The Lunar Observer

A publication of the Lunar Section of ALPO

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Back issues: http://www.alpo-astronomy.org/

December 2020

Online readers, click on images for hyperlinks

In This Issue

I wish each of you and your families a wonderful and safe holiday season. As we come to the end of a most unusual year, I am hoping this finds all of you healthy and that you remain such!

This is another fantastic issue of *The Lunar Observer*, made possible by all of our contributors. This issue has numerous great images and drawings of our Moon. Again, numerous contributors have submitted articles about the Moon, including essays by Rik Hill, Robert H. Hays, Jr. and David Teske. Alberto Anunziato and Raffaello Lena have very interesting takes about lunar wrinkle ridges. Sergio Babino and Alberto Anunziato also explore a craterlet in Mare Crisium. Very interesting work from all!

A few quick notes. In the ALPO Lunar Image Gallery, there is an annual index of all the work in *The Lunar Observer* for 2020. Please send in work to Jerry Hubbell and myself for Focus-On 41-50 as early as possible, as well as any other submissions for *The Lunar Observer* as the holidays coincide with the end of the month. Also, I might be having some trouble receiving emails. I try to give contributors a quick note that I have received their submissions, so if you don't hear from me in a couple days, please drop me a line.

Happy Holidays and stay safe!
David Teske

Lunar Calendar December 2020

Date	Time UT	Event
December 2	0800	Moon 0.2° north of M35
3		Greatest northern declination +24.8°
6		West limb most exposed -6.3°
7	2200	Vesta 0.5° south of Moon, occultation Europe, Russia, China
8	0037	Last Quarter Moon
8		South limb most exposed -6.8°
12	2100	Venus 0.8° south of Moon, occultation Russia, Hawaii, western North America
12	2100	Moon at perigee, 361,773 km
14	1616	New Moon, Lunation 1212
16		Greatest southern declination -24.9°
17	0400	Jupiter 3° north of the Moon
17	0500	Saturn 3° north of the Moon
19		East limb most exposed +6.5°
21		Northern limb most exposed +6.9°
21	2341	First Quarter Moon
21		North limb most exposed +6.9°
24	1700	Moon at apogee, 405,011 km
24	2300	Uranus 3° north of Moon
29	1500	Moon 0.2° north of M35
30	0328	Full Moon
30		Greatest northern declination +24.8°

The Lunar Observer welcomes all lunar related images, drawings, articles, reviews of equipment and reviews of books. You do not have to be a member of ALPO to submit material, though membership is highly encouraged. Please see below for membership and near the end of *The Lunar Observer* for submission guidelines.

Comments and suggestions? Please send to David Teske, contact information page 1. Need a hard copy, please contact David Teske.

AN INVITATION TO JOIN THE A.L.P.O.

The Lunar Observer is a publication of the Association of Lunar and Planetary Observers that is available for access and participation by non- members free of charge, but there is more to the A.L.P.O. than a monthly lunar newsletter. If you are a nonmember you are invited to join our organization for its many other advantages.

We have sections devoted to the observation of all types of bodies found in our solar system. Section coordinators collect and study members' observations, correspond with observers, encourage beginners, and contribute reports to our Journal at appropriate intervals.

Our quarterly journal, *The Journal of the Association of Lunar and Planetary Observers-The Strolling Astronomer*, contains the results of the many observing programs which we sponsor including the drawings and images produced by individual amateurs. Additional information about the A.L.P.O. and its Journal is on-line at: **http://www.alpo-astronomy.org.** I invite you to spend a few minutes browsing the Section Pages to learn more about the fine work being done by your fellow amateur astronomers.

To learn more about membership in the A.L.P.O. go to: **http://www.alpo- astronomy.org/main/member.html** which now also provides links so that you can enroll and pay your membership dues online.

Lunar Topographic Studies

Coordinator – David Teske - david.teske@alpo-astronomy.org
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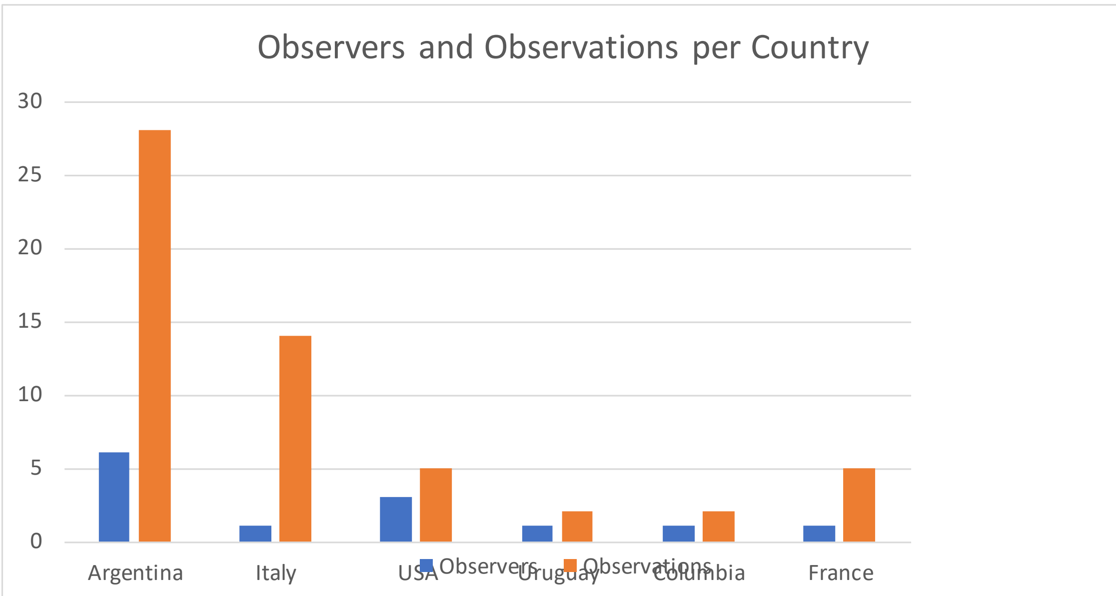
Assistant Coordinator-Wayne Bailey– wayne.bailey@alpo-astronomy.org
Website: http://www.alpo-astronomy.org/

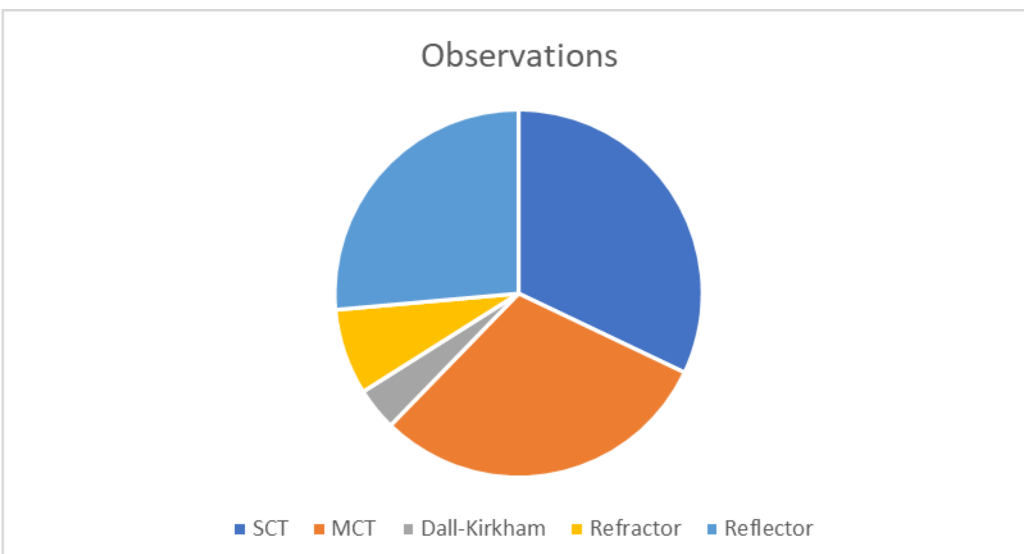
Observations Received

Name	Location and Organization	Image/Article
Alberto Anunziato	Paraná, Argentina	Article and drawings Some Considerations about Visual Observations of Wrinkle Ridges on the Moon and An Elusive Craterlet on the Northwest Rim of Peirce.
Sergio Babino	Montevideo, Uruguay	Image of Vallis Alpes and Vallis Rheita. Article and images An Elusive Craterlet on the Northwest Rim of Peirce.
Juan Manuel Biagi	Paraná, Argentina	Image of Aristarchus and Atlas.
Cappelletti, Ariel	Córdoba, Argentina, SLA	Image of Aristillus, Clavius(2), Diophantus, Plato and Euclides.
Jairo Chavez	Popayán, Colombia	Images of the Waning Gibbous Moon with Mars and the Last Quarter Moon.
Michel Deconinck	Aquarellia Mobile Observatory from the area of "Le Poil" in the French Alps	Drawings of the Serpentine Ridge, Grimaldi (3) and Taruntius.
Robert H. Hayes, Jr.	Worth, Illinois, USA	Article and drawing Müller.
Richard Hill	Loudon Observatory, Tucson, Arizona, USA	Article and image Spotting Hubble, The Land of Cracks and A Wet Place?
Raffaello Lena	Rome, Italy	Article and images Observing Crisium 1 (second preliminary report): Is an Inflation of the Upper Surface Layers Associated with the Formation of the Wrinkle Ridges?
Pedro Romano	San Juan, Argentina	Images of Archimedes, Macrobius, Montes Apenninus, Mare Crisium and
Leandro Sid	AEA, Oro Verde, Argentina	Images of the Waxing Gibbous Moon (2), Mare Vaporum, Alphonsus, Bullialdus, Plato and Tycho.
David Teske	Louisville, Mississippi, USA	Article and images In the Land of Astrophysicists.
Román García Verdier	Paraná, Argentina	Images of Stevinus, Proclus and Petavius.
Fabio Verza	SNdR Luna UAI - Milan, Italy	Images of Eratosthenes, Sinus Iridum, Copernicus, Plato, Philolaus, Wargentin (2), 6.53-day-old Moon, Theophilus, Aristoteles, Ariadaeus and 7.57-day-old-Moon.

December 2020 *The Lunar Observer*
By the Numbers

This month there were 56 observations by 13 contributors in 6 countries.





SUBMISSION THROUGH THE ALPO IMAGE ARCHIVE

ALPO's archives go back many years and preserve the many observations and reports made by amateur astronomers. ALPO's galleries allow you to see on-line the thumbnail images of the submitted pictures/observations, as well as full size versions. It now is as simple as sending an email to include your images in the archives. Simply attach the image to an email addressed to

lunar@alpo-astronomy.org (lunar images).

It is helpful if the filenames follow the naming convention :

FEATURE-NAME_YYYY-MM-DD-HHMM.ext

YYYY {0..9} Year

MM {0..9} Month

DD {0..9} Day

HH {0..9} Hour (UT)

MM {0..9} Minute (UT)

.ext (file type extension)

(NO spaces or special characters other than "_" or "-". Spaces within a feature name should be replaced by "-".)
As an example the following file name would be a valid filename:

Sinus-Iridum_2018-04-25-0916.jpg
(Feature Sinus Iridum, Year 2018, Month April, Day 25, UT Time 09 hr16 min)

Additional information requested for lunar images (next page) should, if possible, be included on the image. Alternatively, include the information in the submittal e-mail, and/or in the file name (in which case, the coordinator will superimpose it on the image before archiving). As always, additional commentary is always welcome and should be included in the submittal email, or attached as a separate file.

If the filename does not conform to the standard, the staff member who uploads the image into the data base will make the changes prior to uploading the image(s). However, use of the recommended format, reduces the effort to post the images significantly. Observers who submit digital versions of drawings should scan their images at a resolution of 72 dpi and save the file as a 8 1/2"“x 11” or A4 sized picture.

Finally a word to the type and size of the submitted images. It is recommended that the image type of the file submitted be jpg. Other file types (such as png, bmp or tif) may be submitted, but may be converted to jpg at the discretion of the coordinator. Use the minimum file size that retains image detail (use jpg quality settings. Most single frame images are adequately represented at 200-300 kB). However, images intended for photometric analysis should be submitted as tif or bmp files to avoid lossy compression.

Images may still be submitted directly to the coordinators (as described on the next page). However, since all images submitted through the on-line gallery will be automatically forwarded to the coordinators, it has the advantage of not changing if coordinators change.

When submitting observations to the A.L.P.O. Lunar Section

In addition to information specifically related to the observing program being addressed, the following data should be included:

Name and location of observer
Name of feature
Date and time (UT) of observation (use month name or specify mm-dd-yyyy-hhmm or yyyy-mm-dd-hhmm)
Filter (if used)
Size and type of telescope used Magnification (for sketches)
Medium employed (for photos and electronic images)
Orientation of image: (North/South - East/West)
Seeing: 0 to 10 (0-Worst 10-Best)
Transparency: 1 to 6

Resolution appropriate to the image detail is preferred-it is not necessary to reduce the size of images. *Additional commentary accompanying images is always welcome.* **Items in bold are required. Submissions lacking this basic information will be discarded.**

Digitally submitted images should be sent to:
David Teske – david.teske@alpo-astronomy.org
Jerry Hubbell –jerry.hubbell@alpo-astronomy.org
Wayne Bailey—wayne.bailey@alpo-astronomy.org

Hard copy submissions should be mailed to David Teske at the address on page one.

CALL FOR OBSERVATIONS: FOCUS ON: Lunar 100

Focus on is a bi-monthly series of articles, which includes observations received for a specific feature or class of features. The subject for the January 2021 edition will be the Lunar 100 numbers 41-50. Observations at all phases and of all kinds (electronic or film based images, drawings, etc.) are welcomed and invited. Keep in mind that observations do not have to be recent ones, so search your files and/or add these features to your observing list and send your favorites to (both):
Jerry Hubbell –jerry.hubbell@alpo-astronomy.org
David Teske – david.teske@alpo-astronomy.org

Deadline for inclusion in the Lunar 100 numbers 41-50 article is December. 20, 2020

FUTURE FOCUS ON ARTICLES:

In order to provide more lead time for contributors the following future targets have been selected: The next series of three will concentrate on subjects of the Selected Areas Program.

Subject	TLO Issue	Deadline
Lunar 100 (numbers 41-50)	**January 2021**	**December 20, 2020**
Lunar 100 (numbers 51-60)	**March 2021**	**February 20, 2021**

Focus-On Announcement

We are pleased to announce the future Focus-On topics. These will be based on the Lunar 100 by Charles Wood. Every other month starting in May 2020 , the Focus-On articles will explore ten of the Lunar 100 targets. Targets 41-50 will be featured in the January 2021 *The Lunar Observer*. Submissions of articles, drawings, images, etc. due by December 20, 2020 to David Teske and Jerry Hubbell.

L	FEATURE NAME	SIGNIFICANCE	RUKL CHART
41	Bessel ray	Ray of uncertain origin near Bessel	24
42	Marius Hills	Complex of volcanic domes and hills	28, 29
43	Wargentin	A crater filled to the rim with lava or ejecta	70
44	Mersenius	Domed floor cut by secondary craters	51
45	Maurolycus	Region of saturation cratering	66
46	Regiomontanus central peak	Possible volcanic peak	55
47	Alphonsus dark spots	Dark-halo eruptions on crater floor	44
48	Cauchy region	Fault, rilles and domes	36
49	Gruithuisen Delta & Gamma	Volcanic domes formed with viscous lava	9
50	Cayley Plains	Light, smooth plains of uncertain origin	34

Ex- plore the Lunar 100 on the link below:

https://www.skyandtelescope.com/observing/celestial-objects-to-watch/the-lunar-100/

The Lunar 100: Features 1-10 May 2020 Issue – Due April 20, 2020

The Lunar 100: Features 11-20 July 2020 Issue – Due June 20, 2020

The Lunar 100: Features 21-30 September 2020 Issue – Due August 20, 2020

The Lunar 100: Features 31-40 November 2020 Issue – Due October 20, 2020

The Lunar 100: Features 41-50 January 2021 Issue – Due December 20, 2020

The Lunar 100: Features 51-60 March 2021 Issue – Due February 20, 2021

The Lunar 100: Features 61-70 May 2021 Issue – Due April 20, 2021

The Lunar 100: Features 71-80 July 2021 Issue – Due June 20, 2021

The Lunar 100: Features 81-90 September 2021 Issue – Due August 20, 2021

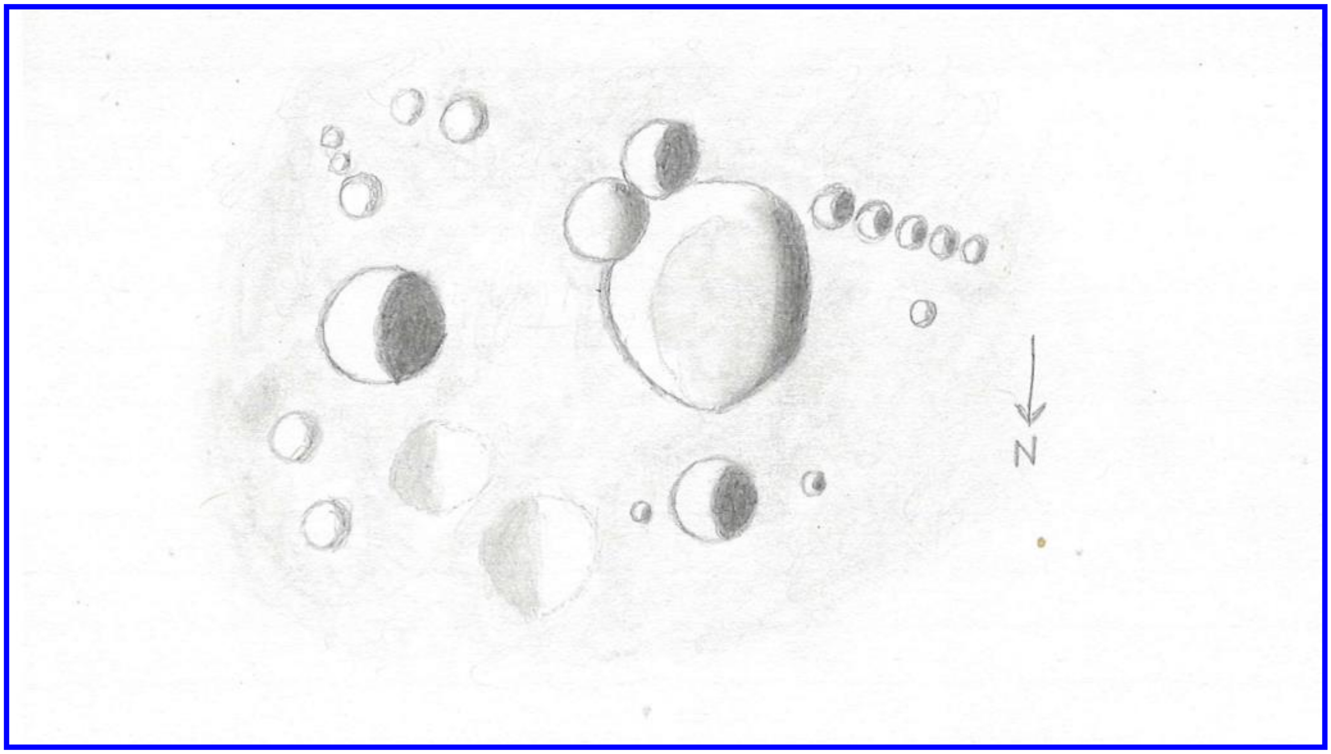
The Lunar 100: Features 91-100 November 2021 Issue – Due October 20, 2021

Jerry Hubbell –jerry.hubbell@alpo-astronomy.org
David Teske – david.teske@alpo-astronomy.org

Müller

Roberts H. Hays, Jr.

I observed this crater and vicinity on the morning of August 9, 2020. This area is between Hipparchus and Ptolemaeus. Müller is the somewhat polygonal shaped with some nearly flat sides and a pointed north end. Its floor appears smooth and featureless. Müller A abuts the south end of Müller and has a bright interior. Müller O is very similar in size to Müller A, but it is less bright and possibly shallower. Müller O also intrudes slightly into Müller. The large crater to the east is Hipparchus J, and Hipparchus T and U are smaller shallower craters to its north. Several saucers are south of Hipparchus J. Albategnius Q is the largest and westernmost of this group. The conspicuous crater north of Müller is Hipparchus K. This crater is similar to Müller A. Two small craters flank Hipparchus K; the one to its west is Hipparchus B. Two large low mounds are between Hipparchus J and K. Müller F is the easternmost of a crater chain southwest of Müller. At least three and possibly four other small craters follow F. Another small pit is noted north of this chain.



Müller, *09 August 2020, 08:08-08:44 UT. 15 cm reflector telescope, 170 x. Seeing 8-7/10, transparency 6/6.*

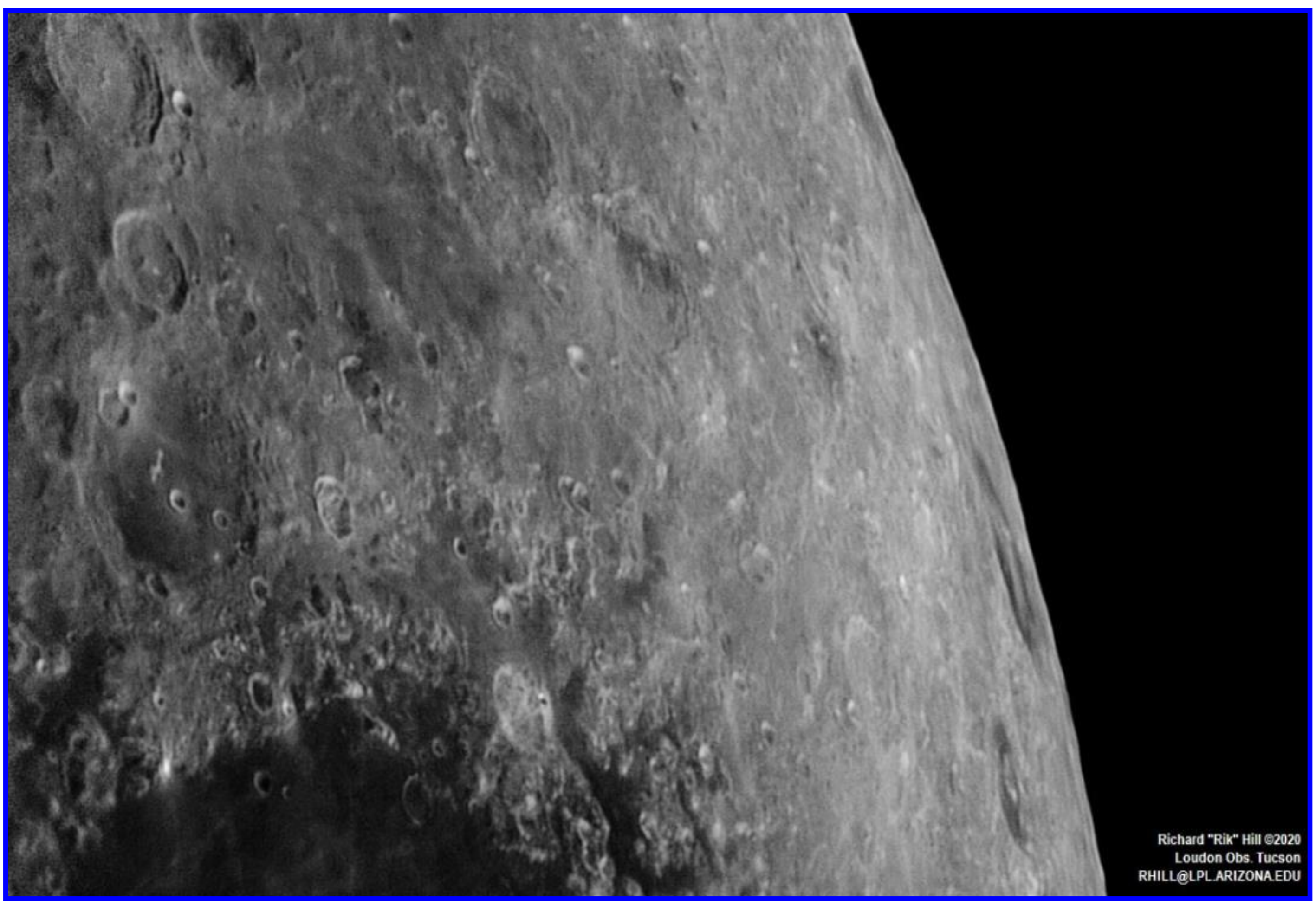
Spotting Hubble

Rik Hill

Seven days into this particular lunation, we had a favorable libration just at the northern edge of the limb on this image. It allowed for a very good view of a couple craters not usually seen so well. The large dark area is the lower left is the northern shore of Mare Crisium and Mare Anguis, the dark meandering patch on the right side of Mare Crisium. Notice just above it is the large crater Cleomedes (129 km) and above that is the well-defined Geminus (88 km). Then at the top edge of the image is Messala (128 km) with its nicely terraced walls. Moving towards the limb you see another well-defined crater, Berosus (77 km) and to the lower right another similar sized crater with a curious dark stripe across its floor, Hahn (87 km). It appears from Lunar Orbiter images and Gazetteer of Planetary Nomenclature: 1:1 Million-Scale Maps of the Moon, that most of the northeast half of the floor on this crater is simply a darker material than the southwestern half.

On the limb, straight across right from Crisium is a dark floored crater. This is Hubble (83 km) not often seen this well with its longitude of 87°. This crater is named after Edwin P. Hubble as is the famous telescope and minor planet (2069) Hubble. Below it is another dark floored crater, Cannon (60 km). Further towards Crisium is the outline of the crater Plutarch (70 km) which is usually the near limb feature for this region!

Hubble, *Richard Hill, Loudon Observatory, Tucson, Arizona, USA. 24 October 2020 02:00 UT colongitude 359.5°. 6 inch Dynamax Schmidt-Cassegrain telescope, 2 x Barlow, 665 nm filter, Celestron Skyris 132M camera. Seeing 8-9/10.*



Some Considerations About Visual Observation of Wrinkle Ridges on the Moon

Alberto Anunziato

For me, the typical lunar observing night always begins with observing the lunar features suggested by the Lunar Observing Schedule of the Lunar Geological Change Detection Program. Then, the walk through the main attractions of the evening begins. And generally, I go to visit "the land of long shadows", the areas of the terminator in which the highlights and shadows appear sharply defined, as in an expressionist film noir: the maria. The first reason is aesthetic, as Elger says: “Most observers will agree with Schmidt, that observations and drawings of objects on the somber depressed plains of the moon are easier and pleasanter to make than on the dazzling highlands, and that the lunar “sea” is to the working selenographer like an oasis in the desert to the traveler-a relief in this case, however, not to an exhausted body, but to a weary eye” (page 9). And in that landscape, tiny mountain ranges stand out under a rising sun, the wrinkle ridges (or dorsa), which “At this stage of illumination they are strikingly beautiful in a good telescope, reminding one of the ripple-marks left by the tide on a soft sandy beach” (quoting Elger once more, page 7).

