From the Director.

Figure 1. The partial eclipse of the Moon taken on 2023 Oct 28. (Left) by Robert Bowen at 20:43UT from Cyprus. (Right) by Glenn Bates at 22:01UT, from Milton Keynes, UK.

Visibility of lunar eclipses from the British Isles have been few and far between over recent years. Even if the Moon was actually above the horizon at the time of the eclipse, the nasty weather has usually gotten in the way. October 28th this year was no exception, we were hit by rather a lot of cloud. Seeing how long it takes to set up a telescope outside, I decided to have a telescope parked in the kitchen that could be quickly placed outside in case the poor weather predictions had some flaws in the claims of expected cloud cover. As a backup I also decided to use a Samsung Galaxy S20 Ultra smart phone, on a tripod, ready to put outside if the telescope option failed. The telephoto lens on this produces some really impressive images under normal daylight photography conditions. My observing strategy was to rather than permanently stand outside under seemingly continuous cloud cover, waiting for a gap to pass over, to get on with life indoors and occasionally take glances out of the window.

Amazingly some gaps did eventually appear, and the smart phone and my eyes were the first instruments placed outside to observe. I and Massimo Giuntoli (over in Italy), were struck by how dark the umbral shadow looked visually. Massimo observed with 10x50 binoculars from 20:30-20:37 UT and mentions that the colour of the umbra was a dark grey, no reddish hue seen, and the edge of the umbra was definitely not sharp. Massimo said that the interior of the eclipsed portion of the Moon was not visible to the eye.

Although I attempted to image with a zoom setting on my so called "smart phone", the results were anything but smart, making the Moon look like early pre-telescopic era sketch, resembling a Man in the Moon. Before things deteriorated with the break in the clouds, I managed to set up my 8-inch Newtonian, equipped with initially a long wave thermal IR camera operating at 7.5-14 microns. The umbra showed up a as very slightly darker (cooler) area of the Moon, but was not as dark (cooler) as I had noticed during previous total lunar eclipses. Indeed it was very difficult to see where the umbra started and ended as it was very fuzzy.

As the Full Moon is generally featureless in the thermal IR, I decided to switch to a short wave IR camera, with a filter, covering the waveband on 1.5-1.7 microns. This time, I was able to see clear detail in the umbra, resembling bright earthshine views. The contrast between the shadow and the dayside of the Moon in this waveband was not so different. Unfortunately before I could do a calibration, and hit the record button, the gaps between the clouds, over Newtown, Mid-Wales, vanished and that was the end of the eclipse for me!

Alex Vincent sent in some images (see p.24) that were significantly better than my efforts, but they too were thwarted by cloud. The best results I have seen so far came from Glenn Bates (Fig 1 – Left) and Robert Bowen (Fig 1 – Right).

Why are we interested in lunar eclipses? First of all there is the Danjon scale, which tells us how dark the eclipse is and that is related to the upper atmosphere of the Earth. This can help with climate models. Also because many TLP's have been seen during lunar eclipses, and the surface undergoes wild, short term temperature swings, it is worth checking out with time lapse imaging to compare with accounts of past TLP observations. 2024 has a partial lunar eclipse on 17-18th Sep, visible from the UK, Europe etc. and there is a penumbral eclipse visible from the Americas earlier on 25th Mar – so please make a note in your diaries to observe these.

Finally, to all our readers, from the team in the Lunar Section, we all wish you seasons greetings and a good start to 2024 with a lot more clear sky on our wish list!

Tony Cook.

…........................

Basin and Buried Crater Project by Tony Cook.

No images or sketches have been sent in specifically for the BBC project, taken during the last month, and as my academic work has taken its toll on my time in the last few weeks, I haven't had time to analyse NASA's Quickmap for basin or buried crater studies.

Please do think about imaging some of the candidate basins and buried craters listed on the web link: https://users.aber.ac.uk/atc/basin_and_buried_crater_project.htm , over the next moth and email them to me. Or alternatively investigate evidence for them on NASA Quickmap website: https://quickmap.lroc.asu.edu/ - at least that approach does not depend upon the weather.

…........................

Lunar Occultations December 2023 by Tim Haymes.

Time capsule: 50 year ago: in Vol 8 No.12
[With thanks to *Stuart Morris* for the LSC archives.]

*Beginners guides
*Miss C.M. Botley, The case of ATLAS (see below)
*Winifred S. Cameron: Program for TLP observation.
*Elger's Albedo Scale for Lunar surface brightness.

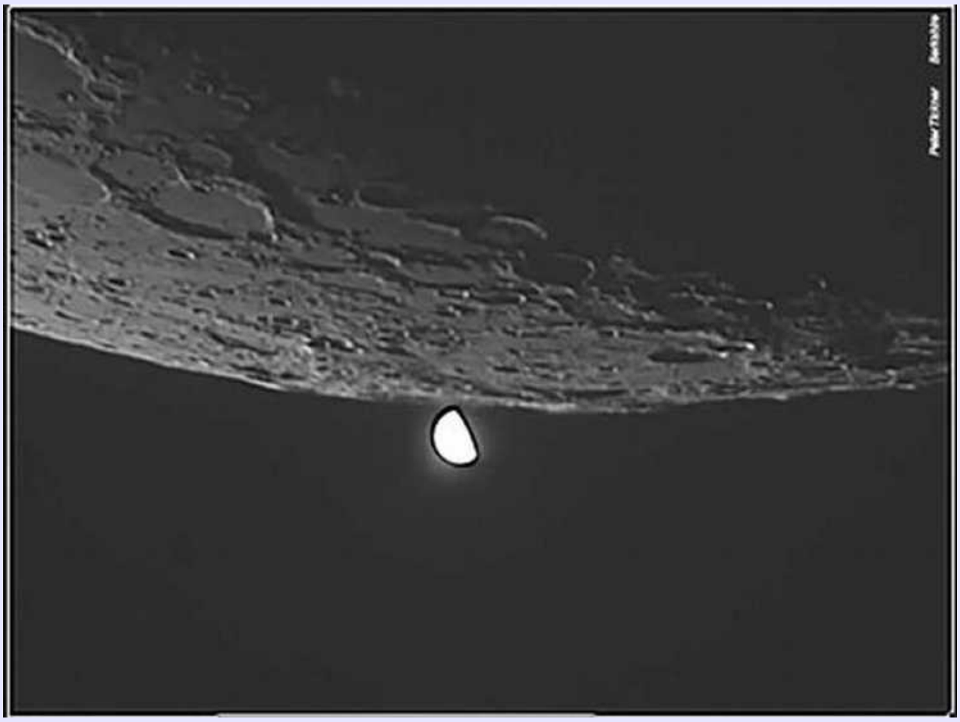
Reports of the Daylight Occultation of Venus on November 9th

T Haymes (near Oxford) wrote: *I rushed outside in a shower to open the observatory. The rain stopped but water droplets were running off the shutter into the obervatory, fortunately not onto the instruments. Broken cloud was passing. My C11 had not been set up for visual for imaging in a bright sky so I looked through the 10x50 finder. Venus was close to the southern cusp approaching DB, when cloud blocked the image. The RD was unobserved.*

P Tickner (Reading) wrote: *A minor miracle - clear skies here for the ingress - captured it at 50fps using my Semrock 935/170 nm IR filter and ASI174MM with clear view of Venus and the Moon with 14" F10 LX200. I used Tangra software to get an estimated time for the Venus bright limb ingress.*

2nd contact	DB 09:48:09s
Occult4 predicted	DB 09:48:05s

First contact nicely imaged by P Tickner.   The large crater on the limb is Bailly. See the Henry Hatfield Photographic Lunar Atlas, Plate 10C.



Miss Botley reports on the "occultation puzzle" of Atlas (27 Tau = ZC560) in LSC Vol8 No12.

Tim Haymes comments: *MNRAS are scanned by Oxford Academic, and a report for the occultation of the Pleiades observed from Madras by Pogson, can be read on-line. The date of the passage is Jan 7th (Not Jan 6th as reported in LSC), at 21hr UT.* https://academic.oup.com/mnras/article/36/5/265/987383 *, however this isn't the report in question. ATLAS was not occulted at Madras Observatory on this date.*

THE CASE OF ATLAS

by Miss C.M. Botley

Atlas, 27 Tau. in the handle of the small Pleiades "dipper" is of course well known to astronomers though to the naked eye it is fused with Pleione. There is an occultation puzzle about this star.

In 1827, F.G.W. Struve observed it, aperture not stated, and found it to be a very difficult double-duplex difficilima. With perhaps undue promptitude he entered it in the catalogue he was compiling as Sigma 453. He took another look in 1831, finding it "wedge shaped". In 1836 he looked again, it was then single, and single it has remained since, despite checks by that prince of double star observers, W. Burnham, who observed it several times with 6" and 18" apertures. Indeed, he personally rejected Struve's observation.

Yet, in 1876 on Jan. 6 Hartwig saw the star fade in two stages at occultation.

What is the explanation? It is obvious that Struve was a very competent observer. Is it possible that in 1827 there was a then unrecognised asteroid close by? The elongation of 1831 might have been due to seeing or to eyestrain. Perhaps a further examination of Atlas with as large an aperture as possible would be in order.

However, it does seem that Hartwig's fade can be included as one of those not to be explained by duplicity.

* * * * *

Occult4 lists event timings for 27 Tauri, including observations from England. Of interest are those reported by three observers at the same location in Hull, on March 19th 1972. There are no remarks on double star phenomena attached to the visual observations in Occult4. These tend to be reported to the LSC and Journals. The WDS gives 27-Tau as a multiple system with the main pair sep 0.5" (STF453 – Struve). Here are some of the observers, their names may be familiar. The March 19th 1972 observations are not in the LSC.

1991 Sep 11, RB
P.L.Carter, D. Strachen

1972 Mar 19, DD
H Morgan (Woolston), R Waterfield (Woolston), M Daly (Farnham), J Ells (RGO), E Beet (Ashamstead), D Brierley (Malvern), *S Barnett, C Waddington, J Rowe (Hull x3)*, D Hitchins (Stalmine)

1971 Nov 04, DB
K Blackwell (Westham), R Stark (Harrow)

1953 Sep 27, DB
W Lindley (Padstow)

1950 Oct 28, DB-RD
E Lindsay (Dunsink Obs), I Browne (Cambridge Obs), W Ogilvie (Carnoustie)

1916 Sep 17, DB-RD
A Hunter (RGO)

This month:
Of interest on the evening of December 23rd, is a good reason for declining the n-th mince pie ! Four stars are occulted at the dark limb from 1955 to 2253UT. The first three predictions are stars that show some duplicity, so it would be of interest if any of these can be detected as a step-event by eye or video. The sp M1 star is the variable AS Aries.Enjoy the festive season, and good observing to all.

Occultation predictions for 2023 December (Times at other locations will +/- a few minutes)
Oxford: E. Longitude -001 18 47, Latitude 51 55 40
To magnitude ca 8

yy	mmm	d	h	m	s	Ph	Star No	Sp D*	Mag v	Mag r	% ill	Elon	Sun Alt	Moon Alt	Moon Az	CA o	Notes
23	Dec	1	3	49	13	M	1169	K5	5.3	4.5	85-	135		63	199	10S	76 Gem (*Graze)
23	Dec	1	5	7	30.8	R	79672	DK5	7.6		85-	134		56	231	80N	
23	Dec	3	2	35	43.0	R	1393	G7	6.5	6.0	69-	113		49	130	78N	
23	Dec	5	4	29	14.3	R	118593	kK2	7.6	7.0	50-	90		43	145	76S	
23	Dec	7	1	45	56.8	R	1772	cA2	3.9	3.9	32-	69		3	95	63N	eta Vir
23	Dec	8	6	22	43.6	R	1890	K0	7.3	6.8	22-	56		26	150	86S	
23	Dec	17	18	3	33.2	D	3243	G8	7.3	6.8	27+	63		19	204	65N	
23	Dec	18	20	52	7.0	D	146509	pK0	7.1	6.6	39+	77		14	233	59N	
23	Dec	19	22	7	36.8	D	147015	F0	7.1	7.0	51+	91		17	243	77S	
23	Dec	20	18	19	53.5	D	109408	kF0	7.9	7.7	61+	103		40	169	38S	
23	Dec	20	19	29	1.6	D	109427	M*	7.7	6.9	61+	103		41	191	74N	
23	Dec	21	21	37	42	M	110020	cF5	7.6	7.4	73+	117		42	219	11S	(*Graze)
23	Dec	23	19	55	24.8	D	485	cK2	7.0		89+	141		55	144	90S	
23	Dec	23	21	5	11.9	D	487	cK3	5.2		89+	142		59	173	89N	63 Ari
23	Dec	23	21	37	42.5	D	75906	DG5	7.5	7.0	89+	142		59	187	57N	
23	Dec	23	22	7	45.8	D	492	A1	6.1	6.1	90+	142		58	200	64S	65 Ari
23	Dec	23	22	53	21.7	D	75923	M1	8.0	7.0	90+	143		55	218	46N	AS Ari
23	Dec	24	19	10	22.8	D	76523	cM2	7.6		95+	154		46	112	65S	
23	Dec	25	4	11	9.3	D	683	A2	7.4	7.4	96+	157		22	284	77N	
23	Dec	25	18	51	41.3	D	780	cG5	6.8	6.3	98+	165		37	93	64S	
23	Dec	27	21	18	8.9	R	1088	A4	5.8	5.7	99-	168		43	100	76S	47 Gem
23	Dec	28	6	30	46.1	R	1131	A2	7.3	7.3	98-	165		26	280	83N	
23	Dec	28	19	6	36.7	R	1211	SA1	6.3	6.3	96-	158		14	68	62N	4 Cnc
23	Dec	28	22	58	7.4	R	79980	G8	7.3	6.8	96-	157		48	114	74N	
23	Dec	29	4	53	28.0	R	80089	G5	7.2	6.7	95-	155		46	248	57N	
23	Dec	29	5	26	5.7	R	80105	A0	7.9	7.9	95-	155		41	255	58S	
23	Dec	29	5	41	37.3	R	1251	B9	5.9	5.9	95-	154		39	259	61N	lambda Cnc
23	Dec	29	20	36	45.3	R	1334	kG5	7.0	6.6	92-	147		18	77	42N	
23	Dec	29	23	43	2.4	R	1348	G5	8.1	7.6	91-	145		45	115	43N	
23	Dec	31	4	19	3.0	R	1462	K0	7.3	6.6	84-	133		53	201	36N	
23	Dec	31	6	44	22.7	R	98892	dK0	7.7	7.1	83-	132		37	246	65N	
24	Jan	2	1	19	19.2	R	1645	cF8	6.7	6.4	69-	112		28	119	87N	
24	Jan	2	2	10	35.2	R	1648	G5	6.9	6.5	68-	112		35	131	37N	
24	Jan	2	3	55	10	D	1656	K2	7.4	6.6	68-	111		43	162	6S	
24	Jan	2	4	7	11	R	1656	K2	7.4	6.6	68-	111		43	167	24S	
24	Jan	3	3	49	31.5	R	1746	KF2	7.0	6.8	59-	100		35	150	15N	
24	Jan	4	2	9	25.8	R	1837	K2	7.4	6.6	50-	90		15	119	54N	

*Graze See HBAA 2023 p44.

Double Stars

Note:D* The D column (above) which previously was removed, indicates a Double Star. The characters w,S,c etc indicate the type of double and is explained in Occult4 Help. To save a bit of editing, I have left them in-place. Please use them to signify the star is in the Washington Double Star Catalogue. (WDSC) New doubles are being discovered in occultation recordings, particular close doubles not detectable by other measurement techniques. For example, 245 doubles have been discovered while observing asteroidal occultations. The separations are usually small and in the range 10-100 mas. Please send double star occultation reports to the LS.

Communication from Members.

What are the white streaks behind the western rim of Copernicus?

By K.C.Pau.

On the evening of 23rd October 2023, the sky became clear after a long period of cloudy days. The gibbous moon was just in between the two high rise buildings opposite to my balcony. Within the telescope field of view, I found the morning terminator was very close to the west rim of Copernicus. The southern part of the west rim first appeared as a few short bright streaks under the early morning sunlight. Later on, northern part of the rim began appearing as another several bright streaks. Two parallel very short bright streaks were also visible just west of the northern part of the rim. Now the whole arc of the west rim was almost completely visible and the two bright streaks were still there (Fig. 1).

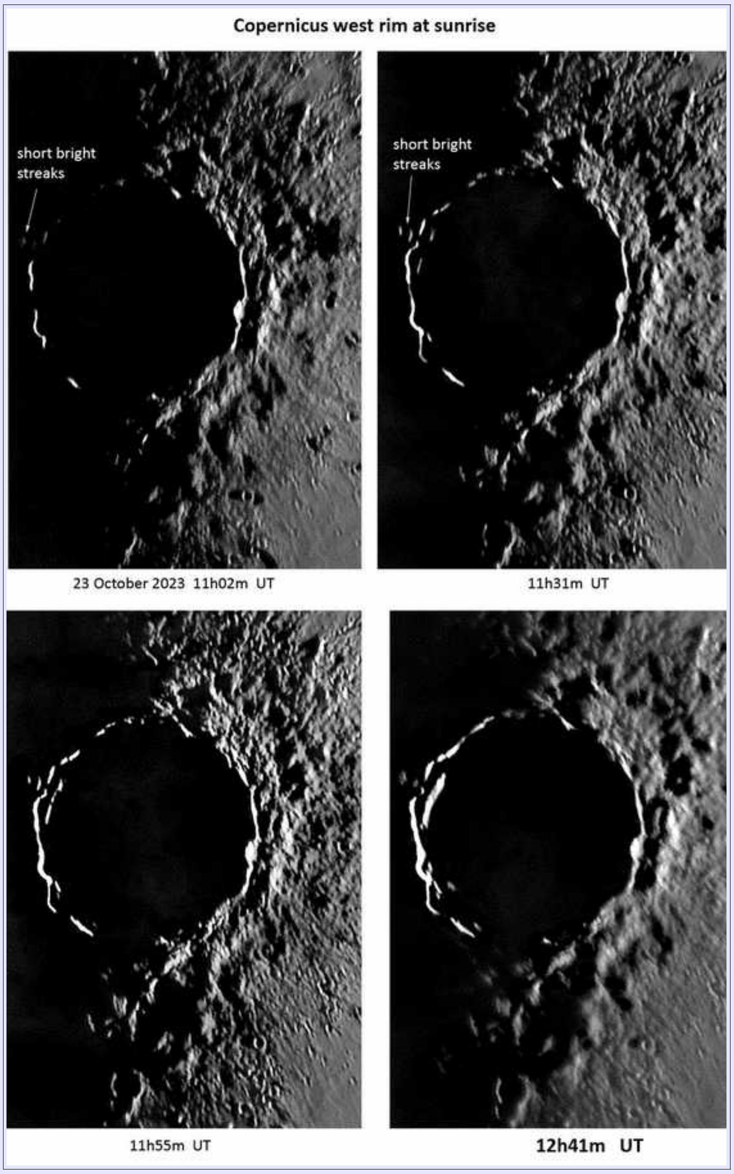


Fig.1

Certainly, they were real features, not an illusion. What are they? Are they part of the west rim? Questions filled up my mind. To my understanding, these two streaks should have the same height as the west rim, otherwise, they would not be lit up by the sunlight simultaneously as the west rim. As far as I know, there seems to be no geological features which are as high as Copernicus's rim in the vicinity. Then I checked another Copernicus photo taken on the next evening (24th October) to see if there are any peculiar feature along the western crater flank. Two prominent bumps were found at the corresponding position of the bright streaks and were not far away from the west rim (Fig. 2).

The next step, I used the path tool of the QuickMap to produce the cross-sectional view along the said crater flank. The outcome was quite surprising as the height of the two bumps was higher than the west rim (Fig. 3). The high resolution photo of the QuickMap shows these two bumps to be two long and rather flat-top ridges, running parallel to each other in north-south direction (Fig. 4). They may be the thick ejecta that had deposited along the flank during the formation of Copernicus. Cross-sectional views of these two ridges along the N-S direction reveal that both the highest part is at the southern end (Figs. 5, 6 and 7). Thus, this portion of the ridges would receive the morning sunlight earlier than the other part and appeared as two short bright streaks.

