circular depression may have a representation approximately similar to the profile of a crater. There is some visual evidence from the photographs examined that there could be a concentric circular area, that is, one circular area inside another. Observation of the cross sections seems to support this interpretation, but is by no means conclusive. For the supposed interior region, a diameter of about 178 km was estimated.

Based upon the exploration carried out, it is not possible to conclude that the area of interest is definitely an ancient crater or basin. The images and methods used are only suggestive and are not sufficient to establish any conclusion. Clearly more in-depth studies are needed to determine the true nature of this depression.

§

If you think that you have discovered a new impact basin, or unknown buried crater, please check whether it has been found previously on the following web site, and if not email me its location and diameter so that I can update the list.

https://users.aber.ac.uk/atc/basin_and_buried_crater_project.htm.

Alternatively, if you want an observational challenge, try to see if you can image one of more of the basins or buried craters at sunrise/set and establish what colongitude range they are best depicted at. Or you can even do this “virtually” with LTVT [software](#). As you can see from the tables on the web sites there are lot of blank cells to fill in on the sunrise and sunset colongitude columns – so a good opportunity for you to get busy!

Lunar Lectures.

Three informative lectures presented by the late Dr Paul Spudis and hosted by the National Space Society are available on 'YouTube' for those familiar with the site. They are obviously not new (2008), but contain a lot of information on lunar surface science and exploration. The lecture on Exploration may now be a bit outdated, but the first two are useful from a geological perspective. They can be found via the following link:



<https://www.youtube.com/playlist?list=PLaBObyQHLzmop8y9espovVYeIs56yiavw>

Lunar domes (part LXIII): Lunar domes Grace and Diana.

By Raffaello Lena.

The extrusive origin of lunar domes and their similarity to terrestrial features like small shield volcanoes have been described in the literature^[1-3]. Important clusters of lunar domes are observed in the Hortensius/Milichius/T. Mayer region in Mare Insularum and in Mare Tranquillitatis around the craters Arago and Cauchy^[4-6]. A first map of the area under description, the Cauchy shield, was produced by the author^[7], and a classification of these domes was performed based on previous works^[4, 8, 9, 10]. The domes near Vitruvius have been described in another paper^[11].

In this sixty-third note I will describe two domes known as *Grace* and *Diana*, which are detectable in the telescopic image shown in Fig. 1 made by Christian Viladrich.

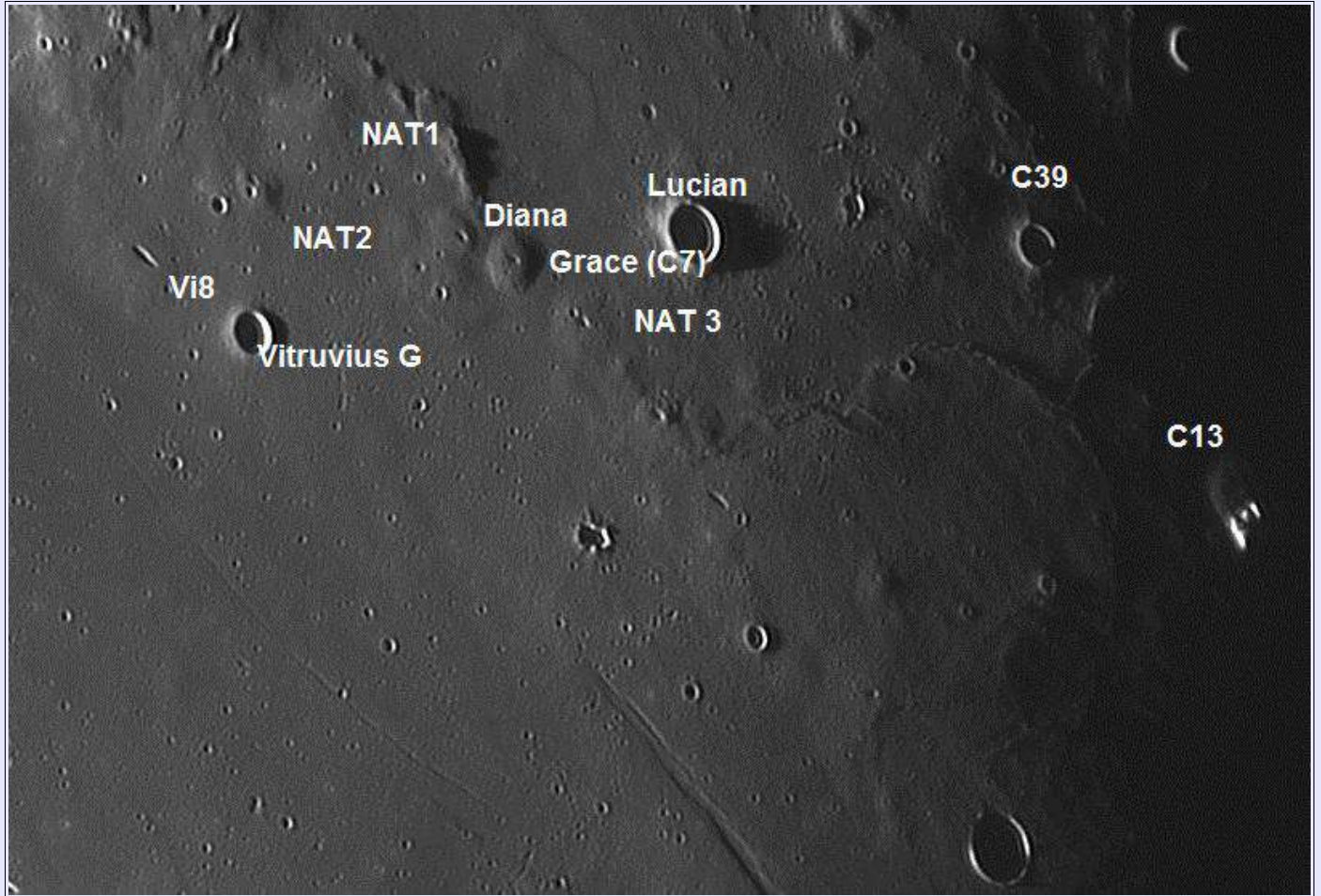


Figure 1: Image taken by Viladrich on October 25, 2021 at 03:50 UT, using a RC 500mm of diameter. In the image are labeled only some domes. For a map based on telescopic images see the Lunar domes atlas by the author in the Vitruvius quadrant <http://vitruviuscauchy.blogspot.it/>

The insert shown in Fig. 2 displays the domes under strongly oblique solar illumination, emerging from the terminator. This “old image” present in my archive has been taken by Jim Phillips.