Wrinkle ridges are common features on the Moon, Mercury, Venus, Mars and our planet. What would wrinkle ridges look like from the surface of the Moon? “On Earth, features that are morphologically similar to wrinkle ridges on the Moon and Mars occur where thrust faults have broken the Surface” (Plescia, page 1289), as we can see in the images of the 37 km long fault scarp produced by the 1968 Meckering earthquake in Australia, although probably the most similar landscape on our planet is that of the mounds known as “kames” in Scotland and “eskers” in Ireland, alluvial deposits of glacial origin (Elger, page 8). On the Moon they have an average width of 3.70 km and an average height of 300 meters (according to the global mapping carried out by Z. Yue et al.).

In addition to the aesthetic pleasure of observing features that are “very evanescent, gradually disappearing as the sun rises higher in the lunar firmament, and ultimately leaving nothing to indicate their presence beyond here and there a ghostly streak or vein of a somewhat lighter hue than that of the neighboring surface” (as Elger says, page 7), the observation of wrinkle ridges offers a series of details that cannot be found in atlases or even in images obtained in lunar orbit with frontal light. Wrinkle ridges do not have much prominence in photographic atlases and generally few details are observed in their images. Even in the Lunar 100, we only find 1, Serpentine Ridge is Lunar 33. Beyond aesthetic pleasure, another reason to visually observe wrinkle ridges is that we can perceive with a small telescope (always near the terminator) details of its structure that do not they are found, for example, in the Virtual Moon Atlas or Rükl's Atlas. In the sketches I register everything I see, as far as possible, since the hand that draws is more clumsy than the eye that observes. But there was the annoying feeling that I was drawing structures or details that I could not find in atlases or books. It was with the reading of a wonderful work ("The Modern Moon. A Personal View" by Charles Wood) that I was freed from that annoying feeling of not finding the details I was observing. “One of the ironies of lunar observing is that a homemade 6-inch reflector is capable of revealing much of the detail that can be photographed through the largest telescopes on Earth… Your brain can discard the periods of fuzzy seeing and concentrate on the fleeting moments of sharp viewing”, says Wood (page XIV) in the cited book, which applies especially to maria: “the surfaces of lunar maria are typically so flat that you have to look closely to see any relief. But because the Moon lacks any significant atmosphere to dim and diffuse the Sun’s rays, every small crater rim and hillock cast a long black shadow when the Sun is low. This “shadow magnification” permits viewing many find details that provide information unavailable from studies of mare surfaces under higher illuminations… with “shadow magnification” you can see vertical features only 25 to 50 meters high, because they cast shadows thousands of meters long! Cruise the terminator with high magnification, and if the seeing is steady, you will be rewarded with details unknown to scientists who study only Lunar Orbiter photographs that are compromised by their relatively higher Sun angles” (page 42).

Charles Wood then gave me confidence that I was recording details of wrinkle ridges that I couldn't find in the available images, thanks to shadow magnification. It was also in "A Modern Moon", where for the first time I found an explanation for the differences in brightness and shadows that I observed in the wrinkle ridges.

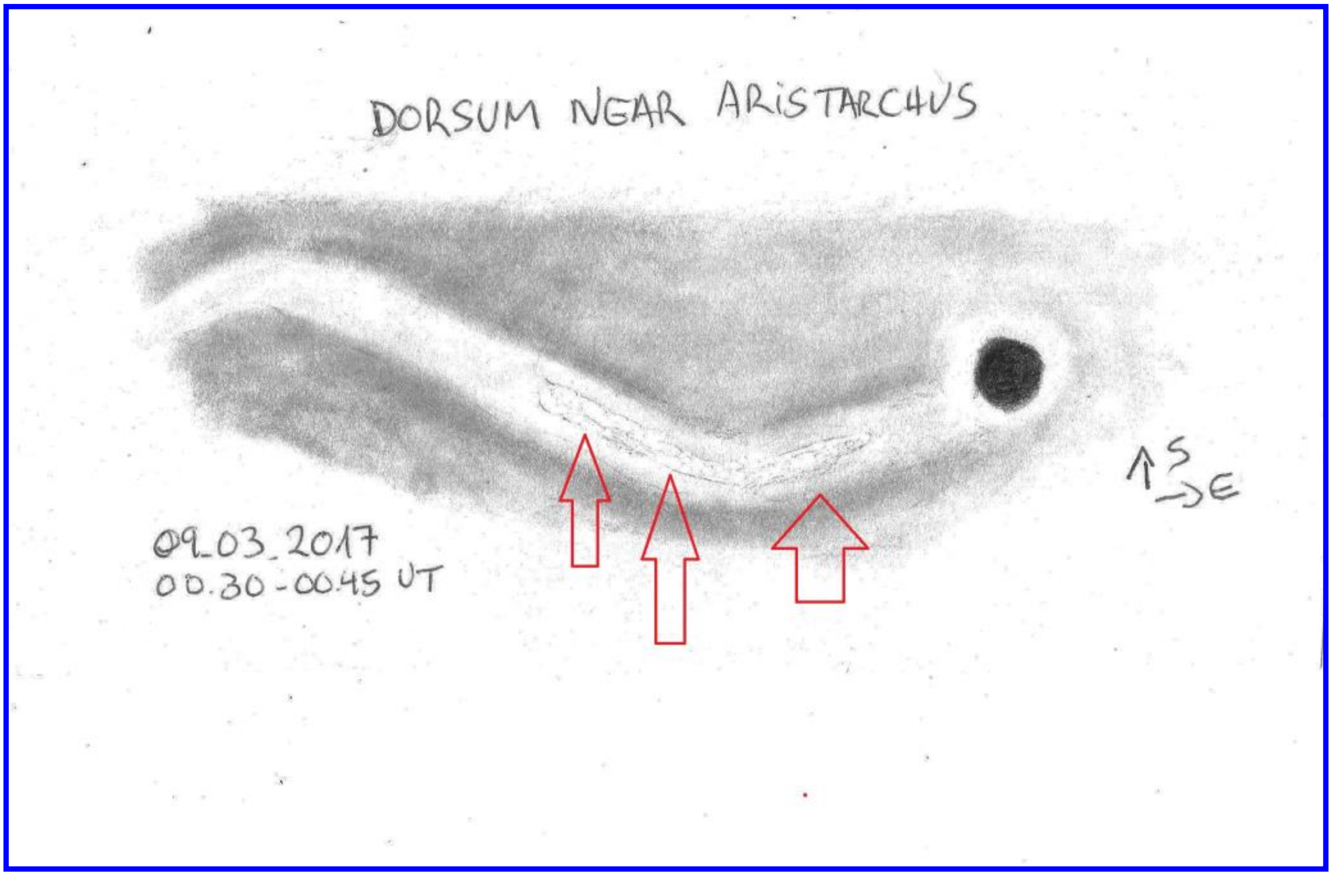


Image 1, Dorsum Near Aristarchus, *Alberto Anunziato, Paraná, Argentina. 03 September 2017 00:30-00:45 UT. 105 mm Meade EX Maksutov-Cassegrain telescope, 105 x.*

The most interesting example of visual observation that distinguishes between arch and crest is a wrinkle ridge near Aristarchus (image 1), in an area with numerous concentric wrinkle ridges. This sketch was forgotten in my observation diary, probably because I did not accurately indicate the crater that intersects the wrinkle ridge, it was the last observation of the night and I probably had the urge to go to the bathroom or some other urgent reason that prevented me from accomplish a full record. The wrinkle ridges near Aristarchus are spectacular and this is an example: we see how the crest appears brighter, very similar to the drawing that accompanies Aubele's text (image 2).

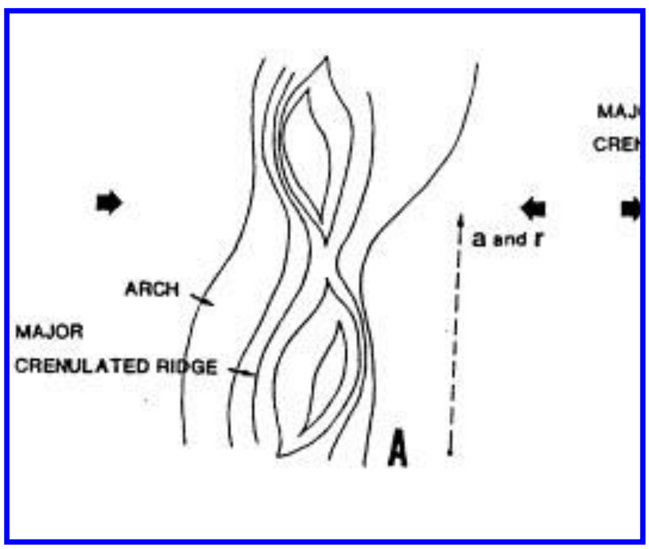
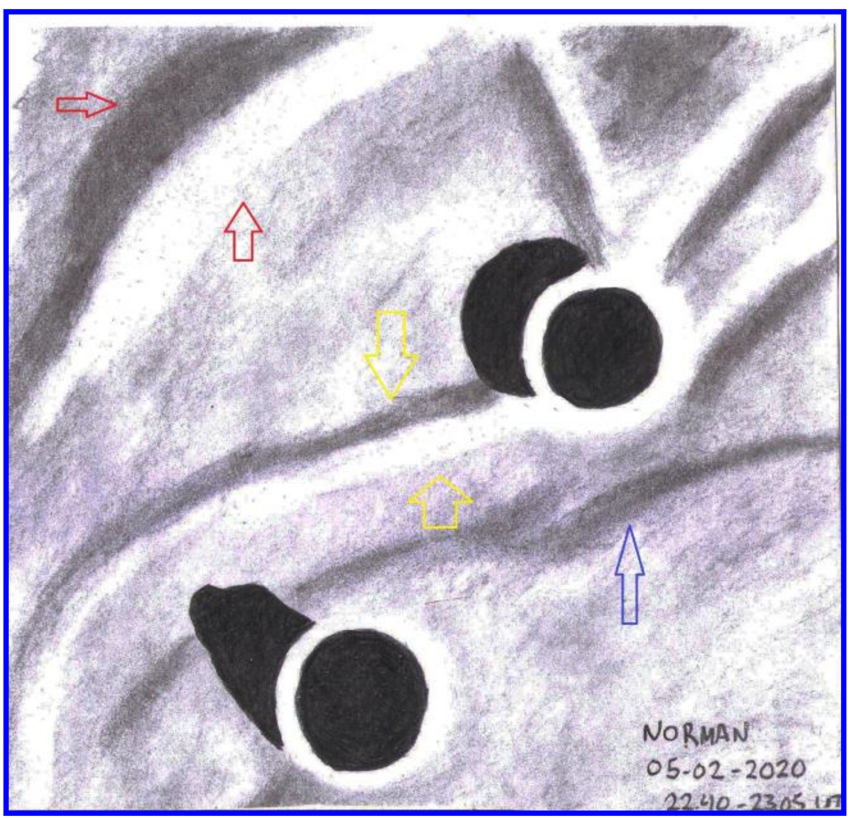


Image 2, *Aubele, J.C. (1989), Morphologic components and patterns in wrinkle ridges: kinematic implications, MEVTV Workshop on Tectonic Features on Mars, p. 13-15.*

In the image of a wrinkle ridge that intersects Luther crater (image 3) we can also see two brighter areas that would be the crest on the arch. Another interesting image is one of the many ridges in the vicinity of Norman and Euclid C (image 4), the red arrows indicate an elevation in the center of the illuminated area that is reflected in the shadow that projects what would be the crest of the ridge.

Image 3, Luther, *Alberto Anunziato, Paraná, Argentina. 02 May 2017 01:30-02:00 UT. 105 mm Meade EX Maksutov-Cassegrain telescope, 105 x.*

Image 4, Norman and Euclides C, *Alberto Anunziato, Paraná, Argentina. 28 April 2020 22:40-23:05 UT. 105 mm Meade EX Maksutov-Cassegrain telescope, 105 x.*



Distinguishing the two components of a wrinkle ridge with a small telescope is not easy, I think that we will only be able to observe the crest that rise well above the arch. The most prominent feature that we can observe in a wrinkle ridge, that gives us an idea of its height, is the shadow they cast. Says Wood: "Although not very high (100 to 300 meters), ridge crests are often sufficiently steep that they cast shadows, and their sunward-facing slopes are brighter than those with gentler arches" (page 44).

Let's look at some examples. In image 4 we see (yellow arrows) the most classic shadow and brightness distribution from which we could infer the existence of a steep ridge that casts shadows and a steep slope that strongly reflects sunlight. While the blue arrow shows us a ridge whose presence we can only infer by the shadow it casts (without bright areas), from it we can deduce that it is high and with a less steep slope than the ridge indicated by the red arrows. Sometimes on the same ridge there is a segment that casts shadow and another segment that does not (image 5 yellow arrow), although both are bright, which would indicate that the segment that casts shadows is higher. In summary, visually ridges are presented with the following combinations: ridges that cast shadows only, ridges that shine without casting a shadow, and ridges that are distinguishable by their brightness and by the shadow they cast. And we could relate shadow with height and brightness with a steeper slope (according to Wood's quote).

Image 5, Euclides D, *Alberto Anunziato, Paraná, Argentina. 31 May 2020 22:20-22:45 UT. 105 mm Meade EX Maksutov-Cassegrain telescope, 105 x.*

Finally, Wood provides us with another important piece of information to evaluate our visual observations: "Ridges crest are usually sinuous and sometimes migrate from one side of the swell to the middle or even the other side" (Wood, page 44). With a small telescope like mine, it is very difficult to distinguish arch from crest, both components are usually seen integrated. But from this Wood data, the observations can be refined to distinguish changes in orientation of the ridge crest on the same arch and not confuse them with different separate segments, as may have been the case with image 4, in which the red arrows indicates two bright areas on both sides of the shadow, in what could be a bifurcation in two segments of the crest or the beginning of a migration of the crest moving to the other coast of a wide arc.

Having acquired theoretical information on the morphology of wrinkle ridges, and having revisited their visual observations near the terminator, the new observations will be much more useful in terms of being able to record the morphology of wrinkle ridges in more detail, to the extent that the aperture of the telescope allows it. We know that the vision could be educated and that once we know what we are going to observe it is more easily recognizable, although the danger of observing with confirmation bias increases. It is curious that wrinkle ridges were observed for the first time in the early 1890s (according to Yue) or in the late 18th century by Schröter (according to Elger) and today we can observe what Hevelius, for example, failed to observe. It is possible to optimize the visual observations of wrinkle ridges in order to refine the morphological data on its structure obtained from it, such as adding indications of brightness using the Elger scale or planning the observation by preparing a template with the ridge plot, in order to concentrate the observation time in specifying details, similar to how the observations were made in the USAF Lunar Mapping Lunar Program for the Apollo Program. Knowing the morphology of ridges, and how it can be visually captured through a telescope, generic indications can be added to record whenever you observe these types of lunar accidents: are there shadows? How dark are they? In what direction? Are there differences in brightness in the illuminated areas? Is the crest visible at the top? Is there a change in direction of the crest?

Wrinkle ridges are very beautiful to behold and their visual observation with small telescopes, reinforced with some knowledge of their morphology, can be very profitable.

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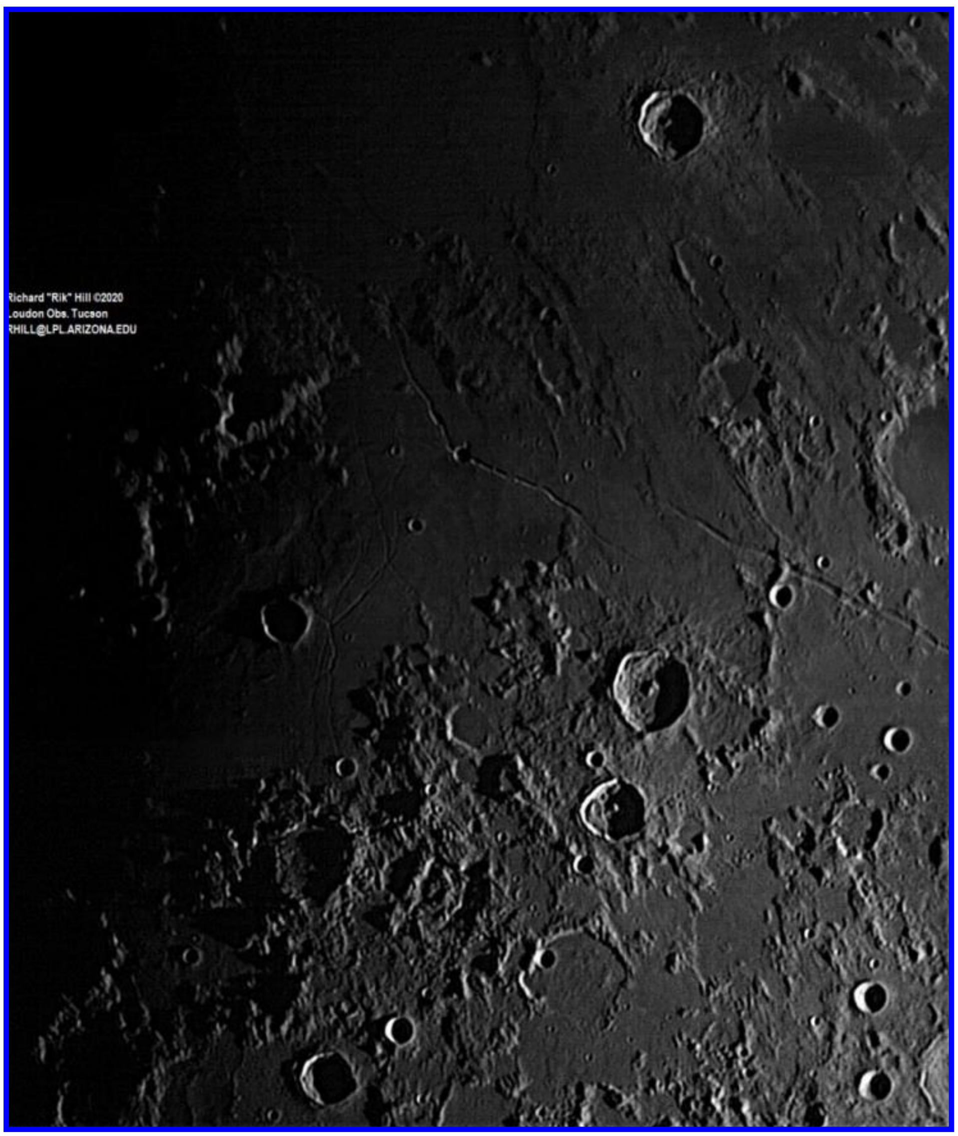
The Land of Cracks
Rik Hill

Almost dead center of the Moon's visible disk is the region of Mare Vaporum, a very interesting region that can take hours to explore thoroughly. I've imaged this area before and its always a great treat to go back to it. The crater below and just right of center is Agrippa (48 km) and below it is Godin (36 km). Near the top of the image is Manilius (41 km). To the right is a flat region, in the upper right corner of the image, that is Lacus Lenitatis. Left of Agrippa is a crater deep in shadow. This is Triesnecker (27 km) with a beautiful system of rimae. These graben-like fissures range from 1-2 km across as measured with LROC QuickMap. A graben is where land on either side spreads apart and the block between drops down. Think of that, you can go out of your house and see 1 km in any direction so you could easily see across the rimae! Above Agrippa is the beautiful Rima Hyginus with the crater Hyginus (10 km) in the middle. This is a totally different rima made up of a series of volcanic vents that trail off to the right to a very large graben, Rima Ariadaeus some 5 km wide where you can clearly see the block that moved down. Above this rima is an oddly shaped crater, Boscovich (48 km) with obvious outflows of mare material coming out of it and a nice thin rima on its floor, Rima Boscovich.

If you draw a line from Agrippa through Godin and go the same distance south you come to a remarkably polygonal crater, or remnants of a crater, that is Lade. Another polygonal crater can be seen to the left of both Agrippa and Godin. It's a smaller crater, Dembowski (27 km) and with a little more searching you will find more.



Agrippa, *Richard Hill, Loudon Observatory, Tucson, Arizona, USA. 24 October 2020 02:11 UT colongitude 359.5°. 6 inch Dynamax Schmidt-Cassegrain telescope, 2 x Barlow, 665 nm filter, Celestron Skyris 132M camera. Seeing 8-9/10.*

The Elusive Craterlet On the Northwest Rim of Peirce

Sergio Babino and Alberto Anunziato

For some time now we have tried to observe the northwestern shore of Mare Crisium as many times as possible, and collect all the images within our reach, for a joint observation program between the Sociedad Lunar Argentina and the Sociedad Astronómica Octante (Uruguay). When comparing the images, something surprised us in the outline of the Peirce crater in image 1: what appears to be a craterlet on the northwestern rim (detail in image 2). The contrast with Image 3, for example, where we see a detail of the area, is surprising. In image 1 the shadows occupy the eastern part of Peirce and in image 3 the western part, so it seems that the small crater on the northwestern rim in image 2 could be completely covered by shadows in image 3, but in this image, we see the entire rim and there really doesn't seem to be any traces of the craterlet. More surprising was the search in vain in lunar atlases, like Rükl's, of this

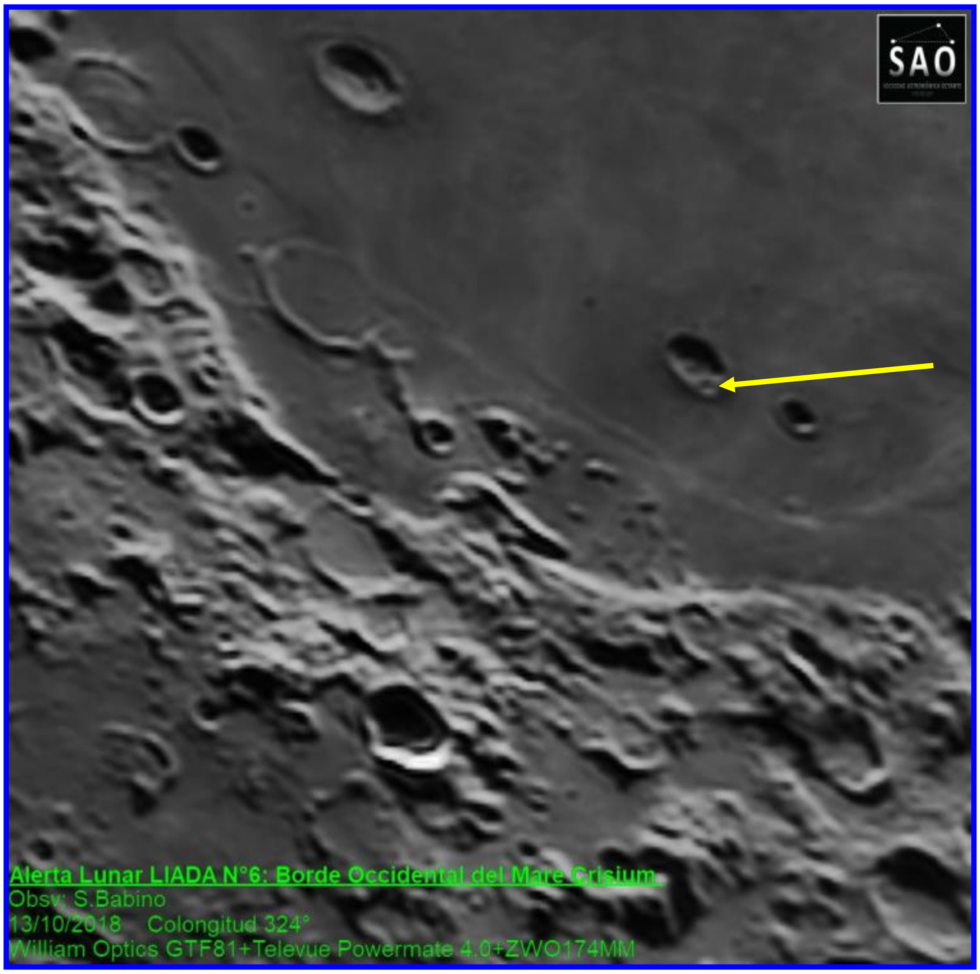


Image 1, Peirce, *Sergio Babino, Montevideo, Uruguay . 13 October 2018 22:27 UT. 81 mm refractor telescope, ZWO ASI 174 camera. North down, west left.*

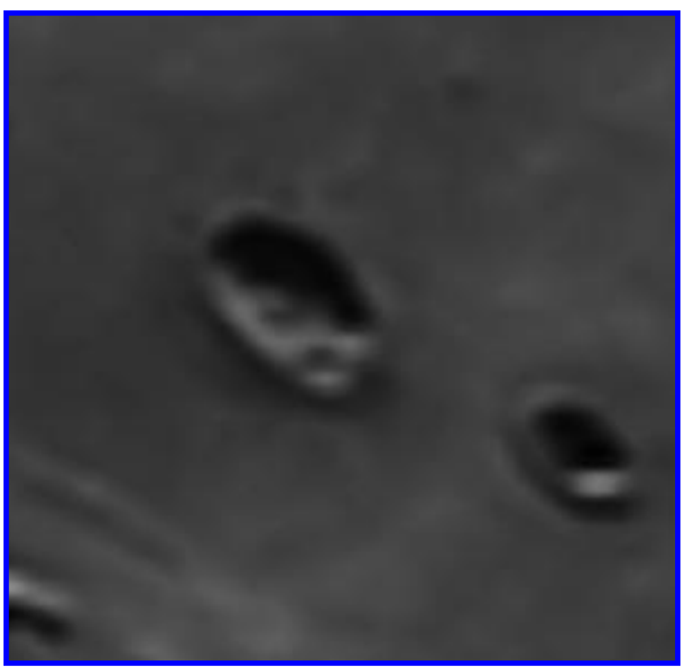


Image 2, *close up of Peirce image 1.*

craterlet on the northwestern rim of Peirce, it does not even appear in the LRO Quickmap (image 4). A new crater that appeared between February 2018 (date image 3) and October 2018 (image 1)? Comparing the apparent diameter of what appears to be a small crater on the northwestern rim of Peirce with the diameter of Peirce itself, 18 kilometers, it can be understood that the impact to generate a crater at least a couple of kilometers in diameter would not have gone unnoticed.