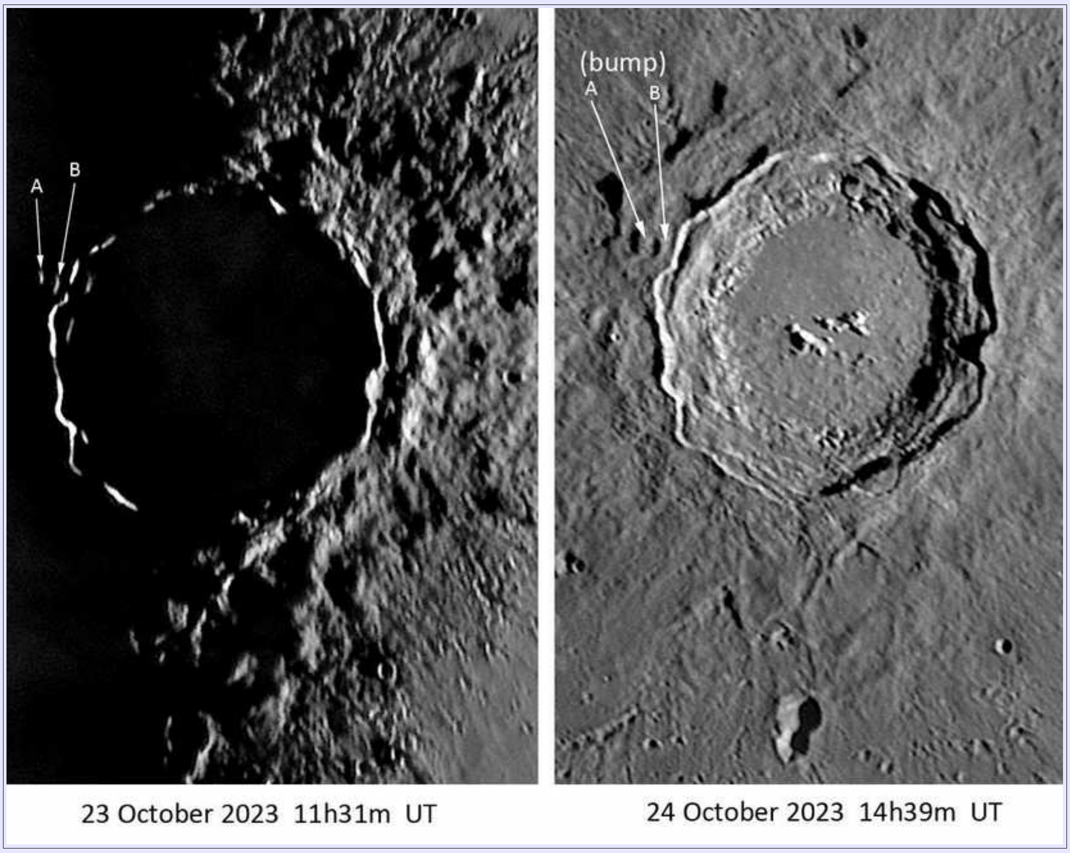


Fig.2

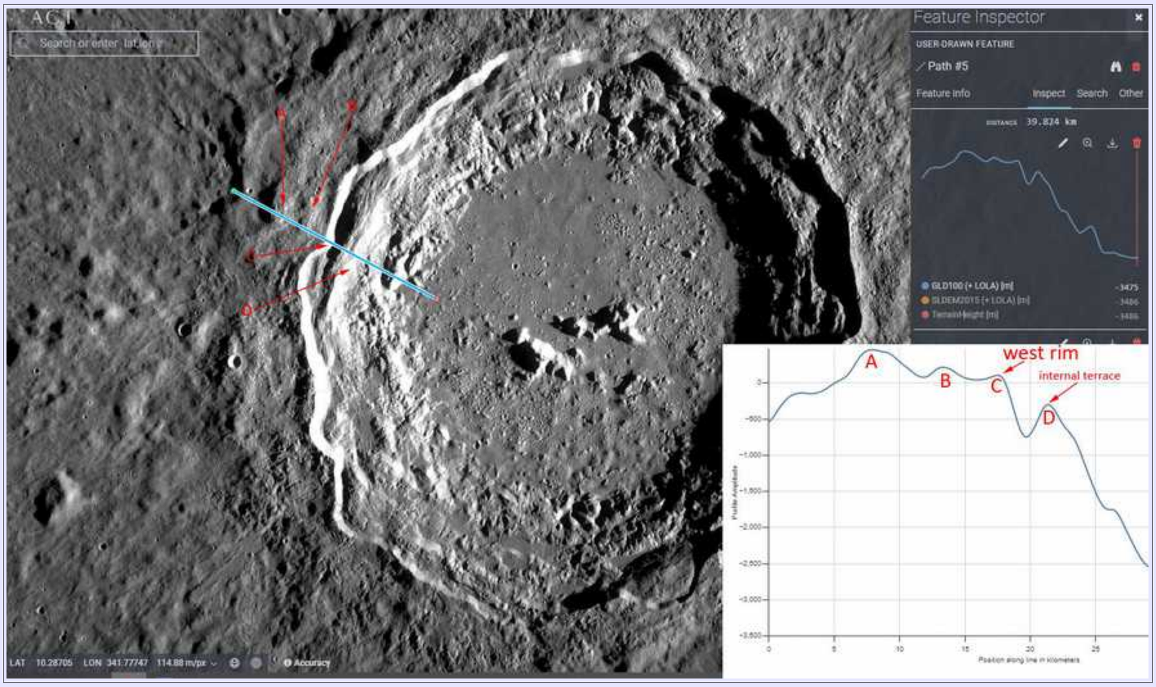


Fig.3

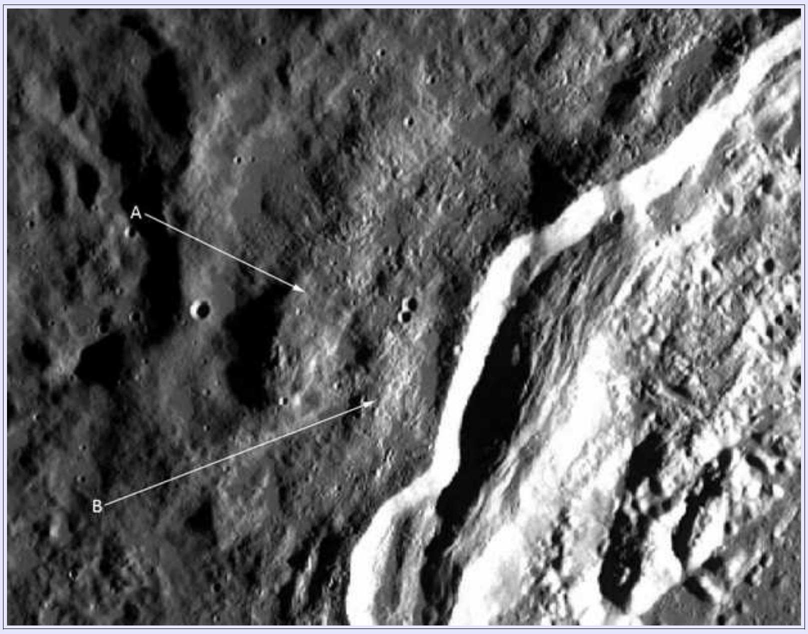


Fig.4

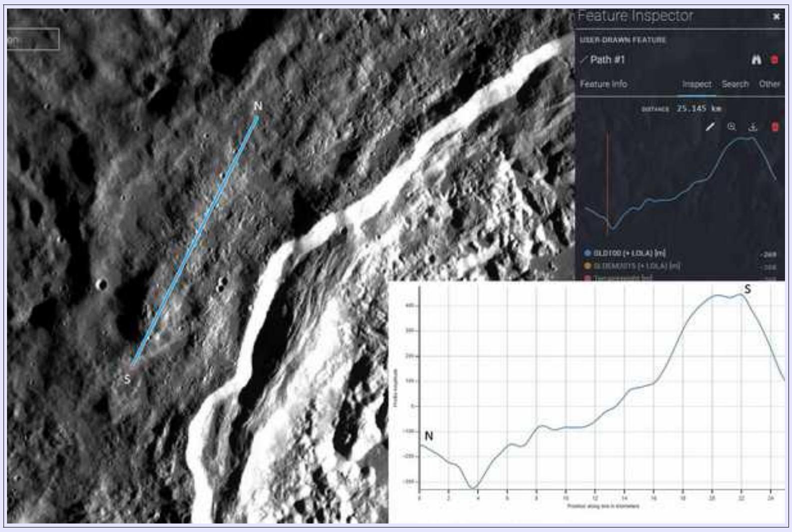


Fig.5

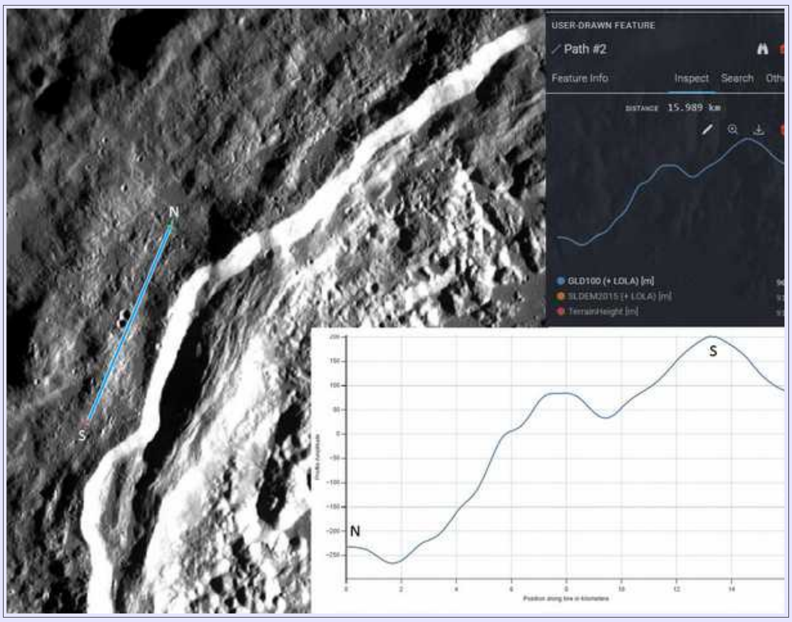


Fig.6

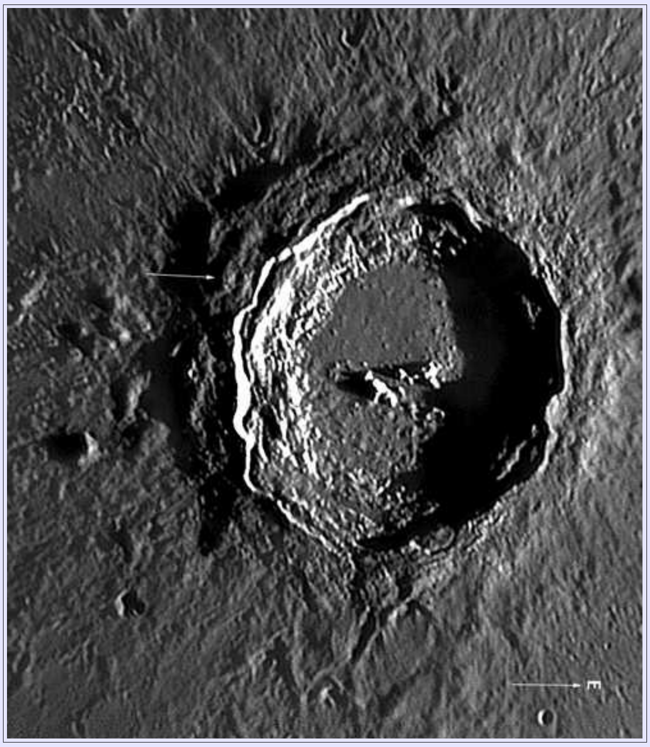
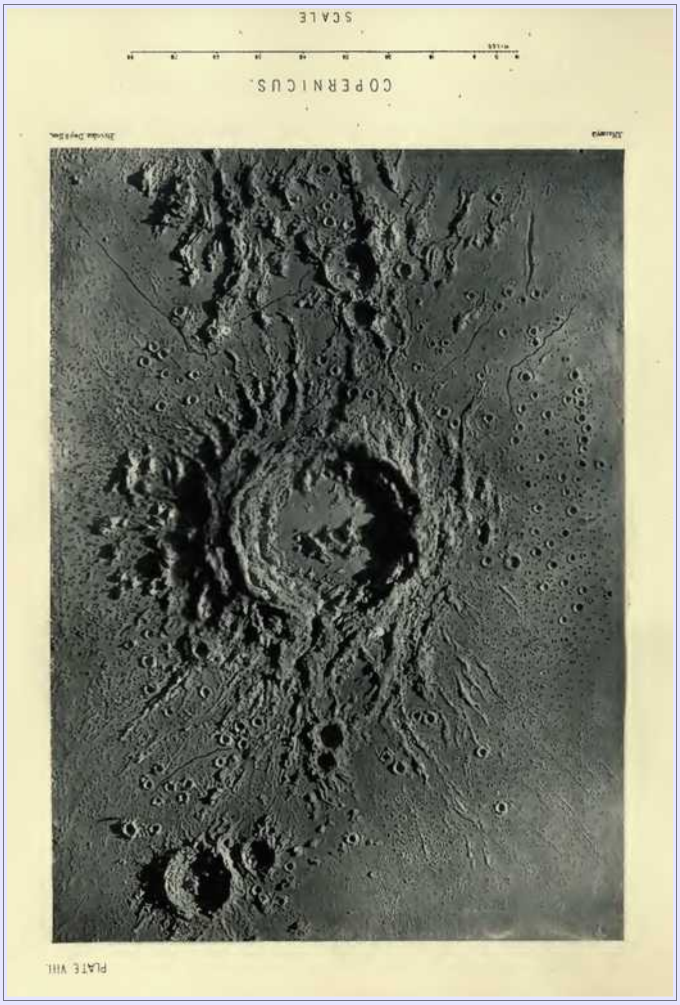


Fig.7. Image taken on 22Nov2023 at 12h48m UT. Visually, the ridge looks much higher than the rim

…...

By way of comparison.



Drawing of Copernicus (Plate VIII) from The Moon considered as a planet, a world, and a satellite, by James Nasmyth and James Carpenter. London 1874. Inverted to allow comparison with K.C's photos.

Images from Members.

The Moon between the stars Regulus and Algieba in Leo.

Image by Alex Vincent.

Bullialdus

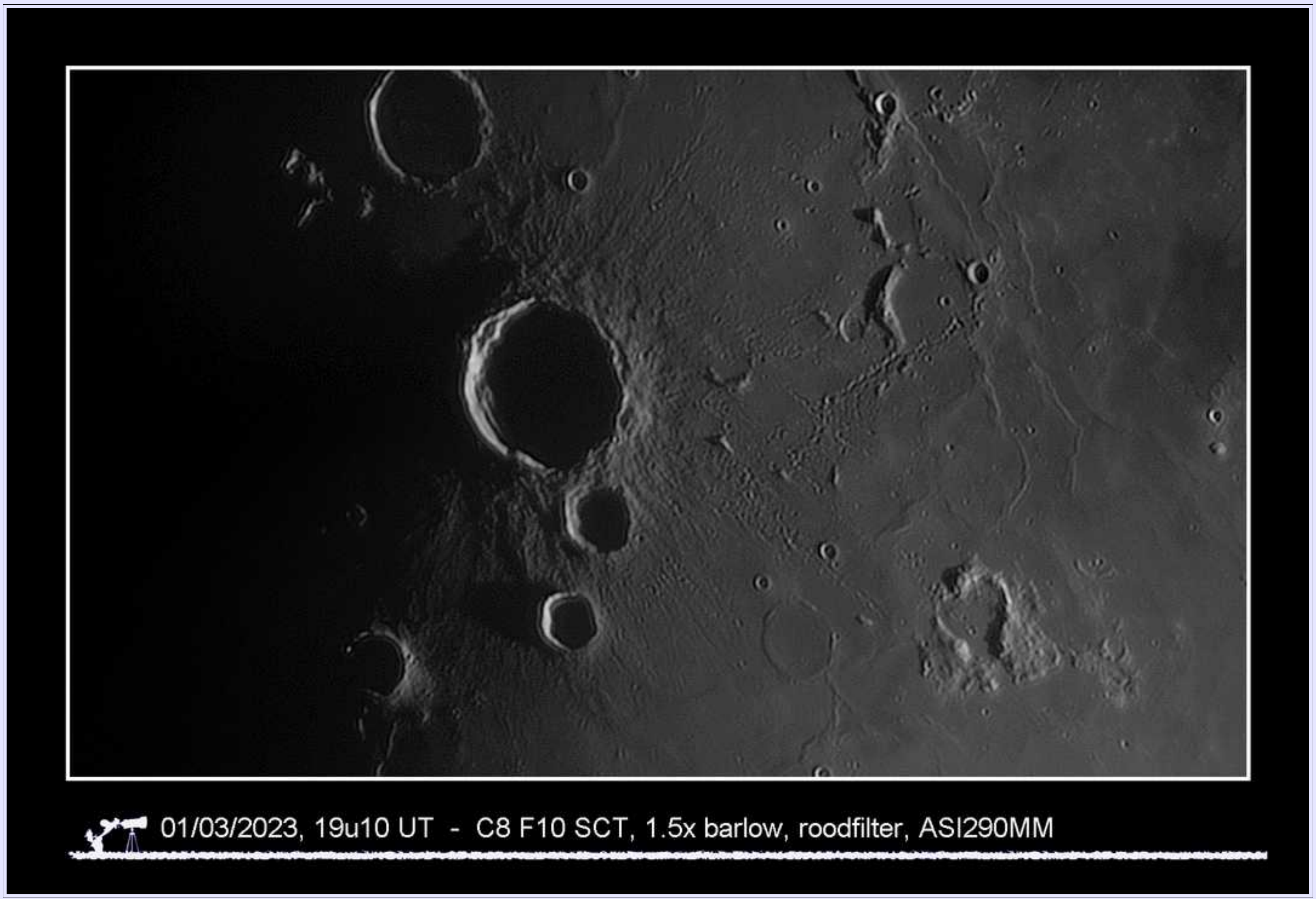
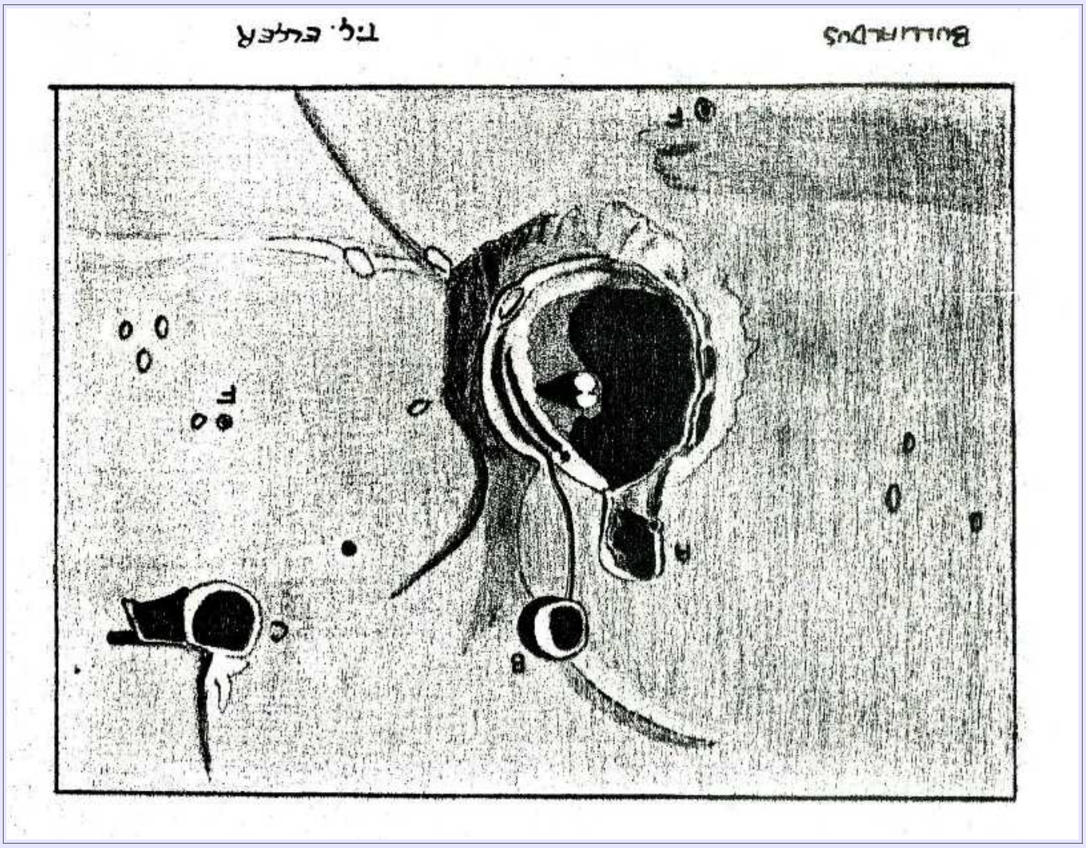


Image by Alexander Vandenbohede with details of time/date as shown.



Bullialdus by T.G Elger – note the orientation!

Geological Notes: If you compare Alexander's image to the drawing below it by T.G Elger, which is reproduced from The Moon, Vol.10, No.1 October 1961 you will see some features common to both. Elger's observations were noted by the editor of The Moon, W.Leslie Rae F.R.A.S and are reproduced below.

BULLIALDUS

Drawing by T. G. Elger. 1882 April 27. 2100 - 2230h. $8\frac{1}{2}$" RFL x 284. Fair definition.

Elger's description of this observation is as follows:

"I observed a delicate cleft extending from the "cleft" (my apostrophes. Ed.) in the east wall to the ring plain B: it is slightly convex towards the west and passes near the east wall of Bullialdus A, forming apparently the west border of a narrow plateau which reaches from the south wall of Bullialdus to B. It has all the characteristics of a true rille but it is not shown by either Neison or Maedler."

Elger's notes on Bullialdus from The Moon, Vol.10, No.1 .

Now, it appears that this feature was of interest to Rae, and he included the comments below regarding these observations and a description of the same features by Percy Wilkins and Patrick Moore.

