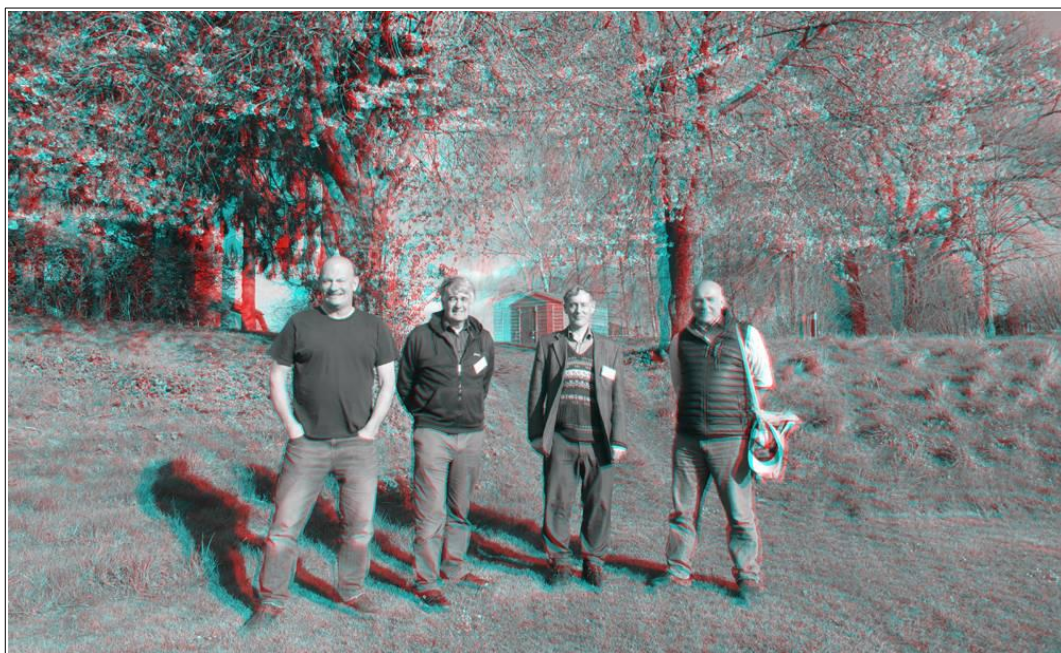


## Editorial

By Tony Cook.

It was a real pleasure, after nearly two years of, lock down, to meet so many BAA and Lunar Section members at the Lunar Section Meeting at Winchester, Southern England, held on Saturday 9<sup>th</sup> April 2022. The meeting occupied the afternoon programme of the residential Winchester weekend. We had a head count of some 80+ in the audience, and it was nice to see no empty seats. I would like to thank our speakers for the time and trouble that they went to prepare and give their talks, and for being on the receiving end of questions from the audience during the panel meeting at the end. I am hoping to have an account of the meeting ready by the next circular, and some of the lecture slides may be appearing on the Lunar Section website in the near future.



The 2022 BAA Lunar Section Speakers – From Left to Right: Nick James, Tim Haymes, Tony Cook and Barry Fitz-Gerald. Note that this is a stereo anaglyph image, so if you put a red filter over the left eye and a blue/green filter over the right eye, you should get a 3D view.

At the meeting I talked about some past BAA projects as well as current ones. I also floated the ideas of four new possible projects: the Basin and Buried Crater Project, Impact Flash Observing, Lunar Light and Dark Spots, and Volcanic Dome Hunting. We will introduce the first one, in this circular and see if it sparks any interest. The other projects we will start up in the next few months – though if you are especially interested, email me about impact flash observing, Barry Fitzgerald about light and dark lunar spots, and Raff Lena over lunar domes, to find out how you could contribute. As we have seen in the past some projects thrive, and others

fizzle out, so we shall wait and see what happens – the ball is in your court!

Finally, there will be a total lunar eclipse on May 16<sup>th</sup>, with the Moon starting totality at 03:29 UT and ending at 04:54 UT, with mid totality occurring at 04:11 UT. First contact (U1) of the umbra is at 02:28 and the last contact (U4) is at 05:55 UT. The Penumbral phase of the eclipse starts (P1) at 01:32 UT and ends (P4) at 06:51 UT. From the UK it is really not a favourable eclipse as the Moon sets at 04:10 UT and it will be low down on the SW with first contact starting when the Moon is a mere 10° above the horizon. All altitudes are calculated for Birmingham, so going further south and west may help slightly. Anyway, if you do manage to capture images or make sketches, please email them into us for the next circular.

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### Observations Received.

Observations have been received from the following: Alexander Vandenbohede, Bill Leatherbarrow, K.C.Pau, David Finnigan, John Tipping, Leo Aerts, Rik Hill, Rod Lyon, Trevor Pitt and Paul Abel .

### Heraclitus.

This image of Heraclitus (Fig.1) was taken by Alexander Vandenbohede on 2022 Apr 09 UT20:20 (Instrument details given in the image) shows this crater to have an elongated central ridge. Another crater, Schiller has something similar too, and that is a very elongated glancing blow impact crater. So, taking a closer look at the outline of Heraclitus, we see that it is 110 km long x 70 km wide, and so it too maybe a glancing blow or oblique impact crater. Alternatively, the ridge maybe the co-joining three overlapping, but heavily degraded impact craters?



Fig.1 Heraclitus by Alexander Vandenbohede .



### **Birt and Rupes Recta.**

Bill Leatherbarrow sent us this incredible image of sunrise of Birt and Rupes Recta, taken on 2022 Apr 09 UT 19:21 at a colongitude of 9.3°. U-IR filter used (Fig.2). This is an especially topical image, as apart from showing the double crater Birt, and the Rupes Recta (Old name Straight Wall with Stagg's Head at southern end), it also shows the remains of a buried crater without an official IAU name that contains both Birt and Rupes Recta.

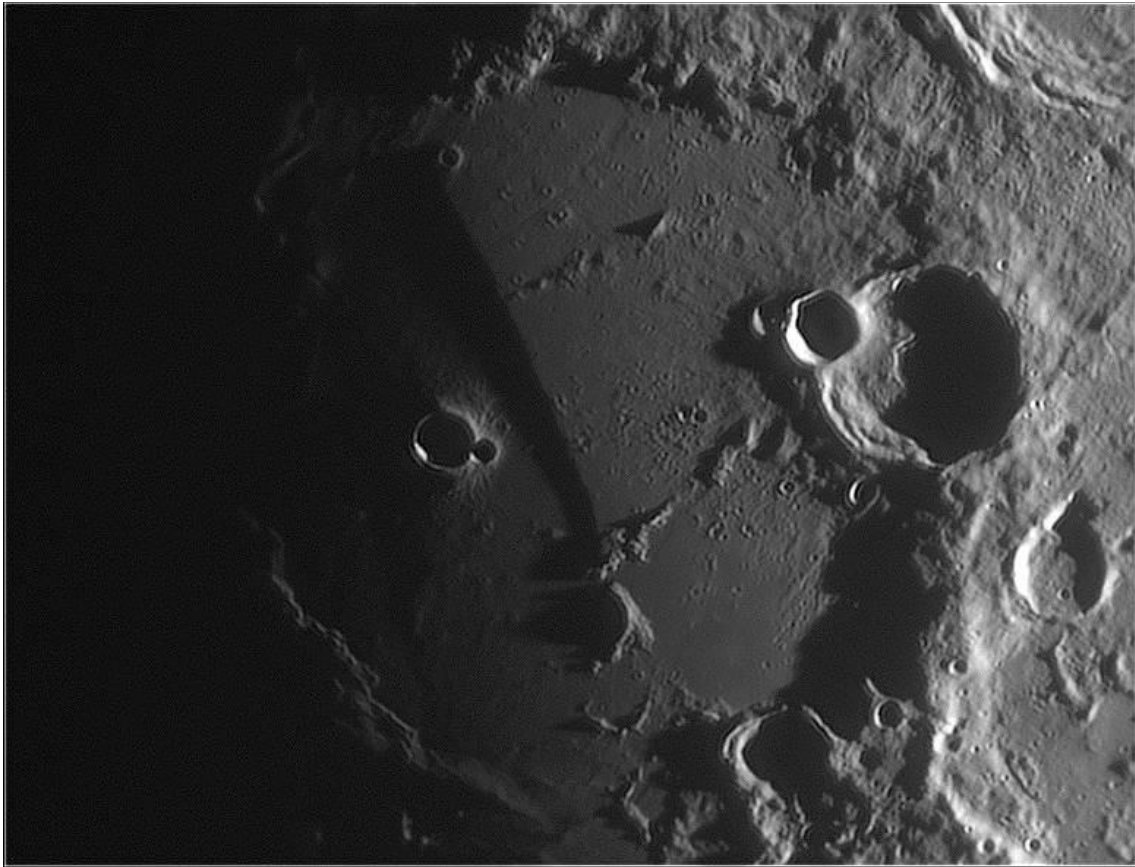


Fig.2 Birt and Rupes Recta by Bill Leatherbarrow.

### **Clavius by Rik Hill.**

Rik comments: The monster crater on the left side is the 231km diameter Clavius, one of the larger craters on the nearside of the Moon (Fig.3) . It has a fabulous arc of smaller craters on its floor starting with Rutherford (56km) on the bottom wall of Clavius up to Clavius-D (28km) above it, then farther on is Clavius-C (21km) and next is Clavius-N (13km) ending with Clavius-J (12km). This distinctive arc of craters makes Clavius very identifiable. Notice the radial streaks of impact ejecta from Rutherford across the floor of the great crater. Also notice the small piece of a flat ridge catching the first sunlight just to the right of Rutherford and next to it on the Clavius crater wall is an odd little wisp that is a breach in the wall itself as seen on the LROC QuickMap. Below Clavius is the shadow filled Blancanus and further below is the spectacular crater Moretus with its beautifully terraced walls and clear central peak, very like Tycho just north of Clavius.

Above left of Moretus is Gruemberger (97km) and to the right of that is Cysatus (51km). Then to the right of Moretus is Curtius (99km). North of Curtius, just above the mid-line of the image, is the flat floored crater Zach (73km). Above right of Zach is a curious gathering of merged and flooded craters. It's not named but is still fascinating and intricate in detail. One of those unnamed treasure you can find all over the Moon!

This image was made from pieces of 3 images each of which was a stack of 1800 frame AVIs using AVIStack2 (IDL). Post stacking processing was done with GIMP and IrfanView. Enjoy, - Rik

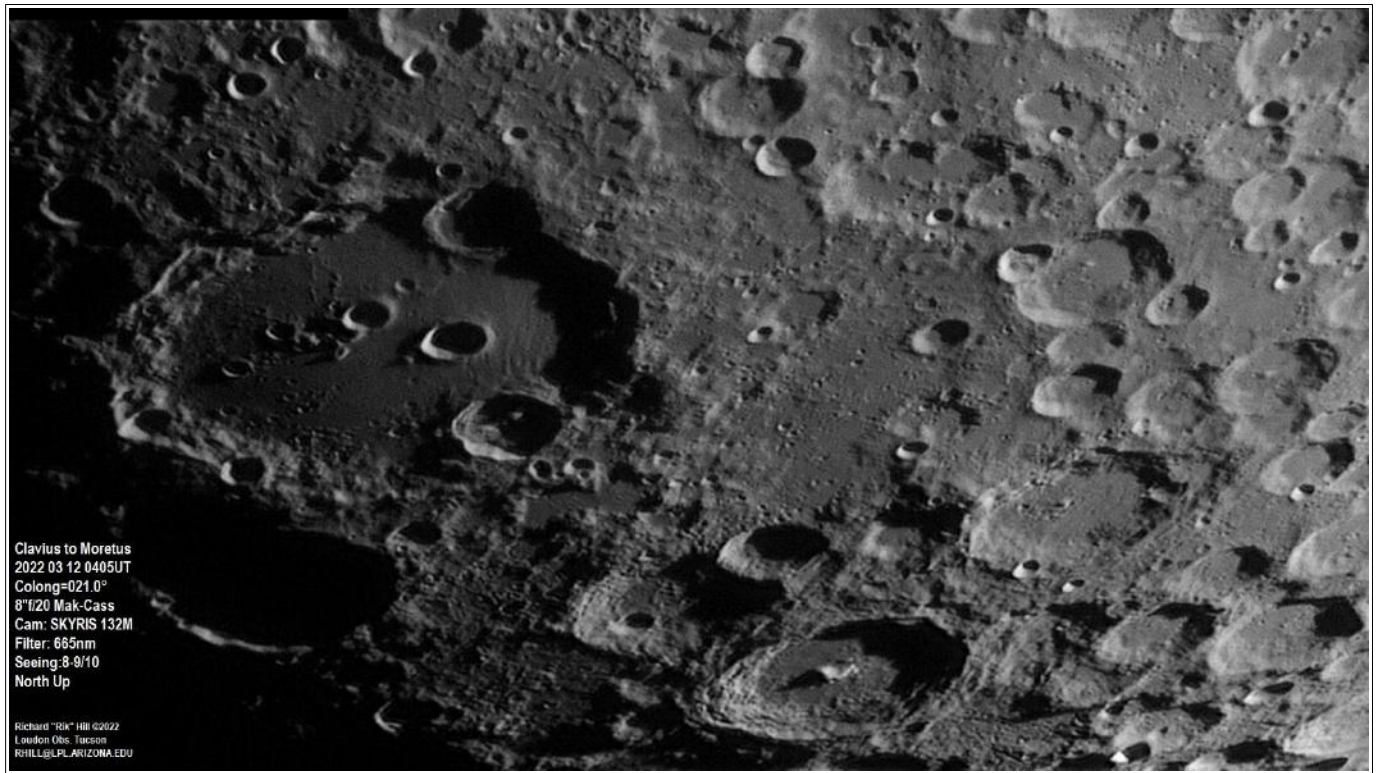


Fig.3 Clavius by Rik Hill.

### Lacus Mortis.

David Finnigan sent in this nice image (Fig.4) of this part buried (on one side), part visible, 160 km diameter hexagonal floor fractured, lava flooded, crater. Near the centre of this area is the 40 km diameter crater Burg. In David's image you can see three wrinkle ridges, two of which are radial, and at least one rille on the floor. Details about equipment used, date, time can be found in David's image.

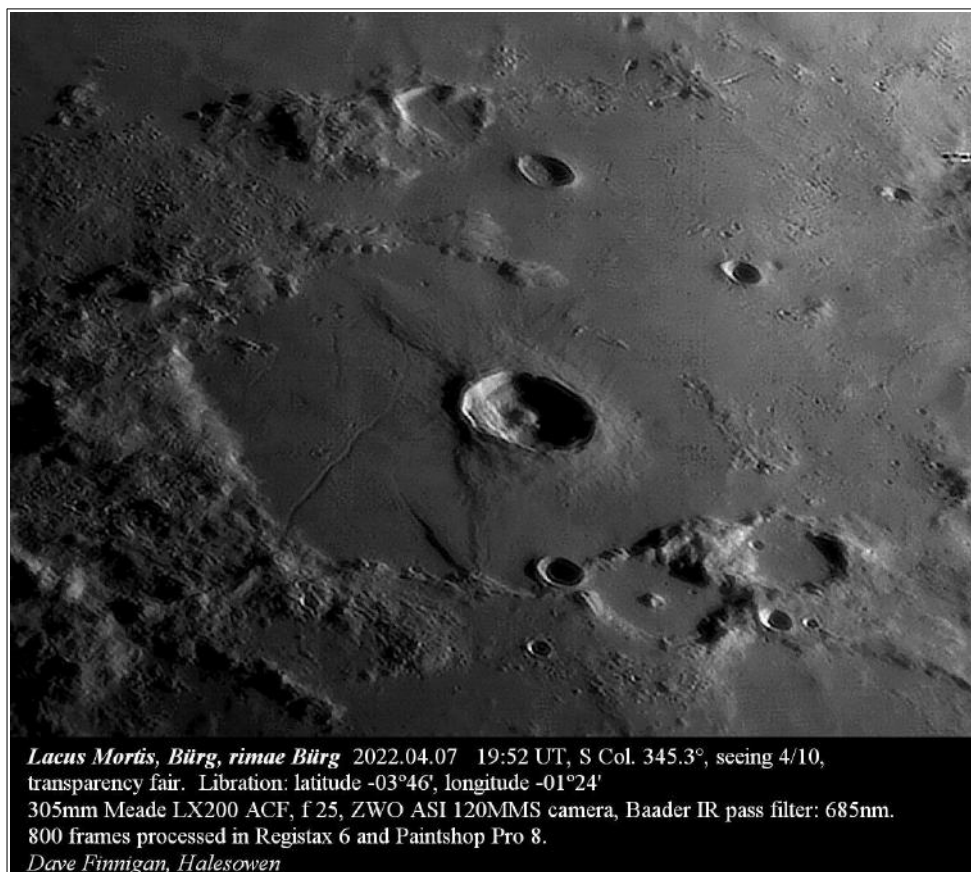


Fig.4 Lacus Mortis by David Finnigan

### **Montes Apenninus.**

K.C. Pau has sent in this spectacular view of sunrise over the eastern rim of the Imbrium Basin (Fig.5).



Fig.5 Montes Apenninus by K.C. Pau.

