The Lunar Observer

A Publication of the Lunar Section of ALPO

April 2023

In This Issue

The Artemis spacesuit was debuted in March 2023. When will they be on the Moon? See page 2.

Online readers, click on images for hyperlinks

Lunar Reflections

Wishing each of you a very pleasant month. It seems to me that the Moon made the news here several times this past month. Probably the biggest news was the debut of the new Artemis space suits. The prototype was gray, but the real one will be white. It is scheduled to be first used in November 2024 when Artemis II orbits the Moon with four astronauts. By the time that you read this, those astronauts will be announced. The plan is still for Artemis III to land on the Moon in late 2025. I hope so! On page 7 I placed a map of possible Artemis landing sites.

Thank you for reading *The Lunar Observer*. This issue, as always, has some pretty interesting topics. Alberto Anunziato tours some very interesting wrinkle ridges with his telescope, fellow astronomers lunar images and data from lunar orbit! Guillermo Scheidereiter looks at the sodium tail of the Moon (yes, that is real!). It is a most interesting comparison with the planet Mercury's sodium tail. Rik Hill has expeditions to mountains in the lunar north and David Teske explores giant craters of the lunar southwest. As always, Tony Cook give us very interesting information about lunar geologic change and buried basins and craters. Plus, contributors from across the planet have contributed excellent lunar drawings and images to this issue of *The Lunar Observer.*

Please remember to follow the future Focus-On topics and gather observations of these features. Next up is the mysterious and interesting Reiner Gamma. Observations are due to Alberto and myself by April 20, 2023.

Clear skies,
-**David Teske**

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The new Artemis space suit makes its public debut.

Lunar Topographic Studies

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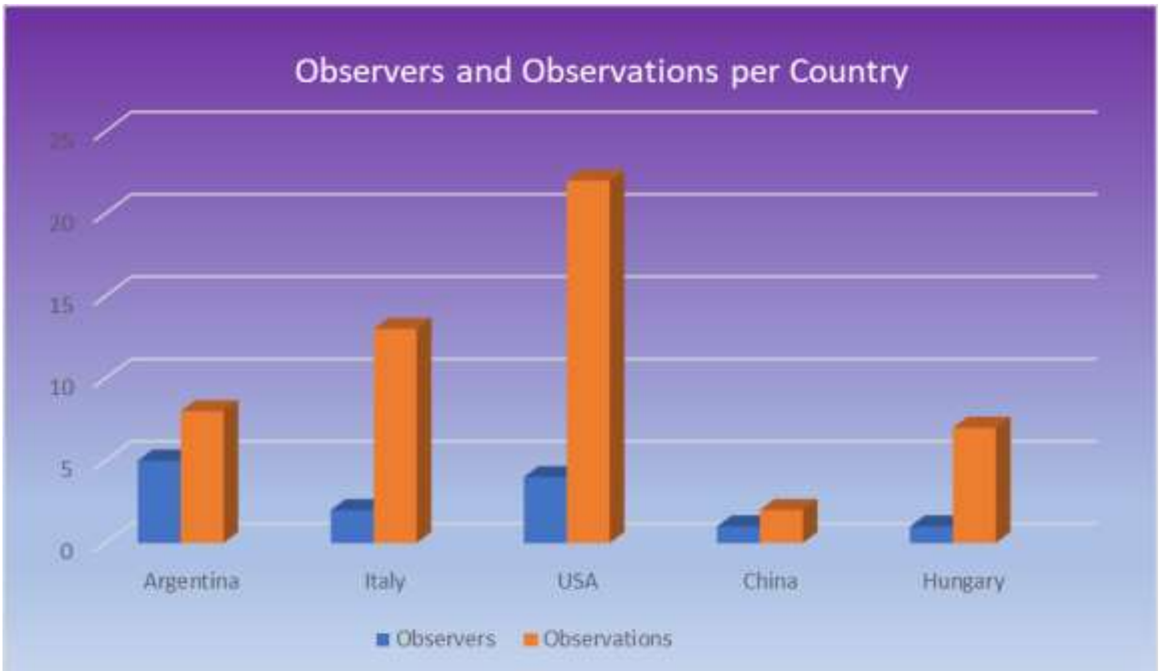
Observations Received