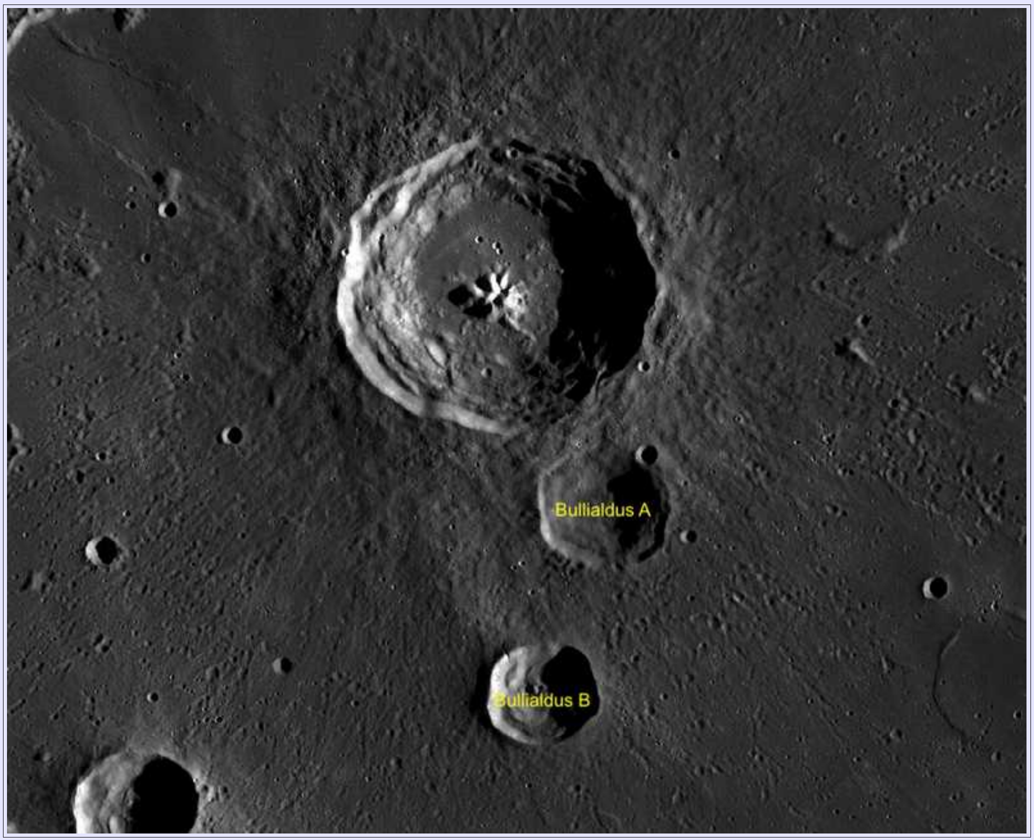
This observation interested me because of its complete contradiction to the description of the area given by Wilkins and Moore. Their description is that "On its south-east is another crater, B, connected with the wall of Bullialdus by a wide but shallow valley." I certainly do not subscribe to the policy adopted by some observers of 'disproving Wilkins', but in this case I must bring the discrepancy to notice as the two statements conflict to such an extent that they are tantamount to two descriptions, one saying that Copernicus is a crater, the other that it is a dome. All photographs that I have seen agree with Elger's description, although I have my doubts about his use of the word "plateau": I would prefer to describe this feature as a broad, rocky ridge or a mountain spur. Elger's showing of the rille on the west of this feature is also interesting and to my knowledge has not been shown previously. His use of the word "cleft" in describing the commencing point of his rille in the east wall of Bullialdus. All observations I have seen of this crater show terracing on the inner east walls rather than cleft formation, and even Elger's drawing suggests terracing. It is, however, an interesting observation.

Rae's comments on the Bullialdus observations from The Moon, Vol.10, No.1 .

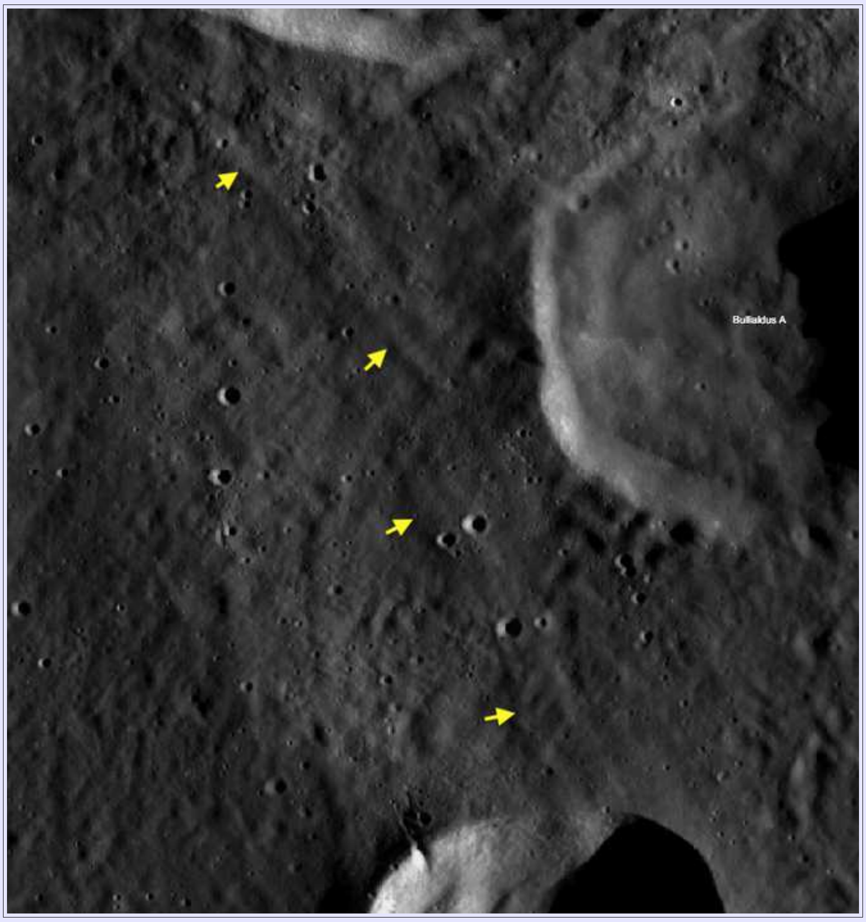
As you can see, Elger describes a 'cleft' extending from the western* wall (rim) of Bullialdus that extends down towards the northern rim of Bullialdus B, and being slightly concave towards the east and convex towards the western rim of Bullialdus A. This 'cleft' is shown clearly in his drawing and if you look at the image you can make out an apparent notch in the south-western rim of Bullialdus *and* the northern rim of Bullialdus B that tallies with drawing, and a curving shadow that appears to join the two – which corresponds to the 'cleft'. The description by Wilkins and Moore quoted by Rae describes a 'wide but shadowy valley' in this location and not a cleft.

We are lucky today that we can examine these contentious areas from the comfort of our computer, and the LRO imagery shows that there is no cleft as described by Elger, and that if anything the description by Wilkins and Moore is more in keeping with the actual situation. As can be seen from the screenshot below, this area is dominated by the ejecta from Bullialdus, which includes the ridges and troughs characteristic of proximal ejecta. There is something of an an elevated spur running between the southern rim of Bullialdus and Bullialdus B, and this is also draped in this ejecta. These features are probably at the limit of telescopic resolution, and as a result isolated but separate ridges in the ejecta could be linked up visually to form an apparently continuous feature as shown in the NAC image below. So, the cleft is illusory, whereas the 'shallow valley' of Wilkins and Moore can be detected in the imagery and the topographic data. So whilst the interpretation was incorrect, Elger appears to have observed real features in the ejecta blanket of Bullialdus.

* I am using the IAU east and west and not the old version!



LRO WAC image of Bullialdus. Note the ejecta from the crater and the spur of elevated terrain between it and Bullialdus B.



NAC image showing ejecta ridges (yellow arrows) that may have been linked up visually to form the 'cleft' reported by Elger in his 1882 observations.

Rheita Valley.

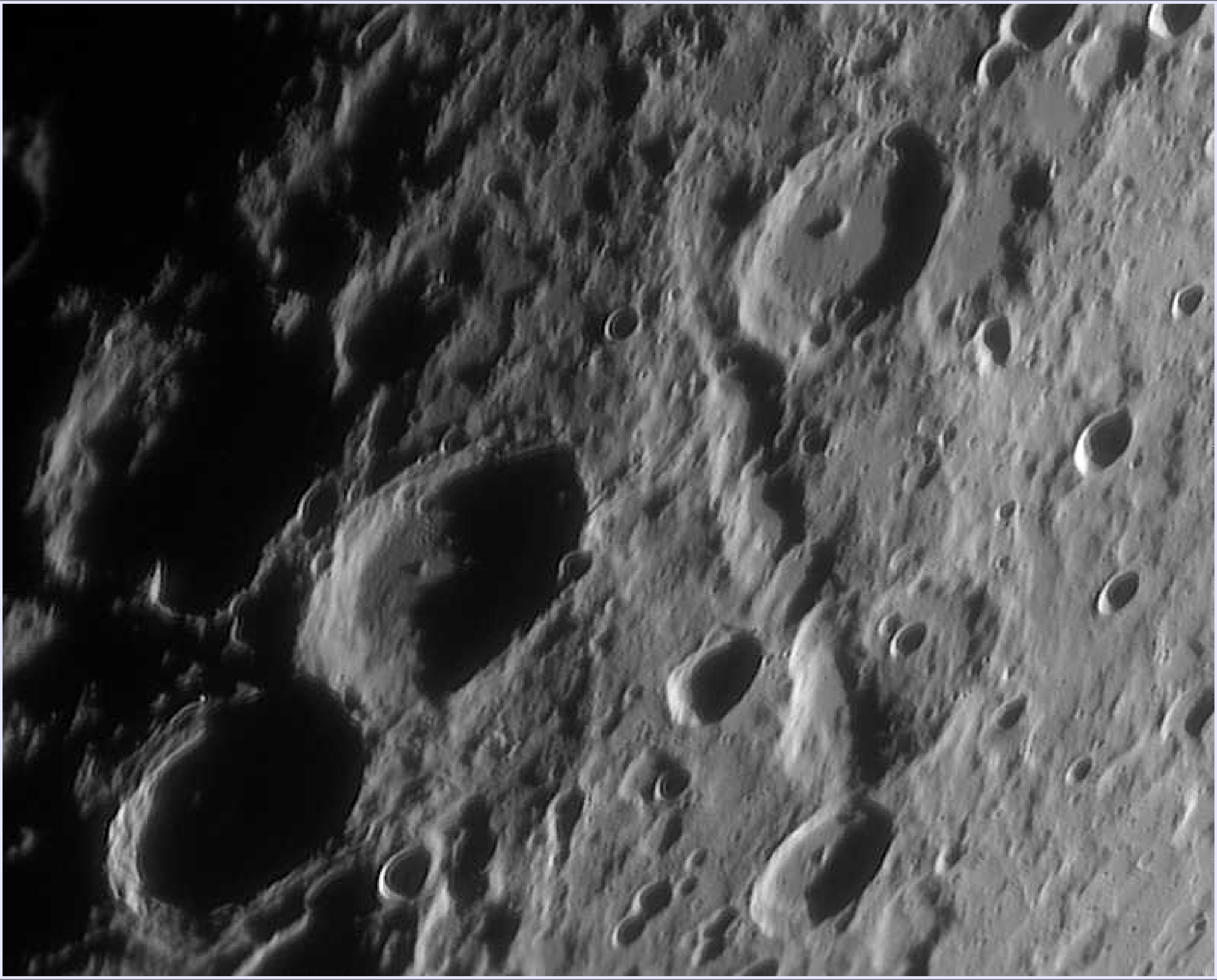


Image by Bill Leatherbarrow taken on 24th April 2023 at 2035UT.

Geological Notes: The 450 km long Vallis Rheita is thought to be a secondary crater chain originating from the Nectaris Basin, and this interpretation is supported by the observation that it is radial to that basin. Bill's image shows the northern stretch of the *vallis*, which stretches from the south-western rim of Rheita for about 180kms to the crater Young D (bottom of frame). Beyond this point the *vallis* becomes narrower as it passes through a number of satellite craters of Mallet for another 220kms or so. These two sections are on slightly different alignments with the northern section pointing a degree or two further towards the NW than the southern part, which suggests to me that they are not one continuous structure but two separate ones with *approximately* the same orientation.

Using the highly scientific method of a lunar globe and a bit of thread, I am also not convinced that the northern section as shown in Bill's image *is* radial to the Nectaris basin, and instead is aligned somewhat tangentially to the basin rim. Secondary crater chains are not always radial to their source crater/basin – a good example being the Stadius crater chain, which are secondaries from Copernicus, but clearly not radial to that crater. In these cases however the individual craters in the chain tend to be arranged in a rather en-echelon configuration and not aligned one after the other as we see in Vallis Rheita. An origin from the Nectaris Basin seems to be the most logical conclusion but I am not 100% convinced. Do you have any ideas on the origin of this feature, if so please share them!

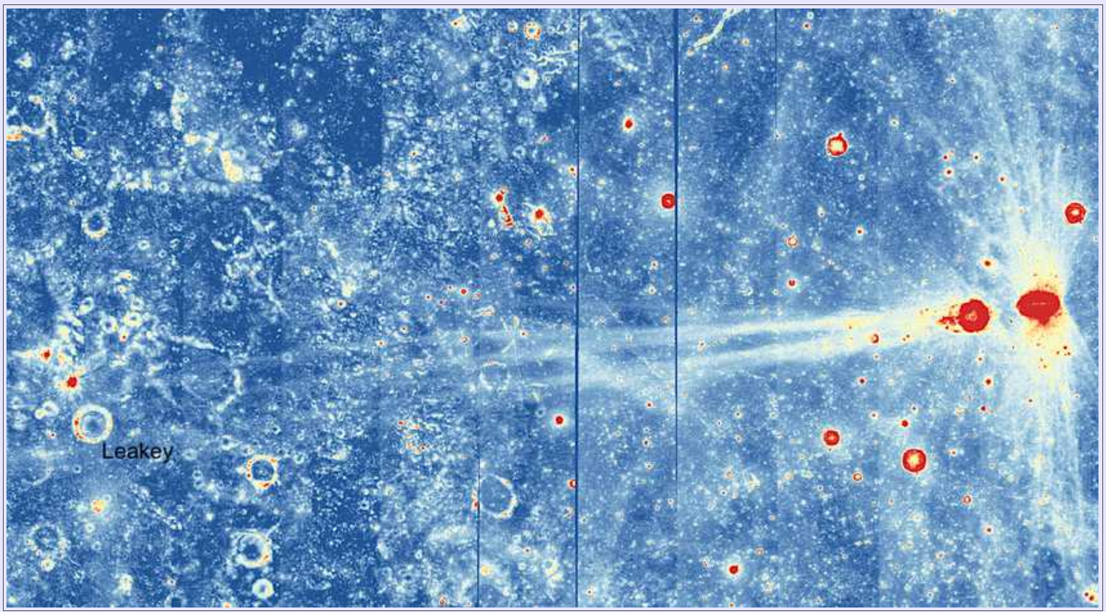
Messier and Messier A.

Image by Bob Stuart and taken on 26th May 2023 at 2016UT.

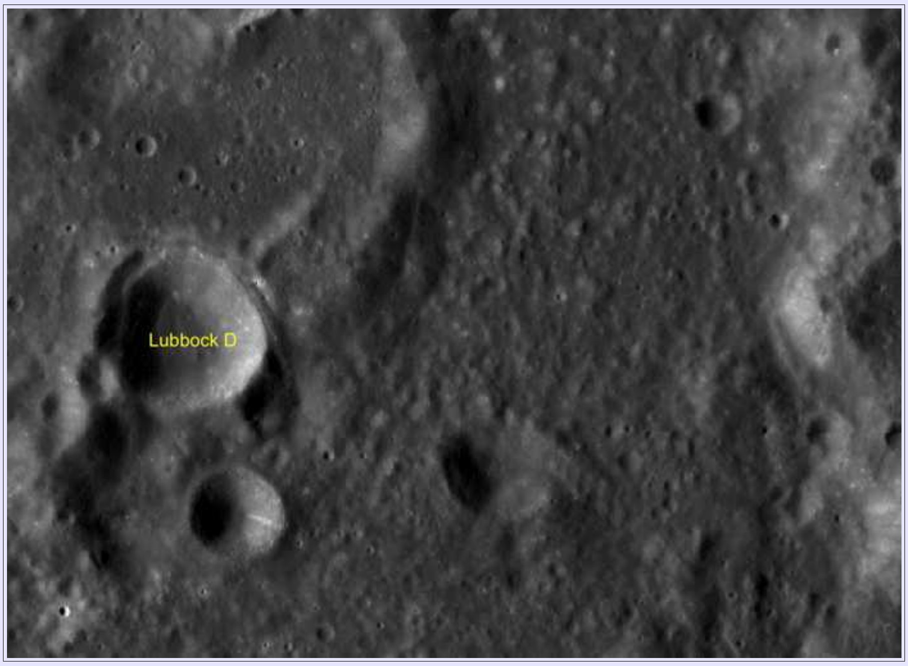
Geological Notes: There is so much of interest in this image that it is difficult to know where to start. It is hard to ignore Messier and Messier A, and their bright ejecta, particularly the 'comet tail' from Messier A, but how far do these rays extend to the west? They are easy to see against the dark mare, but if they extend onto the adjacent Highlands, this contrast effect is lost. The LRO image below with a SELENE/Kaguya Derived Optical Maturity layer enabled, shows that the rays extends onto the highlands, at least as far as the crater Leaky (which is a partial Concentric Crater), and in all likelihood beyond. You can also see that each ray appears to bifurcate, with each component of the comet tail producing two wispy and less well collimated rays towards the west.

This patch of highlands, to the north of Guttenberg and to the south of Mare Tranquillitatis, and which occupies the left hand side of Bill's image is home to some quite peculiar features and textures. For starters there are the rather odd craters Gaudibert and Capella, both strong candidates for some sort of modification by widespread collapse. Then we have the rather unusual topography within Isidorus B and Censorinus C, who's floors are occupied by clusters of small hills, and Censorinus S which looks for all the world like a crater floor without a rim – most peculiar. More widely there are many areas where the surface is broken up into a carpet of small hills, giving it a rather pimply texture.

One possible explanation for this peculiar topography is that the area has been subjected to seismic disturbance and that the shaking has disrupted the surface and broken it up into the odd hilly texture we see. Mercury hosts a similar topography in the form of what is called 'chaotic terrain' which a recent paper* describes as *"cratered landscapes degraded into vast knob fields"*. This might also be a fair description of the terrain in this area, the NAC image below of the terrain near Lubbock D being a good example. And of course Lubbock D is a type of Concentric Crater where rim collapse of some form may have occurred.



LRO image with a SELENE/Kaguya Derived Optical Maturity layer enabled to show the continuation of the 'comet tail' rays from Messier A over the adjacent highlands.



NAC image of hilly or *knobbly* terrain near Lubbock D.

In the case of Mercury, the 'chaotic terrain' is thought to be a result of the focusing of seismic energy at a point antipodal to the Caloris Basin, and in the the present case it is intriguing to note that the Hertzsprung multi ringed basin is antipodal to this area of highland. Lunar Prospector magnetic data also shows a slight magnetic anomaly near the crater Lubbock – and magnetic anomalies *are* also located antipodal to other major impact basins. It is an interesting possibility, but as you can imagine, further investigation is required!

**Rodriguez, Jose Alexis & Leonard, Gregory & Kargel, Jeffrey & Domingue, Deborah & Berman, Daniel & Banks, Maria & Zarroca, Mario & Linares, Rogelio & Marchi, Simone & Baker, Valeciea & Webster, Kevin & Sykes, Mark. (2020). The Chaotic Terrains of Mercury Reveal a History of Planetary Volatile Retention and Loss in the Innermost Solar System. Scientific Reports. 10. 4737. 10.1038/s41598-020-59885-5.*

Walter, Nonius and Lexell.