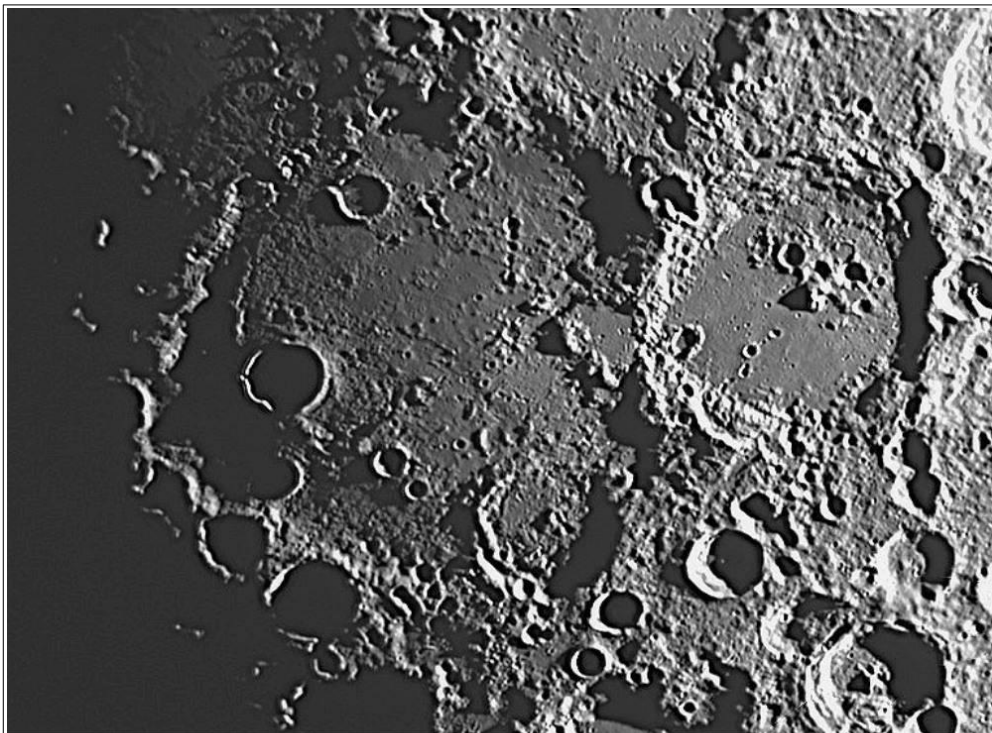
The longest shadow extends more than 180 km. The image was taken on 2022 Mar 10 UT 12:37 using a 250 mm f/6 Newtonian with x2.5 Barlow and a QHYCCD290M camera. Just imagine future astronauts on the Moon in this region at sunrise on the edge of one of these shadows stepping in and out of the edges of these shadows – actually it is not as simple as this as the Sun has an angular diameter of  $0.5^\circ$  so they would have to walk about 15 km in a north-south direction across the edge of one of these shadow spires for the sunlight to go from nothing to the full – such is the blurry nature of lunar shadow edges.

(Correction – my apologies to K.C. as I misspelt his name in the last LSC.)

### **Deslandres and Walther.**

Rod Lyon captured this superb image of the 227 km diameter heavily degraded Deslandres crater (Fig.6). The floor is partly lava filled. Walther crater overlies Deslandres on the eastern side, and so must be younger, and likewise Lexell on the SE corner. A couple of catena, or more likely secondary crater chains, can be seen on the floor of Deslandres. Date, UT and instrument details etc can be seen on the image.





**Deslandres and Walther 2022.04.09 - 19.00 UT**

300mm Meade LX90, ASI 224MC Camera with Pro Planet 742nm I-R Pass Filter.  
600/3,000 Frames. Seeing: 8/10, steady.

Rod Lyon

Fig.6 Deslandres and Walther by Rod Lyon.

### **Ptolemaeus.**

John Tipping took this nice view of this 154 km lava flooded crater (Fig.7).

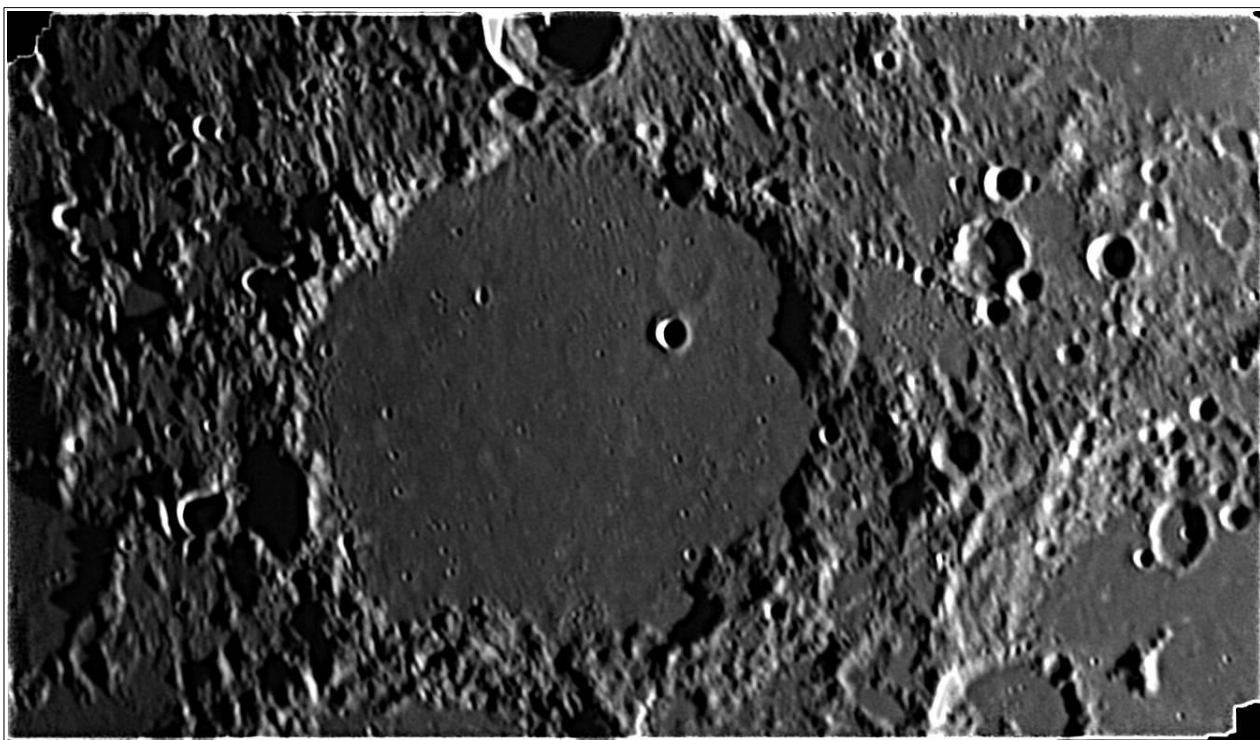


Fig.7 Ptolemaeus by John Tipping.

An obvious crater, Ammonius, 9 km in diameter, can be seen in the NW interior, and to the NW of this is a buried crater, Ptolemaeus B, which is about 17 km across. The floor of Ptolemaeus slopes from high in the west to low in the east, a drop of about 160 m. There is also a drop in the N-S direction of about 100 m, the high

being on the north side. Another thing you may notice about this image, certainly in the surrounding highland texture are SSE-NNW ridge like structures, visible to the east and to the west of the crater, and incising on the NW rim. Without being certain, one could speculate that these might be impact basin ejecta as a few vaguely resemble crater catena (co-joined overlapping craters). John took this image on 2022 Apr 09 UT 20:56.

### **Oceanus Procellarum.**



Fig.8 Oceanus Procellarum by Trevor Pitt

Trevor Pitt has sent in this nice colour enhanced image of Oceanus Procellarum (Fig.8). You can see that Aristarchus has a nice blue colour and both Kepler and Copernicus are relatively yellow-orange in natural surface colours, with light orange-yellow ejecta blankets. For a number of years, it was thought that Oceanus Procellarum was a giant impact basin, and Ewen Whitaker made an interesting case for this, but it is now generally regarded to just be the largest lava flooded area on the lunar surface, perhaps overspilling several underlying basins. The image was taken on 2022 Apr 13 UT 22:22 with a ZWO 120MC camera.

### **Montes Teneriffe.**

It is sometimes nice to see the instruments that our members have used to capture their images. Although Leo Aerts has sent in some pretty amazingly detailed images this month, I have chosen this one to show what can be achieved with a modest 18cm Maksutov Newtonian (Fig.9). Apart from the Montes Teneriffe “Y” shaped mountain range, you can also see the lava flooded Plato crater with a nice sinuous rille coming off its western edge, and the Imbrium ejecta scour mark of Vallis Alpes in the top right. Two mountain peaks, Mons Pico and Mons Piton can be seen – these are often very spectacular at sunrise, with sunward facing slopes lighting up very bright. Instrument, date and time details are on the image.



Fig.9 Montes Teneriffe by Leo Aerts.

### Hansteen.

Paul Abel sketched Hansteen crater, which is on the border of Oceanus Procellarum (Fig.10). The terracing on the wall is evident and the western walls cast long shadows. The drawing was made on March 14<sup>th</sup> 2022. Paul notes that the seeing, which already was poor, broke down at around 2300UT, which is part of the reason why the sketch does not show as much detail as he would usually depict. Hansteen is 45 km in diameter, somewhat polygonal in shape and has extensive concentric floor fractures. The north east corner of the floor has some dark lava infill, though its not visible here due to shadow.



Fig.10 Hansteen by Paul Abel.



## Correspondence Received:

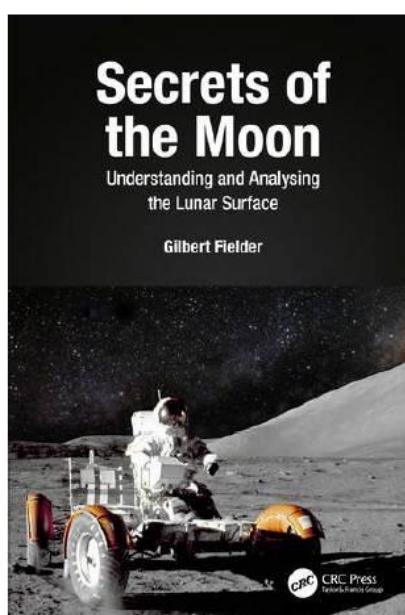
### MOON BLINK WANTED!

Martin Edmunds, from Plymouth University emailed to ask: *“Philip Jennings advised I contact you; I have just placed a small add in the BAA Journal (below) and he suggested it may be possible to include something similar in a future Lunar Circular? - Wanted: Moonblink / Crater Extinction Device. I am interested in devices in any condition. Please contact Martin Telephone 07544683997 Many thanks (and fingers crossed!)”*.

Martin Edmunds ([martin.edmonds@plymouth.ac.uk](mailto:martin.edmonds@plymouth.ac.uk))

### SECRETS OF THE MOON.

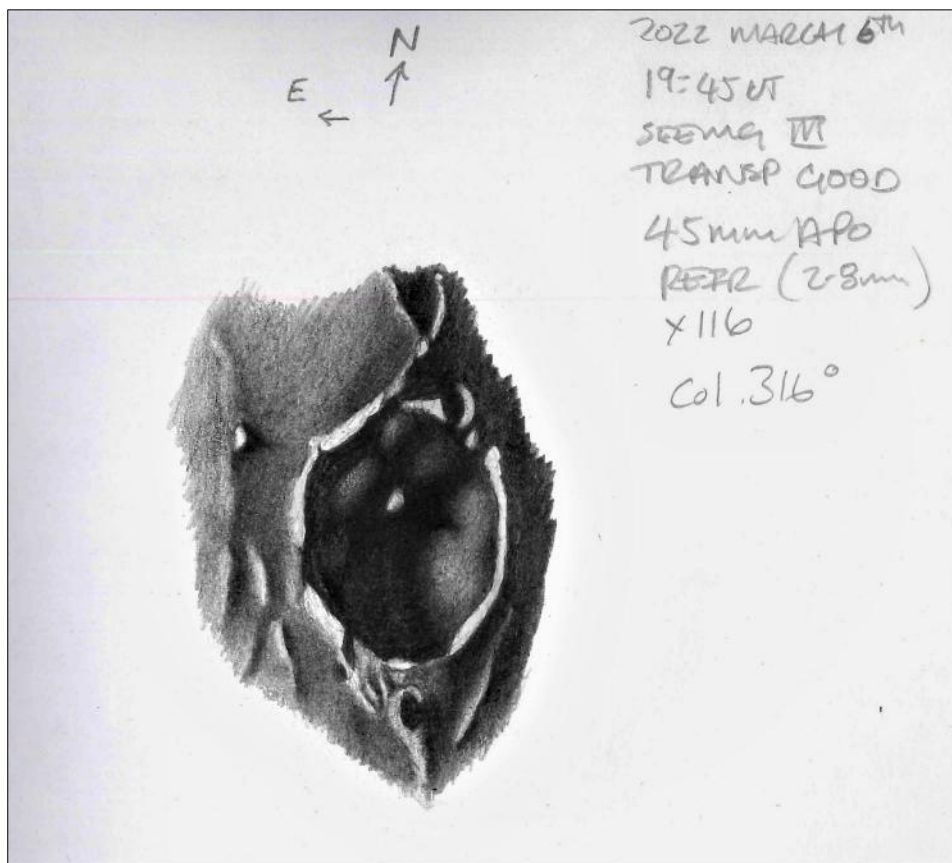
Prof Gilbert Fielder, Reader Emeritus at Lancaster University and a past director of the Lunar Section (from the 1960's), has written in to let us know of his new book: “Secrets of the Moon” – published January 2022, by Cambridge University Press, 244 pages. ISBN: 978-1-0320-1105-9 £140 / \$180 (20% off discount code FMQ13 if ordered on-line).



This covers: “1. Preparatory Studies 2. Studies at Manchester and Pic-du-Midi 3. Wrinkle Ridges 4. The Straight Wall 5. Thoughts on Mare Imbrium 6. The Apparent Acceleration of the Moon 7. The Slowing Rotation of the Earth 8. The Receding Moon 9. Distorted Craters 10. The Lunar Grid System 11. Mapping the Grid around the Whole of the Moon 12. Faulting and the Rotation of the Moon 13. The Origin of the Lunar Grid System 14. Melting in the Moon 15. The Origin of the Moon 16. Fine Lineaments and their Significance 17. The Ages of the Lunar Surface Features 18. The Origins of Small Craters 19. The Proportion of Endocraters to Impact Craters 20. The Origin of Crater-chains in Grid Fractures 21. The Origins of Small Craters in a Lava Flow 22. Small Double Craters 23. Double Craters and the Depth of Compaction of the Regolith 24. Dating the Mare Flows 25. Studies of Large Craters 26. The Ray-Craters Tycho, Copernicus and Aristarchus 27. Unexpected Volcanic Flows 28. Volcanic Tumuli of the Floor of Tycho 29. The Unusual Rocks of Tycho, Copernicus and Aristarchus 30. Cracks in Tycho and Kilawea 31. Central Peaks and the Impact Process 32. The Crater Aristarchus 33. The Crater Copernicus 34. Dating the Lavas of Tycho and Aristarchus 35. The Origin of the Lavas in Impact Craters 36. Tensions in the Lunar Crust 37. Is there any current Volcanic Activity on the Moon? 38. Maria, Rilles and Wrinkle Ridges 39. Maria and Mascons 40. Ghost Craters and Elementary Rings 41. The Nature of the Lamont Complex 42. Terrestrial Ring Complexes and their Origin 43. Are there Ring Dykes on the Moon? 44. The Origins of Large Lunar Craters in General 45. Return to the Moon.”

**A Note on Taruntius,  
By Nigel Longshaw.**

I was interested in Dr. Paul Abel's sketch of Taruntius in the April Circular as I was observing the feature on the same evening using my Borg 45mm ED refractor. My own sketch, taken at the eyepiece around one and a half hours later than Dr. Abel's indicates the advancement of lighting. In my case, like Dr. Abel, I found seeing conditions very poor and I had difficulty fixing any of the finer details. Therefore, the attached can only be judged as a brief overview. Even so my sketch indicates a shortening of the shadow from the central peak and a lighter patch to the northeast of the central peak. This probably represents the features just catching the first light in Dr. Abel's drawing. The colongitude at the time of my observation was 316 degrees and I was using a power of x116.



The evening coincided with a repeat TLP report of 1980 April 18<sup>th</sup> when the floor of Taruntius was reported to change from black to light grey over a period of about 30 seconds. Both my own and Dr. Abel's drawings indicate how shadows can recede quite rapidly to reveal the crater floor. Taruntius is a flooded crater with relatively low walls which might contribute to the apparent speed at which the interior shadows appear to dissipate but it's difficult to perceive that this would happen over such a short time frame suggested by the TLP report.

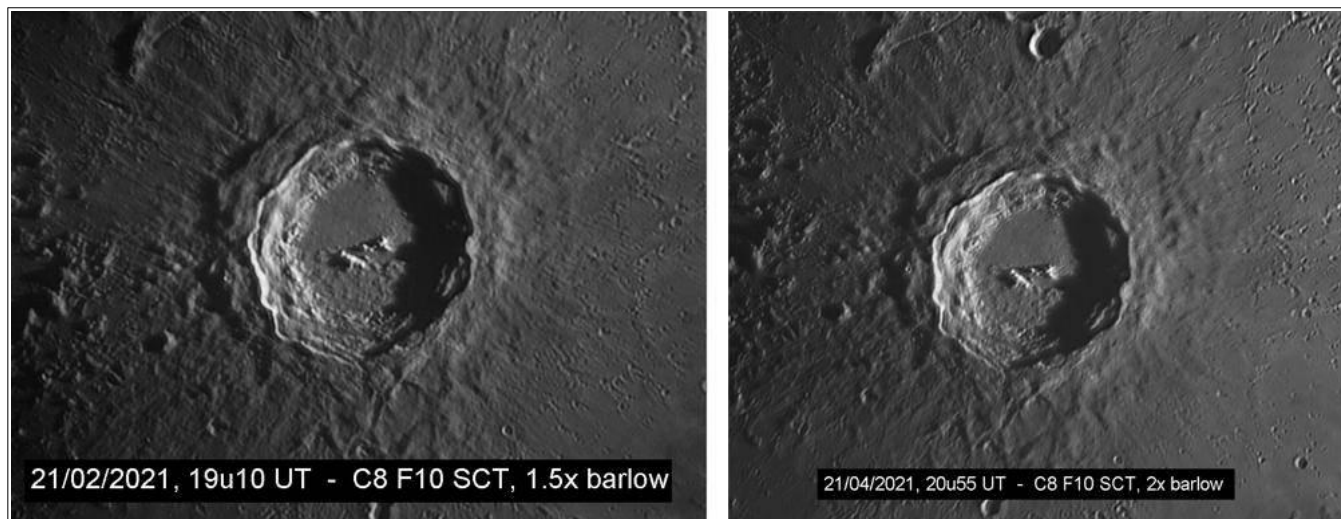
T.G.E.Elger gives a notable account of Taruntius, with a drawing of the formation under higher illumination, in the Journal of the Liverpool Astronomical Society Vol. 5 part 7 p.212-214.