Figure 3 displays LRO WAC imagery with the two examined lunar domes. The morphometric properties of *Diana* and *Grace* have been derived using telescopic imagery and photoclinometry and shape from shading methods as described in our book^[4].

A map of this region obtained using ACT react quick map is shown in Fig. 4.

Based on telescopic images, examined 15 years ago, the following results have been derived using the photoclinometry and SfS approach^[4]:

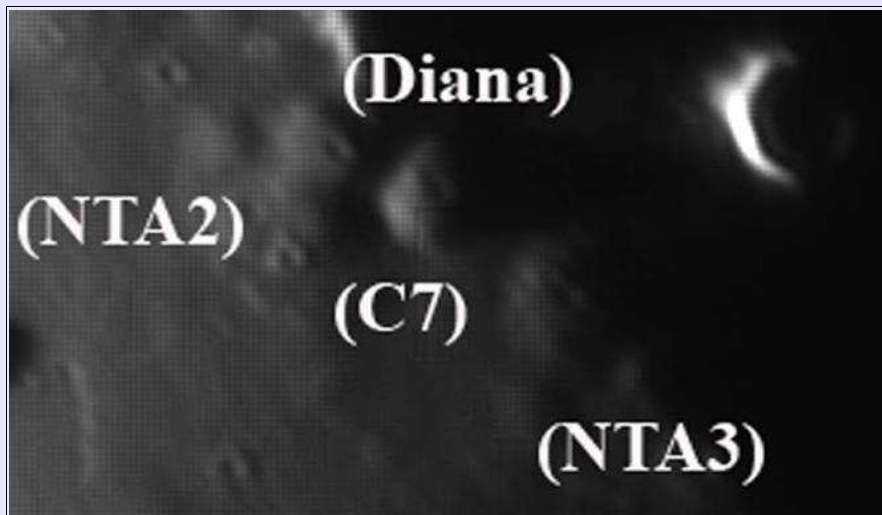


Figure 2: Image taken by Jim Phillips. Refractor 200 mm of diameter Grace is termed C7.

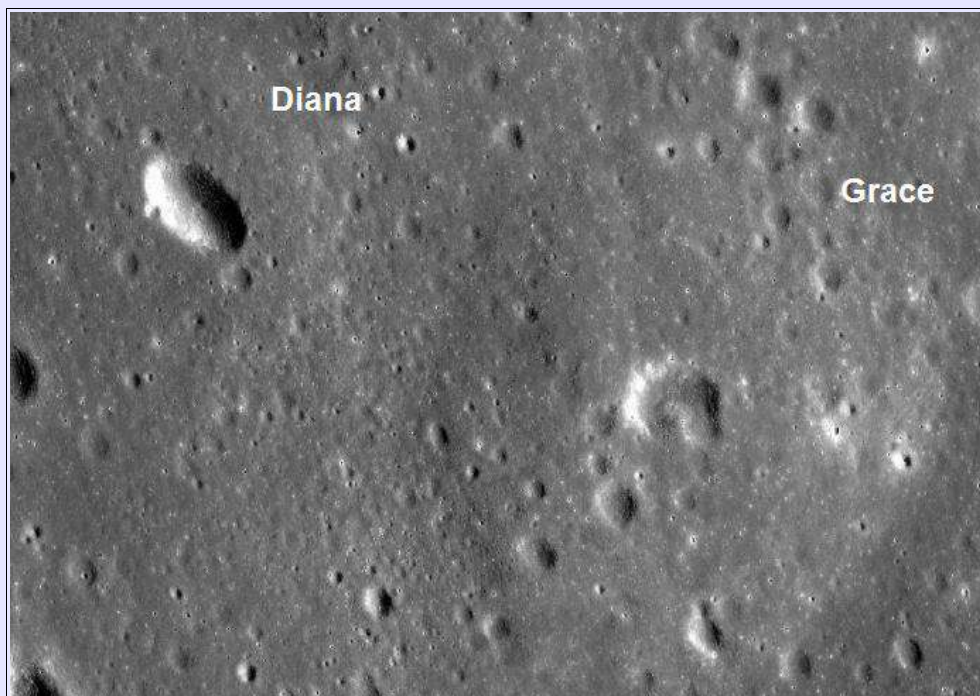


Figure 3: LRO WAC imagery with two examined lunar domes. Diana and Grace (named C7) are aligned linearly. This direction is approximately radial to Mare Imbrium. An explanation of the alignment is that domes were formed along crustal fractures generated by major impact events, hence running radially with respect to the basin locations.

Grace, in northern Mare Tranquillitatis, with a diameter of 8km, a height of 140m, an average flank slope of 2° and an edifice volume corresponding to 4.7km^3 is situated near the border of class C and belongs to class C_2 . For *Grace*, the rheologic parameters are $\eta = 4.9 \times 10^5 \text{ Pa s}$ for the lava viscosity, $E = 80 \text{ m}^3 \text{ s}^{-1}$ for the effusion rate, and $T = 1.8$ years for the duration of the effusion process, thus characterized by lower effusion rate and longer effusion time if compared with the values inferred for C28, C29, C30 and C33^[4].

To Class C_2 domes belong two well known domes C2 (Cauchy ω) and C3 (Cauchy τ). Cauchy ω has a diameter of 12.2 km, a height of 125m, an average flank slope of 1.17° and an edifice volume corresponding to 7.2 km^3 , while its neighbor Cauchy τ is characterized by larger diameter (17km), with height of 190m corresponding to a flank slope of 1.3° . For Cauchy ω and Cauchy τ , the rheologic parameters reported in previous studies^[4] are $\eta = 1.0 \times 10^5 - 3.5 \times 10^5 \text{ Pa s}$ for the lava viscosity, $E = 207\text{-}264\text{m}^3 \text{ s}^{-1}$ for the effusion rate, and $T = 1.1\text{-}1.4$ years for the duration of the effusion process, respectively.