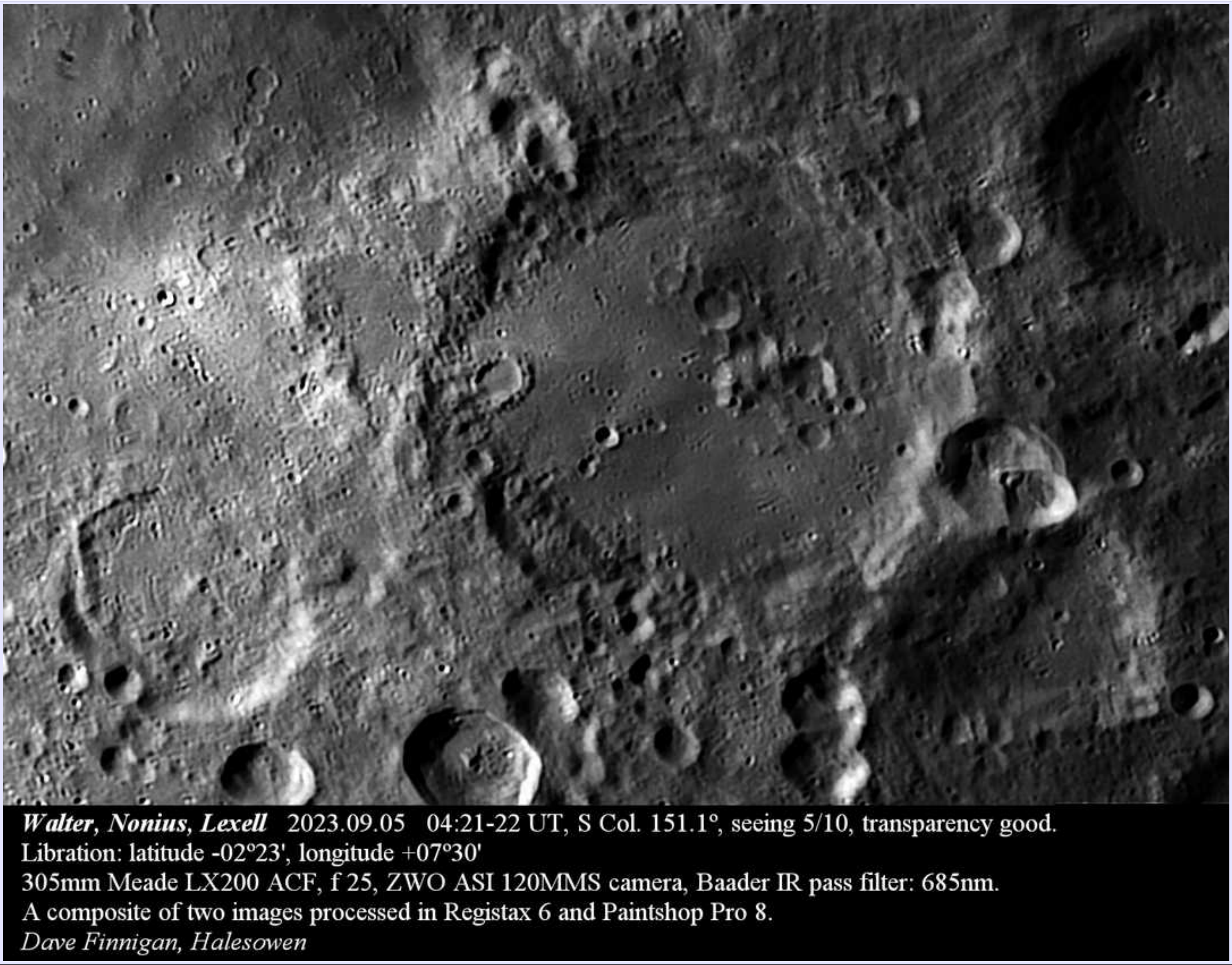


Image by David Finnigan with details of time/date and equipment as shown.

Geological Notes: If you look at plate 65 in Rukl's atlas* or any of the the USGS Geological Maps** prepared in the pre-Apollo era, you will see the crater imaged above labeled as *Walter*, but this changed in 2000 when the IAU adopted the name Walther instead. This was because another *Walter* also existed, which ironically is not even a crater, but a depression between two ridges in the ejecta blanket of Diophantus. Anyway, nomenclature apart, you can see some dark, iron and olivine rich patches within Walther, concentrated around Walther A. This is not volcanic material that has been erupted onto the surface, but appears to be associated with secondary craters and ejecta which originated from Tycho which is some 420kms away to the SW. Now, this could mean that the ejecta itself was rich in these minerals, which would be odd, as the Tycho target area is of highland composition, and much of its ejecta blanket reflects this, *or* the impacts that produced the secondary craters excavated and exposed iron and olivine rich material that was already there, possibly representing buried volcanic deposits. I did at one time favour the former interpretation, but now I am not so sure as mafic rich material is not particularly common in the Tycho ejecta, and some other craters (such as Buch B) in the southern highlands have excavated material similarly rich in iron and olivine, which demonstrates the presence of such material beneath the surface. Of course there is always the possibility that the Tycho impact site itself had isolated mafic deposits present and it is material derived from these that is represented in these rather odd patches of ejecta. There are some small lobes of impact melt like deposits in amongst the dark material in Walther, which is more consistent with the ejecta interpretation so maybe my original opinion was closer the mark?

*Rukl, Anton, Atlas of the Moon, Kalmbach Publishing Co, 1993.
** https://www.lpi.usra.edu/resources/mapcatalog/usgs/I822/150dpi.jpg

Fracastorius

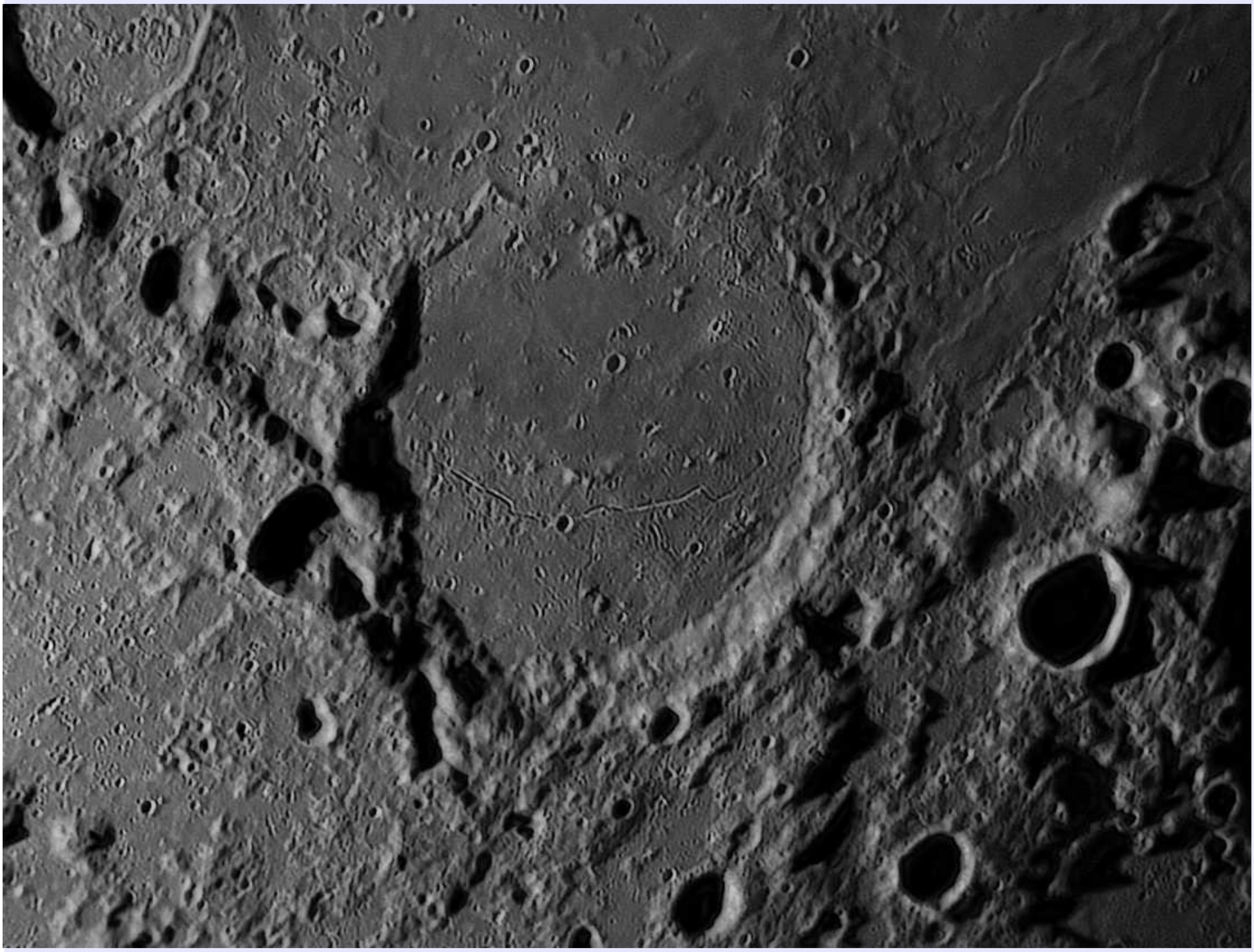
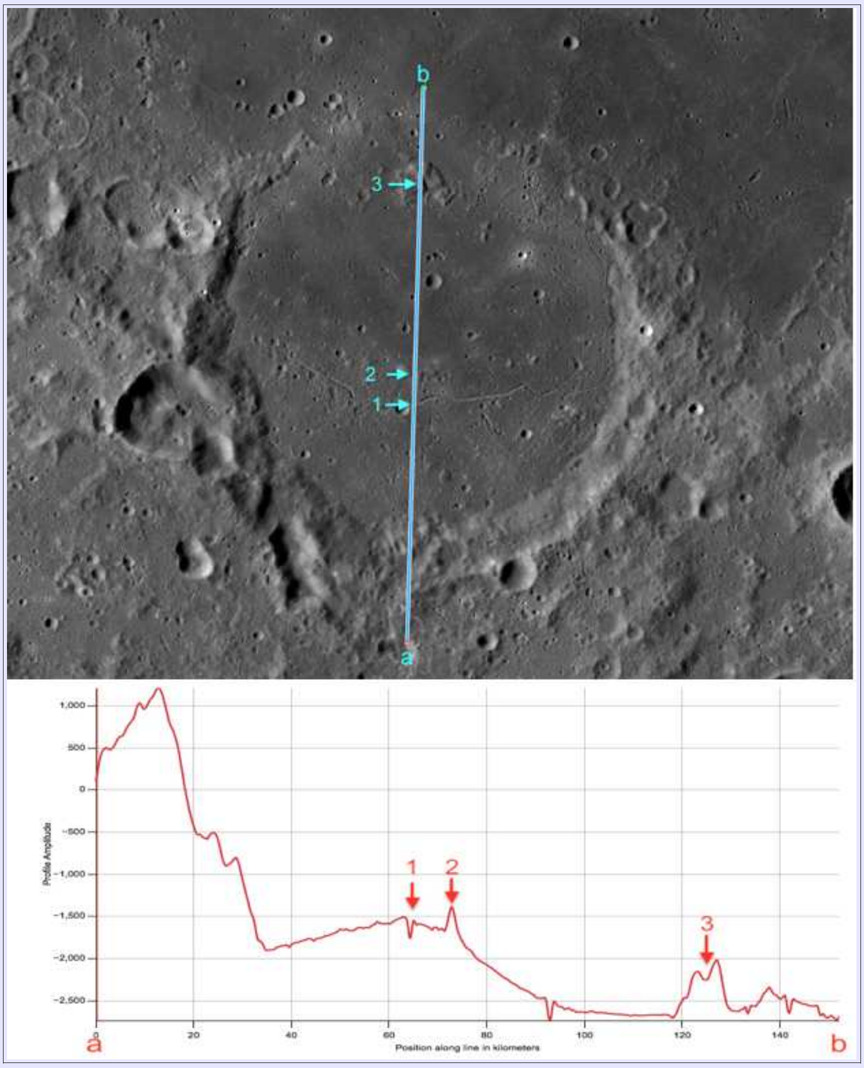


Image by Leo Aerts taken on September 4th 2023 with a Celestron 14, green filter and ASI 290MM. Leo stated that the seeing conditions were near perfect and that the image reflects the full resolving power of this telescope.

Geological Notes: It is fairly certain that Fracastorius owes its morphology to its position on the inner ring of Nectaris Basin, with the prevailing model being that the filling of the basin with mare lavas caused it to subside, taking the northern part of the crater with it. Mare lavas from the basin then inundated the crater, flowing over the lowered northern rim. Fracastorius is a Floor Fracture Crater (FFC) with relatively shallow depth and a system of concentric fractures which are visible up agains the eastern rim. No doubt this facture system was more widespread but has been obscured by later resurfacing. These fractures resulted from the uplift of the crater floor as magma forced its way into the crust below. The prominent graben that crosses the floor from E-W however seems to follow the line of the inner ring, and may be more closely related to that ring (and the probable faulting that was involved in its formation) and not the uplift described above. Oddly, this prominent feature does not have a name that I can find – is it *Rima Frascatorius* I wonder – well I am going to call it that for the time being.

The presence of *Rima Frascatorius* might suggest that instead of merely tilting downwards towards the north as the Nectaris Basin subsided, the crater floor actually fractured along this line, and the northern section tilted downwards and partially foundered beneath the encroaching Nectaris lavas. An analogy might be snapping a digestive biscuit in half prior to dunking. Evidence for this can be seen in the WAC image and cross section below, that shows that the crater floor to the south of *Rima Frascatorius* (feature 1 in the diagram below) actually represents the domed crater floor that formed during the FFC phase of its history – and it is preserved in its original position and height. To the north of this however the crater floor slopes to the north, past a stub of the original central peak (feature 2 in the diagram below) and on to the odd 600m high isolated block that sits at the open northern end of the crater.



The presence of this block can then be explained as a part of the northern rim that tilted downwards with the northern crater floor, and as it dropped it shifted slightly to the south, explaining the miss-alignment with the remainder of the rim.

This 'snapped biscuit' model might also account for Rimae Posidonius (proper IAU name this time) and which cuts across the tilted floor of Posidonius, forming a hinge line along which the slab has broken with the section to the west having sunk beneath the mare lavas that flooded that side of the crater.

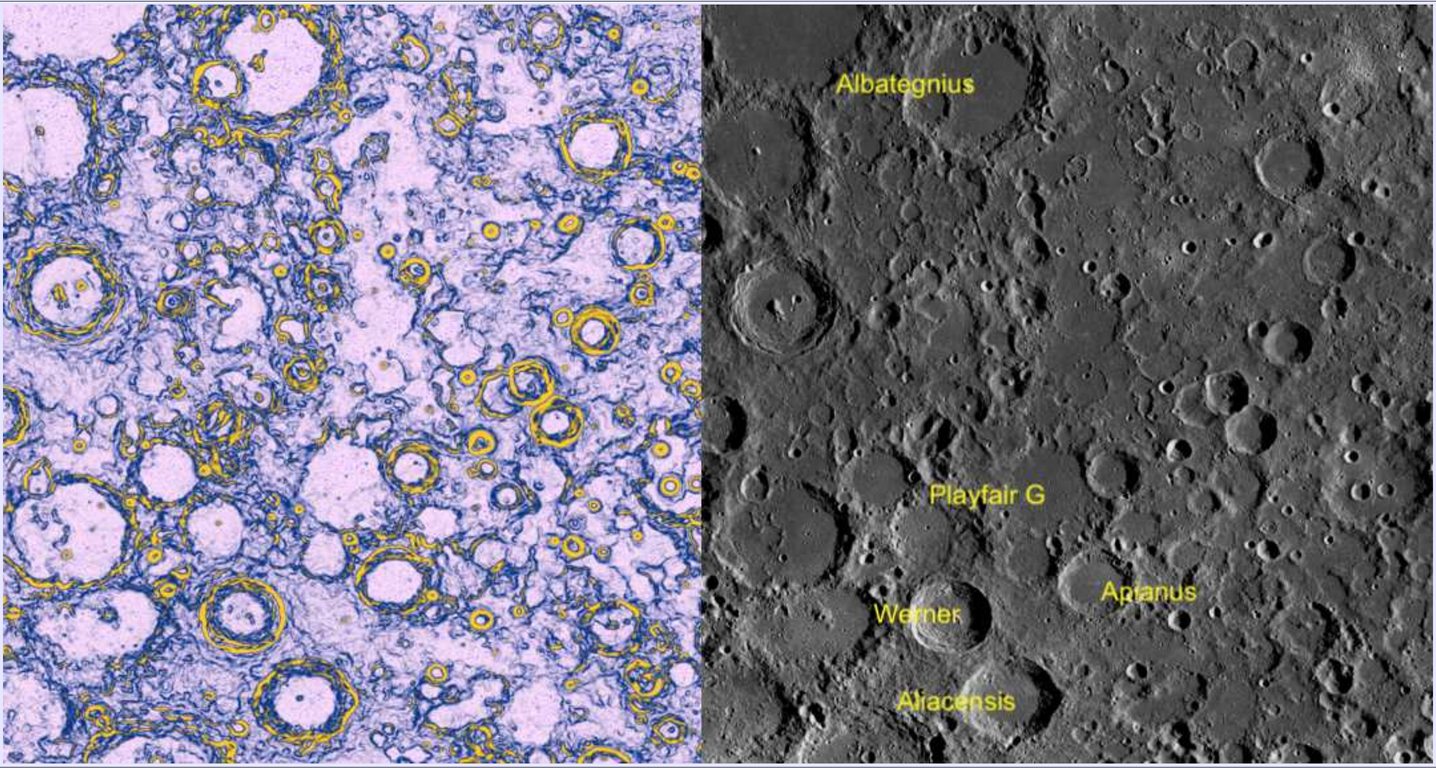
There is a peculiar trefoil shaped crater just outside the rim to the NE, which looks quite unusual. The rim material appears to be of highland composition, suggesting that rather than something exotic it is 3 smaller partially overlapping impact craters. Having said that they do look odd, with no trace of an intervening septum as you might expect from such an overlap, but perhaps this can be explained by the trio having being filled with volcanic material which seems to have erupted into the crater, and could have swamped any older rim material that may have been there.

Aliacensis.

Image by Les Fry with details of time/date and equipment as shown.

Geological Comments: Apart from capturing the 'Lunar X', this image by Les has captured something more subtle that I had not noticed before, despite a prominent, almost central location on the lunar disc. Running from the top right corner, down towards the bottom left is a linear feature, with highland craters deep in shadow to the west but an irregular chain of plains filled depressions to the east. The plains filled crater Playfair G forms the southernmost of these depressions, and in combination they almost suggest the presence of a trough or valley orientated almost north-south (or in this image top-right to bottom left) through this rugged part of the southern highlands.

The Quickmap images below show this feature, with a Terrain Slope rendition on the left and a WAC image on the right. You can see the line of depressions with Playfair G at the southern end quite well in the Terrain Slope version.



Is this a real feature such as a crater chain, valley or fault – or is it just a chance alignment of ancient plains filled craters? There is nothing in the GRAIL data to indicate any subsurface anomalies that could be responsible, and it is not aligned with mare Imbrium which rules out a tectonic connection with that basin. The plains deposits within the depressions appear to have smothered any of the Imbrium Sculpture structures that may have been there, so must be younger in age than that basin.

The rather obvious linear nature of the western edge of this feature had me reaching for V.A Firsoff's Moon Atlas* as I thought it would undoubtedly be recorded in his Selenological Map, and it is as a crater chain which I suspect he considered part of the Lunar Grid system, and therefore of endogenic origin. There is however no evidence to support such a conclusion, so no obvious faults or other surface displacements (such as truncated craters) so a chance alignment of ancient impact craters seems the most plausible explanation.

It is however quite obvious once you know it is there, and I will add it to my long list of things to look at in more detail in due course.

**Moon Atlas*. V. A. Firsoff. Viking, New York, 1962

Copernicus.

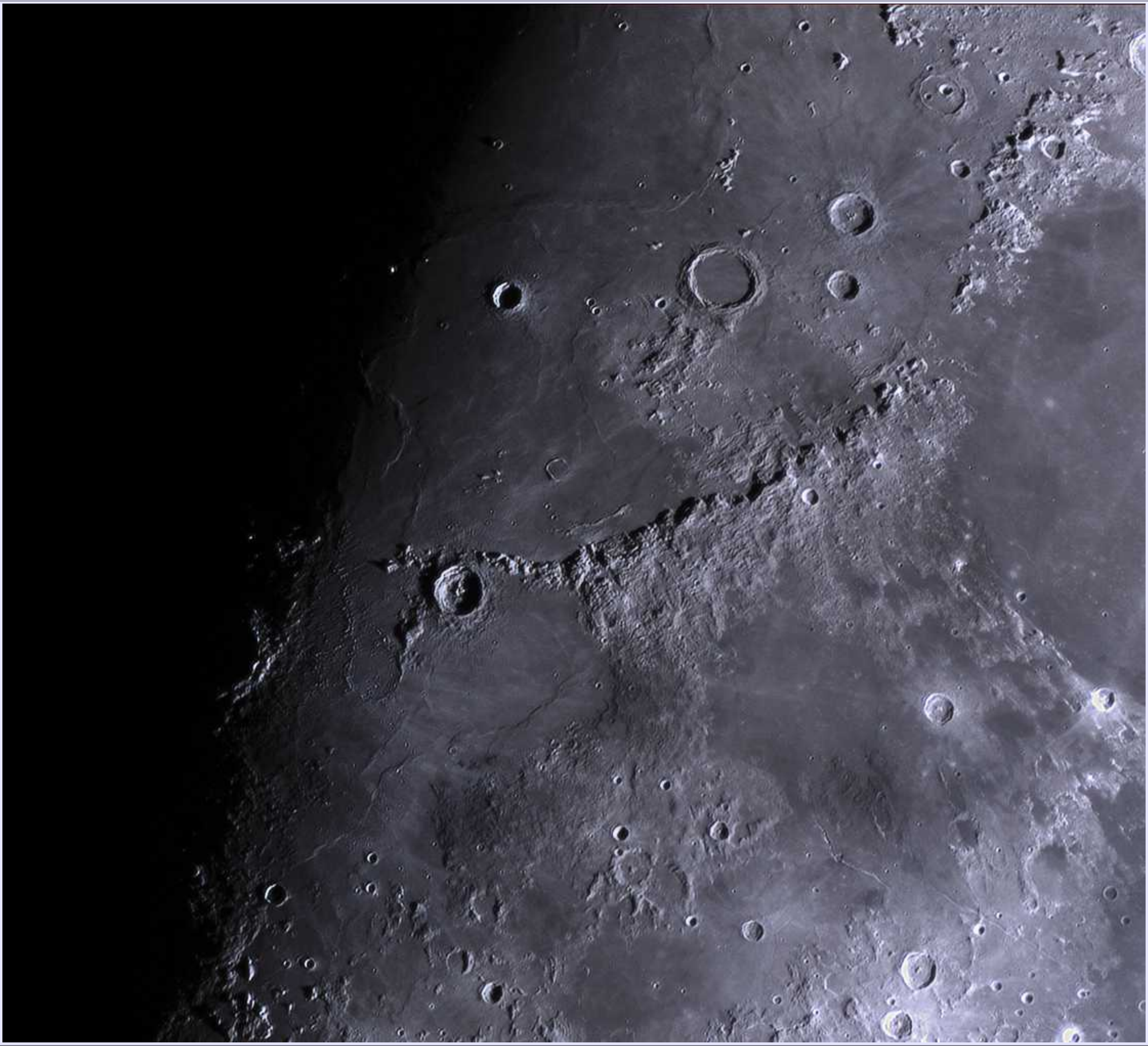


Image by Maurice Collins taken on 23rd October 2023 at 0739UT.