**The hooked shadow of Copernicus reported by Thomes Elger,  
By Alexander Vandenbohede**

I was intrigued by the hook-shaped shadow in Copernicus which was shown in the drawing by Elger. So, I searched in my Copernicus pictures and found comparisons.

The first picture dates from 21/02/2021. There is a nice shadow originating from the large scallop on the eastern rim. On the floor of Copernicus, and just southwest of the mentioned shadow, there are a number of hills (part

of the hummocky floor) that cast a small shadow. The hills have a height of about 350 m, connecting the shadow of the large scallop with the shadow of these hills and we have the hook seen on Elger's drawing. So, I agree with Bill's explanation.

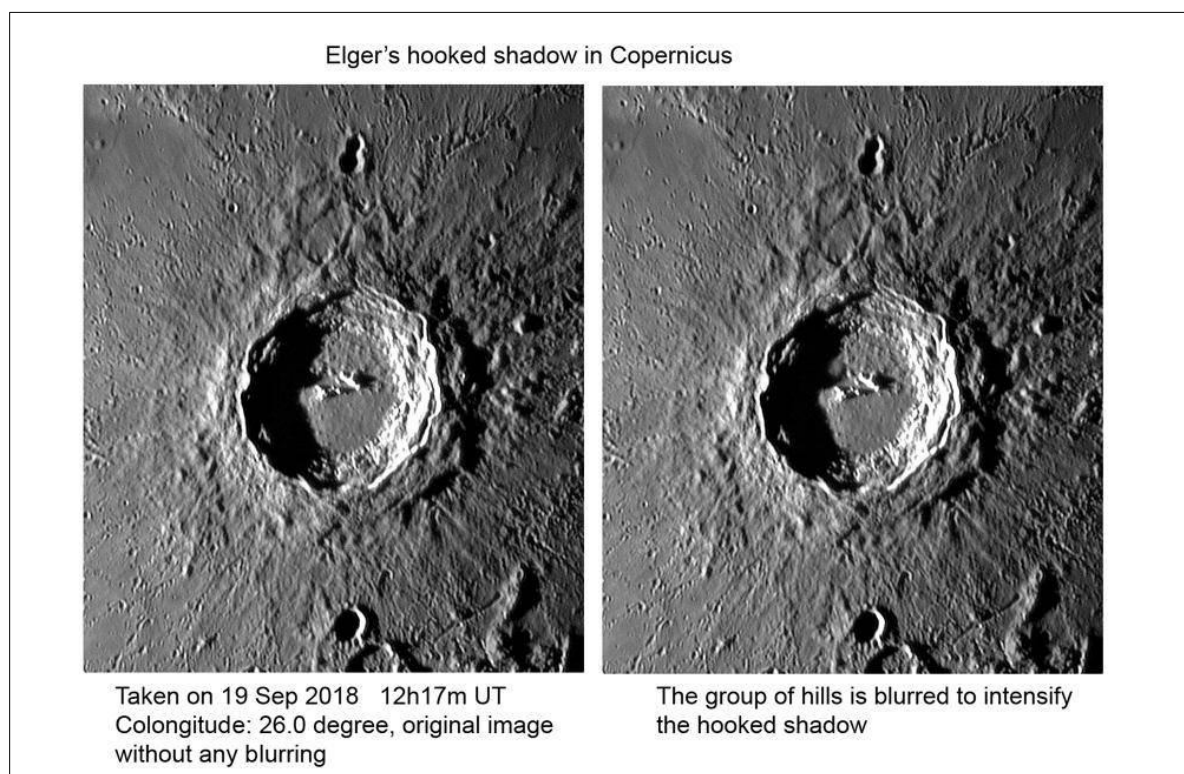


The second image dates from 21/04/2021 and shows almost the same. Observing only a few hours earlier should have resulted in the same view that Elger had, I think.

### A second smaller hook in Copernicus,

By K.C. Pau.

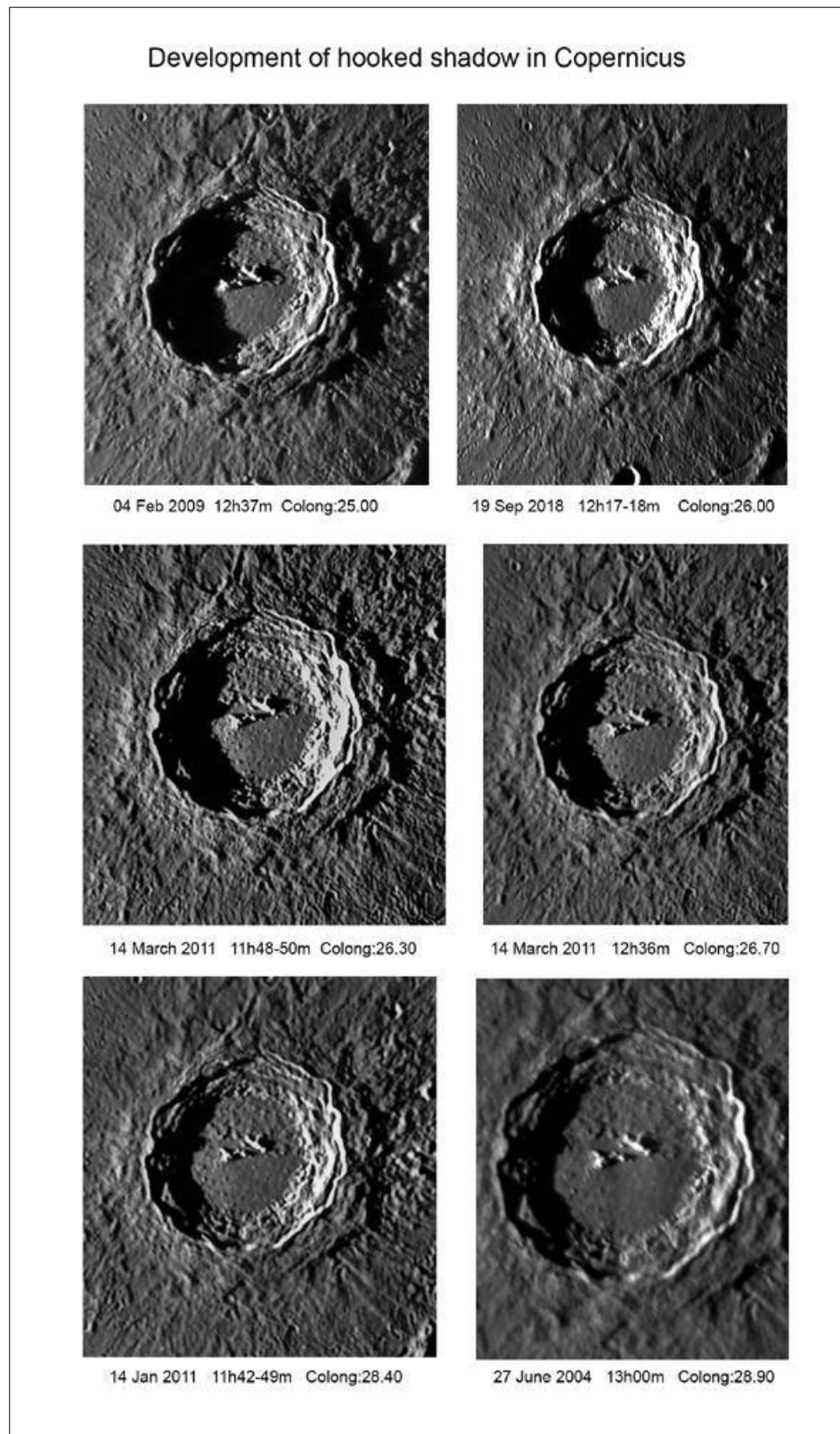
I enclose a photo showing the Elger's hooked shadow in Copernicus, that is mentioned by Bill Leatherbarrow in April 2022 LSC issue. My photo is taken on 19 September 2018 at 12h17m UT with 250mm f/6 Newtonian reflector + 2.5X Barlow + QHYCCD290M camera and colongitude is 26.0 degree, which is quite close to Elger's 26.4 degree. The main part of the hook is cast by the scallop feature on the eastern rim of Copernicus, the other part is the short shadow cast by a group of small hills nearby. The hills are blurred in one photo in



order to enhance the appearance of the hook and to simulate the condition that Elger observed. I think Elger's

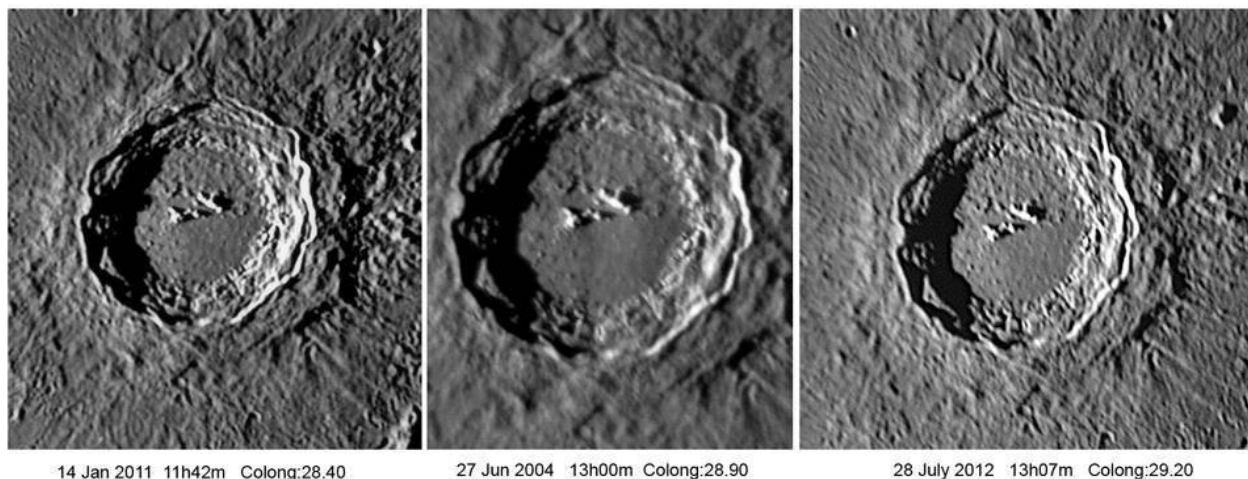


telescope could resolve only part of the hill group so that the group appeared as a dark spot on his drawing.



I have created a series of photos to show the development of Elger's hooked shadow for your information. Moreover, I find another small hooked shadow also cast by the scallop but under higher solar illumination. I also include these images in this mail.

### Development of a small hooked shadow in Copernicus



14 Jan 2011 11h42m Colong:28.40

27 Jun 2004 13h00m Colong:28.90

28 July 2012 13h07m Colong:29.20

### Mare Boundaries.

Trevor Pitt emailed in to ask about where to find out where mare regions start and end on the Moon, I guess as some merge into each other e.g., mare Serenitatis and Mare Tranquilitatis.

The best source I could find was on the NASA/ACT QuickMap website: <https://quickmap.lroc.asu.edu/> and if you click on the Layers button in the top left (three parallel lines), then Geological Features & Maps, then click on Mare Boundaries, it will show you exactly where the boundaries are, though the division between adjoining mare regions sometimes is a bit artificial.

### Tony (Director).

### Lunar Occultations May 2022

By Tim Haymes.

### Time capsule: 50 year ago in the 1972 issue:

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

- Several observers report a fading occultation (SAO 76152) with possible colour changes.
- L Fitton: Thermo-Luminescence as a possible source of TLP – discussed.

### A fading occultation of SAO 76152 on 1973 March 19. LSC Vol7, No 5 (May 1972)

REPORT ON OCCULTATIONS; FADING OF SAO 76152.

In my "From the Director" notes I have said something about the occultation network we are setting out to establish. Therefore, this separate note is a personal one. It may or may not be significant.

On March 19 I was observing occultations in the Pleiades, using x72 and x96 on my 12 $\frac{1}{2}$ in. refl. Various other observers were with me at Selsey, including Lawrence Anslow, who was using my 3in. refractor (x 72). One star due for occultation was SAO 76152. We watched it carefully, and then, to my surprise, I saw it fade for something like half a second before immersion. Simultaneously, Anslow called out 'it faded'. There was no flicker; it just faded out quite perceptibly. My estimate of the time may have been rather too short, and I am prepared to accept anything up to 0.7 sec. Frankly, I was taken unawares.

I thought that the probable cause was that the star may be a close binary; and interesting though it was, I was not unduly alerted. Then, some days later, I had a letter from the Swiss observer Walter Bramli, who had been observing from Wald (Switzerland) with x50 on his 6in. refl. He wrote:

(Contd. P. 39)

### FADING OF SAO 76152 (Contd. from p38)

"The star SAO 076152 became reddish shortly before its disappearance. The amazing thing was, that the star did not go out at once as it does usually, but vanished slowly, taking about 0.7 seconds. We do not know, of course, the reason of this unusual phenomenon. Is it possible that the star was surrounded by a cover of gas? Another reflection: was there a cloud of gas or dust at the edge of the Moon at that time? Was there an eruption on the Moon?"

I admit that I was initially sceptical about this. However, I wrote Mr. L.V. Morrison at Herstmonceux, and told him about the two observations. He writes that the star is not listed as being double by Aiken, Lick or Eichhorn; neither is it a spectroscopic binary. If the fading lasted for 0.7 seconds, the separation would have to be 0".3, in which case it would be listed as a double by Aiken. Mr. Morrison goes on to tell me that about two years ago he listed some of the observations of occultations where fading had been reported and there was no evidence of the star being double. I have asked whether he will be kind enough to send full details - notably the position angle and libration where the star disappeared. I entirely agree with him that the matter needs further investigation, and this is something that we in the Section can tackle.

Meanwhile, I hope that occultation observers will keep a very sharp watch for any further fades. Again, the greatest caution is needed; be sure of your observation before reporting it - but it is possibly very important. I will have more to say about it at the Section Meeting on May 20.

Patrick Moore.

=====

### **Comment by Tim Haymes on SAO 76152**

The star is marked in SkyMap (Chris Marriott) as a double COU560, with PA 359 and 0.3 arcsec (1996), first measured in 1970 (WDS)

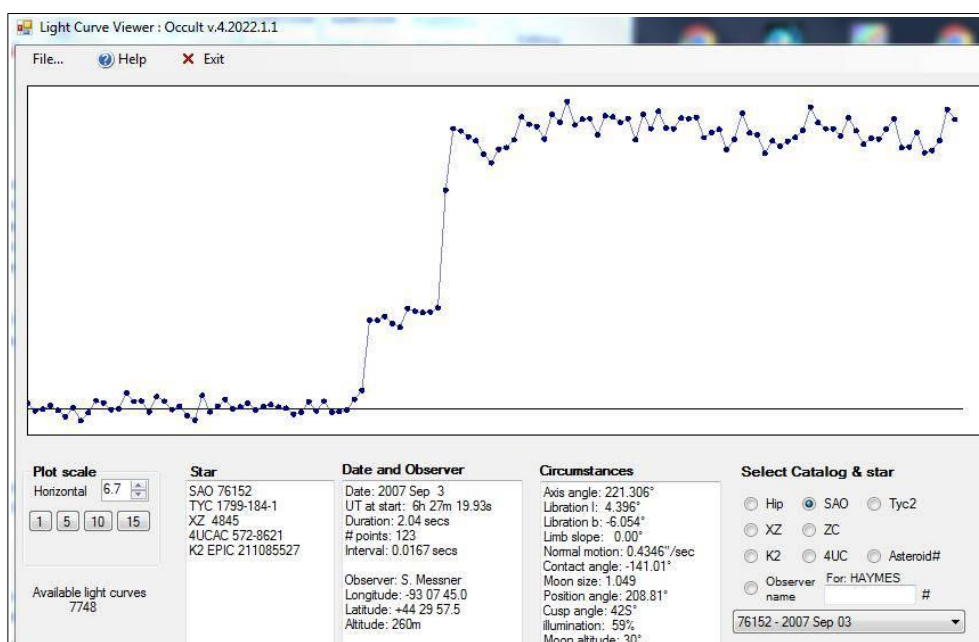
This report is a clear observation of a double star (fade) observed from a dual station (Selsey) and independently confirmed by two Swiss observers: W. Brandli and A. Wild. The occult database contains three observations of SAO 76152 from Switzerland on this date, but not the Selsey timings. The observation by Wild appears twice with different times. The time difference being 0.4 sec, so its likely one timing had the Personal Equation subtracted and was submitted twice. Occult4 db doesn't record any suspected double star behaviour in early observations such as these.

*Previous (UK) observation of SAO 76152 (recorded in Occult4) were made by:*

G. Kirby (Weymouth) - 1972 Mar 19.

Unknown(s) (Weybridge area SW London) - 7 observations 1972 Mar 19 - possibly a Society event?

S. Pattinson (S Croyden) - 1989 Sep 19





The most recent observation of SAO76152 are in 2006 to 2009. Steve Messner (US) observed on 2009 Aug 14 with a video camera. He also recorded the double on 2007 Sep3, and the light curve shows a step reappearance at 60 fps, duration 170 ms.