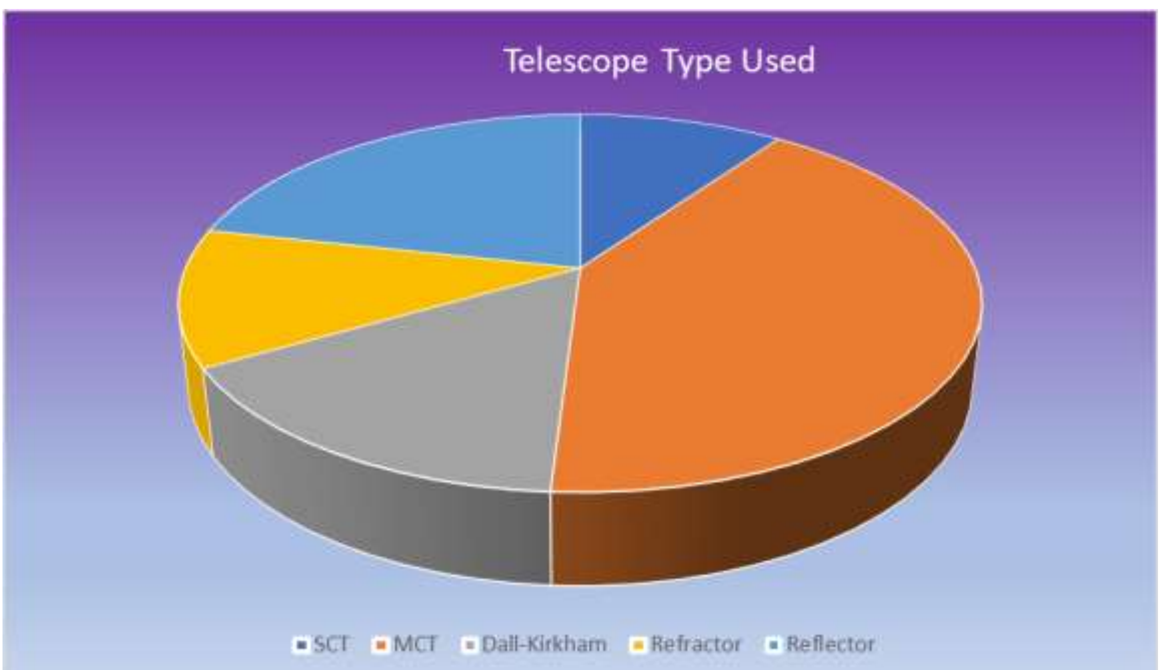
Name	Location and Organization	Image/Article
Alberto Anunziato	Paraná, Argentina	Article and drawing *Dorsum Gast and Dorsum Buckland, Mädler and Other Oddities* and *The Ghost Wrinkle Ridge Near Luther Revisited, drawing of Luther.*
Massimo Bianchi	Milan, Italy	Images of Tycho, Clavius, Sinus Iridum, Gassendi and the Lunar North Pole.
Don Capone	Waxahachie, Texas, USA	Images of Copernicus (2), Kepler, XXX, Schickard, Gassendi, Aristarchus (2) and Tycho.
Francisco Alsina Cardinalli	Oro Verde, Argentina	Article and image *Mädler and Other Oddities.*
Walter Ricardo Elias	Oro Verde, Argentina	Image f Aristarchus, Apianus and Dorsa Smirnov.
István Zoltán Földvári	Budapest, Hungary	Drawings of .Aitken basin, Bürg (2), Plinius, Byrgius, Lansberg and Santbech.
Rik Hill	Loudon Observatory, Tucson, Arizona, USA	Articles and images *Dividing Mountains, The Northern Mountains* and images of Posidonius (6)
Evangelina Leguiza	AEA, Oro Verde, Argentina	Images of Faraday and the First Quarter Moon.
KC Pau	Hong Kong, China	Images of Archimedes, Langrenus, Luther
Guido Santacana	San Juan, Puerto Rico, USA	Images of Armstrong, Mare Serenitatis, Theophilus (2) and Montes Haemus.
Guillermo Scheidereiter	LIADA, Rural Area, Concordia, Entre Ríos, Argentina	Article *Not Only Do Comets Have Tails, They Also Have Tails...*
David Teske	Louisville, Mississippi, USA	Article and image *Footprints of Giants*.
Fabio Verza	SNdR, Milan, Italy	Images of Aristarchus, Clavius, Copernicus, Schiller, North Moon, Sinus Iridum, South Pole and Tycho.

Many thanks for all these observations, images, and drawings.

April 2023 *The Lunar Observer*
By the Numbers

This month there were 52 observations by 13 contributors in 5 countries.





ALPO 2023 Conference: Call for Papers

Tim Robertson & Ken Poshedly,
ALPO Conference coordinators

Overview

Due to the success of attracting more and more viewers and participants to our online conferences, the 2023 Conference of the ALPO will once more be held online, this time on Friday and Saturday, July 28 and 29.
The ALPO conference times will be:

- Friday from 1 p.m. to 5 p.m. Eastern Time (10 a.m. to 2 p.m. Pacific Time)
- Saturday from 1 p.m. to 6 p.m. Eastern Time (10 a.m. to 3 p.m. Pacific Time).
- The ALPO Conference is free and open to all via two different streaming methods:
- The free online conferencing software application, Zoom.
- On the ALPO YouTube channel at *https://www.youtube.com/channel/UCEmixiL-d5k2Fx27Ijfk41A*

Those who plan to present papers or presentations must (1) be members of the ALPO, (2) use Zoom, and (3) have it already installed on their computer prior to the conference dates. Zoom is free and available at *https://zoom.us/*
Those who have not yet joined the ALPO may do so online. Digital ALPO memberships start at only $22 a year. To join online, go to *http://www.astroleague.org/store/index.phpmain_page=product_info&cPath=10&products_id=39*, then scroll to the bottom of that page, select your membership type, click on "Add to Cart" and proceed from there.
There will be different Zoom meeting hyperlinks to access the conference each of the two days of the conference. Both links will be posted on social media and e-mailed to those who wish to receive it that way on Thursday, July 27.
The Zoom virtual (online) "meeting room" will open 15 minutes prior to the beginning of each day's activities.
Those individuals wishing to attend via Zoom should contact Tim Robertson at *cometman@cometman.net* as soon as possible.

Conference Agenda

The conference will consist of initial welcoming remarks and general announcements at the beginning each day, followed by papers and research findings on astronomy-related topics presented by ALPO members.
Following a break after the last astronomy talk on Saturday will be presentation of the Walter Haas Observing Award. A Peggy Haas Service Award may also be awarded.
A keynote speaker will then follow the awards presentations on Saturday. The selection of a keynote speaker is in progress and the final decision will be announced in the summer issue of this Journal (JALPO65-3).

Presentation Guidelines

All presentations should be no more than 15 minutes in length; the preferred method is 12 minutes for the presentation itself plus 3 minutes for follow-up questions. The preferred format is Microsoft PowerPoint.
Send all PowerPoint files of the presentations to Tim Robertson at *cometman@cometman.net* .

