BAA Lunar Section
British Astronomical Association
Director: Bill Leatherbarrow

LUNAR SECTION CIRCULAR

Vol. 57 No. 4 April 2020

FROM THE DIRECTOR

In these extraordinary times, when so many of our members will be feeling anxious and isolated, it is good to know that you are part of a larger group with a common interest that can be sustained, virtually at least, throughout the present crisis. Social distancing should not affect our ability to continue our observational activities and, health permitting, this Circular will continue to be produced each month.

The weather is another matter, but as we move into spring in the northern hemisphere we can reasonably expect improved conditions. Astronomy provides both a distraction from present difficulties and a welcome sense of perspective amidst all the bad news.

So do continue to observe and submit your observations. Please note that it helps me enormously if your images are submitted in JPEG or PNG format and are of a manageable size. Each image should have a file name that includes the feature name, date and time of the observation, and the observer's name.

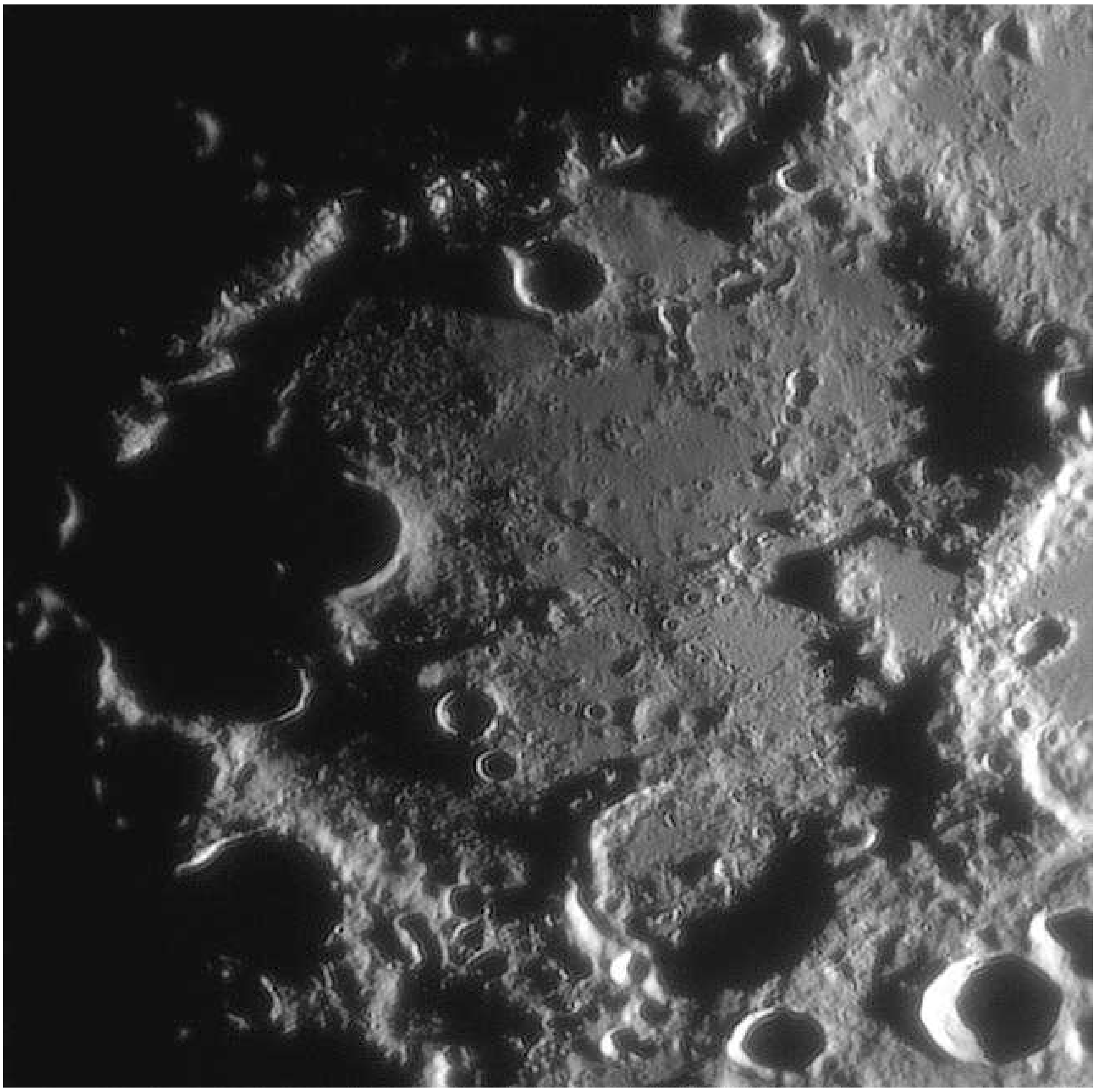
Meanwhile, I wish you all the best. Stay safe!

Bill Leatherbarrow

OBSERVATIONS RECEIVED

Images have been received from the following observers: Leo Aerts (Belgium), Rob Davies, Dave Finnigan, Rik Hill (USA), Ken Kennedy, Rod Lyon, KC Pau (Hong Kong), Bob Stuart, Alexander Vandenbohede (Belgium), Ivan Walton, Chris Williams, and the Director.

DESLANDRES Bill Leatherbarrow



On 2 March 2020, at 19.19 UT, I had a remarkable view of the floor of the huge formation Deslandres. Deslandres has a diameter of around 234 km, but it is so degraded that it was formally named only in 1948 after the French astronomer and one-time Director of Paris Observatory, Henri Deslandres. It had previously been unnamed or referred to informally as ‘Hell-plain’ (after the 33-km crater Hell that lies within it) or Hörbiger (a name suggested by Fauth and still used by Wilkins and Moore as late as 1960). My image hints at the wealth of detail visible within Deslandres in a moderate telescope. The original floor of the crater is lost below layers of subsequent infill, either from ejecta deposits or lava flows. There are two prominent crater chains running roughly parallel to each other. One long one begins outside the northern wall of Deslandres and passes near the western flank of Hell, but this is largely in shadow in the image above. The other is much shorter and consists of a chain of six, possibly seven, shallow depressions to the north of Cassini’s Bright

Spot (see below). These are apparently secondary impacts, but it is by no means clear from where. They do not point back to Imbrium, which is responsible for most of the secondary scarring in this region of the Moon.

There are two interesting younger features on the ancient floor of Deslandres: a patch of mare-like material in the northeastern corner and Hell Q, a fresh 4-km crater with a bright ejecta blanket north of Lexell. Clementine mineralogy data shows the patch to be yellow in colour, suggesting that it is indeed an iron-rich, lower titanium mare-like basalt. Hell Q and its impact blanket are best seen under higher illumination and are otherwise known as Cassini's Bright Spot, where the Italian astronomer suspected transient activity. It has been argued that Hell Q is the result of an oblique impact from the west, since there are suggestions of a downrange 'comet-tail' of ejecta to the east, but the jury is still out on that.

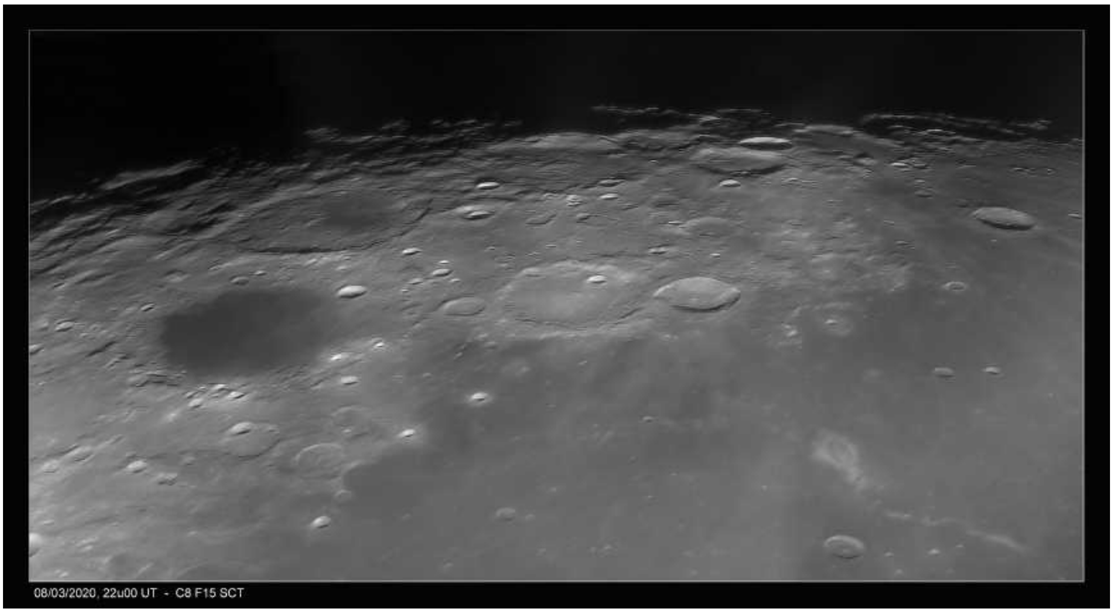
THE WESTERN LIMB

Alexander Vandenbohede

I attach some lunar observations made on 8 March 2020, using my Celestron C8 with 1.5x barlow and ASI290MM in prime focus. Seeing could have been much better but I took my chance because circumstances were good to have another look at the region around the Orientale impact basin.

Libration was quite favorable, -5°16' in latitude and -3°06' in longitude placing the area with maximum tilt towards the earth just north of Bailly. Colongitude was 82.5° which placed the terminator at the Montes Cordillera. It means that the inner part of the impact basin was not visible (in contrast to my observations from last month), but it means also that other interesting structures related to the impact can be seen optimally, especially the ejecta facies of the Hevelius Formation. Again, I rectified the images using LTVT.

The images below show how the ejecta blanket ruined craters like Hedin and Riccioli. This is all part of the so called facies B of the Hevelius Formation, the most common facies consisting of sinuous ridges that extend radially from the basin. It is the continuous ejecta blanket. Between Grimaldi and Riccioli (just south of Grimaldi A) facies D is present. This material is characterized by a lobate extension towards topographical lows. It is a pond of impact melt. The border of the lobe can be clearly seen as a white line; it represents a change in height of about 700 m!


08/03/2020, 22u00 UT - C8 F15 SCT


08/03/2020, 22u00 UT - C8 F15 SCT

RILLE NEAR LINNÉ G KC Pau

Here is a photo taken near the Valentine dome on 1 March 2020. I spotted a tiny dark streak (or may be a tiny rille) south of crater Linné G. It ran in a direction from west to south-east. I checked with the LROC-QuickMap and there is a barely seen dark line at the same location. I wonder if it is a rille or something else. It may be an interest for Lunar Section members to image this area at higher resolution. My instrument is 250mm f/6 Newtonian reflector + 2.5X barlow + QHYCCD290M +450 frames stacked. The image was taken on 1 March 2020 at 11h33m UT and the colongitude was 350.8 degrees.

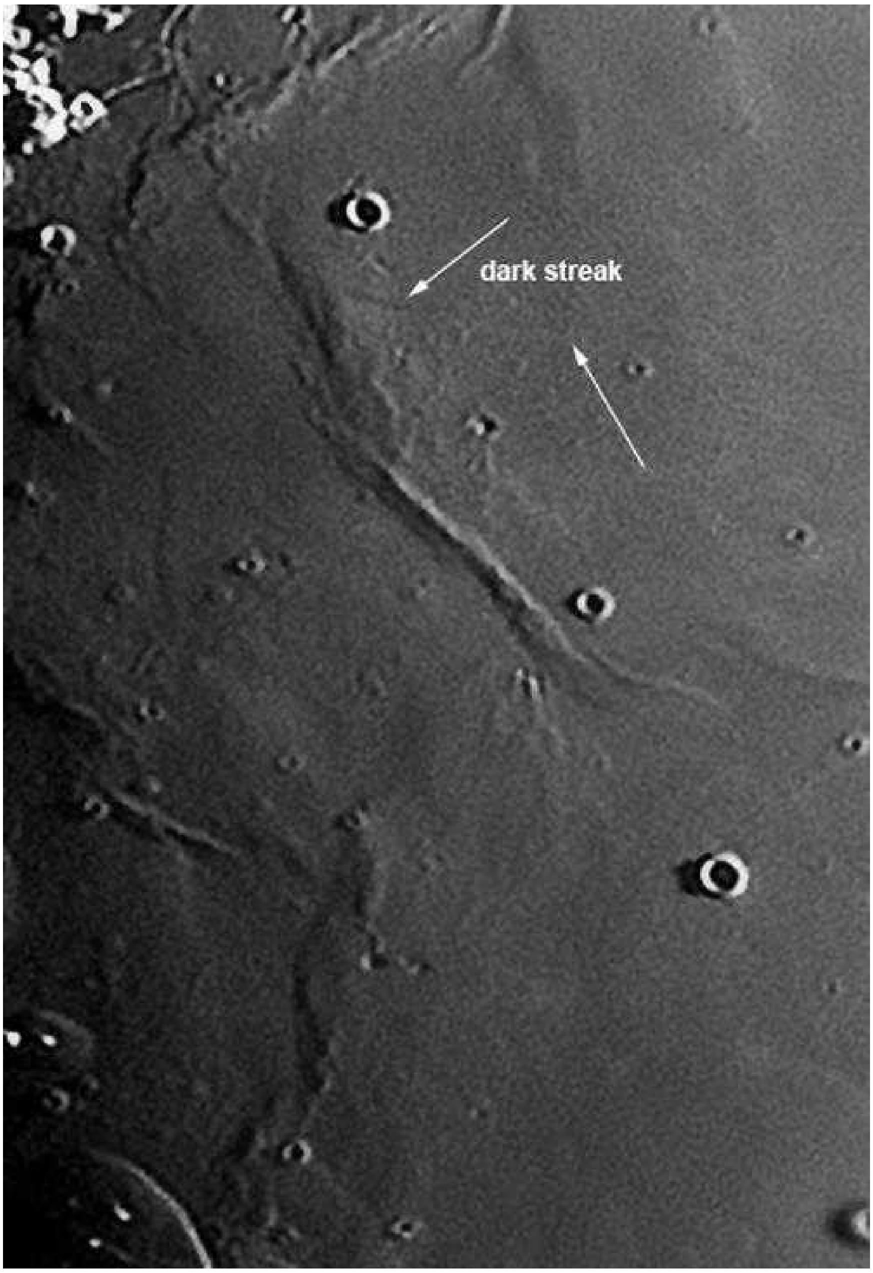
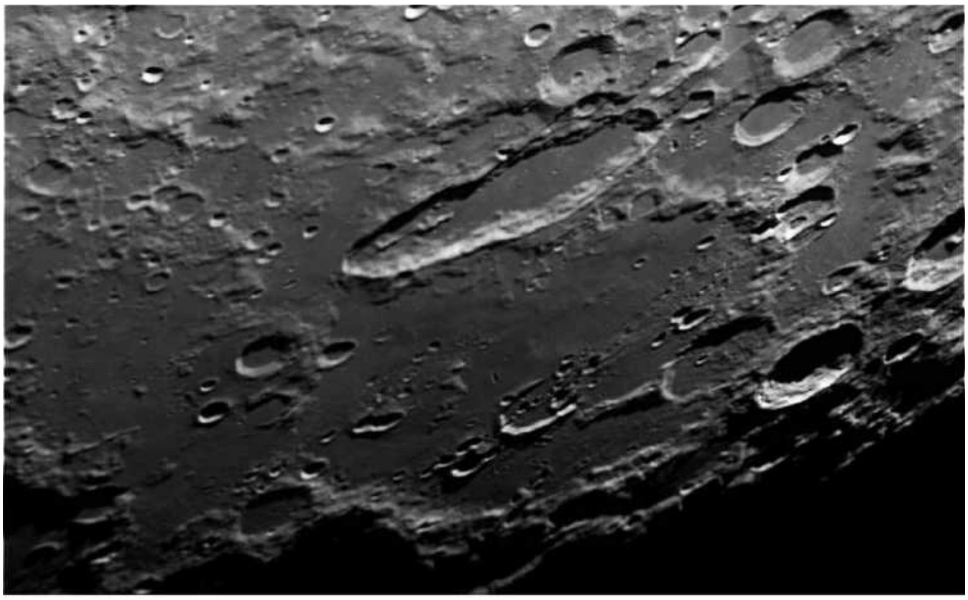


IMAGE GALLERY

Sacrobosco 2020.03.01 18:56 UT, S Col. 354.8°, seeing 4/10, transparency fair.
Libration: latitude +04º23', longitude -07º04'
305mm Meade LX200 ACF, f 25, ZWO ASI 120MMS camera, Baader IR pass filter: 685nm.
640 frames processed in Registax 6 and Paintshop Pro 8.
Dave Finnigan, Halesowen