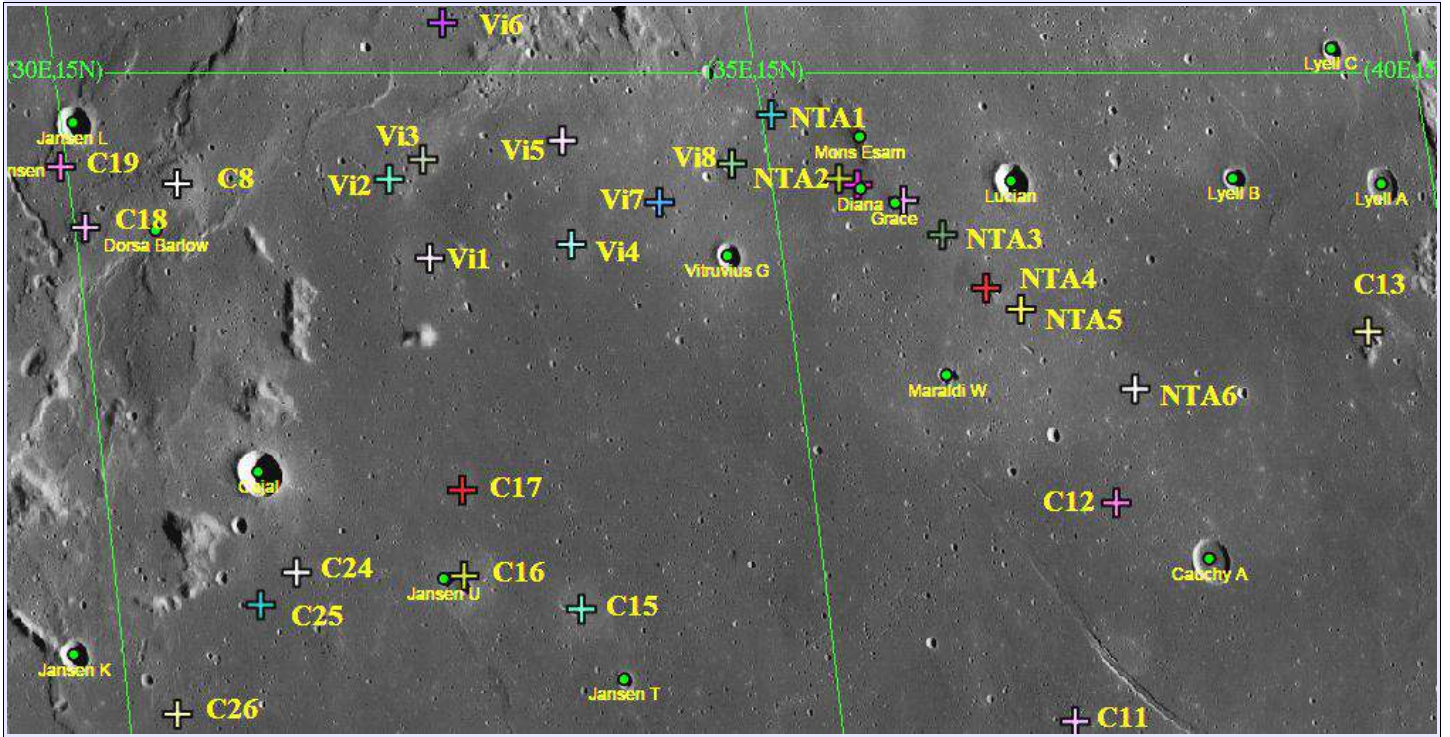


Figure 4: Map of some volcanic features of the Cauchy shield including Diana and Grace. WAC imagery.

Diana, in northern Mare Tranquillitatis, with a diameter of 6.1km, a height of 70m, an average flank slope of 1.3° and an edifice volume corresponding to 1.1km^3 is intermediate between classes A, C₂ and E₂. For *Diana*, the rheologic parameters are $\eta = 3.4 \times 10^4 \text{ Pa s}$ for the lava viscosity, $E = 92 \text{ m}^3 \text{ s}^{-1}$ for the effusion rate, and $T = 0.38 \text{ years}$ for the duration of the effusion process, thus characterized by lower viscosity and effusion time if compared with *Grace* [4, 8-9].

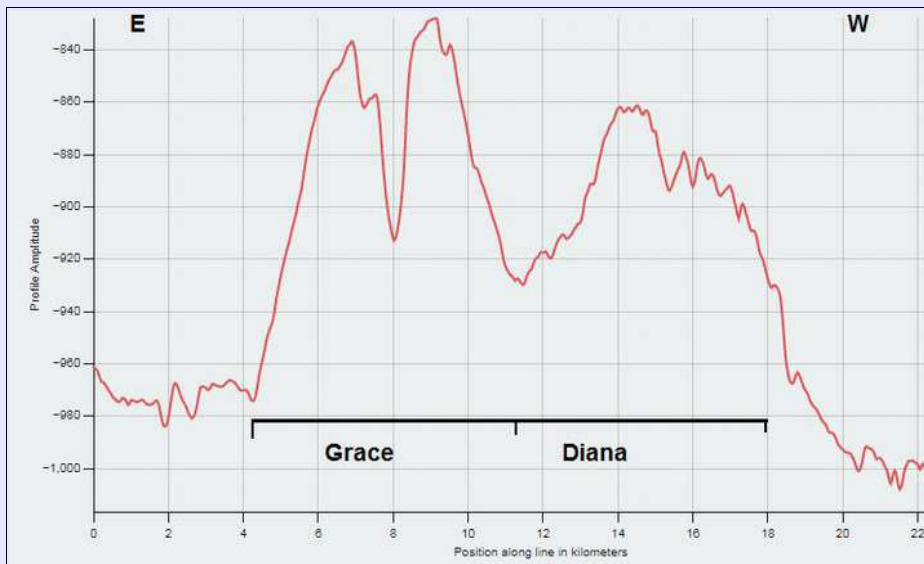


Figure 5: LRO WAC-derived surface elevation plot in East-West direction based on LOLA DEM intersecting Grace and Diana.

Comparison with LOLA DEM

ACT-REACT Quick Map tool was used to access to the LOLA DEM dataset, obtaining the cross-sectional profile of Diana and Grace (Fig. 5). Thus in the current study I will compare the probe's data with our previous results derived by telescopic imagery and photoclinometry and SfS analysis. Grace displays an asymmetric profile. The elevation amounts to 140m (Fig. 6). The diameter is determined to 8km and thus corresponding to

our previous measurements described above. The height of Diana amounts to 70m, and the diameter is determined to 6.25km in accord with the derived height based on previous data using telescopic imagery (Fig. 7). A 3D reconstruction of the region of interest was obtained using ACT React quick Map (Fig. 8). The heights of Diana and Grace correspond to previous results of our studies^[4].