Suggested Topics

Participants are encouraged to present research papers and experience reports concerning various aspects of Earth-based observational astronomy including the following.

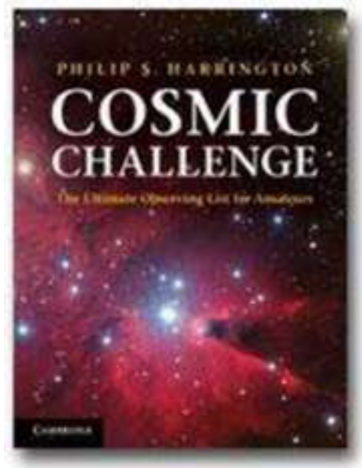
- New or ongoing observing programs and studies, specifically, how those programs were designed, implemented and continue to function.
- Results of personal or group studies of solar system or extra-solar system bodies.
- New or ongoing activities involving astronomical instrumentation, construction or improvement.
- Challenges faced by Earth-based observers such as changing interest levels, deteriorating observing conditions brought about by possible global warming, etc.

Information about paper presentations, the keynote speaker and other conference data will be published in this Journal and online as details are learned.

Lunar X and V Visibility 2023
Submitted by Greg Shanos

Table 4.3 Lunar X and Lunar V Visibility Timetable

	2023
Jan	29; 00:37
Feb	27; 15:02
Mar	29; 04:59
Apr	27; 18:10
May	27; 06:28
Jun	25; 18:02
Jul	25; 05:07
Aug	23; 16:07
Sep	22; 03:26
Oct	21; 15:27
Nov	20; 04:23
Dec	19; 18:16

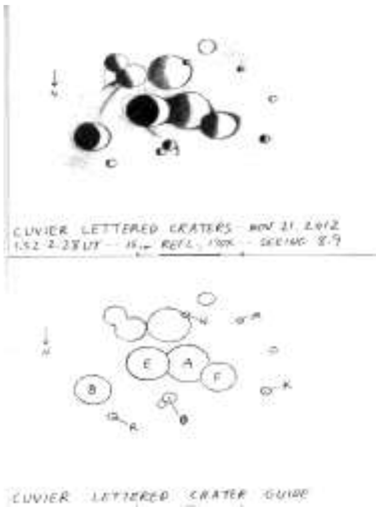


Note: The dates and times listed are based on calculations made with the Lunar Terminator Visualization Tool (LTVT) by Jim Mosher and Henrik Bonda. This useful freeware program may be downloaded from https://github.com/fermigas/ltvt/wiki.