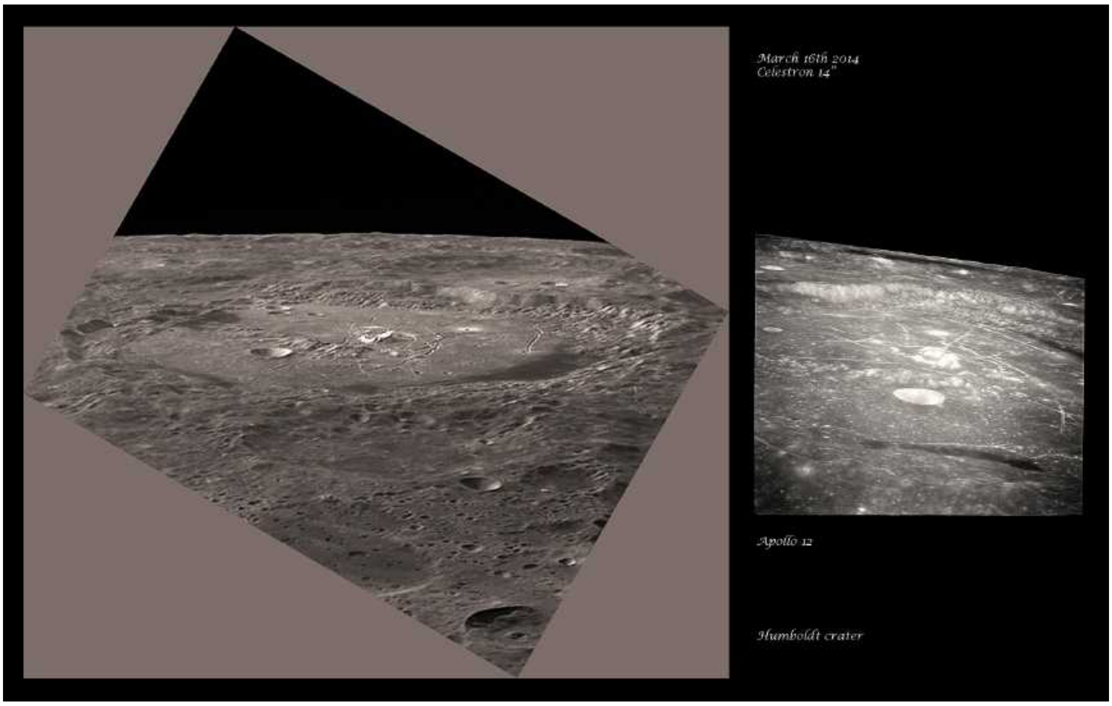


Schiller 2020.03.06 - 18.53 UT
300mm Meade LX90, ASI 224MC Camera with Pro Planet
742nm I-R Pass Filter. 500/5,000 Frames. Seeing: 7/10.

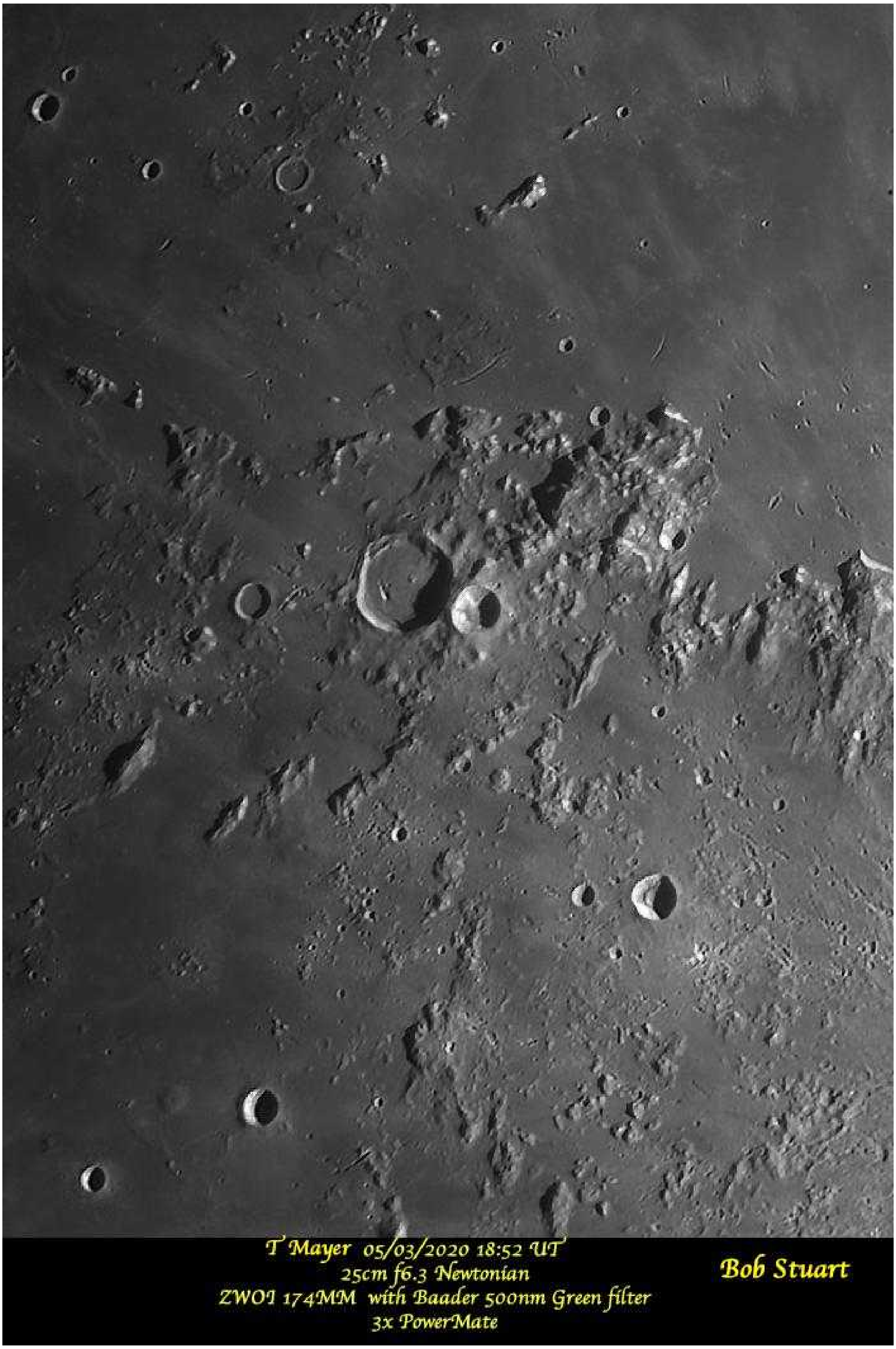
Rod Lyon

Birt and Rupes Recta, 3 March 2020, C8 SCT (Ken Kennedy)

Image by Rob Davies



Leo Aerts' recently reprocessed image of Humboldt crater bears comparison with an image taken from Apollo 12


T Mayer 05/03/2020 18:52 UT
25cm f6.3 Newtonian
ZWO1 174MM with Baader 500nm Green filter
3x PowerMate
Bob Stuart

LUNAR DOMES (part XXXVI): A large intrusive dome near Turner F and Gambart Raffaello Lena

Lunar domes have formed as effusive shield-like volcanoes, or the magma remained subsurface as laccoliths. In the former case, lava flows accumulated around the vent, building up a volcano on the lunar surface. In the latter case, magma accumulated within the lunar crust, slowly increasing in pressure and causing the crustal rock above it to bow upward. The profile of domes that are flat suggests that there was no gradual inclination at the vent (the rising lava did not build up the dome in a series of flows) but a subsurface intrusion of magma (intrusive origin) [1, 2]. To date, only a fairly small number of intrusive domes have been examined in detail with respect to their morphometric properties. Common properties of and differences between intrusive lunar domes and possible equivalent features on the Earth are not yet fully understood. In this contribution I examine a dome near the crater Turner F and Gambart which is located in the southern part of Mare Insularum at longitude 14.84° W and latitude 0.84° S, having a diameter of about 30 km (Figs 1 and 2). It is not shown on the USGS lunar geologic map I-458 of the Riphaeus Mountains region of the Moon [3].

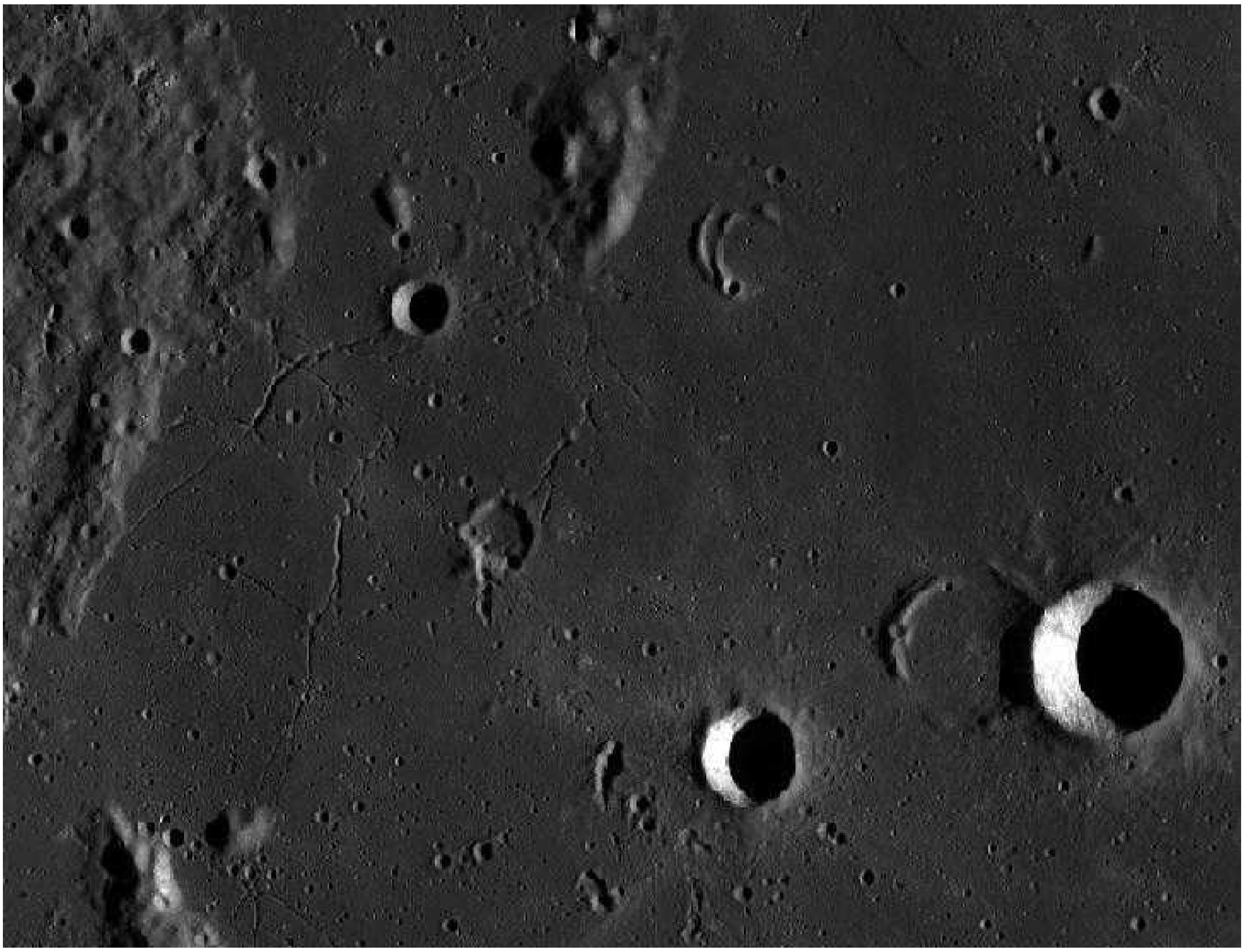


Figure 1: WAC image of the examined dome, with rilles on the summit.

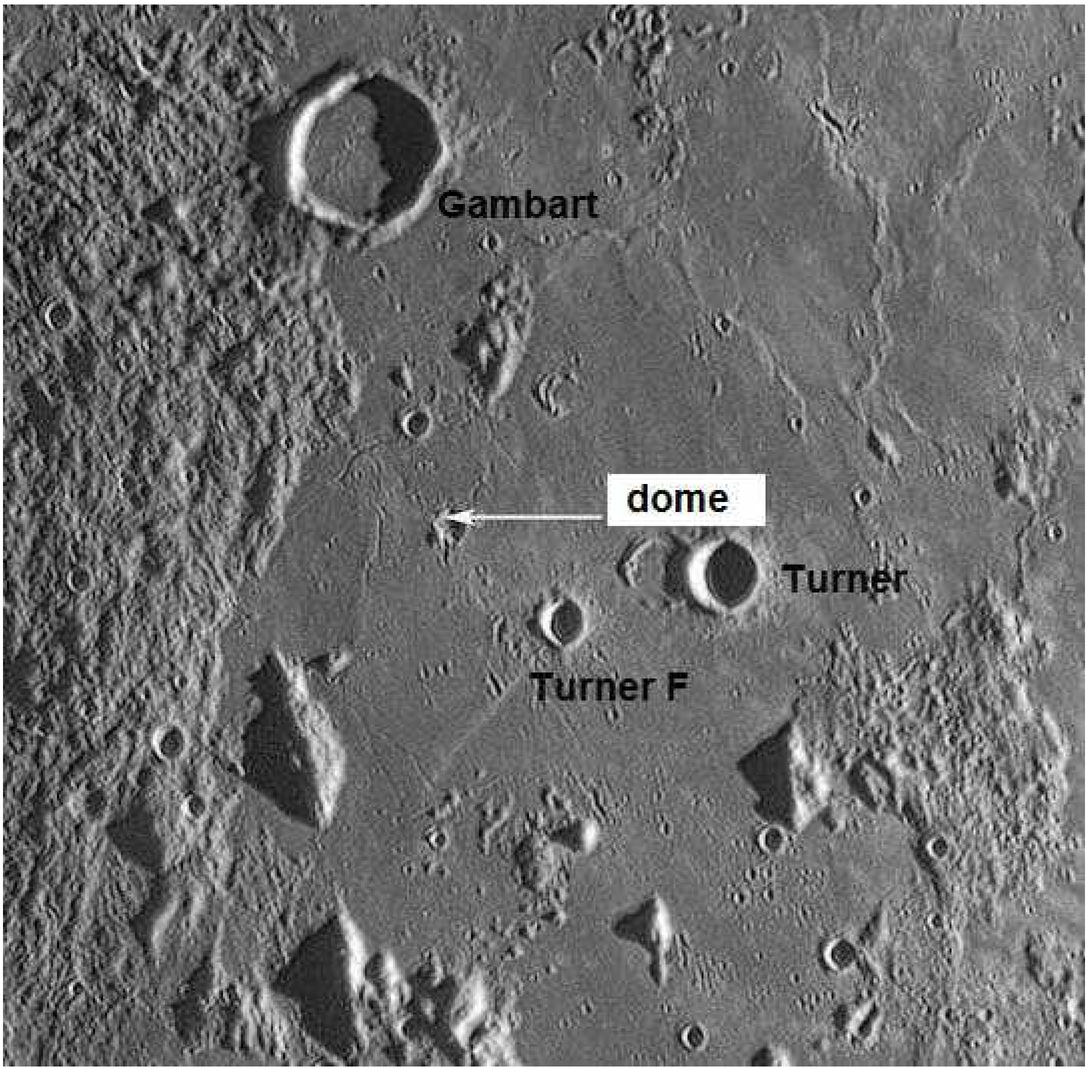


Figure 2: WAC image of the examined dome, image taken by George Tarsoudis (in our archive).

The height of the dome has been determined to 140m and the average flank slope corresponds to 0.57°.

I have recently used the LOLA DEM comparing the results obtained with spaceprobe data to previous measurements based on CCD telescopic images.

The ACT-REACT QuickMap tool is thus used to access the LOLA DEM, allowing us to obtain the cross-sectional profiles (Fig. 3).