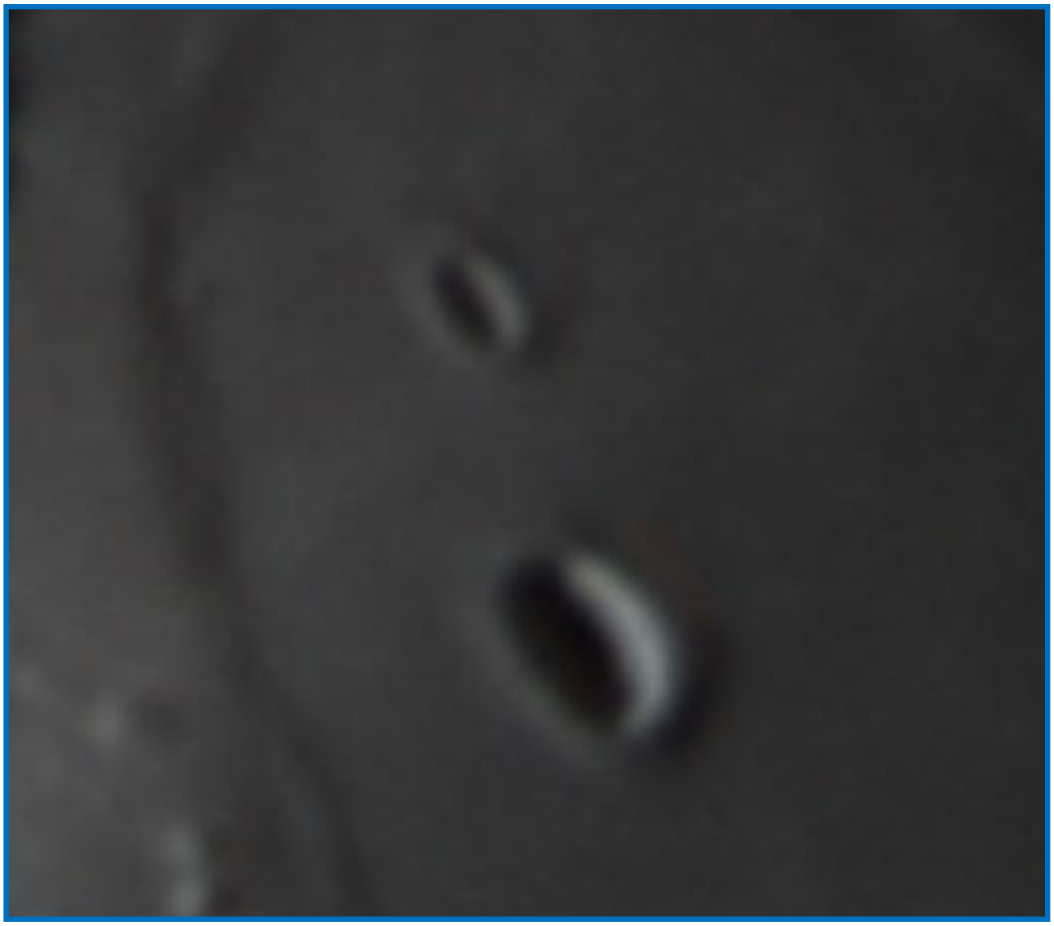


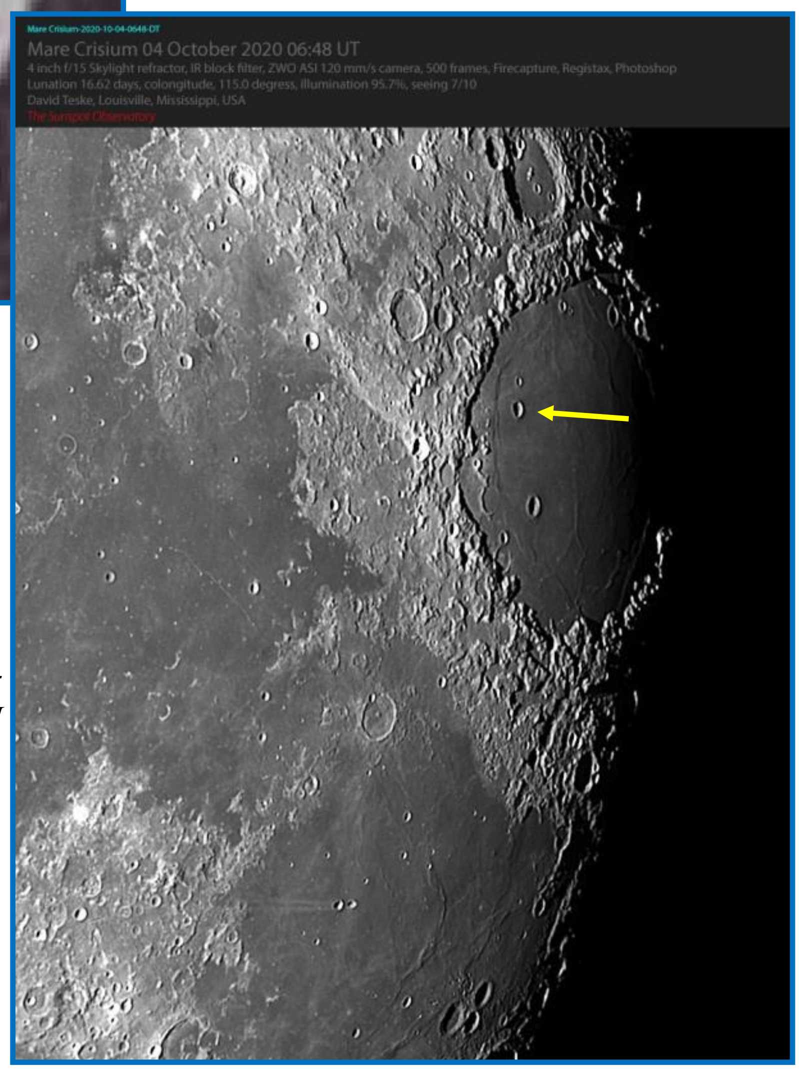
Image 3, Peirce, *Alberto Anunziato,* Oro Verde, Argentina . *02 March 2018 05:48 UT. CPC Celestron 11 inch Schmidt-Cassegrain telescope, Canon EOS Digital Rebel XS camera. North is up.*

Image 4 below, Pierce, *LRO QuickMap.*

A fleeting vision of a parallel universe whose only difference with ours would be that on its Moon Peirce would have one extra craterlet? Too many variables to analyze. So, getting back to seriousness, we kept looking in the books for an image in which the already irritatingly elusive little crater could be seen at that time. The solution came from a photographic atlas that is rarely used today but that has helped us with numerous lunar searches, the Lunar Orbiter Photographic Atlas of the Moon, which in its Plate 512 (whose detail we see in image 5) shows a very similar landscape of the northwestern rim, although what looks like a craterlet is more elongated than in image 2.

We continued searching through the images we had on file and found an image contributed to our incipient observation program of the northwestern shore of Mare Crisium by David Teske (image 6), in which we found the little devil again enlarging the image. At this point in the topographic search we had a series of three images in which the area looked quite different (image 7). In this image we have the image of David (at 115.1º colongitude) and image 3 (120º colongitude), similar in illumination, although the image of David (left) is sharper and shows that our probable small crater is also visible in last quarter, only it would be much more visible in first quarter (324º colongitude, right).

Image 5, Pierce, *Lunar Orbiter Photographic Atlas of the Moon, Plate 512.*



Peirce, *David Teske, Louisville, Mississippi, USA. 04 October 2020 06:48 UT. 4 inch f/15 refractor telescope, IR block filter, ZWO ASI 120 mm/s camera.*

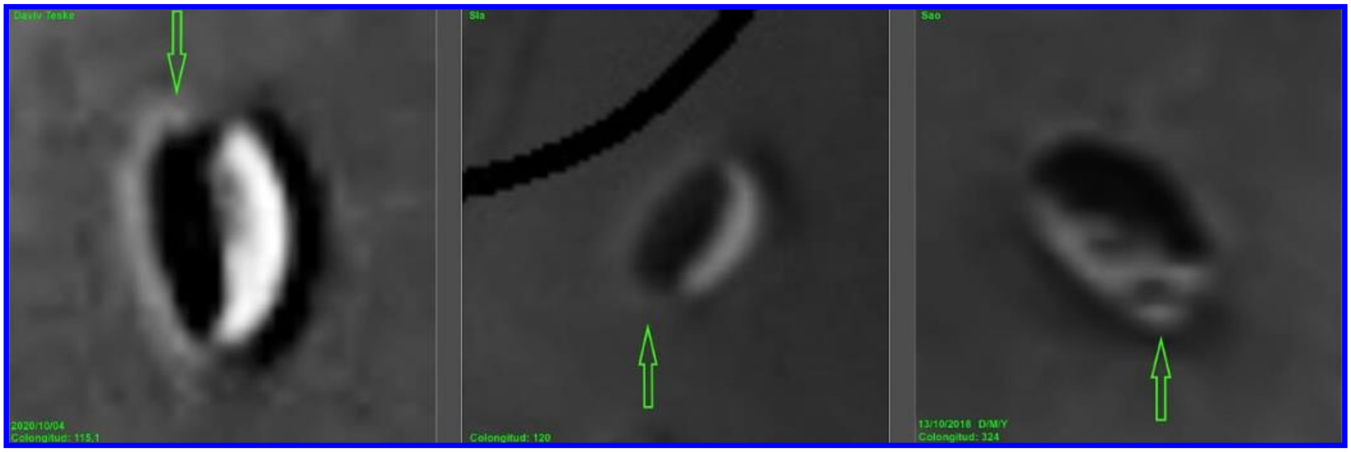


Image 7, Pierce, Close-up of images 1, 3 and 6.

The most complete study on Peirce's topography is easily found on the Internet, belongs to Lan Fleming and consists of two parts called: "Peirce Crater: Apollo 17 vs Lunar Orbiter 4" and “The Crater Peirce: Battle Zone in a Crisium War?” In this study we found image 8, composed of an image of the Lunar Orbiter 4 and another of Apollo 17. The area marked as "C" by Fleming is the one that corresponds to the northwestern rim, in the image of the Lunar Orbiter (left) it seems to be distinguished a crater, although it looks more elongated than in image 2. Our small crater would be located in the elevated area that interrupts the contour of the Peirce rim and that Fleming calls "ramp": "Other interesting features of Peirce are the two ramps, one to the north and the other to the south, both leading down from the rim of Peirce to the floor of the crater. These ramps do not fan out onto the crater floor as one would expect rock slides to do. Also, if these structures were the result of rock slides, some evidence of collapse depressions at the crater rim should be present. Instead, at the top of the northern ramp there is a curious domed structure with small ridges radiating out around its perimeter outside of the crate”. A dome, then? At least "a curious domed structure", but with a disproportionately large opening for its pit. A casual impact? Peirce is quite recent, it formed after the solidification of the lava that formed the surface of Mare Crisium, in the Eratosthenian period, a time when craters of its size were already rare, and yet it has two craters in its interior, in the southern area (as we see in image 4), to which we had to add the small crater on the ramp located on its northwestern edge. Undoubtedly, a complicated topography that of Peirce.

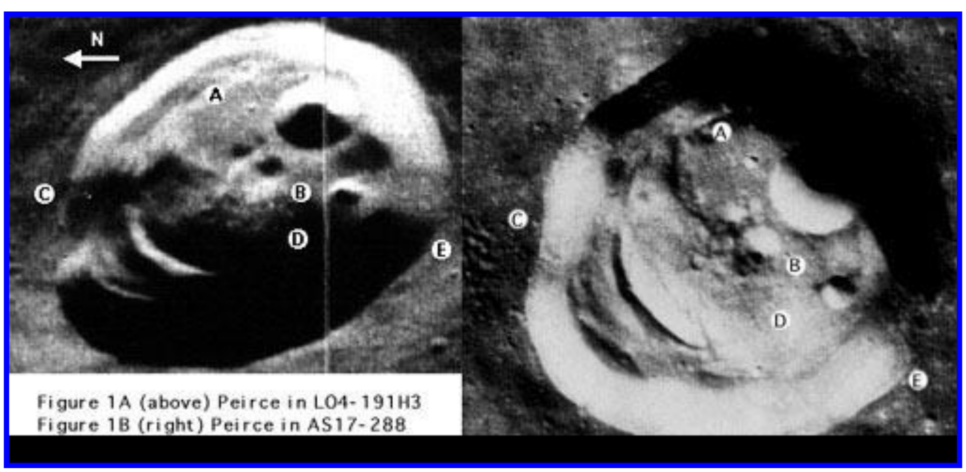


***Image 8, Peirce,** Lunar Orbiter image LO4-191H3-Apollo 17 image AS 17-288.*

As a culmination of our search, we found in the wonderful Atlas by Kwok C. Pau "Photographic Lunar Atlas for Moon Observers" images that exactly match our image 2 (image 9-B) and our image 3 (image 9-A) in pages 81 and 85 respectively. Finally, image 10 is an enlargement of image 3, a detail of the probable crater in the ramp on the northwestern rim of Peirce, in it we see that Peirce's pattern of shadows and bright areas is repeated in the probable craterlet. A craterlet that may or may not be, more elusive than the famous Linne. Or rather, as Fleming says, it would be a set of tiny ridges on a elevated part of the rim (a ramp) that with certain illumination (around 324º colongitude) would generate illuminated areas and shadows that would be identical to a crater, which could be corroborated with image 11, composed of two captures from the Alcyone software (based on images from the LRO), with different illumination. We intend to continue trying to discern whether it is a true crater or a complex series of topographic features that simulate the shape of a crater.

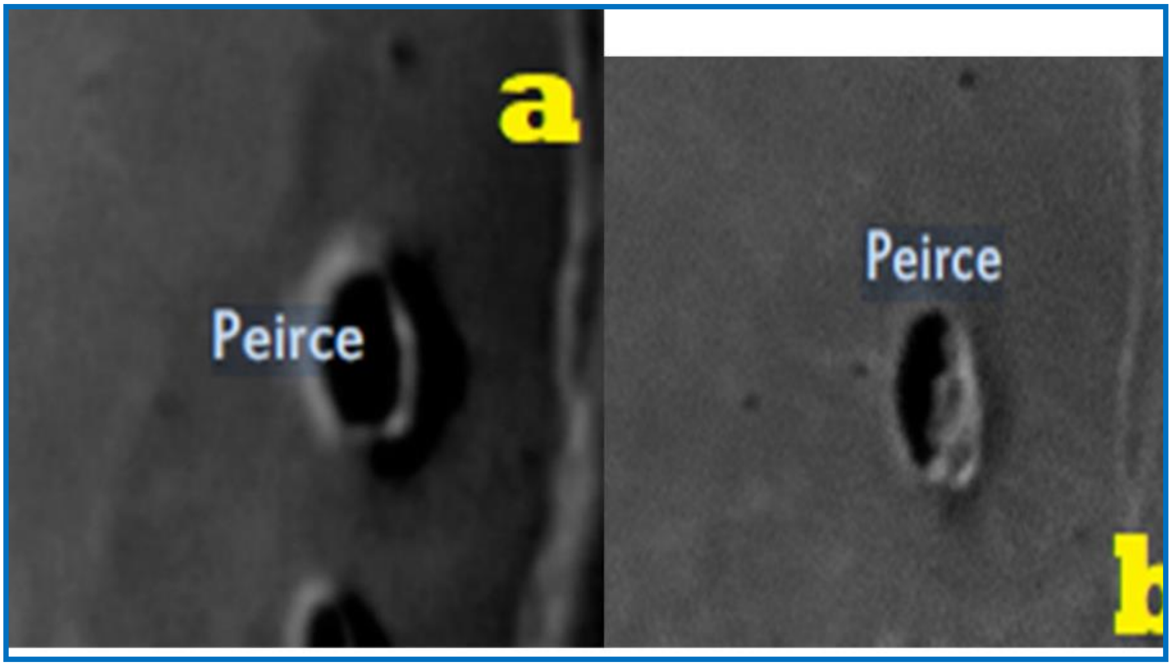


***Image 9 Peirce**, Kwok C. Pau's "Photographic Lunar Atlas for Moon Observers".*

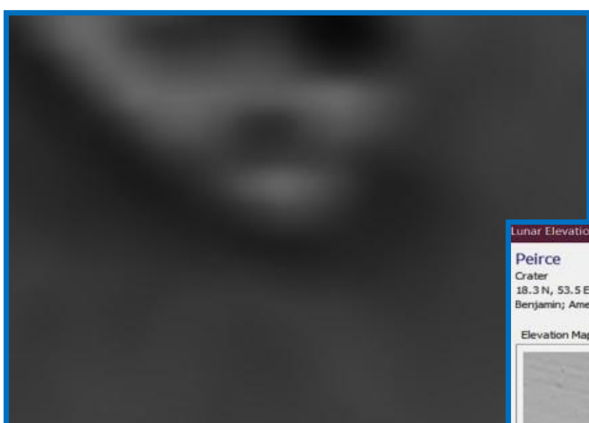


***Image 10, Peirce,** Alberto Anunziato,* Oro Verde, Argentina . *02 March 2018 05:48 UT. CPC Celestron 11 inch Schmidt-Cassegrain telescope, Canon EOS Digital Rebel XS camera. North is up. Close-up.*

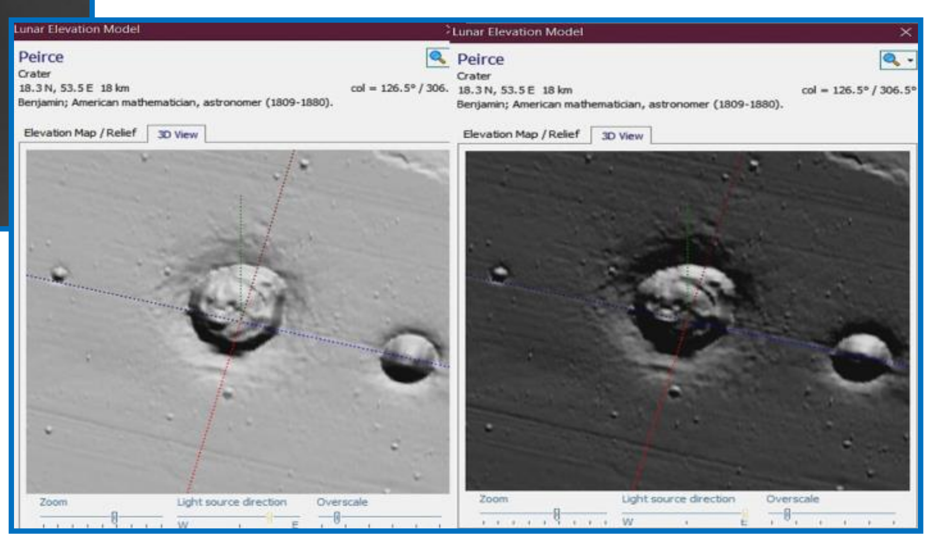


***Image 11, Peirce,** Alcyone software.*

Observing Crisium 1 (second preliminary report): Is an Inflation of the Upper Surface Layers Associated with the Formation of the Wrinkle Ridges?

Raffaello Lena

In a previous note a possible dome, provisionally termed *Crisium 1* (Cr1), has been described. It is detectable in the image taken by Tedorescu on October 3, 2020 at 23:02 UT (see http://www.alpo-astronomy.org/gallery3/var/albums/Lunar/Lunar-Domes/2020-Images/dome%20in%20Crisium%20-%20preliminary%20report-01.pdf?m=1604599104).

A campaign to encourage lunar observers to image Cr1 under waning moon phase was organized and started on November 1, 2020. This was done completely through internet, specifically through the use of e-mails and astronomical forums. The goal of this project was to image Cr1 under low solar illumination angle and to describe the relationship between Cr1 and the nearby topography of the Mare Crisium.

New Observations (November 1-2, 2020)
Fig. 1 displays the image of this second survey taken by Maximilian Teodorescu, from Romania, on November 1, 2020 at 22:03 UT.

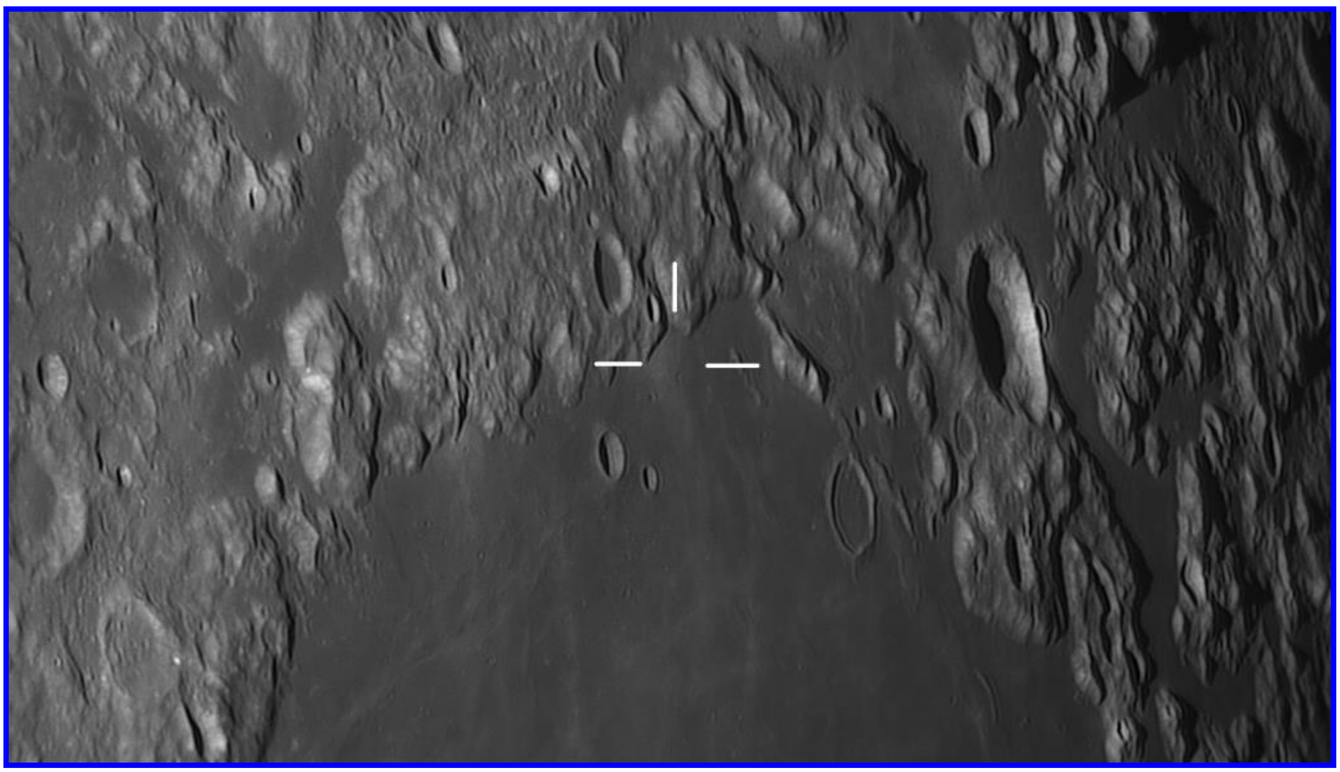


Figure 1: Image taken by Teodorescu on November 1, 2020 at 22:03 UT using a 355 mm Newtonian telescope and ASI 174MM camera.

Another image of this region was made by Pau, from Hong Kong, on November 2, 2020 at 17:27 UT (Fig. 2). The image taken under lower solar illumination angle displays the wrinkle ridges around the examined region.

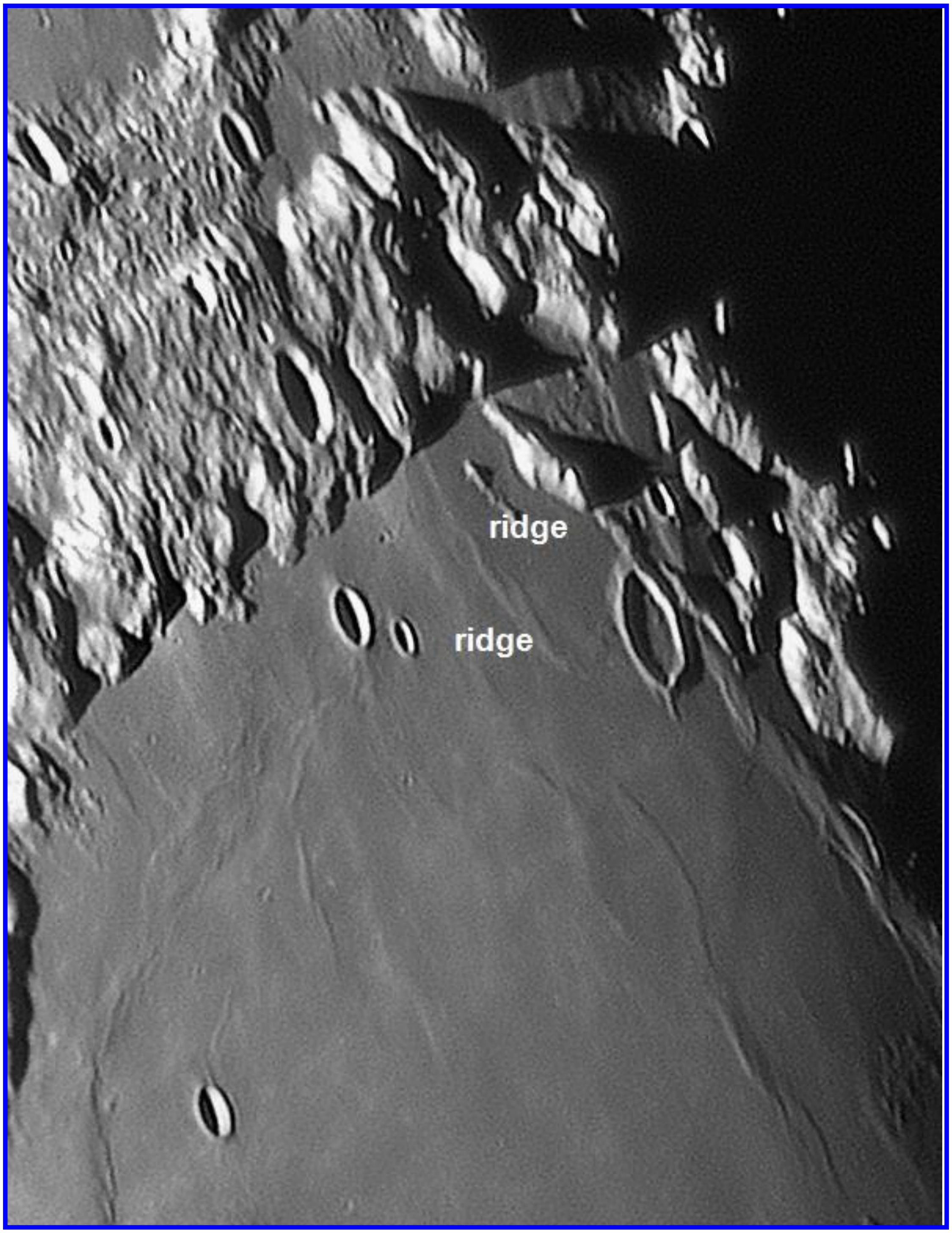


Figure 2: Image taken by Pau on November 2, 2020 at 17:27 UT using a 250 mm f/6 reflector and a QHYCCD290M camera.