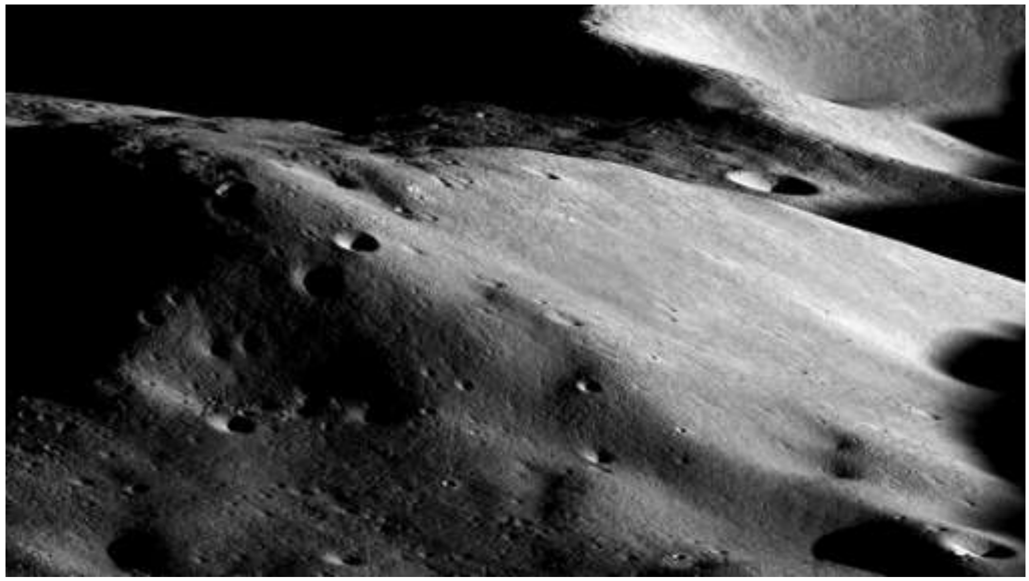
Lunar Topographic Studies

Now and Then

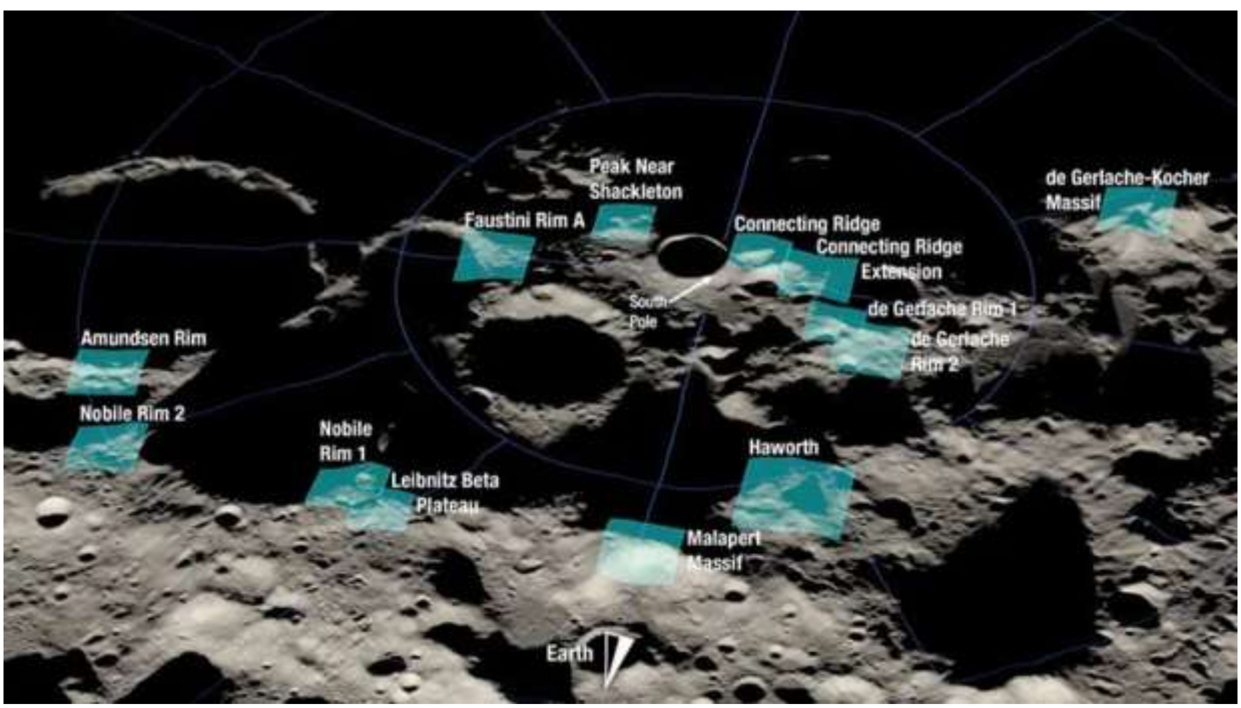
David Teske



In *The Lunar Observer* 10 years ago (April 2013) the Feature of the Month was the numerous craters around the crater Cuvier in a remarkable sketch by Robert H. Hays, Jr. of Worth, Illinois, USA. As today, he drew this very complicated scene with a 6 inch reflector at 170x. Also in this issue were observations by Maurice Collins, John Duchek, Howard Eskildsen, Richard Hill, Damian Peach and Phillip Morgan. It is great to see many of these lunar observers still active!



What will *The Lunar Observer* have in it in ten years? Maybe news about the landings of the Artemis spacecraft. Recently, the Lunar Reconnaissance Orbiter sent back stunning images of the Malapert Massif near the Lunar South Pole. This massif rises 5,000 m above its base. What a landing that would be! The image at the right shows a LRO image of the Malapert Massif. Left is a map of possible landing sites for Artemis III near the Lunar South Pole. Which of these sites can you see with your telescope?

