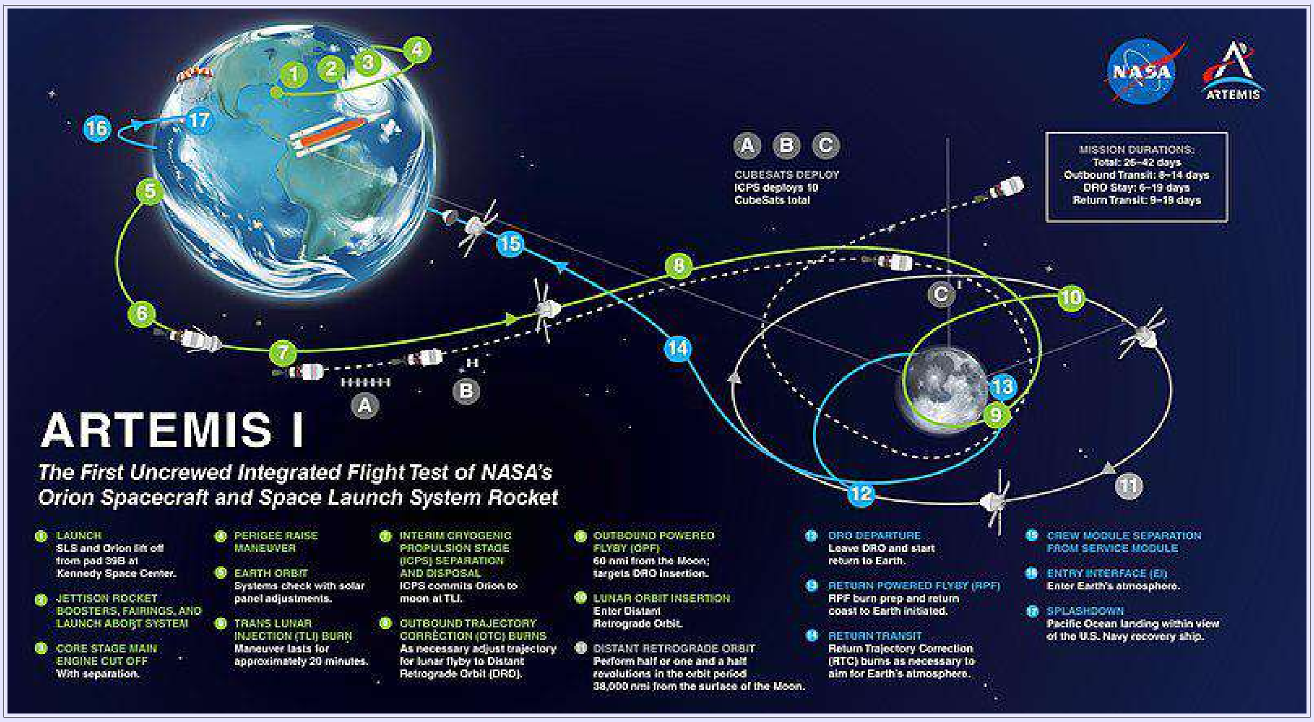
From the Director:

Artemis I on the launch pad. Credit: (NASA/Joel Kowsky)

As I write this, the NASA Artemis I unmanned mission is scheduled to lift of on the maiden flight on 2022 Sep 03 UT 18:17. Just in case of launch scrubs due to technical issues that they cannot fix in a 2 hour launch window, it could also launch on September 5th. The element of risk is high as they have never launched the SLS, which unimaginatively stands for Space Launch System before as a "whole", though the two expendable solid rocket motors, strapped to the side, were developed from Shuttle technology, and the Orion capsule has been sent into space a few years ago. However, engineering simulation software has improved by several orders of magnitude since the Apollo era, so the engineers and mission control should be fairly confident. But one still cannot predict the unforeseen, such as whether there was something they forgot to model in the simulation software, or something that was below the specifications getting through the quality control testing. It is for this reason that no astronauts will be

onboard this first mission.
Anyway, hopefully we shall see the biggest rocket ever launch since the Apollo era, over fifty years ago. What is exciting is that apart from Artemis flying briefly as close as 100 km from the surface, before entering a Distant Retrograde Orbit. Ten cubesats will be released which should tell us more about the Moon and its environment. The entire mission will last about three weeks and thoroughly test out the Orion capsule systems in deep space.



The Artemis I mission flight plan. Image Credit: NASA - https://www.nasa.gov/image-feature/artemis-i-map

Now it should be possible for you to observe the Artemis I spacecraft, at least part of the way to the Moon. The minimum requirements are a Goto scope, capable of pointing at and following any RA and Dec you give it, and the ability to take long exposure images of things like comets, asteroids, nebulae etc. NASA's JPL has a Horizon Portal: https://ssd.jpl.nasa.gov/horizons/app.html#/ and if you feed in your longitude, latitude and height above sea level, a given date and time range, specify apparent RA and Dec output, and then feed in a Target Body name of: "Artemis I" (note Roman Numeral for "1"), hopefully it should produce the RA and Dec of the spacecraft that you can point your scope at. Just as a rule of thumb, once Artemis I falls to a magnitude of fainter than +10.0, you are unlikely to even be able to see it against the night side of the Moon, let alone the dayside. However if it is far from the glare Moon then you can see it much fainter with a longer exposure. If the spacecraft's solar panels are aligned you maybe able to see sun glint which would make it a lot brighter, even close to the Moon, though this would have to be a chance alignment. Also, if it does a motor burn, this may show up as remarkably bright in the near IR. There are also a couple of cubesats that JPL Horizon's website can also let you track: "OMOTENASHI" is a Japanese lunar lander – this is probably too small and faint to detect, and the "NEA Scout" which will deploy an 86m^2 solar sail, and after a series of lunar flybys, before going off and visit a near-Earth asteroid, possibly 2020GE? I am indebted to Jon Giorgini, a senior analyst at JPL's Navigation & Mission Design section of the Solar System Dynamics Group, for providing much of this information about JPL's Horizon portal.

So if you do manage to image any of these spacecraft, please send your images in. It will be interesting to see who of our members can detect the spacecraft furthest from the Earth, or closest to the Moon.

Tony Cook.

Communications Received:

WESTERN HUMORUM
by Bill Leatherbarrow

Rod Lyon's fine image of Gassendi in the August LSC reminded me how that crater invariably steals our attention when we look at the western reaches of the Humorum basin. And justifiably so, since it is an arresting sight given its size and the intricate system of rilles on its floor. But there are other features that deserve our attention on the western 'shores' of Mare Humorum and my image of 14 January 2022, taken with an OMC300 at 21.14 UT (Fig.1) shows some of them. Most notable is the fine crater Mersenius with its clearly convex floor and interior rilles no doubt caused by the uplift of that floor. There is a multitude of rilles in the vicinity, some traversing highland terrain, others favouring smoother mare surfaces. Most notable among these are the de Gasparis and Mersenius systems, although there are others on the surface of the Mare Humorum itself.

Figure.1

Just to the east of the craters Liebig and Mersenius D there is a scarp where the mountainous terrain gives way to the smoother surface of the Mare Humorum itself. This scarp is the Rupes Liebig and it is not without interest. Directly east of Liebig there is a relatively fresh 8-km crater Liebig F. Its relative youth is evidenced by its sharp rim and the fact that it sites astride the older scarp. Compare that with the strange unnamed half-crater perched on the scarp just to the north. This is clearly much older and pre-dates the scarp itself. For a start what remains of its rim is much degraded and subdued. Moreover, the faulting that gave rise to the scarp clearly took away the eastern half of the crater, which has presumably disappeared beneath subsequent flows of mare lavas. 3-D modelling (Fig.2) in QuickMap (2x vertical exaggeration) shows this feature and its relationship to the scarp very well. Off hand, I cannot think of a similar feature elsewhere on the Moon and would be glad to hear from anyone who can.

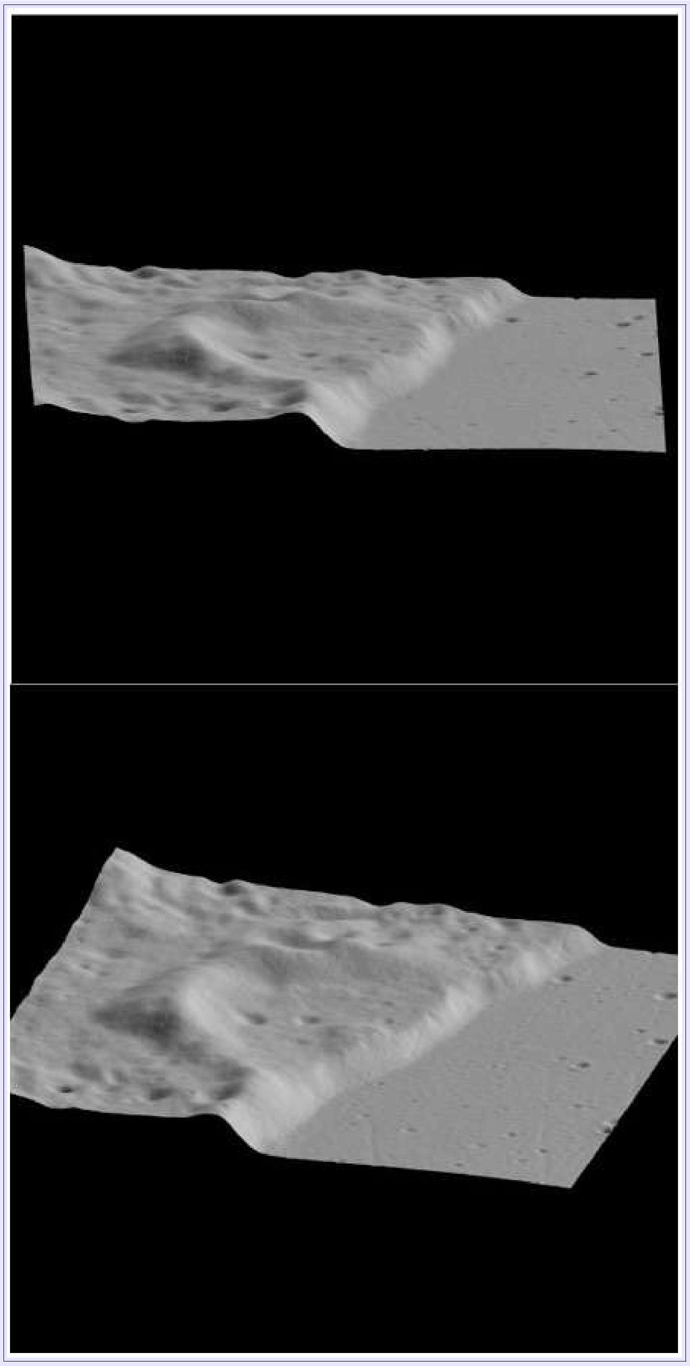


Figure.2.

Finally, Rupes Liebig would appear to be a scarp for only some of its length. Further north it seems to turn into a rille. There is nothing unusual about this since both scarps and linear rilles of this kind have a common origin in surface faulting. There is an even clearer example in the Rimae Bürg system, just to the southwest of Bürg itself.

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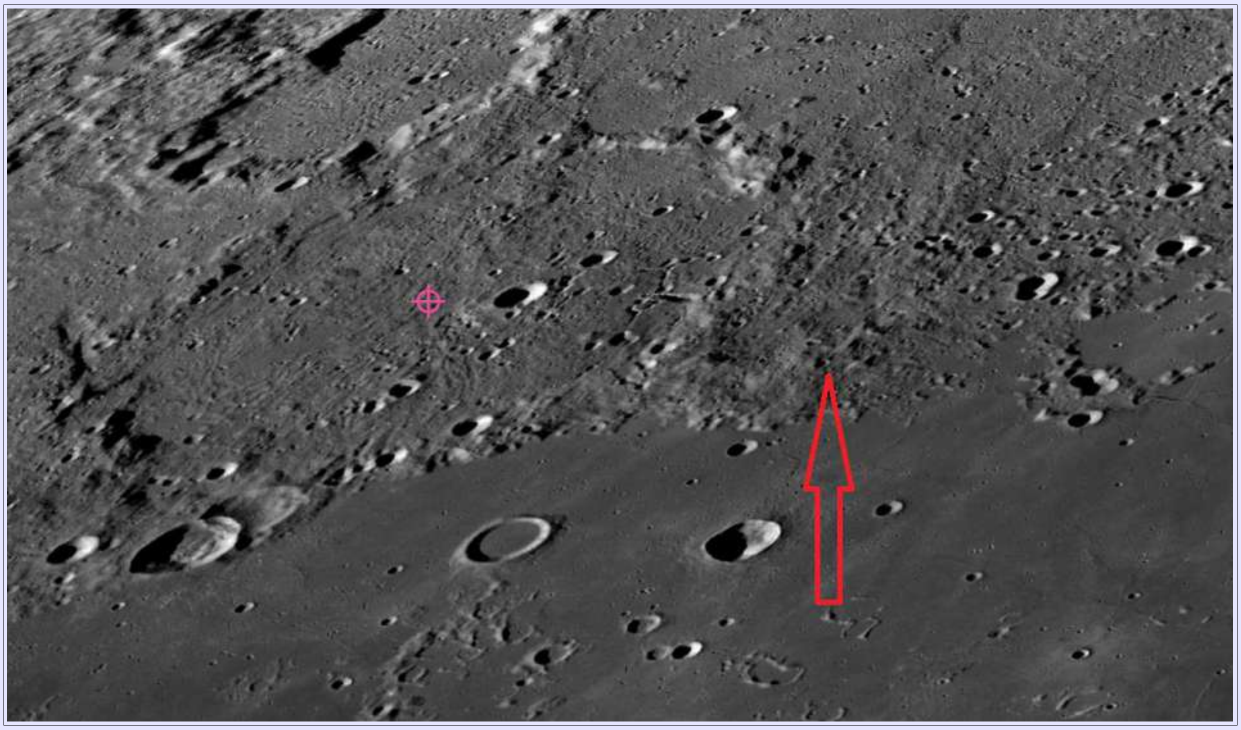
The Herschel Rectangle.
By Daryl Dobbs

Interesting letter regarding the rectangular feature to the west and north of Herschel in the last 2 editions of the LSC. I tend to agree the crater seems more like J Herschel, a look at Quickmap does suggest a feature which D. Davis may have seen, which is roughly slightly north and west of J Herschel. I've attached a screenshot of J Herschel from Quickmap with a red arrow indicating the rectangular feature D Davis might have seen. One problem I do have, is the feature I've arrowed is only around 50km long and the ratio seems more like 3:1 than the 80-100km long and 4:1 ratio as mentioned in D.Davis's report. One explanation is estimating the size by purely visual means can be rather difficult, (the scale hasn't been included in the screen shot).

The link to the Quickmap page is below.
LROC :: QuickMap (asu.edu)



It would be interesting to see what the arrowed feature looks like under various lighting conditions and using a similar size telescope and magnification. Apart from the size discrepancy it does seem to fit rather well with D. Davis report.

At the risk of being a nuisance, I've got further thoughts on the Herschel rectangle, as far as I'm aware the Questar is a smallish reflector 3.5 inch I suspect, the patch I highlighted in my previous email according to IAU convention is to the East of J Herschel. This makes me wonder if he got E & W mixed up which is easy to do.

When he observed the Moon would have been about 25 degrees in altitude (allowing for conversion UT to PDT), if he used the Astronomical League scale of 1-7 with 1 being the worst he had quite a good night transparency wise.

Since the Moon was 3 days away from full, the area would have been under high illumination and with a magnification of x 80 & x120 quite a wide area would have been on view. Running a rough simulation in Stellarium using his location and date and time adjusted for local daylight saving time, there doesn't seem anything to the West and slightly North outside J Herschel, but the area I arrowed earlier does stand out as being a dark rectangle. Looking at the area in Quickmap doesn't indicate anything obvious W & N either.

Since J Herschel is 165km any dark area internally at the dimensions stated would take up a considerable amount of the area, with a stretch of the imagination the area from J Herschel C to the western wall might be observed as a 80-100km darkish rectangle with a width 15-20km. To me this nowhere near as obvious as the arrowed rectangle, looking in the Hatfield Lunar Atlas at a high illumination doesn't bring up any new candidates for a dark patch. Out of pure interest I looked at HP Wilkins map of the area and he didn't indicate anything in the recorded position either.

Much as I would like this to be a TLP I'm leaning towards a mix up of East and West when observed through a small reflector at a low magnification.

I'd be interested in the results of your investigation, I think the area requires imaging under similar illumination to be 100% sure.

Fracastorius .
by Maurice Collins.

While waiting for a Rocket Lab launch attempt, and watching on my phone (the launch was eventually scrubbed due to high winds), I imaged the 4.5 day Moon with the ETX-90. It was windy here also and the telescope was shaking a bit. Luckily the image was not affected. The terminator was running through Mare Nectaris and Fracastorius, and in the image (Fig.1) I can see what looks like a lighted central peak in Fracastorius, though that crater only has a very small peak if you can call it that.

Fig.1 Fracastorius as image by Maurice Collins on 2022 August 02 UT 01:11.

Fig 2 and 3 below show LTVT simulations revealing the raised area at the centre of the crater.

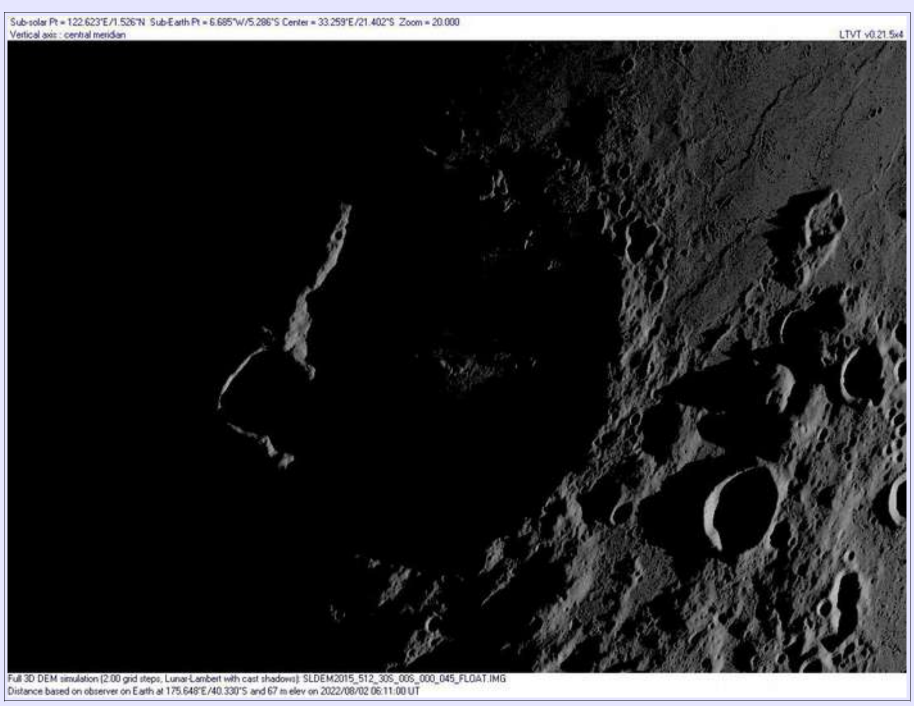


Fig.2

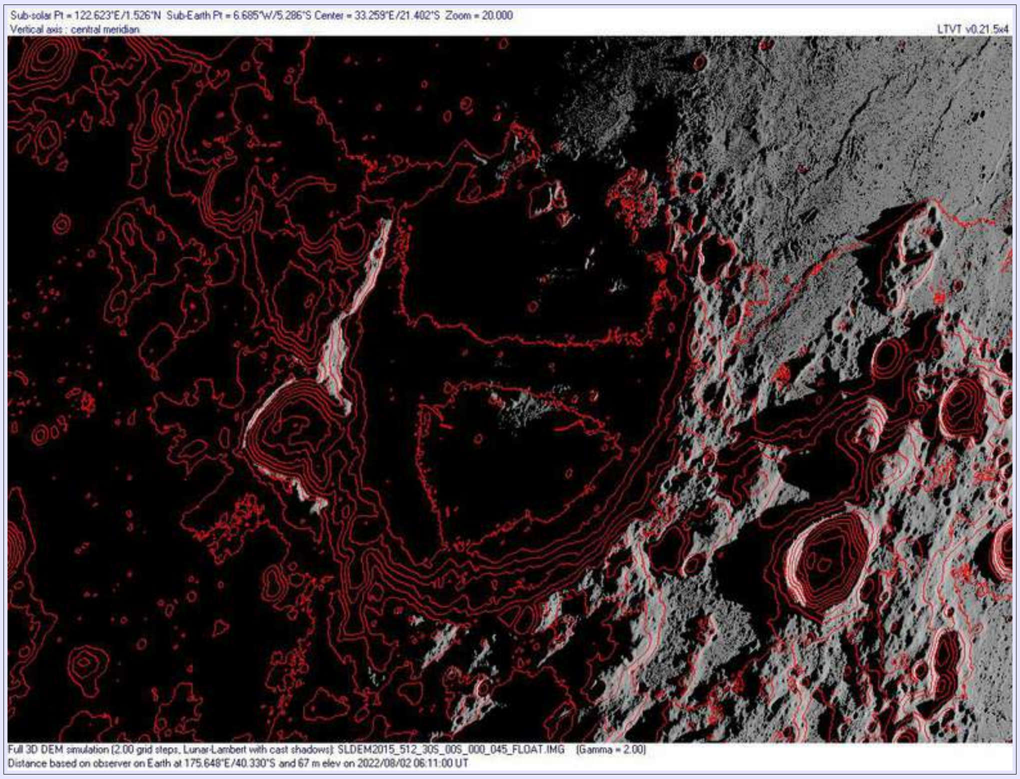


Fig.3.