Alessandro Bianconi from Italy has imaged Cr1 under lower solar illumination angle (about 3.5°) as shown in Fig. 3. The image was taken on November 2, 2020 at 22:53 UT. Note that under low solar illumination angle the dome surface is partially covered by the shadow of the nearby massif/hills located on the Crisium rim.

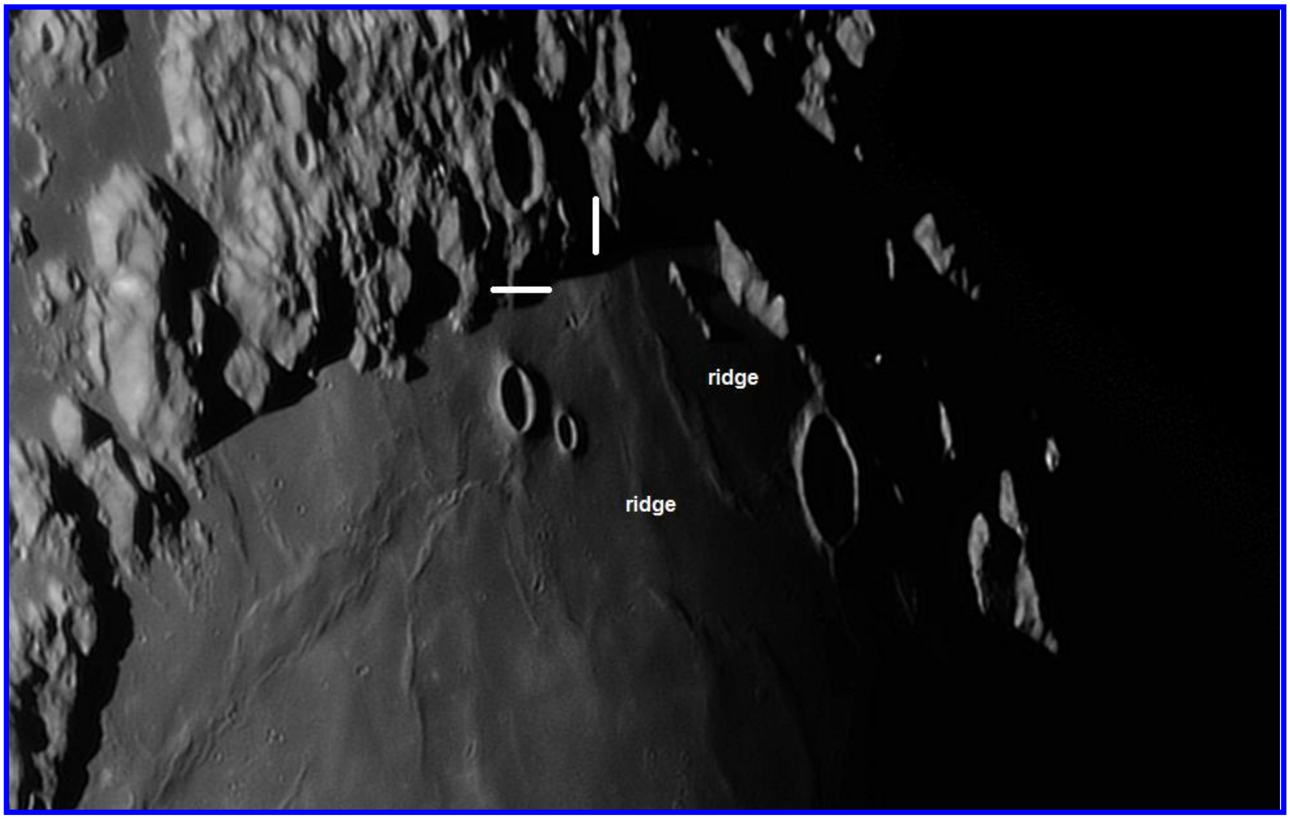


Figure 3: Image taken by Bianconi on November 2, 2020 at 22:53 UT using a C14 HD edge 10Micron GM2000HPSII and ASI174MM.

The recent telescopic images display a connection with the southern ridge when the region is imaged under grazing lighting conditions. Moreover two features like scarps traversing the surface of Cr1 are detectable located in direction SW (see feature A in fig. 8) and NS (see feature B in fig. 8), respectively.

Domes and ridges

Several known lunar domes, examined in the past, are characterized by a connection with wrinkle ridge. Some examples are represented by the dome Grimaldi 1 located in Grimaldi, C16 in the Cauchy region and the dome near Turner. The following figures show these domes (Figs. 4-7).

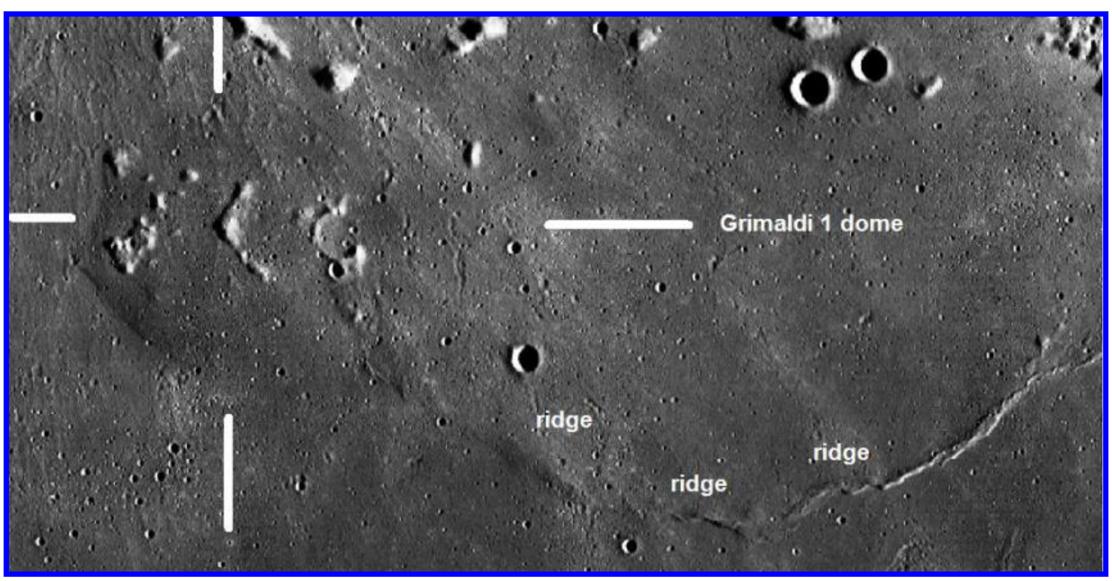


Figure 4: LRO WAC imagery. Dome Grimaldi 1.

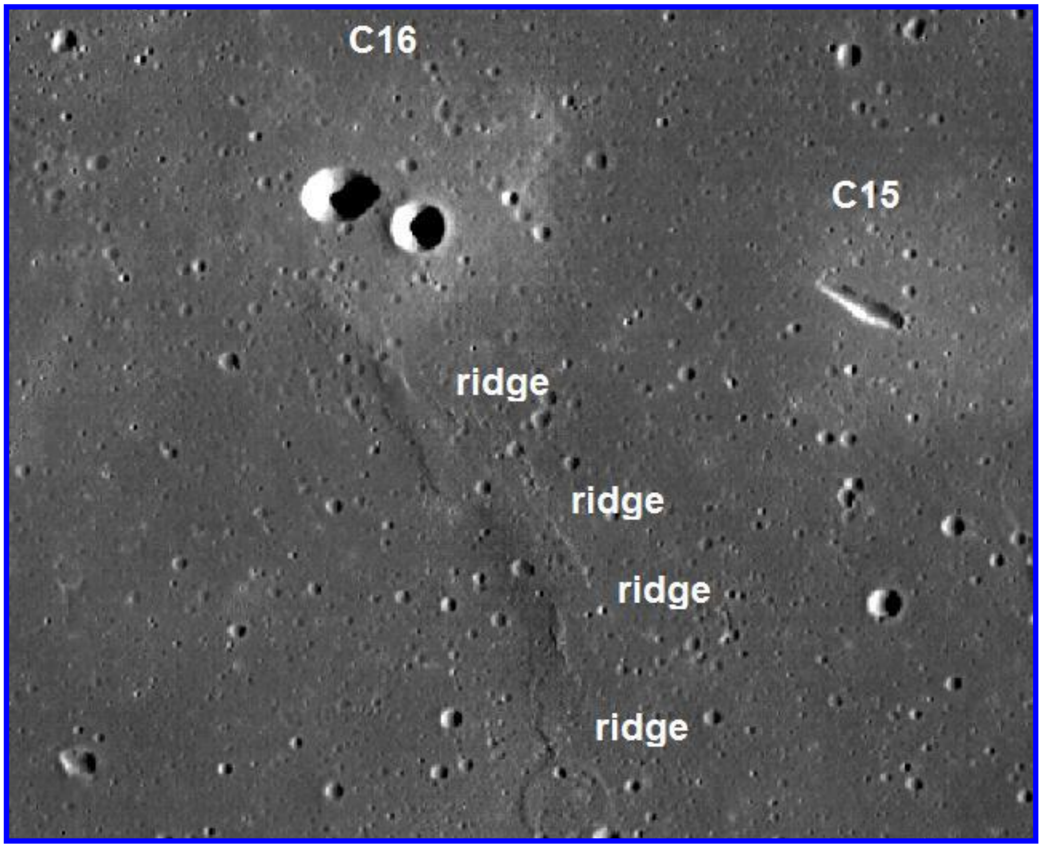


Figure 5: LRO WAC imagery, and the dome C16. The ridge is detectable also in CCD telescopic images in the lunar domes atlas (http://4.bp.blogspot.com/-qr0dWD-NPag/U7btUDmheYI/AAAAAAAAANE/ke9jfz_YUCA/s1600/Cauchyst390.jpg).

Figure 6: A dome near Turner with associated ridge. Apollo image AS12-50-7438.

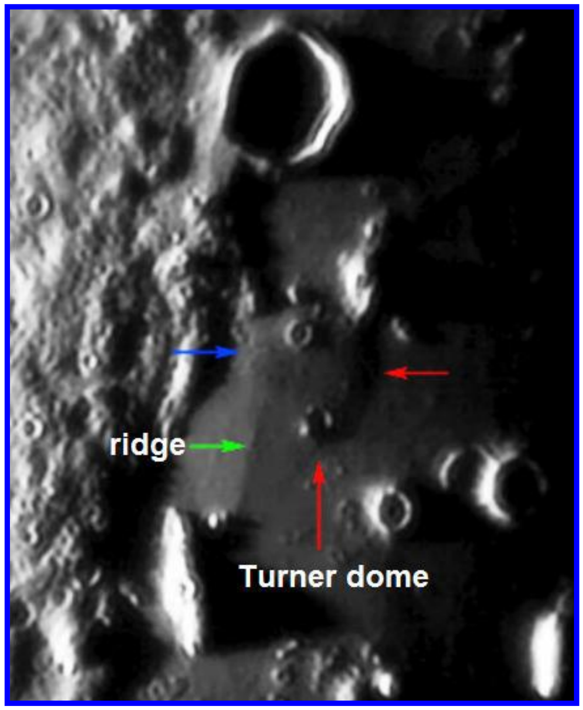


Figure 7: A dome near Turner with associated ridge. Image of the author.

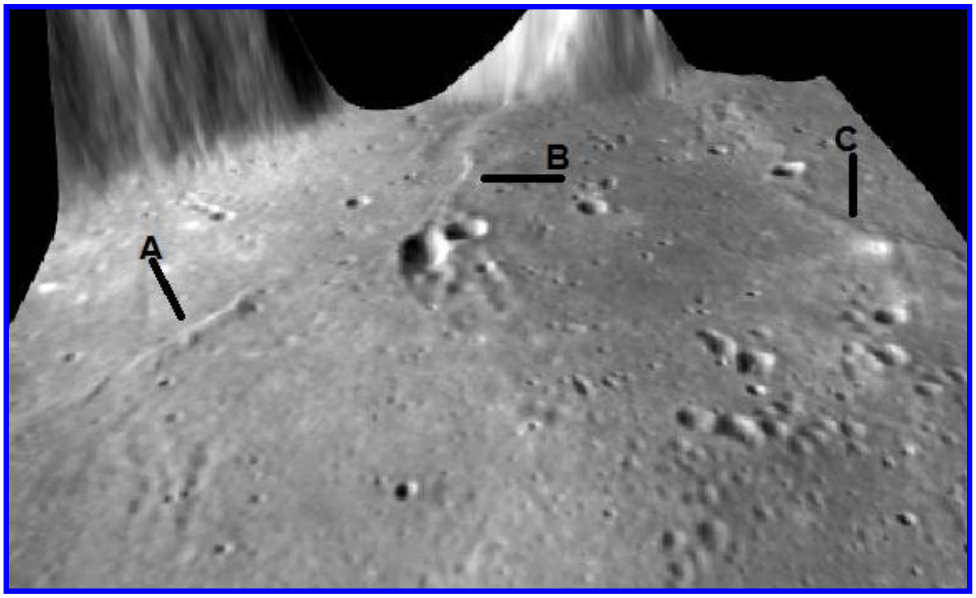
Possibly the structure of Turner extends into the ridge. It would then be the manifestation of a subsurface volcanic dike with sill formation [Lena et al., 2013].

Digital elevation map LOLA DEM

ACT-REACT Quick Map tool was used to access to the LOLA DEM dataset, obtaining the cross-sectional profiles and 3D reconstruction for the examined region (Figs. 8-9).

Based on WAC imagery two low scarps run up through the surface of Cr1 near the elongated crater (Figs. 8-9).

The first feature, labelled as B, is 70-80m high and could be a continuation of another lobate scarp, labelled as A that approaches the dome from the SW. The scarp A is 60-70m high based on LOLA DEM measurements. There is another ridge that approaches the eastern rim of Cr1 from SE (labelled as C in Figs. 8-9). The scarp B heads off towards the N and the mountain massif that forms the border of the mare Crisium.



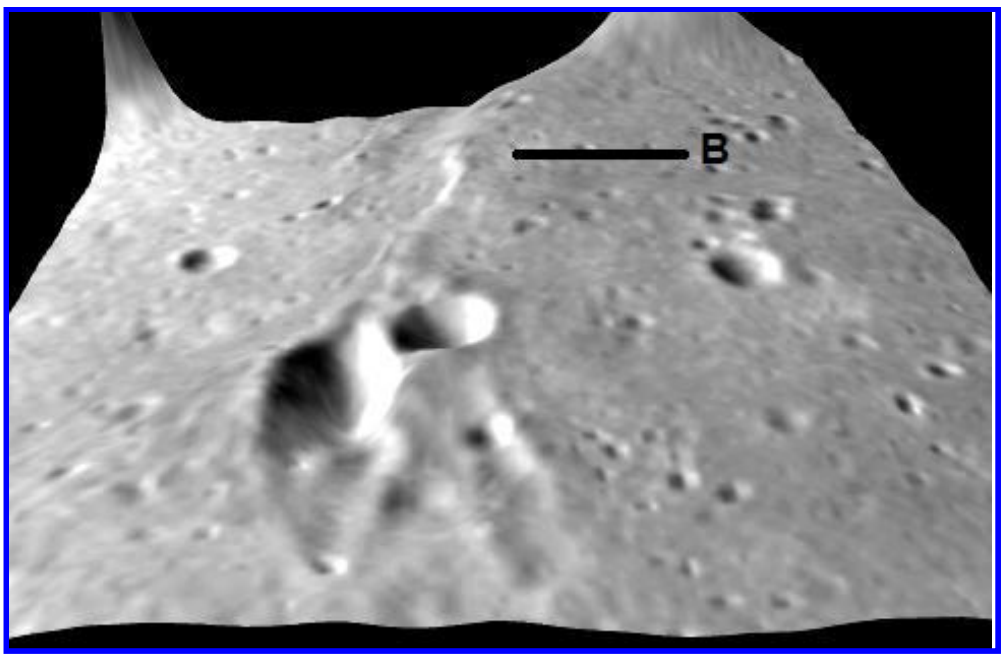


Figure 8: LRO WAC-derived surface elevation. See text for detail.

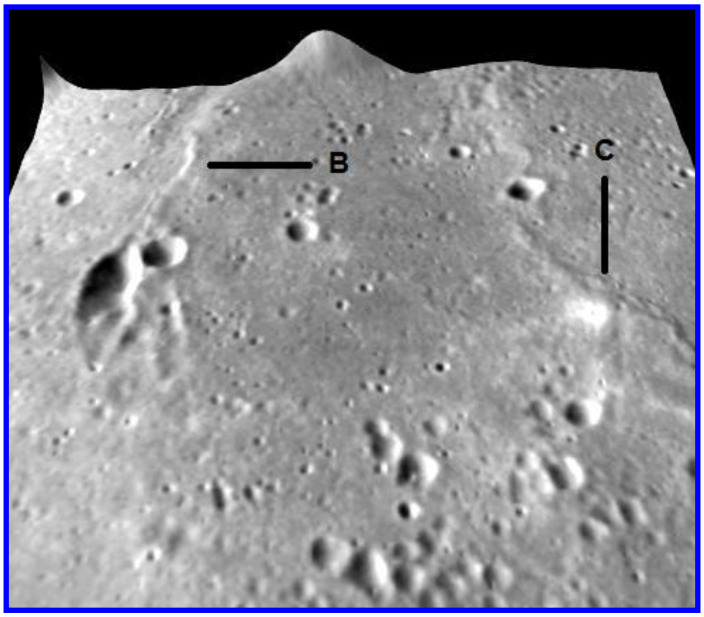


Figure 9: LRO WAC-derived surface elevation.

Along the boundary of the two lobate scarps the feature forms a west facing escarpment suggesting a low angle thrust fault, with the terrain on the eastern side overriding that on the western side (Fig. 9).

Morphometric updated data

Based on new terrestrial telescopic images and the boundary with the mentioned ridges, I have updated the morphometric data without the inclusion of the ridges (and their heights) in the corresponding measurements. This correction yields lower values of the height as shown in Figs. 10 and 11. In the revised measurements the crater Cleomedes F has been used as reference point of the southern rim of Cr1.

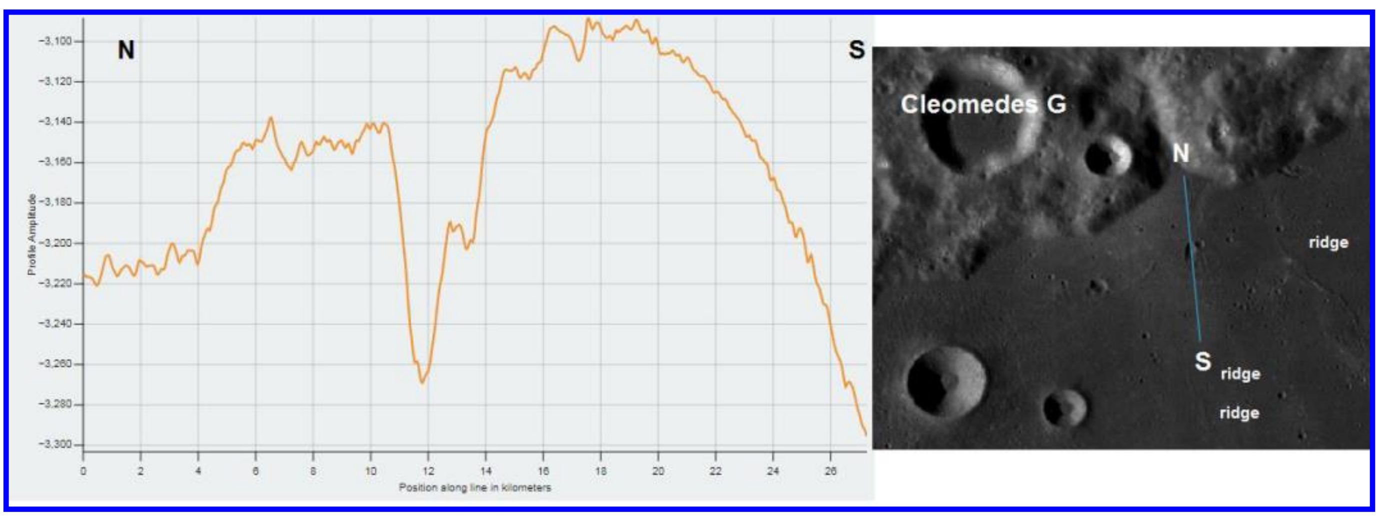


Figure 10: LRO WAC-derived surface elevation in NS direction, excluding the southern ridge to the South of Cr1, as shown in the telescopic images. The height amounts to 160m in NS direction. Note that including part of the ridge the height amount to about 230m as computed in the first preliminary report.

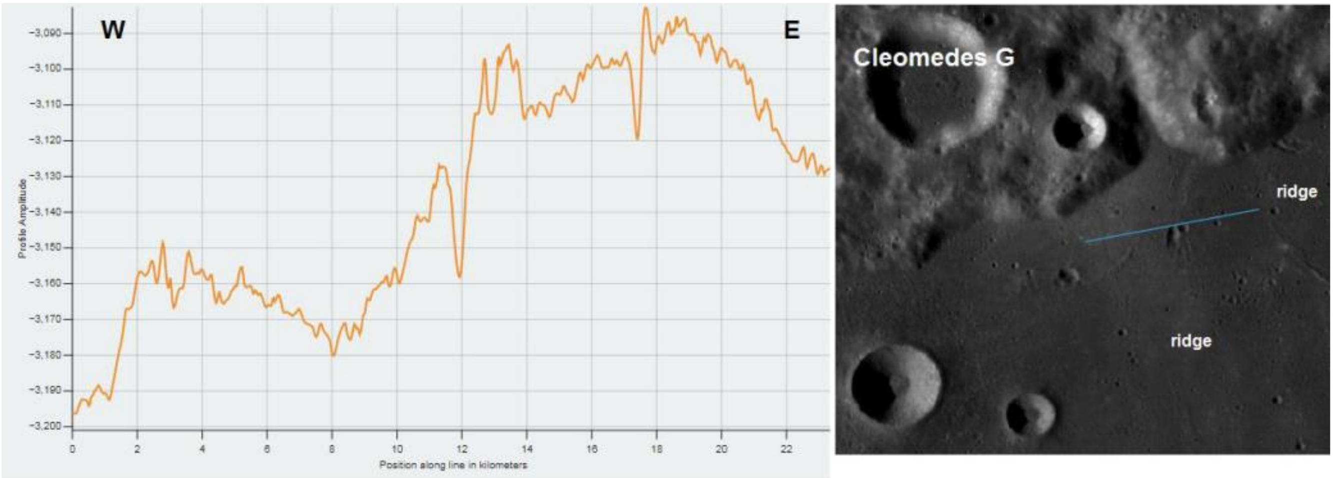


Figure 11: LRO WAC-derived surface elevation in WE direction, based on the boundary shown in the telescopic images. The height amounts to 70m in WE direction.

The outline of a dome can be described by a major axis **a** and a minor axis **b**; thus the dome diameter may be defined as the geometric mean:

$D = \sqrt{\mathbf{a}\ \mathbf{b}}$ and its circularity as $c = \mathbf{b/a}$, while the flank slope is defined as slope= arctan (2h/D).
The mean diameter amounts to 24.65km (a=27.0km and b=22.5km) and the circularity is determined to c= 0.83.

Possible interpretation
In the work by Head and Gifford, mare domes of class 4 are associated with mare ridges and arches [Head and Gifford, 1980. Lunar mare domes: classification and modes of origin. Moon Planets 22, 235–257].
The fact that Cr1 is located close to border of impact basin would indicate a formation due to:
1) Magma rise through dikes guided by stress fields resulting from basin subsidence as a consequence of lava loading. The derived morphometric data are compatible with the classification of a C1 effusive dome but, in this scenario, is not clear the origin of some lobate scarps on its summit (as described in the section *Digital elevation map LOLA DEM*). However lobate scarps and ridges are present in some well known domes, e.g. Mons Rümker
https://agupubs.onlinelibrary.wiley.com/reader/content/1677c5db7e8/10.1002/2016JE005247/format/pdf/OEBPS/pages/bg3.png

Or
2) An up-arching of the central part of Cr1 as result of a next magma intrusion forming a laccolith within the crust. In this scenario, after an effusive phase, a magmatic intrusion occurred creating a west facing escarpment. Based on the circularity (c=0.83) and modelling results Cr1 does not match the properties of putative intrusive domes regarded in previous studies. Another thing that may argue against an intrusive origin for Cr1 is the lack of any sort of extensional fractures (rilles). However it is equally possible that it is could be an intrusive dome where the low pressure did not result in the tensional features usually associated with laccoliths, but these domes of class In2 are more elongated than Cr1 (c>0.8) and characterized by smaller and slightly steeper edifices with diameters of 10–15km and flank slopes between 0.4° and 0.9°.

Or
3) Cr1 can be interpreted as a larger extension of the southern ridge, and thus not an effusive lunar dome.

Or
4) This complex bulge may have formed when magma, or volcanic gases, rose under a lava flow near the surface and inflated it. Thus, based on new acquired data described above, the most likely explanation could be that Cr1 is an inflation of the upper surface layers associated with the formation of the wrinkle ridges that cross the mare margins.

Conclusion
I encourage high-resolution imagery of this area during the next lunation to confirm the hypothesis of an inflation of the surface layers associated with the formation of wrinkle ridges. If any reader has further hypotheses, the debate is welcome (lunar-domes@alpo-astronomy.org). Cr1 is a complex feature and raises quite a lot of questions regarding interpretations of these bulges associated with ridges.

References

1) Head, J. W., Gifford, A., 1980. Lunar mare domes: classification and modes of origin. The Moon and Planets 22, 235-257.

2) Kerr, A. D., Pollard, D. D., 1998. Toward more realistic formulations for the analysis of laccoliths. J. Structural Geology 20(12), 1783-1793.