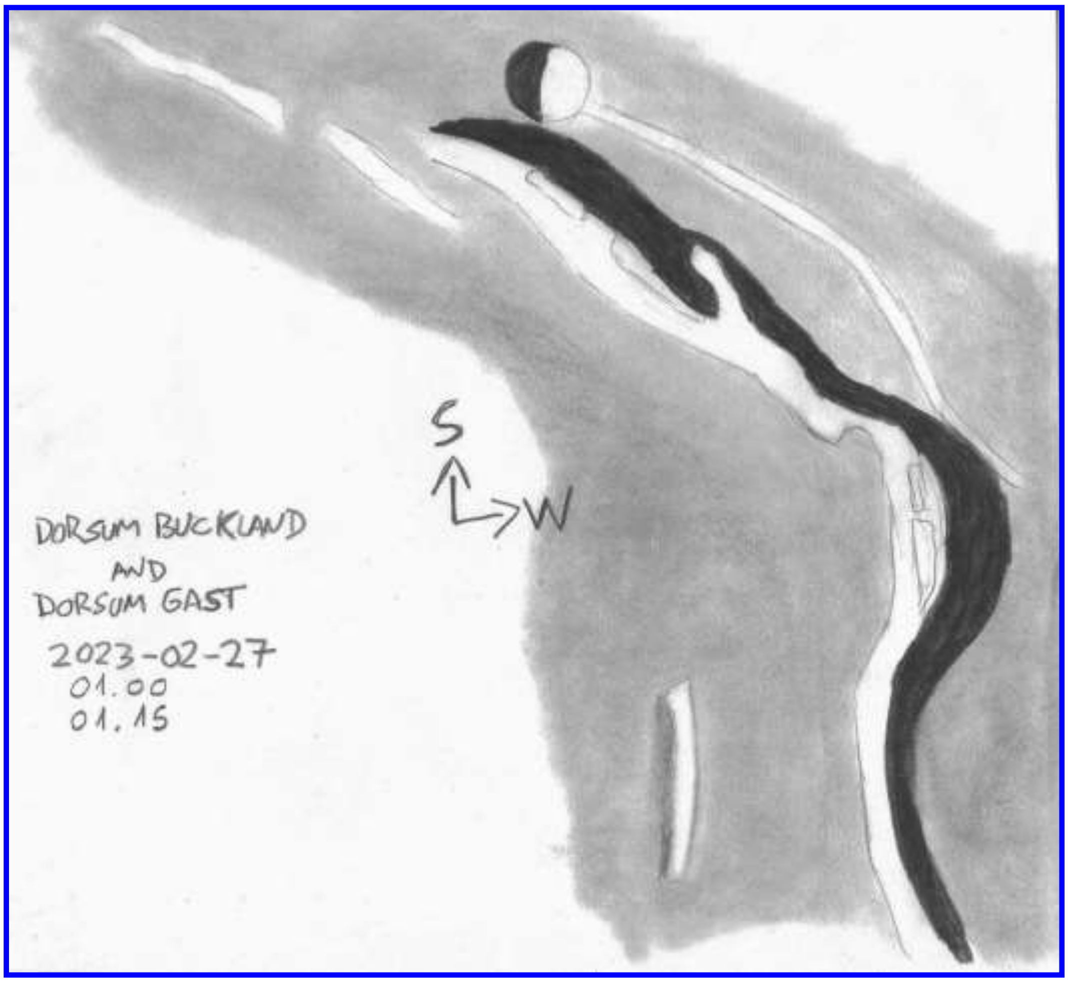


Lunar Topographic Studies
Now and Then

Dorsum Gast and Dorsum Buckland

Alberto Anunziato

With the terminator passing near the west shore of Mare Serenitatis, the most prominent set of elevations is that formed by the Dorsum Gast and Dorsum Buckland. Mare Serenitatis is a festival of wrinkle ridges, including perhaps the most spectacular of all: Dorsa Smirnov (also known as Serpentine Ridge), which will be the subject of the Focus On Section for the month of November 2023. The only crater that seen in the image (and which I drew merely as a cartographic indication, without claiming precision in its details) is Sulpicius Gallus and the bright line that seems to end in the crater is part of the Rimae Sulpicius Gallus. It is a region of extraordinary interest, not only geologically (it is a young volcanic area) but also practical, since materials of importance for a future lunar colonization could be found in the pyroclastic deposits of the region (Sulpicius Gallus was one of the areas of interest of the abandoned Constellation Program). It is interesting how visual observation with a small telescope, for reasons of resolution, represents the segments of the wrinkle ridges as a continuum, while photographic images allow better identification of the segments. Here we see two united ridges: Dorsa Buckland is the one that runs parallel to the west shore of Serenitatis, Dorsa Gast is that from south to north. Likewise, the limit between the two is not clearly established. I marked with continuous lines the brightest areas that would correspond to the superior structural element of each segment, the crest. The isolated segment, casting some shadow, to the east of Dorsum Gast could belong to Dorsum Von Cotta.



Dorsum Buckland and Dorsum Gast, *Alberto Anunziato, Paraná, Argentina. 2023 February 27 01:00-01:15 UT. Meade EX105 Maksutov-Cassegrain telescope, 154x.*

Lunar Topographic Studies
Dorsum Gast and Dorsum Buckland

Not Only Do Comets Have Tails, They Also Have Tails...
Guillermo Scheidereiter

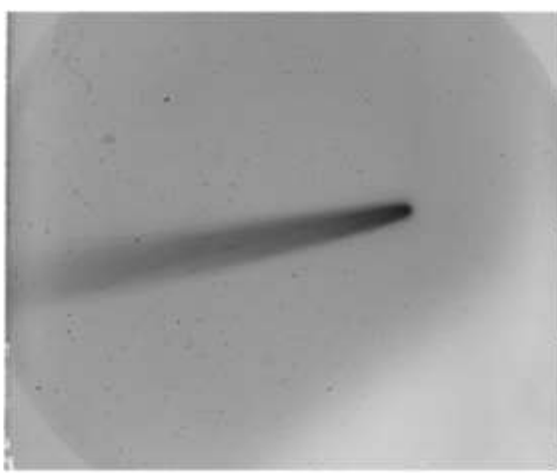
Comets have tails. Indeed, very roughly, we could say that what distinguishes comets from other objects in the starry sky is... its tail. In his beautiful book Cosmos, Carl Sagan writes:

"*A comet is composed mainly of water ice (H_2O) with some methane ice (CH_4), and some ammonia ice (NH_3).*"

Also, we find rocks, gas and dust in comets. A comet's tail is formed by a sublimation process that occurs when the object passes close to the Sun while in an elliptical orbit of considerable eccentricity.

Humanity has witnessed countless comets and the chronicles bear witness to this. Then, the advent of the telescope and the subsequent accessibility of these to the population, in recent decades, together with technological instruments such as cameras, hardware and software and the construction of observatories that monitor the sky constantly, has multiplied the discovery of comets and allowed comets that are not within human sight to be observed and recorded.

Perhaps, the most emblematic example is that of the famous Halley's Comet, officially called 1P/Halley that visits us every 75 years (on average). His last passage through the vicinity of our planet occurred in 1986 and, previously, in 1910, where he dazzled observers with a spectacle worthy of the splendor of the heavens. The following photographs of Halley's Comet are a beautiful contribution made to this article, the Argentine architect and amateur astronomer, Cristian Willemoës, who together with Raúl Melía (also Argentine), did a great job of digitizing photographic plates of the Astronomical Observatory of Córdoba, Argentina. The following photographs were taken from the Observatory in 1910, by American astronomer Dr. Charles Dillon Perrine and his wife Bell Smith who, at the time, worked in data processing (Perrine was director of the observatory from 1909 to 1936). They constitute a magnificent and invaluable historical record of the passage of Halley's Comet and the incipient history of Astronomy in Argentina.



Left: Halley's comet, photographed May 11, 1910, from the National Conservatory of Córdoba, Argentina, by Dr. Charles Dillon Perrine and Bell Smith, with Saegmüller-Brashear camera and 30-minute exposure; digitized by Raúl Melía and Cristian Willemoës. Right: Halley's comet photographed on June 6, 1910, from the National Observatory of Córdoba, Argentina, by Dr. Charles Dillon Perrine and Bell Smith, with Saegmüller-Brashear camera and 120-minute exposure; digitized by Raúl Melía and Cristian Willemoës; processed by Cristian Willemoës.