Editor Comments: See image by Rod Lyon on page 17 for a further discussion of this feature!

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Viscardy Atlas – a response to previous correspondence by Nigel Longshaw and Tony Cook.
By Richard McKim.

You and Nigel are right about the location of Viscardy's observatory. He was interviewed in the Bulletin of the French Astronomical Society around 1974, where there are examples of his work and a picture of his telescope. I have this issue somewhere. My friend Jean Dragesco spoke highly of him. Viscardy and I had also had a nice correspondence over several years, and he sent me some fine photos of Mars. These were published in our journal and his best ones were taken in 1988. He also did very good Jupiter photography. You may recall Martin Mobberley actually visited him once, and gave a meeting talk about it. Viscardy was very wealthy and I believe was an owner or part owner of one of the local casinos. But I do not recall whether that story came from Martin or from Jean Dragesco. When I visited Dragesco in southern France to help prepare the English translation of his astrophotography book in 1993 he showed me a copy of the Viscardy atlas. It was a fine achievement. Dragesco gives a very useful list of (and some praiseworthy or marvellous acidic comments upon) all the lunar atlases published up to 1993 in his own book.

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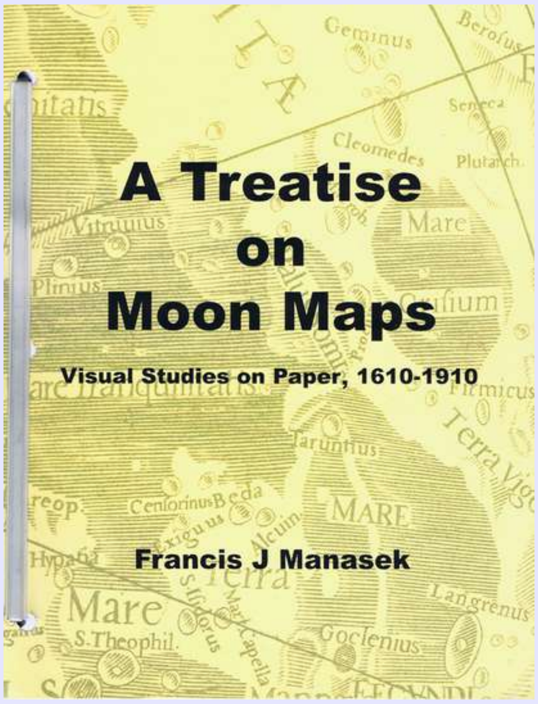
Francis J. Manasek, A Treatise on Moon Maps: Visual Studies on Paper, 1610-1910.

Self-published, 2022. Contains 372 pages, 350 images, and bibliography. Free Download PDF ‘open access’ only at: www.fmanasek.com/intro.pdf.

Reviewed by Robert A. Garfinkle, FRAS



In my own 3-volume lunar observer’s handbook *Luna Cognita* (Springer 2020), I give coverage to Moon maps and charts, but I only discussed those maps on which the astronomer/cartographer included official new name(s) for the lunar feature(s). Retired former Harvard medical histologist Francis J. Manasek has gone way beyond my nomenclature work to present a more detailed study of the hand-drawn maps of the Moon from the time (1610) of Galileo’s first drawings of the Moon in *Sidereus nuances* up to the work of Walter Goodacre’s 1910 portfolio *Atlas of the Moon*. Yes, there were photographs taken of the Moon from the 1850s to the present day and were in most cases created to serve as maps of the Moon, but as the author states, they are not maps, because they are just photographs and are therefore not part of his study presented in this book**.**

The Preface is by noted astronomical historian Bill Sheehan. After the informative Introduction, the book has ten illustrated chapters, that cover printing techniques, telescopes, in-depth studies of lunar maps, very detailed illustrations, summary, and discussion. The bibliography contains over 300 entries.

Mr. Manasek was an academic basic scientist studying early heart development and has published numerous papers in peer-reviewed journals. For almost sixty-five years he has been collecting antiquarian maps and books and for a similar period he observed the Moon using a variety of telescopes. He is the author of *Collecting Old Maps*. After retirement he studied the history of science at Oxford University and graduated with a Master’s degree.

Chapter 1 opens the study of Moon maps by covering the various techniques of printing the maps and making such types of lunar images by woodblock, engravings, etches, and other ways of producing the lunar images for the press. The different types of early printing presses are also covered.

Chapter 2 covers different types of early telescopes and mounts employed by the lunar observers who created the maps studied in the book. After this chapter the author takes you on a journey to view how the then new art form of drawing the Moon opened the study and observations of our nearest celestial neighbor and the rest of the Solar

System. In many cases throughout the book Mr. Manasek has magnified portions of a map to illustrate just what he is trying to show as either a problem with the art or praise it. He takes the time in some cases to compare the original map against a copy of it. Many old maps were copied repeatedly in various later publications. He even discusses the different drawing methods of displaying the flying putti (cherubs) on a couple of maps.

The need for a precision lunar map was a goal of Tobias Mayer (1723–62) as he wanted to use the timing of the umbra shadow during a lunar eclipse covering or uncovering a lunar feature to allow one to determine local time and longitude. His map was very accurate for its time. The map was published in 1775 and was the first lunar map to have the lines of latitude and longitude added to it.

Chapter 7 is devoted to the work and techniques of Johann Hieronymus Schroder, Wilhelm Gotthelf Lohrmann, Wilhelm Beer and Johann Mädler, Edmund Neison, Julius Schmidt, Johann Nepomuk Krieger, Philipp Fauth, and Walter Goodacre. A full discussion covers the different styles used by these men in the late 1700s through the early 1900s. A hot topic here is the use of hachure (lines) to try to show the angle of the slope of rims of lunar craters and ridges. Thick and thin lines help to show these slopes The author defiantly does not like Schmidt's 1878 lithographic work as being slopy, out of focus, and the "Individual hachures being difficult to distinguish but there is subtle toning to the flatter lunar surface." Manasek liked Fauth's work for its "cleanliness" and for not being cluttered by trying to depict every detail on the Moon.

Also covered is the 1860s failed attempt by William Radcliffe Birt (1808–81) to draw the lunar features as simple outlines with the hope that other observers would fill in the missing data. This incomplete project was funded by the British Association for the Advancement of Science. Only four of the planned sheets were ever completed.

Why has this magnificent work not been issued by a book publisher? I'll let the author speak for himself: "As an octogenarian, I decided to avoid the endless tribulations of conventionally publishing this book. Academic presses would only consider the work if it was much abbreviated and with but few illustrations of small size, making them irrelevant. The book's relatively small audience and need for quality printing make it unsuited for trade presses. Consequently, I decided to make my research available free as an 'open source' publication." Thank you, Mr. Manasek.

Johann Krieger (1865–1902) used a series of Lick Observatory lunar photographs and laid a glassine sheet over each of his 72 plates to create his 2-volume photo-visual atlas. Using ink, charcoal, and pencil he added features onto the glassine sheets that photographs of his time could not capture.

The only major problem that I have with the treatise is really a personal one. I dislike endnotes. I prefer footnotes, because to view them you do not have to thumb through several pages to find the note you want among a list of that chapter's numerous entries. Most of the chapters have about 80 to 100 endnotes. That is a positive feature in that the author's work is thoroughly documented. While searching a long list of endnotes for the one you want, it is easy to lose your place where the reference is in the main text or even the page you were on. No index is another problem but since the work is in electronic format the reader can use the Find button to locate what he wants to find.

Whether you are an observer of the Moon, or someone interested in the details of the craft of creating celestial maps, I highly recommend that you download this free book and study its wealth of details on mapmaking techniques and styles used before photography took over the art of mapping the Moon. The mapmaking techniques covered in this treatise used to create maps of the Moon also apply to many non-lunar maps made during the years covered in this book.

–Robert Garfinkle is the author of the astronomy book *Star-Hopping: Your Visa to Viewing the Universe* (Cambridge Univ. Press, 1994, 1997), a co-author of *Advance Skywatching* (Time-Life Books/The Nature Company, 1997), and author of *Luna Cognita* (Springer 2020). Since 2004, he serves as the Book Review Editor for the Journal of the Association of Lunar and Planetary Observers. Mr. Garfinkle is an avid collector of antiquarian and space-age maps of the Moon. Asteroid 31862 Garfinkle is named in his honor.

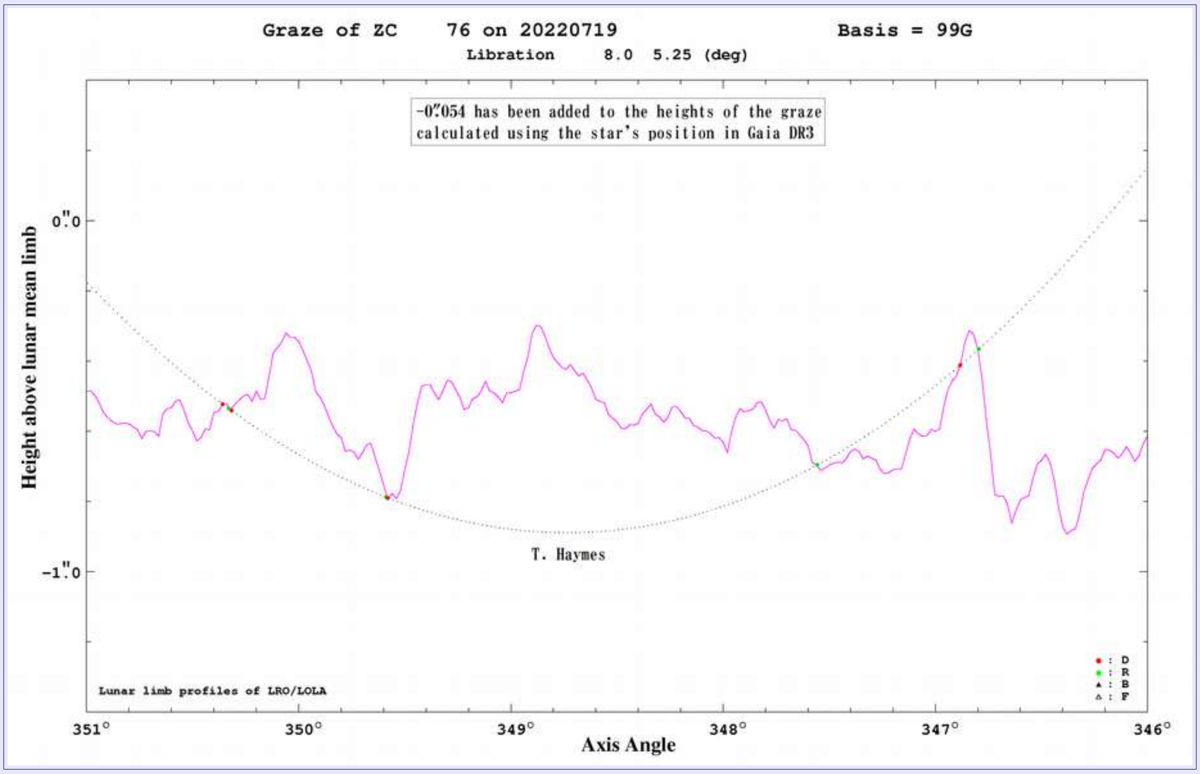
Lunar Occultations September 2022
by Tim Haymes.

Time capsule: 50 year ago: in Vol 7 No.9
[With thanks to *Stuart Morris* for the LSC archives]
*Lunar Occultation Program Report No2 is prepared by Ken Gayner (coordinator)
*Information to accompany timed observations is listed.
*Standard forms from the NAO are available.

Note from the coordinator: Those who have observed and reported times to the LS or NAO/Greenwich in the past will remember the standard form well. We all used them. This format is retained in the Occult4 database for display, but timing information is now entered on a more user friendly data-entry-screen. When timings are entered in Occult4, the observer will get immediate feedback on the timing quality (O-C). This helps to avoid errors in reporting, e.g. star ID, date or time.

Observations: Graze occultation of 14 Ceti (ZC 76) on 2022 July 19 @ 0159UT (HBAA #7)

Tim Haymes received the corrected limb profile from Dr Mitsuru Soma (IOTA) - Global Graze Coordinator in Japan. On the preliminary Occult4 profile (see last month) there was a small offset of the time points from the LOLA limb. The shift was removed by addition of -0.054" to the height of the graze calculated using the star's position in Gaia data release three (most recent) which could be due to proper motion. As can be seen from the graphic, the limb profile and observations are superimposed. A good result.

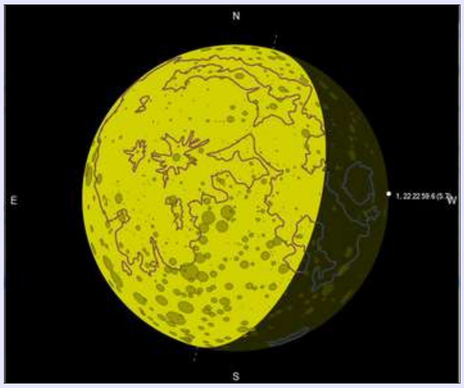


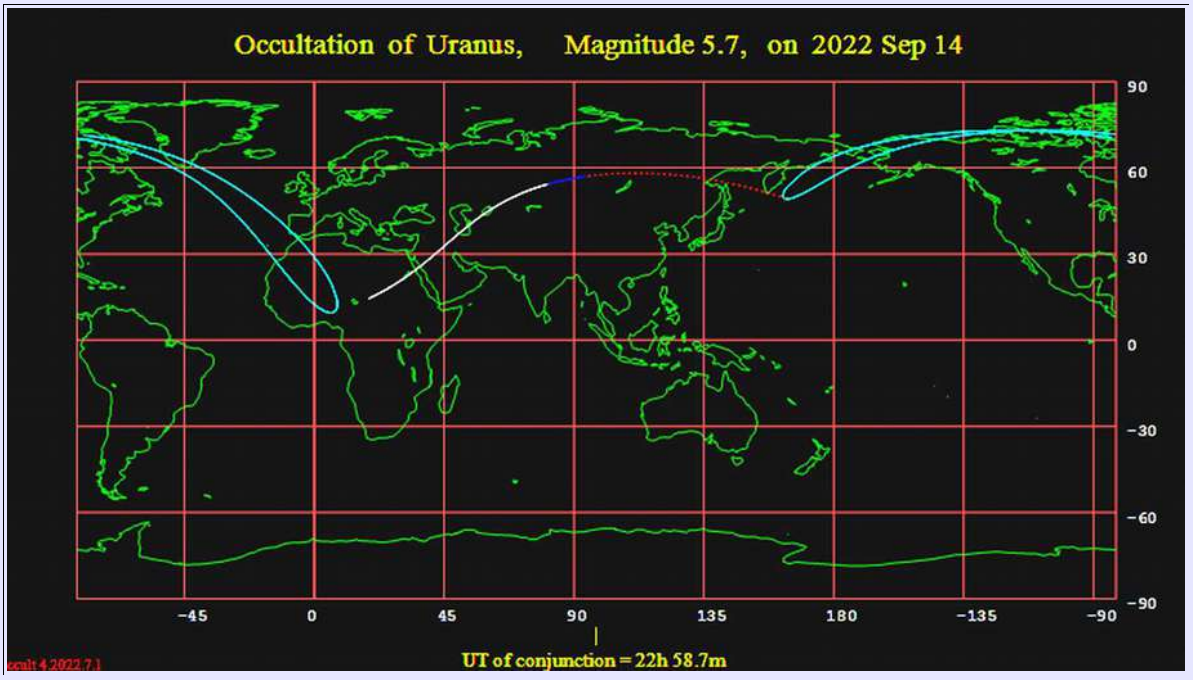
Highlight of the Month

Uranus RD on the 14th at 22.3 h UT.

Visibility: Greenland, Iceland, Ireland, UK, Europe, Scandinavia, N Africa, Middle East Uranus reappears at the lunar dark limb near cusp angle 75 North. The time given is the centre of the disk and the limb contact times of the planet are +/- 4 seconds. Emergence will take about 8 seconds in all.

Location	CA	UT
London	77N	2220 25s
Exeter	74N	2218 15s
Manchester	73N	2222 59s
IoM	76N	2218 43s
Edinburgh	70N	2227 02s
Inverness	68N	2229 16s
Dublin	70N	2221 59s
Paris	81N	2216 41s
Amsterdam	80N	2223 24s





Occultation predictions for 2022 September (Times as other locations will +/- a few minutes)
E. Longitude - 1 18 47.1, Latitude 51 55 40.3. To magnitude r8.0
Moon altitude >8 degrees.