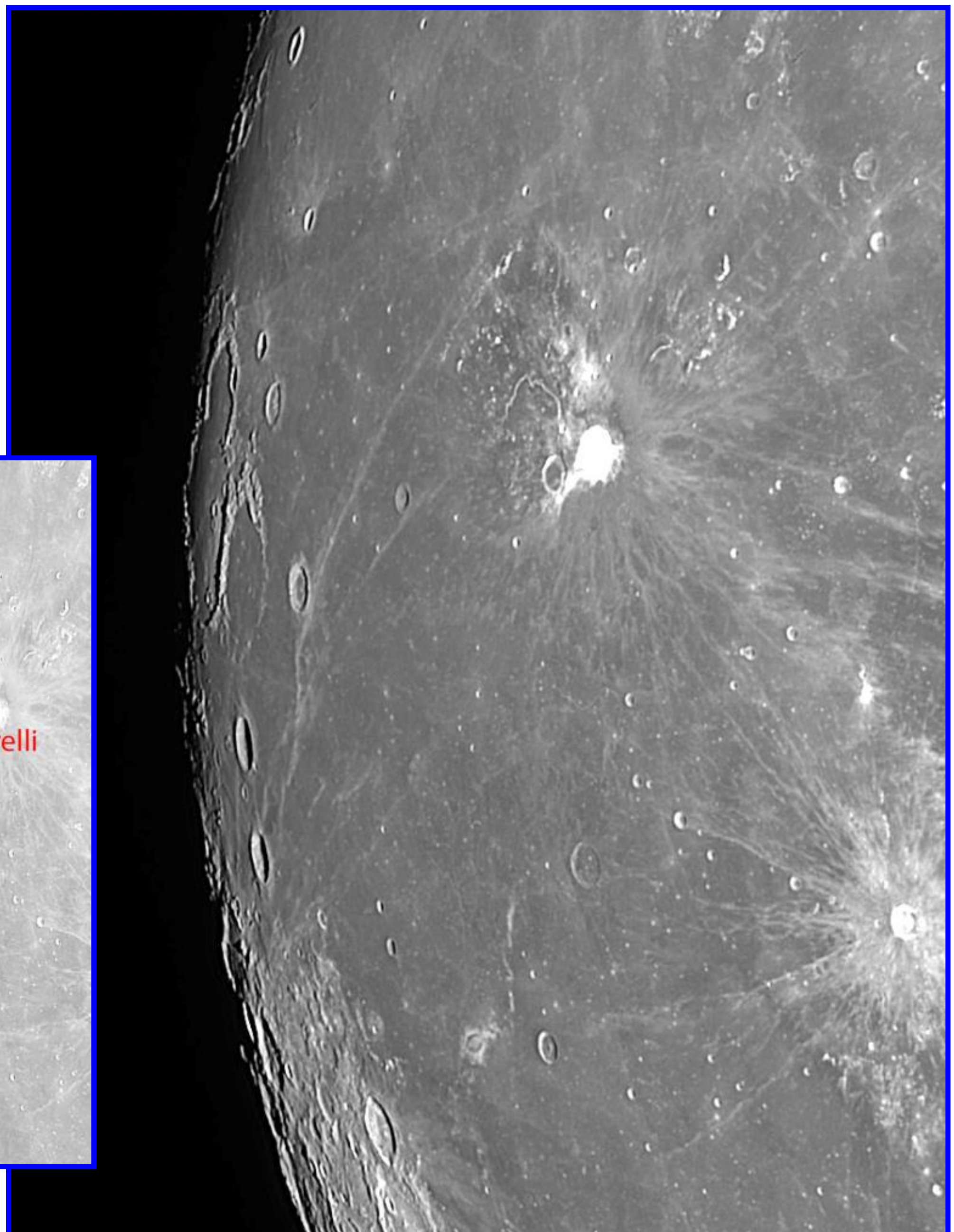
3) Lena, R., Wöhler, C., Phillips, J., Chiocchetta, M.T., 2013. Lunar domes: Properties and Formation Processes, Springer Praxis Books.

__Mare Vaporum,__ Leandro Sid, AEA, Oro Verde, Argentina. 23 November 2020 02:00 UT. 1250 mm x 90 mm - Meade StarNavigator NG 90 mm Maksutov-Cassegrain telescope, Samsung Galaxy J7 Prime 2 camera.

In the Land of Astrophysicists
David Teske

In the far northwest of the Moon, near the limb, is a trio of craters that are named after great astrophysicists of the past. Russell and Struve are joined together in one large flooded plain. Russell is the smaller, more northerly of these plains with a diameter of 103 km. Named after Henry Norris Russell, this American astronomer co-authored the Hertzsprung-Russell diagram that provided astronomers a relationship between a star's color and brightness. Struve, just south of Russell is the remains of a flooded walled plain with a diameter of 164 km. Struve was named for three generations of the family. Friedrich G. Wilhelm von Struve, who lived from 1793 to 1864 was the German-Russian astronomer who was the director of the Pulkovo Observatory. He observed double stars which allowed astronomers an opportunity to determine the masses of stars. Just east of Struve is Eddington. Again, a flooded walled plain, Eddington has a diameter of 118 km. Eddington was the English astrophysicist and mathematician Sir Arthur S. Eddington, who studied the internal structure of stars and relativity.

__Struve,__ David Teske, Louisville, Mississippi, USA. 01 October 2020 03:39 UT, colongitude 77.0º. 4 inch f/15 Skylight refractor telescope, IR block filter, ZWO ASI 120mm/s camera. Seeing 7/10.



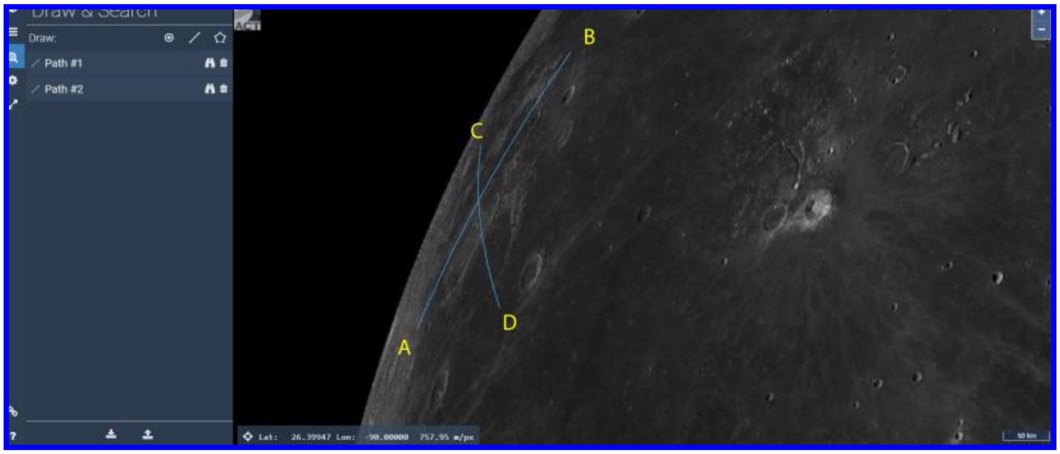


***Figure** 2 LROC elevations explored..*

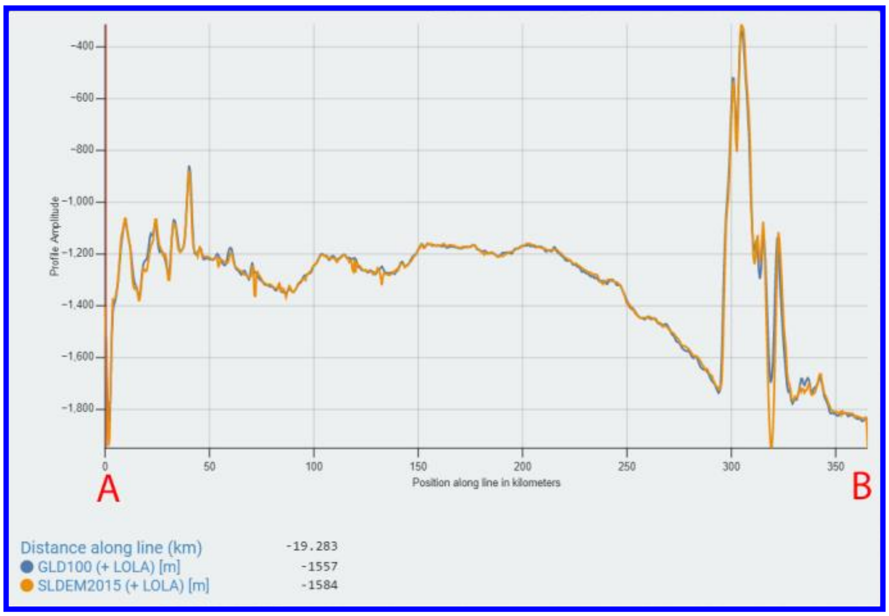


***Figure 3** LROC path A-B. Struve to Russell.*

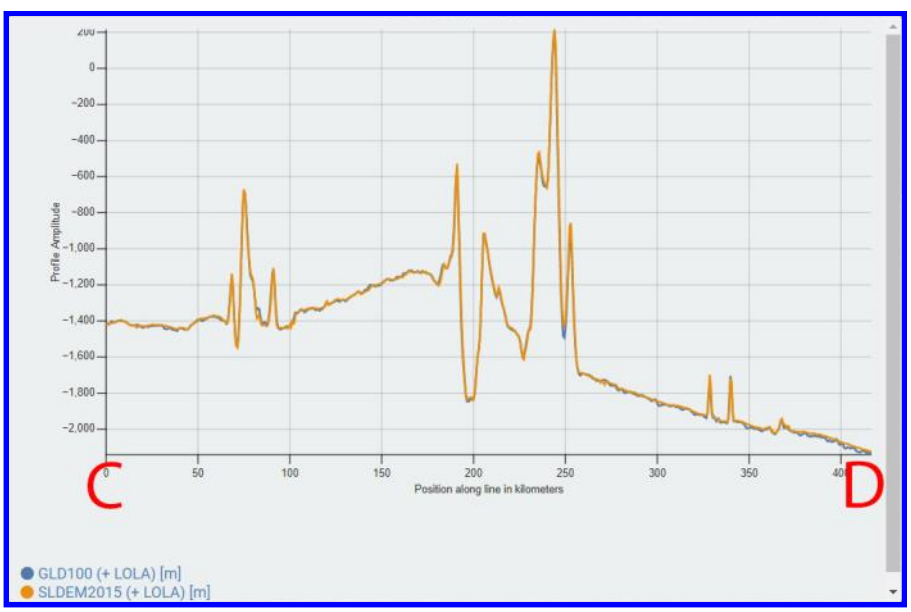


***Figure 4** LROC path CD Struve to Eddington.*

These three craters not only have the common trait of being named for astrophysicists but also being very flat. Looking at the LROC images (Figure 2), traveling northwards along line AB (figure 3) shows that indeed, Struve and Russell are very flat with a slope downwards towards the north. Likewise, line CD (figure 4) shows a very flat terrain moving from northwest to southeast, with a downward slope in Eddington towards Oceanus Procellarum.

Just out in the "ocean" from Eddington is Seleucus, a 43 km diameter crater with terraced walls and a small central peak. The eastern wall of Seleucus are covered by fresh rays from Glushko. About halfway between Seleucus and Vallis Schröteri is Schiaparelli with a diameter of 24 km. It appears that another ray from Glushko is on the southern rim of this crater. Just east of Russell is the 37 km wide crater Briggs. Briggs is easily identifiable as it has a central mountain ridge that runs north to south.

South of Eddington in very far western Oceanus Procellarum lie two twin craters. Northernmost is Krafft, a 51 km diameter crater with sharp walls. Just south of Krafft is the 49 km wide crater Cardanus. Cardanus again is a sharp-edged crater with a small central peak. The 60 km span between Cardanus and Krafft is spanned by Catena Krafft. This catena is made of heavily eroded overlapping craterlets whose diameter decreases from south to north. This chain of craters runs onto the floor of Krafft (figure 5).

Figure 5 *LRO Catena Krafft.*

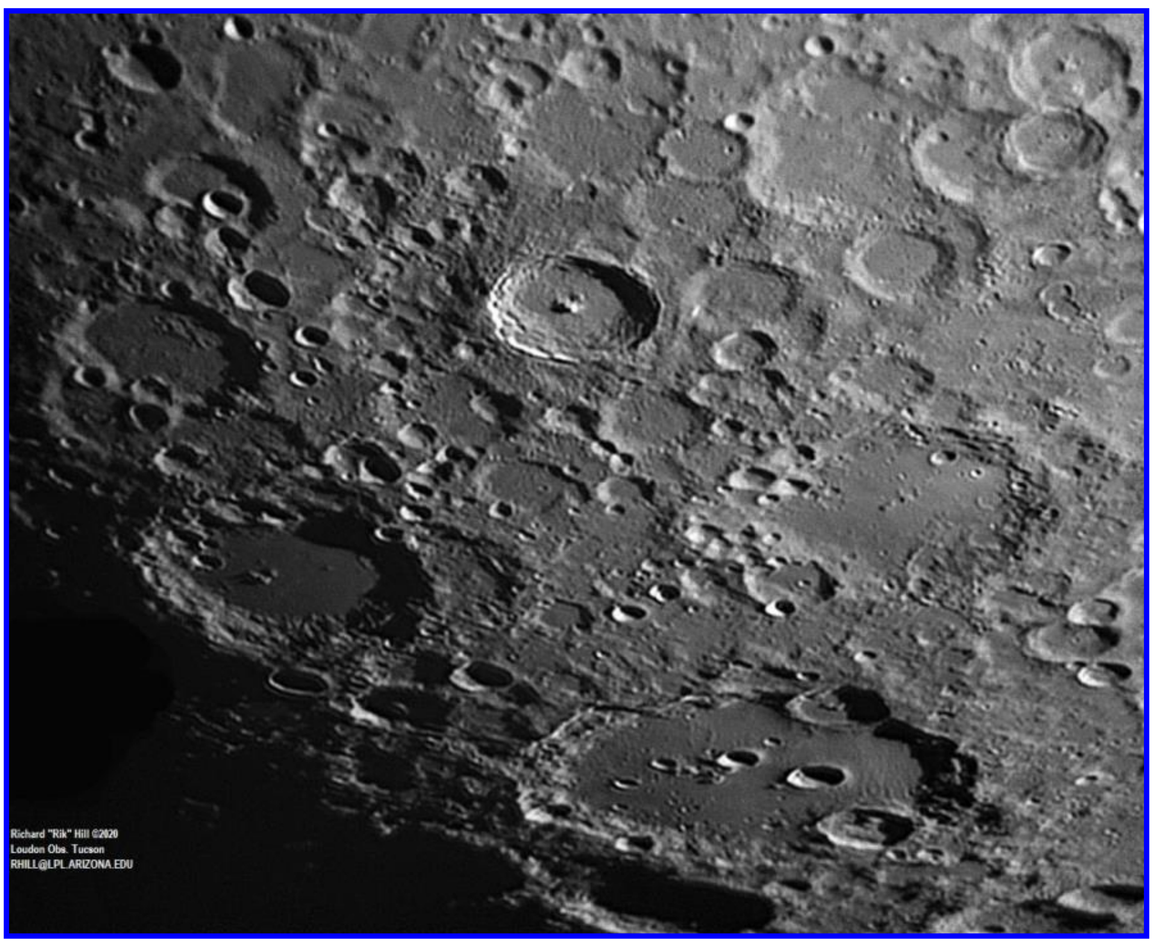
A Wet Place?

Rik Hill

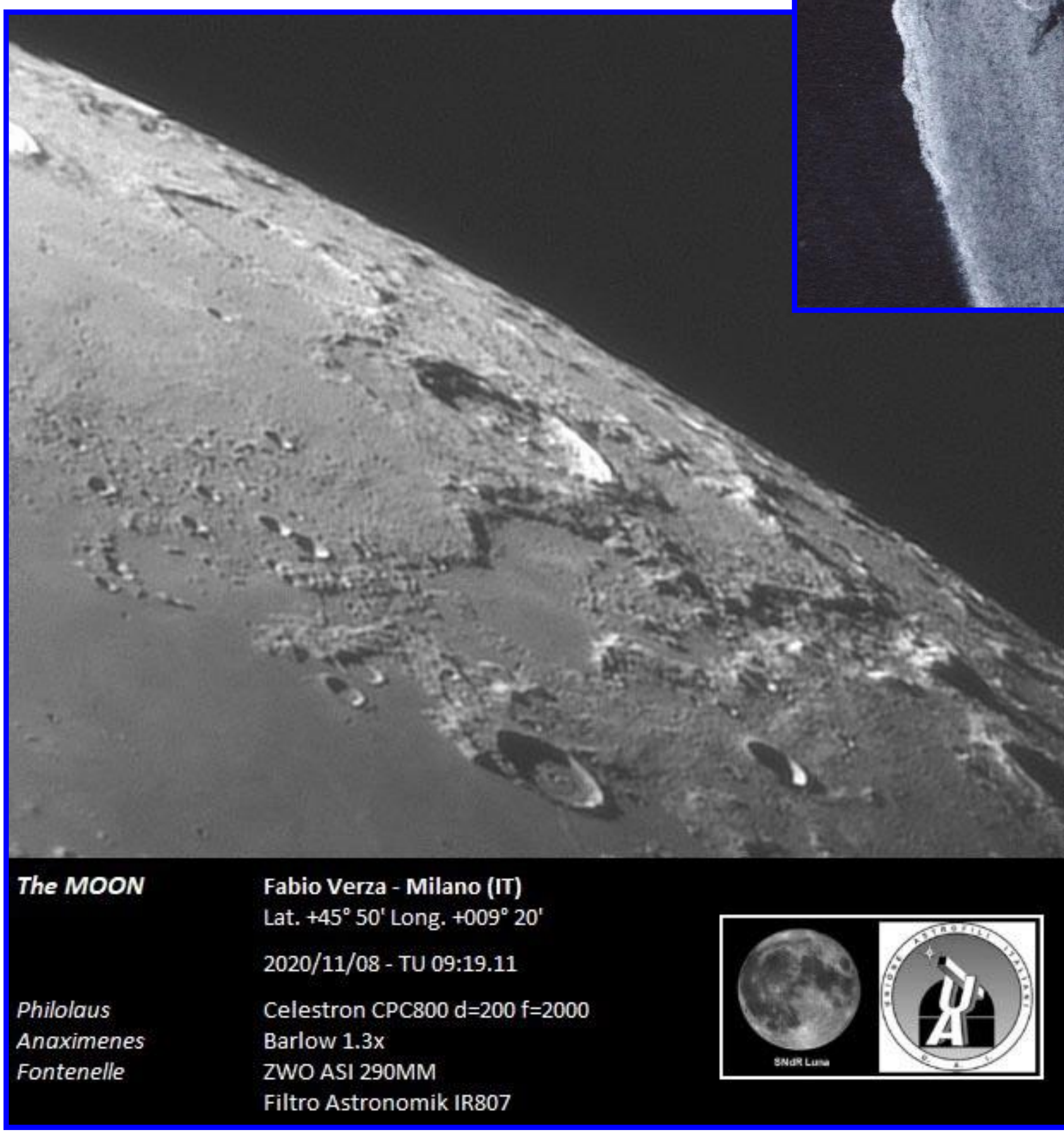
How many times have you looked at this monster crater, Clavius (231 km)? Ever feel thirsty? It was recently reported (10/26) in *Nature Astronomy* that water molecules were detected in this crater by the Stratospheric Observatory for Infrared Astronomy, or SOFIA. Water molecules have been detected before in permanently shadowed areas on the moon but not in sunlit areas like this. SOFIA consists of a 2.5-meter telescope in a 747SP jet that flies in the stratosphere to get above over 90% of the Earth's atmospheric water vapor. It detected the infrared signal of water in this crater at 6.1 microns wavelength. The trapping mechanism for this water is not yet known, whether locked in micrometeorite impact glasses or between soil grains. The concentration is between 100-412 parts per million (ppm) about 1% what you would find in the driest places on the earth. Not much but could be harvested by future inhabitants.

Also, in this image we see the crater Tycho (88 km) above center with its terraced walls and nice central peaks. It's the youngest large crater in this image less than a billion years old. Below it, at the bottom edge of this image is Clavius, where the water molecules were detected. I wish I knew exactly where in this crater was the detection. To the lower left of Tycho another large crater, Longomontanus (150 km) with the curious off-center central peaks and to the lower right is Maginus (168 km), in a little rougher shape! The region of Tycho satellite craters to the upper left of the main crater is worthy of a night's study. Many morphologies there.

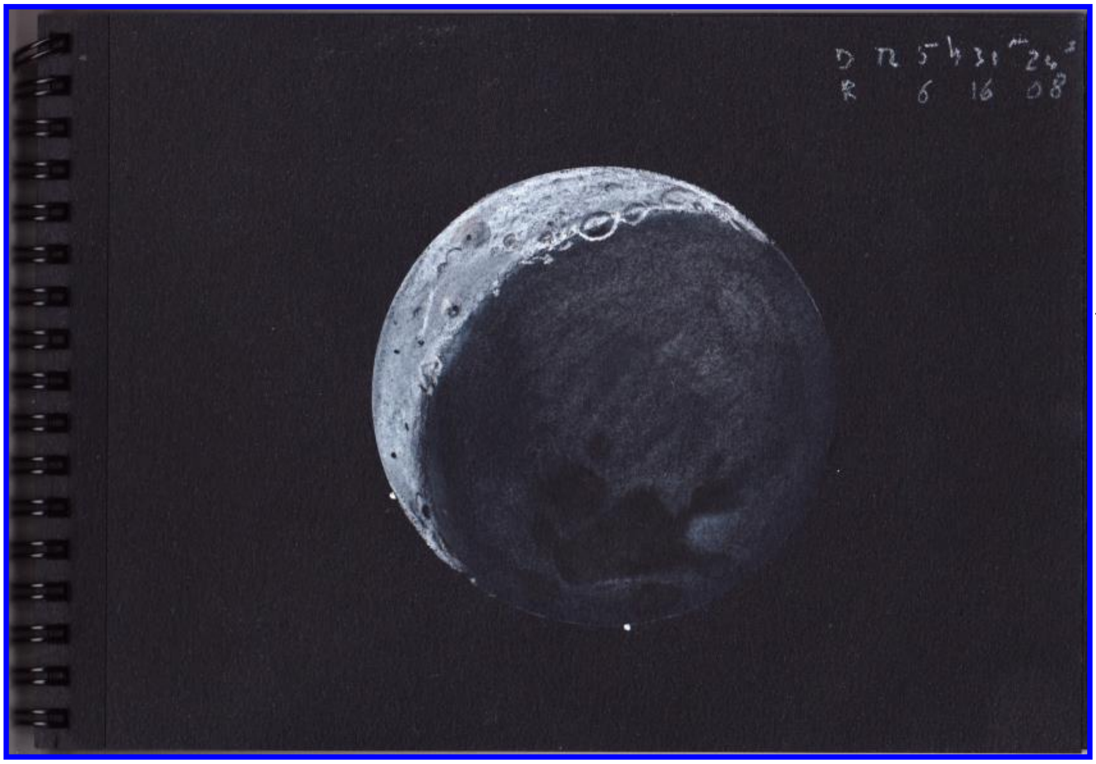
Tycho to Clavius, *Richard Hill, Loudon Observatory, Tucson, Arizona, USA. 25 November 2020 03:18 UT colongitude 29.2°. 6 inch Dynamax Schmidt-Cassegrain telescope, 2 x Barlow, 665 nm filter, Celestron Skyris 132M camera. Seeing 8-9/10.*



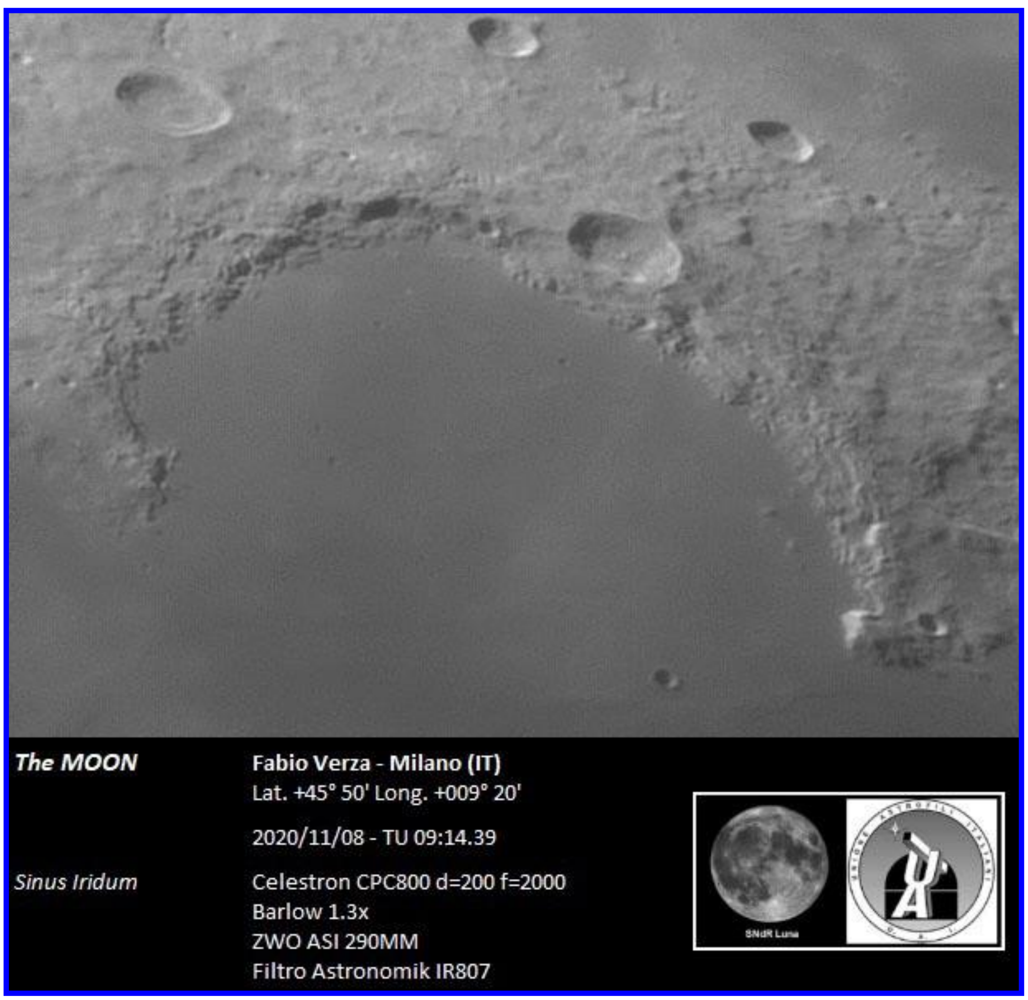
Grimaldi, *Michel Deconinck, Aquarellia Mobile Observatory from the area of "Le Poil" in the French Alps. 13 September 2020 03:30 UT. Bresser refractor telescope, 102 mm, 1000 mm fl. 145 x.*