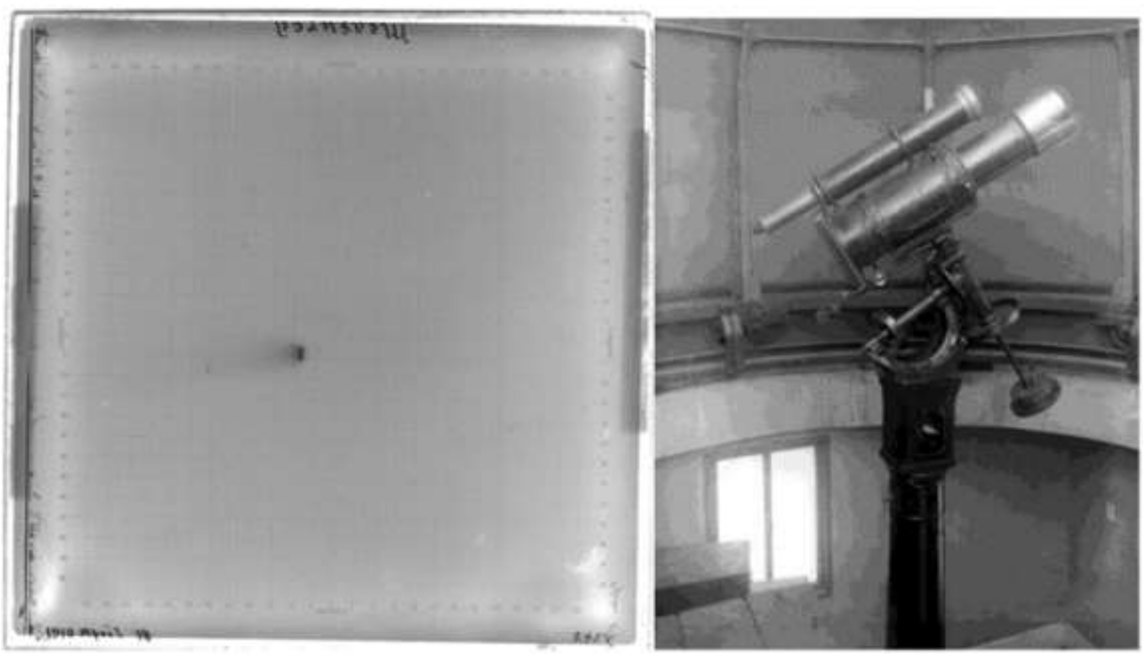
Lunar Topographic Studies
Not Only Do Comets Have Tails, They Also Have Tails...

In the book Córdoba Estelar by Edgardo Minniti and Santiago Paolantonio (who are also creators of the website Historia de la Astronomía), the following story by Dr. Perrine is included, more than illustrative of that show:

"In its approach to Earth, the comet increased rapidly until, from these southern latitudes it was observed completely dominating the celestial host, crossing with its tail magnifying the sky from the horizon to the zenith. In the middle of May [1910] the comet, attaining its largest size, acquired magnificent proportions. It then offered a truly astonishing spectacle in its silent majesty, matched only, in celestial phenomena, by a total eclipse of the Sun... The already wintry air of those early mornings when we waited for its departure did not seem to chill our flesh any more than our eyes froze when we saw the comet ascend with its steely and cold appearance over the horizon of the eastern Pampas. "

Also, allow me, dear reader, to share with you, the first photograph of Halley's Comet obtained from the observatory with the astrographic telescope, by the English photographer Federico Percy Symonds. Cristian Willemoës tells us about the photo:

"*It was the first useful photo of Halley's Comet taken by Symonds on April 18, 1910, with the Astrographic. Lumiere plates were used, and since photography was just being invented, silver and gelatin glass plates had impurities. Three exposures were made to rule out that a star was confused with an impurity.* "



Left: First useful photograph of Halley's Comet taken with the astrographic telescope of the National Observatory of Córdoba by Federico Percy Symonds on April 18, 1910. Digitized by Raúl Melía and Cristian Willemoës. Right: Saegmüller-Brashear camera used in photographs of Halley's Comet. Image taken from the book Córdoba Estelar by Edgardo Minniti and Santiago Paolantonio.

After this beautiful historical and almost romantic passage through Halley's Comet and these magnificent introductory photographs, you may be interested to know (or not...) that, surprisingly, comets are not the only celestial bodies that "have tails". For a short time now, it has become popular among astrophotographers and amateur astronomers to capture "Mercury's tail" in a photograph.

Lunar Topographic Studies
Not Only Do Comets Have Tails, They Also Have Tails...

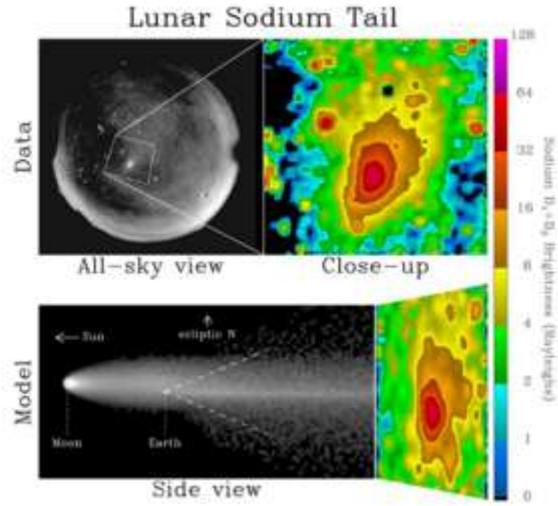
In the early eighties, scientists predicted that Mercury had a tail, but it wasn't until 2001 that this prediction was confirmed. The explanation for the existence of Mercury's tail lies in the sodium atoms on its surface that are ejected by micrometeorite impacts and the subsequent action of the solar wind. The atoms are thrown from the surface of Mercury forming the curious tail that reaches a length of about 100 times the diameter of Earth. Although many elements are expelled, sodium takes center stage because sunlight is scattered by the sodium atoms, giving the tail a yellow or orange color. Although the tail is not visible to the naked eye, it can be photographed with a special filter that operates at the proper wavelength for photographing sodium, 589 nanometers. According to specialists, the opportune moment to capture the phenomenon occurs sixteen days after the perihelion of Mercury, which the planet reaches every 88 days.