### **The next series of occultations of S76152**

These begin in 2024, and the UK has a graze event on 2025 Apr 1 2030UT, and again on 2025 Sep12 but at low elevation in the evening. Then a total occultation occurs on 2025 Dec 04. Another graze (across Scotland) is predicted for 2026 Jan 27. A few more total occs see out the series. It would be nice to report another *fade* event, first reported by the late Sir Patrick Moore from his garden in Selsey.

### **Winchester Weekend 2022.**

It was a pleasure to meet with LS members again. The presentation I gave at the Lunar Section Meeting on lunar occultation observation, will become available as pdf. More anon.

Pete and Paul's Challenge #2 is to observe the Lunar Eclipse on May 16<sup>th</sup>. The Moon enters the Umbra (U1) at 02:27:53 UT (0328 BST) and I have included stars occulted in the Earth's shadow this month.

### **Observing Opportunities: May 16<sup>th</sup> Lunar Eclipse**

The moon will be in Libra (+8 / 224) at commencement of the Umbral phase so occultations will be a challenge even if you can see that area of sky. From the writers garden a mobile instrument will need to be set up and its position located on Google Earth. TYC 6179-152-1 (mag 7.0) is the brightest star occulted during the eclipse. The ingress is at PA 106 degrees at 0311UT (0411BST).

### **Observations reported.**

**T. Haymes:** Seven DD events were timed on April 7<sup>th</sup> from Steeple Aston, OXON. The LSC predictions lists TU Gem and several other stars in this rich area. Occultations were timed with C11 and F6.3 focal reducer, QHY174mGPS camera in SER format at 25 fps; recorded with SharpCap. TU Gem was conspicuous in the camera and recorded at 200 fps (5ms exposure).

Ninth magnitude SAO78009 was occulted in close to graze conditions at the Northern Cusp. This was not expected, as I don't predict grazes of such faint stars. The graze zone was about 4 Km North of me. This event was total and no other phenomena were recorded. It could have been recorded at a graze site.



Above: SAO 78009 (9<sup>th</sup> mag) at the Northern cusp (video frame with C11)

**Brian Mills** (Hildenborough) writes to say he has some unreported observations, and hope to buy the WAT-910HX/RC. The availability of this excellent video camera is in short supply.

There is no time limit on past observations. Please send a summary to the sub-section and the main report to the European IOTA collector. If you are unfamiliar with this, then send the report to me (Tim Haymes) for checking, and I can forward the timings on your behalf - thank you for your observations.

### Occultation predictions for 2022 May (Times as other locations will +/- a few minutes)

E. Longitude - 1 18 47.1, Latitude 51 55 40.3. To magnitude 9.0

		day	Time		P	Star	Sp	Mag	Mag	%	Elon	Sun	Moon	CA	Notes	
yy	mmm	d	h	m	s	No		v	r	ill		Alt	Alt	Az	o	
22	May	3	20	36	4.6	D	76868	B5	8.0	7.9	8+	33	-9	16	289	36N
22	May	3	21	5	41.4	D	76885	F2	7.8	7.6	8+	33		12	294	50S
22	May	3	22	0	17.2	D	76911	G5	8.9	8.5	8+	34		5	304	55N
22	May	3	22	1	27.8	D	76916	B9	8.6	8.5	8+	34		5	304	80S
22	May	3	22	12	37.0	D	76915	K2	8.2	7.3	8+	34		3	306	23S
22	May	4	21	34	38.8	D	77682	B1	8.4	8.3	14+	44		16	291	34S
22	May	4	23	16	15.4	D	900	B1	4.8	4.9	15+	45		3	309	81N
R900 = 139 Tauri is double: ** 5.6 5.6 0.060" 221.0, dT = -0.09sec																
22	May	5	20	59	50.1	D	78708	A0	8.8	8.8	21+	55	-11	29	276	60S
22	May	5	21	39	50.8	D	78736	K2	8.4	7.8	22+	55		23	284	82S
22	May	5	21	59	25.5	D	78744	A0	8.5	8.4	22+	55		20	287	43S
22	May	5	22	6	47	m	78738	F0	8.7	8.5	22+	56		19	289	6N
22	May	5	23	17	52.4	D	78792	K0	8.3	7.7	22+	56		10	301	68N
22	May	5	23	47	53.2	D	78817	K7	8.6	7.8	22+	56		6	306	79N
22	May	6	0	1	31.2	D	78810	A3	8.0	7.8	22+	56		4	309	15N
22	May	8	0	26	58	m	80288	K5	8.6	8.2	40+	79		11	293	5N
22	May	8	20	23	26.6	d	80772	K5	8.7	7.9	48+	88	-6	50	229	83S
22	May	8	22	38	15	M	1390	G0	7.7*	7.4	49+	89		32	262	8N
22	May	8	23	8	47.7	D	1393	G7	6.5*	6.0	49+	89		27	268	50S
22	May	9	0	34	37.7	D	80842	F0	8.9	8.7	50+	90		14	284	44N
22	May	9	1	24	17.9	D	1400	F5	8.3*		50+	90		7	293	31S
22	May	9	20	32	50.2	D	98979	G5	8.3	7.8	58+	100	-7	51	214	36N
22	May	9	21	8	39.3	D	98983	K2	8.4	8.0	58+	100	-11	47	226	53S
22	May	10	0	13	34.9	D	99030	F8	8.8	8.4	60+	101		21	268	70S
22	May	11	1	42	41.5	D	99443	F8	8.5	8.2	70+	114		10	273	65S
22	May	11	1	52	36.1	D	1612	F5	7.3	7.1	70+	114		9	275	42N
22	May	11	20	34	19.3	D	119032	F5	8.4	8.2	78+	124	-7	44	180	28S
22	May	11	20	51	2.5	D	119045	K0	8.9	8.4	78+	124	-9	44	186	77S
22	May	11	21	14	52.1	D	119051	K0	8.8	8.2	78+	124	-11	43	194	63S
22	May	11	22	23	20.2	D	1709	K0	6.6	6.0	78+	124		38	215	87S
22	May	12	23	26	25	m	138889	A0	7.2	7.2	87+	137		31	217	8N
22	May	13	0	54	20.8	D	1821	F0	2.8		87+	138		21	238	58N
22	May	13	0	55	2.8	D	X 54027	F0	3.5	3.3	87+	138		21	238	58N
22	May	13	0	56	53.7	D	138918	F5	8.9	8.7	87+	138		20	238	71N
22	May	13	2	18	44	m	1825	G8	5.9	5.5	87+	139		9	255	3N
22	May	14	0	26	30.7	D	139377	K5	8.0	7.2	94+	151		24	217	71S
22	May	14	0	53	11.9	D	139383	G5	8.9	8.5	94+	151		21	224	60S
22	May	14	2	26	25.9	D	139408	G5	7.7	7.1	94+	152		9	244	19S
22	May	14	21	33	3.0	D	2053	A1	4.5	4.5	98+	163		22	158	47S
22	May	14	21	43	0.3	D	158492	M4	8.7	7.8	98+	163		23	161	37S
22	May	14	23	55	48.5	D	158530	G0	9.0	8.7	98+	164		23	195	67N
22	May	15	0	41	11.6	D	158546	K0	7.3	6.8	98+	164		21	206	68S
22	May	15	1	2	5.9	D	158557	A*	8.5	8.3	98+	164		19	211	87S
22	May	16	3	11	30.0	D	2207	A4	7.0	6.6	25E	179	-8	7	225	PA105
22	May	17	0	25	53.8	R	184337	B6	7.0	7.0	99-	168		14	174	61N
22	May	18	1	24	27.6	R	185438	G1	8.6	8.3	95-	153		11	174	45N
22	May	18	2	23	59.4	R	185463	F5	8.7	8.5	95-	153		11	187	44S
22	May	19	2	22	45.9	R	187063	B2	8.9	8.9	88-	139		10	172	85S
22	May	19	2	55	37.3	R	187089	B9	7.9	7.8	88-	139	-9	10	179	39S
22	May	20	2	43	24.5	R	188513	F2	8.6	8.4	79-	125	-10	10	163	58N
22	May	24	2	25	57.8	R	3458	K0	6.2*	5.5	36-	73	-11	2	107	39N
22	Jun	1	21	34	19.4	D	78468	A2	8.2	8.1	5+	26	-9	7	304	78S
78468 is double: ** 8.8 8.8 0.10" 90.0, dT = +0.18sec																
22	Jun	2	21	17	15.4	D	79351	B9	8.9	8.9	10+	37	-8	15	292	13S
22	Jun	3	22	58	45.4	D	80105	A0	7.9	7.9	17+	49		7	300	81N
22	Jun	4	21	11	22.7	D	80626	K0	8.7	8.1	24+	59	-7	27	270	34S
22	Jun	4	21	53	9.8	D	80648	K0	8.7	8.2	24+	59	-10	20	278	68S
22	Jun	5	0	6	44.8	D	80693	G0	8.4	8.1	25+	60		2	302	88N
22	Jun	5	21	29	40.5	D	1456	F2	8.4	8.2	33+	70	-8	28	262	47N

Key:

P = Phase (R or D), **R** = reappearance **D** = disappearance

M = Miss at this station, Gr = graze near this station (possible miss)

CA = Cusp angle measured from the North or South Cusp.

PA = Position Angle measured from the North though East for a Lunar Eclipse.

Mag(v)\* = asterisk indicates a light curve is available in Occult-4

Star No:

1/2/3/4 digits = Robertson Zodiacal catalogue (ZC)

5/6 digits = Smithsonian Astrophysical Observatory catalogue (SAO)

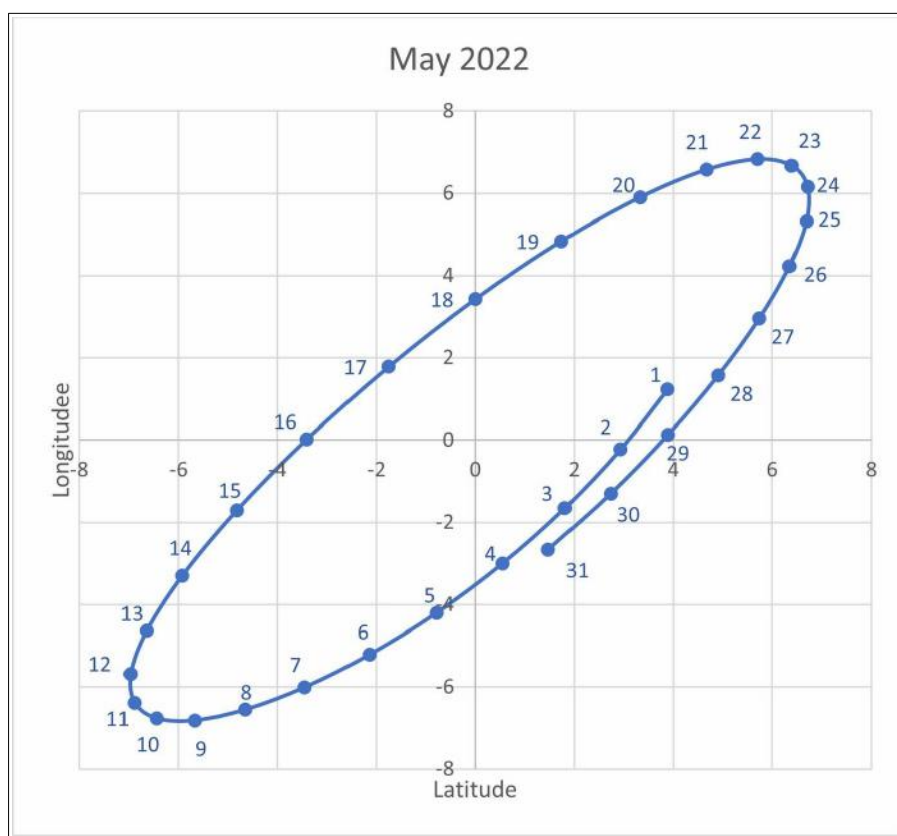
X denotes a star in the eXtended ZC/XC catalogue.

The ZC/XC/SAO nomenclature is used for Lunar work. The positions and proper motions of the stars in these catalogues are updated by Gaia. Please report timings to Tim Haymes in the Occult4 data format.

*Detailed predictions at your location for 1 year are available upon request. Ask the **Occultation Subsection***

**Coordinator:** tvh dot observatory at btinternet dot com

**Those interested in Grazes (only) – please indicate your travel radius in Km, and your home post code.**



Lunar Libration diagram for May 2022



## Basin and Buried Crater Project

By Tony Cook.

Have you ever come across the 500 km diameter “Werner-Airy” impact basin on the near side of the Moon? Probably not as it is a highly degraded Pre-Nectarian suspected impact basin. Take a look in Fig 1 and you can see that under the right illumination conditions you can just about make out the circular structure of this suspected impact basin that was named by Don Wilhelm, but who had some doubts about it being a true basin. That is the way with a lot of basins, much careful research is needed, using many different types of observational data to eventually confirm their existence – something that Don Wilhelms did not have many years ago.

So welcome to a new project within the BAA Lunar Section. The aim here is to image/sketch and characterize known, suspected, and unknown impact basins (i.e. greater than or equal to 300 km across – but there are some multi-ring crater exceptions), and also to catalogue as well as measure the diameters of unnamed buried craters. At this stage we do not intend to do any immediate science with this, at least until we have reached our cataloguing objectives, but to put the catalogue on-line for ourselves, and other researchers to use and reference, and hopefully cite the contribution of the BAA lunar Section.



**Figure 1.** The Werner-Airy suspected impact basin as imaged by Anthony Cook on: 2021 Dec 24 UT 00:04-00:11 using a colour web-camera on an undriven Questar telescope. The SW part of the Nectaris impact basin is in the upper right of the image.

### Impact Basins

Why are we doing this? Surely after all these years, all impact basins, and buried craters have been mapped and made it into the International Astronomical Union (IAU) catalogue of named lunar formations? Well amazingly this is not the case as far as I can make out. Many Impact basins do have names – usually after the Mare (if they have this – otherwise a couple of craters that span the basin e.g. Bailly-Newton), but the basin, as a whole, does not have an entry in the IAU database. Planetary scientists have produced catalogs of impact basins, but there are several lists, each by a different group of researchers, and there does not appear to be much coordination. Although we are limiting ourselves to 300 km as the cut-off between a basin and a large crater, the demarcation is a little blurred and large craters that have two or more rings can be included too.

### Buried Craters

Similarly, there are catalogs of craters and the IAU keeps an up-to-date list of all named craters, but there is relatively little on craters that have been buried by lava, and that are barely visible except under shallow

illumination. A good example is “Ancient Newton”, an unofficial name for what sometimes resembles a crater beneath Mare Imbrium, located between Plato and Mons Pico. Ancient Newton is only visible under shallow illumination close to the morning or evening terminator.

Basin	Far/Near Side	Lon	E/W	Lat	E/W	Diam (km)	Status	Age	No. Rings	Col-SR1	Col-SR2	Col-SS1	Col-SS2
<a href="#">Al-Khwarizmi-King</a>	F	112	E	1	N	590	Uncertain	PN	2				
<a href="#">Amundsen-Ganswindt</a>	F	120	E	81	S	335	Probable	PN	2				
<a href="#">Antoniadi</a>	F	172	W	70	S	140	Known	UIm	2				
<a href="#">Apollo</a>	F	152	W	36	S	537	Known	PN	3				
<a href="#">Australe</a>	N	93	E	39	S	880	Probable	PN	2				
<a href="#">Bailey</a>	N	69	W	67	S	300	Probable	N	2				
<a href="#">Bailey-Newton</a>	N	41	W	77	S	402	Uncertain	PN	2				
<a href="#">Balmer-Kapteyn</a>	N	70	E	15	S	500	Uncertain	PN	4				
<a href="#">Birkhoff</a>	F	146	W	59	N	325	Probable	PN	2				
<a href="#">Compton</a>	F	104	E	55	N	175	Known	LIm	2				
<a href="#">Coulomb-Sarton</a>	F	123	W	52	N	440	Uncertain	PN	4				
<a href="#">Crisium</a>	N	59	E	17	N	740	Known	N	5				
<a href="#">Cognitum</a>	N	22	W	11	S	350	Uncertain	PN					
<a href="#">Cruger-Sirsalis</a>	N	66	W	15	S	400	Proposed						
<a href="#">Dirichlet-Jackson</a>	F	158	W	14	N	470	Proposed						
<a href="#">Fecunditatis</a>	N	51	E	8	S	690	Uncertain	PN	2				
<a href="#">Fitzgerald-Jackson</a>	F	170	W	23	N	400	Proposed						
<a href="#">Flamsteed-Billy</a>	N	45	W	7	S	570	Uncertain	PN	2				
<a href="#">Fowler-Charlier</a>	F	139	W	37	N	316							
<a href="#">Freundlich-Sharonov</a>	F	175	E	19	N	600	Uncertain	PN	1				
<a href="#">Grimaldi</a>	N	68	W	6	S	172	Known	PN	3				
<a href="#">Grissom-White</a>	F	161	W	44	S	600	Uncertain	PN	1				
<a href="#">Hertzsprung</a>	F	129	W	3	N	570	Known	N	4				
<a href="#">Humboldtianum</a>	N	82	E	57	N	650	Known	N	6				
<a href="#">Humorum</a>	N	39	W	24	S	425	Known	N	6				
<a href="#">Imbrium</a>	N	16	W	33	N	1160	Known	Im	6				
<a href="#">Ingenii</a>	F	164	E	34	S	315	Probable	PN	4				
<a href="#">Insularum</a>	N	31	W	8	N	600	Uncertain	PN	2				
<a href="#">Keeler-Heaviside</a>	F	162	E	10	S	500	Uncertain	PN	4				
<a href="#">Kohlschutter-Lenov</a>	F	158	W	13	N	400	Proposed						
<a href="#">Korolev</a>	F	157	W	4	S	440	Known	N	4				
<a href="#">Lomonosov-Fleming</a>	F	105	E	19	N	620	Proposed	PN	1				
<a href="#">Lorentz</a>	F	95	W	33	N	365	Known	PN	2				
<a href="#">Marginis</a>	N	86	E	13	N	580	Uncertain	PN	1				
<a href="#">Mendeleev</a>	F	142	E	5	N	325	Probable	N	2				
<a href="#">Mendel-Rydberg</a>	N	94	W	50	S	630	Known	N	1				
<a href="#">Milne</a>	F	113	E	31	S	272	Probable	PN	2				
<a href="#">Moscoviense</a>	F	148	E	27	N	420	Known	N	5				
<a href="#">Mutus-Vlacq</a>	N	21	E	52	S	700	Probable	PN	2				
<a href="#">Nectaris</a>	N	36	E	15	S	333	Known	N	5				
<a href="#">Nubium</a>	N	17	W	21	S	690	Uncertain	N	1				
<a href="#">Orientale</a>	N	93	W	19	S	930	Known	Im	6				
<a href="#">Pingré-Hausen</a>	N	82	W	56	S	300	Uncertain	PN	1				
<a href="#">Planck</a>	F	137	E	58	S	314	Probable	PN	2				
<a href="#">Poincaré</a>	N	164	E	57	S	325	Known	PN	2				
<a href="#">Procellarum</a>	N	15	W	23	N	3200	Uncertain	PN	1				
<a href="#">Riemann-Fabry</a>	F	99	E	41	N	320	Uncertain						
<a href="#">Schiller-Zucchi</a>	N	45	W	56	S	335	Known	PN	2				
<a href="#">Schrödinger</a>	F	132	E	75	S	312	Known	Im	2				
<a href="#">Schrödinger-Zeeman</a>	F	165	W	81	S	250	Proposed		2				
<a href="#">Schwarzschild</a>	F	121	E	70	N	212	Probable	N	2				
<a href="#">Serenitatis</a>	N	18	E	28	N	920	Probable	N	5				
<a href="#">Sikorsky-Rittenhouse</a>	N	111	E	68	S	310	Uncertain	N	1				
<a href="#">Smythii</a>	N	88	E	1	N	740	Probable	PN	5				
<a href="#">South Pole-Aitken</a>	F	169	W	53	S	2500	Known	PN	2				
<a href="#">Sylvester-Nansen</a>	N	45	E	83	N	400	Proposed		2				
<a href="#">Tranquillitatis</a>	N	31	E	9	N	700	Uncertain	PN	2				
<a href="#">Tsiolkovskiy-Stark</a>	F	128	E	15	S	700	Uncertain	PN	1				
<a href="#">Wegner-Winlock</a>	F	109	W	42	N	300	Uncertain						
<a href="#">Werner-Airy</a>	N	12	E	24	S	500	Uncertain	PN	1				