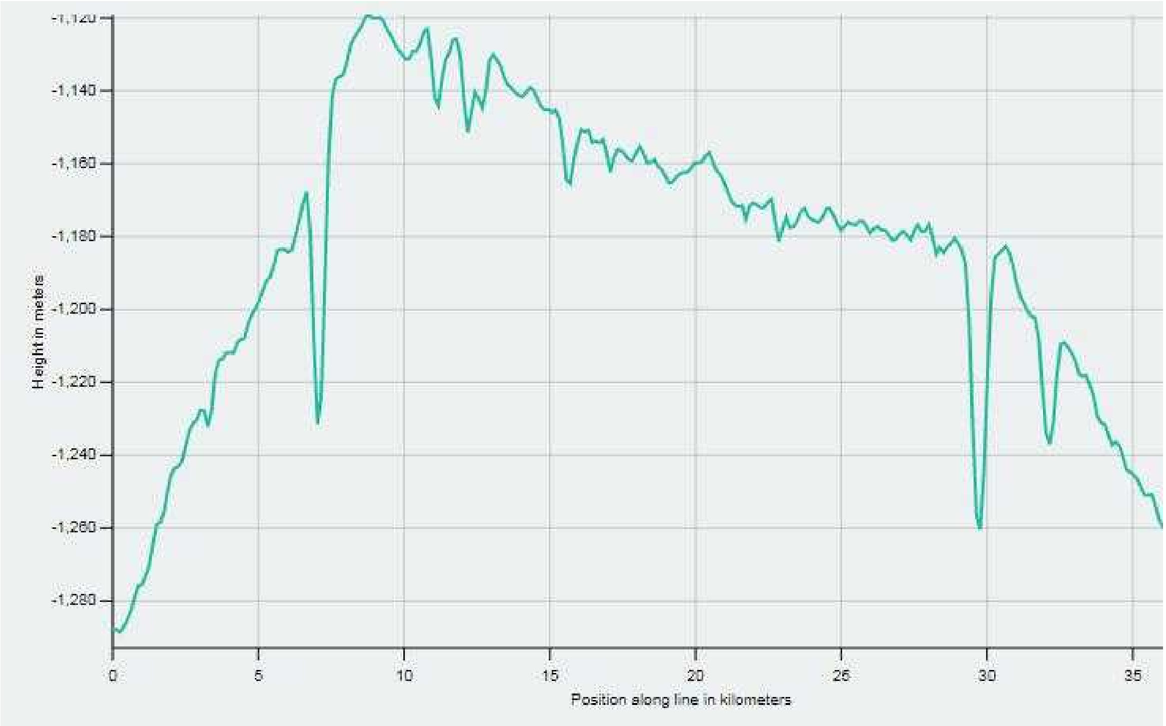


Figure 3: LOLA DEM and profile in E-W direction of the examined dome, near the craters Turner F and Gambart.

Several individual rilles can be distinguished on its surface (Figs 1-2).

In the northern part of this dome there is a straight rille, likely due to tensional stresses, consistent with laccolith formation. Further rilles are visible on the surface of the ridge located nearby in southwestern direction but not on the dome itself. Possibly the structure extends into the ridge [4]. It would then be the manifestation of a subsurface volcanic dike with sill formation. Intrusive domes do not have summit pits [2].

They are characterized by low flank slopes always well below 1°, in the range 0.1°–0.7°. Intrusive domes with even lower flank slopes may exist, but such structures would be extremely difficult to observe. Many domes of intrusive nature are characterized by straight rilles traversing their surface and/or by the presence of preexisting engulfed small peaks, as it is the case for the examined dome. Hence the rilles and tensional fractures observed on the surface suggest that they are associated with dikes that remained subsurface but ascended to shallow depths below the surface [2].

The present dome belongs to class In1 of possible lunar intrusive domes (Fig. 4). The first class, In1, comprises large domes with diameters above 25 km and flank slopes of 0.2°–0.7°; class In2 is made up by smaller and slightly steeper domes with elongated shapes and diameters of 10–15 km and flank slopes between 0.4° and 0.9°. Domes of class In3 have diameters of 13–20 km and flank slopes below 0.3°.

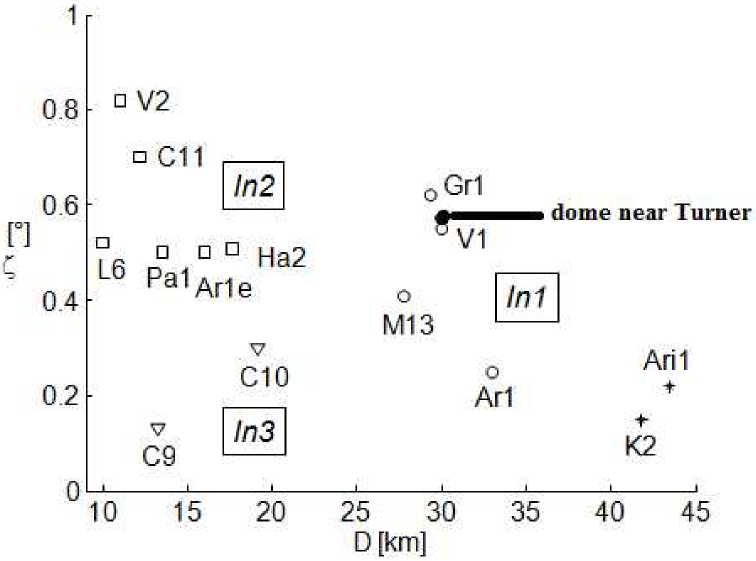


Figure 4: Diameter D vs. flank slope ζ diagram (indicating the dome classes In1–In3) of the candidate intrusive domes as introduced in [2].

Slightly different solar elevation angles may result in strong differences in the appearance of the dome. The 'ideal' image should be taken under a very low solar angle (see Fig. 5) close to the terminator. On August 7, 2007, at 02:18 UT I imaged the dome and the image shown in Fig. 5 displays clearly its elevation. In fact it displays a curved edge, showing that the centre of the structure is higher than the edges.

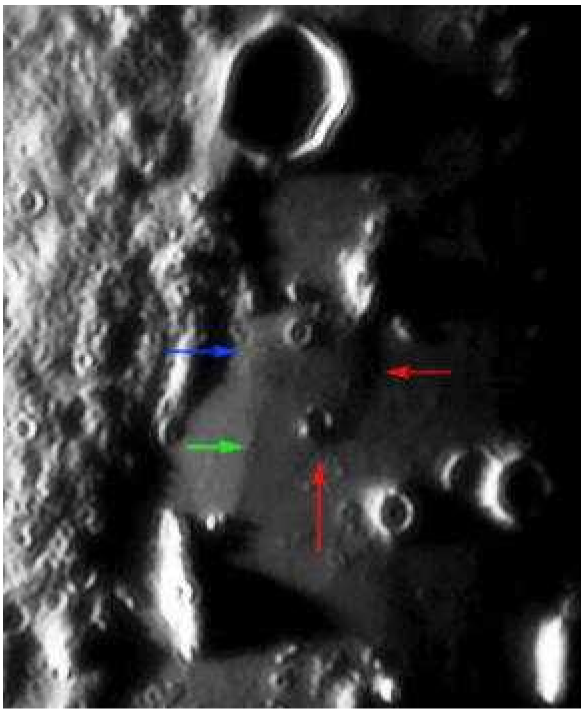


Figure 5: Dome near crater Turner. Image acquired by the author on August 7, 2007, at 02:18 UT with a 180 mm aperture Maksutov Cassegrain. The blue arrow marks a rille, the green arrow a ridge.

It is an interesting object for lunar observers to improve their knowledge of lunar domes and, of course, for lunar imagers interested to image it at higher possible resolution under low solar illumination angle. I will be happy to receive further images of this dome.

References

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

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

[3] Eggleton (1965) USGS I-458.

[4] Lena et al. (2005). 'A study about a lunar dome near the crater Turner'. *JALPO,* 47-2.

[*Note from the Director:* At the time of writing I am pleased to say that Raf appears to be safe and well and is working from his home in Rome]

CLAVIUS, BUT NOT AS WE KNOW IT Barry Fitz-Gerald

The Nectarian age Clavius is probably one of the most familiar craters on the Moon, and with a diameter of some 230kms is probably one of the biggest. In fact it may even deserve promotion to the next league as a peak-ring basin, which is where the central peak of a complex crater is replaced by a continuous or semi-continuous ring of peaks. In this case only the north-western arc of the peak ring can be seen nestled between Clavius D and C, the remainder of the ring being submerged by light plains type deposits. The nature of these deposits is still debated, but probably includes contributions from volcanic and basin-forming processes, and in the case of Clavius a liberal sprinkling of Tycho ejecta and melt deposits.. Located at almost 60° south, the view of Clavius from Earth is somewhat foreshortened but there is nothing to suggest it is anything other than a large circular crater. This perspective may, however, conceal some features that could cast a different light on its origin.

Fig. 1 shows Clavius and the terrain to the east as if viewed from vertically above, without any foreshortening, and what becomes visible is a crater chain running from the eastern rim of Clavius eastwards for some 570kms towards the crater Hommel. The chain is not obvious and appears to be very eroded and buried by later deposits especially near Clavius. Sufficient detail can however be made out to determine that the chain consists of lines of small craters, each approximately 6kms is diameter, with somewhat straight rims, giving them a rather boxy look. These lines of craters are as noted quite degraded, and it is only possible to say that proximal to Clavius there are maybe 2 parallel lines of craters, which then widen to 3 or 4 parallel lines to the south of Jacobi. East of Jacobi and between Mutus T and Tannerus the lines fan out over a smoother area of highland plains to form a broad and rather more conspicuous fan (Fig. 3).

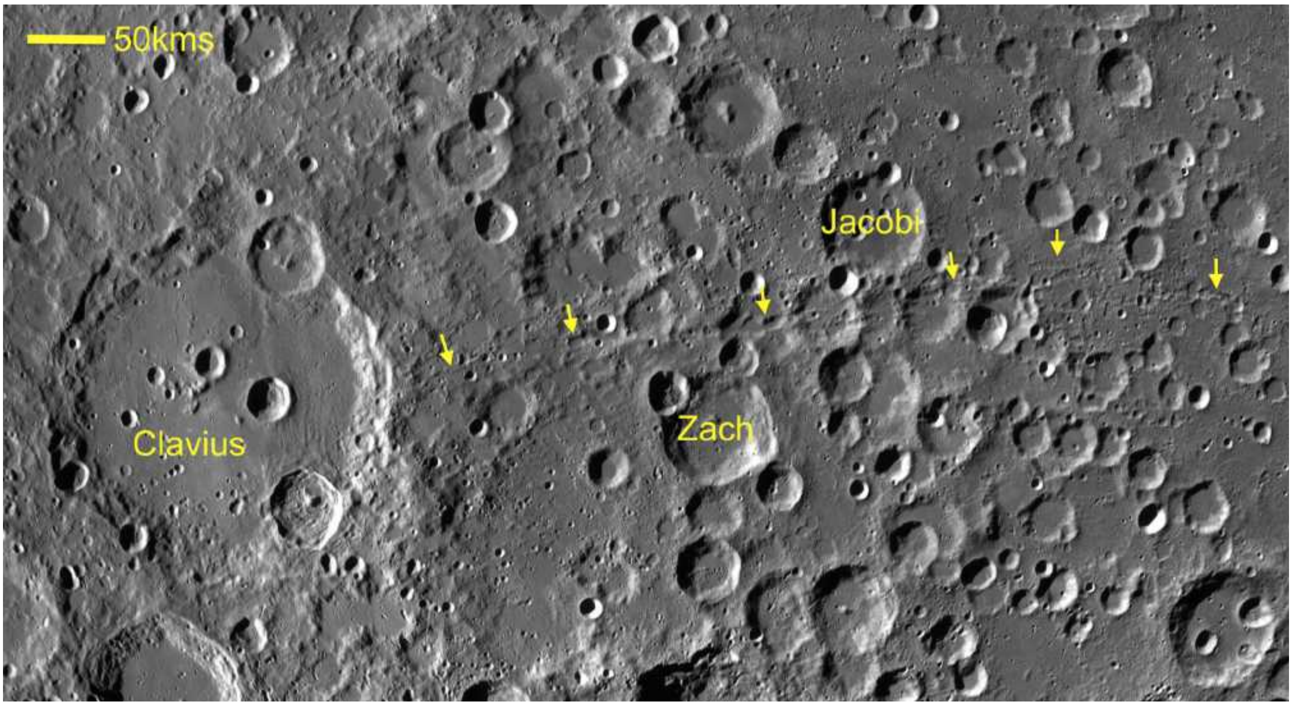


Fig. 1 View of Clavius from vertically above showing crater chain extending from the eastern rim towards the east for some 570kms.

Crater chains such as these are usually produced by secondary impacts, with the 'boxy' look to the individual craters being quite characteristic. Secondary crater chains surrounding the Orientale Basin have this squared-off look, the impression being a result of the straight septum that forms as adjacent secondary projectiles impact virtually simultaneously.

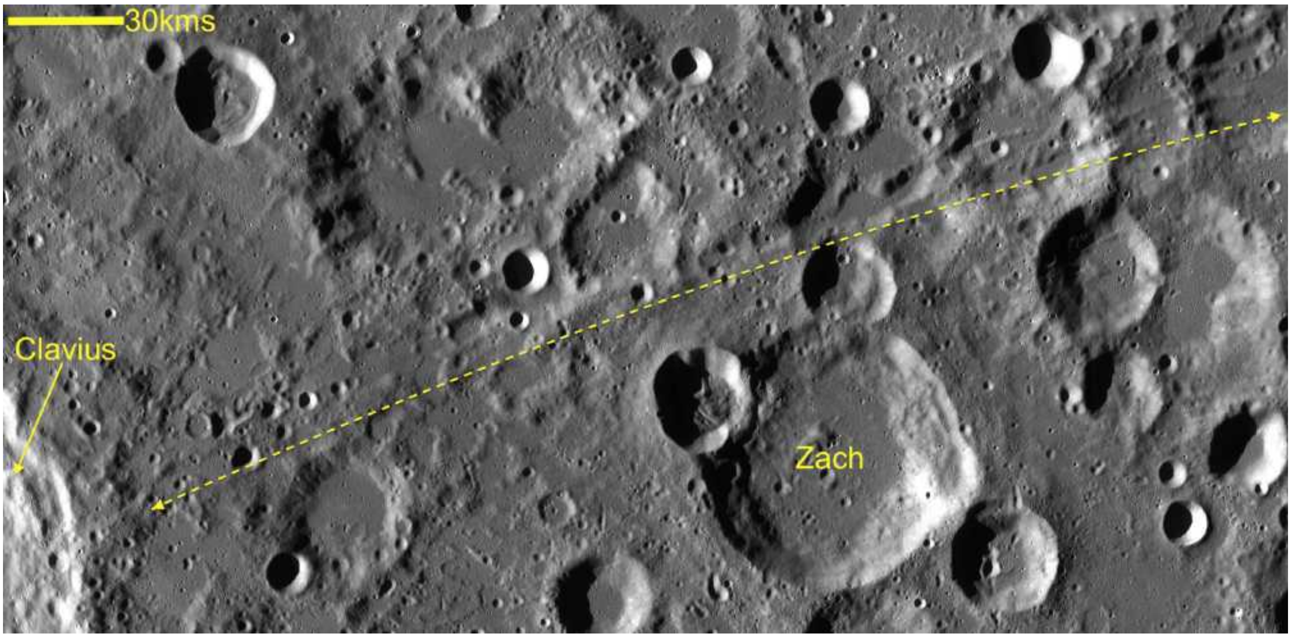


Fig. 2 Detail of crater chain extending from rim of Clavius to a point just south-west of Jacobi. Note the 'boxy' morphology of the individual but obscure craters.

One interpretation of this crater chain therefore is that it is a secondary feature formed during the Clavius impact, and as Clavius is a Nectarian Age crater, this would explain its degraded nature. But unlike the Orientale Basin where crater chains extend radially in most directions, this is the only 'prominent' crater chain visible in the vicinity of Clavius, an observation that if accurate requires some explanation.