Left: Photograph of Mercury and its Sodium tail, taken by Dr. Sebastian Voltmer, April 29, 2022 (above, the Pleiades). Right: Photograph of Mercury and its tail, taken by Steven Bellavia, Oct. 11, 2022.

But the interesting thing is that the Moon also has a tail! Once a month, during the new moon, a faint beam of light appears in the sky on the opposite side of the Sun. This spot is about three degrees and is faint enough that it is not noticeable by the human eye. The mystery finds its clarification in the same process that explains the tail of Mercury. The Moon is also bombarded by meteorites and micrometeorites that expel material from the surface and the solar wind is responsible for dispersing it in the opposite direction to the Sun. The sodium atoms ejected in the process are pushed into a long tail like that of a comet and are what allow us to photograph the tail of the Moon, in the same way that occurs with Mercury.

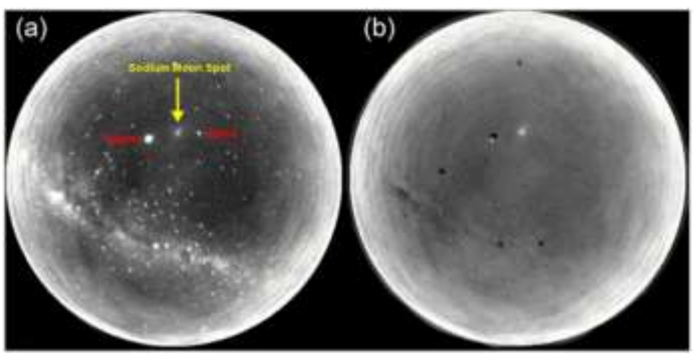
It was in November 1998 when scientists studying the activity of the Leonid meteor shower, with cameras from the McDonald Observatory in Fort Davis, Texas, USA, noticed that, after the peak, a sodium spot persisted for more than three days. It intensified as the New Moon approached and then suddenly disappeared.

From further study and simulation modeling, they concluded that the sodium spot came from the Moon and formed a tail that stretches for more than 800,000 km and that the Earth passes through on every New Moon. From there, observations began that showed that, although the spot always appears in the same lunar cycle, it does not do so with the same intensity, that is, there is a fluctuation in the brightness of the sodium spot. Since then, scientists have wondered what caused these fluctuations.



Above: All-sky image taken on November 19, 1998 from MacDonald Observatory, with the sodium spot and an enlarged view (model) in the upper right. Bottom: simulation of the Moon's sodium tail.

An All-Sky camera installed by Boston University at the Complejo Astronómico El Leoncito (CASLEO), in the Province of San Juan, Argentina, took 21,000 photographic records between 2006 and 2019. The images made it possible to estimate that the intensity of the Moon's tail correlates with the impact of meteorites, particularly the fastest and most massive ones that randomly collide with the Moon, that is, occasional meteorites that do not impact as a result of a shower, usual for meteors such as the Leonids.



Left: All-sky image taken on April 28, 2006 with the All-Sky camera at El Leoncito Observatory (CASLEO). The yellow arrow points to the sodium spot and below you can see the Milky Way. Right: the same photograph where only the sodium stain is observed.

Specifically, the scientific article says about the moonspot of sodium (SMS):

"*No correlation was found between the SMS brightness and the 11-year solar-cycle, the proton or the He flow pressure, the density, the speed or the plasma temperature of the solar wind, but an annual pattern was found. A ~0.83 correlation (Pearson's "r") was found between the SMS brightness and a 4-year average of sporadic meteor rates at Earth, suggesting a cause-and-effect. The new insights gained from this long-term study put new constraints on the variability of the potential sources of the Na atoms escaping from the Moon.* "

These investigations reveal very important information about the characteristics of the Moon's atmosphere, since the fact that it has a sodium tail implies that the lunar atmosphere does not resemble a spherical planetary or satellite atmosphere, but rather interacts with exterior space in a shape similar to a comet.

The researchers [write](#):

"*... the lunar atmosphere is continuously being produced and lost, forming a so-called transient atmosphere. Sodium atoms (Na) have a high resonant scattering cross section for solar photons at visible wavelengths, and thus serve as the most robust tracer for remote sensing of the full atmosphere/exosphere*."

In addition, the study characterizes the geometric shape of the spot and its photometry, which depend on the Sun-Earth-Moon geometry, showing that the light curve is not symmetric and the maximum peak in brightness occurs approximately five hours after the moon is new and, also, that this brightness is related to the ecliptic latitude of the Moon.

While the researchers continue with the studies on the tail of the Moon, let me tell you, dear reader, that the photographic visualization of the sodium spot is not exclusive to the scientific world, since there are amateurs who have obtained photographs of the lunar sodium tail with equipment accessible to anyone, such as a reflex camera and a 589 nm sodium filter. Do you dare to try to capture the tail of the Moon?