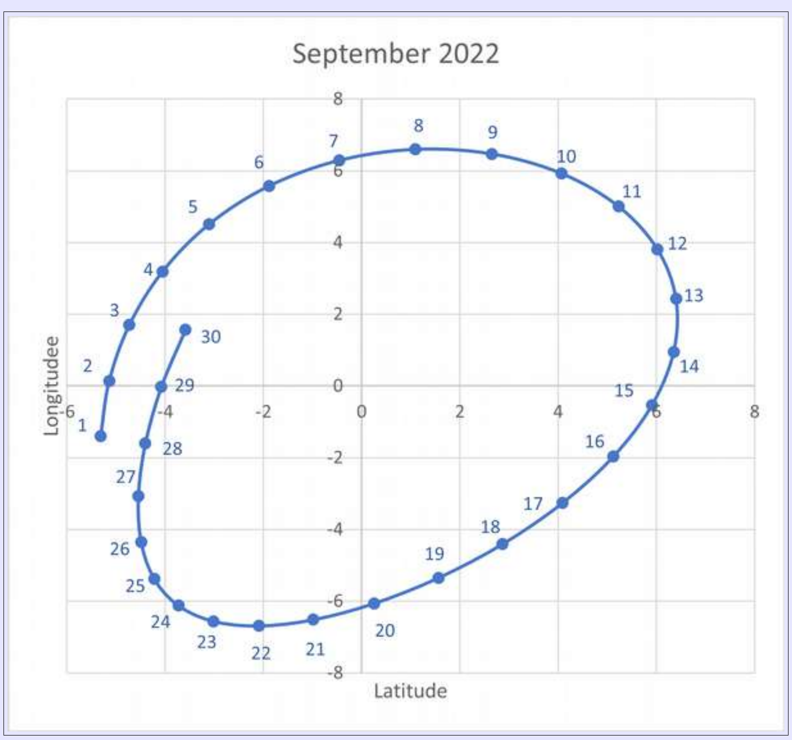
yy	mmm	day d	Time h	m	s	P	Star No	Sp	Mag v	Mag r	% ill	Elon	Sun Alt	Moon Alt	Moon Az	CA o	Notes
22	Sep	4	20	23	29.2	D	2545	F0	6.4	6.2	62+	104		8	200	40S	Dbl*
22	Sep	5	19	50	43.9	D	2727	A*	7.4	7.4	73+	117	-11	10	179	58S	
22	Sep	6	20	8	26.4	D	188677	K1	8.1	7.4	83+	131		11	169	35S	
22	Sep	6	20	24	0.9	D	188688	G8	7.7	7.2	83+	131		11	172	86S	
22	Sep	6	21	18	18.8	D	188724	F5	7.7	7.5	83+	131		12	184	82N	Dbl*
22	Sep	6	22	1	50	m	2910	G3	4.7	4.3	83+	132		11	194	1N	omega Sag
22	Sep	6	23	7	4.0	D	2914	G8	4.8	4.4	84+	132		7	208	44N	60 Sag
22	Sep	7	22	34	23.9	D	3073	K5	7.8	7.0	91+	145		15	188	84N	
22	Sep	7	22	57	28.2	D	189937	F3	8.2	8.0	91+	146		14	194	33N	
22	Sep	8	23	56	15.8	D	3227	K0	6.3	5.8	97+	160		19	195	27N	
22	Sep	9	0	33	20.1	D	164841	K0	8.1	7.6	97+	160		18	204	75N	
22	**Sep**	**11**	**21**	**10**	**12.4**	**R**	**76**	**F5**	**5.9**	**5.7**	**97-**	**160**		**17**	**113**	**68S**	**14 Ceti**
22	Sep	13	0	56	25.5	R	109940	G0	8.3	7.9	92-	146		43	155	35S	
22	Sep	14	21	29	12.4	DB	Uranus		5.7	5.7	78-	124		12	78	-54N	Uranus
22	Sep	14	22	20	46.7	RD	Uranus		5.7	5.7	77-	123		20	88	75N	Uranus
22	Sep	14	23	45	34.2	R	93290	F0	7.7	7.5	77-	122		33	105	6S	
22	Sep	15	0	48	58.6	R	93307	K2	7.7	6.9	77-	122		42	119	17S	
22	Sep	15	4	26	6.5	R	93347	G5	8.1	7.8	76-	121	-12	56	198	60N	
22	Sep	15	23	39	12.0	R	76346	K0	7.8	7.2	68-	111		28	91	84N	
22	Sep	15	23	41	10.3	R	586	K0	6.8	6.3	68-	111		28	91	78N	

22	Sep	16	0	1	30.8	R	76362	K7	8.5	7.7	68-	111		31	95	28S	
22	Sep	16	0	46	42.7	R	76373	K0	7.6	7.0	68-	110		38	104	37S	
22	Sep	16	4	12	49.0	R	599	K0	4.4	3.8	66-	109		60	172	88N	37 Tau
22	Sep	16	4	29	50.5	R	601	G5	5.9	5.6	66-	109	-12	60	179	63S	39 Tau
22	Sep	16	4	33	47.9	R	76439	G5	7.9	7.6	66-	109	-11	60	181	74S	
22	Sep	17	3	16	35.4	R	740	F0	6.3	6.2	57-	98		54	128	24S	
22	Sep	17	4	57	23.6	R	743	A0	5.8	5.8	57-	98	-8	63	169	77N	98 Tau
22	Sep	17	22	50	42.3	R	852	B3	5.2	5.3	49-	89		10	61	68S	125 Tau
22	Sep	17	23	40	51.5	R	77407	M0	8.4	7.5	49-	89		17	69	46N	Dbl*
22	Sep	18	1	12	32.0	R	869	B9	7.4		48-	88		31	86	70N	
22	Sep	19	2	30	47.3	R	78630	K2	8.1	7.4	38-	76		35	90	60S	
22	Sep	21	1	57	55.3	R	80165	F2	7.5	7.3	21-	55		14	69	82N	
22	Sep	21	3	0	7.7	R	80192	G5	8.5	8.0	21-	54		22	80	59S	
22	Sep	22	4	6	11.1	R	80764	K2	7.8	7.0	13-	43		23	85	88S	
22	Sep	22	4	35	9.6	R	80772	K5	8.7	7.9	13-	43		27	91	72S	

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.

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 or nearest town.
An aperture of 20cm will be used unless advised to the contrary.



Libration chart for September 2022.

Images have been received from the following members: Les Fry, Philip Masding, Maurice Collins, Dave Finnegan, Rod Lyon, Luigi Morrone, Rick Hill, Leo Aerts, Trevor Smith, K.C Pau, Aldo Tonon, Franco Taccogona and Bob Stuart.

Catena Abulfeda.

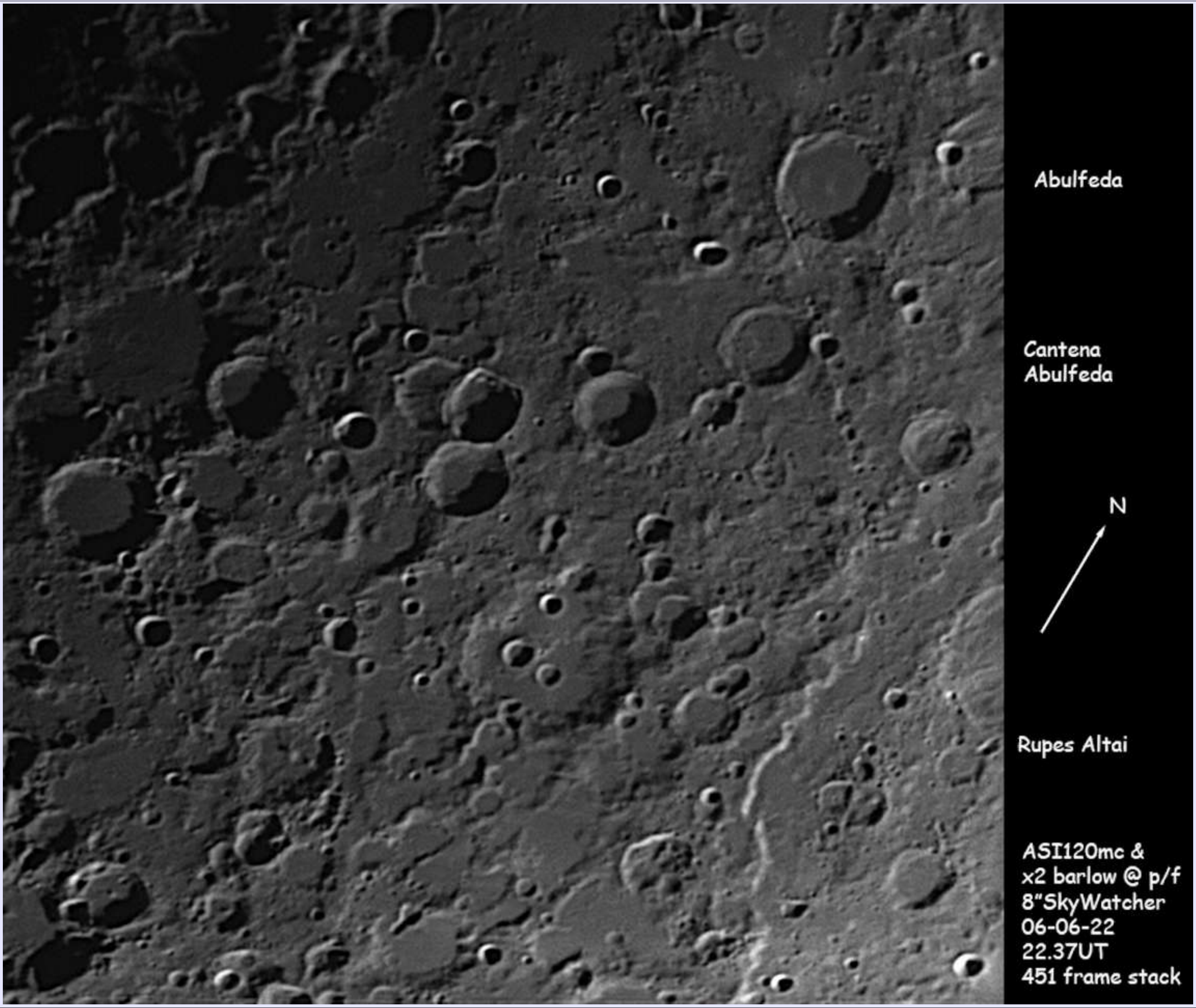


Image by Les Fry, details equipment/date in image caption.

Editor Comments: The nature of crater chains such as Catena Abulfeda is somewhat uncertain though the most logical explanation is that they are the result of the impact of a tidally disrupted rubble pile type asteroid. In this case the largest crater in the chain Almanon C may not belong to the chain as it appears to cut the smaller crater in the chain to its east and is slightly less optically mature than the remaining craters in the catena. The individual crater components of the chain are not as regularly arranged or spaced out as those in the most well known chain Catena Davy, possibly indicating a more highly disrupted impactor with greater dispersion of the individual components. Of course this is just one possible cause, and spectacular crater chains can be formed as a result of secondary impacts produced by jets of ejecta from large craters or basins, the Schrödinger Basin for instance has the spectacular Vallis Schrödinger and Vallis Planck extending away from it and to either side of southern Mare Australe. In the present case however Catena Abulfeda does not appear radial to any large impact structures and so the disrupted asteroid hypothesis may be more likely.

Copernicus.

Image by Philip Masding.

Editor Comments: Along with this and other images Philip included a note on his imaging technique which I felt would be quite useful information for other who are experimenting with kit and methods:

"*All of the images were taken with my rather old 250mm Meade LX200 and a ZWO ASI 290MM. I first imaged the moon with this telescope using a VHS video camera in 1996. As cameras have evolved results have improved dramatically. The present combination of the f10 telescope and the ZWO camera is ideal since the pixel size matches the telescope resolution very nicely with no need for any Barlow lens. I also use an IR pass filer which definitely helps with the seeing. The only drawback is that a few minutes of full frame video rapidly fills up the computer hard drive. On the plus side it means I have to process the images to clear space for the next observations!*"

Please feel free to include any hints and tips regarding your imaging techniques/equipment as well as processing secrets and hacks when you submit your images!

Delambre.

Image by Maurice Collins using an ETX-90 without any tracking working (*I found upon opening the base that the batteries had gone flat since I last used it and leaked badly, corroding the terminal clips all the way through*)

Editor Comments: I have included comments by Maurice regarding his tracking woes in the caption to show that things may not always go according to plan, but the results can still be pretty good. This is one of several images he submitted recently and dedicated to the memory of Brendan Shaw.

Though center stage is occupied by Delambre, this image captures Mare Tranquillitatis and Sinus Asperitatis to the south with the low angle impact crater Torricelli set within a larger, circular but almost completely submerged impact structure. At 12:00 o'clock to Torricelli is the 6.8km diameter crater Torricelli B, with a small elongate hill of highland material immediately to its south. Torricelli B itself has a dark ejecta halo of high titanium basalt which is particularly apparent to the north, south and east of the rim, and has a bright streak of highland material up its northern inner wall. It has been the focus of several historic TLP reports in the past which have been mentioned several times in Tony Cooks's Lunar Geological Change section.

Doppelmayer.

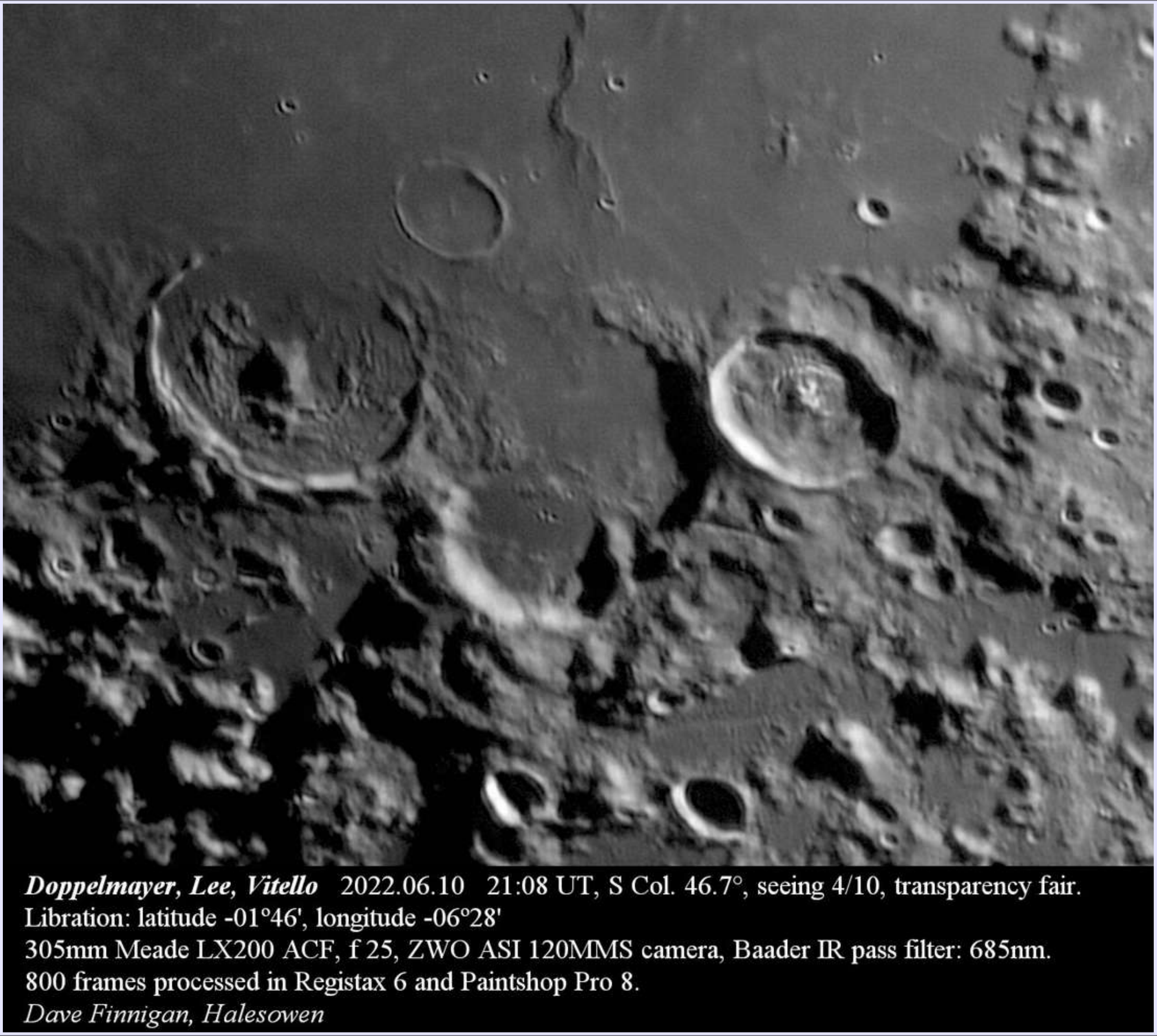
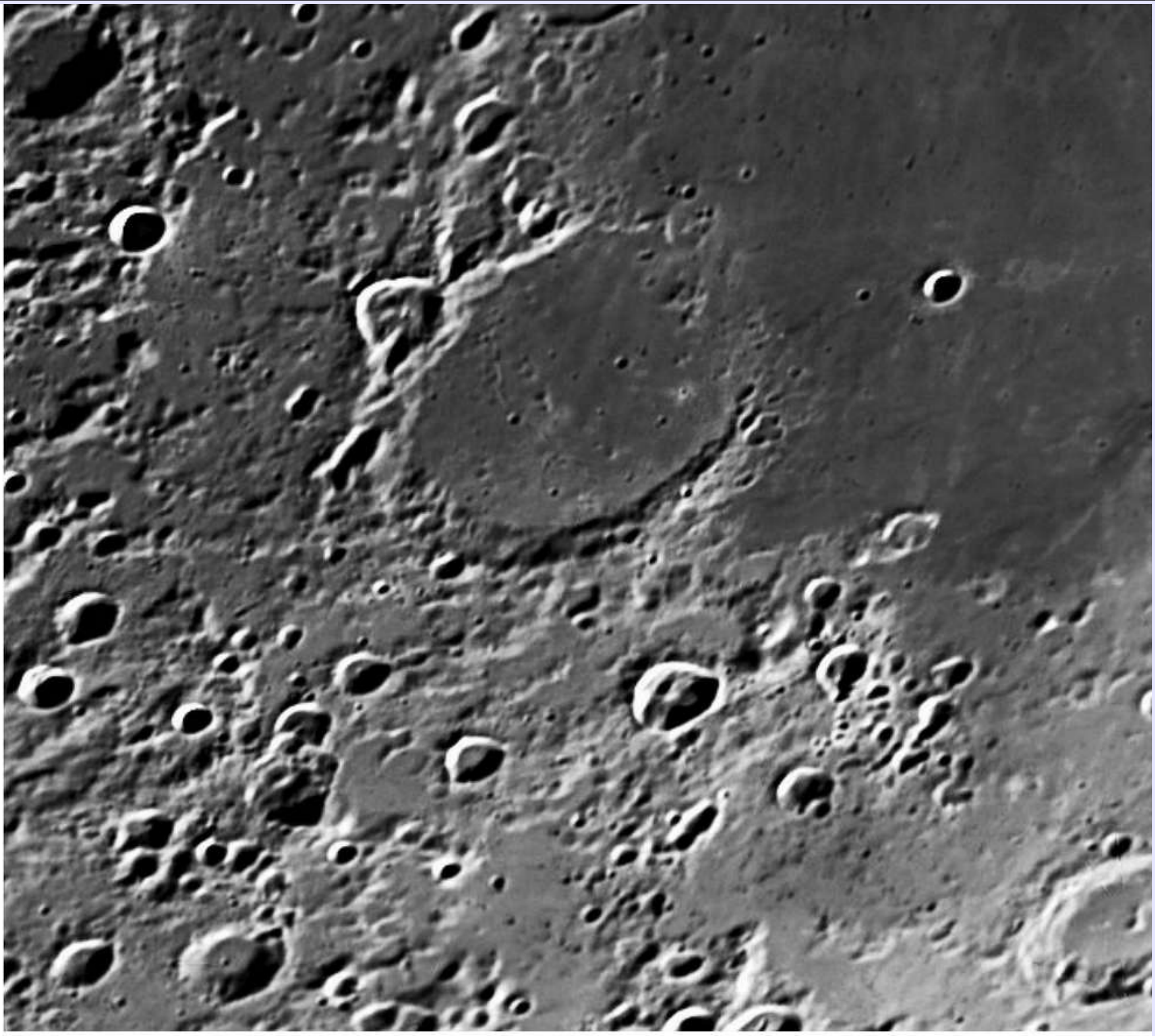


Image by Dave Finnegan. details equipment/date in image caption.

Editor Comments: This study of the southern shore of Mare Humorum shows the partially flooded Floor Fracture Crater (FFC) Doppelmayer, and its neighbour Vitello, another volcanically modified impact crater. As can be seen, apart from the south the rim, which is some 500m higher, much of the remaining rim of Doppelmayer is much lower than the central peak, and any trace of a rim is obviously absent to the north. This shows that whilst the central part of the crater, including the central peak has been pushed upwards, as is the case with many FFC's, much of the northern part of the crater has subsided as the central part of Mare Humorum sank under the weight of its basalt lava infilling, allowing the mare lavas to flood into the crater and cover its northern floor. Widespread deposits of dark pyroclastic (visible as low albedo material in Dave's image) material dominate the central and eastern part of the crater as well as the terrain to the east, indicating extensive and prolonged volcanism, possibly associated with the circum-basin fractures that probably formed the conduits that allowed magmas to invade both Doppelmayer and Vitello. It looks like Doppelmayer formed on a bench type structure that originally circled the Humorum basin but which is now largely submerged – similar in some respects to the Appenine Bench or the Montes Rook Formation of the Orientale Basin.

Fracastorius.