Philolaus, *Fabio Verza, SNdR Lunar, Milan, Italy. 08 November 2020 09:19 UT. Celestron CPC800 Schmidt-Cassegrain telescope, 1.3 x barlow, Astronomik IR807 filter, ZWO ASI 290 MM camera.*



***Grimaldi,** Michel Deconinck, Aquarellia Mobile Observatory from the area of "Le Poil" in the French Alps. 14 September 2020 03:31 UT. Bresser refractor telescope, 102 mm, 1000 mm fl. 40 x.*



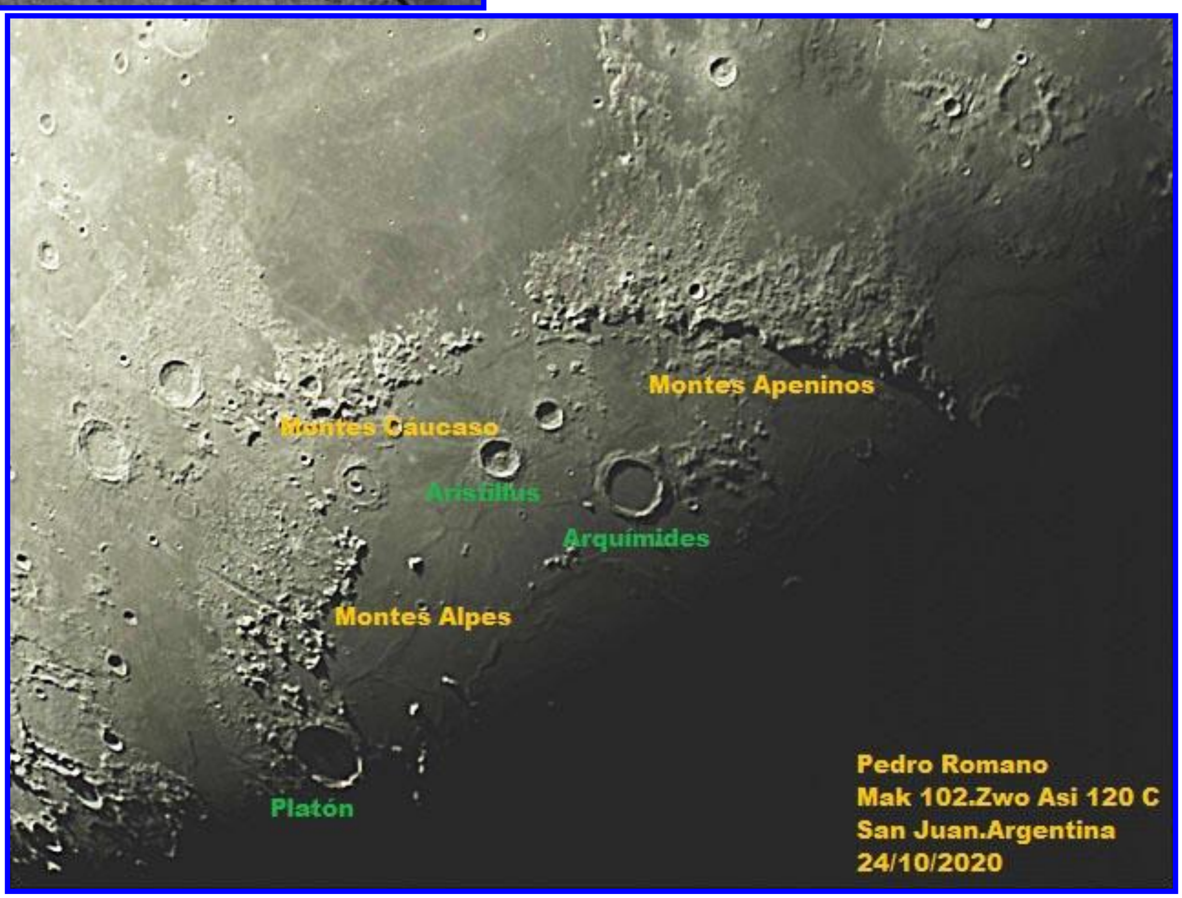
***Sinus Iridum,** Fabio Verza, SNdR Lunar, Milan, Italy. 08 November 2020 09:14 UT. Celestron CPC800 Schmidt-Cassegrain telescope, 1.3 x barlow, Astronomik IR807 filter, ZWO ASI 290 MM camera.*

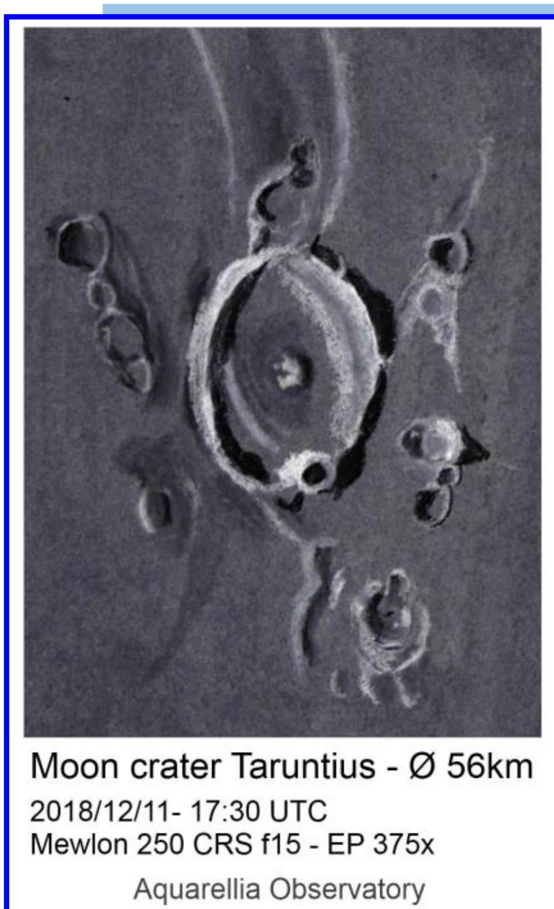
Grimaldi, *Michel Deconinck, Aquarellia Mobile Observatory from the area of "Le Poil" in the French Alps. 15 September 2020 04:00 UT. Bresser refractor telescope, 102 mm, 1000 mm fl. 145 x.*

Montes Apenninus, *Pedro Romano, San Juan, Argentina. 24 October 2020 04:24 UT. 102 mm Maksutov-Cassegrain telescope,*

Serpentine Ridge, Michel Deconinck, Aquarellia Mobile Observatory from the area of "Le Poil" in the French Alps. 05 April 2018 20:00 UT, colongitude 150.1°. Mewlon CRS (Dall Kirkham) 250mm f/10, Ethos 13mm eyepiece, 192x magnification, pastels Conté grey, black and white + blending stump on Canson paper 240gr black. North/Up, East/Right.

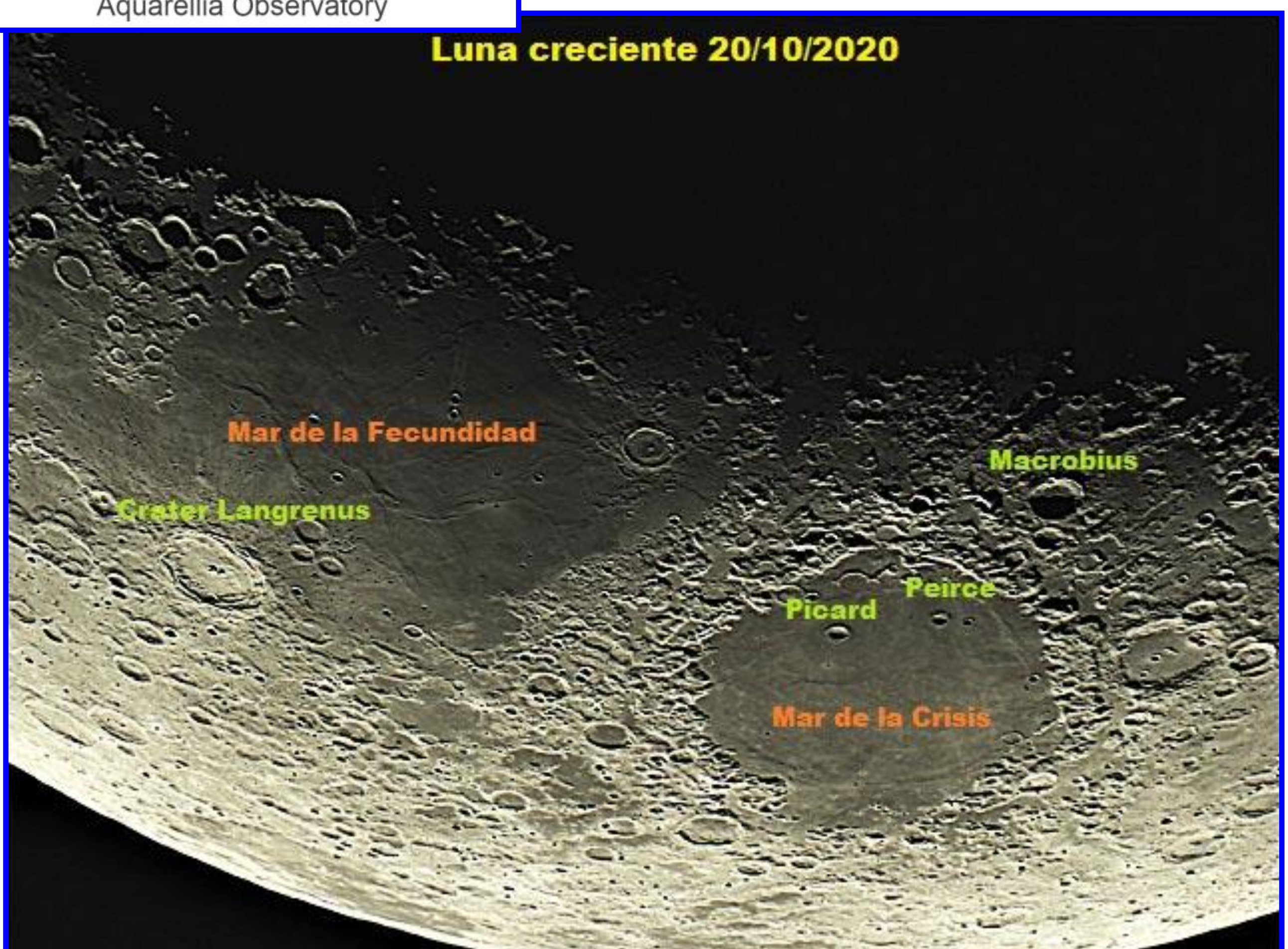
Archimedes, *Pedro Romano, San Juan, Argentina. 24 October 2020 01:24 UT. 102 mm Maksutov-Cassegrain telescope, ZWO ASI 120 camera.*





Taruntius, *Michel Deconinck, Aquarellia Mobile Observatory from the area of "Le Poil" in the French Alps. 05 April 2018 20:00 UT, colongitude 150.1º. Mewlon CRS (Dall Kirkham) 250mm f/15375 x.*

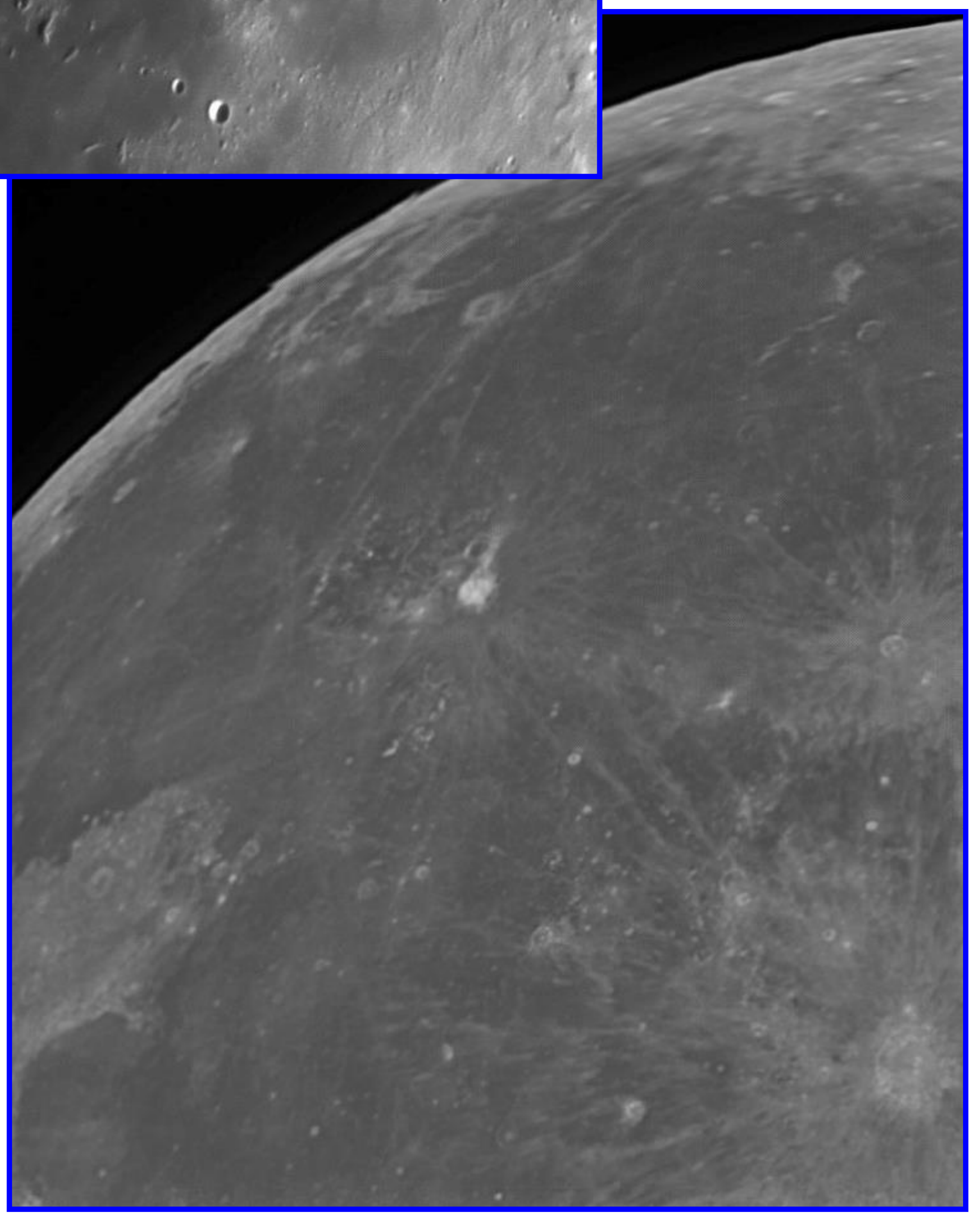
Macrobius, *Pedro Romano, San Juan, Argentina. 20 October 2020 02:20 UT. 102 mm Maksutov-Cassegrain telescope, ZWO ASI 120 camera.*



Mare Crisium, *Pedro Romano, San Juan, Argentina. 24 October 2020 05:20 UT. 102 mm Maksutov-Cassegrain telescope, ZWO ASI 120 camera.*

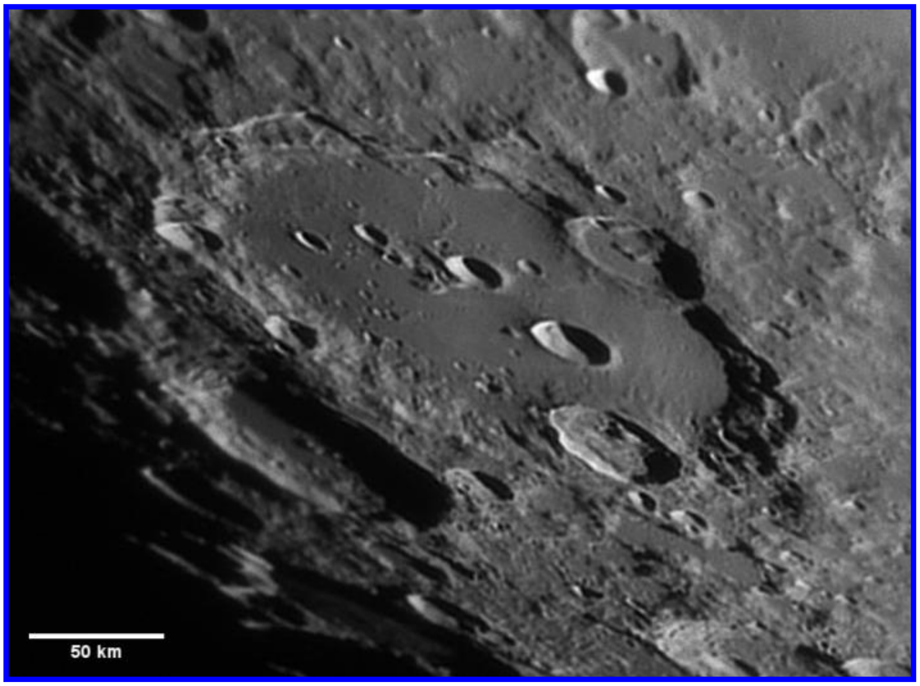
Aristillus, Cassini, Montes Caucasus, Eudoxus, Aristoteles, Montes Alpes, Rima, Vallis Alpes, *Ariel Cappelletti, Córdoba, Argentina, SLA. 26 October 2020 23:40 UT. 254 mm Newtonian reflector telescope, QHY5III 462c camera.*

Euclides, Montes Riphaeus, Lansberg and Reinhold, *Ariel Cappelletti, Córdoba, Argentina, SLA. 26 October 2020 23:47 UT. 254 mm Newtonian reflector telescope, QHY5III 462c camera.*



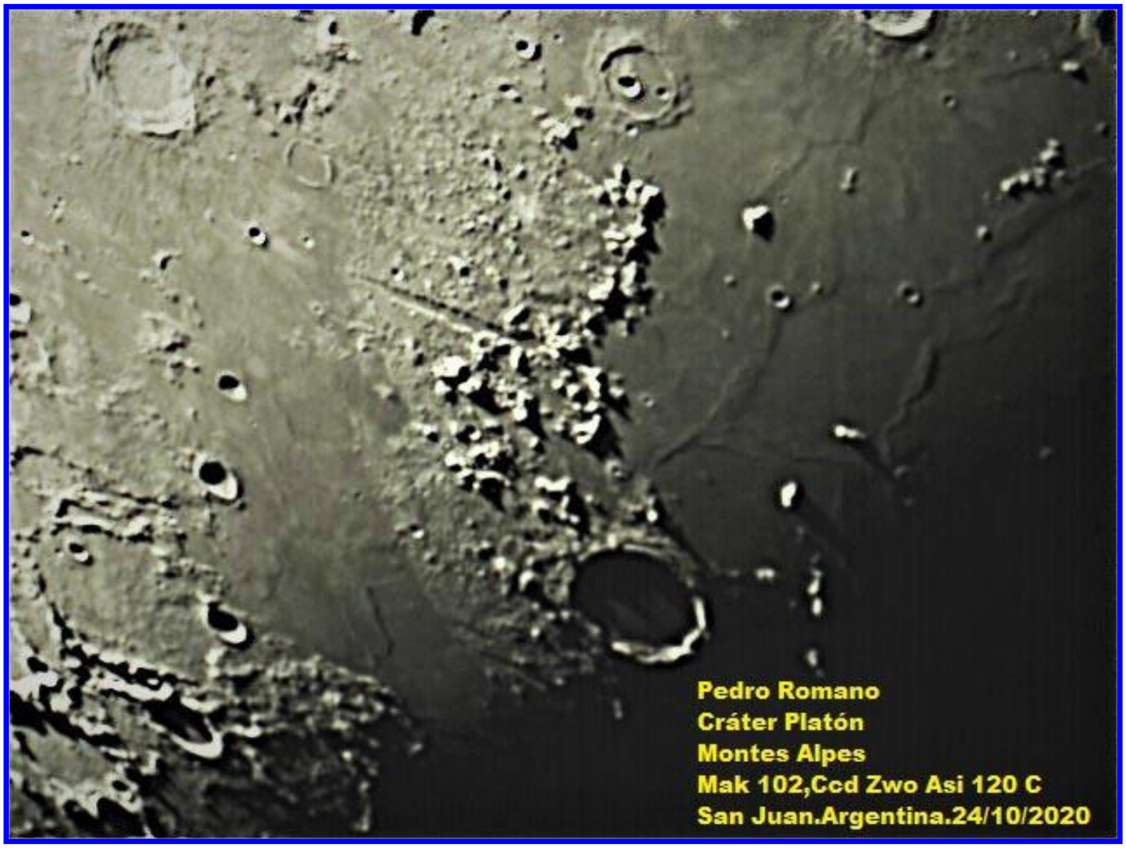
Aristarchus, *Juan Manuel Biagi, Paraná, Argentina. 01 November 2020 04:20 UT. 180 mm Newtonian reflector telescope, QHY5-II camera.*

Waning Gibbous Moon and Mars, *Jairo Chavez, Popayán, Colombia. 03 October 2020 03:45 UT. Konus 114 mm reflector telescope, Moto E5 PLAY.*



Clavius, *Ariel Cappelletti, Córdoba, Argentina, SLA. 26 October 2020 23:45 UT. 254 mm Newtonian reflector telescope, QHY5III 462c camera.*

Stevinus, *Román García Verdier, Paraná, Argentina. 01 November 2020 04:33 UT. 180 mm Newtonian reflector telescope, QHY5 -II camera.*



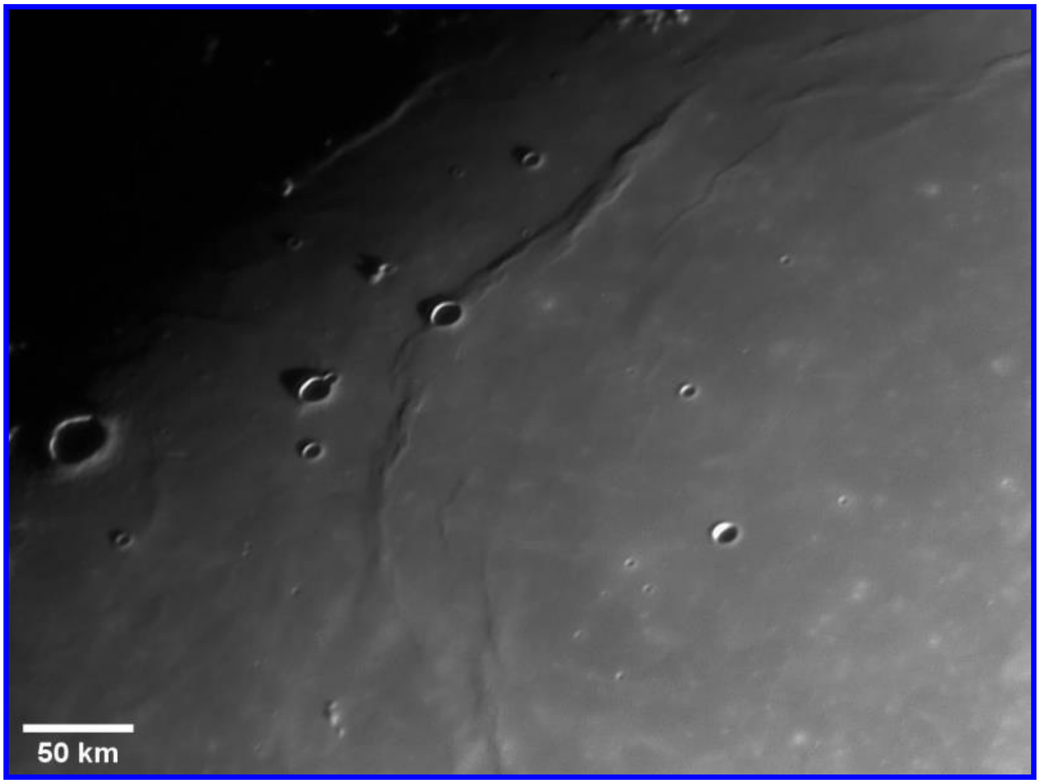
Plato, *Pedro Romano, San Juan, Argentina. 24 October 2020 06:24 UT. 102 mm Maksutov -Cassegrain telescope, ZWO ASI 120 camera.*

Atlas, *Juan Manuel Biagi, Paraná, Argentina. 01 November 2020 04:24 UT. 180 mm Newtonian reflector telescope, QHY5-II camera.*

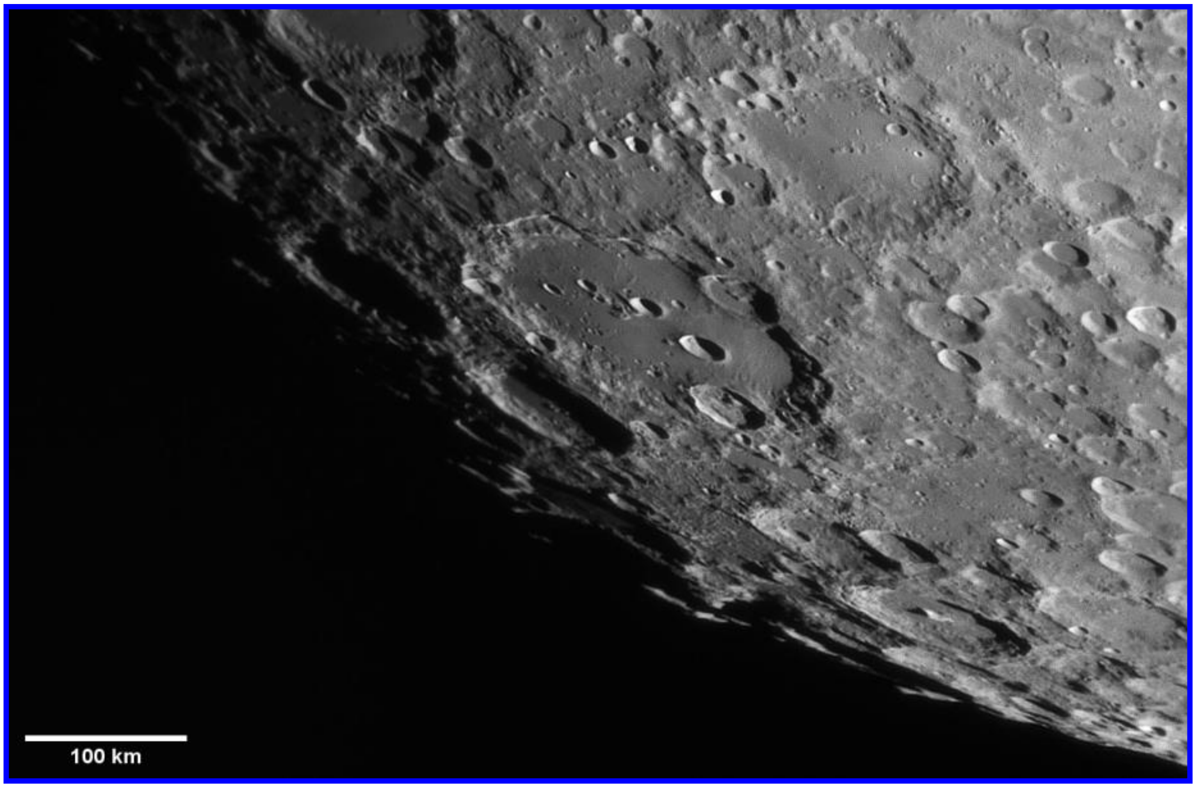
Plato, *Ariel Cappelletti, Córdoba, Argentina, SLA. 26 October 2020 23:46 UT. 254 mm Newtonian reflector telescope, QHY5III 462c camera.*