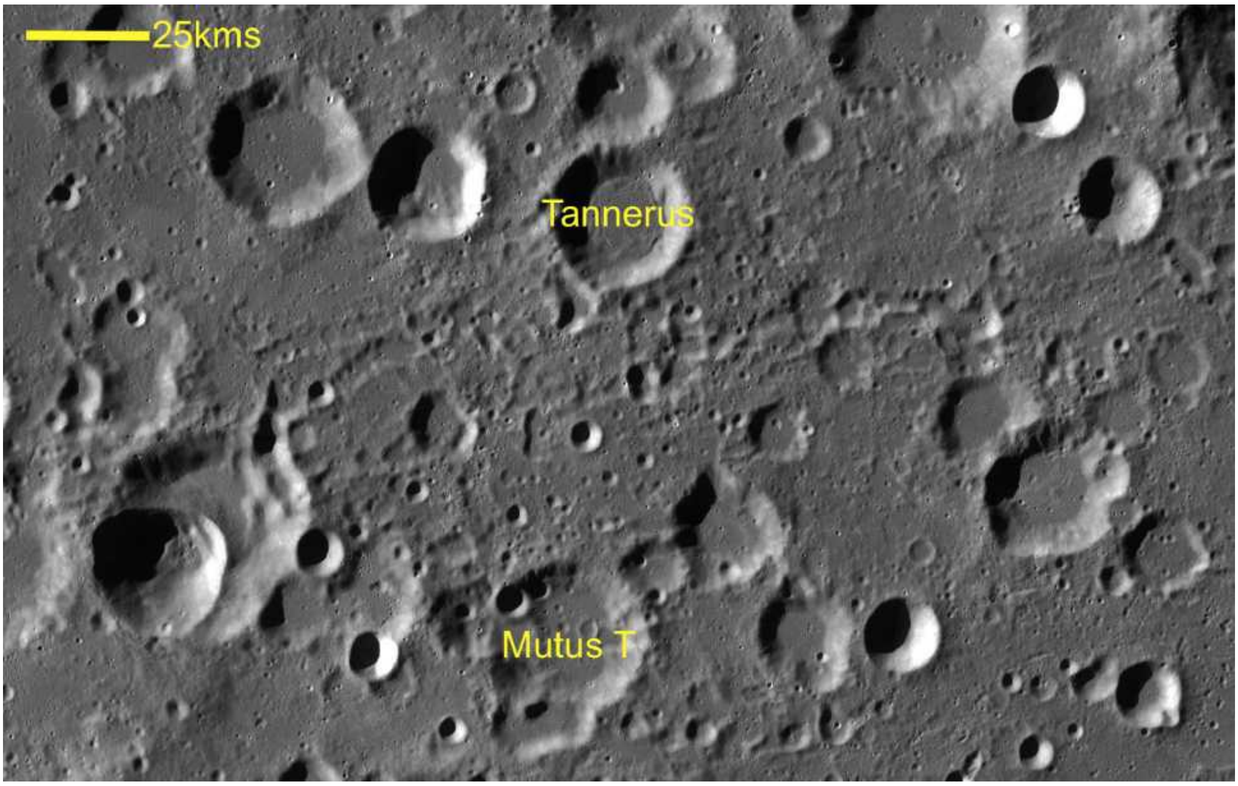


Fig. 3 Crater chain from Jacobi to just west of Hommel. Note the crater chain fans out between Tannerus and Mutus T. The boxy nature of the craters is well seen to the south of Jacobi.

Some clue as to what may be going on can be found on the lunar far side and Mare Moscoviense. This mare is only the central part of a large multi-ringed impact basin with an outer ring diameter of around 450kms, so a different creature to Clavius altogether. There are however some features common to both that may owe their origin to the same or comparable processes. The Moscoviense Basin has been termed a 'Tomahawk Basin' (Schultz and Stickle, 2011) due to the shape of the basin and in particular the shape of the mare filled inner part. This is the result of the basin-forming impact being a low-angle one, with the impactor arriving from the south-west, and with the added complication that the impactor suffered 'decapitation' with the upper parts shearing off the main body and continuing downrange to form their own impact structures. In the case of Moscoviense this produced a fan of secondary craters to the northeast (downrange) and a line of line or lines of secondary craters along the impactor's azimuth direction (Fig. 4). These secondary craters are very degraded but where visible can be seen to have the boxy morphology we saw in the Clavius crater chains.

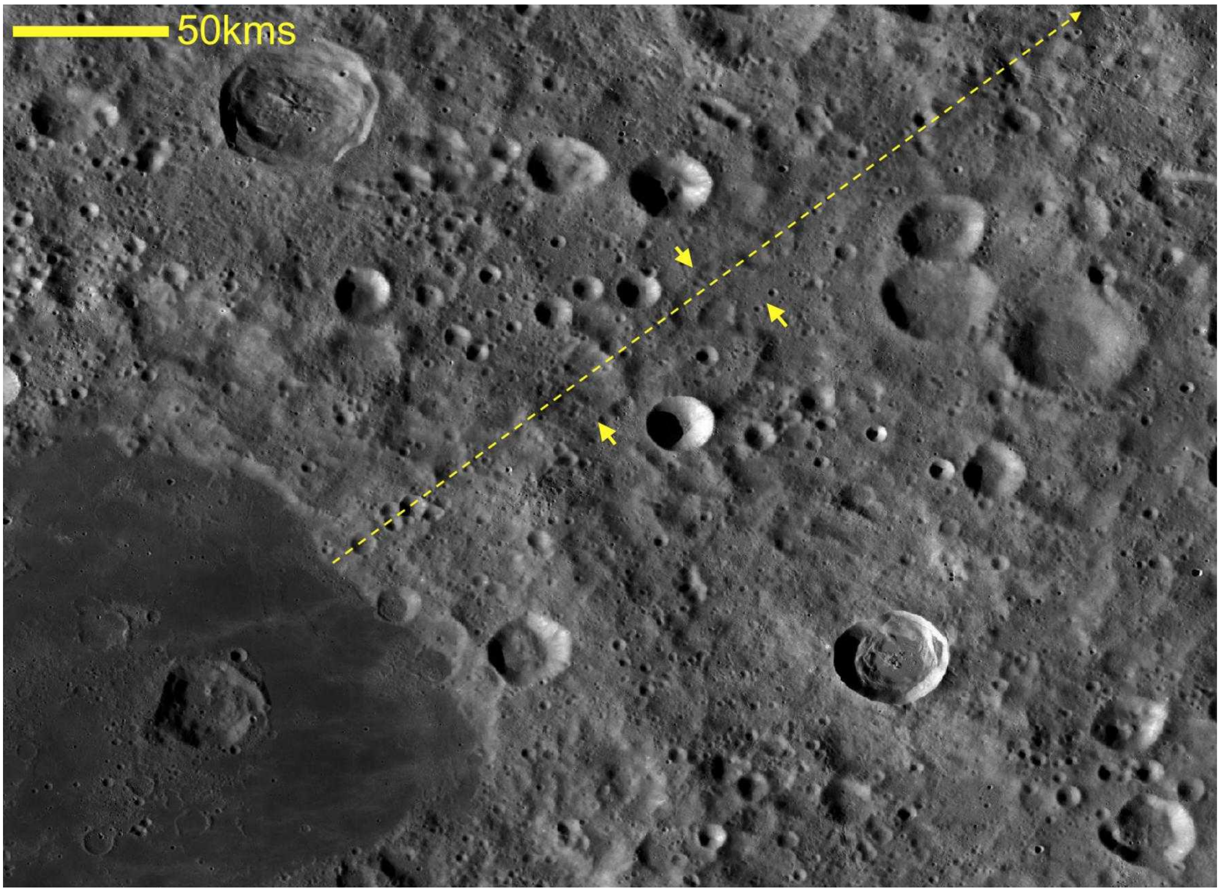


Fig. 4 North-eastern section of the Moscoviense Basin showing line(s) of highly degraded boxy craters extending away from the down-range rim.

Another result of oblique impact in basin formation is that the down-range massif is more pronounced than the up-range one (Schultz , et.al., 2012), an effect believed responsible for the prominence of the Apennines when compared to remainder of the rim of the Imbrium Basin. We can see this in Moscoviense (Fig. 5) where the northeastern inner ring (down-range) is enhanced compared to to the southwest (up-range). A similar situation applies in smaller low-angle impacts where the up-range rim is lower than the down-range one.

If we go back to Clavius we can see that the crater chain would make sense if Clavius was a low angle impact crater with the impact direction from west to east, making the eastern rim the down-range one. In Moscoviense we also have a fan of other highly degraded secondary craters in the down-range direction, and a careful look at the surface to the east of Clavius (just to the south of Deluc D for example) also reveals indications of highly degraded box-shaped craters consistent with this type of distribution (Fig. 6).

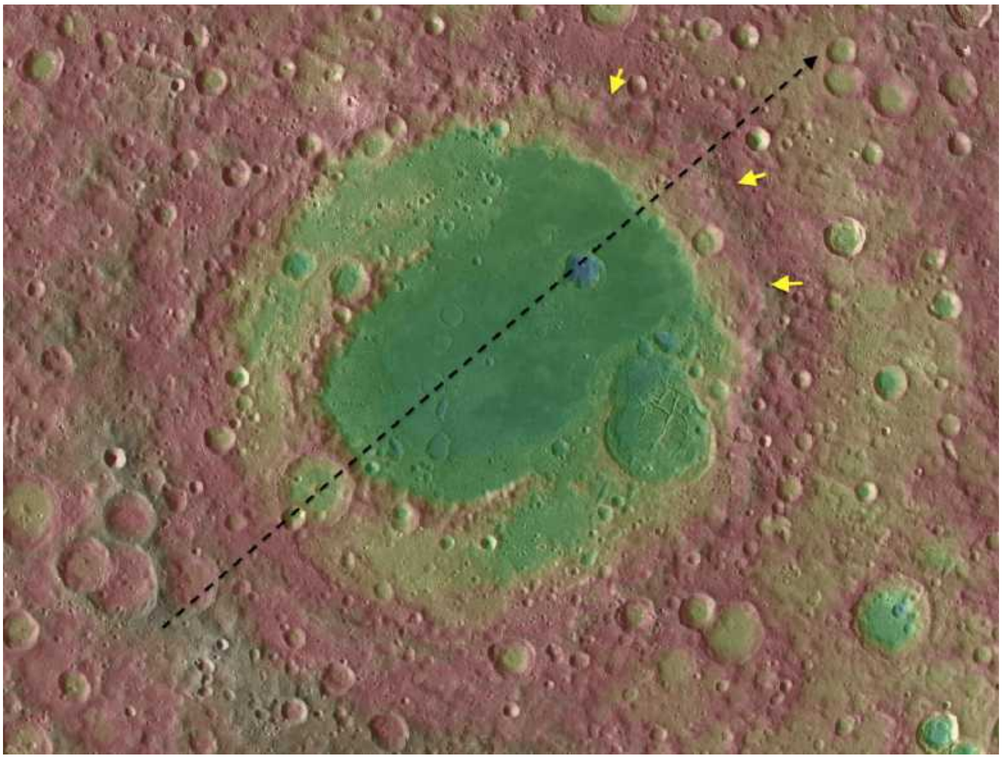


Fig. 5 GLD100 (60S to 60N) + LOLA (60-90) overlay for the Moscoviense Basin showing the more well developed down-range massif (yellow arrows) and the proposed impactor direction of flight (black dashed arrow). Browns indicate highest topography.

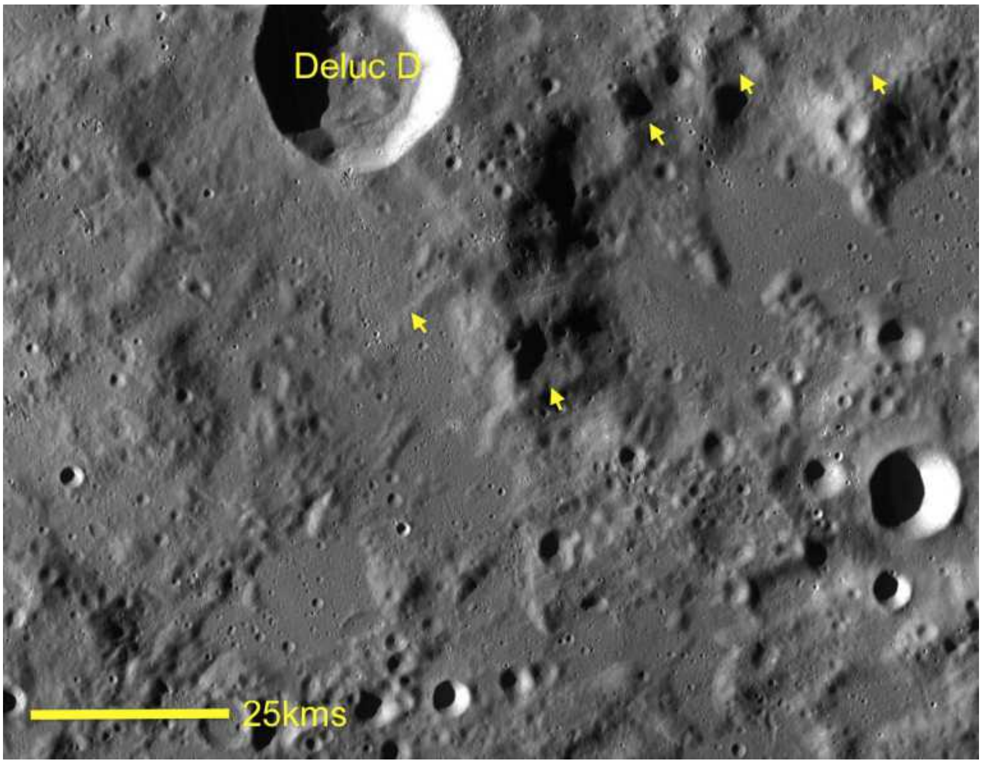


Fig. 6 Highly degraded box-shaped craters and linear features to the east of Clavius consistent with a fan-shaped distribution of secondary impacts.

The topography of Clavius is also comparable to Moscoviense as can be seen from Fig. 7 which is another GLD100 overlay image, but this time of Clavius. The elevated nature of the eastern rim massif as compared to the western is apparent with the former corresponding to the down-range rim if Clavius were indeed a low-angle impact crater.

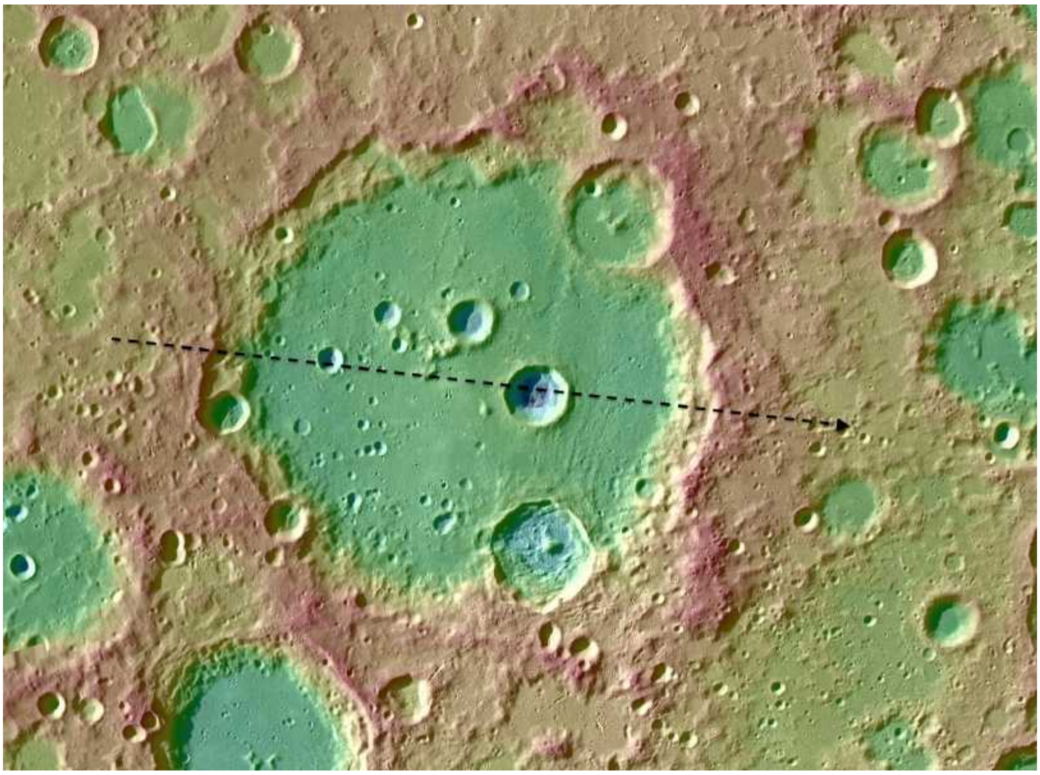


Fig. 6 GLD100 (60S to 60N) + LOLA (60-90) of Clavius showing the elevated eastern rim massif. Black dashed arrow suggests the possible trajectory of the impactor that produced the crater.