Fracastorius 2022.06.05 - 20.28 UT
300mm Meade LX90, ASI 224MC Camera with Pro Planet 742nm I-R Pass Filter.
600/3,000 Frames. Seeing: 7/10, with some turbulence. Rod Lyon

Image by Rod Lyon, details equipment/date in image caption.

Editor Comments: Fracastorius lies on the southern shore of Mare Nectaris and on top of the first prominent basin ring – though the presence of wrinkle ridges and gravity data might suggest the presence of another ring interior to this one. Like many craters bordering mare basins, Fracastorius appears to be tilted towards the basin center with the rim on the basin side submerged beneath the mare lavas (see Doppelmayer above). The geometry of the floor here is, however more complicated than a simple northwards tilt, with the rougher southern floor being slightly bulged upwards and the smoother northern floor descending in a gentle curve towards the basin. It is possible that it is the crest of this bulge that Maurice Collins captured in his image on page 5 of this LSC, not a central peak as such but a raised ridge running across the middle of the crater floor. The prominent curving fracture that runs concentric to the Nectaris ring and across the floor of Fracastorius marks the summit of this southern bulge, suggesting that uplift was responsible for its formation, whilst the presence of less obvious fractures, particularly along the base of the eastern wall suggest that the crater may be a Floor Fracture Crater, albeit a heavily modified one.

Piccolomini.

Image by Luigi Morrone at 18:55UT ON 5th July 2022 using a Celestron C14 Edge HD (355mm), Fornax52 Mount, ASI174MM Camera, Baader FFC Barlow, Optalong R Filter.

Editor Comments: In the previous photo we saw Fracastorius perched on one of the inner rings of the Nectaris Basin, here we see a much younger complex crater Piccolomini, perched on what may be the outer ring of the same basin. You can see this ring in Luigi's image, running from the crater down towards the lower left of the frame. The crater has one of the most impressive central peaks on the nearside, rising some 2000m above the crater floor and superficially it is quite similar to the central peak of Theophilus which also lies on the edge of the Nectaris Basin. The location of the crater straddling the basin ring has had a conspicuous effect on the width of the terraces within the crater. To the south the terraces span quite a broad zone, being between 18 and 20kms wide, whilst to the north the terraces are only around 11kms wide. This is probably the result of the southern rim being over 1500m higher than the northern rim, with consequently a lot more post impact collapse occurring here than to the north. Luigi's image shows this well, with the southern rim of the crater lying on the higher terrain outside the basin ring, whilst the northern part of the crater lies on the lower terrain towards the basin center.

Rupes Recta.

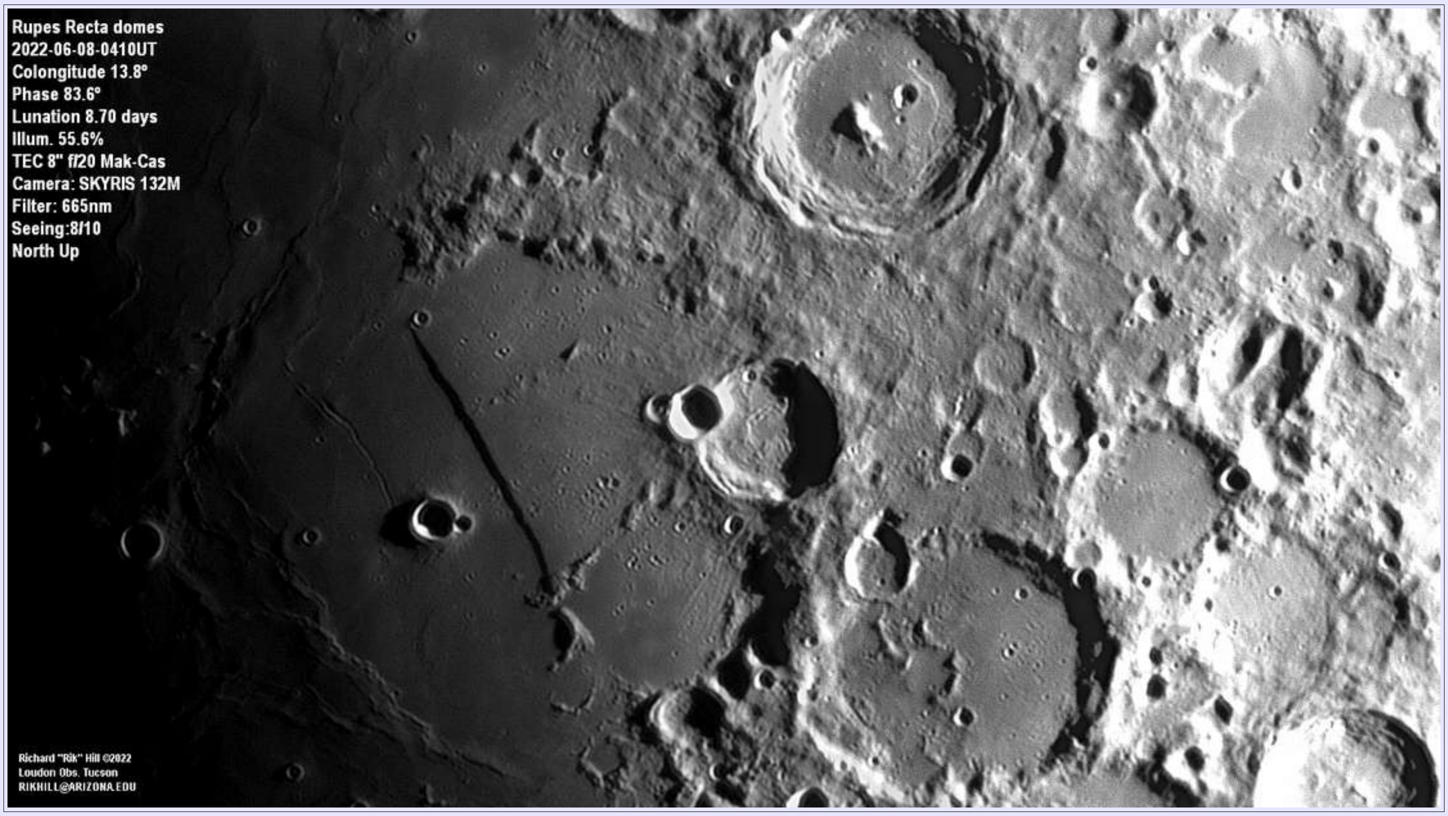


Image by Rick Hill,details equipment/date in image caption.

Rick Comments: *Southwest of the great crater Arzachel (100km dia.) seen here in the top middle of this image, is the feature called the Straight Wall, or Rupes Recta, a fault running some 114km. In truth, it is neither straight nor a wall. It is an escarpment some 2-3 km wide with a height of 240-300 m (possibly even 450m according to Wood) so it is far from the vertical cliff it at first appears. Neither is it straight as can be seen here! At the south end of the Rupes is an interesting set of mountains nicknamed the Stag's Horn Mountains because of their shape.It's not an official name but many lunar observers from the 1950s and 60s are well familiar with them by that name. About 40 km further west is Rima Birt that parallels the Rupes and between the two is the recently formed crater Birt (17km) overlapped by the even more recent Birt A on the east side. At its north end is another shorter unnamed rima. All this seems to sit in the ruins of an ancient flooded crater some 300 km in diameter. On the east side of this larger structure is the crater Thebit (60km) and below right the larger crater Purbach (121km). Notice the shadow cast by Birt. There's a mild swelling just beyond and below it. If this is a dome, there is no listing for it. Moving further up the Rupes you get to a point where it widens at the top showing another swelling. This is a recognized dome Birt 1 or B1. Over on the parallel small rima, a little north of this spot is another widening and swelling that is Birt 2. These are among the most difficult domes I have recorded yet but what about the southernmost one? Time will tell.*

This montage is made from two stacked 1800 frame AVIs stacked withAVIStack2 (IDL) and merged with Microsoft ICE. Final processing was done with GIMP and IrfanView.

Montes Caucasus.

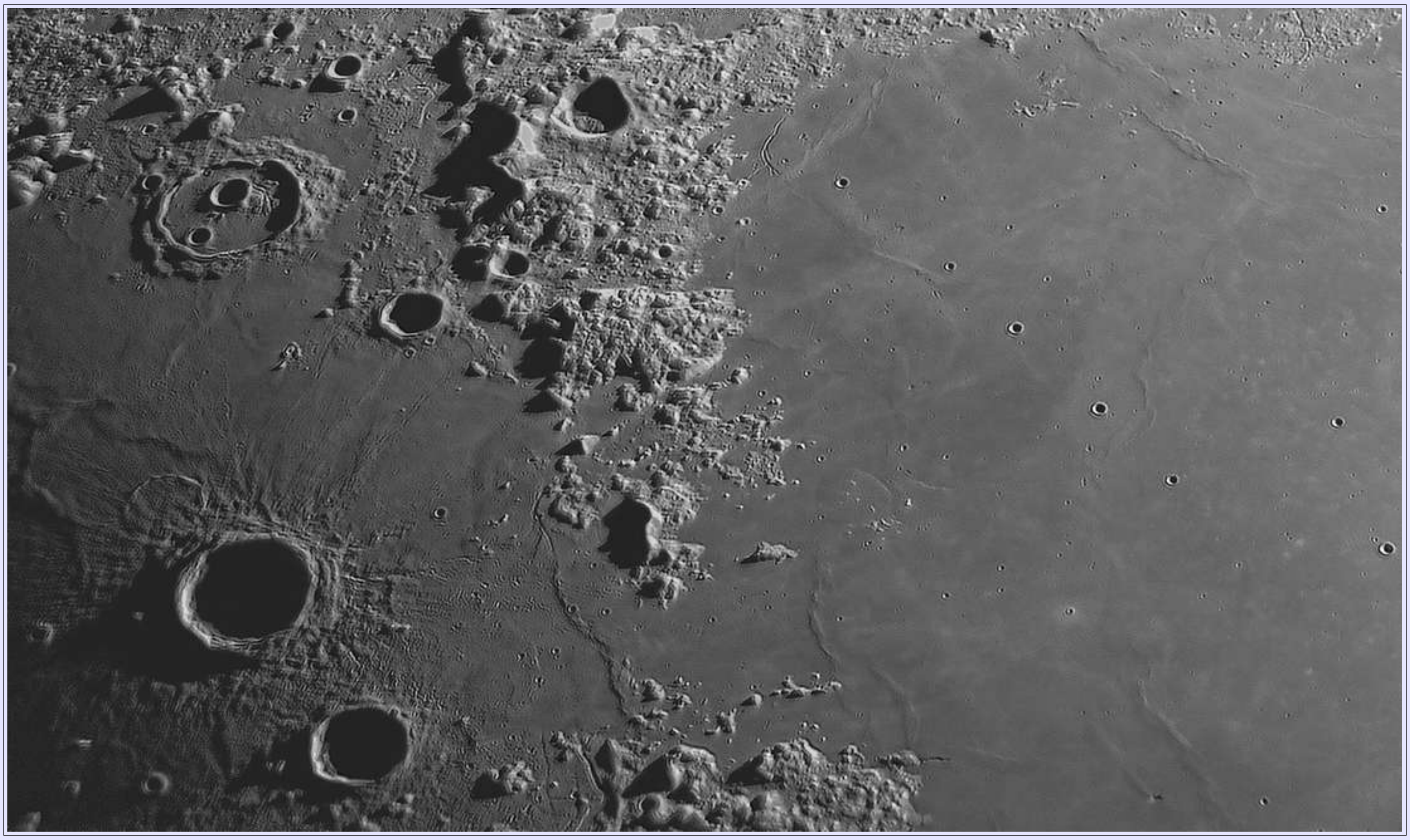


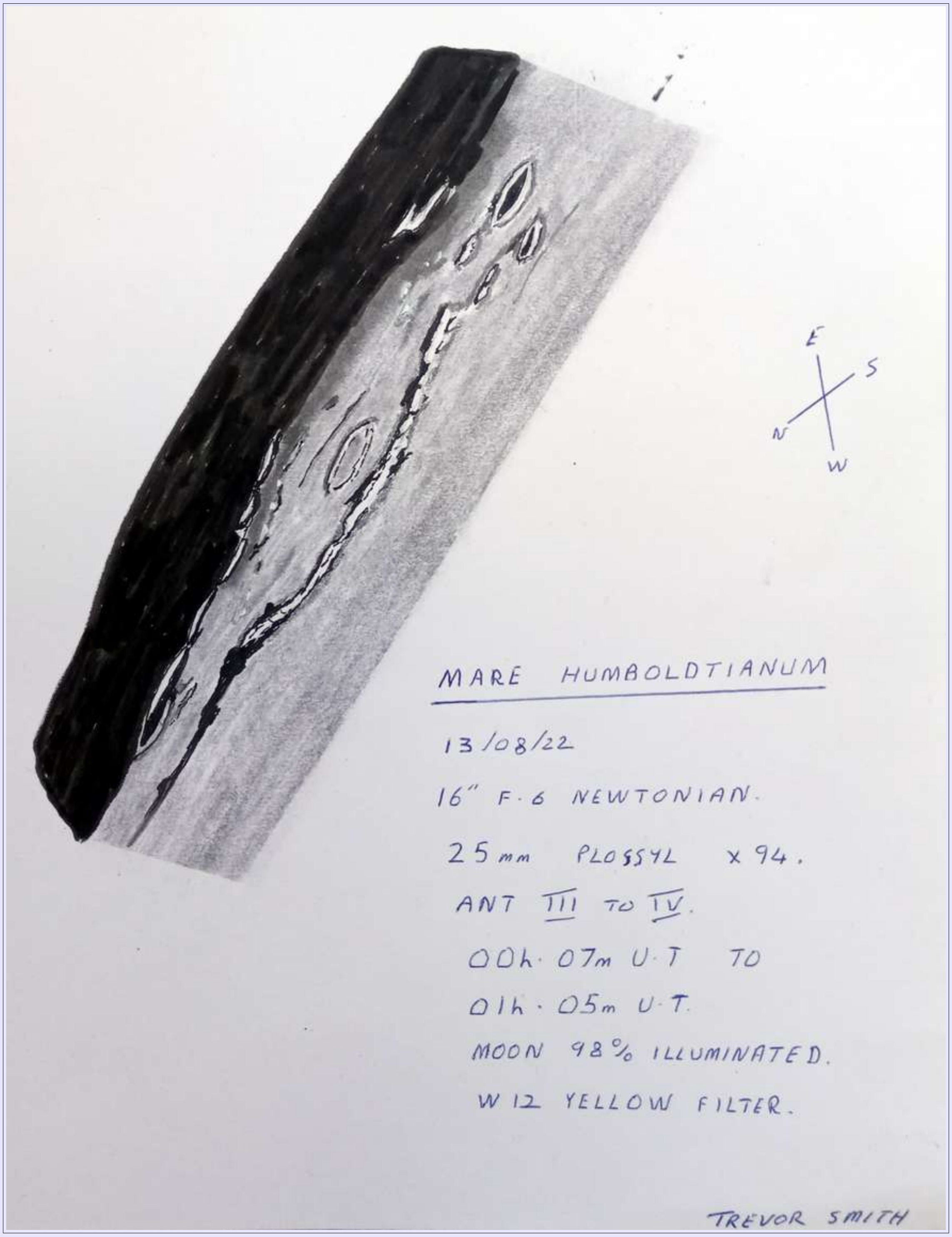
Image by Leo Aerts with C14, red filter and webcam ASI 290MM.

Leo Comments: *Herewith a recent wide field view of a small part of Mare Imbrium, Montes Caucasus, Mare Serenitatis, with grazing light conditions over Cassini and Aristillus, Autolycus in almost complete darkness. While we have high noon sun on Mare Serenitatis, Valentime Dome and LinnÈ are plainly visible. Remark: this imaging result was made with the Sun still (low) above the horizon.*

Editor Comments: Clearly the resolution provided by Leo's 14 inch aperture has allowed some very fine detail to be resolved here.The profusion of small secondary craters in the ejecta blanket of Aristillus cover the surface over much of mare on the left side of the image, fewer can be seen to the right on the surface of Mare Serenitatis, except where they have slipped through the gap between Montes Apenninus and Montes Caucasus, or through other low points in the basin rim. The Valentine Dome can be seen just below right of centre – this well known dome and a smaller dome of similar morphology was analysed by Raf Lena and others in a BAA Journal article in 2006* where they concluded that the most likely explanation for the structure was that it represented a Laccolith, which is where a subsurface magma body pushes the surface upwards but does not erupt at the surface. Rima Calippus, a short curved linear rille can be seen on the northern edge of Mare Serenitatis towards the top of the frame. The surface here is very gently bowed upwards, probably in response to another subsurface intrusion, but in this case the fractures that formed as a result of this upwards pressure served as conduits for the eruption of pyroclastic material which form areas of dark mantling around the vents. These patches might be a difficult telescopic target, but should be visible with reasonable magnification under high sun angle illumination.

*Lena, Raffaello & Pau, K. & Phillips, Jim & Fattinnanzi, C. & Wöhler, C.. (2006). Lunar domes: a generic classification of the dome near Valentine located at 10.26°E and 31.89°N. Journal of the British Astronomical Association. 116. 34.

Mare Humboldtianum.



Drawing submitted by Trevor Smith, details of equipment and date/time as shown in drawing notes.

Editor Comments: Trevor included some of his detailed observing notes together with this drawing, and they are reproduced below. The drawing shows the rather obscure scarp like feature just beyond the partially submerged ghost crater in the foreground, beyond this the mare drops in a gentle curve by some 300m towards Bel'kovich A which was at the time of observation, hidden in the shadows to the east. Mare Humboldtianum is 275kms in diameter and is the centre of the much larger Humboldtianum Basin which is 650kms in diameter. The western part of the mare is covered in a bright ray which originates from the crater Hayn (also in shadow at the time of drawing) and heads south between Endymion B and Mercurius. The ray is not radial to Hayn because it is the edge of a Zone of Avoidance in the ejecta as Hayn is the result of a low angle impact from the south.

MARE HUMBOLDTIANUM

THE EARLY HOURS OF SATURDAY 13/08/22 FOUND THE SKIES CLEAR FOR A CHANCE. THE AIR WAS WARM AND STILL WITH A TEMPERATURE OF 17·7°C INSIDE THE OBSERVATORY.

THE 98% ILLUMINATED MOON LOOKED FULL TO THE NAKED EYE BUT THE TELESCOPE EASILY SHOWED THE TERMINATOR HAD NOT QUITE COVERED A THIN STRIP TO THE NORTH EAST LIMB.

THE LIBRATION WAS SUCH THAT THE EAST LIMB AREA WAS WELL PLACED FOR OBSERVATION.

A QUICK SCAN WITH A 25mm EYE-PIECE AT 94x SHOWED THE FINE SIGHT OF MARE HUMBOLDTIANUM TO BE FAVOURABLY PLACED. OWING TO DIFFERENT LIBRATIONS THE MARE CAN BE A DIFFICULT OBJECT TO OBSERVE.

THIS MORNING IT'S IMPRESSIVE 270Km DIA LAVA FILLED FLOOR WAS A WONDERFUL SIGHT WITH IT'S SOUTH/WESTERN RAMPARTS SHINING IN THE LUNAR DAWN, THESE WERE IN STARK CONTRAST TO THE DARK SHADOW FILLED NORTH/EASTERN PARTS OF THE MARE.

I COMMENCED OBSERVING AT 00h·07m U.T AND DECIDED TO DO A QUICK SKETCH. I USED A YELLOW W12 FILTER WHICH HELPED WITH THE CONTRAST. I INCREASED THE MAGNIFICATION WITH A 9·5mm PLOSSYL EYE-PIECE GIVING 247x. THE SEEING WAS ONLY ANT III TO IV. OBSERVING FINISHED AT 01h·05m U.T.

THE WEST RIM IS VISIBLE AS A FAIRLY BRIGHT ARCUATE CHAIN OF MOUNTAINS. AN EASY TO SEE VERY ELLIPTICAL AND LOW WALLED CRATER LIES INSIDE THIS RIM AND IS SEEN WELL AGAINST THE DARK GREY, SMOOTH LOOKING FLOOR OF MARE HUMBOLDTIANUM. JUST TO THE EAST OF THIS CRATER IS WHAT LOOKS TO BE A RIDGE OF SOME SORT RUNNING IN A NORTH TO SOUTH DIRECTION.