**Table 1.** Known/Probable/Uncertain lunar impact basins – much of the information has come from :

[http://the-moon.us/wiki/Lunar\\_Basins\\_List](http://the-moon.us/wiki/Lunar_Basins_List) , but we shall use this as an initial starting block to refine the database. Do not worry too much about the status column – this was the best knowledge I could find when compiling the table, undoubtedly new images and spacecraft data will help us refine this. “Age” corresponds to the geological era of formation e.g. LIm, UIm, and Im are Lower Imbrium, Upper Imbrium, and Imbrium. N is Nectarian, and PN is Pre-Nectarian. We will add selenographical colongitudes into the last four columns when we establish the best start and end times to see the basins at sunrise and sunset conditions on the Moon.

Why is this important? This applies to basins too - it gives us an idea of what was there before the lava flooded the impact basins. So, we are effectively looking back in time a few hundred million to billions of years. A good example of a buried crater can be found in Bill Leatherbarrow’s image of the Rupes Recta and Birt area,

shown elsewhere in this circular (Fig.2 p3).

### Work to be done

I see four areas that amateur astronomers can contribute to this project:

- 1) Compile a catalogue of all known impact basins and buried craters using the lists published by for example Paul Spudis, or mentioned in scientific papers of new spacecraft mission results.
- 2) To read through old copies of the Lunar Section circular, and other amateur publications, looking for accounts of suspected impact basins and buried craters, so we can attribute discoverers/proposers of these geological structures.
- 3) Using the basins and buried craters that we know about, to image/sketch these at the telescope, trying to find the best selenographical colongitudes to see them at.
- 4) If you do not have a telescope, or it is cloudy, then to use tools such as [LTVT](#) or NASA/ACT [QuickMap](#), to visualize the surface at different illumination angles and directions to spot suspected basins/buried craters, and to characterize/measure their centre location and the diameters of any basin rings, or buried crater perimeters.

Please send any images of the basins/buried craters or your thoughts on what might be basins, to me, and every month I will talk about a specific basin/buried crater from the lists provided (Tables 1 and 2) and show what image or visualization evidence exists for this.

This will be an iterative process and we may find that some basins/buried craters that we thought were previously unknown, but had been discovered earlier. I will put the list of basins that we know about, known, suspected, and buried craters onto the following website: [https://users.aber.ac.uk/atc/basin\\_and\\_buried\\_crater\\_project.htm](https://users.aber.ac.uk/atc/basin_and_buried_crater_project.htm)

Crater	Far/Near Side	Lon	E/W	Lat	N/S	Diam (km)	Status	Age	Col-SR1	Col-SR2	Col-SS1	Col-SS2
Ancient Newton	N	8.4	W	47.3	N	125	Uncertain					
Nicolet-Thebit	N	6.8	W	22.3	S	212	Proposed					
Sinus Asperitatis	N	28.2	E	5.4	S	87	Proposed					

**Table 2.** Buried Impact Craters. This catalogue has only just begun, and there are a lot more buried craters on the Moon than these three. Again, the headings are similar to the impact basin catalog, except the craters do not have rings.



## Mons Piton and Pico, By Barry Fitz-Gerald.

Mons Piton and Pico have attracted a fair amount of attention from lunar observers due to the spectacular illumination effects they generate during the course of the lunar day. Projecting up as they do from the lavas of Mare Imbrium (Pico~2000m and Piton~2300m according to GDL100 data via Quickmap) they can cast impressively long shadows across the adjacent plains, but have also been subject to a number of historic TLP reports. TLP reports have been viewed somewhat skeptically over recent years, with a variety of 'non-lunar' effects being fingered as the culprit. Such reports include many describing hazes or cloud like mists such as: “*a large patch of haze appeared and drifted off across the mare*” from the 25<sup>th</sup> February 1953 for Mons Pico or “*enveloped in an obscuring cloud-like mist*” for Mons Piton from 20<sup>th</sup> September 1958<sup>[1]</sup> but whether these observations of obscurations and mists are real lunar events or are explicable in terms of atmospheric, instrument or observer effects is an open question. However, it is possible that some of the better and more spectacular events *may* well have a lunar geological origin. Here is one report taken from a comprehensive list of TLP reports <sup>[2]</sup> which was made by the US observer David Darling on the 6<sup>th</sup> February 1987 regarding Mons Piton:

*“Mt. became > like a shimmering block of ice or a jewel in the sun. Phosphorescent glow like mother-of-pearl. Got still brighter. Mt. shape became fatter & blunter both N-S & E-W. Glow peaked after 15m & mother-of-pearl began to fade. Albedo < 8 or 9 and it was > feature at that time.”*

This was followed by another report by the same observer of the same feature made on the 6<sup>th</sup> April 1984:

*“Brightest feature on Moon, brightest he had ever seen it. Another person observing independently at this time remarked about brilliance. Did not see mother-of-pearl effect as was seen on Feb 6. Brilliance was dazzling & variations were shimmering giving a silvery or metallic sheen.”*

Though both reports come from the same observer, the second appears to have been corroborated by another un-named observer. These are just two examples, but what is I think significant is that Mons Piton generally exhibits a low albedo, and to give the impression of being the “*brightest feature on Moon*” would imply a fairly radical change in appearance. But does this mean what was witnessed marked a real physical surface effect resulting from a geological event, or was it just down to seeing?

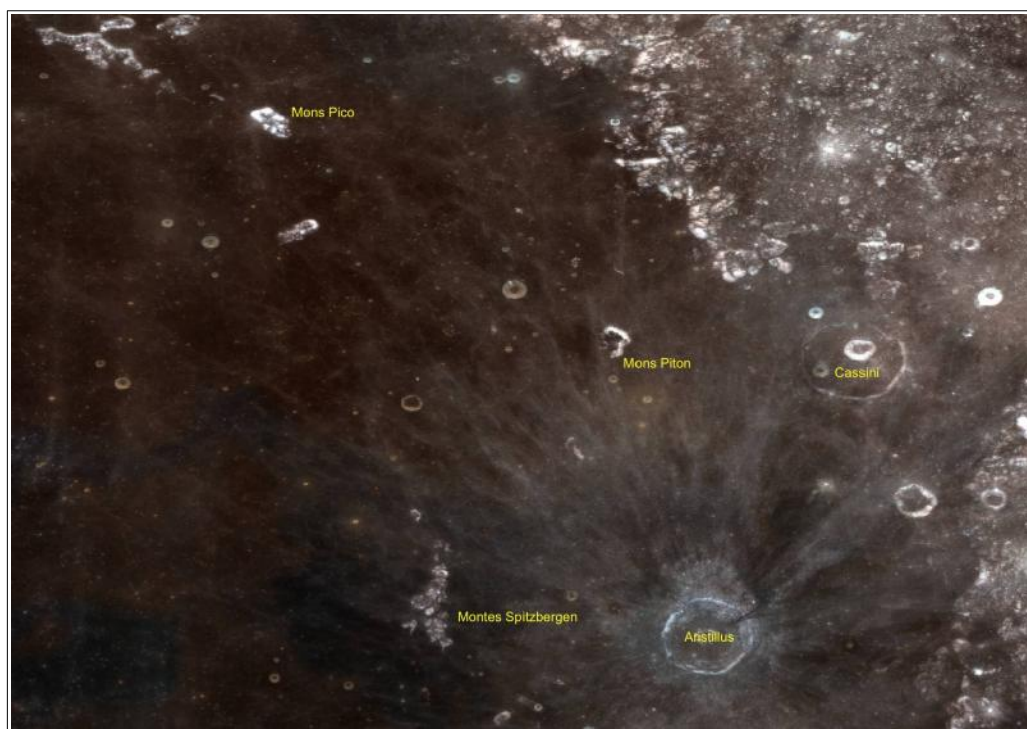


Fig.1 LRO-Quickmap image of the environs of Mons Piton and pico with the 'Resolved Hapke parameter map' overlay enabled.

Maybe spacecraft data can shed some light on these features, and indicate whether there is any evidence for recent geological change that could be responsible for the reports made. Fig.1 shows an LRO Quickmap image of the general environs of both features, with which I am sure you are pretty familiar. The Resolved Hapke

parameter map overlay is enabled and produces a realistic rendition of the lunar surface and colour variations. As can be seen, the western flanks and central region of Mons Piton are much darker than the eastern and northern flanks, and almost appears to merge into the mare to the west. In comparison Mons Pico is relatively bright but with thin, lower albedo lanes which probably represent darker deposits within hollows and gullies running down the flanks. One difference between the two peaks is that Mons Piton was in the firing line of ejecta from the crater Aristillus, and a bright ray with the spectral signature of highland material brushes along its western flank and along the adjacent mare surface. Fig.2 shows a telescopic image of the same area, showing the much darker western flank of Mons Piton.



Fig.2 Telescope image of Piton and Pico of area shown in Fig.1.

Fig.3 shows another Quickmap image, this time of Mons Piton and Pico with the abundance of plagioclase colour coded from red, indicating high abundance, to blue indicating low abundance. The plagioclase rich eastern and northern flanks of Piton are apparent as is the ray from Aristillus which approaches from the south and appears to clip the western flank of Piton, and may have caused the 'splash' of plagioclase rich material on the mare surface to the north. Mons Pico exhibits an apparently greater strength in the plagioclase signal shown by the red/green colouration. Pico also has plagioclase rich deposits on the adjacent mare surface to the west, but these appear to be the result of mass wastage or avalanches down off the flanks and onto the mare surface.

In both cases the abundance of plagioclase, which in this case probably takes the form of bright mineral anorthosite, accounts for the relatively high albedo of both features when compared to the surrounding mare surface, with the higher abundance in the case of Mons Pico producing the greater relative albedo. The presence of plagioclase in both of these massifs is a predictable consequence of their inferred mode of origin, in that they represent uplifted highland rocks produced during the formation of the Imbrium Basin. Mons Pico apparently forms part of a submerged basin ring, which includes Montes Teneriffe, Recti and Spitzbergen, but Piton is not part of this ring and appears to be an oddly isolated peak.



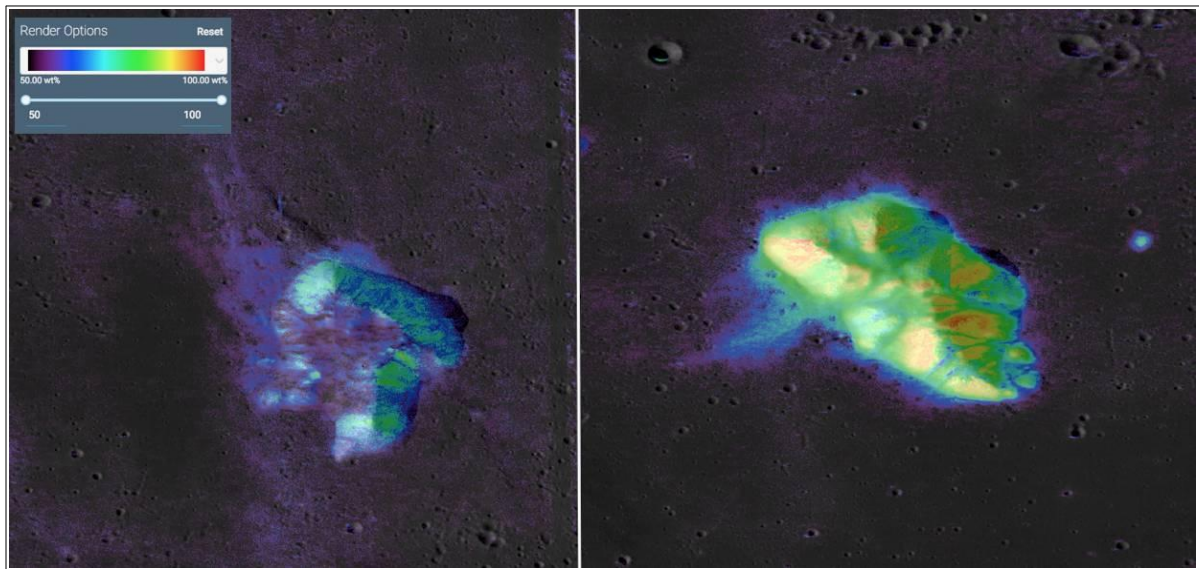


Fig.3 LRO-Quickmap image of Mons Piton (left) and Mons Pico (right) with the SELENE/Kaguya Mineral Mapper for the abundance of plagioclase (wt %) enabled. Note the ray of highland material from Aristillus to the west of Piton and the high abundance of plagioclase along the east and north facing slopes. Pico shows a significantly stronger plagioclase signal compared to Piton. What appears to be a plagioclase rich avalanche debris apron can be seen on the mare surface to the west of Pico.

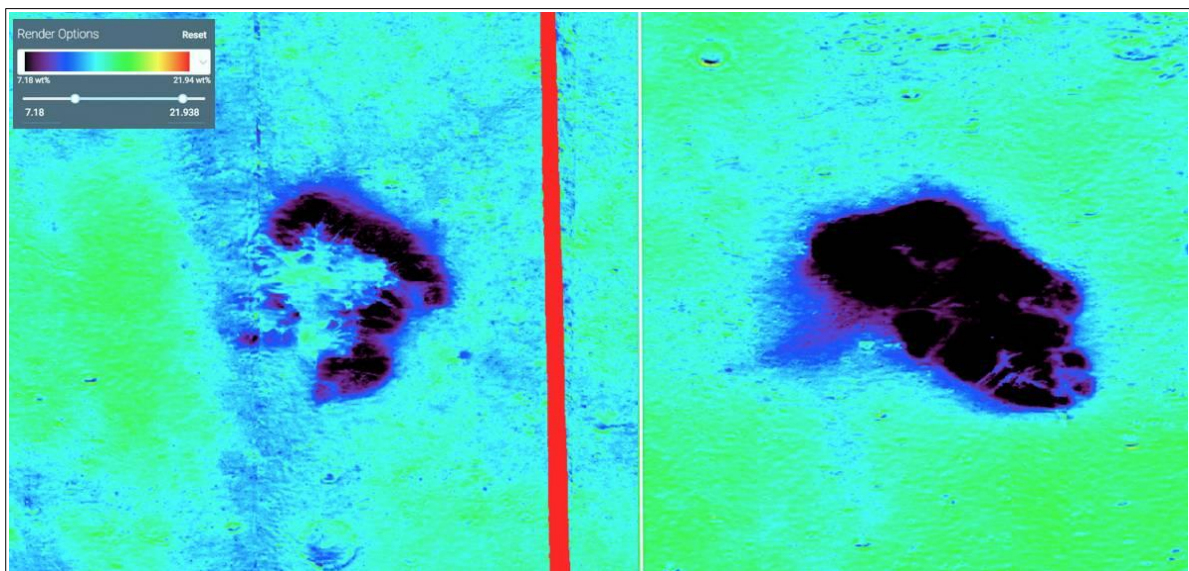


Fig.4 LRO-Quickmap image of Mons Piton (left) and Mons Pico (right) with the SELENE/Kaguya Mineral Mapper for the abundance of FeO (wt %) enabled. Note the ray from Aristillus is visible brushing past Piton, as is the avalanche debris off the western flank of Pico which shows up in blue because of its low iron content. The central and western part of Piton shows a strong FeO signal, comparable to the surrounding mare basalts.