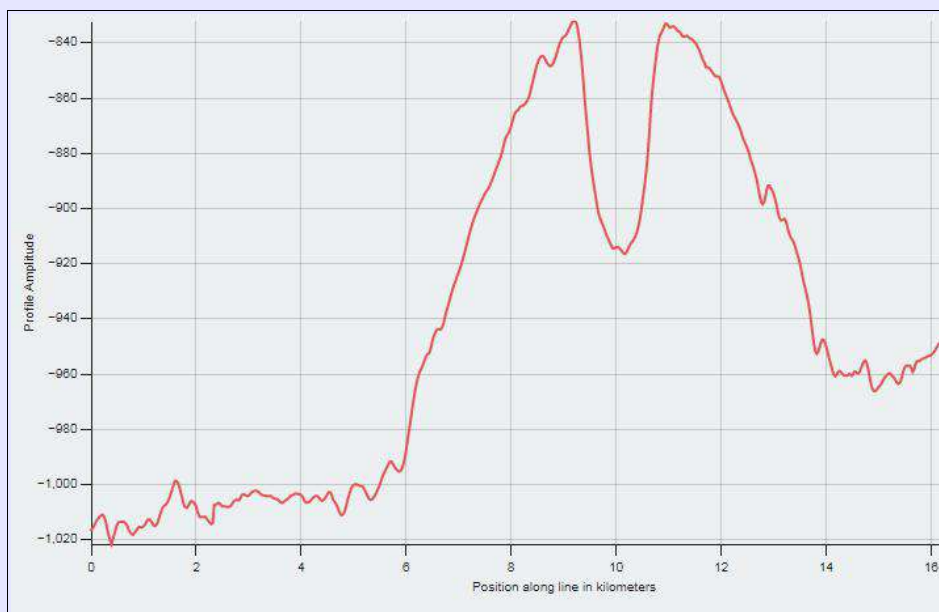


Figure 6: Grace, LRO WAC-derived surface elevation plot in East-West direction based on LOLA DEM. The depth of the vent is 100m.



Figure 7: Diana, LRO WAC-derived surface elevation plot in East-West direction based on LOLA DEM. The depth of the vent is 150m.

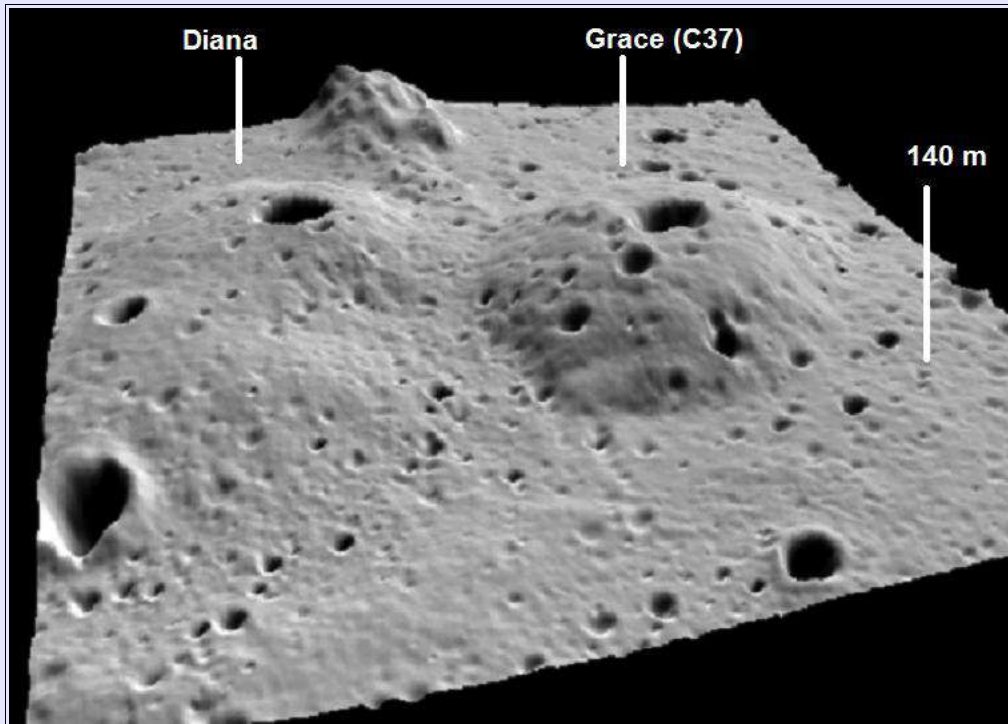
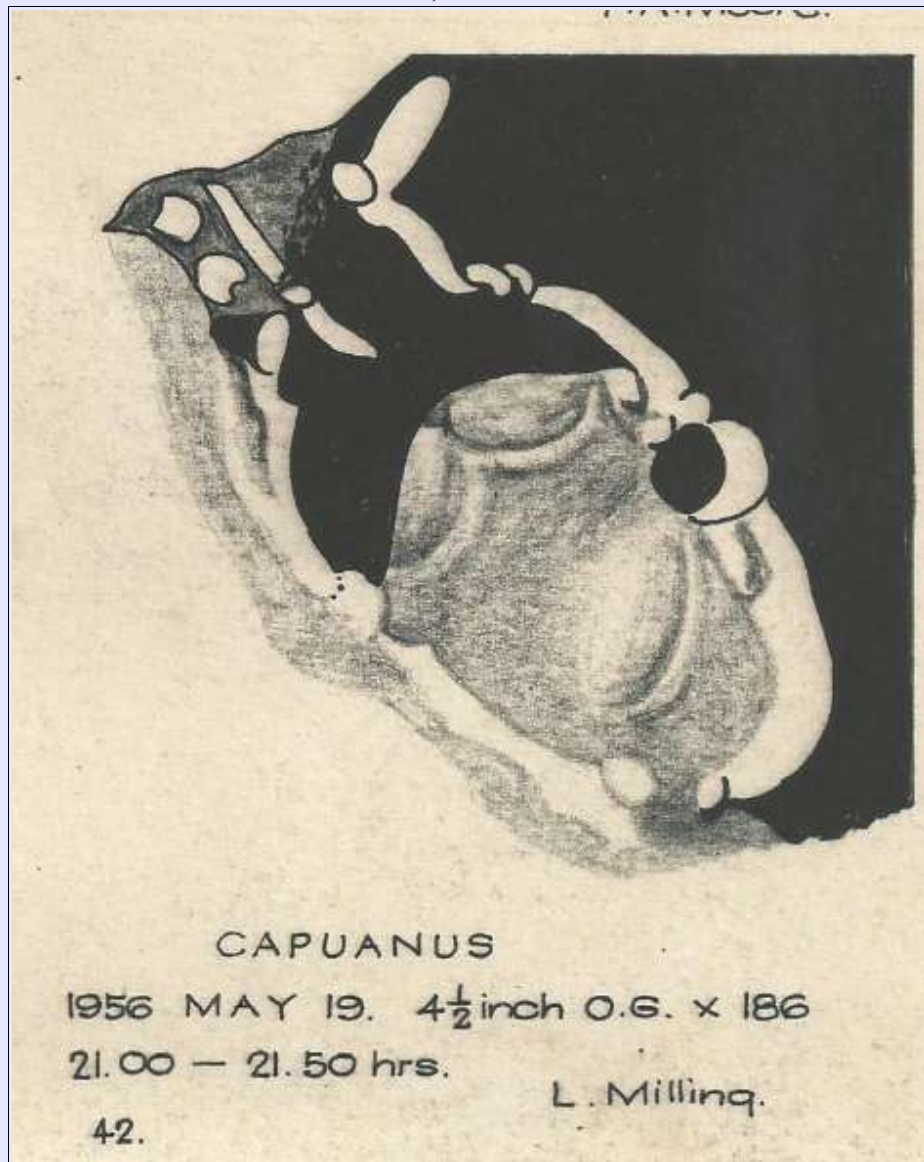