THE EASTERN PORTION OF THE MARE JUST SEEMS TODAY TO MERGE INTO THE BLACKNESS OF THE TERMINATOR SHADOW.

TO THE OUTSIDE OF THE NORTHERN EDGE OF THE MARE WAS A THIN SLIVER OF A CRATER WITH IT'S FLOOR IN FULL SHADOW. THIS WAS THE 86Km DIA CRATER CALLED HAYN. THIS AREA RAPIDLY BECOMES SOMEWHAT CLUTTERED AND DUE TO FORESHORTENING AND LIBRATION IT CAN BECOME QUITE DIFFICULT TO IDENTIFY SPECIFIC CRATERS.

THIS IS AN AREA OF THE MOON THAT I DO NOT TEND TO OBSERVE VERY OFTEN, IT MADE A NICE CHANGE FROM LOOKING AT THE MORE USUAL FEATURES ON THE MORE ACCESSIBLE WESTERN LIMB.

TREVOR SMITH
CODNOR, DERBYSHIRE

Mare Imbrium.

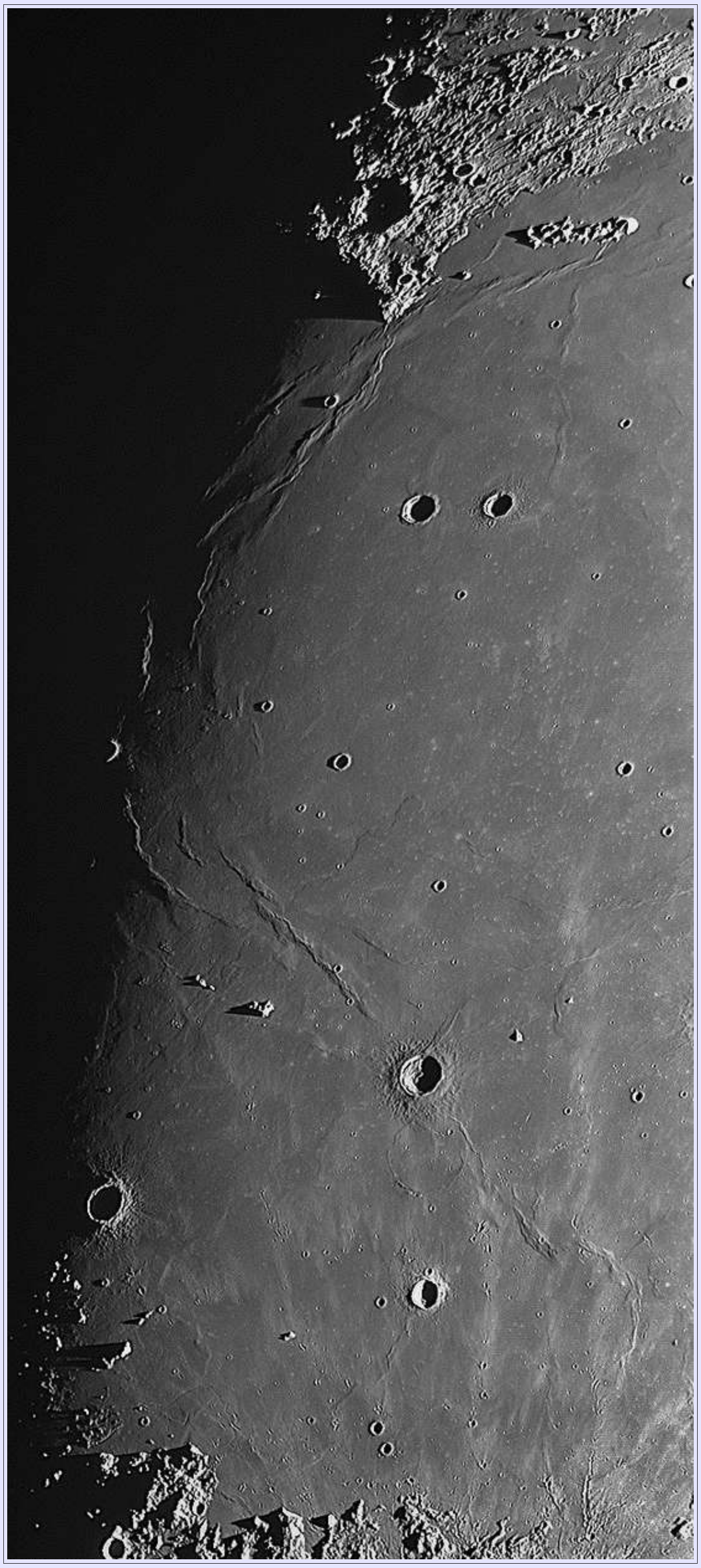
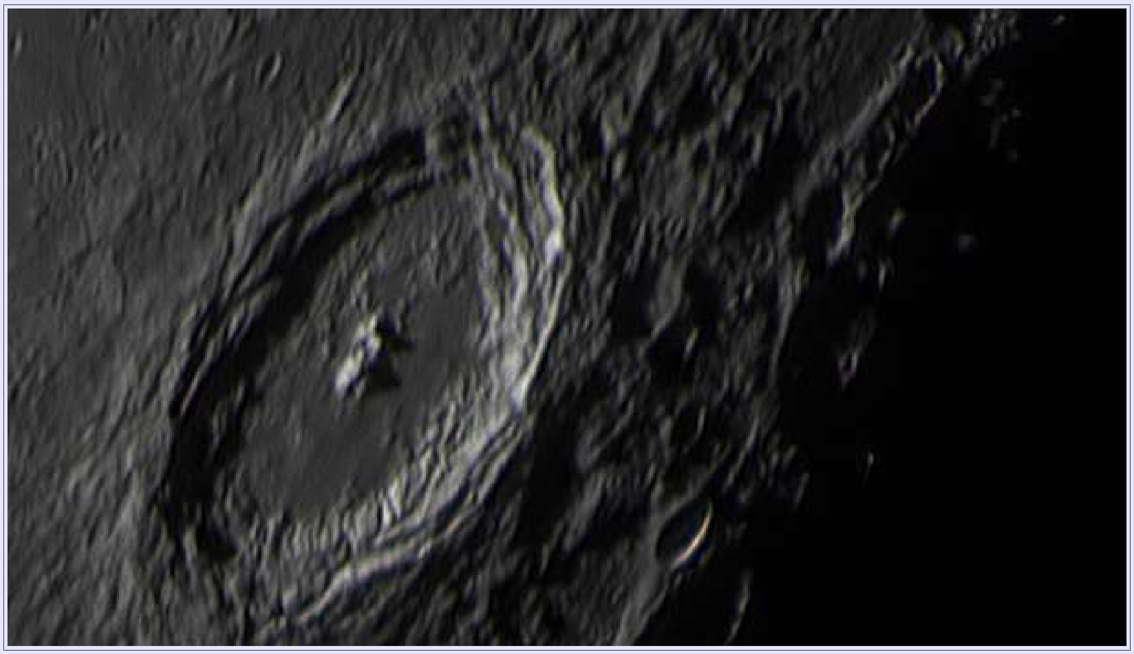
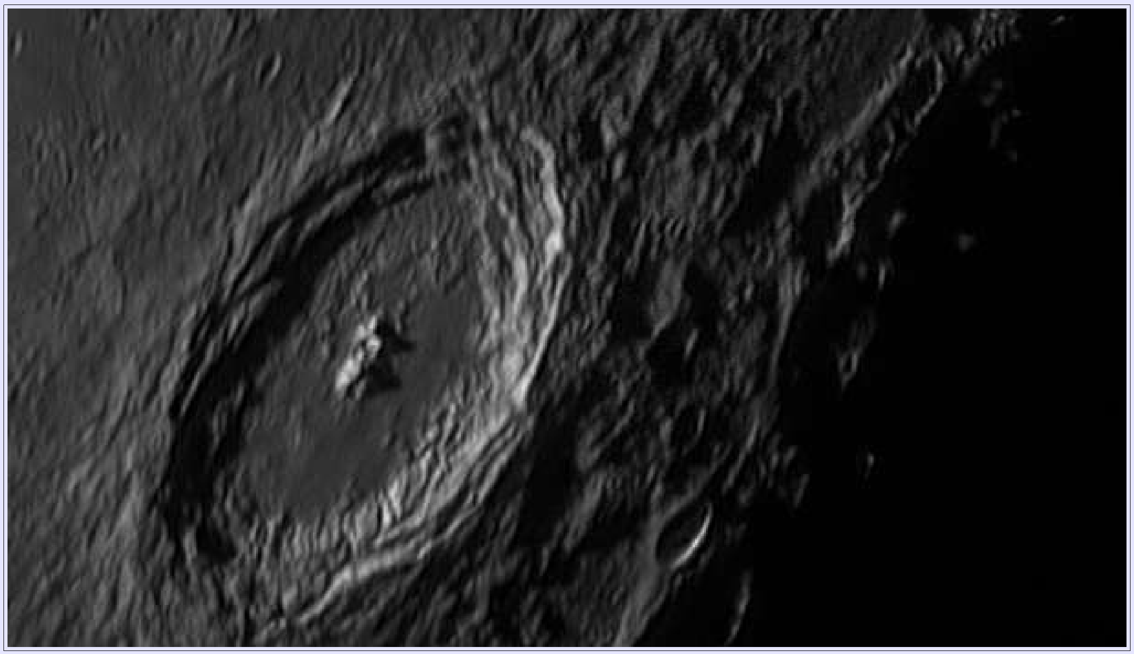


Image by K.C Pau taken on 23January2021, 11h43m UT with 250mm f/6 Newtonian reflector + prime focus + QHYCCD290M camera.

K.C. Comments: *Enclosed is a wide-field photo showing the panoramic view of the western part of Mare Imbrium for LSC. The lava flow front is clearly shown near the centre of the photo under the oblique illumination. Mare ridges arising from the tip of Promontorium Laplace of Sinus Iridum run all the way down to the foothills of Montes Carpatus.*

Langrenus.





Images by Bob Stuart taken on 14/08/2022 03:21 UT 25cm f6.3 Newtonian 2.5x PowerMate, ZWO 178 MC. Upper image taken in colour, lower in monochrome.

Bob Comments: *As I had my colour camera on for Jupiter and Mars and the Moon had become visible I took a colour shot of Langrenus as it so happens. I don't usually do colour on the Moon as it doesn't seem to work well. But this time not too bad, there are some colours around some of it definitely fringing due to low altitude.*

Editor Comments: As noted in the July LSC Langrenus has been the site of one of the only suspected TLP events that resulted in an academic publication, though on that occasion the phenomenon was reported over the northern floor. The upper image here shows, as Bob comments some colour fringing, which appears prominent around the eastern rim of Langrenus M to the south-east of the main crater.

Descartes: Apollo 16 Landing Site.

Image by Aldo Tonon, details of equipment and date/time shown in image.

Editor Comments: For those of you not familiar with this landing site, the bright spot at the centre of the image is the 700m diameter crater South Ray, visible because of its very fresh nature and the brightness of the plagioclase rich ejecta blanket. Apollo 16 landed some 5kms from the crater, which the astronauts did not visit, probably a wise decision as such a fresh crater would have an extensive and probably hazardous concentration of boulders surrounding it. The conspicuous light patch between the two bright craters Dollond E and Descartes C (just below South Ray in this image) is the location of a prominent magnetic anomaly, and as in the case of Reiner Gamma this brightness may be a result of shielding from radiation damage as the magnetic field deflects solar and cosmic ray particles away from the surface.

Lassell.

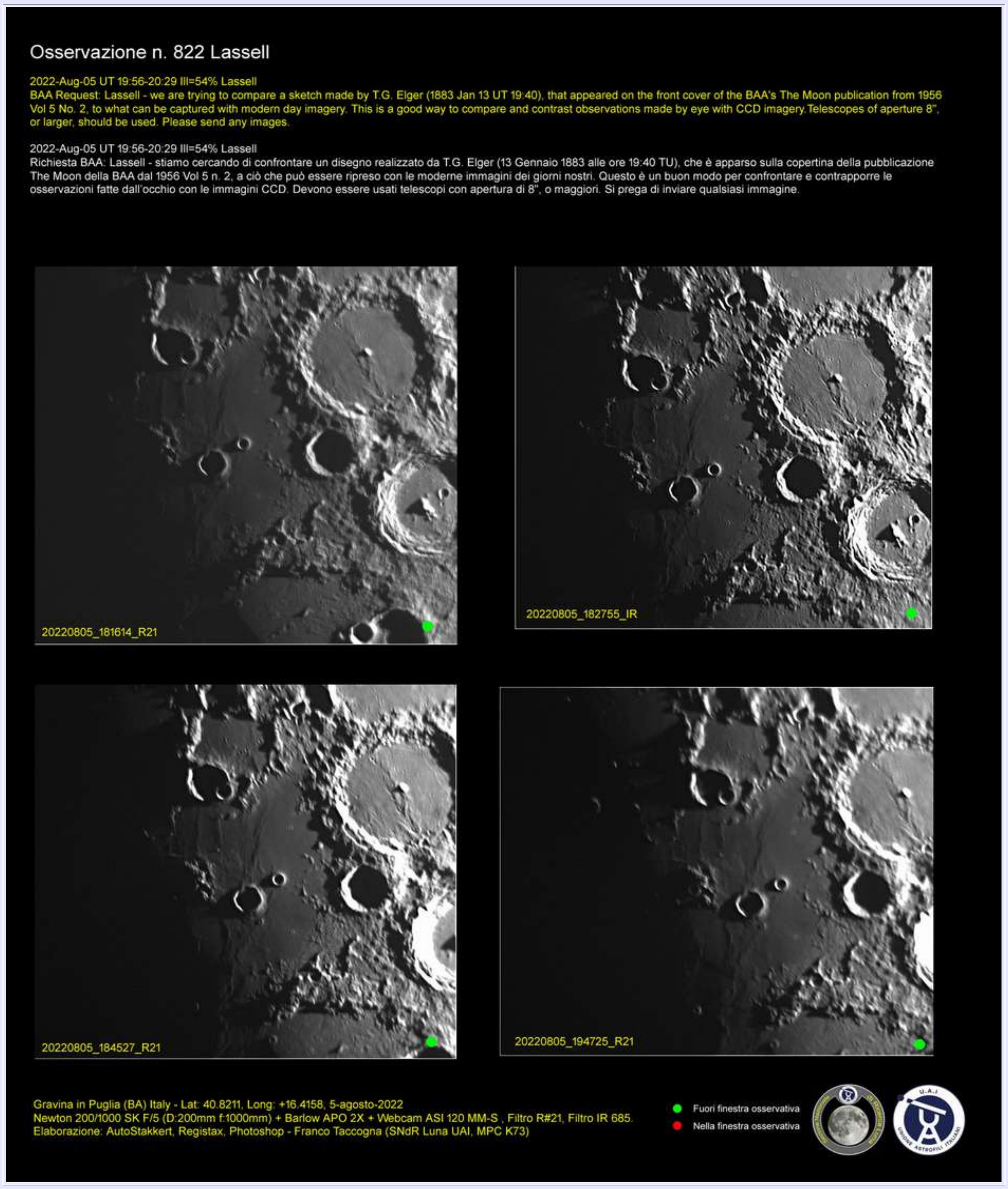
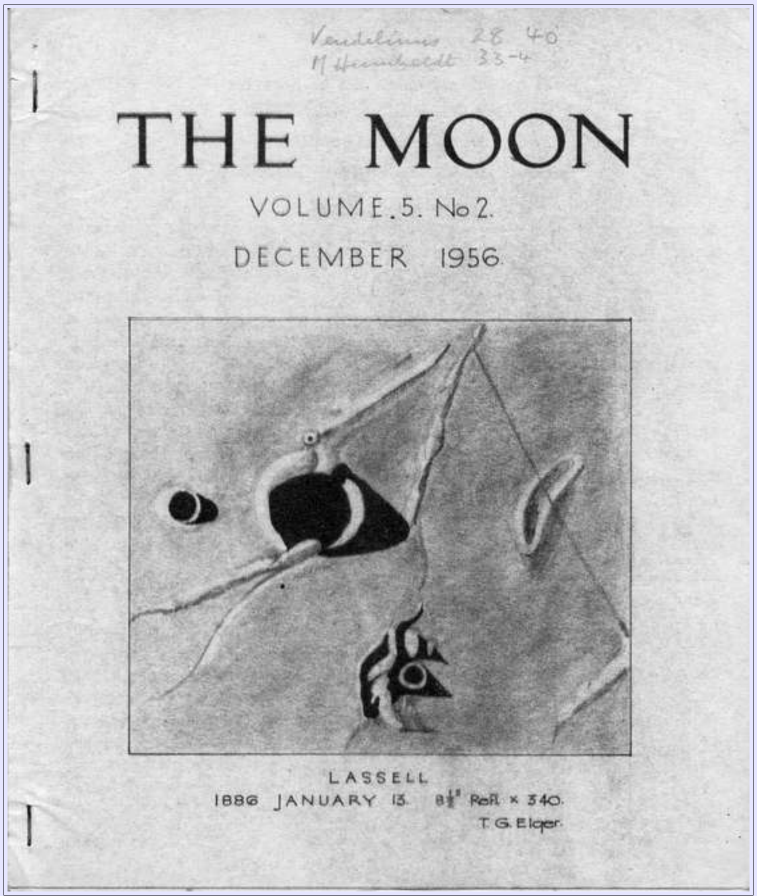
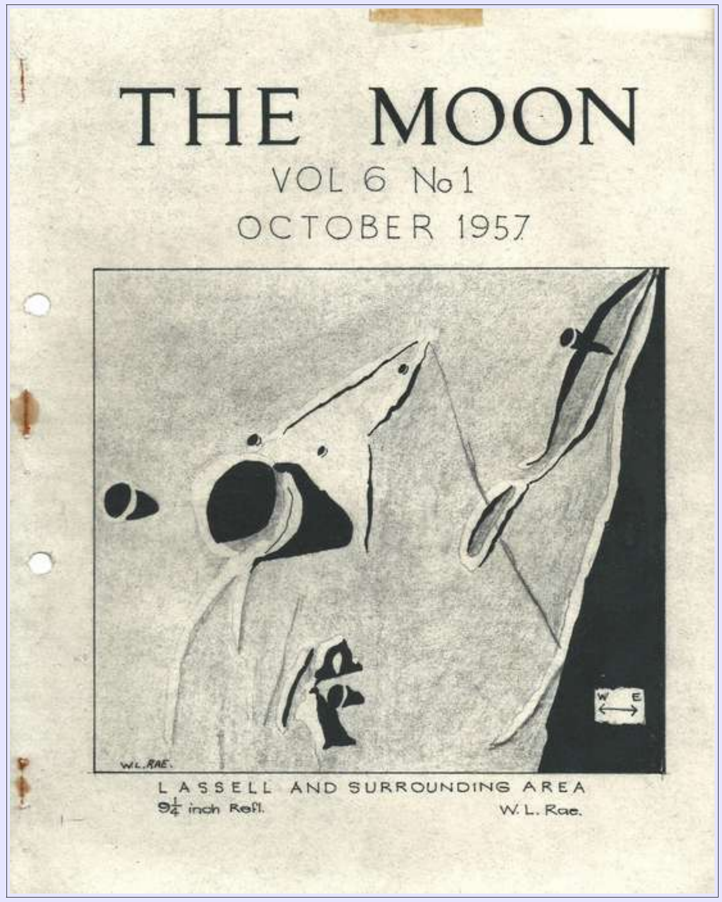


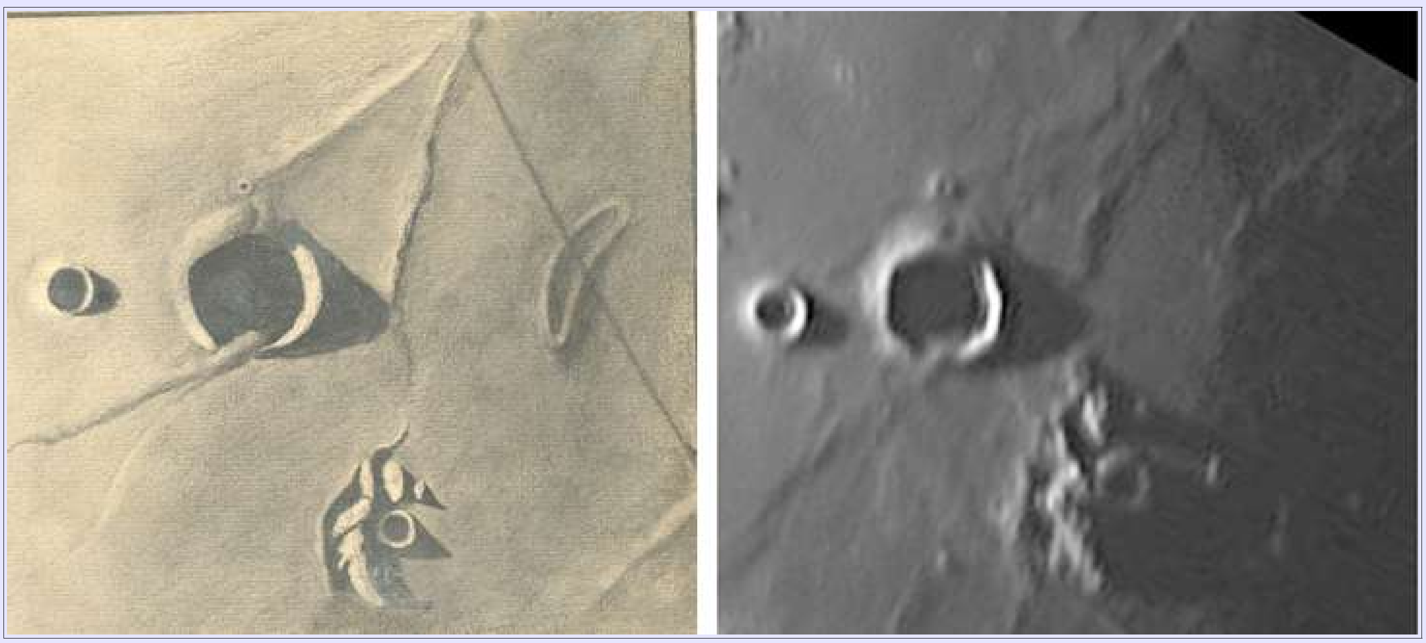
Image by Franco Taccogona, details of equipment, time and date shown in image.