Fig.4 is another Quickmap image with an overlay to show the abundance of iron oxide which is abundant in mare basalts, but not in highland rocks. What is seen here is that the low albedo sections of Piton have a relatively strong iron signal, indicating the presence of material more at home in the mare and not the highlands. The same situation can be seen if one examines the olivine (another mineral common in mare basalts) abundance overlay, which shows a strong signature associated with the central and western part of the massif.

So whilst Pico looks mineralogically to be mostly of a highland composition, Piton has a highland nature to the east and more of a mare nature to the west, producing something of a conundrum. One possibility for some this apparent diversity in rock types within Piton could lie with the Aristillus impact ejecta, which may have thrown material from the impact site on to Piton, or who's secondary craters may have excavated local mare material and deposited it up onto the western flanks. The more distant Pico would not have been subjected to such effects and maintained its pristine highland nature. There is no indication that any volcanism has affected Mons Piton, with a lack of anything resembling volcanic features on the mount or on the adjacent mare surface. Lunar



volcanism can however involve subtle and difficult to see vents, so this cannot be ruled out as a possible source for the mare like deposits, but a blanketing of mare like deposits from elsewhere *seems* to be the most parsimonious explanation.

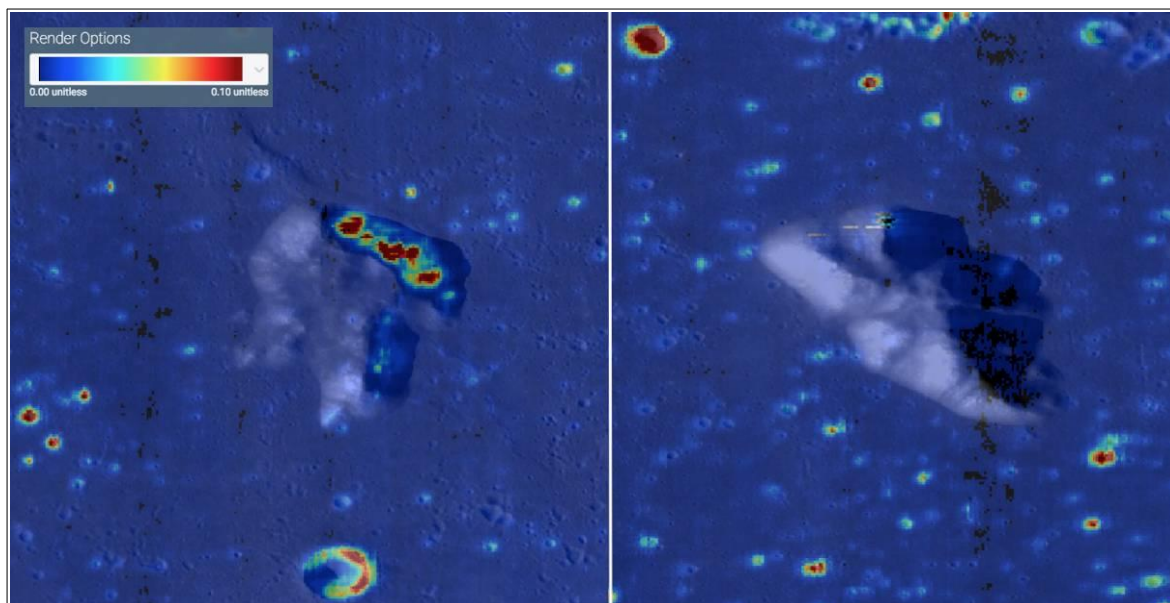


Fig.5. The same areas as in Fig's 2 and 3 but with the Quickmap LRO Diviner 'Lunar surface rock abundance and regolith fines temperatures' layer enabled.

Moving on to physical properties, Fig.5 shows the same two peaks with the 'Lunar surface rock abundance and regolith fines temperatures' overlay enabled showing areas of enhanced 'rockiness' such as around the rims of fresh craters. In this we can see that the eastern flanks of Piton have quite a rocky nature, but nothing similar is visible in on Pico. One interesting thing to note in the image of Pico however is that the rocky small craters in the area which corresponds to the avalanche footprint in Fig's 3 and 4 appear to have been smothered and are quite indistinct, an observation which *may* suggest that this veneer of debris arrived on the surface from the slopes above in relatively recent lunar geological times.

Zooming in closer to the eastern flank of Piton (Fig.6) we see that the slopes are draped in many dry debris flows of varying albedos and ranging in nature from fine grained to very coarse with abundant boulders (Fig.7).

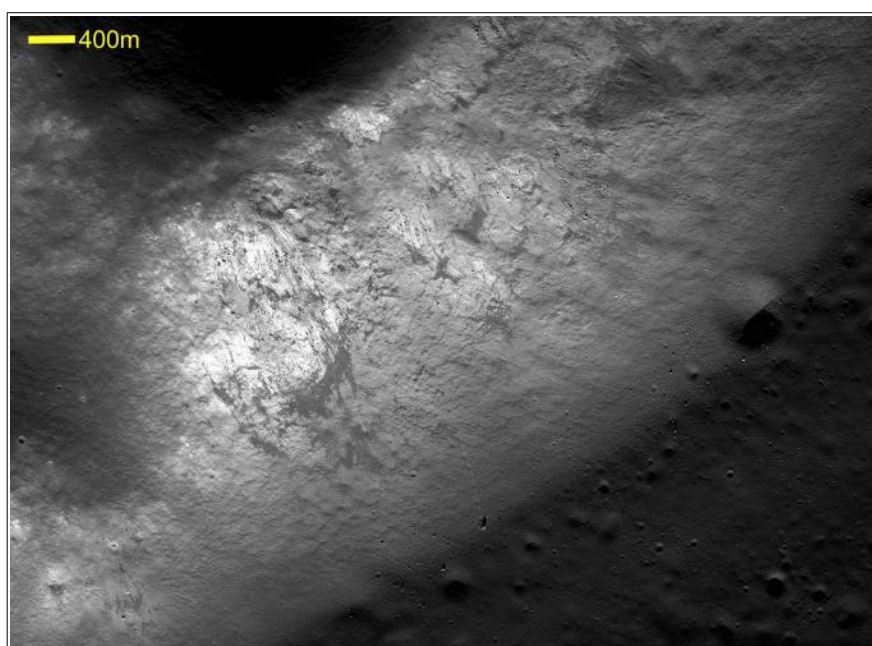


Fig.6 LROC NAC image of the eastern flank of Mons Piton showing the many individual dry granular flows or avalanches and numerous boulders around the base of the slope.

Numerous large boulders lie on the adjacent mare surface, some at the end of fresh boulder trails, showing that rocks of some size have been tumbling down off these slopes over a protracted period of time.

Part of the explanation for this extensive rockiness can be seen in Fig.8 which is a SELENE image of Piton showing that it is associated with a rather subtle wrinkle ridge that snakes its way northwards from the direction of Aristillus and is visible telescopically under low angle illumination.

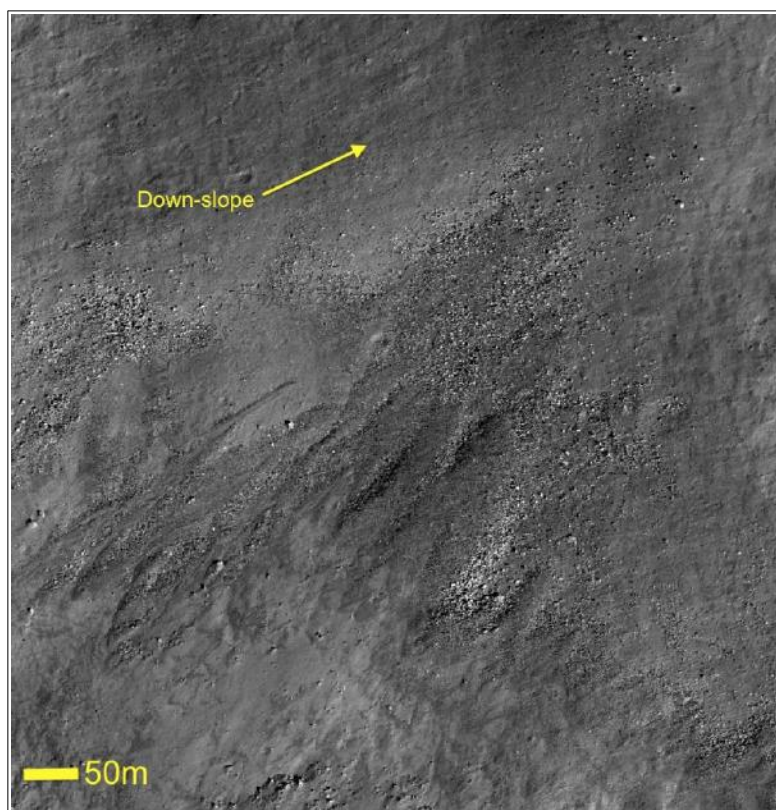


Fig.7 LRO-NAC image of boulder rich avalanches and channels filled with finer debris on the eastern flank of Mons Piton.

This ridge shows up as a slight bulge skirting the base of the eastern flank before heading north across the mare surface for a few kilometres as a scarp some 150m high. It is not possible to associate this particular ridge definitively with the rockiness shown on the eastern flank, but maybe more relevant to this matter is a pair of smaller sharper ridges that appear to run towards the southern flank of Piton, one of which is shown in Fig.8 with blue arrows. These small ridges have several patches of boulders along their crests (Fig.9), showing that the thrust faults that are probably responsible for them have been active in relatively recent lunar geological history. Again, it is not possible to say when this activity occurred in real terms, but it raises the possibility that the seismic effects of such movements may have de-stabilised the regolith deposits on the steep eastern flanks of Piton, and resulted in avalanche type activity and the marked rockiness evident in the images and the LRO-Diviner data.

The persistence of the low albedo mare type deposits over the western part of Piton can possibly be understood by looking at the 3D rendition shown in Fig.10 which simulates the view of the mount from the south-east. As can be seen the eastern flanks are steep and streaked with darker lanes where low albedo material has collapsed off the summit ridge. To the west of this ridge however the slopes are much gentler and probably provide a more stable environment for the accumulation of these darker mare like deposits. These reach a probable depth of several 10's of meters, as a 250m diameter fresh impact crater, which should have a depth in the 20 - 40m range has not excavated highland bedrock, but has an ejecta blanked rich in unweathered olivine, indicating mare like deposits (Fig.11).



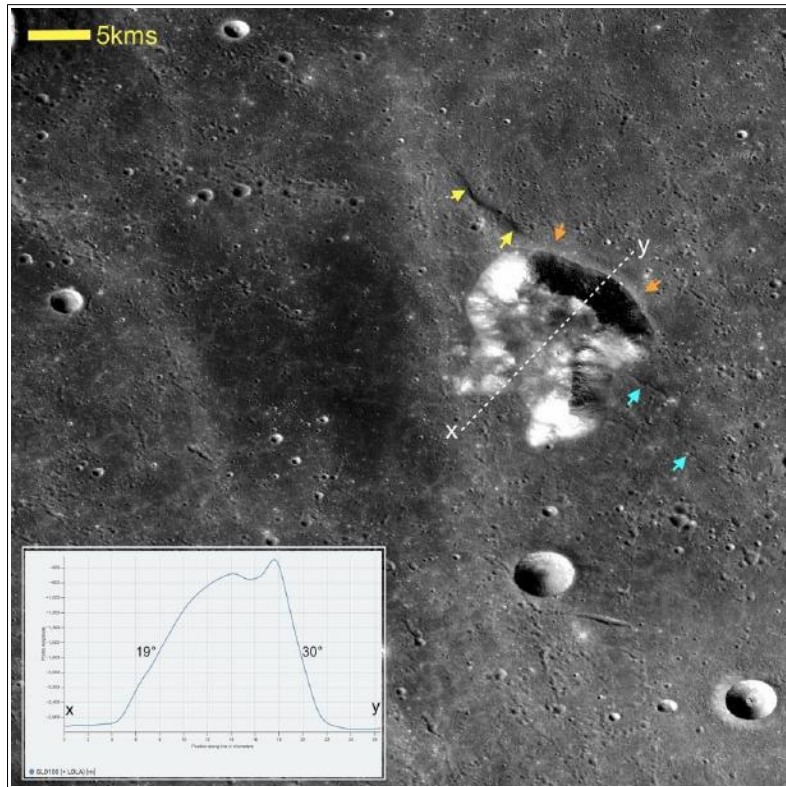


Fig.8 SELENE image of Mons Piton showing the associated wrinkle ridge which forms a bulge at the base of the eastern flank (orange arrows) before transforming into a 150m high scarp on the mare surface to the north (yellow arrows). One of a pair of smaller, sharper ridges can be seen to apparently run up to the base of the southern flank (blue arrows). The inset shows a profile along line X-Y illustrating the difference in slope between the eastern and western flanks.

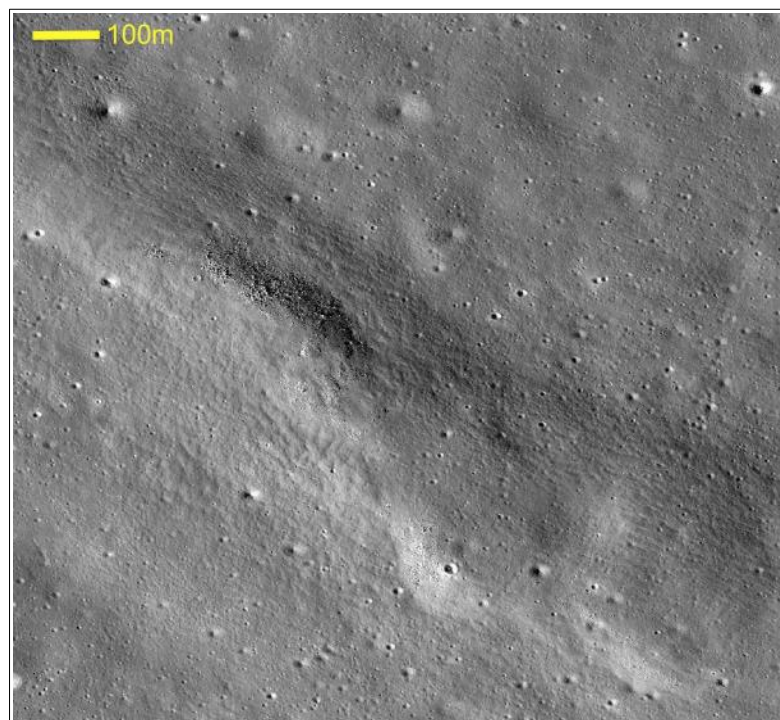


Fig. 9 Bouldery outcrops along the crest of the small ridges to the SE of Mons Piton and identified with the blue arrows in Fig.8.

Mons Pico in contrast to Piton has a more symmetrical profile with slopes in the region of  $20^\circ$  and an absence of any patches with an enhanced rocky signature as seen in the LRO-Diviner data. There are many dark streaks and lanes running down the flanks, and these probably represent accumulations of mare derived material which has accumulated in gullies (Fig.12).



As has already been noted the mare around Mons Pico is surrounded by an aureole of plagioclase rich debris that has fallen off the slopes above, but this material is very fine grained and not composed of coarse rocky debris. A spectacular debris apron reaching some 12kms from the base of the mount can be seen to the west, and I wonder if this shows up telescopically as a slightly higher albedo patch of mare surface under some illuminations?

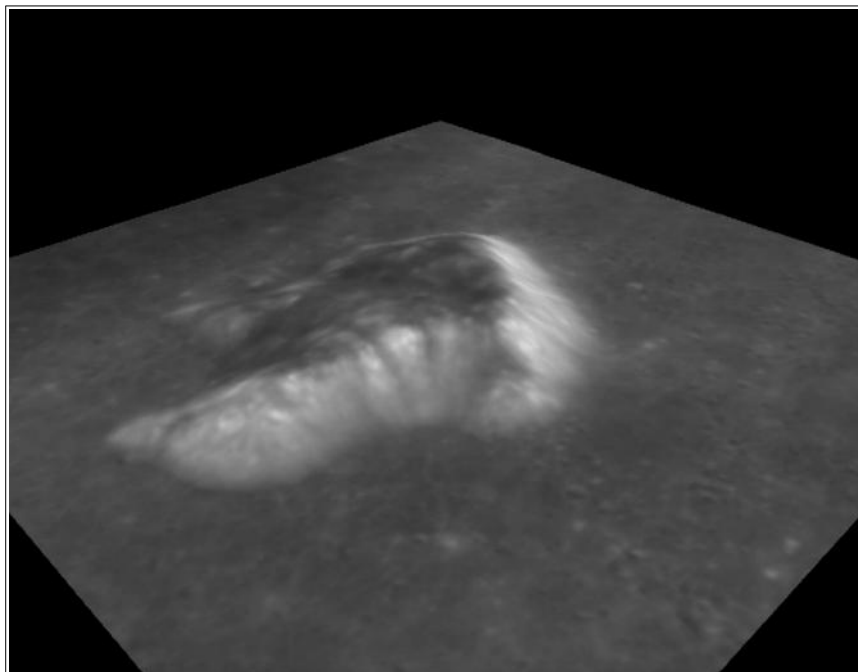


Fig.10 LRO 3D model of Mons Piton simulating the view from the SE showing the steep slopes on the eastern flank and the gentler slopes on the western flanks.