Figure 8: 3D reconstruction of the examined region based on LOLA DEM using ACT React quick Map.

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CAPUANUS.

By L. Milling.

The dark floor of Capuanus was occupied by three huge dome-shaped features. Two similar domes were visible at the edge of the receding interior shadow, protruding northwards to where the other dome, oval in shape, lay across the northern end of Capuanus. At the southern tip of this was the crater B in the eastern wall. Compared with Dr. Cooke's drawing in the 10th. Lunar Memoir, my recorded domes seem larger and fewer. I may have run individual domes together, due perhaps to the small aperture used.

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This drawing and description by L. Milling from 1956 illustrates some dome like features on the floor of Capuanus. Les Fry's image in this LSC shows one of these domes, which correspond to one of three that Raf Lena labelled *Ca1* in a 2011 Lunar and Planetary Science Conference abstract (see reference with Les's image). Whilst this dome is fairly prominent, the others (*Ca2* & *3*) are not at all obvious in spacecraft imagery, though their apparent size obviously impressed L. Milling. These features are therefore rather like the domes reported by very many visual observers on the floor of Flammarion which are conspicuous when favourably lit but fade to invisibility when viewed by orbiting spacecraft under more limited conditions of illumination. These phantom domes also often lack any diagnostic volcanic landforms such as lava flows or vents, making positive identification even more of a challenge.

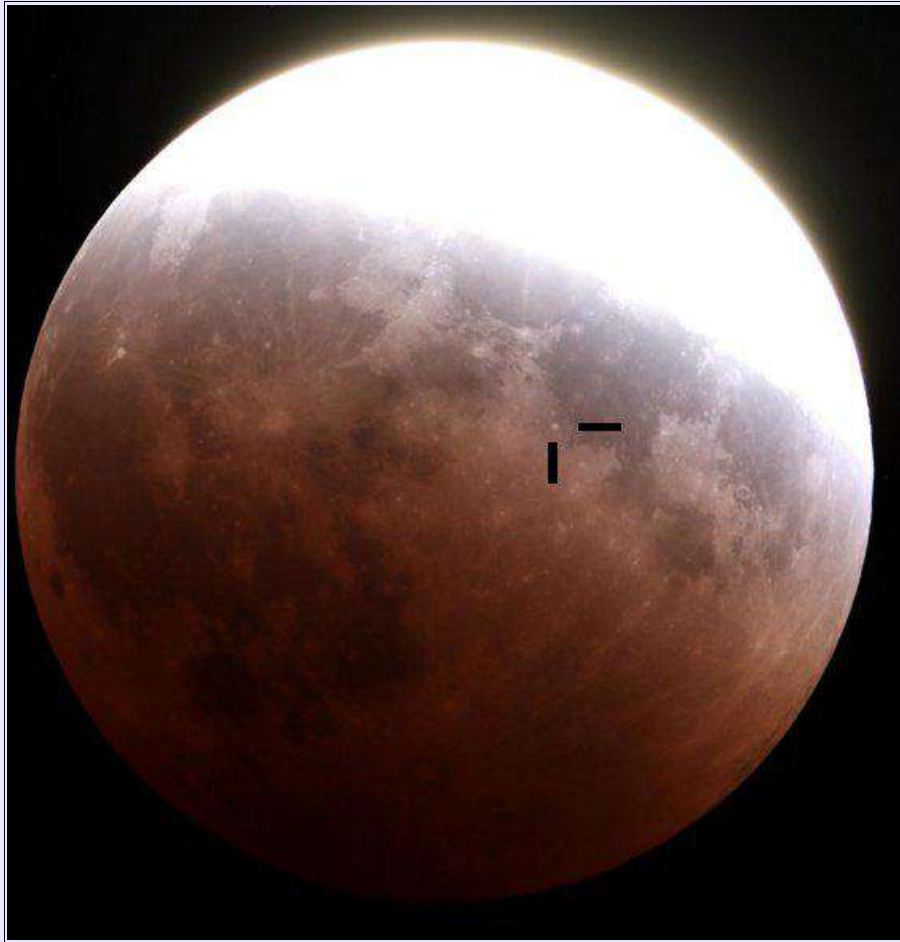


Figure 1. The 2021 May 26 lunar eclipse as photographed by Peter Anderson (BAA) and orientated with north towards the top. Tick marks indicate the crater Dionysius

News: In the January newsletter I discussed the lack of archive observational data for a TLP observed by Grant Searle of Concord, Sydney, Australia, at 18:28-18:57UT during the 1978 Sep 16 total lunar eclipse. It took the form of a bright star-like point on the western shore of Mare Tranquilitatis. Apparently, Ken Wallace (Australia) had photographed the bright point earlier at 17:37.5 UT. I am very grateful to Peter Anderson for sending me a copy of the eclipse report from his local astronomical society. In this Peter mentions that Dionysius was a nebulous looking bright spot, and by far the brightest crater on the eclipsed part of the Moon before 18:40UT, but after this it had faded. By 18:50UT it was a faintly flickering spot in the poor seeing and by 18:58UT it could no longer be seen as a bright spot. Unfortunately, twilight prevented further studies. Apparently in an earlier eclipse in March of the same year, Peter noted that Dionysius had more of a star-like core to it. Although not from 1978, Fig 1 illustrates how prominent Dionysius can be. So, I suspect that what Grant Searle was referring to on the western shore of Mare Tranquilitatis was probably Dionysius.