The possibility that Clavius is a low-angle impact has been suggested before (Li, et.al) and the presence of the crater chains and enhanced down-range rim would appear to support this conclusion. Additional support for this view can be found in the disposition of proximal ejecta which is visible outside the rim of Clavius. Unfortunately this ejecta is only clearly visible outside the northern and eastern rims; to the south this ejecta is not so readily apparent. The ejecta that is visible *appears* to reflect a somewhat enhanced distribution to the north in the form of stubby lobe-like extensions which may reflect an enhanced cross-range distribution which is another feature of low-angle impacts (Fig. 7). To the south-west a short degraded boxy crater chain can be seen on the floor of Scheiner that may be related to Clavius. If so, this might represent part of the up-range ejecta pattern, most of which is now lost due to burial and erosion (Fig. 8), but which may have included a Zone of Avoidance to the east.

The area around Clavius is covered by many linear features which are nothing to do with the crater and probably represent regional tectonic features related to older impact basins. The Clavius crater chain is however definitely a crater chain and not a tectonic feature, but it is also possible that it has nothing to do with Clavius itself. One possible but unlikely source could be the Orientale Basin but if this was the case, some trace of it should be visible on Clavius's more ancient crater floor, and in any case it is not radial to the larger basin. Another possible source could be the nearby Schiller-Zucchius Basin, but this is Pre-Nectarian in age and few of its secondary craters are preserved and these are all highly eroded and indistinct. A linear feature near the southern rim of Clavius (Fig. 7) and another west of Blancanus (Fig. 8) are roughly orientated with the Clavius crater chain, but both appear to be tectonic features and are not obviously impact structures. In short there are many linear features in this area but none of them are obvious crater chains such as the one east of Clavius.

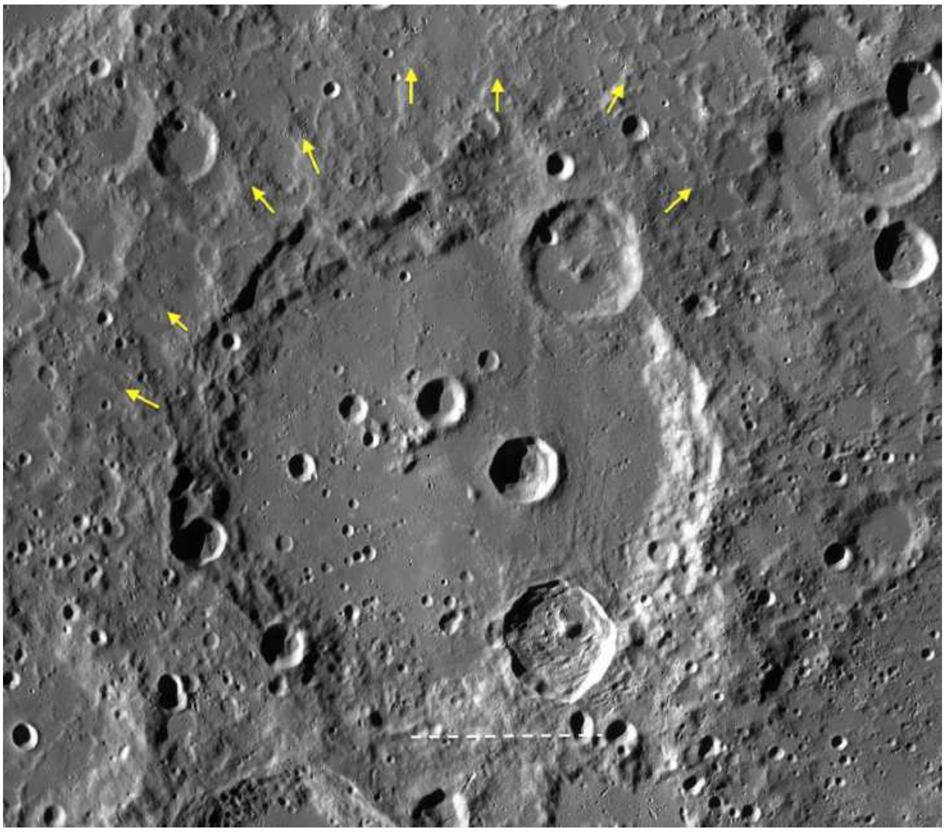


Fig. 7 Lobes of proximal ejecta (yellow arrows) to the north of Clavius, showing a somewhat cross-range distribution. Other linear features orientated similarly to the crater chain are present in the Clavius area, one is marked with a dashed white line in this image.

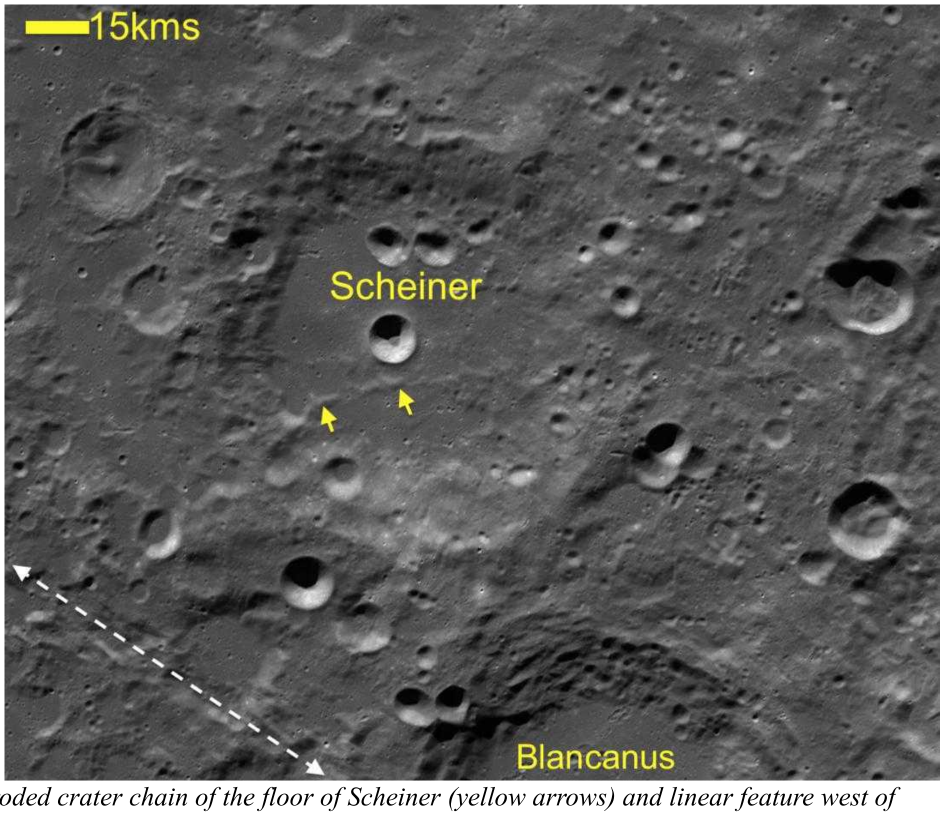


Fig. 8 Eroded crater chain of the floor of Scheiner (yellow arrows) and linear feature west of Blancanus (white dashed arrow)

Many low-angle impact craters and basins have secondary crater chains extending away in the down-range direction, and so the presence of such a structure associated with Clavius is not a big surprise. That of course pre-supposes that Clavius is such a crater, and the foreshortened telescopic view gives no indication that it is. The crater chain seems to be virtually undetectable in most terrestrial images, though it is visible in some Consolidated Lunar Atlas images (although it helps to know what you are looking for). A simulated view from lunar orbit such as the one in Fig. 9 provides a more convincing link between the crater chain and Clavius and provides a different perspective on a familiar feature.

Please have a look for yourself at this area at http://lroc.sese.asu.edu/ and use some of the numerous overlays and 3D globe function which is particularly useful in working out relationships between various topographic features.

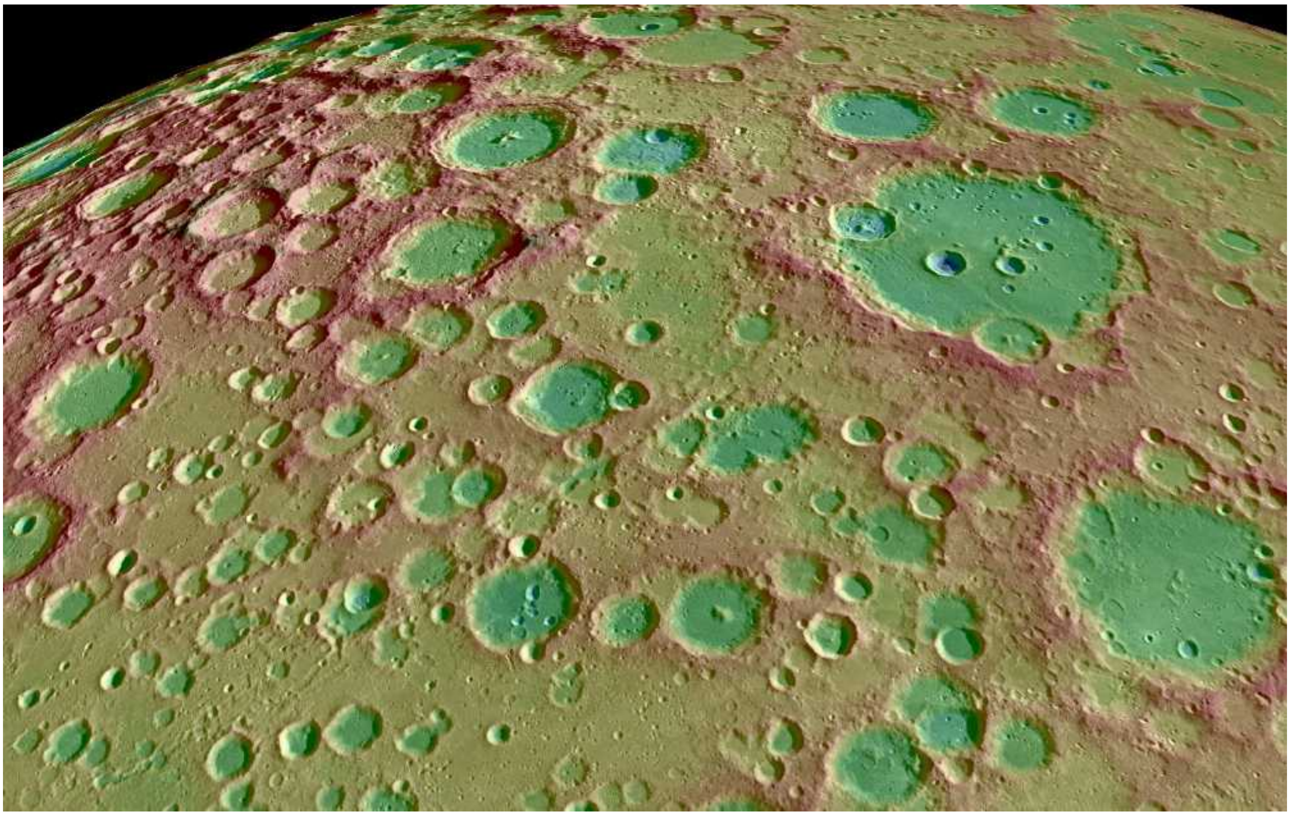


Fig. 9 3D Globe (LRO Quickmap) view of Clavius from the northeast showing the crater chain emerging at the eastern rim and heading towards the bottom left hand corner of the image. A GLD100 overlay provides an indication of topography.

Acknowledgements:

LROC images reproduced by courtesy of the LROC Website at http://lroc.sese.asu.edu/index.html, School of Earth and Space Exploration, University of Arizona.

References:

Schultz, P. & Stickle, A. (2011) Arrowhead Craters and Tomahawk Basins: Signatures of Oblique Impacts at Large Scales. 42nd Lunar and Planetary Science Conference (Abstract)

Schultz, P., Stickle, A. & Crawford, D. (2012). Effect of Asteroid Decapitation on Craters and Basins. 43rd Lunar and Planetary Science Conference (Abstract)

Li, B., et.al. (2015) The Shape and Elevation Analysis of Lunar Crater's True Margin. 46th Lunar and Planetary Science Conference (Abstract)

LUNAR OCCULTATIONS April 2020 Tim Haymes

SPECIAL EVENT ZC1014 March 4th

As mentioned previously, this star was (and still is) a suspected double star. Recent observations of the dark limb disappearance have helped, but more observations are needed in due course of the Saros.

Observations of ZC1014 are reported by Tim Haymes (BAA) and Oliver Klös (IOTA-ES). The former in the UK was made in cloudy conditions and a single contact (DD) was timed but a fainter companion was not detectable owing to very poor signal-to-noise.

The second observation was by Oliver Klös in Germany (personal communication) in good conditions but no step event was detected at 20ms time resolution. This suggest the star is not a double, or was unresolved at this particular limb contact angle.

Further observations of double stars (project fade).

Phillip Denyer (Hornchurch) reports a successful double star detection on 2020 Feb 29, 1900UT when X64337 of magnitude 9.5 was occulted. The companion was about 0.3 mag fainter, and the step duration 800ms. A WAT-910HX video cameras and C11 were used.

Tim Haymes recorded a long duration step event while observing the wide double STF777 (X7439) in Taurus on 2020 Mar 3rd. The duration was 11.0 seconds. The instrument was a 203mm F/4 and QHY174m-GPS in AVI mode 40ms exposure. Video here: https://www.youtube.com/watch?v=kyoKiFb_A6s

The observation and reporting of double star occultations provides an independent method of finding their separation and positions angle, particularly when the companion is difficult to resolve.

Reporting double star step events.

The coordination of double star observations (Lunar) has been passed to *Martin Unwin* (NZ) unwinm51@gmail.com The project's initiator: Brian Loader (NZ), has retired from the analysis. We are in indebted to Brian for the many occasions he has explained the finer points in the use of light curve analysis with Limovie. The occultation sub-Section now has a good set of notes and examples to help us, written largely by Alex Pratt. Please enquire for these notes if you wish to take part in this aspect of the Lunar Section Occultation program.

Reporting Total Lunar occultation

Jan Manek (IOTA regional collector 4 Europe) asks that all observations be sent to him at lunoccult@iota-es.de Reductions will be sent to the observer. Jan has written some notes on the reporting of observations, which I would like to summarise here.

Jan Manek wrote:

'The preferred address is **lunoccult@iota-es.de** and any reports sent there are also archived there. I monitor and download the reports from there and process them. Due to various SMTP related problems, the preliminary reductions (with possible questions included) are sent from different email address. Please send observations on a regular basis.

Basically there are two formats accepted - simple text file (but strictly formatted) and Excel file. Any other format is not supported and will not be processed. The formatted .dat text file is generated from Occult4. There is a small reporting tool that can be used (lunarReport.exe) which avoids the full installation of Occult4, and this small app prepares the correct format.

The Excel sheet is the second option - but only the prepared one by IOTA, used according to directions. (LunarOccultationReportForm V2.0c5.xls and "Using the New Excel Lunar Occultation Report Form.doc").

The files and instructions can be **requested from Tim Haymes.** I have a google drive address to access them. It's advisable to send your *first* report to Tim for checking. Further reports can be sent to me at lunoccult@iota-es.de'.

Grazing Occultations

Please use the Occult4 .dat report format. I will check it and forward the report to Mitsuru Soma (Global Collector) Mitsuru.Soma@nao.ac.jp

More experienced observers can check their residuals with Occult4 and send their .dat file direct to Mitsuru Soma with a copy to Jan Manek.

Reduced Observations 2018, 2019

Reductions have been received by the Section from Jan Manek. Anyone who has not received their reductions should sent a copy of the original report to Tim Haymes who will investigate.

Consistency of timing events.

Dave Herald – author of Occult4 and IOTA global data coordinator, and Dave Gault, describe a method of time-checking which is published in the *Journal for Occultation Astronomy (JoA) 2020-1*

All-of-System Time Testing Lunar Occultations
Dave Gault and Dave Herald http://www.iota-es.de/joafree.html

Summary: The method looks at the observers' event times and calculates the mean and deviation. This should be within a range of accepted values. The calculation is automatically displayed in Occult4 version 4.9.5 using the [Reduce & Plot] button on the reporting page.

The same analysis is provided by Jan Manek in his reduction sent to observers. Here are the reductions for the writer for observations in 2019:

Quarter-1 [23 observations] Mean clock correction +0.00 +/- 0.06 sec
Quarter-2 [22 observations] Mean clock correction +0.03 +/- 0.06 sec
Quarter-4 [2 observations] Mean clock correction +0.01

These indicate good observations made by analogue video and GPS video time insertion (VTI). One frame time at 25fps is 0.04sec.

This *analysis* is important when other methods of recording and time insertion are used or being considered. USB3/CCD cameras and computer derived time (e.g. TimeBox, NTP) can be assessed to establish if there is an offset compared to the so called 'gold standard' of analogue video and VTI which most observers currently use.