Geological Notes: This image shows the extensive pyroclastic deposits surrounding Sinus Aestuum (notable for being rich in the mineral spinel) and to the north of Rima Hyginus. The surface of Sinus Aestuum itself is covered by bright ray material from Copernicus which is just emerging from the terminator.

On a more modest scale, but probably subject to more debate than most parts of the Moon, is the diffuse bright smudge of Linné in Mare Serenitatis. This crater was, as you are no doubt aware, the subject of a vigorous ding-dong between various observers in the 19th Century who could not agree on what Linné was or whether it was a crater at all. Now we can say that it is a youthful 2.2km diameter impact crater that has excavated the mare basalts to a depth some 500m. These small fresh craters are usually referred to as being 'bowl shaped' but recent studies on Linné show that the profile is more akin to a 'truncated cone', with a small flat floor as opposed to a curved one. Those craters that do have a 'bowl shaped' profile may well have started off life like Linné, but subsequent collapse of the walls covered the primary flat floor and produced a more concave profile.

Posidonius.

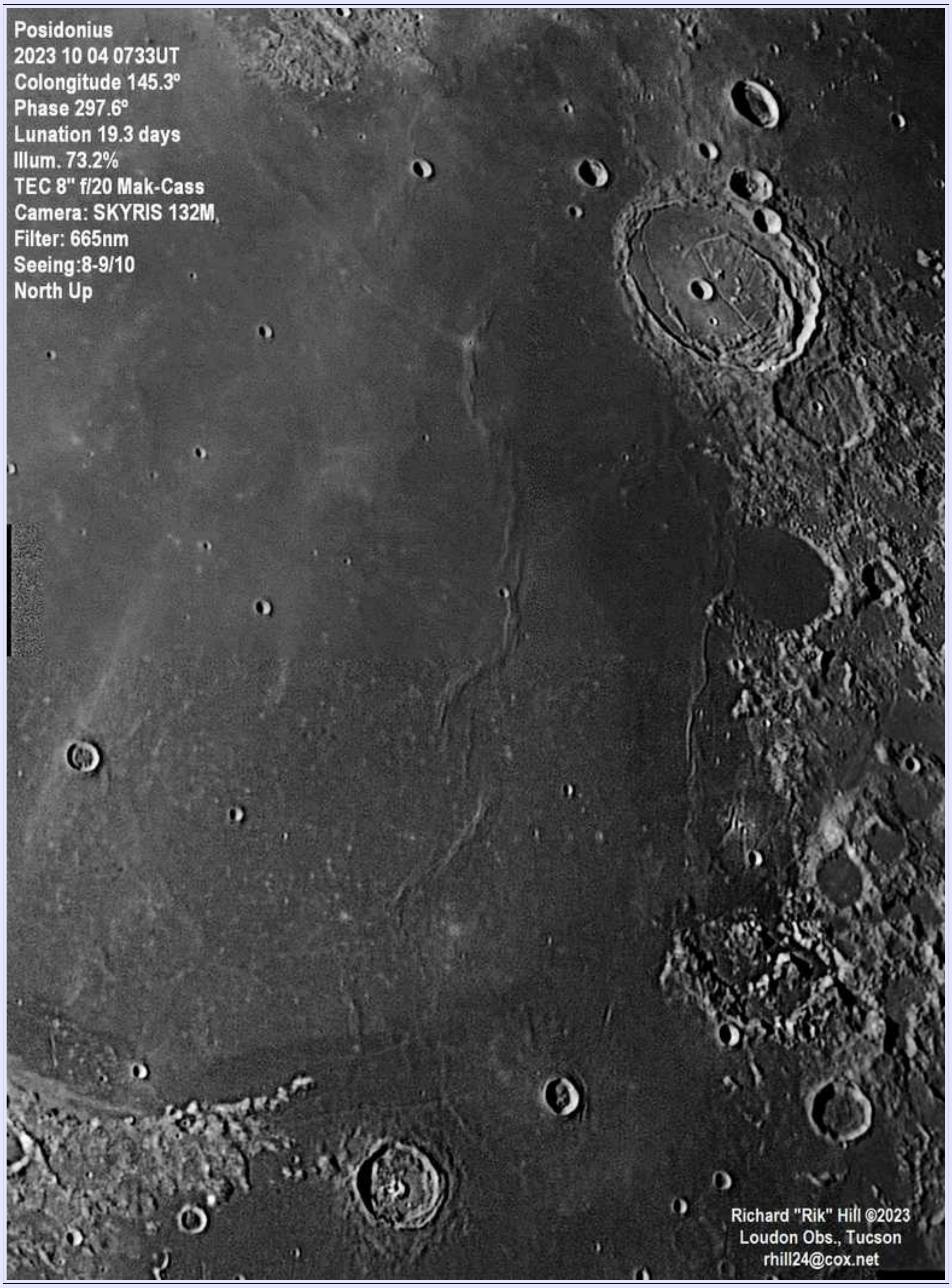


Image by Rik Hill with details of time/date and equipment as shown.

Rik Comments: *At my age one usually does not invite conversation about wrinkles. But, no matter, I will plunge into the topic! Here we see sunset on the great crater Posidonius (99km dia.) in the upper right of this image with the wonderfully fractured floor. Below this crater is another much older crater, Charcornac (53km). You can guess at its relative age just by the ruin of its walls and the many rimae that cross its floor. Moving further south we come to the fascinating embayment opening on Mare Serenitatis, Le Monnier (63km) also very old, possibly going back to just after the formation of the Moon itself. Then at the bottom of this right edge is another embayment with a crater above and below filled with rough peaks. The crater below is Vitruvius (31km) and above is none other than Littrow (32km) with the rough peaks being near the Taurus-Littrow landing site of Apollo 17.*

Between Littrow and Le Monnier is what we used to call wrinkle ridges. The two here form a fairly straight line named Dorsa Aldovandri. Then further out in the mare and parallel to this coastline is another larger wrinkle *ridge Dorsa Smirnov, not having anything to do with a beverage but named for 20th century Soviet naturalist. In my early days of lunar observing, early 1960s, this was called the Serpentine Ridge and it took a little work before I clearly saw it in my little 2.4ins refractor. In a larger telescope it can be quite impressive. The uppermost end of the main dorsum is split into a Y and the bottom end terminates just north of the crater Plinius (44km) seen at the bottom edge of this image where Smirnov splits off into Dorsa Lister and farther on, Dorsum Nicol. Where the dorsum splits on the north end you will see a white spot at that point. You can see a tiny 2km crater in the middle of that white spot. This is Posidonius Y. The crater and itís white ejecta has nothing to do with the dorsum, just a coincidental juxtaposition and is actually just a couple kilometres south of the split.*

Before leaving, notice the large 50km ghost crater to the upper left of Plinius in Serenitatis. It even has a ghost central peak! This was made from portions of 3, 1800 frame AVIs stacked with AVIStack2 (IDL) and put together with MS ICE software then finished off with GIMP and IrfanView.

…........................

Partial lunar eclipse of 28th October 2023.

Images by Alex Vincent. The timings were 1: 19.32 UT, 2: 20.51 UT, 3: 20.51 UT. and 4: 21.16 UT

Schickard.

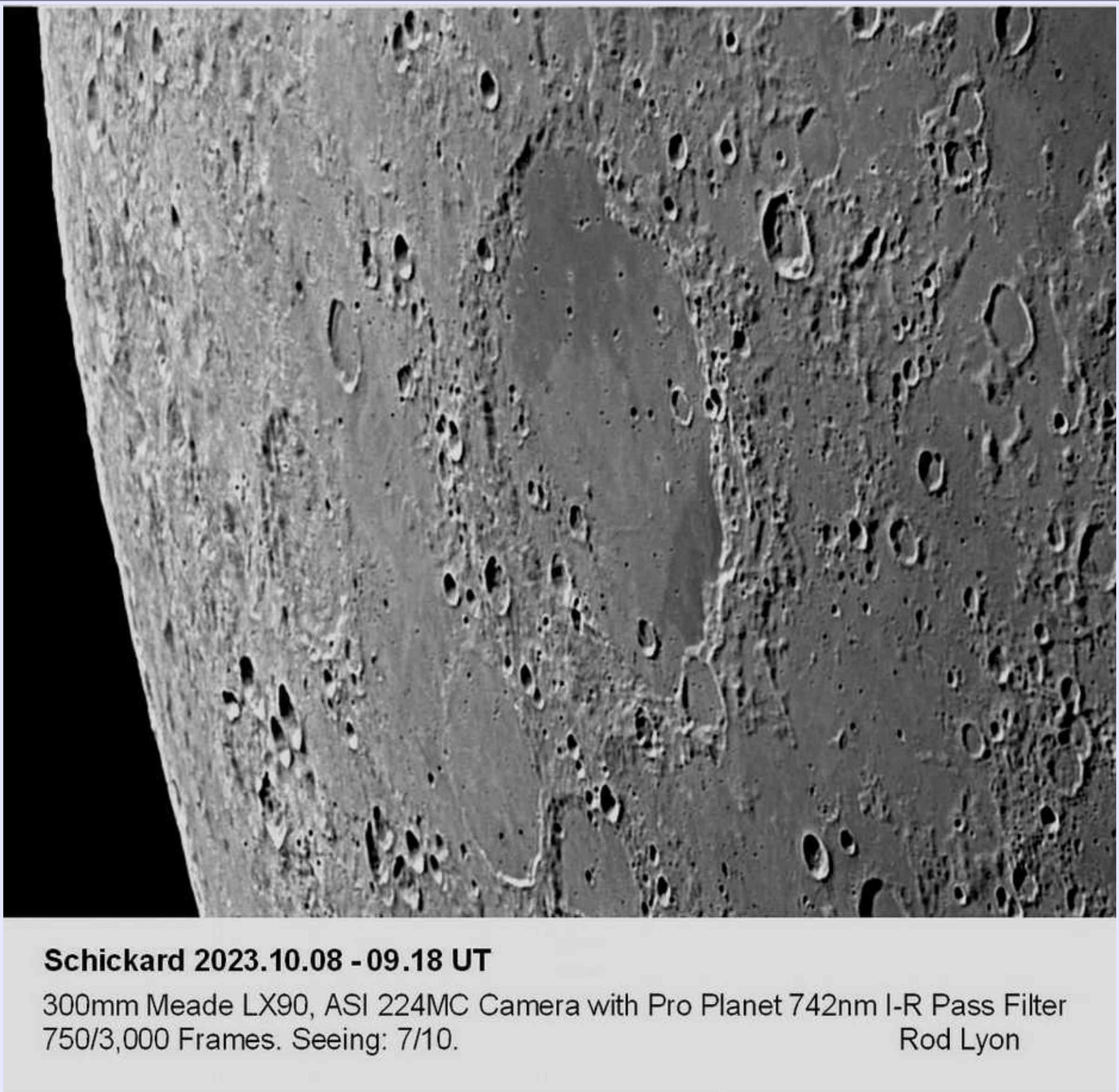


Image by Rod Lyon with details of time/date and equipment as shown.

Geological Notes: Schickard has always attracted a lot of attention from lunar observers as can be seen in the accompanying drawing (Fig.1) by R. Milligan from 1955 (The Moon, Vol.4 No.1 September 1955), and I recall the interest the veteran lunar observes Keith Abineri had in the crater, particularly in the early to mid 90's when he conducted some detailed studies using Lunar Orbiter 4 images (which he published in the JBAA). The LRO data allows us a much more detailed view of the crater and can point to the origin of some of the features noted in earlier studies.

An example is the linear feature running between Schickard C and Schickard A shown in Milligan's drawing and which he states Percy Wilkins recorded as a cleft. Spacecraft images show this to be a part of the Hevelius Formation, ejecta from the Orientale Basin, which in this location takes the form of parallel ridges and grooves all radial to that basin. These deposits form the oldest visible part of Schickard's crater floor, and as can be seen from the LRO image (Fig.2) they extend much further to the west than is shown in Milligan's drawing, something apparently recorded by Wilkins. The short linear feature Milligan shows extending away (to the SE) from Schickard C is by contrast a wrinkle ridge (and not an extension of the cleft as Milligan thought) which has formed on the light plains that previously filled the remainder of the crater, but now only occupies the higher central part, being hemmed in to the SE and NW by younger, darker mare like deposits. The light plains could well represent an earlier mare type filling, as the small (~1200m deep) Schickard R has excavated darker mafic material from beneath the light surface layers, indicating the presence of mare like material below.

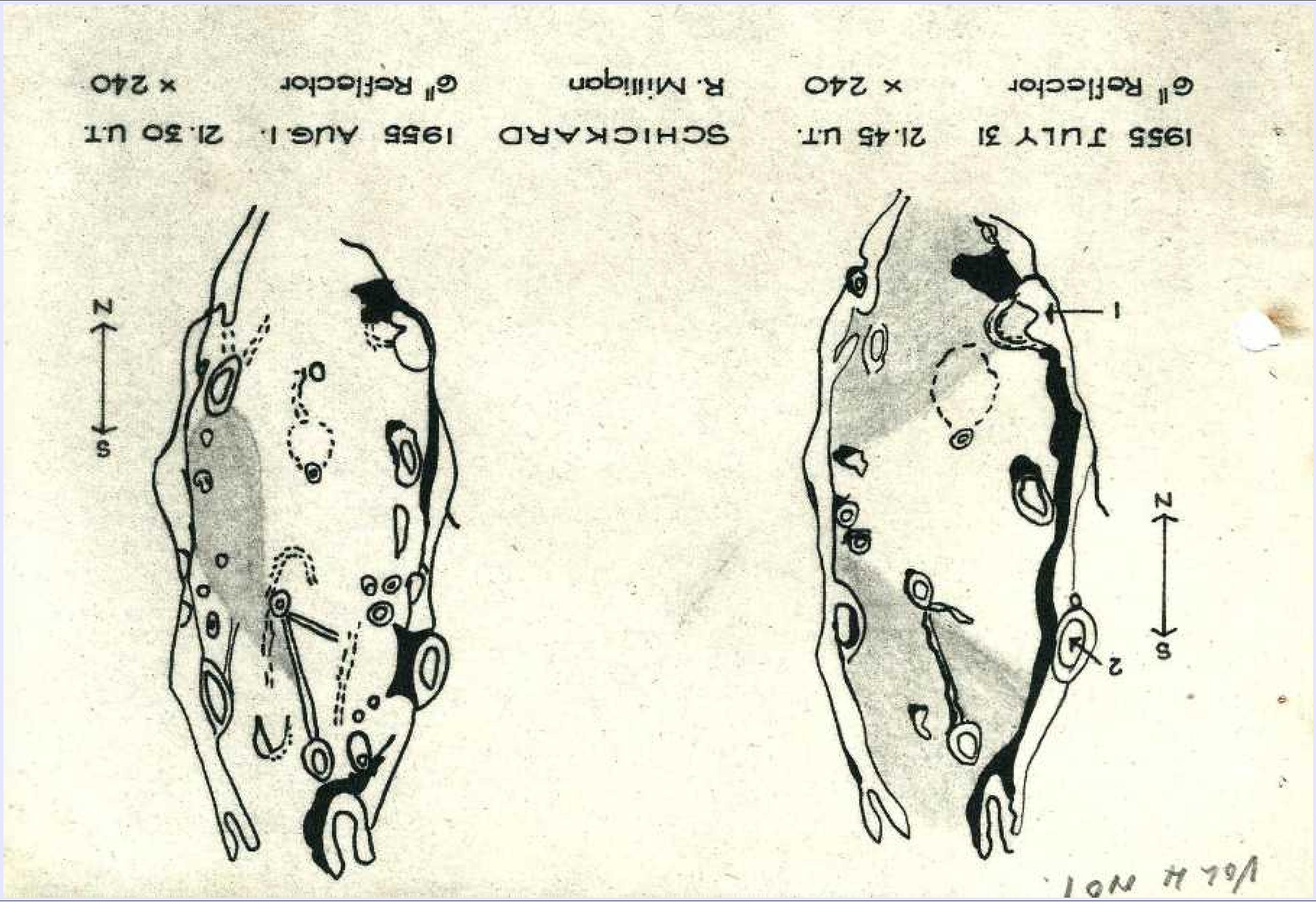


Fig.1 Drawing of Schickard by R. Milligan taken from The Moon, Vol.4 No.1 September 1955. Keen eyed observers will note that this drawing is upside down to allow comparison with Rod's image!

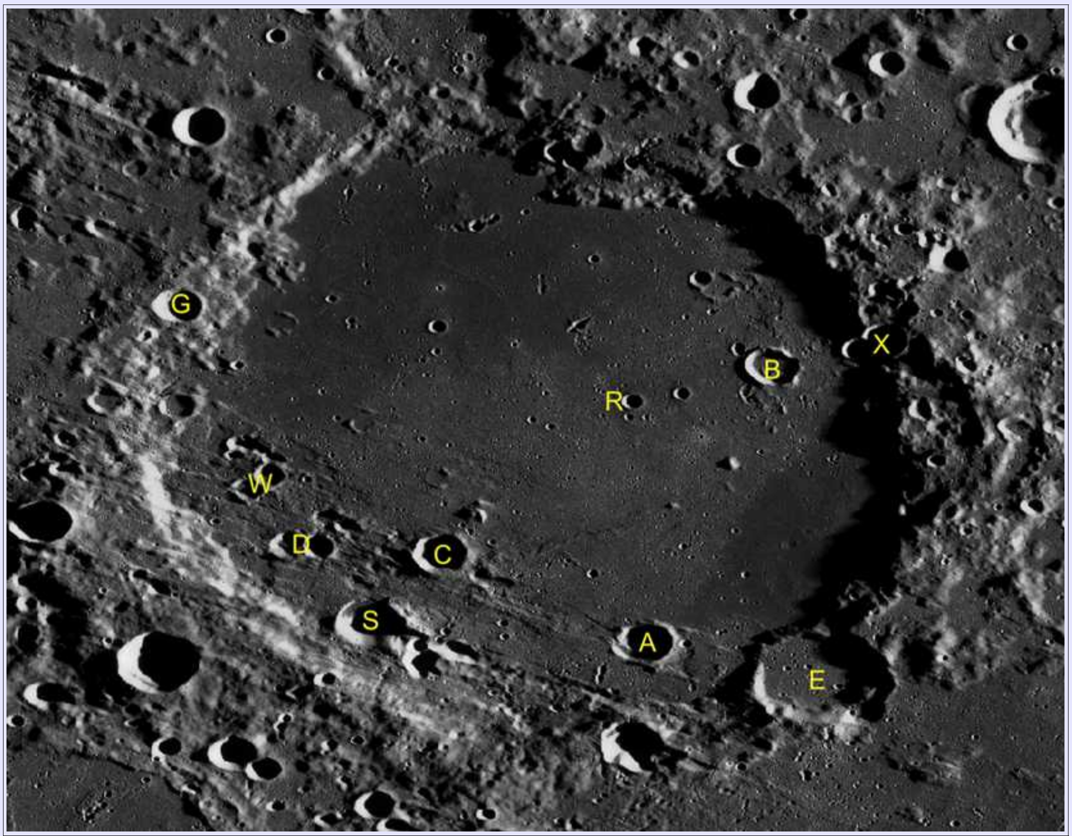


Fig.2 LRO image of Schickard with the satellite craters labelled. The Big Shadows layer is enabled.