Last Quarter Moon, *Jairo Chavez, Popayán, Colombia. 09 November 2020 05:38 UT. Konus 114 mm reflector telescope, Moto E5 PLAY.*

Diophantus, *Ariel Cappelletti, Córdoba, Argentina, SLA. 26 October 2020 23:44 UT. 254 mm Newtonian reflector telescope, QHY5III 462c camera.*

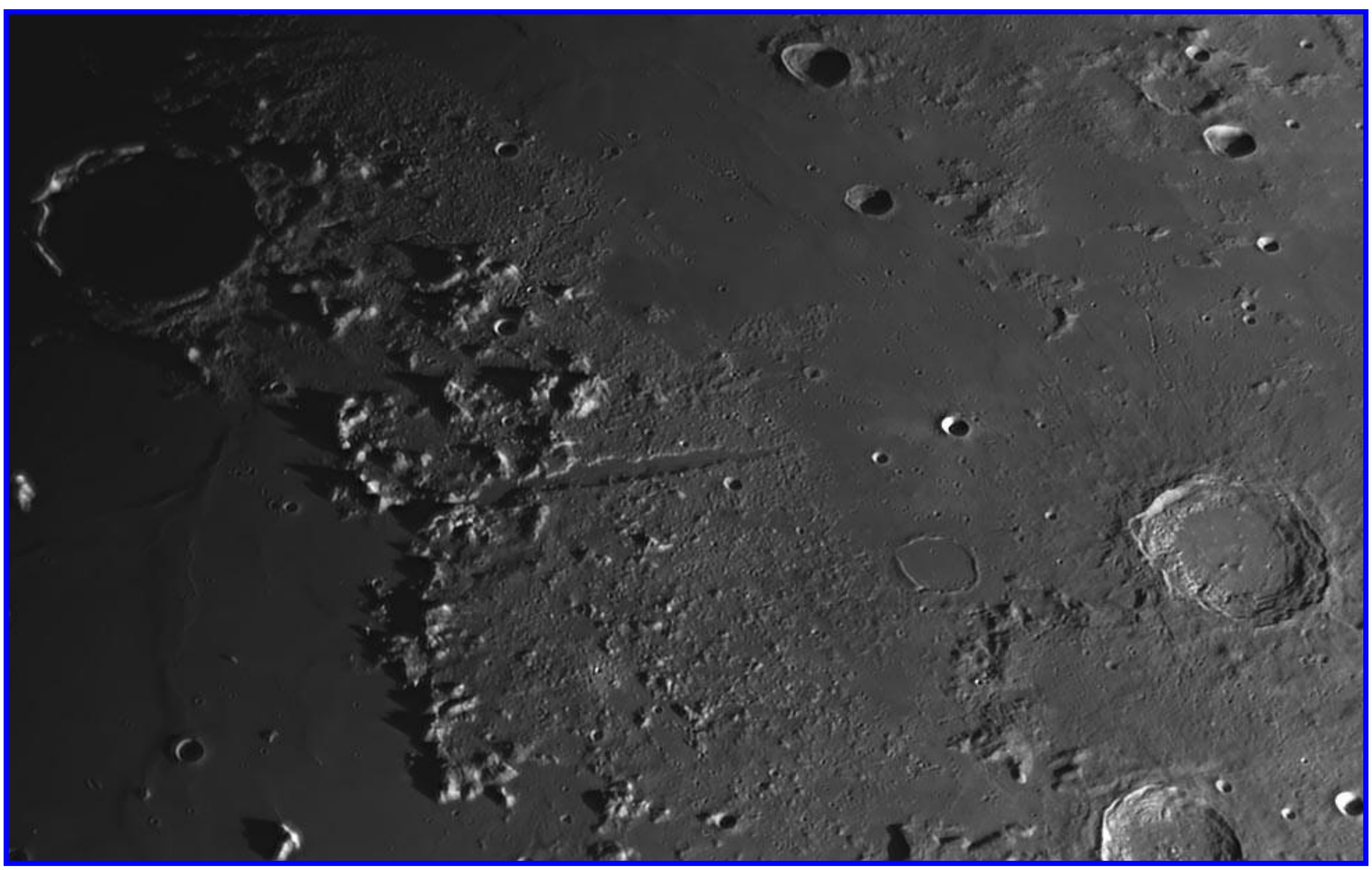


Proclus, *Román García Verdier, Paraná, Argentina. 01 November 2020 04:31 UT. 180 mm Newtonian reflector telescope, QHY5-II camera.*



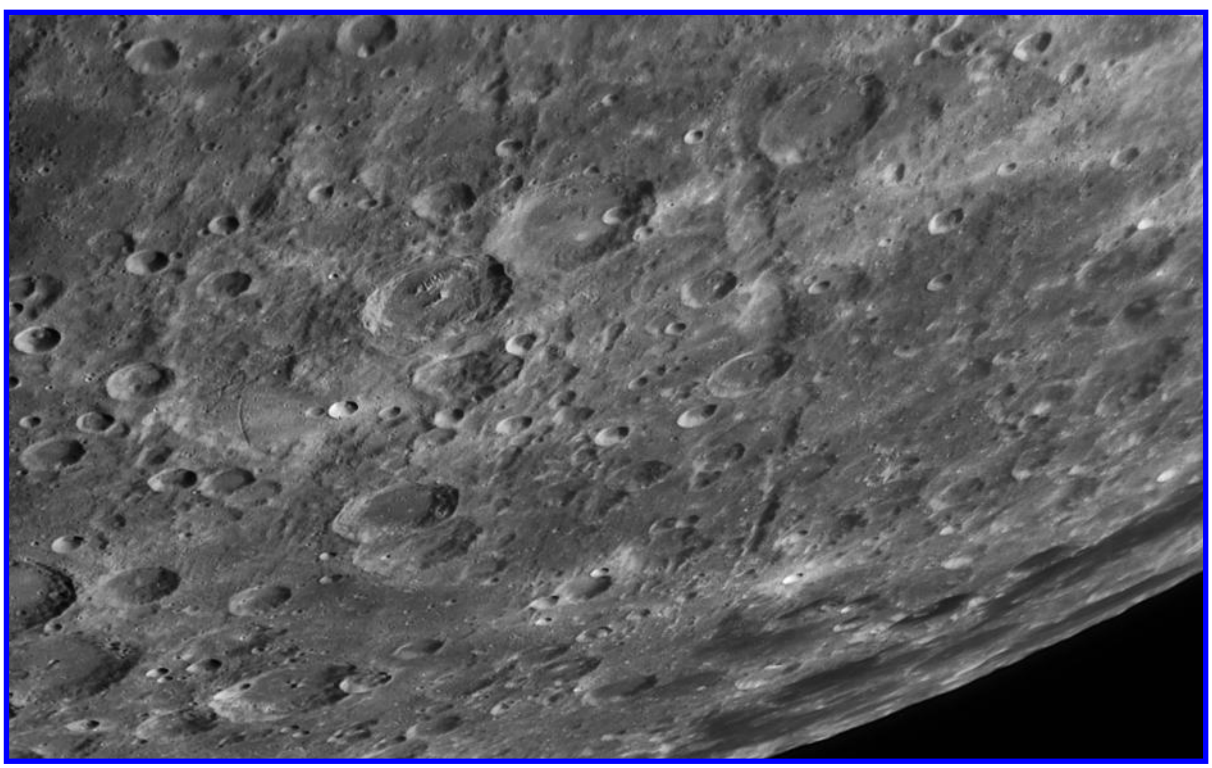
Clavius, *Ariel Cappelletti, Córdoba, Argentina, SLA. 26 October 2020 23:42 UT. 254 mm Newtonian reflector telescope, QHY5III 462c camera.*

Vallis Alpes, *Sergio Babino, Montevideo, Uruguay. 24 October 2020 22:47 UT. 203 mm catadrioptic telescope, ZWO ASI 174 mm camera.*

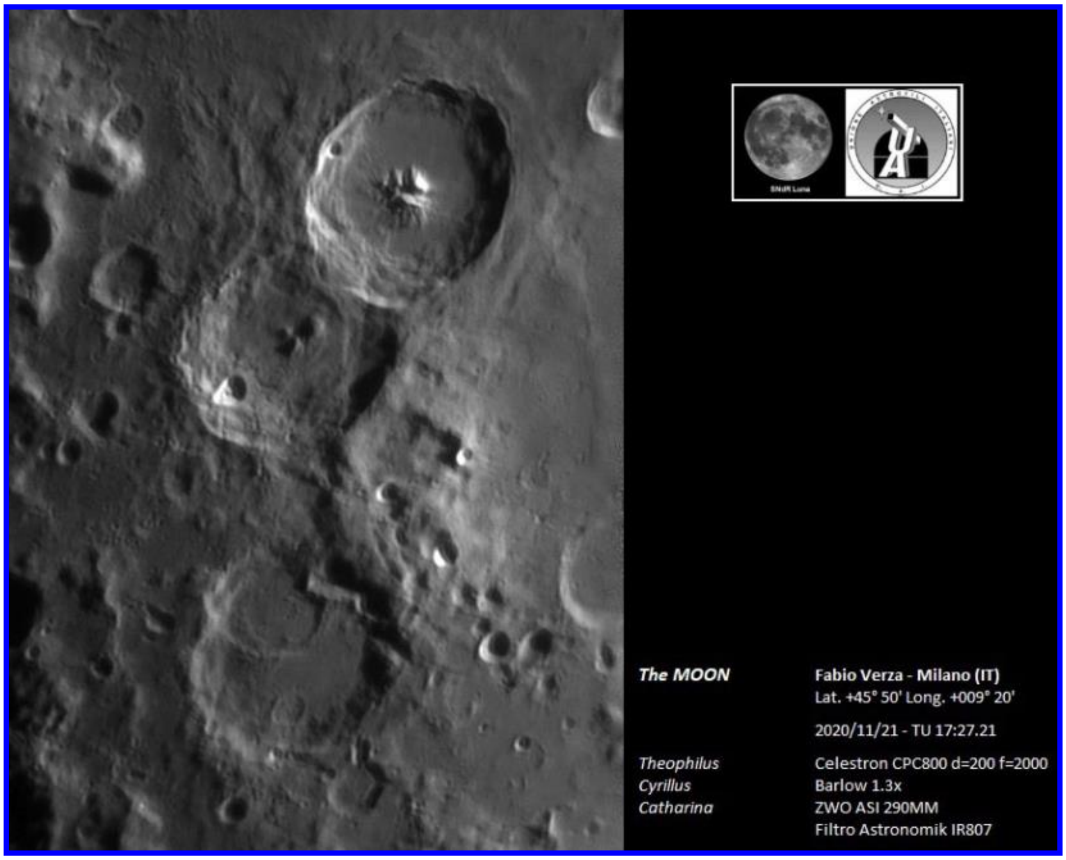


Petavius, *Román García Verdier, Paraná, Argentina. 01 November 2020 04:33 UT. 180 mm Newtonian reflector telescope, QHY5-II camera.*

Vallis Rheita, *Sergio Babino, Montevideo, Uruguay. 24 October 2020 22:31 UT. 203 mm catadrioptic telescope, ZWO ASI 174 mm camera.*



6.53 Day-Old Moon, *Fabio Verza, SNdR Lunar, Milan, Italy. 21 November 2020 17:44 UT. Celestron CPC800 Schmidt-Cassegrain telescope, 0.5 x reducer, Astronomik IR807 filter, ZWO ASI 290 MM camera. Mosaic of four photos.*



Theophilus, *Fabio Verza, SNdR Lunar, Milan, Italy. 21 November 2020 17:27 UT. Celestron CPC800 Schmidt-Cassegrain telescope, 1.3 x barlow, Astronomik IR807 filter, ZWO ASI 290 MM camera.*

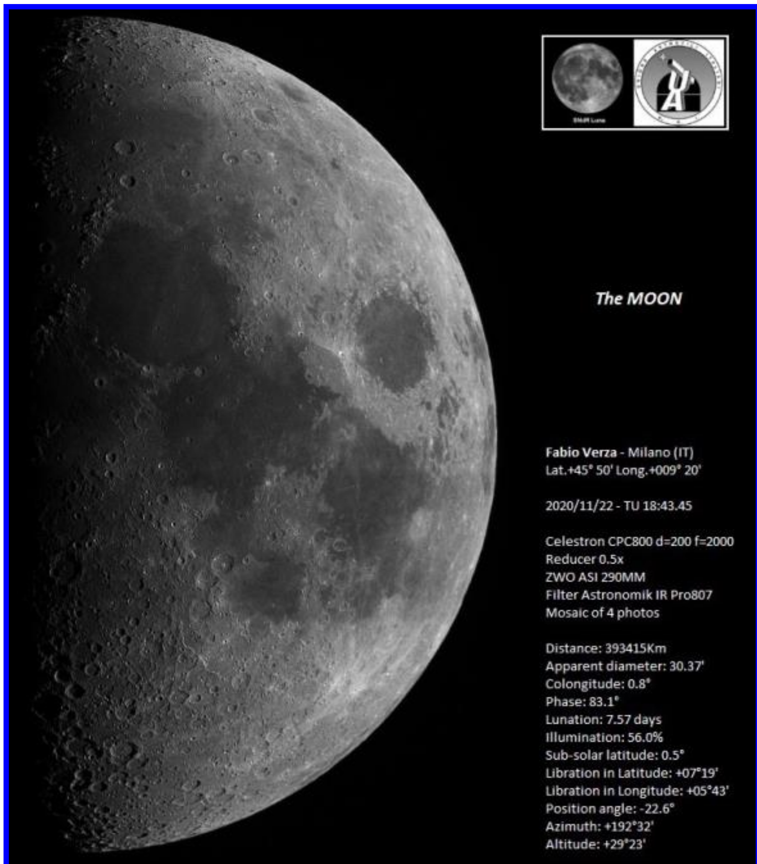
Waxing Gibbous Moon, *Leandro Sid, AEA, Oro Verde, Argentina. 23 November 2020 02:44 UT. 1250 mm x 90 mm - Meade StarNavigator NG 90 mm Maksutov-Cassegrain telescope, Samsung Galaxy J7 Prime 2 camera.*

Aristoteles, *Fabio Verza, SNdR Lunar, Milan, Italy. 21 November 2020 17:35 UT. Celestron CPC800 Schmidt-Cassegrain telescope, 1.3 x barlow, Astronomik IR807 filter, ZWO ASI 290 MM camera.*

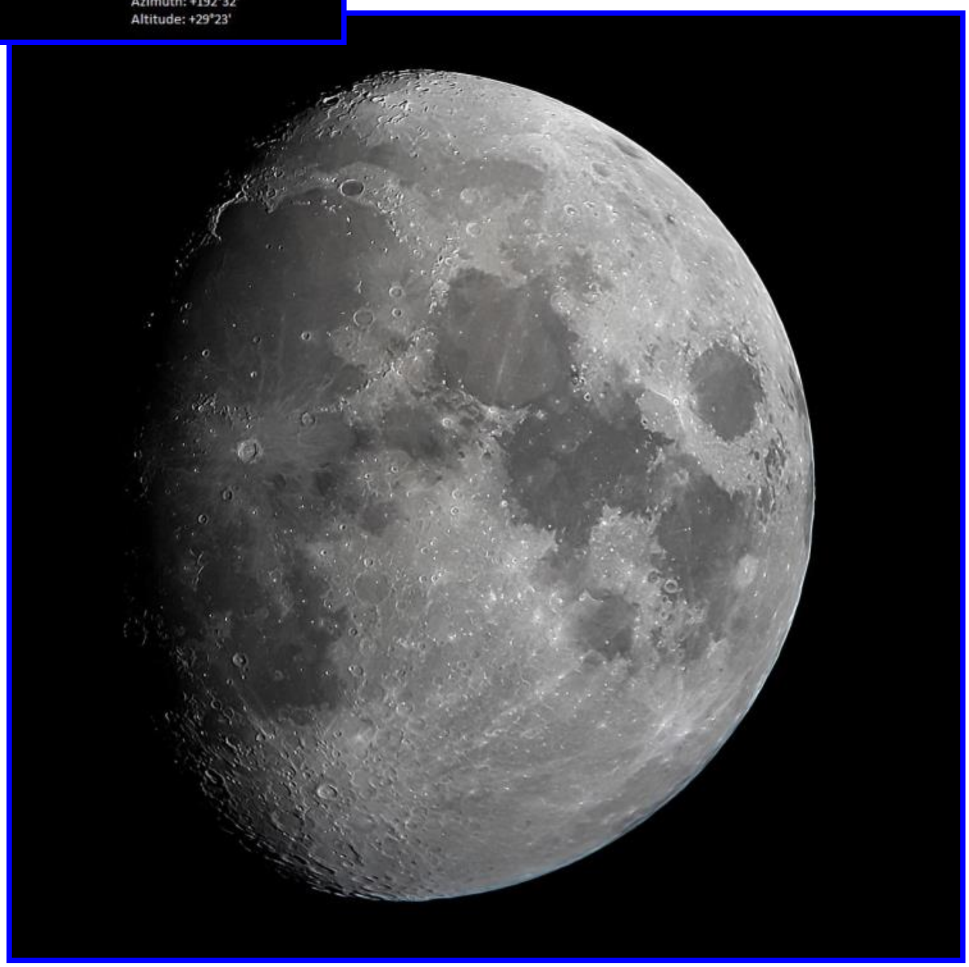
Alphonsus, *Leandro Sid, AEA, Oro Verde, Argentina. 23 November 2020 02:42 UT. 1250 mm x 90 mm - Meade StarNavigator NG 90 mm Maksutov-Cassegrain telescope, Samsung Galaxy J7 Prime 2 camera.*

Ariadaeus, *Fabio Verza, SNdR Lunar, Milan, Italy. 21 November 2020 17:31 UT. Celestron CPC800 Schmidt-Cassegrain telescope, 1.3 x barlow, Astronomik IR807 filter, ZWO ASI 290 MM camera.*

Bullialdus, *Leandro Sid, AEA, Oro Verde, Argentina. 26 November 2020 00:47 UT. 1250 mm x 90 mm - Meade StarNavigator NG 90 mm Maksutov-Cassegrain telescope, Samsung Galaxy J7 Prime 2 camera.*



7.57 Day-Old Moon, *Fabio Verza, SNdR Lunar, Milan, Italy. 22 November 2020 18:43 UT. Celestron CPC800 Schmidt-Cassegrain telescope, 0.5 x reducer, Astronomik IR807 filter, ZWO ASI 290 MM camera. Mosaic of four photos.*



Waxing Gibbous Moon, *Leandro Sid, AEA, Oro Verde, Argentina. 26 November 2020 02:01 UT. 1250 mm x 90 mm - Meade Star-Navigator NG 90 mm Maksutov-Cassegrain telescope, Samsung Galaxy J7 Prime 2 camera.*

Plato, *Leandro Sid, AEA, Oro Verde, Argentina. 26 November 2020 01:41 UT. 1250 mm x 90 mm - Meade StarNavigator NG 90 mm Maksutov-Cassegrain telescope, Samsung Galaxy J7 Prime 2 camera. (no hyperlink)*

Tycho, *Leandro Sid, AEA, Oro Verde, Argentina. 26 November 2020 01:17 UT. 1250 mm x 90 mm - Meade StarNavigator NG 90 mm Maksutov-Cassegrain telescope, Samsung Galaxy J7 Prime 2 camera.*

Lunar Geologic Change Detection Program

Coordinator Dr. Anthony Cook- atc@aber.ac.uk
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2020 December

Introduction: In the set of observations received in the past month, these have been divided into three sections: Level 1 is a confirmation of observation received for the month in question. Every observer will have all the features observed listed here in one paragraph. Level 2 will be the display of the most relevant image/sketch, or a quote from a report, from each observer, but only if the date/UT corresponds to: similar illumination (±0.5º), similar illumination and topocentric libration report (±1.0º) for a past LTP report, or a Lunar Schedule website request. A brief description will be given of why the observation was made, but no assessment done – that will be up to the reader. Level 3 will highlight reports, using in-depth analysis, which specifically help to explain a past LTP, and may (when time permits) utilize archive repeat illumination material.

LTP reports: No Additional LTP reports have been received for October. Concerning Luigi Morrone (UAI/BAA) candidate impact flashes reported in last month's newsletter, my PhD student, Daniel Sheward has now remeasured the coordinates of these and come up with :- flash 1 was at 37.5°W±0.3° 26.4°S±0.2°, and flash 2 was at 23.4°W±0.3°, 3.5°N±0.1°. He will also take a look at new NASA LROC images once these are released into the public domain, in order to see if there is evidence of any new impact craters.

Stöfler: On 2020 Nov 22 UT 18:15-18:45 Trevor Smith (BAA) reported seeing a long slightly tapering grey band stretching across almost the whole of the floor of Stöfler, from west to east. This band resembled Jupiter's equatorial belt in appearance (darkness), was easy to see and did not look like a shadow. The band was slightly darker at its western end. No lighter streaks were seen to the floor of Stöfler or Faraday. No atmospheric spectral dispersion or obscurations were seen, though the seeing conditions were poor (Antoniadi IV). We shall put this into the Lunar Schedule website and see if it recurs.

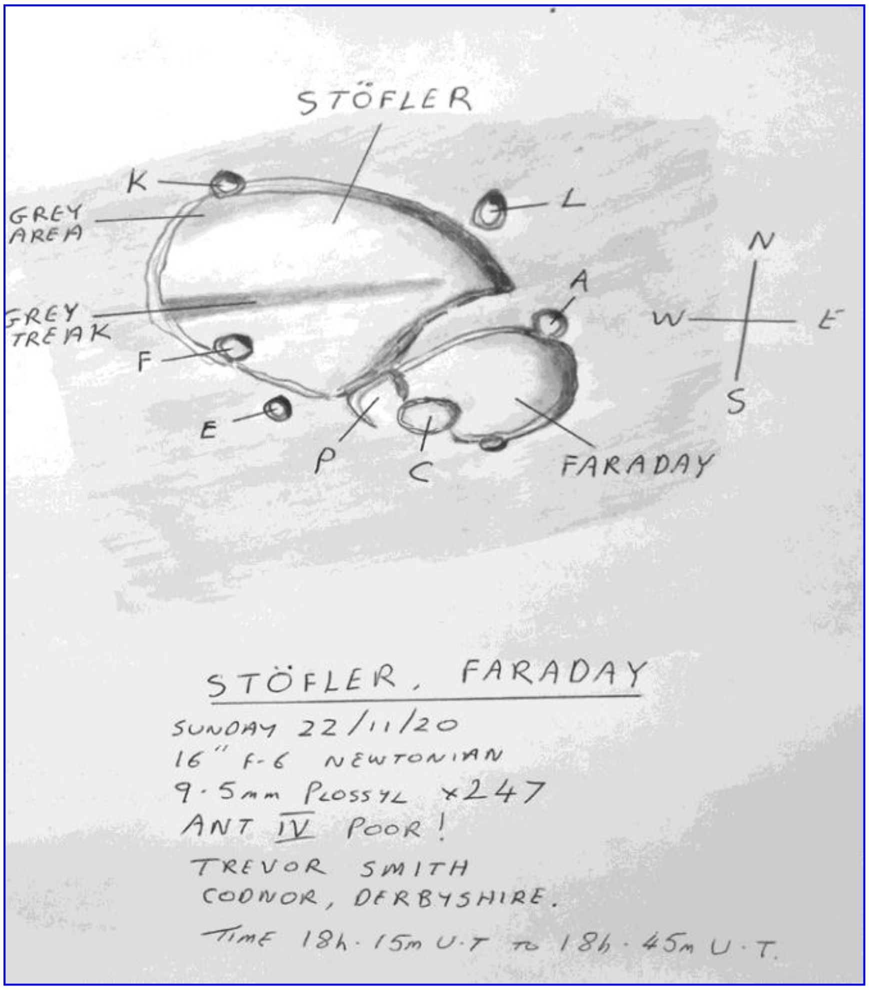

Figure 1. *Stöfler as sketched by Trevor Smith (BAA) on 2020 Nov 22 UT 18:15-18:45.*

News: I'd like to wish our readers a Happy Christmas / Happy Holidays. By the time you read this, the Chinese Chang'e 5 lander, will have hopefully landed on the Moon in the region on Mons Rumker. If you are interested, some radio amateurs have been following the telemetry from this probe: https://twitter.com/uhf_satcom Due to pressure of work, I've only had time to put one observation into Level 3 this month.

Level 1 – All Reports received for October: Jay Albert (Lake Worth, FL, USA - ALPO) observed/imaged: Aristarchus, Gassendi, Plato and Posidonius. Alberto Anunziato (Argentina - SLA) observed: Mons Piton, Montes Teneriffe, and Theophilus. Anthony Cook (Newtown, UK – ALPO/BAA/NAS) imaged several features. Maurice Collins (New Zealand – ALPO/BAA/RASNZ) imaged Aristoteles, Atlas, and several other features. Rob Davies (BAA/NAS) imaged earthshine. Daryl Dobbs (UK - BAA) observed: Bullialdus, Jansen, Plato, and Tycho. Fernando Ferri (Italy - UAI) imaged: Tycho. Les Fry (UK – NAS) imaged: Clavius, Fra Mauro, Pytheas, and Rupes Recta. Rik Hill (Tucson, AZ, USA – ALPO/BAA0 imaged: Alabtegnius, Hubble, Mare Vaporum, and Tycho. Davide Pistritto (Italy – UAI) imaged: Deluc H and Mare Frigoris. Leandro Sid (Argentina – AEA) imaged: Proclus and several features. Trevor Smith (UK – BAA) observed: Gassendi, Mare Crisium, Plato and Proclus. Franco Taccogna (Italy – UAI) imaged: Deluc H, Lichtenburg, Posidonius, and Tycho. Aldo Tonon (Italy – UAI) imaged: Herodotus. Ivor Walton (Cranbrook, UK – CADSAS) imaged: Mare Serenitatis and the whole lunar disk.