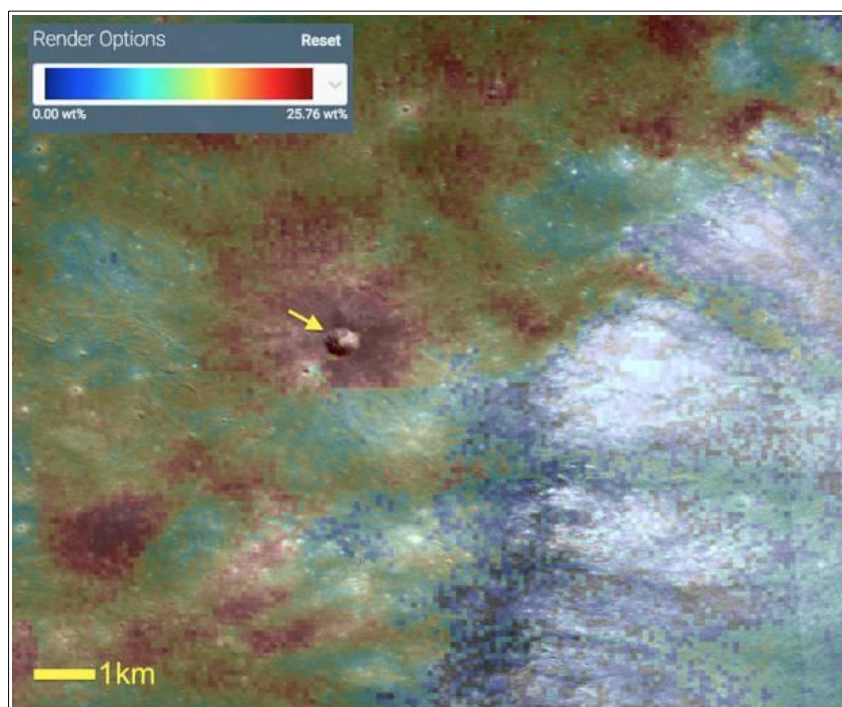


Fig.11 Small fresh crater (~250m diam – yellow arrow) on the western flank of Piton which despite having a depth of several 10s of meters has only excavated mare type material as shown in this image colour coded to show the abundance of olivine.

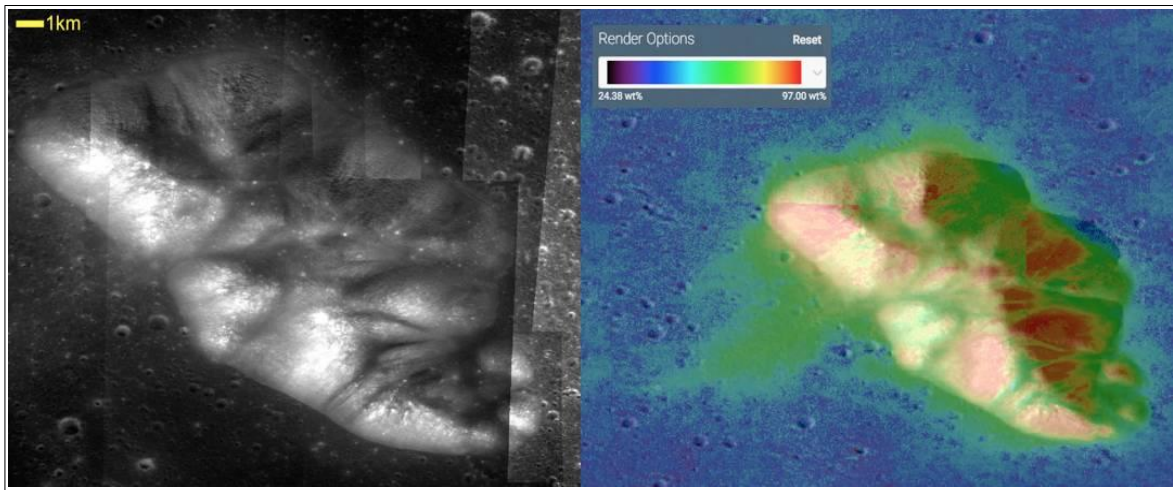


Fig.12 LRO NAC image of Mons Pico (left) and the SELENE/Kaguya Mineral Mapper overlay for the abundance of plagioclase image (right). Note the aureole of plagioclase rich debris surrounding the massif, particularly to the west.

The fine grained nature of these deposits is reflected in the nature of the downslope movement of regolith, which does not take the form of multiple avalanches with abundant boulders, but is dominated by areas where the surface regolith has sloughed away downslope in multiple often overlapping patches, to expose immature and apparently less consolidated material (Fig.13). These patches have a coarse rippled texture and often have adjacent patches of smoother presumably undisturbed regolith nearby. Boulders and boulder trails are present, but they are not a dominant feature on these slopes, and the downslope movement is therefore probably dominated by fine grained material as shown by the deposits on the surrounding mare surface.

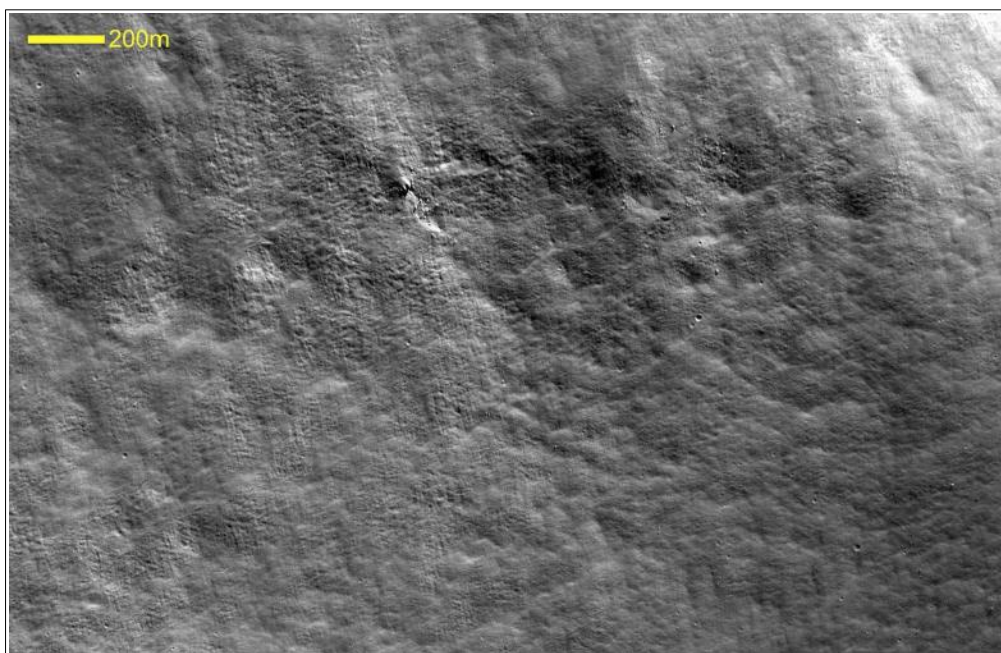


Fig.13 LROC-NAC image of the western flank of Mons Pico showing the multiple overlapping patches of disturbed regolith. The down-slope is towards the bottom right.

So, Piton and Pico show very different appearances and features. Piton's western flanks appear to merge into the adjacent mare due to the lower slopes to the west and the mantling of mare like material. This material does not appear to be a local volcanic deposit, but is probably an accumulation of mare material derived from elsewhere and propelled onto the massif by a combination of local and more distant impacts. The dips and hollows of Piton's western flank probably provided stable locations where these deposits could accumulate to some depth and avoid slumping down onto the surrounding mare surface. The extremely rocky nature of the eastern flank probably reflects the steepens of the slopes (of at least  $30^\circ$  and more in places) as well as potential de-

stabilisation of the regolith due to tectonic activity associated with the wrinkle ridge(s) that pass within close proximity to the massif. The rockiness suggests that apart from down slope movement of regolith actual bedrock is eroding off the flanks. Plagioclase rich debris can be seen on the surrounding mare surface, particularly to the north, but it is possible that a lot of this is the result of impacts of debris from the Aristillus impact event.

Pico appears far more homogeneous in geological terms, being plagioclase rich, probably dominated by the bright mineral anorthosite. Mare like composition can be seen as dark streaks on the flanks and summit but these probably represent deposits derived from nearby impact crater ejecta, concentrated in gullies and hollows. The surface morphology of the flanks suggests that most of the down slope movement involves the upper regolith layers and does not involve the deeper solid geology, apart from occasional locations where bedrock is exposed, providing the source areas for boulders and their trails. Pico also appears untroubled by nearby wrinkle ridges, a possibly indication a more tranquil tectonic compared to Piton.

Could any of these observations be related to historic TLP reports? I suppose the answer must be 'possibly', but we might be straying too far into speculation for that to have much validity. Clearly both massifs show evidence of unstable slopes and avalanche type activity over the recent lunar geological past, but as we know 'recent' in lunar terms can stretch back millions of years. That said, the potential exists for on-going activity as the slopes have been and probably still are on the limit of stability, and tectonic or impact activity could provide the impetus for renewed collapse. What is unknown is how this would affect the local appearance, and whether it could generate the visual effects reported in cases quoted earlier? In addition, the presence of avalanche debris on an adjacent mare surface, of slightly different composition and albedo, may contribute to some anomalous appearances, whilst the dark western slopes of Piton may render its outline indistinct under other circumstances. In any case I have added both to my list of TLP sites to observe in the faint hope that I might one night witness what David Darling saw in 1987.

## References:

1. Cameron, W.S 1978, Lunar Transient Phenomena Catalog, World Sp. Sci. Data Cntr.,78-03 (NASA-TM-79399; Greenbelt: NSSDC)
2. Cameron, W.S (2006) Lunar Transient Phenomena Catalog Extension. National Space Science Data Center World Data Center A For Rockets & Satellites 78-03.

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## Lunar Geological Change Detection Programme.

By Tony Cook.

**TLP reports:** Alexandre Amorim (Brazil) observed Fracastorius on 2022 Apr 21 UT 01:35-02:12 and noted a little bright spot near the centre of the otherwise completely shadow filled crater. The bright spot was surrounded by a coma effect. Clouds intervened but by 02:12 the spot was no longer visible, just a thin patch of light close to the crater's centre. Observations started when the Moon's altitude was 15° and ended when it was 23° above the horizon. Alexandre used a 90mm f/10 refractor, with 25 & 10mm eyepieces. This should not necessarily be regarded as a TLP as it might just be some hillocks on the floor poking through the sunset terminator. Nevertheless, until we get a repeat illumination observation, we shall assign an ALPO/BAA weight of 1 to this report.

**Routine Reports received for March included:** Jay Albert (Lake Worth, FL, USA – ALPO) observed: Alphonsus, Aristarchus, Messier, Plato, Proclus, Ross D and Torricelli B. Alberto Anunziato (Argentina – SLA) observed: earthshine, Kies, Moltke, Plato, Proclus and Ross D. Anthony Cook (Newtown – ALPO/BAA) videoed earthshine and imaged several features in visible light and the thermal IR. Walter Elias (Argentina – AEA) imaged: Aristarchus and Grimaldi. Valerio Fontani (Italy – UAI) imaged: Censorinus, Fra Mauro,



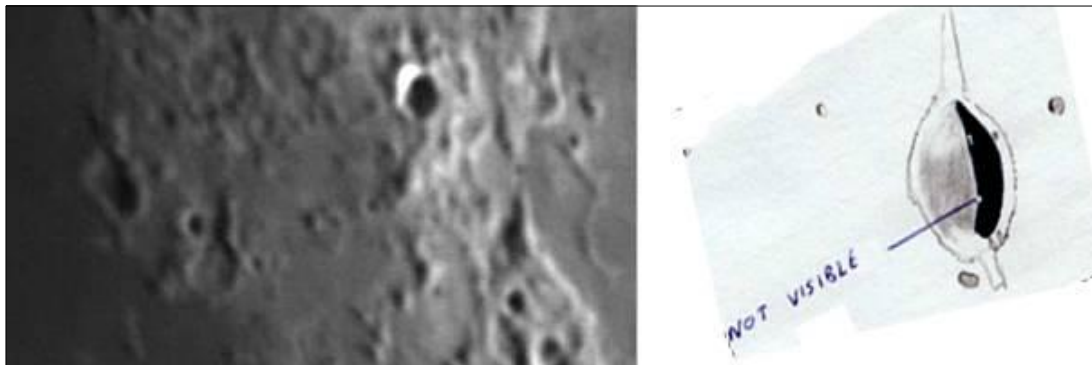
Herodotus, and Lansberg. Les Fry (West Wales, UK – NAS) imaged: Harpalus, J Herschel, Letronne, Mare Humorum, Mersenius, Prinz and Schiller. Rik Hill (Tucson, AZ, USA – ALPO/BAA) imaged: Clavius, Endymion, and Mare Frigoris. Massimo Giuntoli (Italy – BAA) observed: Cavendish E. Mark Radice (near Salisbury, UK – BAA) imaged: Aristarchus and Gassendi. Trevor Smith (Codnor, UK – BAA) observed: Aristarchus, Herodotus, Lichtenberg, Lyell, Mersenius, Plato, Schickard, and Vallis Schroteri. Bob Stuart (Rhayader, UK – BAA) imaged: Clavius, Copernicus, Gassendi, Hainzel, Mare Frigoris, Mersenius, Ramsden, Schiller, Sinus Iridium, and Vitello. Ivan Walton (Kent, UK – BAA) imaged: Atlas, Gutenberg, Janssen, and Mare Crisium.

### Routine Reports Received:

Note that time is unfortunately limited this month for a full analysis, so it will be left mostly up to the reader to compare the original and modern-day observations:

**Lyell:** On 2022 Mar 07 UT 20:27 Ivan Walton (BAA) imaged this area under some 29 min before, and Trevor Smith observed visually 20:55-21:20UT under similar illumination ( $\pm 0.5^\circ$ ) to the following report:

*Lyell 1972 Nov 10 UT 23:43 Observed by Bartlett (Baltimore, MD, USA, 3" refractor x54, x100, x200S=3, T=5) "At apparent centre of floor & edge of morning shadow an elongated, N-S irreg. obj. dull whitish-gray, albedo=4 like a c.p. (photo in Kwasan atlas in 1963 taken at col. 339.3 deg has a faint suggestion of a bright spot in that place- (plate 20) LO IV66 h2 & 73 H2, sun elev. @ 20deg show an even, dark floor with a very small crater right in center -- unresolvable at earth. Kwasan photo's spot could be an artefact" NASA catalog weight=3. NASA catalog ID #1349. ALPO/BAA weight=2.*

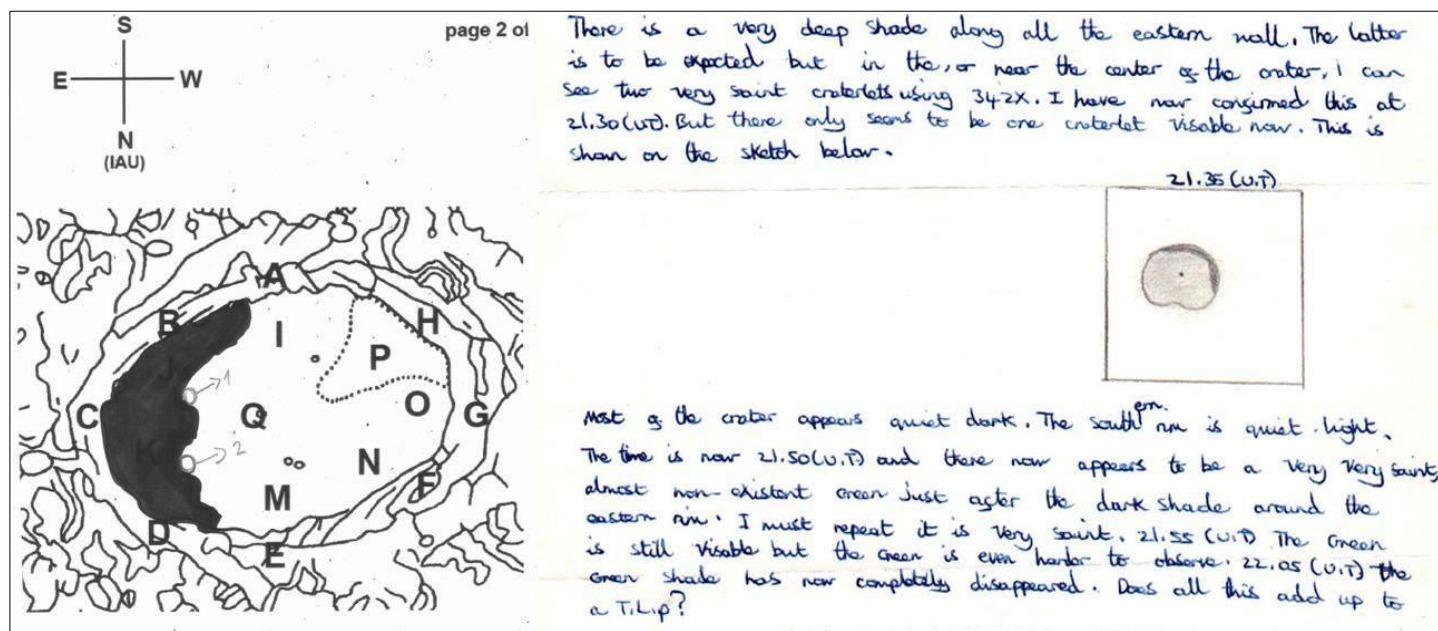


**Figure 1.** Lyell on 2022 May 07 and orientated with north towards the top. **(Left)** As imaged by Ivan Walton (BAA) at 20:27 UT – Lyell is the crater on the far left. **(Right)** a sketch by Trevor Smith from 20:55-21:20 UT, made using a 16" Newtonian at x247 under Antoniadi III-IV seeing conditions.

Ivan's image (Fig 1 – Left) gives a good context view of the area. Trevor has a detailed sketch in Fig 1 (Right) and notes that: *"The eastern floor was one third in shadow. The northern floor was lighter in colour than the southern interior floor. A prominent lone mountain stood out well to the eastern exterior floor of Palus Somni some 5km or so away from Lyell. On the western border of Lyell's interior black shadow was a noticeable white elongated spot. This was elongated in a north to south direction and looked quite impressive at times of better seeing. It was difficult to say if this was an isolated peak from or close to the east rim on looking at a photograph in my Cambridge Photographic Moon Atlas Map 19A, it shows a linear mt or ridge to the north/east interior rim. I wonder if this is the object I saw. A lone mountain or offset central peak is well shown on the photograph but this is situated further to the south. I could not see this Mt as it was still covered in black shadow. I believe that if I had observed a few moments later then this peak would have been visible as the rising lunar Sun would have just caught its peak protruding through the craters eastern rim shadow! I am not certain that the linear Mt or ridge on the Cambridge photograph is the object depicted in my quick sketch, and to me it may be (the linear ridge) a little too far to the east."* We have covered this TLP before in the 2021 Apr newsletter. We shall leave the ALPO/BAA weight at 2 for now.