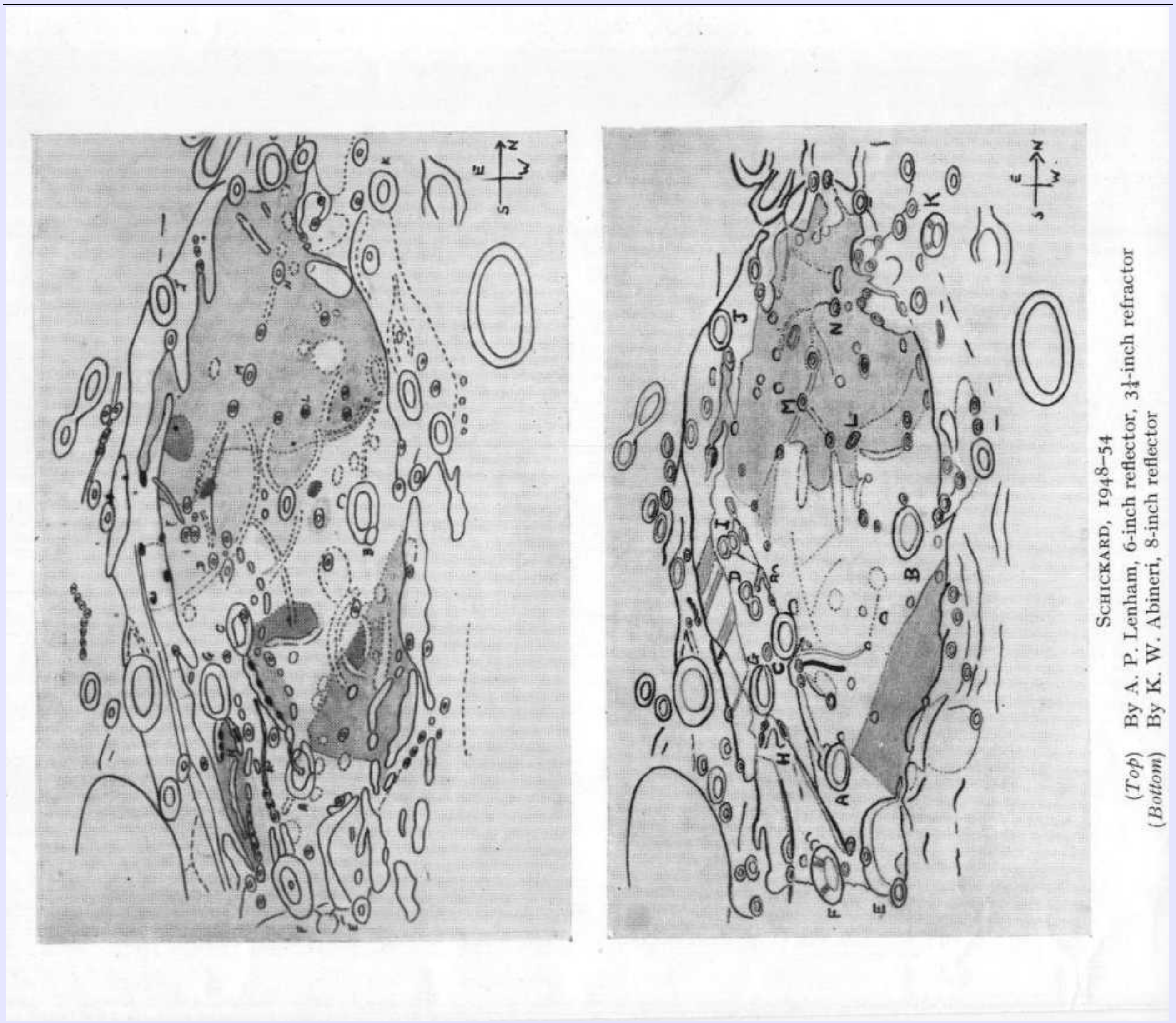


Fig.3 Drawings of Schickard By A, P. Lenham (left) and K, W. Abineri (right) from their paper 'Schickard' in the Journal of the British Astronomical Association. Vol.65 No.6.

Milligan used a drawing by A, P. Lenham to get the outlie of the crater (Fig.3) a practice apparently not uncommon at the time, and many outline charts can be found in copies of The Moon of this vintage. I am not altogether sure what is going on with his depictions of the dark areas in the crater though, but the earlier drawings by Lenham and Abineri seem much more accurate when compared to Rod's photo and the LRO image.

Between the the satellite craters Schickard A and E is a small patch of light coloured material which appears to truncate the southern dark area on the main crater floor – this is visible in Rod's image, with a rounded outline projecting in to the darked floor. Keith Abineri thought that this might be a volcanic dome*. Unfortunately the LRO images do not show anything dome like or volcanic at this location, but Keith only had access to Lunar Orbiter 4 images at the time, and none of the mineralogical information we have access to now. There are in all probability some volcanic features in the crater, but there are no really obvious candidates with the exception of two small hills on the northern floor, to the SW of Schickard N, but there is not much in the way of evidence to back this up. If you are aware of any suspects I would be pleased to hear.

***Abineri, K. W. 1991 A suspected dome on the southern floor of the lunar crater Schickard, Journal: Journal of the British Astronomical Association, vol.101, no.4, p.230-232**

Aristarchus.

Image by Mark Radice with details of time/date and equipment as shown.

Mark Comments: *Where else can you enjoy high resolution planetary geology but on the Moon? And what better than seeing a valley cut by flowing lava!*

We know today that craters on the Moon and other planetary bodies are created in impacts. For centuries after the invention of the telescope, however, early astronomers were convinced that craters on the Moon were created by volcanism. This makes sense when we consider that there are very few surviving craters on the Earth. Those that were formed millennia ago are long since eroded away or lost in plate tectonics whereas those on the moon are permanently frozen in time, free from the destructive tendencies of climatic and geologic processes.

Early scientists knew craters only as volcanic calderas. Amazingly, it wasn't until Ralph Baldwin showed in 1949 (ie only ~75 years ago) that shell and bomb craters from the horrors of World War II, explosion pits from industrial accidents and lunar craters shared similar depth-diameter ratios unlike their volcanic namesakes. That being said it still took several decades for this idea to become accepted – even as high resolution imagery and samples were returned from the space race and eventually with first hand geological samples from the moon landings.

That being said, although the vast majority of craters are from impacts there are clear signs of volcanic activity. Nowhere is this more apparent than the Aristarchus Plateau, an isolated rectangular-patch of highland material surrounded by the lava flood plains of Mare Imbrium.

I took the image above on 24 November on a beautifully clear night using a Celestron C11 in my garden observatory and a mono Player One Saturn M camera. It was lovely and clear but awful seeing from the jet stream made the fine features hard to resolve.

Here we see the bright, young (at 450 million years!) Aristarchus crater. Note the dark stripes on the inner surface, evidence of landslides down the rim to the crater floor. Alongside is the crater Herodotus which looks like it has been flooded with lava. In fact it has! Between the two craters is a small volcano. On this peak is a small crater, nicknamed the cobra's head which is the original volcanic caldera. Flowing north form the plateau to the lower maral surface is a channel, Schroter's Valley (after the pioneering astronomer Schroter who mapped this area in his work Selenotopographische Fragmente (1791)). Looking carefully at the volcano itself, we can see another small outflow that appears to flow towards Herodotus which, I assume, is why it has been partially filled with lava.

Casting our gaze towards the arc of the ruined crater Prinz shows there are numerous small calderas, each with narrow channels. In fact, we can tell volcanic calderas from impact craters as calderas don't have crater rims unlike impact craters.

Image by Mark Radice with details of time/date and equipment as shown.

The following night was very different. Here we had awful transparency (see the picture of the moon halo) but amazing seeing. This time I used a colour camera (ASI ZWO 224MC) to take a high resolution picture of the Aristarchus Plateau. Boosting the colour contrast highlights the different soil types and mineralogy. We have the orange soils indicating relatively low titanium content on the plateau itself whereas around Aristarchus itself we can see the blue, titanium-rich material that has been excavated in the impact.

What a fascinating area! Mineralogy, volcanism, impact craters all in one field of view and a beautiful moon halo glowing in the sky.

Halo around the Moon and Jupiter.

Image by Alex Vincent and taken with a 10mm digital lens at f2 with a 1600 ISO and with one to two second exposures. They were all taken at 20.59 UT.

Lunar Occultation of Venus - 9th November 2023 by Alan Tough.

Alan writes: *Here in Elgin we had perfect weather conditions for this morning's occultation of Venus by the Moon. I even got up early to catch the Moon and Venus in the pre-dawn sky.*

Pre-Dawn: Time: 06:25 UT Equipment: Sky-Watcher ED80 refractor, HEQ5 Pro mount, Canon EOS 5D Mark III DSLR. Exposure: 2 sec @ f/7.5 and ISO-500

2 minutes before Disappearance Equipment: Sky-Watcher ED100 refractor, HEQ5 Pro mount, Canon EOS 5D Mark III DSLR. Exposure: 1/800 sec @ f/11 and ISO-400.

Reappearance: Equipment: Sky-Watcher ED100 refractor, HEQ5 Pro mount, Canon EOS 5D Mark III DSLR. Exposure: 1/800 sec @ f/11 and ISO-400.

From The Archive.

Aristarchus, Herodotus and Schröter's Valley.

Drawing by B. Burrell, made on 27th March 1934 at 12h and reproduced from Memoirs of the British Astronomical Association, Vol.32, Part 2A. October 1936.

Walter Goodacre, the then Director commented in the Memoir noted in the above caption, that the representation of Schröter's Valley has 3 angular bends instead of the 2 shown in photographs and that the shape of Herodotus shows too much distortion. He also shows Schröter's Valley entering Herodotus, and not stopping to the north of the crater. But if you compare it with Mark Radice's monochrome image you can see some logic in the way Burrell drew the scene.

Lunar domes (part LXXI): Domes in Vendelinus region. By Raffaello Lena

Vendelinus is an ancient lunar impact crater located on the eastern edge of Mare Fecunditatis. To the north of Vendelinus lies the prominent Langrenus crater, while to the southeast lies Petavius crater. The smaller Lohse crater overlaps the rim to the northwest, and at the south end there is the Holden crater. The floor of Vendelinus is flat and covered by a dark lava flow. It lacks a central peak [1]. In previous studies [2-3] I have described some lunar domes which are named Vendelinus 1 and 2. These two domes imaged by J. Phillips are shown in Fig.1 with an image scale of 323 m per pixel).

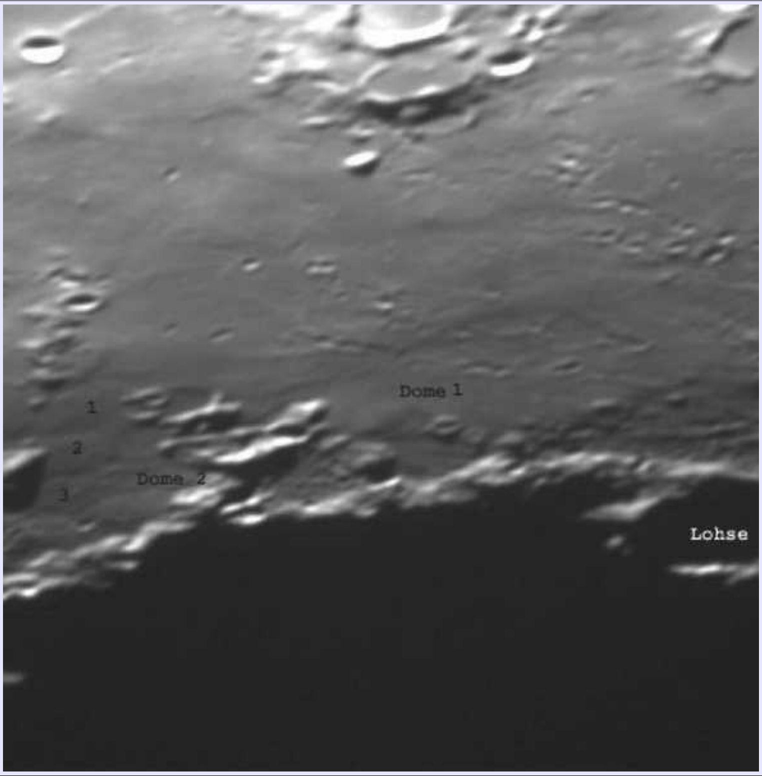


Figure 1: Telescopic image of the examined region. The image was taken by Phillips on February, 26, 2005, at 09:30 UT, using a TMB 8" f/9.

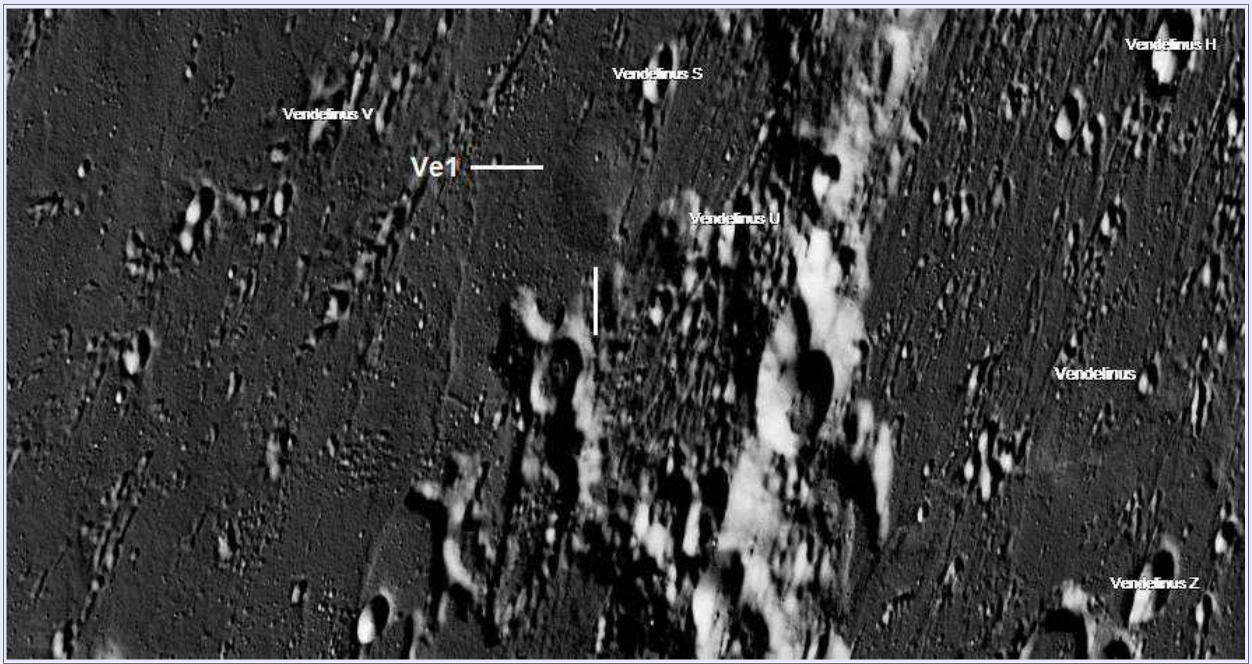


Figure 2: Dome Vendelinus 1WAC imagery.

Note that the craters and the domes appear oblong due to foreshortening. The image in Fig. 1 was taken 18 years ago and shows these difficult domes. These domes are now detectable using the LRO WAC imagery. Fig. 2 displays the dome Vendelinus 1 and Fig. 3 shows the dome Vendelinus 2 and the subtle features marked as features 1-3 in Fig. 1. We can conclude that the WAC imagery confirms the domes imaged using terrestrial imaging. In this contribution I will describe the morphometric properties of two examined domes based on the LOLA DEM and WAC imagery, which was not available at that time (2005).

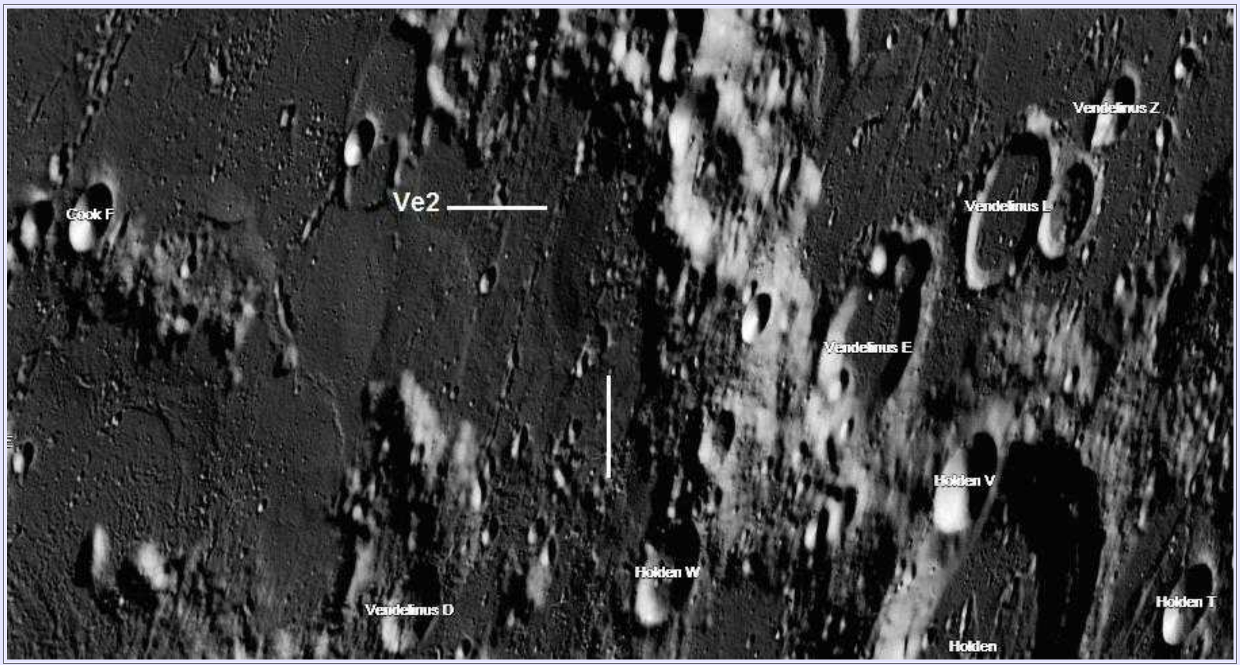


Figure 3: Dome Vendelinus 2 WAC imagery.

Dome Vendelinus 1 This feature is located at coordinates 57.77º E and 15.76° S, with a diameter of 19.0 ± 0.3 km. The height of Vendelinus 1 derived by using the LOLA DEM is 140 ± 10 m, yielding an average flank slope of 0.7° ± 0.1° (Fig. 4). The dome edifice volume, assuming a parabolic shape, is determined to be 9.8 km³.

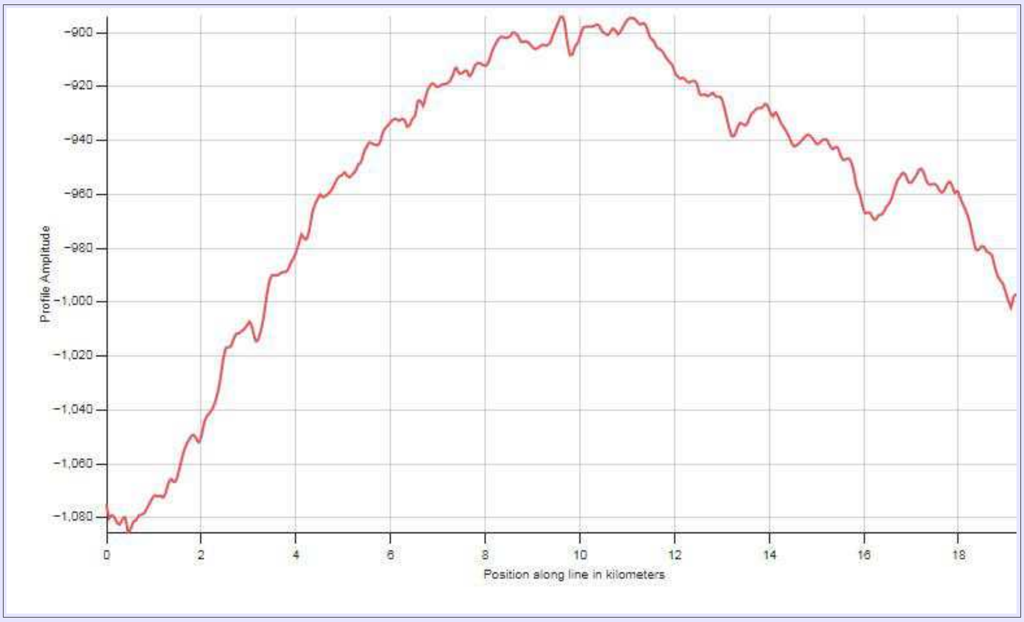


Figure 4: LRO WAC-derived surface elevation plot of an east to west cross-section of the examined dome named Vendelinus 1.

The low slope and large diameter of the dome Vendelinus 1 yields a high effusion rate of 450 m^3 s^{-1}, a lava viscosity of 1.3 x 10^5 Pa s and duration of the effusion process of 1.4 years. The Clementine UVVIS data reveal that the dome appears spectrally red. It has a 750 nm reflectance of R_{750} = 0.1410, and a R_{415}/R_{750} = 0.5913, indicating a low-moderate TiO_2 content. It belongs to Class C_1 in the classification scheme [3]. The 3D reconstruction based on LOLA DEM is shown in Fig. 5.

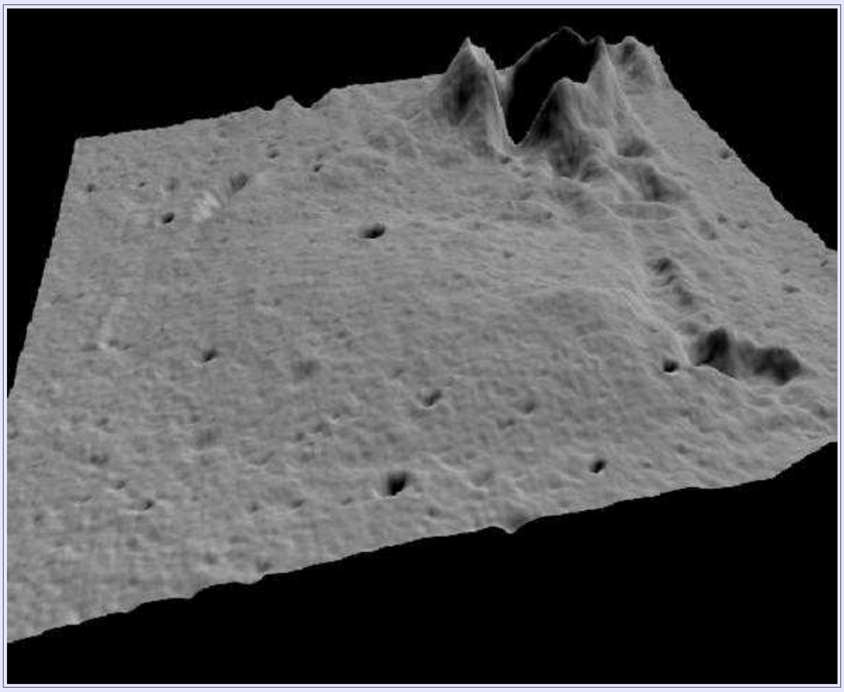


Figure 5: Digital elevation map of the dome Vendelinus 1 based on LOLA DEM. The vertical axis is 7 times exaggerated.