Editor Comments: Tony Cook has fished out a copy of the original 1885 drawing by T.G.Elger of Lassell, which was reproduced on the the cover of The Moon in December 1956 (see below). He has also taken a crop from Franco's image shown above and compared it to Elger's original drawing. The shadows are slightly different between the Elger sketch and the UAI set of images. This is because the Lunar Schedule website was using +/-0.5 deg similarity which Tony now thinks needs to be tightened up to +/-0.4 deg in future. The same area was also drawn by W.L Rae and featured on the cover of The Moon in October 1957 – it is interesting to compare the two! Of course if you visit https://britastro.org/document_folder/baa-document-store/sections/lunar-section/the-moon-1950-1967 you can see the complete archive of The Moon, which includes some extremely fine drawings on their covers and fascinating commentary on lunar science as seen from the perspective of the 1950's onwards.





Left: Cover of The Moon, December 1956 featuring T.G.Elger's drawing of Lassell, Right drawing of same area by W.L Rae featured on the cover of The Moon in October 1957.



A sketch by Elger from 1885 Jan 13 UT19:46. (Right) An image by Franco Taccogna (UAI) taken on 2022 Aug 05 UT 19:47. Image has been rotated, scaled and undergone a non-linear contrast stretch.

Basin and Buried Crater Project.
By Tony Cook.

Buried Craters

This month I thought I would start off discussing buried craters as they have not featured much in the articles so far. By "Buried Crater" I mean any crater like object that is partly buried, or heavily degraded, and which does not have an official IAU name. You can see a list full of candidate buried craters on the following website: https://users.aber.ac.uk/atc/basin_and_buried_crater_project.htm and below in Table 1 is a close up to illustrate what is in it.

Version:	2022 Jul 05												
Crater	Far/Near Side	Lon	E/W	Lat	N/S	Diam (km)	Status	Age	Col-SR1	Col-SR2	Col-SS1	Col-SS2	Ref
QCMA 1	N	17.9	W	74.4	N	48	Proposed						3
PFC 39	N	23.6	W	66.6	N	60	Uncertain						3
QCMA 2	N	9.8	W	63.7	N	146	Proposed						3
PFC 38	N	18.9	W	63.4	N	36	Uncertain						3

Table 1. Part of the buried crater catalog which as of 5 July 2022 contains 168 entries.

As the proposed buried craters do not have IAU names, they are given catalog numbers for now e.g. QCMA 1 is from the "Quasi-Circular Mass Anomaly" list published in Evans, A. J., Soderblom, J.M., Andrews-Hanna, J.C., Zuber, M.T. (2016) "Identification of buried lunar impact craters from GRAIL data and implications for the nearside maria", Geophysical Research Letters, 10.1002/2015GL067394. You can use the buried crater catalog to either go out and image an area to see if you can confirm there is a buried crater there, or use LTVT to simulate a low angle of incidence view in order to bring out low relief detail, or you can use some of the datasets on the NASA Quickmap web site, for example the slope map or slope azimuth map, to see if you can enhance further detail that might be remnants of a crater rim.

Let us take a look at QCMA1 at 17.9W (or 342.1E) and 74.4N and see what Quickmap shows here. Nothing obvious can be seen in the WAC mosaic view (Fig 1 – Top). There is a hint of a part circle of a gravity gradient, but it is offset from the proposed crater centre in the catalog, and is really not very obvious. However in the slope azimuth plot (Fig 1 – Bottom), we see the clearest indication of a circular ring, which perhaps represents the strongest evidence for a buried crater here. Also the crater centre is at 19.0W and 73.7N and the diameter is smaller at 39 km.

So please have a go at using the LROC web site, LTVT, or just imaging the Moon to try to prove the existence of these buried/eroded craters.

Lastly some other items to mention: (1) Concerning the Werner-Airy basin, mentioned last month, Guillermo Daniel Scheidereiter has used the Astro Image-J image processing program to refine the three ring diameters. I am in discussion with Guillermo on how to devise a methodology for impact basin ring measurements. (2) Dominique Hoste sent in some Quickmap visualisations of the Mendel-Ryberg basin, and suspects the antipodal point is near the crater Goddard. (3) Following on from his ALPO conference talk, Chuck Wood answered a question of mine about what gets destroyed when an impact basin forms – it is essentially everything inside the inner ring. Topography beyond this will be affected severely by shock waves, and also buried by basin ejecta deposits. (4) Alberto Anunziato has sent in some images e.g. a possible buried crater on the floor of Grimaldi (See Fig 2) and a Mons Rumker-Dechen buried crater.

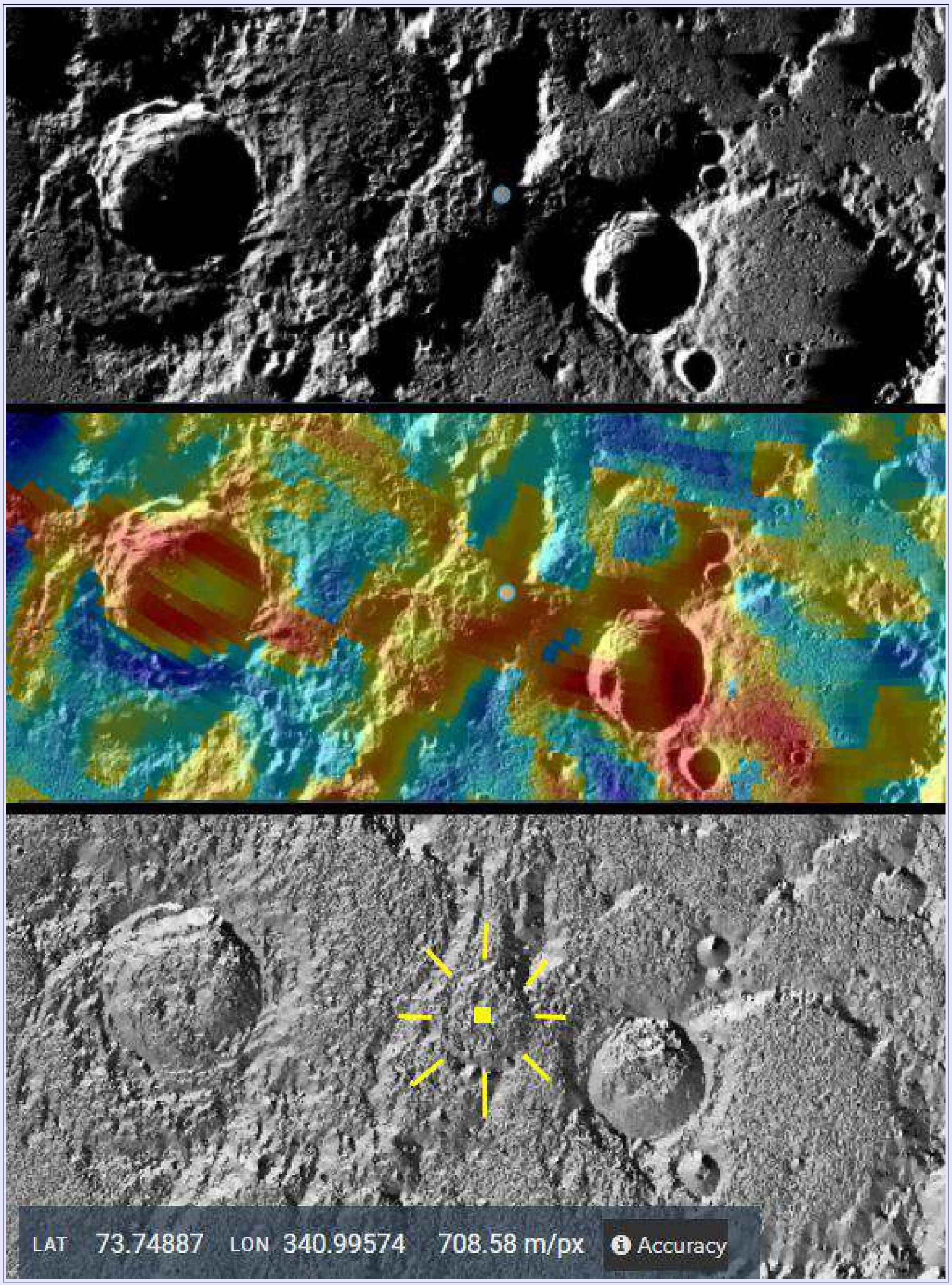


Figure 1. QCMA1 proposed buried crater evidence from the NASA Quick Map web site. **(Top)** WAC mosaic of the near side with shadows. The dot is the catalog location for the proposed crater centre. **(Centre)** A GRAIL Bouguer gravity gradient map. The dot is the catalog location for the proposed crater centre. **(Bottom)** LOLA slope azimuth map. The yellow square highlights a refined centre for the proposed buried crater, and yellow dashes point to slope azimuth evidence for a possible buried rim

I would like to mention that although the proposed buried carter on the floor of Grimaldi looks circular, the ellipticity is wrong compared to other craters in that area, and would actually be quite elliptical if viewed from overhead. So it is either a glancing blow impact crater, or might be attributed to arc-like wrinkle ridges.

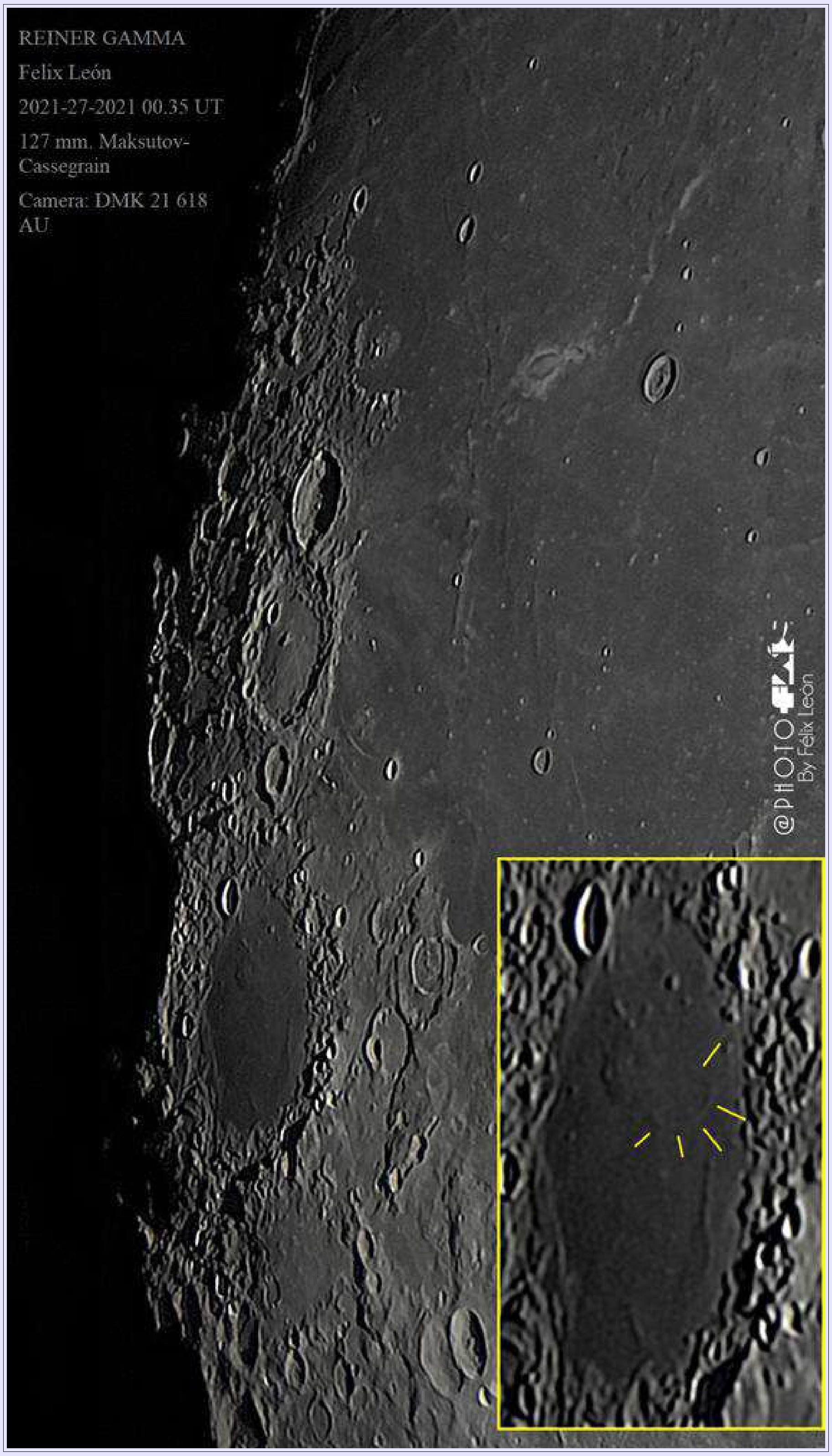


Figure 2 A candidate buried crater on the floor of Grimaldi. Observer and image details included in the image. Yellow dashes in the inset image show where the proposed buried crater rim might be.

Please take a look at our website for other lunar impact basins and buried craters that you may want to image: https://users.aber.ac.uk/atc/basin_and_buried_crater_project.htm. I am really keen to gather imagery of the less certain basins, and also for all basins and buried craters in order to find the best selenographic colongitudes to see them at sunrise and sunset.

Domes?
By Barry Fitz-Gerald.

Lunar domes come in quite an array of forms and sizes, and it can often be difficult to distinguish between a genuine volcanic structure and a piece of lunar real estate that just looks 'dome like'. Evidence for volcanic activity such as vents or lava flows can also be quite difficult to identify, whilst other indications of volcanism such as dark mantling material are not always present or apparent. Rock type exposed at the surface can often be a good indicator of the presence of volcanic mineralogy and the various spacecraft data sets can help in distinguishing the real from the look alike. Despite this, you can often be in two minds as to whether something is the genuine article, and there are a few features that have had me scratching my head for quite some time, so maybe you could have a look at the evidence and break the impasse. One candidate lies just to the east of Gassendi and along the western edge of a low lying area of highlands to the south of the crater Herigonius.

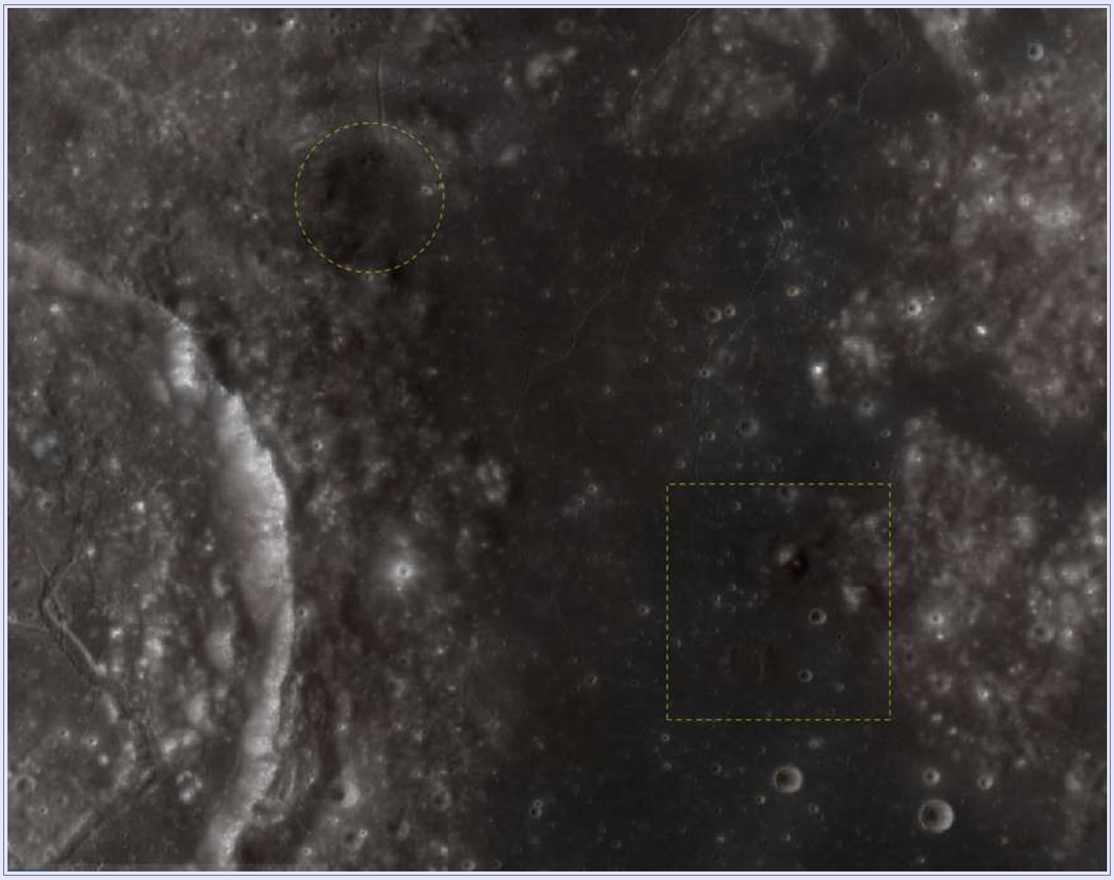


Fig.1 LRO Quickmap image of the eastern part of Gassendi and the dome like feature (yellow box) under discussion below. The yellow circle identifies an area of pyroclastic deposits and possible vents identified in a previous study.