**Plato:** On 2022 Mar 12 UT 01:35-01:40 and 01:45-02:05 Alberto Anunziato and Jay Albert observed this crater respectively under similar illumination to the following report:

*Plato: On 1983 Apr 21 at UT 21:55-22:05 N. King (Winnersh, Berkshire, UK, using a 150cm f/8 reflector, with seeing 1 and transparency good, little spurious colour, just a little in Plato). Although observing since 21:25UT the observer noticed a just detectable faint green colour just after the dark shade around the inner eastern crater rim. The effect faded and by 22:05UT had completely gone. This report is not in the Cameron 2006 catalog. It is a BAA report. The ALPO/BAA weight=2.*

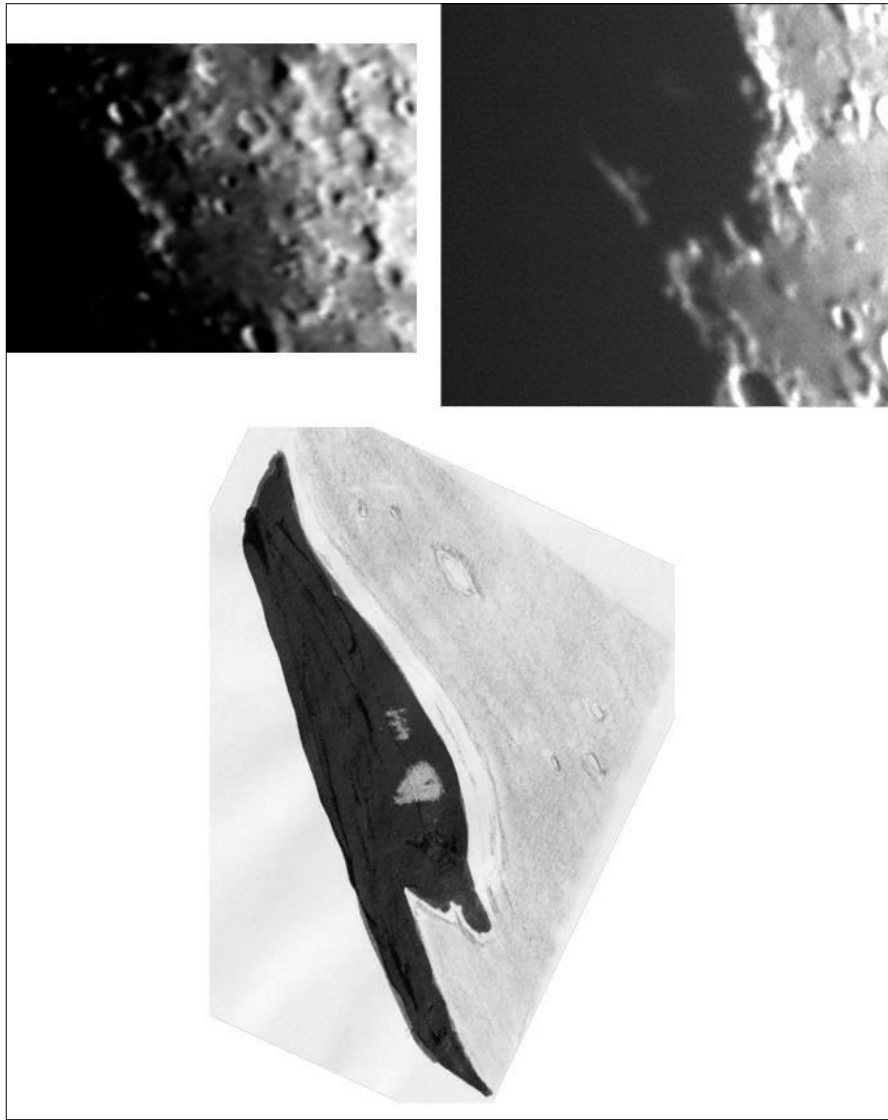


**Figure 2.** Plato crater. **(Left)** shadow extent as observed by Alberto Anunziato on 2022 Mar 12 UT 01:35-01:40 and orientated with north towards the top. **(Right)** Observation by Nathan King (BAA) from 1983 Apr 21 UT 21:25-22:05. 6-inch f/8 reflector used, seeing was Antoniadi I (very good) and transparency was good. Very little atmospheric spectral dispersion seen. South appears to be to the top in his sketch, but it maybe mirror reversed?

Jay was using a Celestron NexStar Evolution 8" at x290, the seeing was 7/10, and the transparency was 3<sup>rd</sup> magnitude. Plato was sharp and detailed with the central, N pair and S craterlets visible. The E wall shadow was prominent and extended about 1/3<sup>rd</sup> of the distance to the central craterlet. He saw no "faint green colour" around the shadow's edge or the E rim. No green or other spurious color was seen in or around the crater. Alberto, using a 105 mm Maksutov-Cassegrain (Meade EX 105) at a magnification of x154 and under 3/10 seeing, commented that just in the limit of the eastern shadow he could see two faint white spots as indicated in Fig 2 (Left). I dug out the original observation by Nathan King (Fig 2 – Right). We have covered repeat illumination observations of this crater before in p26 of the [July 2018](#) newsletter and in p22 of the [2019 June](#) newsletter. I think in view of the quality of the 1983 sketch, I will lower the weight from 2 to 1, though the green colour is still intriguing.

**Schickard:** On 2022 Mar 14 UT 19:47 Bob Stuart (BAA) obtained a regional/context view, at 20:22 UT Les Fry NAS imaged the southern part of this crater, and at 20:55-21:30 Trevor Smith visually observed under similar illumination to the following report:

*Schickard 1972 Sep 19 UT 19:45-20:25, 20:00-23:30 Observed by Watkins (Herts., Eng. 4.5" reflector, x225, S=G) Amery (Reading, Eng. 12" reflector?), Fitton (Lancashire, Eng., 8.5" reflector) and Moore (Selsey, Eng., 12.5" reflector?, 4.5" refractor 45-225x, S=P) "Luminous, nebulous spot attracted Watkin's att'n. Got brighter. Checked 'scope--not instru. Obj. had greenish-gray colour, size @ 15km. Amery & Fitton with blink devices noted nothing unusual at later times (2000-2330h). Aris., Plato, Gass. were neg. at 1930-2025h (date not given, guessed at fr. available info.). Turbulence, lasting secs. at a time." NASA catalog weight=2. NASA catalog ID #1344. ALPO/BAA weight=2.*



**Figure 3.** Schickard as imaged on 2022 Mar 14 and orientated with north towards the top. **(Top Left)** A section of a regional/context view by Bob Stuart taken at 19:47 UT. **(Top Right)** An image of the southern half of the crater, taken by Las Fry (NAS) at 20:22 UT. **(Bottom)** A sketch by Trevor Smith made on 20:55 UT with a 16 inch Newtonian at x247 under Antoniadi III seeing conditions.

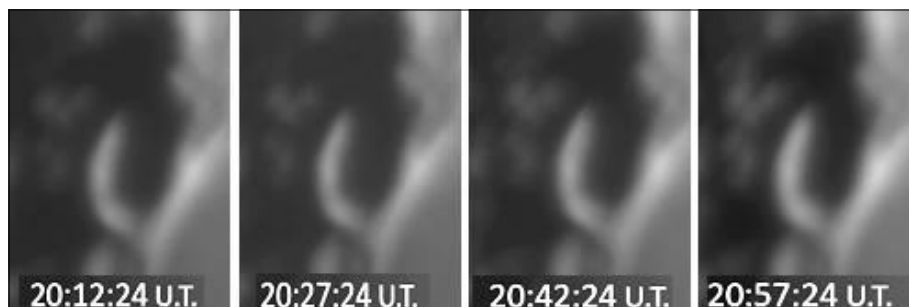
Quite clearly Bob's image (Fig 3 – Top Left) was taken too early to show much of the western rim of the crater, or indeed anything on the shadow filled floor – but at least it illustrates how rapidly sunlight affects this crater at sunrise, as by just 35 minutes later Les has captured (Fig 3 – Top Right) a faint dusky illumination on the floor – presumably as the sunrise rays start to break over the eastern rim? This is undoubtedly what Watkins saw back in 1972, and as would be expected the nebulous spot would have become brighter as the Sun rose. It is also confirmed in Trevor's sketch (Fig 3 – Bottom). Then moving on to Trevor's visual account: *"I looked and at once saw a light grey patch emanating from near the north/east rim in a south/west direction. As it cut into the black shadow covering Schickard's floor. For a second or two it took me quickly by surprise but I quickly realized it was simply caused by a relatively low portion of Schickard's north/east rim letting the sunlight through or rather over it. As I watched, the grey area did indeed slightly increase in brightness as the Sun's altitude rose slowly, bringing the lunar dawn to Schickard's floor! A small lone mt was at the N/E edge of this greyish spot which was elongated in a N/E to S/W direction. A few km to the north was a faint greyish area which brightened as I watched. By 21:12 UT it was quite obvious and by 21:20 UT it was almost the same brightness as the first spot. Black long spires of shadow appearing across this second grey patch. A third greyish patch was also visible to the south of the first patch. To my eyes the patches were light grey in colour and I could see no green in them."*

It seems that the only oddity about this TLP report was not the luminous patch on the shadow filled floor, but why the spot had a greenish-gray colour to it? We shall leave the ALPO/BAA weight at 2 for now.

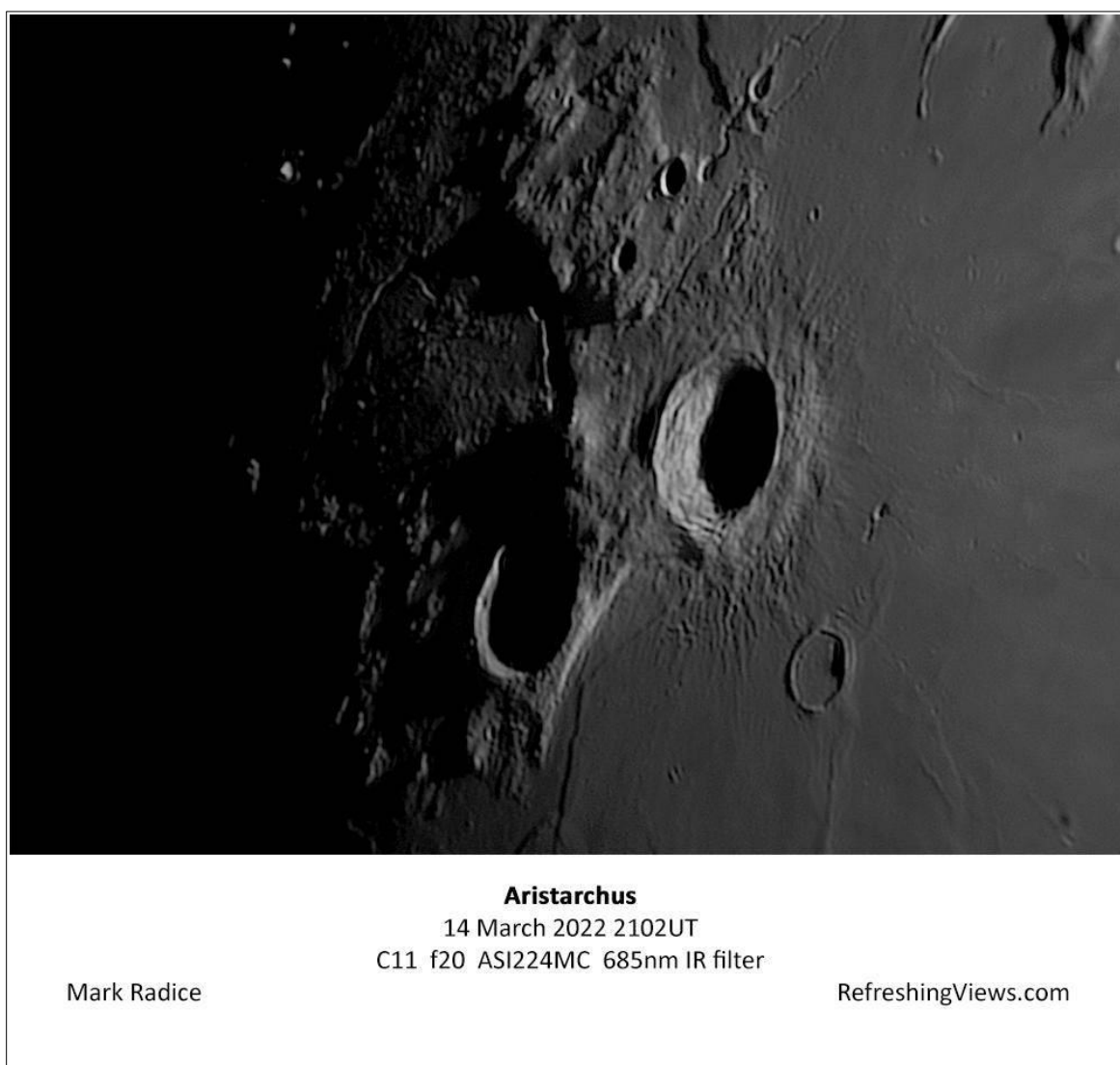


**Herodotus:** On 2022 Mar 14 Mark Radice, Valerio Fontani and Trevor Smith all made observations during the following Lunar Schedule request:

*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 4.** Herodotus, with north towards the top, as imaged by Valerio Fontani (UAI) on 2022 Mar 14 at the UT's given in the image.



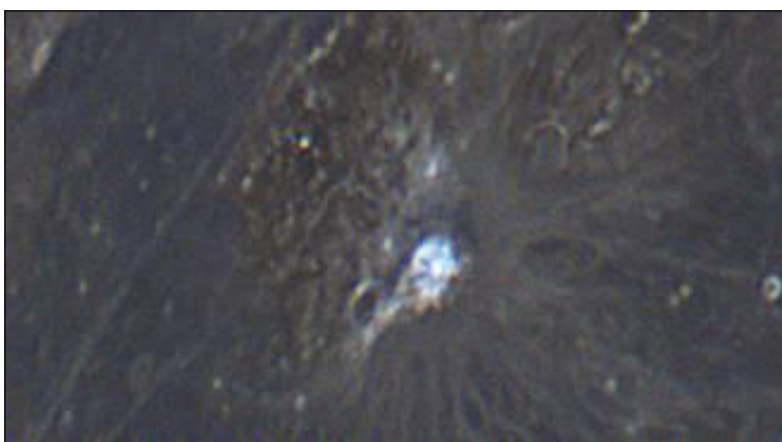
**Figure 5.** Aristarchus, with north towards the top, as imaged by Mark Radice (BAA). For the dates, UT, instrument details etc, see the text in the image.

Trevor observed visually with his 16" Newtonian (Seeing Antoniadi III) from 20:05-20:15 but could not see any sign of a pseudo peak, nor any obscurations or temporary greying of the shadow. Valerio Fontani (UAI) produced an image sequence (Fig 4), but again no sign of what was being requested. Finally, Mark Radice obtained a detailed regional view of the area (Fig 5), but again there is no sign of a pseudo peak or greying of the shadow.

**Cavendish E:** On 2022 Mar 16 UT 21:00 Massimo Giuntili (BAA) continued to monitor this crater to see if it repeats a flare up in brightness that he saw in the past. On this occasion he observed the northern floor was bright but not brilliant. The seeing was Antoniadi III when using his 120 mm refractor (x200). Col. 78.4, sub sol. lat. 1.3, libration: lat. - 5.59 and long. - 5.

**Aristarchus:** On 2021 Mar 21 UT 01:29 Walter Elias (AEA) imaged this crater under similar illumination to the following report:

*Aristarchus 1989 Dec 16 Darling, alerted by Keyes saw Aris >> brighter obj on moon (as it normally is) Comet ray & N rim of Herod. >> could see no detail - Aris. except two bands, moon was pale yellow (low alt.) with halo around it. Nothing unusual elsewhere. Cameron 2006 catalog extension ID #384 and weight=0. ALPO/BAA weight=1, just in case there is some merit in this report?*



**Figure 6.** Aristarchus, with north towards the top, as imaged by Walter Elias (AEA) on 2022 Mar 21 UT 01:20 and orientated with north towards the top.

As you can see from Fig 6, albeit the resolution is limited, there should be at least four bands visible in Aristarchus, and although there are no other bright features to compare with in the image, the crater does look rather bright – which is normal. In view of the fact that the Moon was of low altitude back in 1989 and indeed was yellow in colour as there was a lot of atmosphere in the way, I think we it would be most unusual not to have some detail missing. I will therefore lower the weight back down to the Cameron value of 0, effectively removing it from the ALPO/BAA TLP database.

**General Information:** For repeat illumination (and a few repeat libration) observations for the coming month - these can be found on the following web site: [http://users.aber.ac.uk/atc/lunar\\_schedule.htm](http://users.aber.ac.uk/atc/lunar_schedule.htm) . By re-observing and submitting your observations, only this way can we fully resolve past observational puzzles. To keep yourself busy on cloudy nights, why not try “Spot the Difference” between spacecraft imagery taken on different dates? This can be found on: [http://users.aber.ac.uk/atc/tlp/spot\\_the\\_difference.htm](http://users.aber.ac.uk/atc/tlp/spot_the_difference.htm) . If in the unlikely event you do ever see a TLP, firstly read the TLP checklist on <http://users.aber.ac.uk/atc/alpo/ltlp.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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