Level 2 – Example Observations Received :

Mare Frigoris: On 2020 Oct 10 UT 00:21 (estimated from the supplied selenographic colongitude) Davide Pistritto (UAI) imaged this area for the following Lunar Schedule request:

UAI Request: Mare Frigoris between Plato and Fontenelle (colongitude from 23-27deg or from 185-190deg), a study of the area by Maurizio Cecchini (member of the PNdR Luna UAI) for the confirmation of a probable volcanic dome in the area. The highest possible resolution achievable, with telescopes at least of 8" aperture or larger, is needed. All images, sketches and visual reports should be e-mailed to: u a i . l u n a . l g c @ g m a i l . c o m

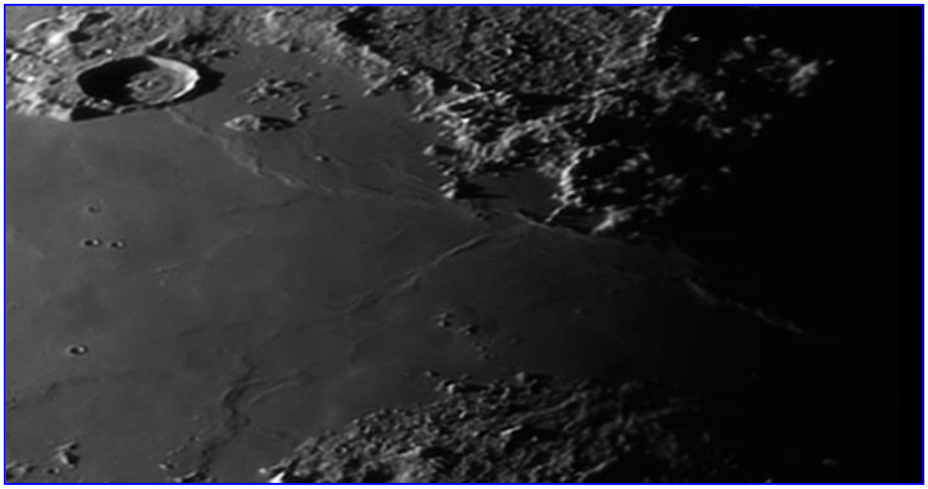

Figure 2. *Mare Frigoris as imaged by Davide Pistritto (UAI) and orientated with north towards the top.*

Davide's image (Fig 2) is interesting as it covers this region at sunset – most of the other observations received so far have been at local lunar sunrise.

Earthshine: On 2020 Oct 15 UT 06:50 Rob Davies (BAA/NAS) imaged the Moon under the following lunar schedule request:

BAA Request: Please try to image the Moon as a very thin crescent, trying to detect Earthshine. A good telephoto lens will do on a DSLR, or a camera on a small scope. We are attempting to monitor the brightness of the edge of the earthshine limb in order to follow up a project suggested by Dr Martin Hoffmann at the 2017 EPSC Conference in Riga, Latvia. This is quite a challenging project due to the sky brightness and the low altitude of the Moon. Please be very careful around sunrise so as not to be observing once the Sun has risen. Do not bother observing if the sky conditions are hazy. Any images should be emailed to: a t c @ a b e r . a c . u k

Figure 3. *The early morning crescent Moon on 2020 Oct 15 UT 06:50 as imaged by Rob Davies (BAA/NAS) and orientated with north towards the top.* ***(Left)*** *Original Image.* ***(Right)*** *Contrast stretched and blurred to bring out detail/ reduce noise in earthshine.*

Rima Hyginus: On 2020 Oct 24 UT 02:11 Rik Hill (ALPO) imaged (Fig 4) this crater under similar illumination to the following report:

Hyginus Cleft 1966 Jul 25 UT 04:40 observed by Kelsey (Riverside, CA, USA, 8" reflector, x300) "Points at opposite ends of cleft were very brilliant in red Wratten 25 filter & very dull in blue Wratten 47 filter. Richer uncertain if real LTP." NASA catalog weight=1. NASA catalog ID #957. ALPO/BAA weight=1.

Figure 4. Huygens and surrounds as imaged by Rik Hill (ALPO/BAA) on 2020 Oct 24 UT 02:11. Orientated with north towards the top.

Montes Teneriffe: On 2020 Oct 25 UT 03:00-03:25 Alberto Anunziato (SLA) sketched this formation under the following Lunar Schedule request:

BAA request: please image this area as we want to compare against a sketch made in 1854 under similar illumination. However if you want to check this area visually (or with a color camera) we would be very interested to see if you can detect some color on the illuminated peaks of this mountain range, or elsewhere in Mare Imbrium. Features to capture in any image (mosaic), apart from Montes Teneriffe, should include: Plato, Vallis Alpes, Mons Pico and Mons Piton. Any visual descriptions, sketches or images of Earthshine should be emailed to: a t c @ a b e r . a c . u k

Alberto comments that in the sketch (Fig 5) there were clearly a lot of shadows and bright spots, the ones marked with "X" were the brighter spots.

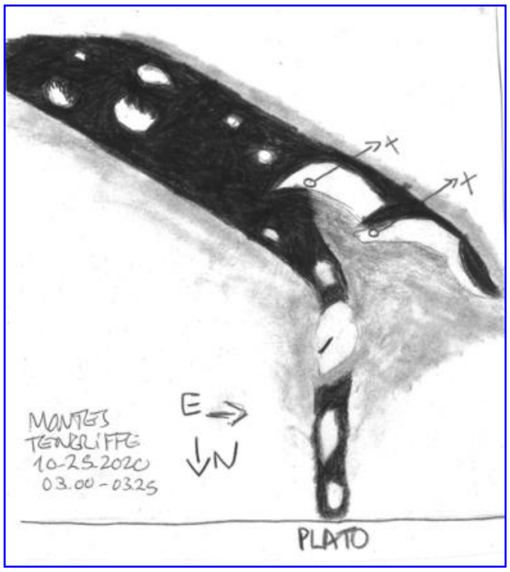

***Figure 5.** Montes Teneriffe as sketched by Alberto Anunziato on 2020 Oct 25 UT 03:00-03:25. Orientation as indicated in the sketch.*

Tycho: On 2020 Oct 25 UT 19:18 veteran UAI observer Fernando Ferri imaged (Fig 6) the Moon following a Lunar Schedule request:

BAA Request: Can you see any sign of "greyness" inside the shadow on the floor of Tycho? This is possibly due to scattered light off of the illuminated walls of Tycho. Minimum sized aperture telescope to use should be an 8" reflector. Any visual descriptions, sketches or slightly over exposed images should be emailed to: a t c @ a b e r . a c. u k

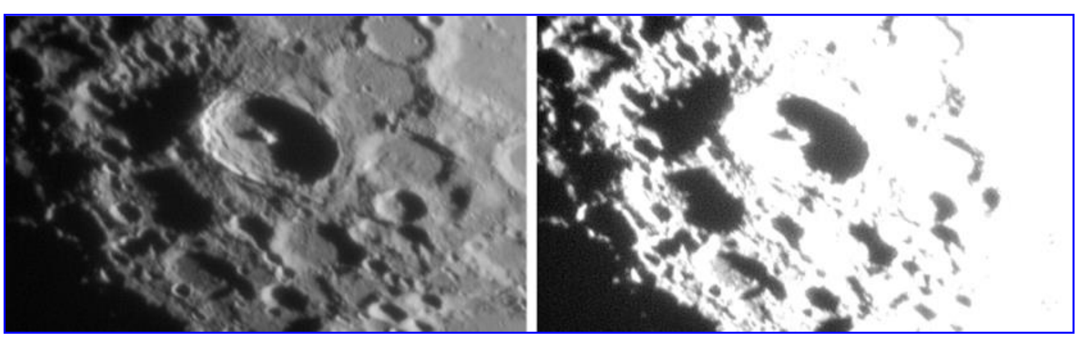

***Figure 6.** Tycho as imaged by Fernando Ferri (UAI) on 2020 Oct 25 UT 19:18. **(Left)** raw image. **(Right)** Image contrast stretched to see inside the shadows.*

The Lunar Schedule request corresponds to a LTP report by Gerald North from 1995 Mar 10 UT 20:00-23:34:

Tycho observed by G. North (UK) seen to have greyness inside parts of its shadow. Confirmed by J.D. and M.C. Cook. Possibly light scattered of illuminated wall into shadow or highland starting to break through the shadow. ALPO/BAA weight=1.

Purbach: On 2020 Oct 25 UT 20:10 les Fry (NAS) imaged (Fig 7) the area around this crater under similar illumination to the following report:

Purbach 1976 Nov 30 UT 19:40 T. Flynn (Edinburgh, UK, 29cm reflector, Wratten 25 and 44a filters) observed that the crater interior was better see through a red filter than a blue. ALPO.BAA weight=1.

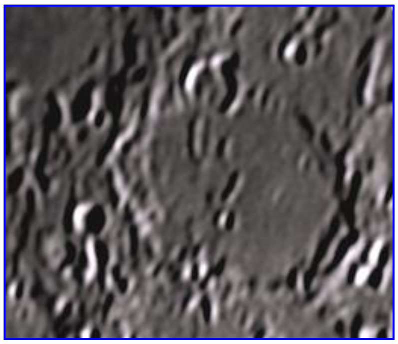

Figure 7. *Purbach from a larger image, obtained by Les Fry (NAS) on 2020 Oct 25 UT 20:10.*

Tycho: On 2020 Oct 26 UT 19:24-19:50 Daryl Dobbs (BAA) observed/sketched (Fig 8) this crater under similar illumination top the following report:

Tycho 1998 Feb 06 UT 22:48-22:54 R. Braga (Corsica (MI), Italy, 102mm f8.8 refractor, x180, with diagonal, Wratten 23A, 80A and an OR5 filter, seeing II, Transparency good). Observer noticed that the floor darkened towards the NW (IAU), particularly with the blue Wratten 80A filter. The ALPO/BAA weight=2.

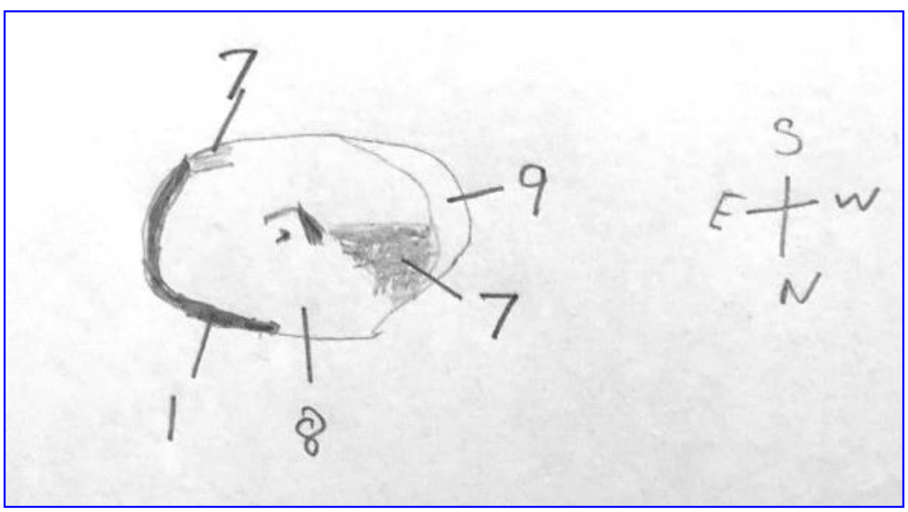

Figure 8*. Tycho as sketched by Daryl Dobbs (BAA) on 2020 Oct 26 UT 19:24-19:50. Orientation is as depicted in the image.*

Daryl comments: "*An area of the crater floor was observed to be darker than the rest of the floor when using the blue filter, not so noticeable when using the red. Interestingly visible when using the yellow and green filter but more noticeable in blue. Still noticeable without filters . The area was from the base of the central peak reaching to the North West wall. The attached sketch gives the tones using the Elgar scale. The dark area was roughly triangular with the apex touching the base of the western side of the central peak. There was also an area of similar shade on the South Eastern inner wall. If the dark feature on the floor was what the observer above seen in my opinion it looks like that normally."*

Posidonius: On 2020 Oct 26 UT 20:20 Franco Taccogna (UAI) imaged (Fig 9) this crater under similar illumination to the following report:

On 1997 Dec 09 at UT 18:42-19:02 P. Salimbeni (Cugliate Fabiasco, Italy, 20cm reflector) observed color on the northern edge of the crater - 23A filter used. This is a UAI reported observation and has come from this organisation's web site. The ALPO/BAA weight=3.

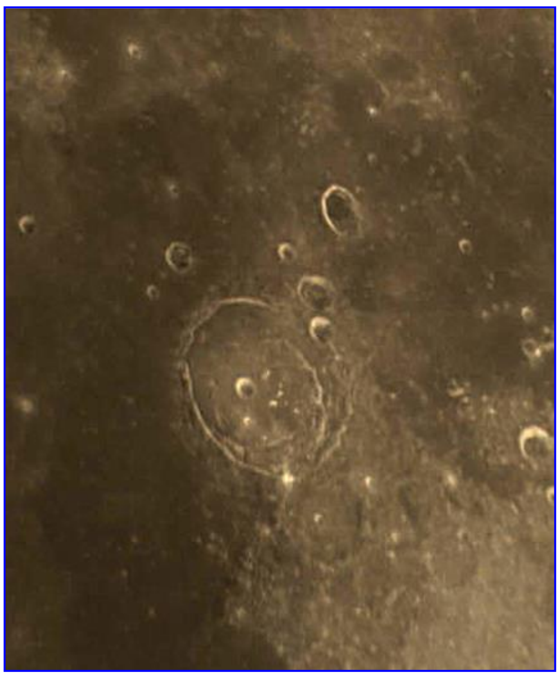

Figure 9. *Posidonius in color as imaged by Franco Taccogna (UAI) on 2020 Oct 26 UT 20:20 and orientated with north towards the top. Color saturation has been enhanced.*

Proclus: On 2020 Oct 26 UT 23:22 Leandro Sid (AEA) imaged (Fig 10) this area under similar illumination to the following Patrick Moore report:

On 1984 Jul 08 at UT 20:10-22:05 P. Moore (Selsey, UK, seeing IV-V) suspected that the floor of Proclus was slightly darker than normal. The Cameron 2006 catalog ID=249 and the weight=1. The ALPO/BAA weight=1.

Figure 10. *A color image of Proclus taken by Leandro Sid (AEA) on 2020 Oct 26 UT 23:22 with color saturation increased to 60% and orientated with north towards the top.*

Plato: On 2020 Oct 27 UT 18:50-19:10 Trevor Smith (BAA) observed this crater under similar illumination to the following report:

On 1975 Mar 23 at UT 20:40 P.W. Foley (Kent, UK) found a brownish color on the north west wall. This is a BAA Lunar Section report. The ALPO/BAA weight=2.

Trevor was able to confirm that the NW wall (inner and outer parts) had a brownish tinge that was not seen on other parts of the crater. Trevor was observing under poor seeing conditions (Antoniadi IV) though and was only able to glimpse one craterlet on the floor. The brownish color seen on the NW rim had no hint of red to it, so he doubted that it was a chromatic effect. But he did see similar brownish effects on the nearby Jura Mountains on their south facing slopes, but the brown was not seen on any other features. Trevor was using a 16" reflector at x247. We may possibly remove this from the LTP database, but place it on the Lunar Schedule web site and encourage some color imaging to see if we can confirm this "normal appearance" of brown color seen here.

Aristarchus: On 2020 Oct 28 UT 01:15-01:55 Jay Albert observed this crater under similar illumination to the following two reports:

Aristarchus 1966 Jul 29 UT 03:40 Observed by Simmons (Jacksonville, FL, USA, 6" reflector x192, S=7, T=4-5) and Corralitos Observatory (Organ Pass, NM, USA, 24" reflector + Moonblink) "Spot on S.wall vis. only in red filter, brightness 8deg. Slightly brighter than surrounding wall. No confirm. Says it might be part that reflected better. Not confirmed by Corralitos Obs. MB." NASA catalog ID #968. NASA catalog weight=1. ALKPO/BAA weight=1.

Aristarchus 1975 Dec 14/15 UT 17:05-00:30 Observed by Foley (Dartford, England, 12" reflector, S=II) and Moore (Sussex, UK, 15" reflector x250 S=IV) and Argent and Brumder (Sussex, UK). In early sunrise conditions, W. wall was less brilliant than usual -- matched only by Sharp, Bianchini, & Marian. Extraordinary detail could be seen on this wall. Also noted intense & distinctly blue color entire length of W. wall. 3 others corroborated detail, but not color. Moore found things normal & saw Aris. brightest at 2030-2125h tho Argent & Brumder made it < Proclus" NASA catalog weight=4. NASA catlog ID #1422. ALPO/BAA weight=1.

Jay comments that: *"The Sun was rising on Aristarchus and Herodotus was not yet visible. The spot on the S wall was best seen without filters. The spot was also seen in the red filter and, with some difficulty, in the blue filter as well. The spot was only slightly brighter than the surrounding wall, as stated in the LTP # 968 report. Contrary to the description of #1422, the W rim of Aristarchus was intensely bright. It was brighter than the W wall of Sharp and marginally brighter than the W wall of Mairan. Only the rim of Aristarchus' W wall was visible. The rest of the wall and the entire interior of the crater was in shadow. Nevertheless, what was visible of the W rim was detailed. There was no blue or other color seen inside or outside of Aristarchus. I used 226x to compare Aristarchus with Sharp and Mairan and 290x for detail on Aristarchus. "*

Herodotus: On 2020 Oct 28 UAI observers Aldo Tonon and Valerio Fontani imaged this crater under similar illumination and topocentric libration to a report:

Herodotus 2002 Sep 18 UT 22:00 Observed by Raffaello Lena (GLR, Italy). Event described was of two pseudo-peak/hill-like features, one on the southern floor of the crater, and another just slightly to the NW of the center. on the southern floor of the crater. Lena suspects a combination of seeing effects and albedo markings on the floor. However, this effect of two spots on the floor has not been repeated again. For further information, theory, and a sketch please see Fig 5 in this web link: http://utenti.lycos.it/gibbidomine/analisi123.htm ALPO/BAA weight=2.

Figure 11. *Herodotus orientated with north towards the top.* ***(Left)*** *A sketch (from website above) by Raffaello Lena (GLR) made on 2002 Sep 18 UT 22:00.* ***(Center)*** *an image by Valerio Fontani (UAI) taken on 2020 Oct 28 UT 18:30.* ***(Right)*** *Image taken by Aldo Tonon (UAI) on 2020 Oct 28UT 18:39.*

Although Valerio's and Aldo's images (Fig 11 Center and Right) are quite detailed and agree well with the accurate sketch that Raffaello (Fig 11 Left) made, they don't seem to show up the two light spots on the floor of Herodotus, nor the two light spots on the outside SW rim. I don't propose to change the weight of this report for now.

Aristarchus: On 2020 Oct 29 Ivan Walton (CADSAS), using a robotic Telescope in Chile. managed to obtain an image (See Fig 12) of the whole Moon that matched similar illumination to the following LTP:

On 2006 Jun 08 at UT 20:30-20:45 C.Brook (Plymouth, UK, 60mm refractor x75) found that Aristarchus was "shining exceptionally bright during daylight on a gibbous moon". The ALPO/BAA weight=1.

Figure 12. A whole disk image of the Moon as captured by Ivan Walton (CADSAS) via a robotic telescope in Chile. Taken on 2020 Oct 29 UT 02:30 and orientated with north towards the top.

Level 3 - In Depth Analysis:

Barrow: On 2020 Oct 23 UT 07:30-07:50 Maurice Collins (ALPO/BAA/RASNZ) imaged the whole Moon and caught the repeat illumination of the following LTP:

Barrow 1972 May 19 UT 20:17 M.Burton (UK, 13.5-inch Cassegrain reflector, x180, seeing IV-III, Transparency: Fair) noted that the E. side of the crater wall was brilliant. There was also a luminous streak across the floor from E-W. No color was detected using a Mon Blink device. ALPO/BAA weight=1.

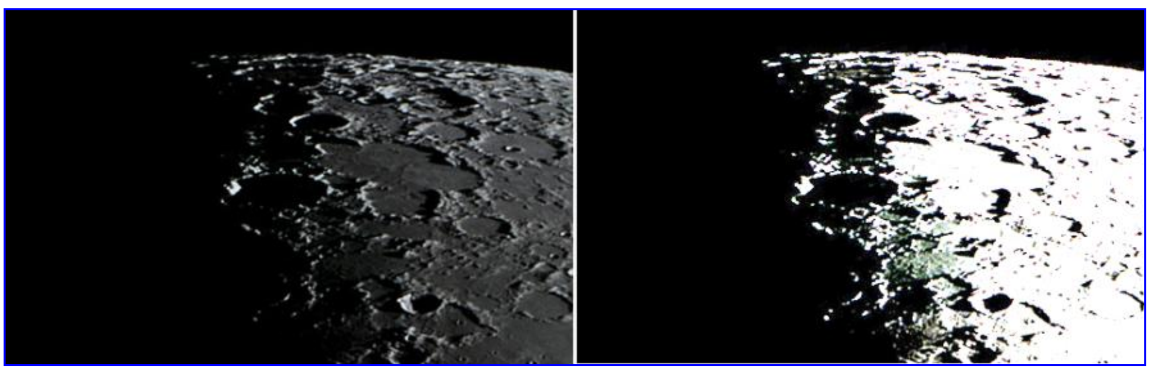

Figure 13. *Barrow as imaged by Maurice Collins (ALPO/BAA/RASNZ) on 2020 Oct 23 UT 07:30-07:50 – an extract from a larger whole Moon mosaic.* ***(Left)*** *Raw image.* ***(Right)*** *Contrast stretched version.*

Fig 13 (Left) indeed shows that the western rim is very bright – so this is normal. Fig 13 (Right) is contrast stretched and starts to show a hint of a light streak across the shadow filled floor. I will lower the weight to 0 and remove this from the ALPO/BAA LTP database, but will include it on the Lunar Schedule web site – just to get some additional images to verify that light streak.

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 LTP, firstly read the LTP 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 LTP alerts can be accessed on https://twitter.com/lunarnaut .

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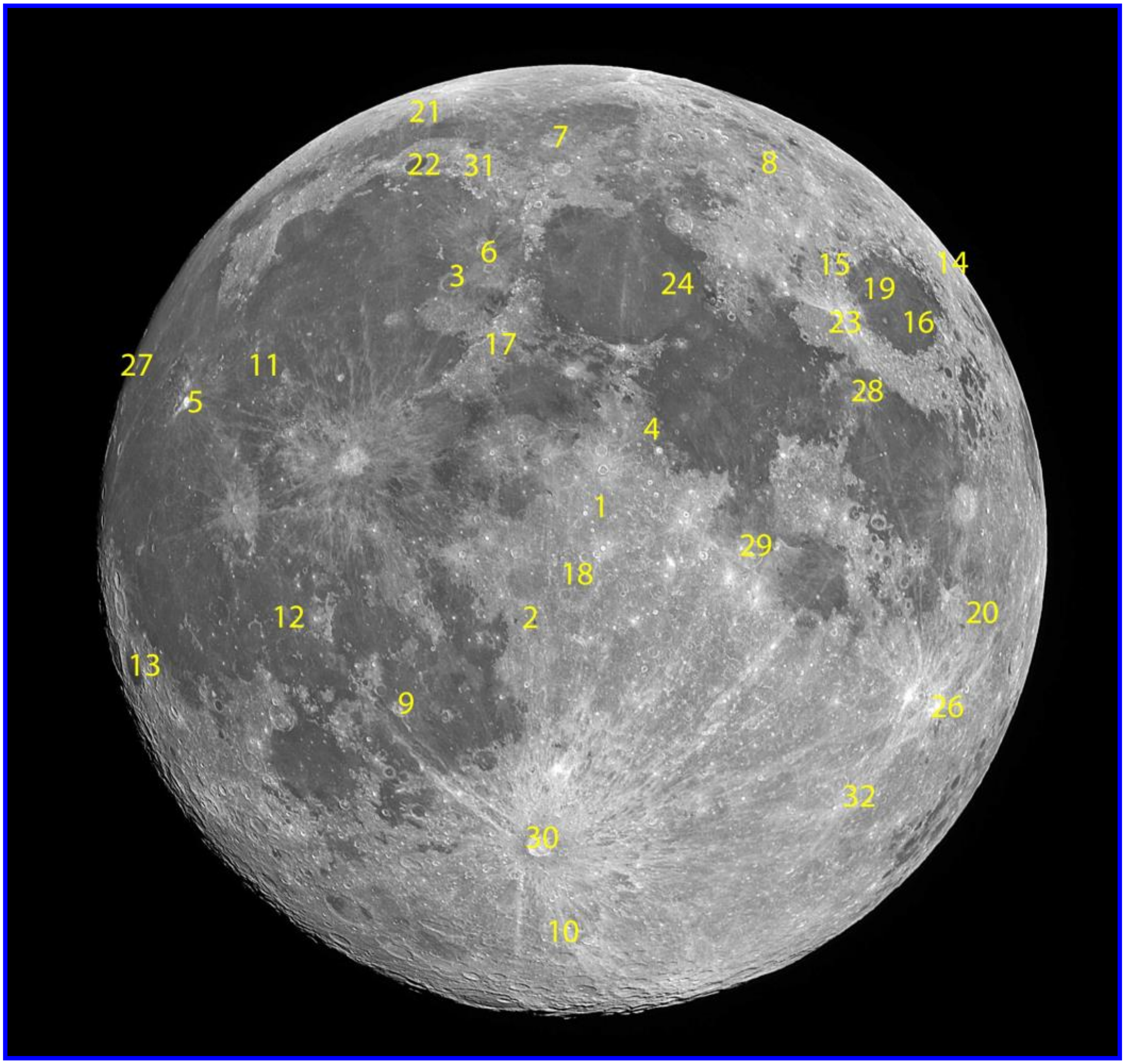
Key to Images In This Issue



1. Agrippa
2. Alphonsus
3. Archimedes
4. Ariadaeus
5. Aristarchus
6. Aristillus
7. Aristoteles
8. Atlas
9. Bullialdus
10. Clavius
11. Diophantus
12. Euclides
13. Grimaldi
14. Hubble
15. Macrobius
16. Mare Crisium
17. Montes Apenninus
18. Müller
19. Peirce
20. Petavius
21. Philolaus
22. Plato
23. Proclus
24. Serpentine Ridge
25. Sinus Iridum
26. Stevinus
27. Struve
28. Taruntius
29. Theophilus
30. Tycho
31. Vallis Alpes
32. Vallis Rheita