For this study I have also derived abundance maps in wt% of FeO, plagioclase, olivine, clinopyroxene, orthopyroxene and TiO_2 content created from topographically-corrected Mineral Mapper reflectance data acquired by the JAXA SELENE/Kaguya. The dome Vendelinus 1 displays a TiO_2 content <1 wt% indicating a low TiO_2 content and plagioclase content of 60.0 wt %. The FeO content is 13.0 wt %. Moreover, it has an enhanced abundance of clinopyroxene (20.0-43.0 wt %) and lower abundance of orthopyroxene (from 21.0 wt % to 33.0 wt %) like the nearby mare units. The olivine abundance ranges from 4.0 wt % to 12.0 wt % in some restricted regions on its summit.

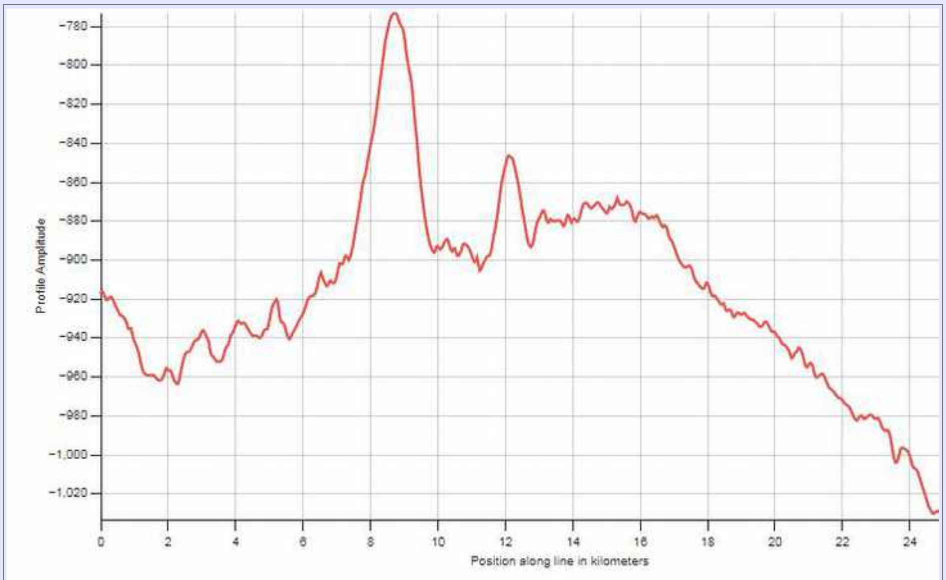


Figure 6: LRO WAC-derived surface elevation plot of an east to west cross-section of the examined dome Vendelinus 2.

Dome Vendelinus 2. Vendelinus 2 is located at coordinates 58.84º E and 17.73° S, with a diameter of 22.0 ± 0.3 km. The height of Vendelinus 2 derived LOLA DEM is 90 ± 10 m, yielding an average flank slope of 0.4° ± 0.1° (Fig. 6). The dome edifice volume, assuming a parabolic shape, is determined to be 17.0 km³. The 3D reconstruction based on LOLA DEM is shown in Fig. 7.

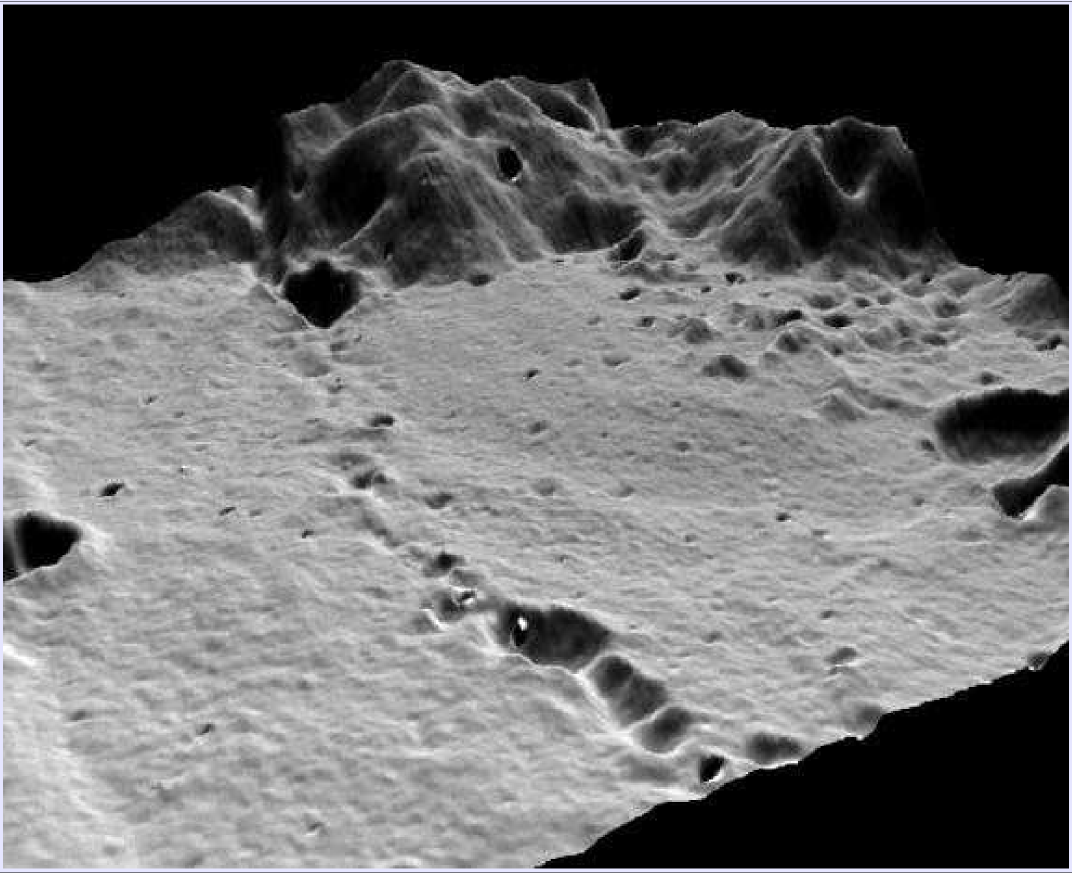


Figure 7: Digital elevation map of the dome Vendelinus 2 based on LOLA DEM. The vertical axis is 7 times exaggerated.

The low slope and large diameter of the dome Vendelinus 2 yields a high effusion rate of 934 m3 s-1, a lava viscosity of 1.1 x 104 Pa s, and duration of the effusion process of 0.6 years. The Clementine UVVIS data reveal that the dome appears spectrally red. It has a 750 nm reflectance of R750 = 0.1589, and a R415/R750 = 0.6038, indicating a low-moderate TiO2 content. It belongs to Class C1 in the classification scheme [3].

The dome Vendelinus 2 displays a TiO_2 content <2 wt% indicating a low TiO_2 content and plagioclase content of 56.0-60.0 wt %. The FeO content is 12.0 wt %. Thus, it is characterized by a lateral contamination due to ejecta of nearby craters including Petavius B. Moreover, it has an enhanced abundance of clinopyroxene (15.0-23.0 wt %) and lower abundance of orthopyroxene (from 10.0 wt % to 19.0 wt %). The olivine abundance ranges from 3.0 wt % to 3.6 wt %.

The other structures

Figure 8 shows in zenithal view the region near the dome Vendelinus 2. This image is compared with the terrestrial telescopic image of Fig. 1.

The 3D reconstruction based on LOLA DEM is shown in Fig. 9. I have found that effectively the swell 2 is identified as a lunar dome (now termed Vendelinus 3) while the structure 1 in Fig. 1 could be a low swell 80 m high (Fig. 10). The structure 3 in Fig. 1 is not a swell based on Fig. 8. Thus, its nature remains uncertain.

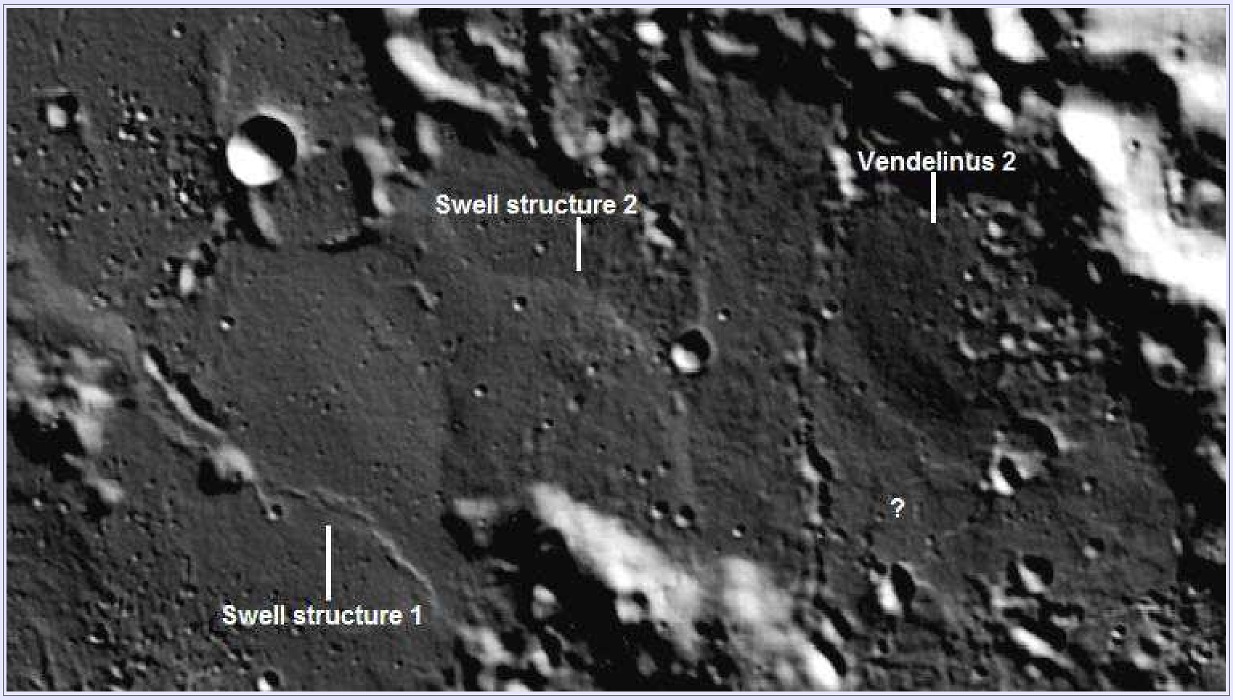


Figure 8: WAC imagery transformed in zenithal view, deleting the foreshortening. In this image the elusive features, termed as structures 1-3 in Fig. 1, have been studied.

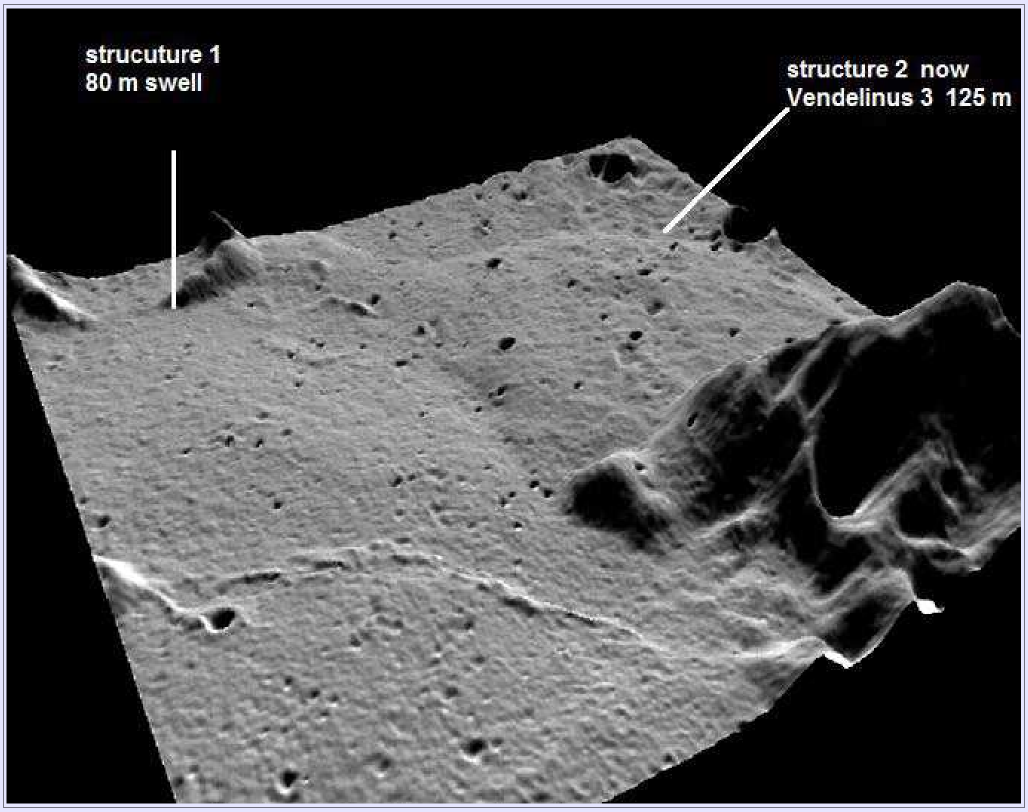


Figure 9: 3D reconstruction of the region under study. The vertical axis is 10 times exaggerated.

Vendelinus 3. This feature described as structure 2 in Fig. 1 is now well recognized as a lunar dome. It lies at 57.82º E and 17.97° S, with a diameter of 18.5 x 22.0 ± 0.3 km, corresponding to a circularity of 0.85. The elliptical shape is well visible from the WAC imagery in cylindrical projection (Figs. 8-9). The height of Vendelinus 3 derived LOLA DEM is determined to be 125 ± 10 m, yielding an average flank slope of 0.6° ± 0.1° (Fig. 11).

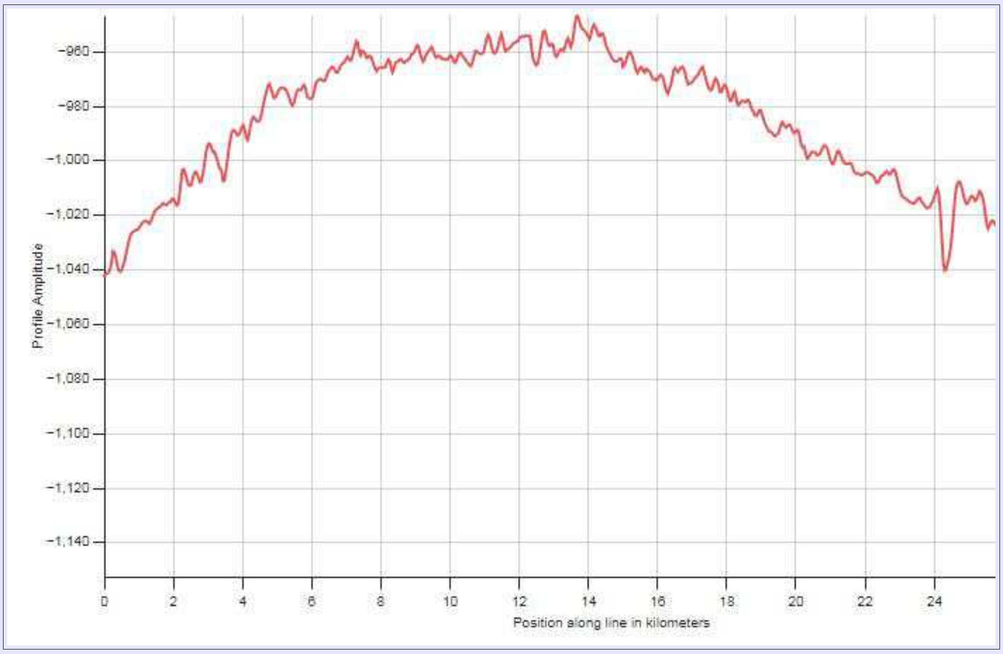


Figure 10: LRO WAC-derived surface elevation plot of an east to west cross-section of the examined swell 1 80m high.

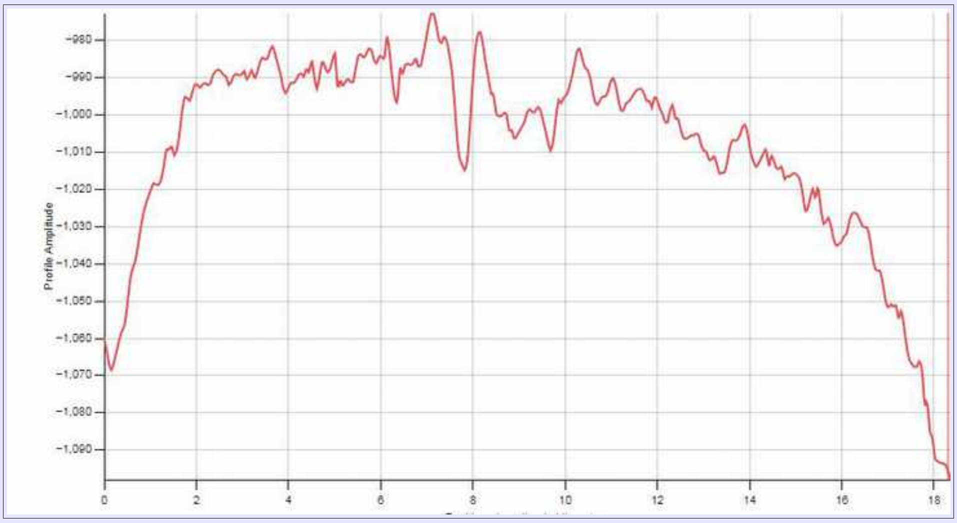


Figure 11: LRO WAC-derived surface elevation plot of an east to west cross-section of the examined Vendelinus 3.

Wöhler and Lena [5] studied some intrusive domes on the lunar surface based on telescope observations and proposed that intrusive domes have low flank slopes (less than 1°), large diameters (usually 10–20 km and can be larger than 30 km), regular but noncircular outline, and lack summit pits. Besides, tensional features such as faults and linear rilles could be found near the intrusive domes of class In1.

A reliable discriminative criterion in the dome classification is the circularity of the dome outline: the putative intrusive domes are elongated and with low slopes (< 0.9°). Class In1 comprises large domes with diameters above 25 km and flank slopes of 0.2°–0.6° and have linear or curvilinear rilles traversing the summit. Class In2 is made up by smaller and slightly steeper domes with diameters of 10–15 km and flank slopes between 0.4° and 0.9°. Class In3 comprises low domes with diameters of 13-20 km and flank slopes below 0.3° [3, 5].

Hence Vendelinus 3 would match the properties derived for putative intrusive dome belonging to class In2 (Fig. 12) and a subsurface intrusion of a magmatic body is most plausible. In the examined images tensional features such as faults and linear rilles have not been found. The assumption of an intrusive origin for this feature has been also described in the preliminary article [2].

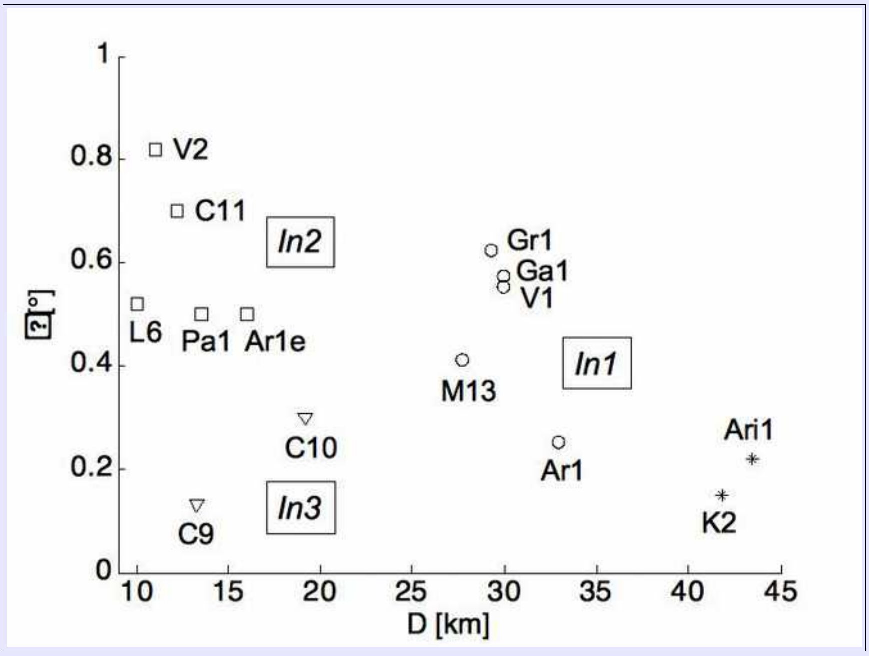


Figure 12: Diameter vs. flank slope diagram illustrating the three established morphometric classes of lunar intrusive domes. Circles, squares, and triangles denote the domes of the classes In1, In2, and In3, respectively.