Fig.1 is an image from the LRO Quickmap site and shows the feature in question within the yellow square. As can be seen, it has a very low albedo and contrasts strongly with the somewhat brighter highlands to the east and the glacis of Gassendi to the west. Indeed in this image it is quite difficult to make it out against the dark mare surface. There are however many dark areas in this region, with a prominent one just to the north-east of Gassendi, identified with a yellow circle. This area has been identified as being composed of pyroclastic deposits, including a possible vent complex[1]. Of course there are many other volcanic features in this region such as the Herigonius Rille system, so a volcanic dome might not seem out of place and the dark feature in the yellow box seems a good candidate, being about the right dimensions (~600m high and ~6kms in diameter at the base) and apparently smothered in dark material that may well be pyroclastic in origin.

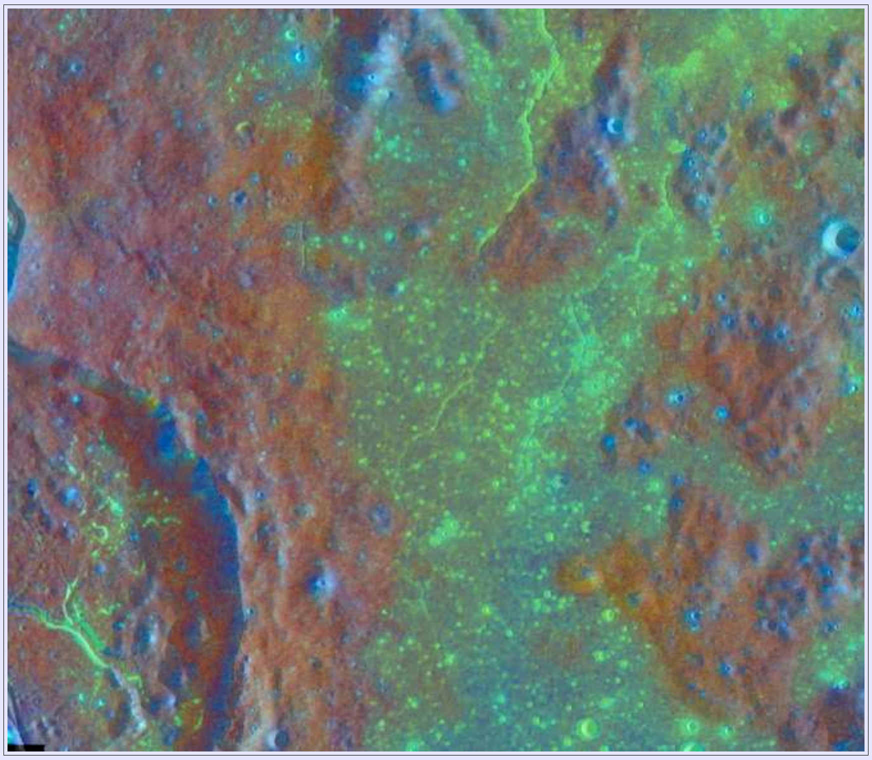


Fig.2 Clementine UVVIS ratio image of area shown in Fig.1. Note the brighter orange colouration of the areas highlighted in Fig.1 which suggest the presence of volcanic pyroclastic material.

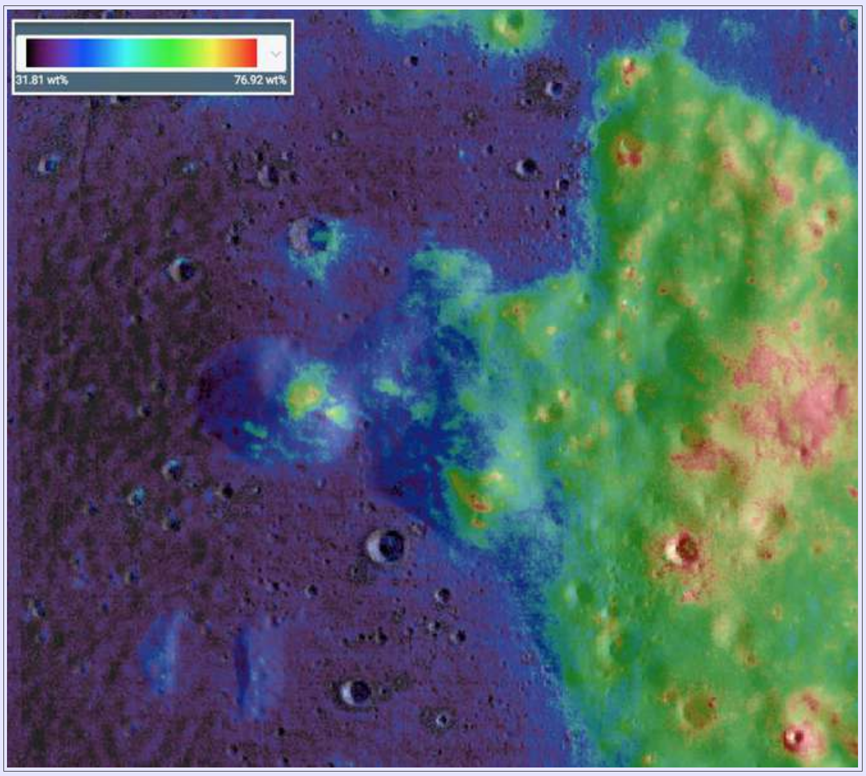


Fig.3 KAGYUA abundance of plagioclase (wt %) overlay of the dome like feature showing higher abundance in reds, yellows and green and lower as blue. Note the splash of higher abundance on the eastern flank oF the 'dome'. Note that as far as plagioclase abundance is concerned the 'dome' has more in common with the mare than the highlands – at least at a superficial level.

Fig.2, which is a Clementine UVVIS ratio image of the area is quite revealing in that is shows the suspected dome and much of the adjacent highlands as a bright orange, this is the same colouration as the pyroclastic/vent complex further north, suggesting that these deposits on the 'dome' and adjacent highlands may also be pyroclastic in nature. This interpretation is supported by other mineral data such as that shown in Fig.3 which is a KAGYUA abundance of plagioclase (wt %) overlay from Quickmap. This shows that whilst the central part of the highland unit has a strong plagioclase signature (reds and greens) the dome like feature and the slopes immediately adjacent to it do not, with the exception of a splash of higher plagioclase abundance on the north/east facing flanks of the 'dome'. The areas shown in this figure as having a low plagioclase abundance also have in contrast a high olivine abundance, indicative of volcanically derived material – which in this case is likely to be pyroclastic in nature and corresponding to the orange areas in Fig.2.

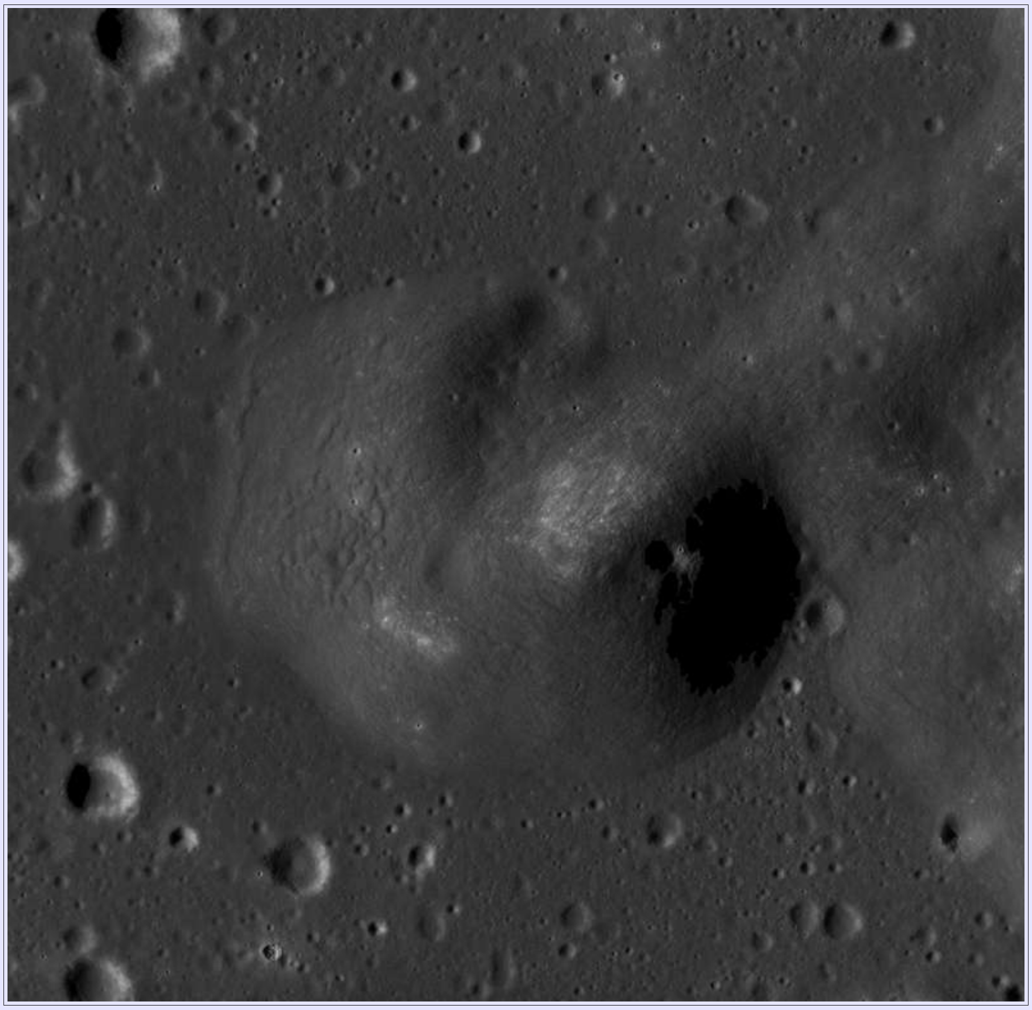


Fig. 4 SELENE image of the dome like feature. Note the unusual texture of the western flanks and the two higher albedo areas on the eastern and southern flanks.

If we look at a more conventional image of the feature as shown in Fig.4 we can see that it appears to be a promontory of the highland unit to the east and could therefore simply be a westward extension of these uplands and not a volcanic feature at all. Of course that does not preclude it being a volcanic dome that formed separately alongside the highlands with the neck of material joining them being a result of 'overlap'.

This image also shows some peculiar texture on the western flanks of the 'dome', and this is shown in more detail in Fig. 5, where the western flank is formed by what appears to be a large slump off the slope and onto the adjacent mare surface. The upper parts of this slump consists of numerous lobate low albedo pillow like mounds, suggestive of deep but unconsolidated material. This texture is quite unlike the 'Elephant Hide' or 'Tree Bark' texture visible on adjacent slopes and which results from the downslope movement of unconsolidated regolith. Might this indicate a relatively thick mantling of pyroclastic material that has sloughed off the upper slopes? The image also shows a roughly 500m diameter and 20-30m deep circular crater just offset to the west of the features summit – could this be the vent from which the pyroclastic deposits were erupted? The presence of suspected volcanic deposits and a vent like structure might suggest we are dealing with a volcanic dome, but whilst tempting, this is not the only explanation.

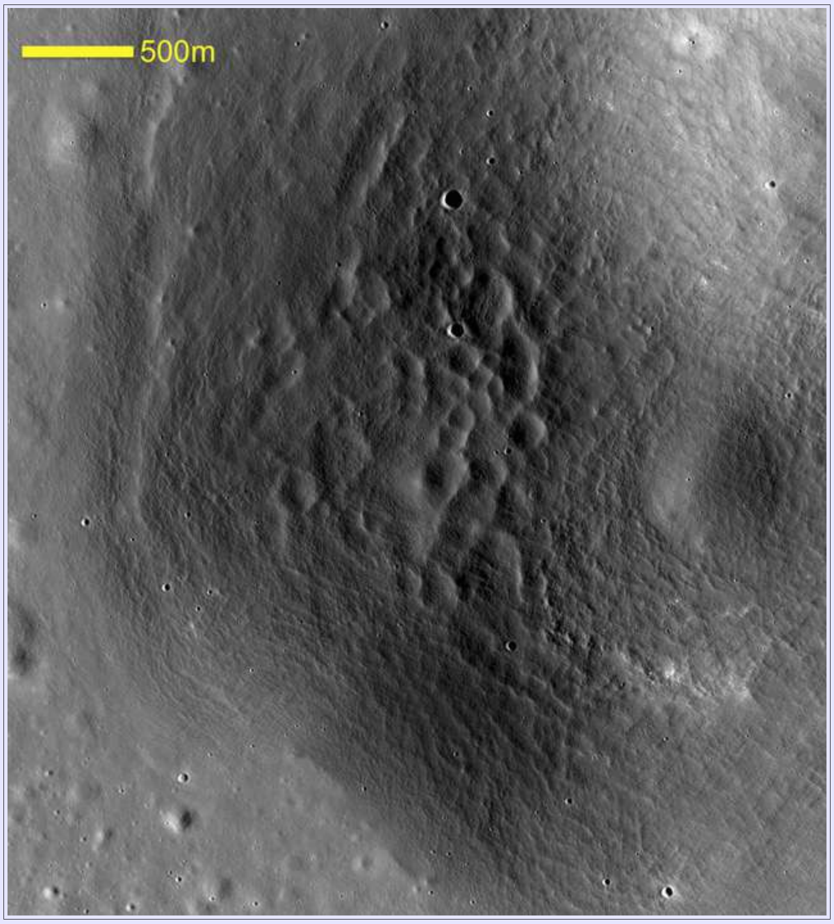


Fig.5 LRO WAC image of the western flank of the feature shown in Fig.4 showing an apparent slump onto the adjacent mare surface, the upper parts of which consist of lobate pillow like mounds of material, quite unlike the textured surface elsewhere on the slopes.

If you look at Figs.3 and 4 you can see a light patch on the eastern flank of the 'dome' that has a strong plagioclase signal, along with a smaller one on the south-western flank. WAC images show these patches to be made up of countless small bright craters, and one interpretation is that they mark the impact of clumps of ejecta from a nearby crater. The strong plagioclase signature might therefore be a consequence of this ejecta blasting the mantling of pyroclastic material off the slopes of the 'dome' to expose the anorthosite rich highland rock beneath. Alternatively if this is a volcanic dome the plagioclase signature could be the result of highland composition ejecta being deposited onto the lower albedo surface, but I suspect the former explanation is more plausible.

Whatever the origin of this ejecta, it appears to have caused an avalanche of material down the north-eastern flank which shows up as the green smear in Fig.3, but may also be responsible for initiating the avalanche off the western flank with its peculiar lobate structures shown in Fig.5. Interestingly, quite extensive deposits of similarly lobate deposits can be found on slopes within the pyroclastic vent area circled in Fig.1 and shown in Fig.6. This again suggests that this peculiar texture is the result of downslope movement of fairly deep deposits of unconsolidated volcanic ash and not the normal movement of a thinner regolith layer.

Another peculiar dome like feature can be found in northern Mare Serenitatis, again with quite dome like statistics (~300m high and ~ 6kms in diameter) and apparently coated in low albedo possibly pyroclastic material (Fig.7 and 8). It even sits on top of a small wrinkle ridge which might suggest it erupted and grew to obscure the underlying topography, supporting a dome interpretation. Though lacking the lobe like morphology seen in the previous example, the low albedo material that mantles this 'dome' has also slumped down the southern and eastern flanks, with some of this material obscuring a shallow graben immediately to the south and also cascading down into a small crater to the south-east. These dark deposits have a strong olivine signature as can be seen in Fig.9, which would be consistent with an avalanche scenario where fresh, previously buried material has been exposed by downslope movement.

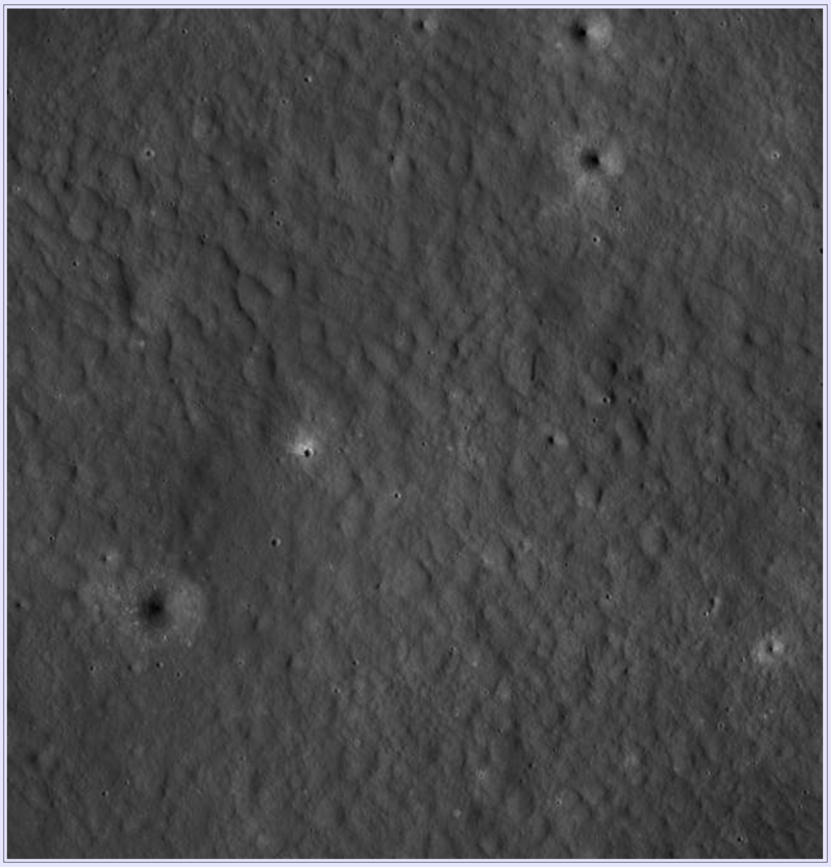


Fig.6 A WAC image of a east facing slope within the pyroclastic/vent area identified within the yellow circle in Fig.1. The terrain slopes towards the right and as can be seen the surface is covered with numerous lobe like features suggestive of deep unconsolidated debris.

Fig.7 Location of a small dome like structure in northern Mare Serenitatis.

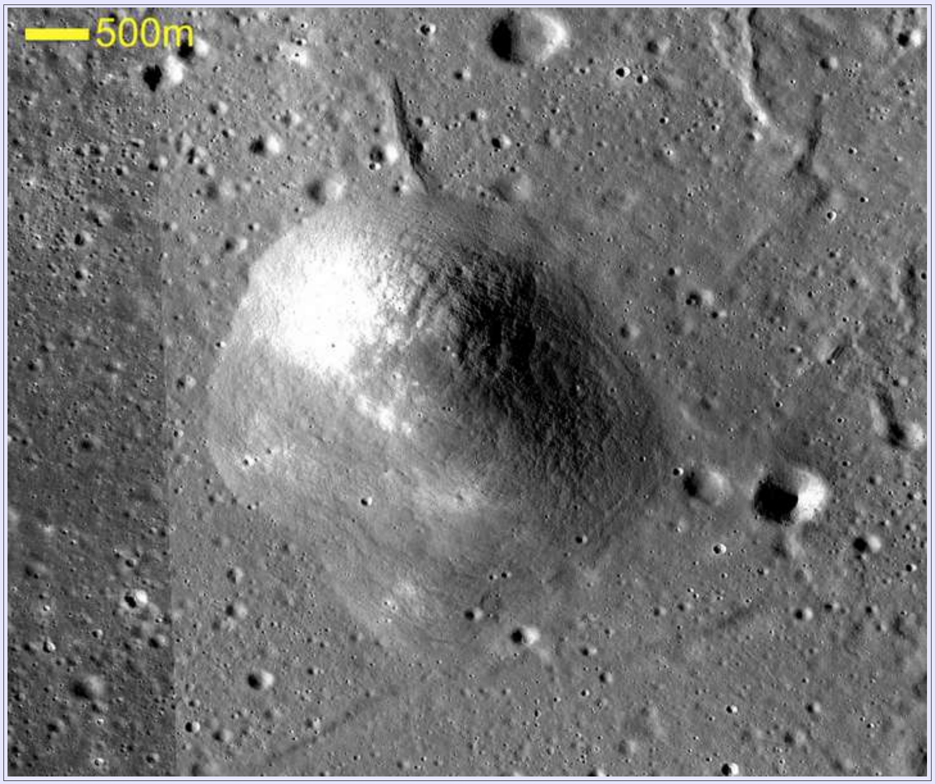


Fig.8 LRO WAC image of the dome like structure identified in Fig.7. Note the small wrinkle ridge that it appear to overly, and the dark material that appears to have slumped off the southern flanks to partially infill the small graben that runs east-west at its base. This material has also cascaded down into the small crater just to the south-east of the 'dome'

There is however nothing obvious in the way of a summit vent or other feature to indicate that this is essentially a volcano, despite the presence of the olivine rich dark deposits on its surface. Also something this example has in common with the previous one is that the slopes on the opposite side to the slump is dominated by a strong plagioclase signature and a high albedo. This too appears to represent a cluster of small secondary impacts from a nearby crater which has blasted away any superficial deposits to revealed a plagioclase rich lithology below. This is well illustrated in the olivine abundance shown in Fig.9, where the plagioclase rich (but olivine poor – hence blue in colour) bright northern flank is opposite the olivine rich (red in colour) slump on the southern flank. This would be consistent with the impact of the secondaries dislodging deposits on the opposite flank, a similar situation to that seen in the first example we looked at.