Visual timings can be assessed the same way by entering the observation details into Occult4 or LunarReport.exe. It's then possible to see if the observing method introduces a bias in the timing.

Visual and video timing of lunar occultations are used to examine long term variations in the Moon/Earth system and to monitor stars for undetected multiplicity, or changes in separation and position angle. Sometimes a single video observation might show an apparent anomaly in the LOLA limb profile.

2020 April predictions for Manchester (Occult4 by D.Herald).
W. Long. 002d 15', N Lat. +53 25', Alt. 50m
Events excluded: Daytime, Bright-limb

y	m	day d	Time h	m	s	P	Star No	Sp	Mag v	Mag r	% ill	Elon	Sun Alt	Moon Alt	Moon Az	CA o	Notes
20	Apr	1	19	41	22.9	D	1100	K	8.2	7.6	54+	95	-9	58	206	87N	
20	Apr	1	19	55	54.7	D	79211	K0	8.7	8.1	54+	95	-11	57	212	56N	
							79211 is double: ** 9.3 9.3 0.10" 244.0, dT = -0.28sec										
20	Apr	1	23	39	19.9	D	79330	K0	7.8	7.3	55+	96		28	271	42S	
20	Apr	2	0	2	34.2	D	1118	A1	6.2	6.2	56+	96		25	275	56N	58 Gem
20	Apr	2	0	28	7.4	D	79364	F5	8.2	8.0	56+	97		22	280	51N	
20	Apr	2	20	59	6.6	D	80053	A0	9.0	8.9	65+	108		55	213	67S	
20	Apr	2	22	26	46.5	D	80087	K0	7.9*	7.2	66+	108		45	241	86S	
20	Apr	2	23	0	26.5	D	80094	K2	8.0	7.4	66+	109		41	249	38S	
20	Apr	3	2	37	25.4	D	1269	G5	6.9	6.3	68+	110		10	292	37N	

20	Apr	3	19	31	49.4	D		98432		9.0*	8.5	75+	120	-7	54	155	61N	
20	Apr	3	21	20	39.2	D		98460	A3	8.4*	8.3	76+	121		54	199	72S	
20	Apr	3	21	35	53.1	D		1377	A3	7.0*	6.9	76+	121		54	204	86S	
20	Apr	3	22	32	36.3	D		98481	F0	7.9*	7.7	76+	122		49	224	67N	
20	Apr	4	0	57	47.1	D		98534	K0	7.7	7.0	77+	123		30	260	65S	
20	Apr	4	1	36	17.3	D		1392	G0	7.3		77+	123		24	268	82N	
20	Apr	5	3	25	35.3	D		99123	K0	7.3*	6.5	87+	138		13	275	52N	
20	Apr	5	19	50	21.5	D		99474	F8	8.4		92+	148	-9	37	131	50N	
99474 is double: AB 8.59 9.87 0.59" 302.3, dT = -1sec																		
20	Apr	5	21	30	49.5	D		1622	K2	8.2*	7.6	93+	149		45	161	34N	
20	Apr	6	23	7	5.9	d		119272	F5	7.6*	7.3	98+	163		40	176	65N	
20	Apr	8	21	11	32.8	R		2008	K0	6.6*	6.0	99-	168		12	122	65N	
20	Apr	8	23	59	30.5	R		139725	G0	8.1	7.8	99-	166		26	162	78S	
20	Apr	9	0	23	18.7	R		2020	A0	6.5	6.5	99-	166		27	168	43N	94 Vir
94 Vir is double: ** 7.4 7.4 0.10" 90.0, dT = +0.13sec																		
20	Apr	9	0	50	31.5	R		2022	F2	5.5	5.3	99-	166		27	176	66S	95 Vir
20	Apr	9	4	7	0.4	R		2032	F0	7.2	7.0	98-	165	-11	17	226	81N	97 Vir
20	Apr	10	2	9	0.6	R		159035	M3	8.1	7.3	94-	152		22	182	30N	
20	Apr	13	1	54	29.1	R		2607	O6	5.9	5.9	69-	112		4	141	67S	9 Sgr
20	Apr	13	2	35	47.1	R		2610	O8	6.9	6.8	69-	112		7	150	71S	
20	Apr	14	3	48	50.1	R		187660	K0	7.3	6.6	58-	99	-12	8	154	82N	
20	Apr	25	21	21	16.3	D		639	F3	6.1	5.9	7+	30		5	295	88S	85 Tau
20	Apr	26	21	17	38.0	D	X	72978		9.8	9.5	13+	42		15	286	47N	
20	Apr	26	22	15	38.9	D		782	A2	7.2*	7.1	13+	42		7	297	51S	
20	Apr	27	20	56	33.0	D		77942	B0	8.8	8.6	20+	53	-11	26	274	73N	
20	Apr	27	21	23	24.1	D	X	82809		9.7	9.7	20+	53		22	279	79S	
20	Apr	27	21	43	26.3	D		77975	B9	8.4	8.4	20+	54		19	283	58N	
20	Apr	27	21	43	50.4	D	X	83039		9.8	9.6	20+	54		19	283	67N	
20	Apr	27	21	45	57.6	D	X	8316	K5	9.7	9.0	20+	54		19	283	48S	
20	Apr	27	21	47	34.3	D		77979	A2	9.6	9.5	20+	54		19	283	56S	
20	Apr	27	21	51	52.7	D		77981	A0	9.1	9.1	20+	54		18	284	47S	
77981 is double: ** 9.8 9.8 0.10" 121.0, dT = +0.25sec																		
20	Apr	27	22	8	22.0	D		77996	G5	7.4	6.9	20+	54		16	287	37S	
20	Apr	27	22	14	22.9	D		78017	F0	9.6	9.4	21+	54		15	288	69N	
20	Apr	27	22	23	38.5	D		78030	K5	8.7	8.0	21+	54		14	290	72N	
78030 is double: ** 9.5 9.5 0.10" 72.0, dT = +0.19sec																		
20	Apr	27	22	57	49.8	D		929	B2	5.8*		21+	54		9	296	32N	3 Gem
20	Apr	27	23	6	27.8	D		931	B9	6.9*		21+	54		8	298	66N	4 Gem
4 Gem is double: AB 7.45 7.80 0.23" 32.9, dT = +0.36sec																		
20	Apr	27	23	47	18.6	D		942	M1	6.5	5.4	21+	55		3	305	84N	6 Gem
20	Apr	28	20	24	29.9	D		78963	A0	7.2	7.2	29+	65	-7	39	257	69N	
20	Apr	28	21	20	33.2	D	X	97021		9.7	9.1	29+	65		31	268	72N	
20	Apr	28	21	44	44.0	D		79010	K0	9.3	8.8	29+	66		27	273	68S	
20	Apr	28	22	32	9.3	D		79040	A2	8.8	8.8	30+	66		20	282	82S	
79040 is double: ** 9.4 10.0 0.14" 144.0, dT = +0.2sec																		
20	Apr	28	22	32	54.8	D		79041	M0	8.7	7.9	30+	66		20	282	79S	
20	Apr	28	22	44	26.6	D		79048	F5	8.3	8.1	30+	66		19	284	71N	
20	Apr	28	23	9	15.9	D		79060	K0	8.2	7.5	30+	66		15	288	73N	
20	Apr	29	22	0	43.6	D		79867	K2	9.0	8.4	39+	78		32	265	68N	
20	Apr	29	23	9	8.6	D		1215	K0	6.8*	6.2	40+	78		22	278	80S	7 Cnc
20	Apr	30	0	15	27.6	D		79946	F8	8.6	8.3	40+	79		13	290	68N	
20	Apr	30	20	36	58.0	D		80512	G5	9.1	8.6	50+	90	-8	49	229	50S	
20	Apr	30	21	2	50.4	D		80527	F5	8.2	7.9	50+	90	-11	46	236	66N	
20	May	1	1	2	41.2	D		1352	F5	7.9	7.7	52+	92		12	287	83N	
20	May	1	20	32	38.7	D		98818	B9	8.6	8.5	61+	103	-8	51	208	31S	
20	May	2	0	27	9.0	D		98892	K0	7.7*	7.1	63+	105		22	267	84N	
20	May	2	0	54	49.2	D		98897	K0	7.6*	7.0	63+	105		18	273	74S	
20	May	2	21	58	22.2	D		1578	K0	6.9	6.2	73+	117		43	216	59S	
20	May	2	22	43	50.0	D		99330	K0	8.0	7.4	73+	117		39	229	32S	
20	May	2	23	5	0.0	D		99337	G5	8.4	8.1	73+	117		36	234	44S	
20	May	3	21	22	55.1	D		1702	M0	4.0*	3.3	82+	130		43	185	48N	nu Vir
20	May	5	0	58	8.7	D		138962	K2	8.3	7.8	91+	146		25	230	70S	
20	May	5	21	1	57.6	D		1950	G6	5.7	5.2	96+	158	-10	27	150	19N	80 Vir

Predictions up to May 5^{th}.

Notes on the Double Star selection.
Doubles are selected from Occult 4, where the fainter companion is brighter than mag 10, and the time difference(dT) is between 0.1 and 10 seconds. **Please report double star phenomena.**

Key:
P = Phase (R or D), **R** = reappearance **D** = disappearance
M = Miss at this station, Gr = graze nearby (possible miss)
CA = Cusp angle measured from the North or South Cusp.

Dbl* = A double star worth monitoring. Details are given for selected stars.
Mag(v)* = asterisk indicates a light curve is available in Occult-4
Star No:
1/2/3/4 digits = Zodiacal catalogue (ZC) referred to as the Robertson catalogue (R)
5/6 digits = Smithsonian Astrophysical Observatory catalogue (SAO)
X denotes a star in the eXtended ZC/XC catalogue.
The ZC/XC/SAO nomenclature is used for Lunar work. The positions and proper motions of the stars in these catalogues are updated by Gaia.

Detailed predictions at your location for 1 year are available upon request.
Occultation Subsection Coordinator: Tim Haymes
tvh.observatory@btinternet.com

LUNAR GEOLOGICAL CHANGE DETECTION PROGRAMME

Tony Cook

Reports have been received from the following observers for Feb: Jay Albert (Lake Worth, FL, USA - ALPO) observed: Aristarchus, Censorinus, Gassendi, Mare Imbrium, and Plato. Alberto Anunziato (Argentina - SLA) observed earthshine and sketched Eudoxus. Aylen Borgatello (Argentina - AEA) imaged Birt, Carlini and Mons Pico. Pasquale D'Ambrosio (Italy - UAI) imaged the Full Moon. Rob Davies (Mid Wales – BAA/NAS) imaged: Mersenius and several features. Walter Elias (Argentina – AEA) imaged: Aristarchus, Gassendi, Proclus, Stevinus, and Tycho. Clyde Foster (South Africa – BAA) imaged Moretus. Victoria Gomez (Argentina – AEA) imaged Mare Imbrium, Plato and Tycho. Leonardo Mazzei (Italy – UAI) imaged Sinus Iridum. Gabriel Re (Argentina – AEA) imaged: Copernicus, Grimaldi and Promontorium Laplace. Phil Shepherdson (Woodthorpe, UK – BAA) observed/imaged Ptolemaeus. Trevor Smith (Codnor, UK - BAA) observed: Aristarchus, Bullialdus, Darney, Eratosthenes, Herodotus, Mons Piton, Plato, Proclus, and Sinus Iridum. Bob Stuart (Rhayader, UK – BAA/NAS) imaged: Anaximander, Aristarchus, Babbage, Capuanus, Clavius, Copernicus, Gassendi, Goldschmidt, Hainzel, Herschel, Kepler, Mairan, Mare Imbrium, Moretus, Philolaus, Schiller, Tycho, W. Bond and several features. Franco Taccogna (Italy – UAI) imaged: Mare Frigoris and the Full Moon. Aldo Tonon (Italy – UAI) imaged: Eratosthenes, Mersenius, Sinus Iridum and the Full Moon.

News: This has been a surreal last few weeks across the globe, with lock down for large parts of the world's population. I have been checking up on many of our observers by email and, fortunately, at the time of writing everybody has been free of Covid-19 but frustrated that they cannot go out much. Fortunately, some have telescopes that they can use from their gardens. However, please do be careful out there, and make sure you wrap up warm and watch out for trip hazards in the dark – we all really want to do our best and avoid keeping out of hospitals right now.

TLP reports: In the November 2019 edition of ALPO's *The Lunar Observer*, p. 32 Alberto Anunziato (SLA), had a sketch showing a bright area on the west rim of Deluc H on 2019 Oct 06 UT 23:40-00:00. I have had a look through similar illumination images in the ALPO/BAA database and cannot find anything resembling this. I shall therefore add it to the Lunar Schedule web site, to encourage some repeat illumination observations to see if it repeats. If not, we shall move it to the TLP database.

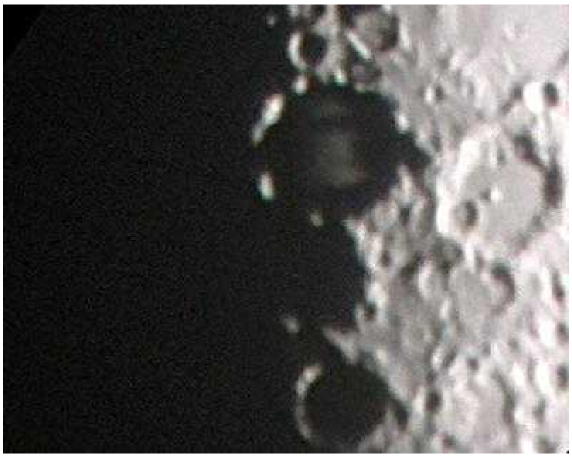


Figure 1. *Ptolemaeus, as imaged by Phil Shepherdson on 2020 Feb 01, taken some time between 19:40-19:50 UT. Image orientated with north towards the top.*

Although this is not a TLP, Phil Shepherdson (BAA) contacted myself and the Director of the BAA Lunar Section, to query the appearance of ‘veiled light’ on the floor of Ptolemaeus that he saw visually and imaged (Fig. 1) on 2020 Feb 01 UT 19:40-19:50. This is the sort of thing we expect observant astronomers to report in the TLP programme. Fortunately, on this occasion both myself and Bill Leatherbarrow, instantly recognized this as the effect of a fine grid of shadow spires from the rim, falling across the flat floor during sunrise. Similar effects can sometimes be seen on the flat floors of Plato and Archimedes. Nevertheless, it’s an interesting and spectacular appearance to look out for, so I have added it to the Lunar Schedule web site, with another idea to test out, namely how does the appearance change when viewed through a polaroid filter? Given that the sunlight reaching the floor is coming through a narrow strip of valleys in the rim, maybe we can check to see if the illuminated floor gets brighter or darker when the polarizing filter is rotated. This may not work, but it might be interesting to try.

Another thing that was not a TLP, but nevertheless transient, and we will unfortunately be seeing a lot more of in the next few months and years, are Elon Musk’s flotilla of Starlink satellites (or the remains of the bankrupt Oneweb company satellites?). On 2020 Mar 27 UT 19:51:58-19:53:16 UT, in just a span of 78 sec, some 4 satellites flew past the earthlit Moon from where I was observing here in the UK. Fig. 2 shows a composite shot of them exiting the SW limb of the Moon. They were not all together like in Fig. 2, but were spaced apart and definitely all travelling in the same direction and the same speed. I am estimating that the magnitude was around 5-6? This probably won’t hinder our lunar observations, apart from showing up as false detections in impact flash software, but will definitely play havoc with our Deep Sky colleagues. Although this technology has a benevolent use of satellites, providing cheap coverage and communication in some of the poorest parts of the world, it also has the potential to massively increase space junk - should anything go wrong and renegade/defunct satellites start colliding!