TLP Reports: No TLPs were observed in January. I have no further news to report about an impact flash videoed on 2023 Jan 26 UT 20:33:30 by Luigi Zanatta (Italy – UAI) and confirmed by my PhD student, Daniel Sherwood (observing remotely from Observatory De La Côte D'azur, France). The flash was located a few hundred km east of Aristarchus. However detailed analysis is underway, and if you were observing earthshine at the time, either visually or with CCD, please do get in touch. I'll report back in due course.

Tim Haymes cc'ed me in on an email from a colleague, "MeterorDerek", who had seen a [twitter report](#) of an impact flash on the Moon made from Hiratsuka, Japan at 20:14:30.8 local time on 2023 Feb 23 or 11:14:30.8 UT. The flash (Fig 2) lasted about 1 second and has since been confirmed by another observer.



Figure 2. Image frame from a video of an impact flash recorded on 2023 Feb 23 UT 11:14:30.8 – image obtained from the following Twitter Page: <https://twitter.com/dfuji1/status/1629259622619176961?s=20>

Routine Reports received for January included: Jay Albert (Lake Worth, FL, USA – ALPO) observed: Aristarchus, Censorinus, Gassendi, and Plato. Alberto Anunziato (Argentina – SLA) observed: Aristarchus, Censorinus, and Vallis Schroteri. Maurice Collins (New Zealand – BAA) imaged the Moon. Anthony Cook (Newtown, UK – ALPO/BAA) imaged: several features in the Short-Wave IR (1.5-1.7 microns). Walter Elias (Argentina – AEA) imaged: Aristarchus, Censorinus, Cichus, Gassendi, Mare Nubium, Mare Tranquilitatis, Messier, Plato, Tycho and Vallis Schroteri. Les Fry (West Wales, UK – NAS) imaged: Alphonsus, Clavius, Dorsum Grabau, Fra Mauro, Hainzel, Mare Humboldtianum, Mare Smythii, Mare Underum, Milichius, Mons Piton, Montes Apenninus, Montes Carpatius, Montes Jura, Monte Rhiphaeus, Philolaus, Pitatus, Plato, Promontorium Kelvin, Stadius, Tycho and W. Bond. Massimo Giuntoli (Italy – BAA) observed: Cavendish E. Rik Hill (Tucson, AZ, USA – ALPO/BAA) imaged Reiner Gamma. Ken Kennedy (Scotland – BAA) imaged Bullialdus. Jeanmarc Lechopier (Teneriffe, Spain – IAU) imaged Kies. Eugenio Polito (Italy – UAI) imaged: Herodotus. Leandro Sid (Argentina – AEA) imaged: Aristarchus, Plato, Vallis Schroteri and several features. Trevor Smith (Codnor, UK – BAA) observed: Eimmart and Plato. Aldo Tonon (Italy – UAI) imaged: Kies. Luigi Zanatta (Italy – UAI) imaged Kies.

Analysis of Reports Received:

Censorinus: On 2023 Jan 01 UT 23:30-23:33 Walter Elias (AEA) imaged this crater under similar illumination to the following report:

Censorinus-Maskelyne 1927 Apr 11/12 UT 23:00-01:00? Observed by Druzdov

(Russia) "2 luminescent pts. observed. Not vis. at same Sun angle on May 7 & 12th. Not vis. on photos of Barn in 5/23/63" NASA catalog weight=3. NASA catalog ID #393. ALPO/BAA weight=3.

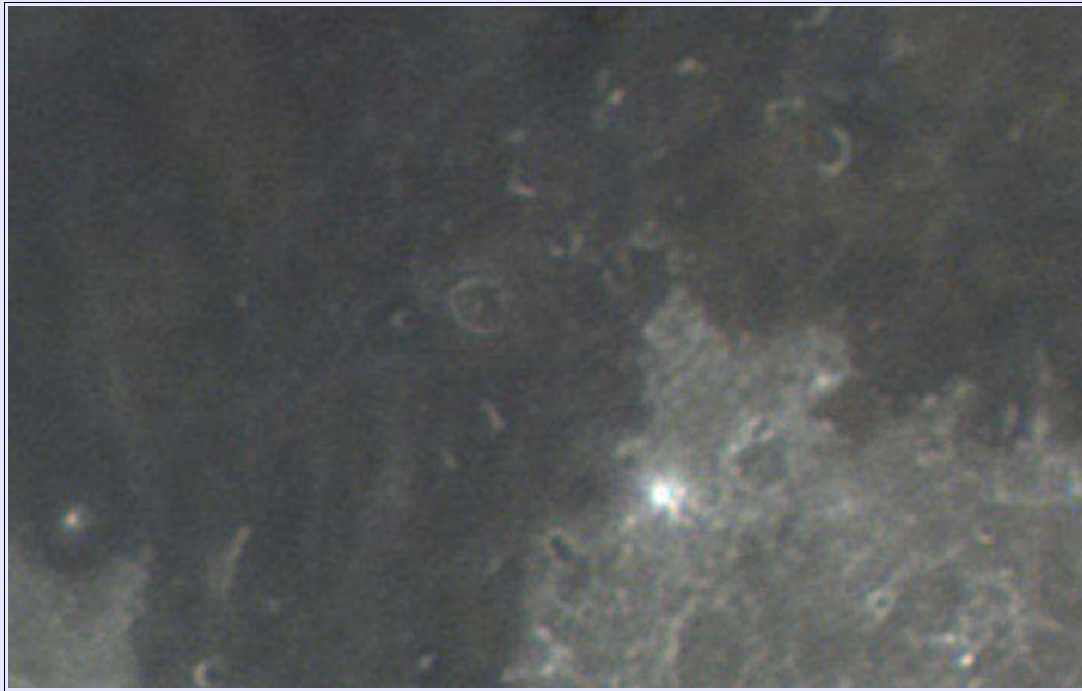


Figure 3. Censorinus as imaged in colour by Walter Elias (AEA) on 2023 UT 23:30 and orientated with north towards the top.

Walter's image (Fig 3) does seem to show two luminous points, but just east and adjacent to Censorinus. The original TLP report mentions Censorinus-Maskelyne, and the two points are not between these two craters. Cameron gives a UT of 23:00-01:00 – but is this estimated by her, or what Chernov wrote down? It would be really helpful to find the original report from 1927. Although I cannot find this TLP in the digitized Cameron cards, which went to make up her 1978 NASA catalog, looking at the reference in her catalog it says that the report was listed in a paper by Florenskiy, P. V. and Chernov, V. M. 1973, *Astron. Herald* VII(1), 38-44. Unfortunately I cannot locate this publication either, so if any members have access to it then please let me know. We shall leave the weight at 3 for now, but at least we have a good image showing what the area should look like under normal conditions.