The laccolith model by Kerr and Pollard [5] has been used to estimate the geophysical parameters, especially the intrusion depth and the magma pressure, which would result from the observed morphometric properties. Under the assumption of an intrusive origin, the laccolith model [4-5] applied to Vendelinus 3 yields intrusion depth of km 1.0 km, uppermost basaltic layer thicknesses of 0.2 km and maximum magma pressure in the laccolith of 8 MPa, thus consistent with an igneous intrusion in the range of class In2 domes and indicating that laccolith formation proceeded until the stage characterized by flexure of the overburden. Intrusive domes of class In1 are characterized by uppermost basaltic layer thicknesses larger than about 0.3-0.6 km, intrusion depths of 2.3–3.5 km and magma pressures between 18 and 29MPa. For the smaller and steeper domes of class In2 the uppermost basaltic layer is typically only 0.1-0.25 km thick, the magma intruded to shallow depths between 0.4 and 1.0 km while the inferred magma pressures range from 3 to 8MPa.

Conclusion

The domes previously described as Vendelinus 1-2 and imaged 18 years ago using terrestrial telescopic image are now identified by analysis carried out of WAC imagery and LOLA DEM. In our catalogue I have included another further dome Vendelinus 3. Based on the derived data Vendelinus 1-2 are two domes belonging to class $C_{1.}$ Vendelinus 3 is a possible intrusive dome, the geophysical parameters, especially the intrusion depth and the magma pressure, are consistent with an igneous intrusion in the range of class In2 domes and indicating that laccolith formation proceeded until the stage characterized by flexure of the overburden.

References

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

[2] Raffaello Lena, Christian Wöhler, Jim Phillips, Maria Teresa Bregante, and KC PAU, 2005, A DOME NEAR CRATER VENDELINUS located at longitude +57.83 ° and latitude -15.74°. TLO the lunar observer, May 2005.

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

[4] Wöhler, C., and R. Lena (2009), Lunar intrusive domes: Morphometric analysis and laccolith modelling, Icarus, 204(2), 381–398, doi:10.1016/j.icarus.2009.07.031

[5] Kerr, A.D., Pollard, D.D., (1998). Toward more realistic formulations for the analysis of laccoliths. Journal of Structural Geology Vol. 20 No. 12, pp. 1783–1793.

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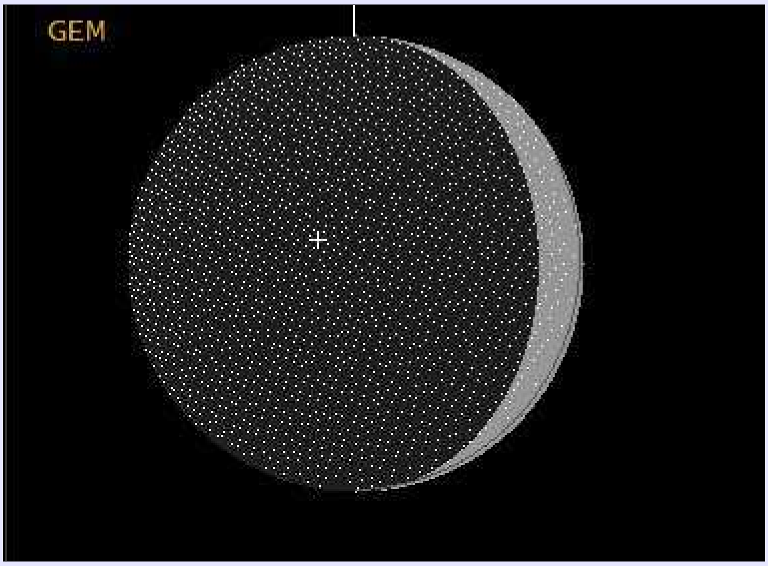

Figure 1. A lunarscan display of the predicted impact distribution of Geminid meteoroids on the Moon at 17:00UT on 2023 Nov 15.

News: Please keep a look out for Geminid meteors impacting the earthshine part of the Moon on 2023 Dec 15. Note the Moon will be at a favorably small phase of just 10% (See Fig 1), so there will little or no glare from the dayside of the Moon. Unfortunately, from the UK it will be rather low down in the sky. As a rule, I usually start observing 10 min after civil twilight ends as that is usually when earthshine becomes visible. Its best to use a camera running at least 10 frames per sec and ideally 20-30 or faster. You can use software such as ALFI or FDS to search for the short < 0.1 sec impact flashes, after, and in the case of FDS, recording the video. Try to keep sunlit peaks out of the field of view if possible. Please let me know what you detect, and at least tell me the start and end UTs of your observing run, even if you find no flashes. Try also to video some stars near the Moon, especially occultations, as these are useful to calibrate any impact flashes against.

TLP Reports: No TLP or impact flash reports were received for October.

Routine reports received for October included: Alberto Anunziato (Argentina – SLA) observed: Proclus and Ptolemaeus. Glenn Bates (Milton Keynes, UK - BAA) imaged the lunar eclipse. Robert Bowen (Mid Wales, UK) imaged the lunar eclipse. Maurice Collins (New Zealand - ALPO/BAA/RASNZ) imaged: Alphonsus, Archimedes, Aristoteles, Clavius, Copernicus, Eratosthenes, Plato, Rima Hadley, Tycho, and several features. Anthony Cook (Newtown, UK – ALPO/BAA/NAS) imaged: the lunar eclipse. Walter Elias (Argentina – AEA) imaged: Aristarchus. Gee Gopinath (Cardiff, UK – Aberystwyth University) imaged the lunar eclipse. Massimo Giuntoli (Italy – BAA) observed: the lunar eclipse. Rik Hill (Tucson, AZ, USA – ALPO/BAA) imaged: Lacus Mortis and Posidonius. Trevor Smith (Codnor, UK – BAA) observed: Aristarchus, Herodotus, Mare Frigoris, and Plato. Alex Vincent (UK – BAA): imaged the lunar eclipse. Ivan Walton (UK - BAA) imaged remotely, using a telescope on the Canary Islands: Copernicus.

Analysis of Reports Received (October): Again, it seems that most people have been affected badly by weather this month. Also, my apologies for the brevity this month, but academic work has taken its toll on my available time for the write up.

Aristarchus: On 2023 Oct 01 UT 03:52 and 04:42 Walter Elias (AEA) imaged this crater under similar illumination to the following report:

On 1988 Aug 28 at UT22:00 P.Moore (Selsey, UK, 5" refractor, x260) detected a red glow along the outer west rim and 99% sure it was not a TLP as there had been a fire nearby so was probably atmospheric. However colour if present, is normally seen on the south rim. The Cameron 2006 catalog ID=336 and the weight=1. ALPO/BAA weight=1.

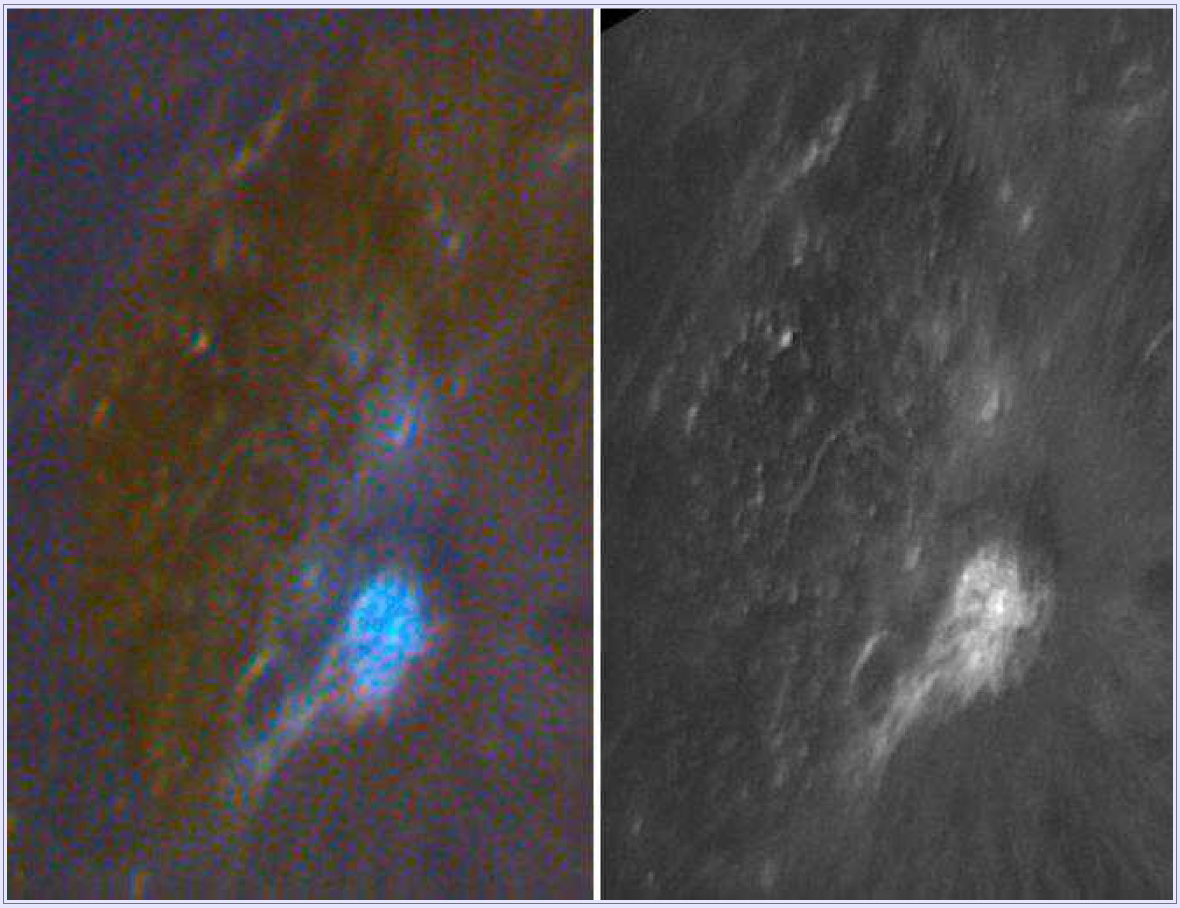

Figure 2. Aristarchus as imaged by Walter Elias (AEA) and orientated with north towards the top. (Left) A colour image taken at 03:52 UT with colour saturation enhanced significantly. (Right) A monochrome infrared filter image taken at 04:42UT.

If natural surface colour was present it would certainly have shown up in the colour saturation enhanced image (Fig 2 Left). There is no red colour on the outer west rim, only some orange on the SE-SW ejecta blanket exterior to the crater. You can see that the crater has an unmistakable blue cast to it and the usual large orange-brown highland plateau area is to the west and north or the crater. with its usual trapezoidal shape. As Patrick Moore was fairly certain that he had seen an atmospheric effect, and he was using a refractor which can suffer from chromatic aberration, I think we should remove this from the ALPO/BAA TLP database by assigning a weight of 0.

Ptolemaeus: On 2023 Oct 21 UT 23:30-23:50 Alberto Anunziato observed this crater under similar illumination and topocentric libration to the following report:

Ptolemaeus 2020 Feb 01 UT 19:40-19:50 P. Sheperdson (York, UK, 102mm Mak - BAA) saw an "ashen" sliver of bright light across the floor. Images taken. This maybe normal appearance - though observer re-observed in May and found the effect different in that there was no "ashen" like effect. Visual sketches and time lapse image sequences welcome. If doing visual work – try using a polaroid filter and rotate it to see if that makes any difference. For imaging work, please over-expose slightly to bring out detail on the floor; you could also try colour imaging of the floor as an interesting experiment - though for comparison purposes image other terminator features exhibiting shadow spires. ALPO/BAA weight=1.

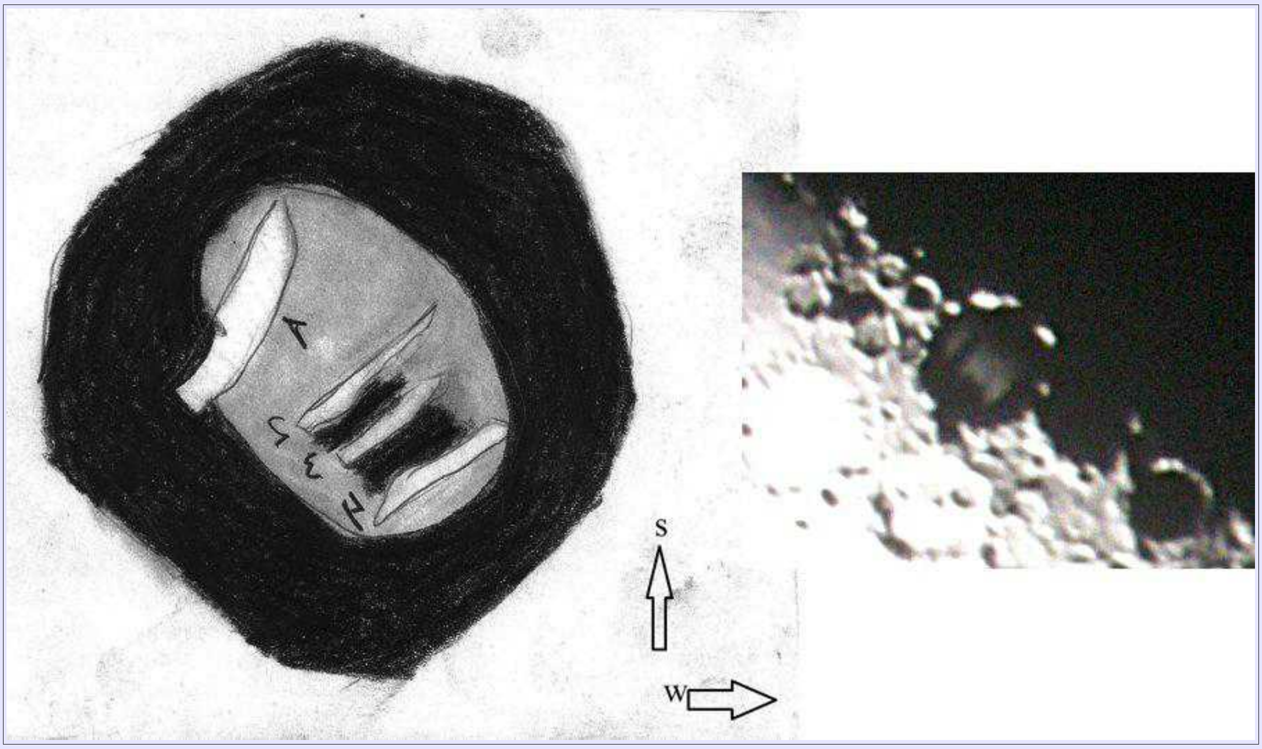

Figure 3. Ptolemaeus with arrow directions as indicated. (Left) A sketch of the floor of the crater by Alberto Anunziato (SLA) made on 2023 Oct 21 UT 23:30-23:50. – numbers are mirror reversed. (Right) A contrast enhanced image of a frame grab from a video made on 2020 Feb 01 after Phil Sheperdson's visual observational report.

Alberto commented…..

UT 23:30-23:50 – *"The centre of the shadow in Ptolemaeus has a lighter, gray area, in which 4 stripes of a very dull brightness appear. They look like elevations, which we know do not exist in the centre of the crater, as between the stripes 2 and 3 and 4 the shadow is black (of tone similar to the shadow of the contour), as if the stripes projected those shadows. The brightness of the stripes is from more to less: 1-3-4-2."*

UT 00:03-00:08 – *"The gray area has extended, the white stripes have a little duller brightness. There is no longer shadow between stripes 2 and 3, although it is maintained between stripes 3 and 4."*

I think Alberto's sketch (Fig 3) is very informative of the shadow spires and gaps though does not address the "ashen sliver of bright light across the floor" that Phil Sheperdson saw. Anyway we will keep an eye on this crater at sunrise and sunset in future, and encourage both visual and time lapse imaging,

Proclus: On 2023 Oct 23 UT 07:31-07:35 Maurice Collins (ALPO/BAA/RASNZ) imaged the whole Moon under similar illumination to the following report:

Proclus 1967 Apr 18 UT 18:40-18:45 Observed by Farrant (Cambridge, England, 8" reflector x175) "Crater appeared quite dark, even bright ring was subdued & seemed thicker than normal. Drawing." NASA catalog weight=3. NASA catalog ID #1028. ALPO/BAA weight=1.

Figure 4 Mare Tranquillitatis on 2023 Oct 23 UT 07:31-07:35 as imaged my Maurice Collins with north towards the top.

Contrary to what Farrant saw, Proclus actually looks quite bright in Fig 4. I think we shall leave the weight at 1 for now. Perhaps it's a libration issue which might have made the slopes on the illuminated walls less bright and less distinct back in 1967? Future observations at a similar libration could help solve this.

Jansen E: On 2023 Oct 04 UT 07:33 Rik Hill (ALPO/BAA) imaged Posidonius and Mare Serenitatis, but on the bottom edge of his image was Jansen E under similar illumination to the following lunar schedule request:

BAA Request: On 2013 Aug 26 Peter Grego observed a dark patch just east of Jansen E. He had not seen this before, therefore it is important to repeat this observation under similar illumination conditions. It may be a buried crater? Ideally suited to scopes of aperture 8" or larger. Please send any high resolution images, detailed sketches, or visual descriptions to: a t c @ a b e r . a c. u k .

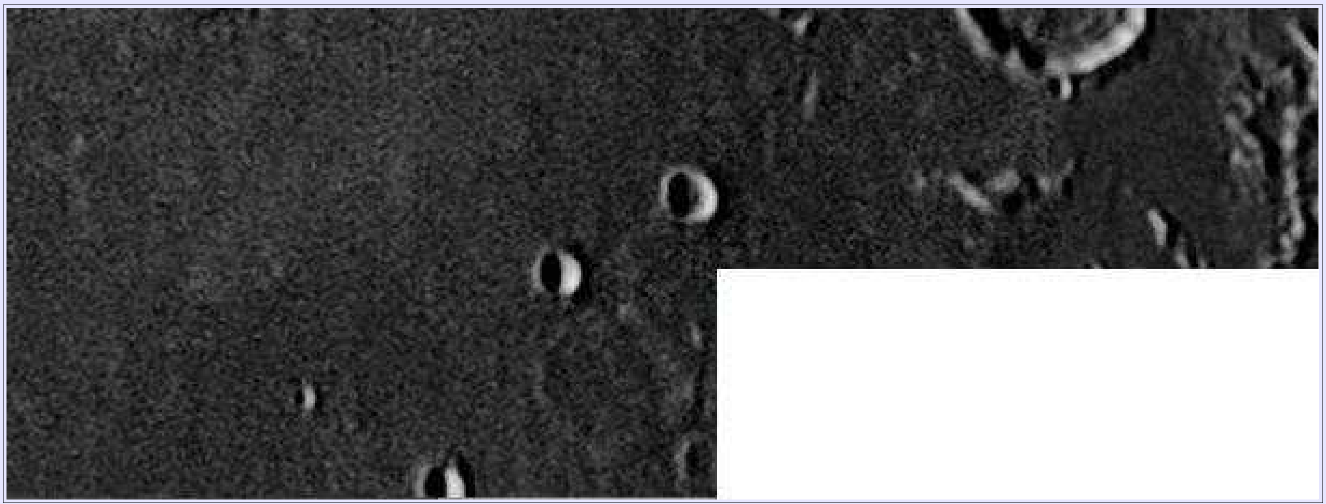

Figure 5. 2023 Oct 04 UT 07:33 An enlargement of the original image by Rik Hill with north towards the top. Jansen E is the crater on the bottom edge about 1/3rd of the way from the left to the right.

Examining Fig 5 reveals just a sharp rim black shadow on the east of Jansen E, and no dusky dark area extending further to the east that was reported by Peter Grego back in 2013. We have covered this report before in the 2013 Oct and 2018 Oct newsletters, and will leave the TLP weight of 1 as it is for now.

Herodotus: On 2023 Oct 26 UT 20:55-21:20 Trevor Smith (BAA) Observed visually this crater under similar illumination to the following report:

On 1965 Jun 12 at UT > 00:00 an unknown observer (Porta?) reported that the area of Herodotus and the Cobra Head expanded and the colour went to rose. The next night the floor was normal. In filters, phenomenon accentuated in orange. The Cameron 1978 catalog ID=880 and weight=3. The ALPO/BAA weight=2.

Trevor noticed that the crater had a slight, albeit noticeable pink/orange hue on the western floor and the interior of the western rim. He thinks this was probably related to atmospheric conditions, but at the same time could not see similar examples of colour elsewhere in that part of the Moon? Trevor was using a 16" Newtonian under Antoniadi IV seeing conditions. We shall keep the ALPO/BAA weight of the 19675 report at 2 for now.

General Information: For repeat illumination (and a few repeat libration) observations for the coming month - these can be found on the following web site: http://users.aber.ac.uk/atc/lunar_schedule.htm . 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 January circular should reach the Director or Editor by the 27th November 2023 at the addresses show below – Thanks!

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