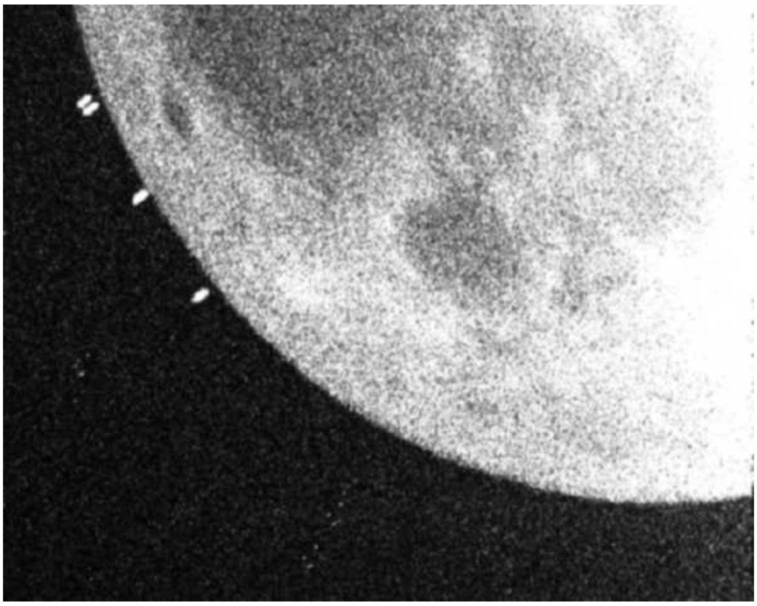


Figure 2. *A Composite view of Earthshine with 4 suspected Skynet satellites exiting the SW limb. Taken by Tony Cook from Newtown, UK on 2020 Mar 27, These four frames are each 1/50th sec exposure and were from frames combined from video captured between 19:51:58 and 19:53:16UT.*

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

Eratosthenes: On 2020 Feb 03 UT 19:10-19:35 Trevor Smith (BAA) sketched and observed visually this crater whilst the Sun was at a similar illumination (±0.5°) to the following Walter Haas report:

```
On 1936 Oct 25 at 01:35 UT W. Haas (Alliance, OH, USA, 12" reflector) saw small bright spots on the floor of Eratosthenes, (Pickering's atlas 9A, col. 30deg, shows no spots - according to Cameron). Cameron 1978 catalog TLP=417 and weight=4. ALPO/BAA weight=1.
```

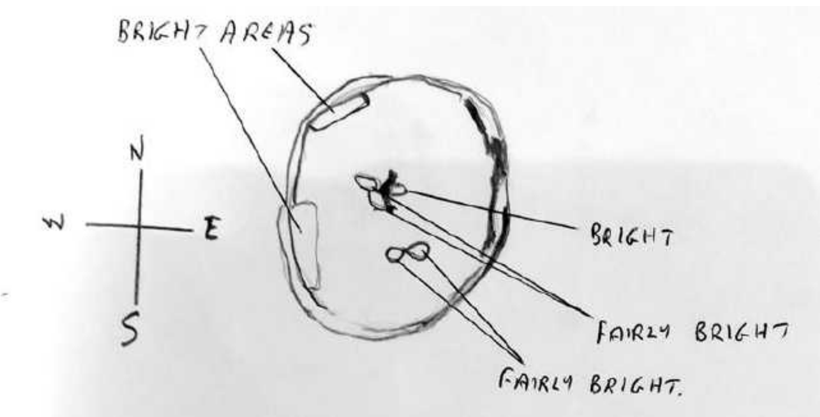


Figure 3. *An Eratosthenes sketch by Trevor Smith (BAA) made on 2020 Feb 03 UT 19:10.*

Trevor comments that there were no signs of any bright spots on the crater floor. The central peak was bright and sunlit. Some lighter areas were labelled as seen in Fig. 3

and these were especially well seen in yellow Wratten 12 and 15 filters. I should point out that Trevor was using a 16” reflector, so if any spots were to be seen they should have been, except for the fact his seeing was a poor Antoniadi IV. We shall leave the ALPO/BAA weight at 1 for now.

Sinus Iridum: On 2020 Feb 04 UT 20:10-20:45 Trevor Smith observed, and at 20:32 Leonardo Mazzei (UAI) imaged, this area under a Lunar Schedule request for similar colongitudes for the following report:

BAA Request: Is there a dark shaded area on the floor of size approximately ~1/4 diameter of Sinus Iridum and on western interior by the rim? Telescopes as small as 2" aperture can be used for this study at a magnification of approximately 110x. Any visual descriptions, sketches or images should be emailed to: a t c @ a b e r . a c. u k .

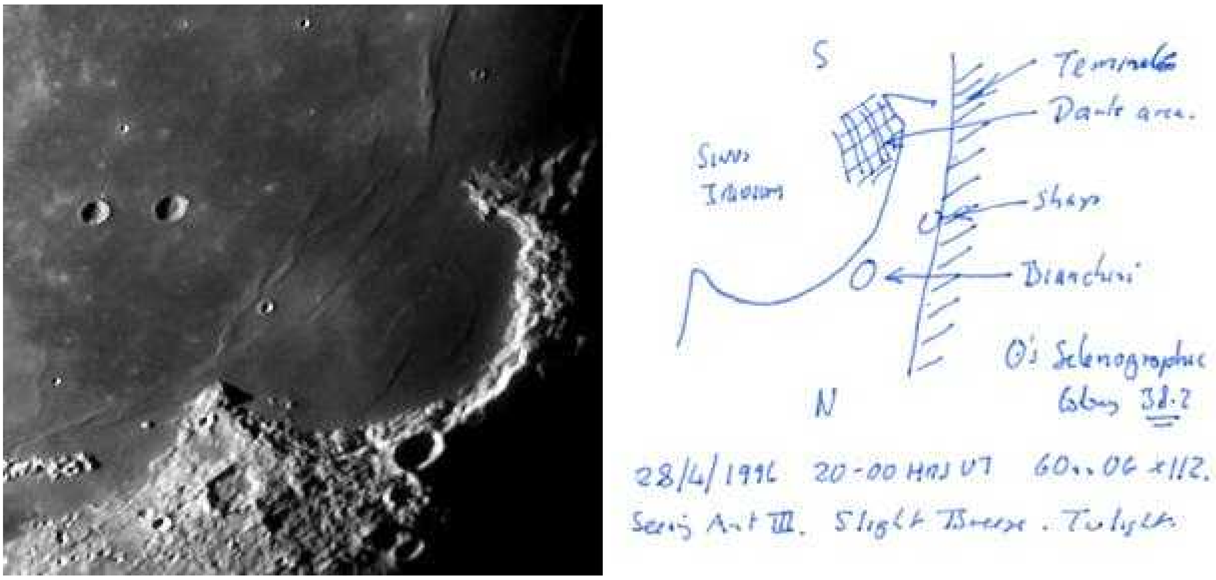


***Figure 4.** Sinus Iridum orientated with north towards the bottom. **(Left)** Image taken by Leonardo Mazzei (UAI) on 2020 Feb 04 UT 20:32. **(Right)** A sketch made by Clive Brook (BAA) on 1996 Apr 29 UT 20:00.*

Astute readers will know that we covered this last month (see p. 72). Again, nothing relating to shading in the SW quadrant of the floor of Sinus Iridum can be seen in Fig. 4 (Left). However, the western half of the floor is darker than the eastern half and this was confirmed by Trevor Smith visually. Given that the scope that Clive Brook used, was just a 2” refractor, the weight of 1 seems reasonable until we can figure out for sure what he saw. Possibly we need to aim at later colongitudes to match the visibility of Sharp.

Gassendi: On 2020 Feb 05 UT 00:40-01:35 Jay Albert, ALPO) observed this crater under similar illumination and topocentric libration (both within ±1.0°) to the first report below, and under similar illumination (±0.5°) to the second report below:

Gassendi 1977 May 28/29 UT 20:45-21:15 Observed by D. Sims (Dawlish, Devon, UK) saw a hazy area on the south east floor that was normal in red and white light but darker in blue. This was partly confirmed by J-H Robinson (Devon, England, 10" reflector) 21:24-23:12 who saw the south east floor of Gassendi to have a loss of detail - but no colour seen, although at 21:57-21:58 it was slightly brighter in red than in blue briefly. P. Doherty (22:45-23:15) *did not see anything unusual. D. Jewitt (22:22-22:55) did not reveal anything unusual, apart from spurious colour. The Cameron 1978 catalog ID=3 and ID=1463. The ALPO/BAA weight=3.*

On 1990 Sep 30 at D. Darling (Sun Praire, WI, USA, 12.5" reflector, x150) observed a red spot on the west wall (bright in red filter and faint in the blue filter. No filter reactions were found elsewhere. Gassendi had much detail visible. A sketch was made. BAA observers in the UK were alerted but they could not observe due to cloud. Cameron 2006 extension catalog ID=411 and weight=5. ALPO/BAA weight=3.

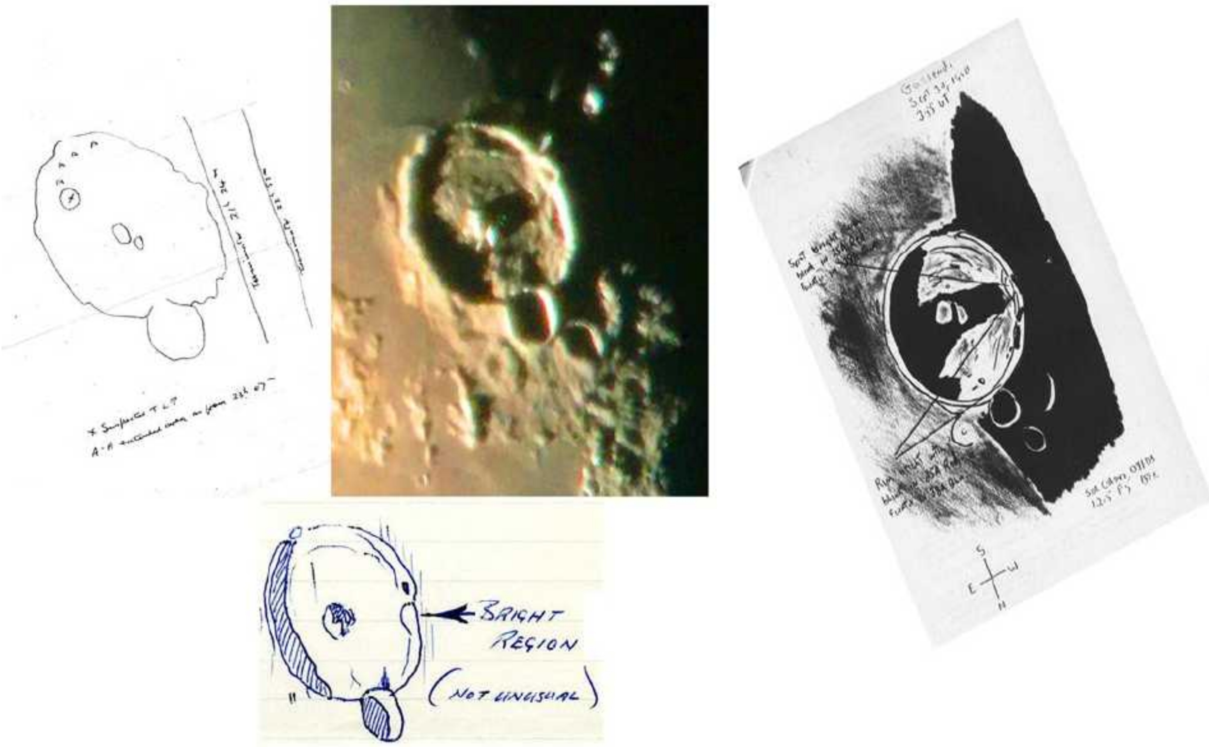


Figure 5. *Gassendi orientated with north towards the bottom right to preserve the label orientation in the three sketches.* ***(Top Left)*** *A sketch by J. Hedley Robinson (BAA) made on 1977 May 28 UT between 21:24 and 22:53*. ***(Top Centre)*** *An image by Jay Albert made using an iPhone, on 2020 Feb 05 UT 01:29 with colour saturation increased to 80%.* ***(Bottom)*** *a sketch by Paul Doherty, made using Patrick Moore's 15" reflector at Selsey, UK on 1977 May 28 UT 23:00.* ***(Right)*** *A sketch made by David Darling on 1990 Sep 30 UT 03:55.*

Jay observed visually and commented that the interior of the crater was beautiful with lots of detail. No red spot, or indeed any other colour, was seen on the west wall or elsewhere. Much of the SE floor was in shadow and the rims were sharp. The interior of the crater was apparently sharper in a red Wratten 25 filter as opposed to the blue/green Wratten 44A filter – where the entire crater was slightly darker than in red or white light. However, everything elsewhere on the Moon was similarly slightly darker in the blue filter anyway. Visible detail on the SE floor (much of which was in shadow) was sharp, not hazy and some of the rills were seen, even on the E floor, near the central peaks. Even with Jay's image having its colour saturation increased to 80% (see Fig. 5 Top Centre), although some colour is visible, this is entirely due to atmospheric spectra dispersion or chromatic aberration as it lies on light/dark boundaries and is visible in other places too. Therefore, in view of the fact that we cannot replicate what Sims (Fig. 5 Left), Hedley Robinson (Fig. 5 Bottom), and

Darling (Fig. 5 Right) saw, we shall leave the weights as they are. We have discussed both reports before in the 2014 Aug (p11-13), 2017 Sep (p22-25), and 2017 Oct (p24-25) newsletters.

Mersenius C: On 2020 Feb 05 Rob Davies and Bob Stuart (BAA/NAS) and Aldo Tonon (UAI) imaged this crater under similar illumination (±0.5°) to the following report:

2005 Nov 13 G. Ward (a lunar observer for 15 years) observed an area just south west of Mersenius C to be blurred and in a greenish cloud. The green colour was more like that of dead grass than one gets from a neon bulb. The effect was seen from 04:50-04:57UT, but could have been going on before it was first noted at 04:50-UT. Seeing was 6-7/10 4" Refractor (2 element). Refractor had been used hundreds of hours before (over a 10-year period) with no similar colour was seen. The observer checked other areas but did not see any similar effects. They also rotated and changed eyepieces, but this made no difference to the TLP. The TLP site seen was picked up on an image taken earlier at 04:47UT by W. Bailey, from Sewell, NJ, USA. Unfortunately, the area concerned, a mountain on the image, was saturated and so we cannot tell if a colour was present there and the seeing was poor. ALPO/BAA weight=3.

Figure 6. *NW orientated with north towards the top.* ***(Top Left)*** *A colour image by Wayne Bailey (ALPO) taken on 2005 Nov 13 UT 04:47.* ***(Top Centre)*** *A sketch by Glen Ward (ALPO) indicating where they had seen a lime green glow in this area on 2005 Nov 13 UT 04:40-04:57.* ***(Bottom Left)*** *a monochrome image by Rob Davies (BAA/NAS) taken on 2020 Feb 5 UT 18:57.* ***(Bottom Centre)*** *A colour image by Aldo Tonon taken on 2020 Feb 5 at 19:24UT. The image has been colour normalized and then had its colour saturation increased to 80%.* ***(Right)*** *Image by Bob Stuart (BAA/NAS) taken at 19:45 UT with a green filter. Note that this has been rotated – hence why part of Mersenius is missing.*

The results of these repeat illumination observations have been especially useful. Although Wayne Bailey's image (Fig. 6 – Top Left) was taken just minutes before Glen Ward's visual sighting of colour (Fig. 6 – Top Centre), Wayne's image was over-exposed on bright area and had a greenish cast, making it difficult to assess Glen's report. Fortunately, Rob's new image (Fig. 6 – Bottom Left) is detailed and allows us to fix the position of the 2005 TLP more precisely. Aldo's colour image (Fig. 6 – Bottom Centre) confirms that there is no natural colour here that could cause the effect that Glen saw. An even more detailed image by Bob Stuart (Fig. 6 – Right), albeit slightly under exposed compared to the other images, can be used to help compare with LROC WAC images of the area (not shown here).

So, is this all we can say? Take a closer look at Wayne's image (Fig. 6 – Top Left) at where the green glow should have been if it had not been saturated on that sunlit area. Notice that the elliptical bright area matches the elliptical shape that Glen saw. Now compare the brightness of this area with Rob and Aldo's images on the bottom of Fig. 4. This region is not as bright in the lower half of where Glen saw the green glow. This difference might suggest that Wayne may have captured at least the brightness of the TLP? However, to be sure it is important to try to simulate the over exposure in Wayne's image in Rob's, Aldo's and Bob's images. This has been done in Fig. 7. You can now see that apart from image resolution issues, the shape of the area in question actually agrees well with all four images. So unfortunately, we cannot confirm any brightening or blurring that Glen reported. We shall therefore leave the weight at 3, but at least now we know that there is no normal natural colour in this region.