Bullialdus: On 2023 Jan 02 Trevor Smith sketched, and Ken Kennedy imaged, this crater under similar illumination to the following report:

Bullialdus 1979 Jun 05 UT 22:00-23:00 Observed by Cook M.C. and J.D. (Frimley, UK, 12-inch reflector, Seeing III-IV, good transparency). MC Cook observed intermittently over this time period (due to cloud) and found the crater sharper in a blue filter than in a red filter. No obscuration seen apart from a darkish patch on the SW rim and spreading over onto an area surrounding the rim, which she took to be shadow, though the main shadow was along the east rim of the crater. JD. Cook observed an orange colouration seen on eastern and the cleft on the SW rim. Dark area seen on southern floor of crater, south of central peak. ALPO/BAA weight=1.

Trevor used an orange Wratten 21 filter and noted that the crater was clear and sharp. Upon using a blue Wratten 38A filter he found it to give a much poorer view and the crater was less sharp. No obscuration or orange colour was seen. The interior of the eastern wall was covered with a grey (not black shadow). A greyish smaller patch was visible on the edge of the south west rim and this appeared to spread (not move) just over onto the SW rim. Six whitish patches could be seen on the floor of the crater.



Figure 4. Bullialdus on 2023 Feb 26, orientated with north towards the top. (Left) a sketch by Trevor Smith made from 19:48-20:20 UT. (Right) A colour image by Ken Kennedy taken at approximately 19:15 UT.

A significant amount of terracing could be seen on the eastern wall. Trevor's sketch (Fig 4 – Left) and Ken's image (Fig 4 – Right) complement each other in terms of the description and detail seen. So the main difference between Trevor's observation and the 1979 report appears to be the orange colour on the eastern rim, though there maybe a hint of that in Ken's image – though it is present on other craters too and is presumably atmospheric spectral dispersion or chromatic aberration related? We shall keep the weight of the 1979 TLP at 1 for the moment, just in case the orange effect seen was not atmospheric or optics related, as a Moon Blink device was available at the time to check this kind of thing out.

Censorinus: On 2023 Jan 03 Jay Albert (ALPO) and Alberto Anunziato (SLA) observed this crater under similar illumination to the following report:

On 1985 Mar 02 at 20:00UT? Marshall (Medelina, Colombia, South America) measured some very low Crater Extinction Device brightness readings of Censorinus compared to Proclus. The Cameron 2006 catalog extension ID=261 and the weight=3. ALPO/BAA weight=2.

Alberto observed from 00:30-00:35 UT with a Meade EX 105 at x154 and noted that the brightness of Censorinus was very similar to Proclus. Jay, observing from 01:45-02:00UT, commented that Censorinus crater was clearly seen and also was as bright as the N wall of Proclus. He used an 11mm Nagler for 185x, Celestron NexStar Evolution 8" SCT, in order to comfortably fit Censorinus and Proclus in the same field of view.

I was able to look up the original Kevin Marshall observation and it seems that he observed from 1985 Mar 02 UT 23:50-00:30. I will correct this in the ALPO/BAA TLP database, nevertheless, a 4-hour discrepancy probably would not explain Censorinus appearing dull, so we shall leave the ALPO/BAA weight at 2.

Herodotus: On 2023 Jan 03 UT 23:30-00:15 Eugenio Polito (UAI) observed for the following Lunar Schedule Request:

BAA Request: Some astronomers have occasionally reported seeing a pseudo peak on the floor of this crater. However there is no central peak! Please therefore image or sketch the floor, looking for anything near the centre of the crater resembling a light spot, or some highland emerging from the shadow. All reports should be emailed to: a t c @ a b e r . a c . u k



Figure 6. Herodotus on 2023 Jan 03 UT 00:15 as imaged by Eugenio Polito (UAI).

Despite an extensive imaging run, no sign of the pseudo-peak was visible during this Jan schedule, even in the last image (Fig 6) when the Sun was at its highest altitude. We shall keep on trying as on the rare occasions that the pseudo peak has been seen, it is over similar colongitudes.

Cavendish E: On 2023 Jan 04 and 05 Massimo Giuntoli (BAA), using a 100mm refractor, under Antoniadi IV seeing, observed this crater visually, trying to see if it repeated a large brightening that they had seen in the past. However on 20:35 and 21:00 UT on these respective dates the crater looked normal.

Vallis Schroteri: On 2023 Jan 05 AEA observers Leandro Sid and Walter Elias observed this area under similar illumination to the following report:

Vallis Schroteri 1991 Aug 23 UT 02:19-02:49 Flashing spot at end of SV fluctuated. Herzog, Darling & Weier confirmed spot but not fluctuation. Spot brighter in red than blue, but Cobra Head was bright in blue. No other region was abnormal. ALPO/BAA weight=3.



Figure 7. Aristarchus as imaged by AEA members on 2023 Jan 05. (Left) Imaged by Walter Elias UT 01:20. (Right) Imaged by Leandro Sid at UT 02:43.

Despite the resolution of the images, if there had been any flashing spot, bright or otherwise at the end of Vallis Schroteri, then it would have shown up clearly on them (Fig 7). However what did the original report mean by “at the end of SV”? Which end – the one at the Cobra’s Head or the where the valley fizzles out on the mare to the north? Alas we have nothing in the archives to help here. There is a white spot/bright crater on the NW rim of Herodotus and a bright craterlet NW of the northern end of Vallis Schroteri. Either of these could flash, or scintillate, if the atmospheric seeing conditions were right. The Cobra’s Head blue colour, mentioned in the TLP description is about right as it is a fresh crater – the scintillating bright spot is reported as bright in red. I think that we shall lower the weight from 3 to 2 as scintillation could account for the flashing effect.

Montes Carpatius: On 2023 Jan 30 UT 19:10 Les Fry (NAS) took an image of the Stadius area that was under similar illumination to the following possible lunar impact flash event from 1955:

On 1955 Aug 27 at UT 01:51 McCorkle (Memphis, Tennessee, USA, 6.5" reflector, x200) observed a 2nd magnitude bright flare on the dark side of the Moon. This remained steady, fading slightly before abruptly disappearing. Cameron suggests that this might have been a meteor. The Cameron 1978 catalog ID=604 and weight=0. The ALPO/BAA weight=1.