So, sadly despite looking like domes these structures are probably just isolated nubbins of highland material that happened to receive a mantling of volcanic pyroclastic material at some stage, and if it were not for later impacts dislodging this dark material and revealing their highland lithology, they could easily be identified as volcanic domes *aka* small lunar volcanoes.

But, this does not account for the presence of dark volcanic material on these features, and some form of vent must exist nearby, though later lavas may well have obscured evidence of these. One possible candidate may exist not too far from the example near Gassendi, as shown in Fig.10. Here an elongate partially submerged crater can be seen with breaches in the rim to the north and south. The remaining arcs are lower at either end and rise upwards towards the mid point. This may represent the summit of an elongate volcanic vent, as it has a high olivine signature and the same orange colouration as the other suspected volcanic pyroclastic deposits in the Clementine UVVIS data shown in Fig.2.

The problem with identifying any vents responsible for these pyroclastic deposits is the fact that these vents were probably active long before the younger mare basalt lavas were erupted, and as a result are now probably submerged beneath the surface, with only their highest parts still visible, if at all. This may be the case with the possible vent near Gassendi, whilst a scan of the surface of Mare Serenitatis near the second example reveals evidence for extensive low albedo, possibly volcanic deposits nearby, as well as a small probable bona-fide volcanic dome some 23kms away to the north-east (and just about visible in Fig.7). So volcanism has taken place here, but much of it may pre-date the youngest mare basalts and is now part of the drowned pre-mare landscape.

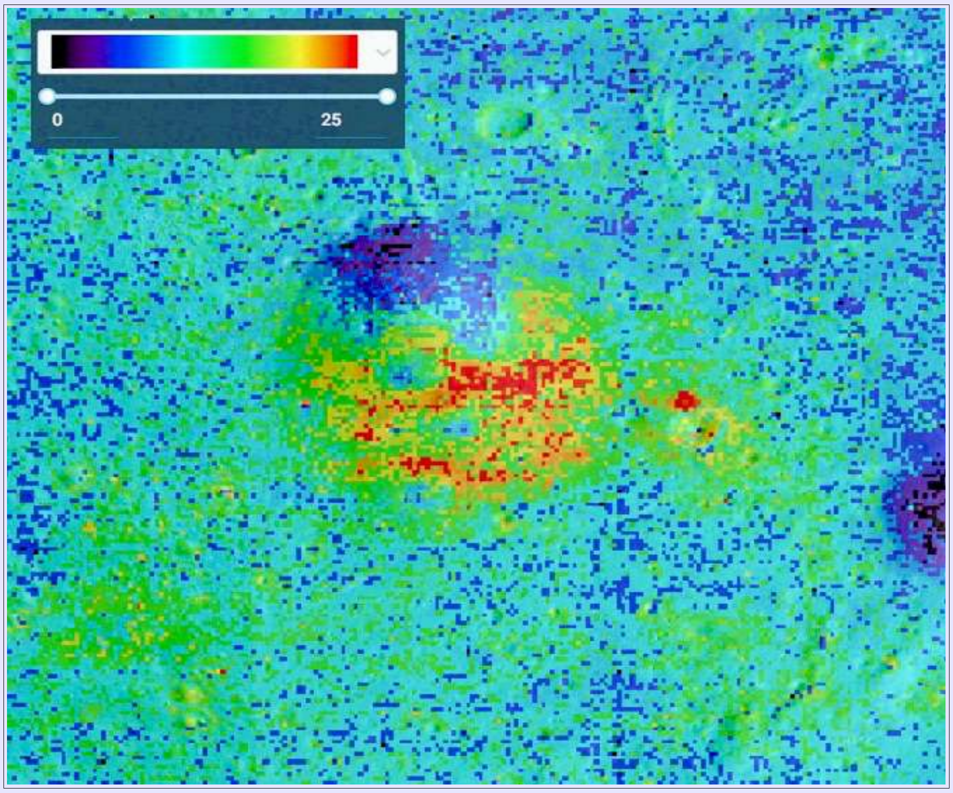


Fig.9 KAGYUA abundance of olivine (wt %) overlay of the dome in shown in Fig.7. Note the blue colouration on the northern flank coincident with the bright patch in Fig.7 indicating a low olivine abundance. Other data shows this to have a highland composition rich in plagioclase. The red bands on the southern flank are olivine rich and correspond to the dark bands in Fig.7. This is consistent with freshly exposed volcanic pyroclastic material – the fresh exposure due to it being dislodged from higher elevations in avalanche type events.

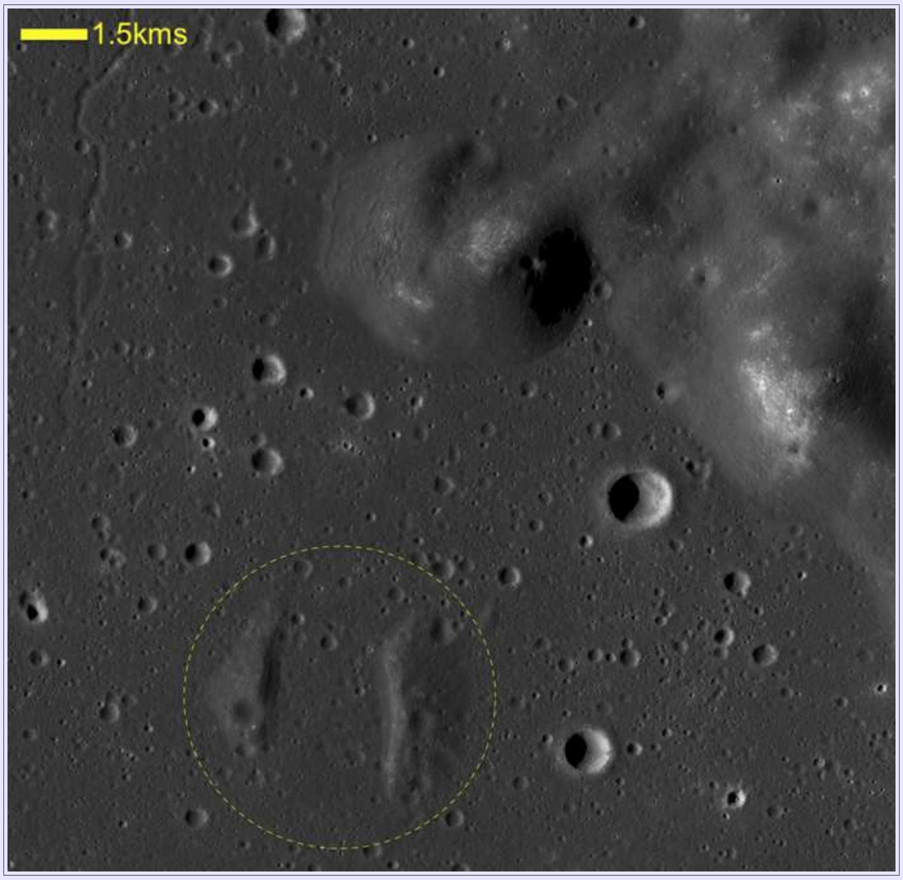


Fig.10 A wider view by SELENE of the area shown in Fig.4. Note the submerged feature to the south of the 'dome' (yellow circle) which may be a submerged vent and the source of the extensive pyroclastic deposits on the adjacent highlands.

So, whilst it would be nice to be able to suggest that these two structures are new domes to add to the long list of lunar volcanoes, it is just not possible to rule them out as simply being nubbins of highland material projecting above the mare lavas and covered in pyroclastic material which was erupted from nearby vents which are themselves now drowned by later lava flows. Depressions that may *appear* to be summit vents (or *near* the summit vents) can be found on both of these examples (see Fig.5 for example) but identifying them as such might be no more than wishful thinking.

So, to summarise, there are abundant volcanic structures on the moon, with a wide diversity of domes, cones and vent being present – but not every structure that looks like a dome is a dome, and until someone gets there with a good old geological hammer and knocks a bit off, these two at least may have to remain as possibles and not probables.

References:

1.Giguere, T.A. (et.al) 2017 Pyroclastics Northeast of Gassendi Crater: Discovery/Characteristics/Implications. Lunar and Planetary Science XLVIII.

Acknowledgement:

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.

Selene images courtesy of Japan Aerospace Exploration Agency (JAXA) at: http://l2db.selene.darts.isas.jaxa.jpDomes?

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LUNAR GEOLOGICAL CHANGE DETECTION PROGRAMME
by Tony Cook.

Figure 1. An image of an aircraft in front of the nearly Full Moon, taken by Patricia Wainwright on 2022 Aug 11 UT 20:26, from Littlestone, Kent, UK. Taken with a Canon EOS R6 with RF100-400 lens. Single point autofocus, spot metering, F/8, 1/500s exposure at ISO 3200.

News: A Fireballs Workshop #3, with a significant No. of contributions on Impact Flashes, was organized by Europlanet and held in Glasgow & on-line on 13/14th August. A couple of presentations were given by well-known members: Brian Cudnik (ALPO): “The Lunar Meteor Observing Program of the A.L.P.O. -Current State and Future

Directions" and Antonio Mercatali (UAI): "Impact flash observations coordinated by the Italian Sezione Luna UAI were given. Also, some new impact flash detection software has been made available, (see: https://drive.google.com/drive/folders/1E10bOIElYU12XG5z3xvycQKmlFU9aaG_) though the last time I looked there was still no online documentation.

TLP reports: No reports were received for August, though another image of an aircraft crossing the Moon in silhouette was received. (Fig 1) – perhaps one of the more distant aircraft images I have seen - if you look at its small angular size, compared the lunar disk. Clearly Kent is a popular crossing point for aircraft across the English Channel.

Figure 2. Rupes Recta as sketched by Paul Abel for the date and UT given in the sketch. Note that north is towards the bottom. The insert on the bottom right is from the NASA Quickmap web site showing an enhanced WAC Color Hapke-Normalized global mosaic.

Again, not TLP but on 2022 Aug 20 Paul Abel made a sketch of Rupes Recta (Fig 2). He commented that this is the first time he had seen it when the evening terminator was close by. The Rima Birt rille was quite distinctive and where it ended in the north, there may have been some slight orange colour though he thought it not a TLP. A quick look on the NASA Quickmap web site, revealed a red "L" shaped feature here, slightly akin to the rectangular red "Wood's Spot" NW in which Aristarchus sits. So this is clearly a rare example of natural surface colour that Paul has spotted here. Why has nobody else seen it visually? Firstly observations after Full Moon are relatively rare due to having to observe during non-social hours. Secondly maybe this orange material is emplaced on westward facing slopes and so is more prominent at sunset than during sun rise?

Routine Reports received for July included: Jay Albert (Lake Worth, FL, USA – ALPO) observed: Alpretagius, Erathothenes, Plato, and Tycho. Alberto Anunziato (Argentina – SLA) observed visually: Gassendi, Jansen, Proclus and Ross D. Maurice Collins (New Zealand – ALPO/BAA/RASNZ) imaged: Bullialdus, Copernicus, and several features. Anthony Cook (Newtown – ALPO/BAA) videoed earthshine and the dayside of the Moon in the SWIR (1.1-1.7 microns), and also in the thermal IR (7.5-15 microns). Valerio Fontani (Italy – UAI) imaged: Archimedes. Aldo Tonon (Italy – UAI) imaged: Descartes. Malcolm Porter (Kent, UK – BAA) imaged the Moon.

Analysis of Reports Received:

Posidonius: On 2022 Jul 04 UT05:42-05:43 Maurice Collins (ALPO/BAA/RASNZ) imaged the whole Moon, but at sufficient resolution to examine this crater at similar illumination to the following two reports:

Posidonius 1821 Apr 07 UT 18:00? Observed by Gruithuisen (Munich, Germany) "Small bright crater in it was shadowless. Schroter also saw it shadowless *several X" NASA catalog weight=4. NASA catalog ID #87. ALPO/BAA weight=3.*

In 1963 Oct 22 at UT 21:00? M. Gabriel Andre (Belgium, 2.25" refractor) noticed that Posidonius A's shadow was not seen when it should have been seen. The Cameron 1978 catalog ID=777 and weight=3. The ALPO/BAA weight=2.

Figure 3. Posidonius, on 2022 Jul 04 UT 05:42-05:43 as imaged by Maurice Collins (ALPO/BAA/RASNZ). Note this is a small section of a larger mosaic and has been orientated with north towards the top.

It is interesting that both past TLP reports refer to shadowless craters, possibly both Posidonius A? Now there is some uncertainty in the UTs from 1821 and 1963, as denoted by the "?" in the Cameron catalog descriptions. From Munich the Moon would have been visible from sunset at 17:57 UT-00:40 UT the next day when it set. Cameron's 18:00 UT estimate is a good compromise and the Moon would have been at a high elevation of 59°. We have discussed this TLP before in the 2014 Jun newsletter. For the Belgium observation, assuming Brussels as the observing site, then sunset was at 16:38 and moonset was at 19:23. So Cameron's 21:00 is clearly wrong here, and I will change it to a guestimate of 17:30 although by then the Moon is just 10° above the horizon.

Nevertheless, in either case interior craterlet should not have been shadowless. We shall therefore leave the weights of these TLP reports as they were.

Archimedes: On 2022 Jul 06 UT20:42, 20:46, 20:52, and 20:57 Valerio Fontani (UAI) imaged this region under similar illumination to the following report:

Near Archimedes 2001 Sep 25 UT 08:30 Observed by Try (Whangarei, New Zealand, 4" f/10 reflector) "observed two possible TLPs on the edge of the terminator near the crater Archimedes. They appeared to be two bright points of light about the size of Mount Piton. They seem to form a triangle with Mount Piton. He observed them for two hours and they were still visible when he ended his observing session. He was observing with a 4" f10 reflector. Then Moon age was 7.9 days old and the colongitude was 4.83. submitted a drawing showing the area where the lights were observed." ALPO report. ALPO/BAA weight=1.

Figure 4. Archimedes as imaged by Valerio Fontani (UAI) on 2022 Jul 06 UT 20:57 and orientated with north towards the top.

Fig 4 shows a couple of sunlit mountain peaks. The first immediately north of Archimedes and the second to the north west by one crater diameter. Whether these are what Try was referring to is unclear as we do not have a copy of their original observation in our archives. So, for now I think the weight will have to remain at 1.

Eratosthenes: On 2022 Jul 08 UT02:45-02:55 Jay Albert (ALPO) observed this crater under similar illumination to the following report:
Eratosthenes 1954 May 11 UT 20:00 Observer: Cattermole (UK, 3" refractor) "Central peak invis. tho surroundings were sharp". NASA catalog ID #563, NASA weight=4. ALPO/BAA weight=2.

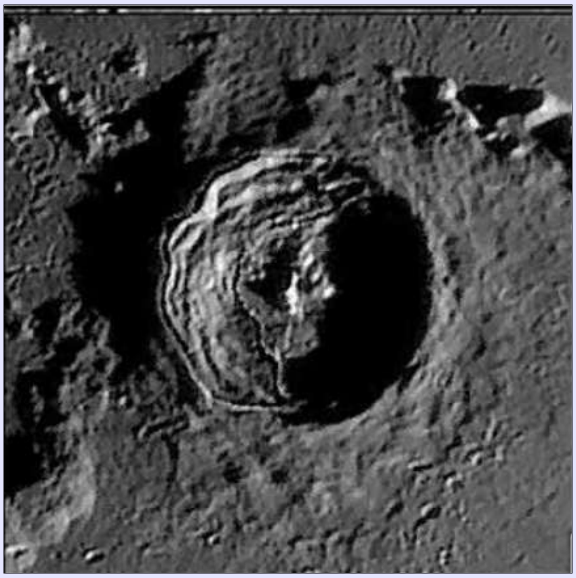

Figure 5. Eratosthenes as imaged by Mike Brown (BAA) on 2012 Mar 31 UT 19:14 and orientated with north towards the top. From p16 of the 2012 Dec LSC.

Jay was using a Celestron NexStar Evolution 8" SCT (x290), the transparency was 3rd magnitude and seeing was 7-8/10. He noted that contrary to the original TLP description, that the central peak complex was clearly visible along with its shadows. The terracing on the interior walls was sharp and detailed. The east wall shadow was black and extended to the base of the east peak of the central peak complex. Just as a comparison, Fig 5 is an archive image, taken under similar illumination. We have discussed repeat illumination observations of this TLP before in the Apr 2015 (p17-18), Feb 2016 (p20), Jan 2017 (p19-20), Dec 2017 (p24) and Jan 2019 (p32 & 34) newsletters. We shall leave the weight as 2 for now though as Peter Cattermole was using a small 3" refractor, maybe it was a resolution issue?

Ross D: On 2022 Jul 09 UT 23:25-23:33 Alberto Anunziato (SLA) observed visually this crater under similar illumination to the following report:

Ross D area - 1966 Aug 27 UT 06:06-06:25 observed by Harris, Eastman, Bornhusrt, Cameron, astronet observers (Tucson, AZ, USA - 21" reflector x200) and by Corralitos observatory (Organ Pass, NM, USA, 24" reflector) "Obscuration on E. wall, bright area E. of crater at its brightest. (I (WSC) was present at obs. but did not note anything not attributable to bad seeing, but am not familiar with the area in normal aspect. Others present did not see anything unusual, but Bornhurst & Eastman confirmed). Corralitos Obs. found due to changing light conditions. NASA catalog weight=1. NASA catalog ID=967. ALPO/BAA weight=1.

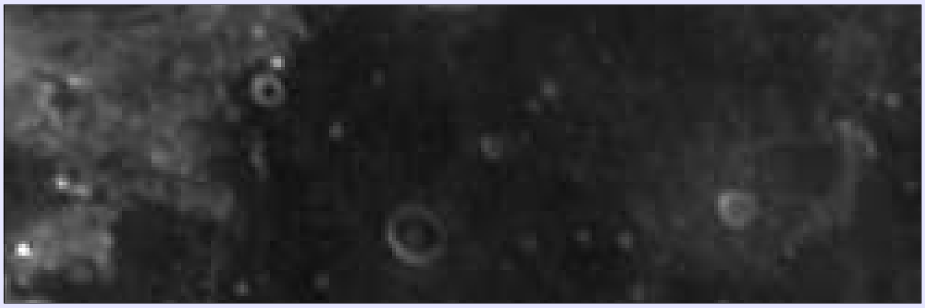

Figure 6. Ross D at the centre of the image as captured by Maurice Collins from a mosaic made on 2009 Jun 04 UT 04:40-05:36. North is towards the top.

Alberto was using a 105 mm. Maksutov-Cassegrain (Meade EX 105, at magnification x154, seeing not very good at 4.5/10). He comments that the east wall seems less bright, but at the limit of the resolution of his telescope, there is a bright area further east, to the east Plinius A, that seems completely normal. For comparison a similar illumination image from 2009 is included (Fig 6). Clearly, we need higher resolution images of this crater. We shall leave the weight at 1 for now.

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