Figure 7. *An enlargement of the region SW of Mersenius C where Glen Ward saw a coloured TLP in 2005 Nov 13.* ***(Far Left)*** *A colour image by Wayne Bailey (ALPO) taken on 2005 Nov 13 UT 04:47 – the blue green cast is an artefact of the processing and is visible elsewhere in Fig. 6 (Top Left).* ***(Left)*** *a monochrome image by Rob Davies (BAA/NAS) taken on 2020 Feb 5 UT 18:57.* ***(Right)*** *A colour image by Aldo Tonon taken on 2020 Feb 5 at 19:24UT.* ***(Far Right)*** *Image by Bob Stuart (BAA/NAS) taken at 19:45 UT.*

Vallis Schröteri: On 2020 Feb 07 UT 00:44 Walter Elias (AEA) imaged the area under similar illumination (±0.5°) to the following report:

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

Figure 8. *Vallis Schröteri, Aristarchus and Herodotus as imaged by Walter Elias (AEA) on 2020 Feb 07 UT 00:44 and orientated with north towards the top.*

Walter's image (Fig. 8) shows up Vallis Schröteri very nicely, however it is unclear where the spot at the end of the valley could be? The Cobra's Head craterlet does not look especially bright. There is a mountain peak to the north of the valley (Mons Herodotus) which is bright, but could not be regarded as being at the end of the valley. For now, I will leave the ALPO/BAA weight at 3.

Mare Crisium: On 2020 Feb 08 UT 19:52 Franco Taccogna (UAI) imaged the whole Moon, but this included Mare Crisium under similar illumination (to within ±0.5°) for the following report:

On 2000 Jun 16 UT 20:37 C. Brook (Plymouth, UK, 60mm refractor, x117 & x40, seeing good, transparency excellent) observed a bright spot on the north rim of Mare Crisium (57E, 25N). It was comparable to the illuminated rim of Proclus in brightness. No colour seen. The spot was not visible the next night. The ALPO/BAA weight=1.

Figure 9. *Mare Crisium from a whole Moon image captured by Franco Taccogna (UAI) on 2020 Feb 08 UT 19:52. Image orientated with north towards the top.*

As you can see from Fig. 9, there is no bright spot on the northern rim of Mare Crisium that was comparable to the bright rim of Proclus. There is sometimes a bright spot on the NW rim shortly after sunrise in this area, but it is definitely not bright here. So either Clive Brook perhaps got the date wrong (his letter was dated the 16th, so am assuming the observation was made on the 16th too – though if it was written the day after then the date would have been the 15th) or more likely this could be a librational effect, requiring a slope angle to be favourable to yield a bright spot. We shall leave the weight at 1 for now.

Full Moon: On 2020 Feb 08 UT 20:19-20:23 Pasquale D'Ambrosio (UAI) took an image of the Moon through a digital camera telephoto, approximately 8 hours before Full Moon. This was part of the Lunar Schedule observing programme:

Figure 10. *The Full Moon as imaged by Pasquale D'Ambrosio (UAI) and orientated with north towards the top.*

The Digital No. (DN) brightness of selected features measured on Fig. 10 were as follows: Bright spot near Hell=168, Proclus=163, Censorinus=153, Tycho=145, Aristarchus=136, Copernicus=118, Kepler=95, Plato=59. Compare this with the relative brightness mentioned in previous Newsletters (e.g. Jan 2020 p47/48) and you can see that the order changes and Aristarchus certainly isn't always the brightest feature on the Moon. This is probably related to libration angle making some slopes brighter depending upon the viewing angle. This has very important implications for the brightness of Aristarchus in Earthshine too. When we have enough data points, we will investigate the relationship with libration, though I suspect that image resolution will have an effect too.

Promontorium Laplace: On 2020 Feb 12 UT 01:21 Gabriel Re (AEA) imaged Sinus Iridum under the same Sun angle, to within ±0.5° to the following report.

Peter Foley observed a tiny yellow-brown region close to the tip of the cape, north east of the precipitous west edge, in the face of the north facing slope. The area concerned was diffuse and varied in density despite the surroundings not varying. Foley noticed no colour elsewhere on the Moon, though Amery thought that he saw some in Aristarchus, but Foley thinks this was spurious. Cameron 2006 catalog extension ID=27 and weight=5. ALPO/BAA weight=3.

Figure 11. *Sinus Iridum as imaged by Gabriel Re (AEA) on 2020 Feb 12 UT 01:21 and orientated with north towards the top.*

Although Gabriel's image (Fig. 11) was monochrome, it provides not only a useful context image, but can also be used to check out Peter Foley's comment that the area N/NE of Promontorium Laplace was diffuse. Gabriel's image shows the area nice and sharp, so therefore Peter Foley's description of the area was abnormal, though it is always possible that the diffuseness was caused by atmospheric seeing. We shall leave the ALPO/BAA weight at 3 for now.

Plato: On 2020 Feb 12 UT 03:13 Victoria Gomez (AEA) imaged this area under similar illumination, within ±0.5°, to the following WWII era report:

On 1944 Mar 12 at UT 23:00 H.P. Wilkins (Kent, UK, 8.5" reflector) observed that Plato appeared incomplete - the central crater had its north wall obscured. Cameron comments that maybe this was due to the low altitude of the Moon? The Cameron 1978 catalog ID=491 and the weight=4. The ALPO/BAA weight=2.

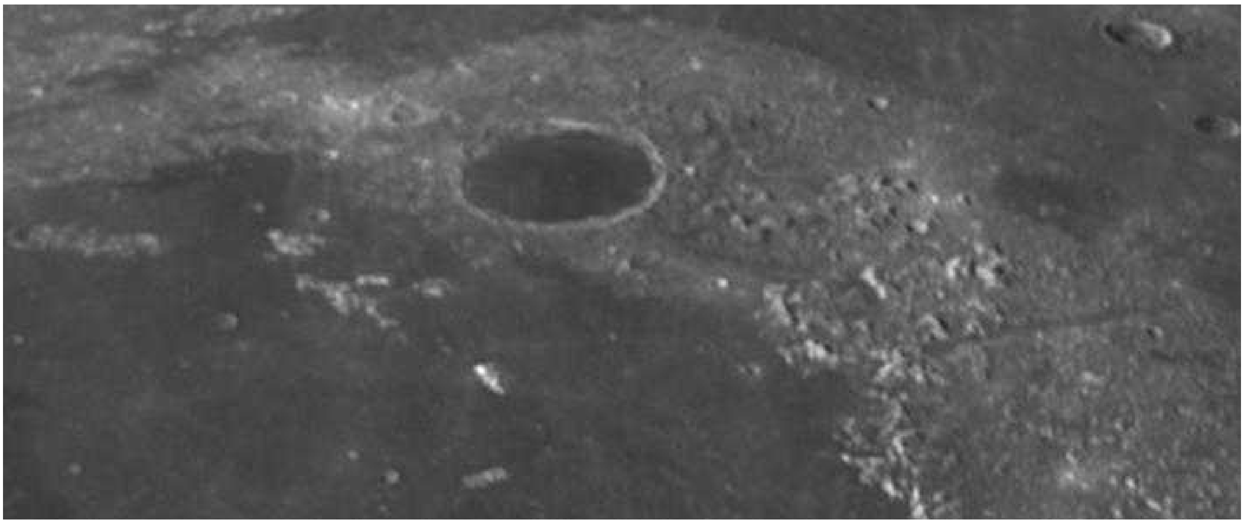


Figure 12. *Plato as imaged by Victoria Gomez (AEA) on 2020 Feb 12 UT 03:13 and orientated with north towards the top.*

Victoria's image (taken with an identical sized telescope) in Fig. 12 confirms that the central craterlet was quite clearly visible, although doesn't quite have enough resolution to say whether or not the north wall of that craterlet was obscured or not. But at least we have a context image now. Incidentally the altitude of the Moon, as seen from Wilkins' telescope back in 1944 was 41°, so this was not low altitude for the UK.

Birt: On 2020 Feb 12 UT 03:21 Aylen Borgatello (AEA) imaged this region, to within (±0.5° similar illumination to the following report:

Birt 1972 Sep 25 UT 23:20-23:45 Observed by Doherty (Stoke-on-Trent, England, 10" reflector x280, S=VG) "All bright areas were similar in intensity (albedo) but 2 larger ones at times seemed brighter. N & S. The E. IAU? wall of the small craterlet showed most prominently & at times suspected a faint pt. of light just W. of its center. This was very suspect however." NASA catalog weight=1. NASA catalog ID #1345. ALPO/BAA weight=1.

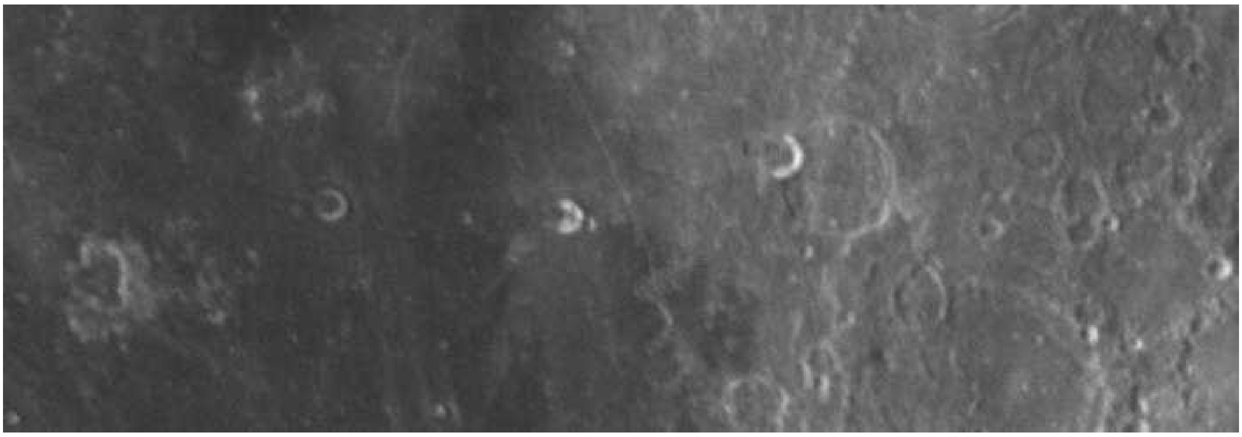


Figure 13. *The crater Birt (located at the centre of the image) as captured by Aylen Borgatello (AEA) on 2020 Feb 12 UT 03:21, and orientated with north towards the top.*

Aylen's image (Fig. 13) shows two bright spots on the NE rim of Birt. The west most has a digital number (DN) brightness value of 190 and the east most DN=197. By contrast the SE rim of Birt is only DN=179 and the E rim of Birt A is just DN=151. However, this is just a snapshot at an instant in time, and there is no way to know how the atmospheric seeing affected image resolution and brightness of the sunward facing slopes of the rims back in 1972. For now, we shall leave the ALPO/BAA weight at 1, but at least we have a nice image showing what the crater normally looks like at this stage in illumination.

Eudoxus: On 2020 Feb 29 UT 21:13-21:33 Alberto Anunziato (SLA) sketched this crater under similar illumination (±0.5°) to a TLP report:

On 1988 Nov 15 at 10:07-10:40 UT P. Jean (Outremont, Quebec, Canada, 4" refractor?) saw to the SE of Eudoxus (18E, ~43N) a luminescent area just over on the night side of the terminator - it was cone shapes and coppery in colour. Cameron comments that maybe it was a very low sun angle effect and she has seen something similar, but on the bright side of the terminator. Jean then goes onto comment that at 10:25UT a very dark line was seen south of the cone i.e. east of the terminator. A sketch was provided and P.Foley commented that the cone did not correspond to any terrain. Cameron 2006 Catalog Extension ID=339 and weight=3. ALPO/BAA weight=2.

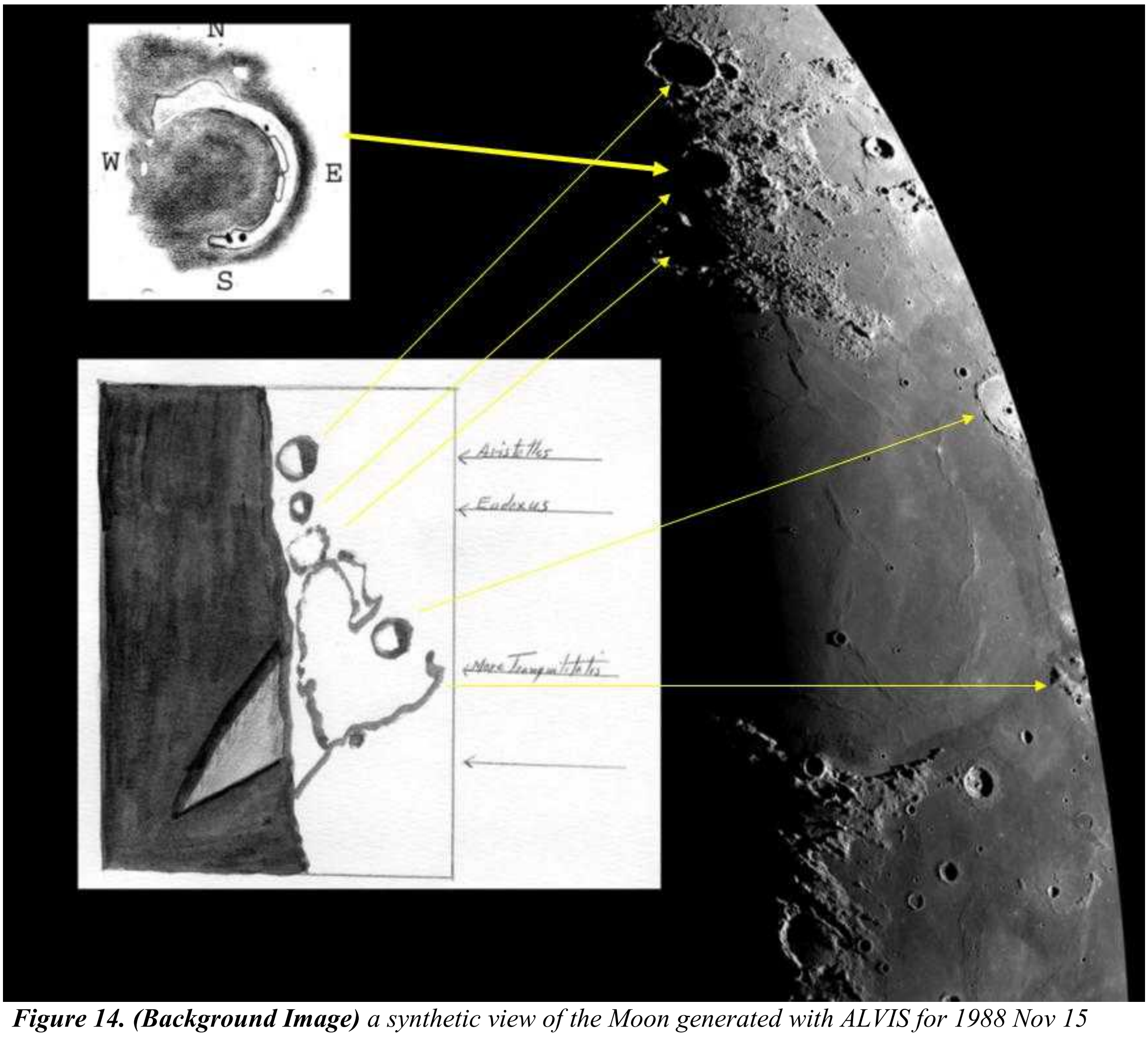


***Figure 14. (Background Image)** a synthetic view of the Moon generated with ALVIS for 1988 Nov 15 UT 10:25 for lunar longitudes 20°W-30°E. Orientated with north towards the top. Various craters have been arrowed for identification purposes. **(Top Left)** A sketch of Eudoxus made by Alberto Anunziato (SLA) on 2020 Feb 29 UT 21:13-21:33. **(Bottom Left)** a sketch by Pirrette Jean made on 1988 Nov 15 UT 10:07-10:40.*

Alberto's sketch (Fig. 14 – Top Left) shows a nice crescent-shaped Eudoxus crater emerging into sunlight on the lunar terminator. This matches with the visibility in the sketch by Jean (Fig. 14 – Left). However, because the effect described by Jean covers such a large geographical area, I decided to generate a virtual view of part of the Moon, as seen from Quebec for the date and UT in question, so as to test out the reliability of the rest of her sketch. The virtual view can be seen in the background for Fig 14 and although this illustrates that there are some cartographic inaccuracies in Jean's sketch, most of the landmarks are visible as indicated by arrows. What is slightly disturbing is that she places the terminator further to the west, which might infer that her UT was wrong. Although the area of Jean's cone shaped protrusion, beyond the terminator, is hidden in the background image in Fig. 14, I can vouch for the fact that there is not normally anything to be seen here.

Due to the terminator issue, and also the fact that a small instrument was used, I will lower the weight from 2 to 1 for now. It should be said that the database shows that Jean was a bit over-sensitive to seeing TLP, perhaps not quite as prolific as Bartlett, but she does show up quite high on the statistics of TLP observers. At least, using the virtual view of the Moon we can say that the extent of the TLP was approximately 10W-5E and 15N-30N.

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

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