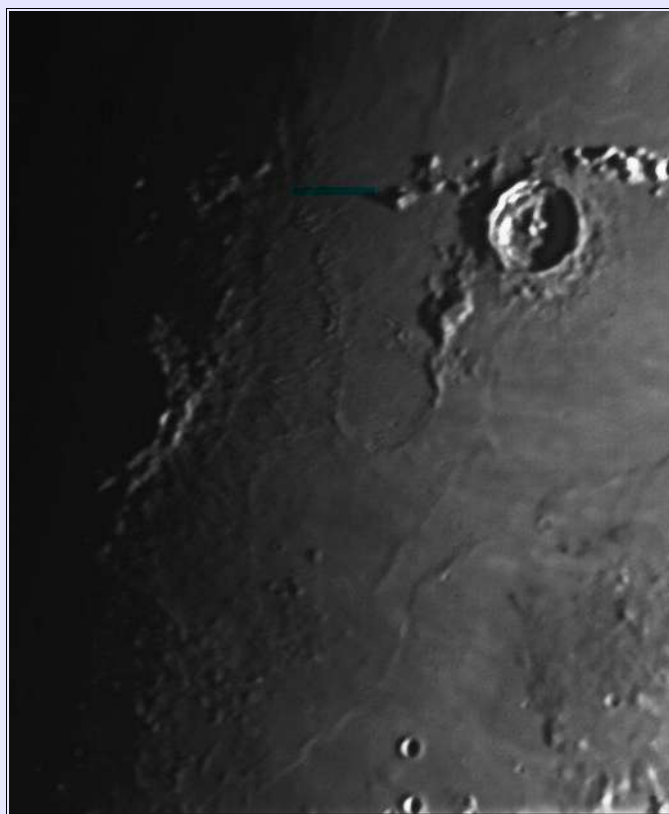


Figure 8. Montes Carpatius (mostly in the dark) located in top left quadrant of the image. Taken by Les Fry (NAS) on 2023 Jan 30 UT 19:10 and orientated with north towards the top.

Les’ image (Fig 8) confirms that Montes Carpatius was mostly un-illuminated, apart from some of the tallest peaks, and so agrees with the original observation. Whether McCorkle’s description of a 2nd mag flare corresponds in brightness to a 2nd mag star next to the Moon, or what a 2nd mag star would look like to the naked eye is uncertain? If the former then it would have been quite bright and the “flare” description very apt. If the latter then there is still a chance that it might have been a brief moment of exceptional seeing, making a point-like sunlit mountain peak brighten up. Another possibility is that McCorkle observed an impact flash? Either way Fig 8 shows quite clearly what the Moon would have looked like at the time if everything was normal. We shall leave this at a weight of 1 for now.

Kies: On 2023 Jan 30 UT 03:05-03:25 UAI observers: Jeanmarc Lechopier, Aldo Tonon, and Luigi Zanatta, imaged this crater and the surrounds, for the following Lunar Schedule request, and a little before and after the requested times:

ALPO Request: A report was made on 1984 Jun 09 UT 04:55-05:15 of a bright point poking out of the shadow a few km east of Kies, that looked unusual to the observer concerned. Unfortunately at this illumination the terminator is well to the west of Kies. It is possible that the observer meant 1984 Jun 08 instead of the 9th and maybe mis-identified another crater as Kies. Please try to image / sketch / visually study this area to see if indeed there are any Kies look-a-likes in the area with a bright point to the east? Any sized scopes can be used for this observation. All observations should be emailed to: a t c @ a b e r . a c . u k

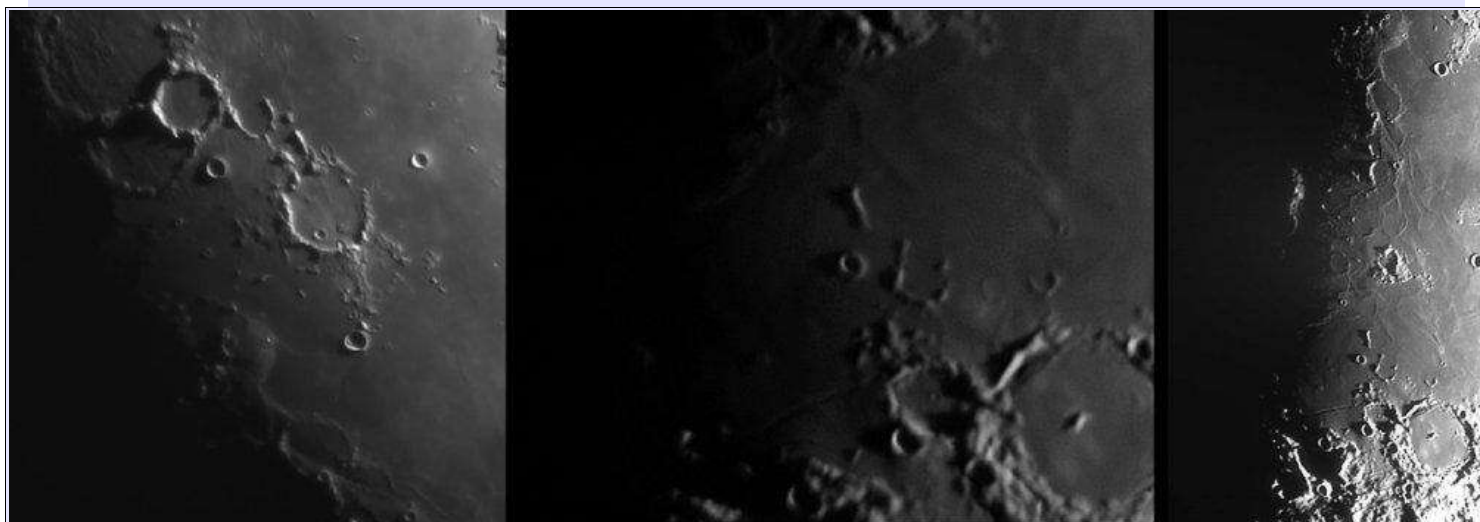


Figure 9. Images of the area in the vicinity of Kies, photographed on 2023 Jan 30 by UAI observers. (Left) As imaged by Luigi Zanatta at 19:11 – just before the lunar schedule request window. (Centre) As imaged by Aldo Tonon at 20:02 UT, during the lunar Schedule Request. (Right) As imaged by Jeanmarc Lechopier at 20:03 UT, during the Lunar Schedule Request window.

Examining Fig 9, perhaps the only bright object poking out of the terminator in this hypothetical date error scenario is the east rim of Bullialdus. Perhaps it's not a date error but a UT error back in 1984. We shall investigate further.

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. 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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Items for the April circular should reach the Director or Editor by the 20th March 2023 at the addresses show below – Thanks!

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