I look back on the magnificent photos of Halley's Comet of 1910, which Cristian Willemoës very kindly sent me (who, precisely, was also responsible for the documentation of the construction of CASLEO, the observatory whose information was absolutely relevant in the study of the tail of the Moon), and I think about what a photograph of the Moon and its magnificent tail would look like from, say, a spacecraft traveling to the planet Mars. Will we ever be lucky enough to see a picture of the Moon and its tail from outside Earth, like we get from Mercury? Refugee in the recesses of the imagination, which luckily sometimes has no limits, I invite you to think about the Moon and its brand-new tail enveloping the Earth, covering us with a fine layer of sodium dust, which has regularly been interacting with our atmosphere for millions of years. Let me, then, modestly conclude, paraphrasing William Shakespeare, that to some or every extent, we are made of the same matter as the Moon, we are a part of it almost as much as of the Earth. Is that why when we see her magnificent and captivating in the sky, we are speechless, immersed in her contemplation, thinking of that magnificent poem by Victor Hugo mentioned in a previous article:

Quel dieu, quel moissonneur de l'éternel été,
Avait, en s'en allant, négligemment jeté
Cette faucille d'or dans le champ des étoiles.

References:

Baumgardner, J., Luettgen, S., Schmidt, C., Mayyasi, M., Smith, S., Martinis, C., et al. (2021). Long-term observations and physical processes in the Moon's extended sodium tail. *Journal of Geophysical Research: Planets*, 126, e2020JE006671. https://doi.org/10.1029/2020JE006671

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https://spaceweatherarchive.com/2022/04/30/mercurys-comet-like-tail/

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Minniti, Edgardo, Paolantonio, Santiago (2013), Córdoba Estelar, Digital Edition, Universidad Nacional de Córdoba, Córdoba, Argentina.

Sagan, Carl, (1997), Cosmos, Planeta, Barcelona, Spain.

Mädler and Other Oddities

Luis Francisco Alsina Cardinalli and Alberto Anunziato

This image was obtained by Luis Francisco Alsina Cardinalli for the Lunar Geological Change Detection Program, specifically to analyze the illumination conditions of Censorinus and Torricelli, in relation to two supposed Transient Lunar Phenomena that occurred in said craters. Pancho (as we call the Franciscos in Spain and Latin America) reported that the heat, the mosquitoes and the arriving clouds prevented him from obtaining more images than IMAGE 1.

***Image 1, Mädler,** Luis Francisco Alsina Cardinalli, Oro Verde, Argentina. 2023 February 27 00:23 UT. 203 mm Newtonian reflector telescope, QHY 5L-II-M camera.*

But it is an interesting image because it shows some oddities in this border area between Mare Nectaris and Mare Tranquillitatis. We start from south to north, that is to say from bottom to top, we start with Mädler (28 km in diameter), a crater that has always attracted us because of the fan-shaped bright area that extends to the south. But in our image what draws attention is the interior of Mädler, crossed by what appears to be a ridge that ends in what appears to be a central peak (IMAGE 2), as described by Thomas Elger "there is a narrow gap (flanked on the W. by a somewhat obscure little crater) through which a curious bent ridge coming up from the N. passes, and, extending on to the floor, expands into something resembling a central mountain" (The Moon, page 136).

Image 2, Theophilus and Mädler, *Luis Francisco Alsina Cardinalli, Oro Verde, Argentina. 2023 February 27 00:23 UT. 203 mm Newtonian reflector telescope, QHY 5L-II-M camera. Close-up of image 1.*

Mädler, because it is so close to Theophilus, one of the most beautiful craters on the Moon, often appears in lunar images, but its interior does not always appear to be crossed by a ridge, and if we see images from lunar orbit missions, we realize that the interior is more complex than what we see in IMAGE 2. Mädler is a crater from the Eratosthenian period, so when the folding occurred, related to the last period of geological activity on the Moon, it was still a young crater.

The topography of the Mädler interior seems to be repeated in the Sabine interior (30 km in diameter) (IMAGE 3), in which we see a ridge interrupting the southern wall and seems to continue into its interior. Garfinkle (in Luna Cognita) states that Sabine's floor (30 km in diameter) “is covered by multiple rings of hills and mountains (…) Current theory holds that the appearance of the floor is the result of uplifting by magma that pushed up the floor and that the rings may be dikes where magma exerted greater lifting forces under weaker rocks near the base of the crater’s walls”, explanation that would apply to Mädler, which is in a similar situation, at the edge of a basin. Indeed, as Charles Wood (in The Modern Moon) argues, Sabine, like its twin Ritter, have “weird floors” (page 85).

Image 3, Ritter and Sabine, *Luis Francisco Alsina Cardinalli, Oro Verde, Argentina. 2023 February 27 00:23 UT. 203 mm Newtonian reflector telescope, QHY 5L-II-M camera. Close-up of image 1.*

To the north of Sabine is its twin Ritter and a little further north are the triplets Ritter C, B and D, running south to north, which, if Sabine and Ritter formed at the same time, could have been secondary craters from an event in which “gravity split an incoming projectile in half, causing two closely spaced impacts. Alternatively, the impact of a binary asteroid or comet could have caused pairs of craters” (The Modern Moon, pages 85/86). Further north, the crater covered by shadows is Manners (15 km in diameter) and finally, always moving parallel to the ridges that form Lamont further east, we arrive at Arago (IMAGE 4), another Eratosthenian crater of about size similar to Mädler and Sabine (27 kms.). Below Arago are the Arago Alpha and Beta domes. In the description of Robert Garfinkle (Luna Cognita) we read characteristics that we observed in IMAGE 4: “The terraced steep eastern walls are higher than the distorted western walls with its ramparts pushed out toward the west. There is a gap in the northern wall where a ridge of landslide materials slope down toward the center of the crater (…) The crater’s floor is hilly and hummocky, with concentric rilles on the floor”. And the central peak? “Although there are numerous peculiar central peaks in lunar craters, this is one of the weirdest (…) The northwest wall of the crater is displaced by a large scallop or arcuate collapse where part of the wall has tumbled onto the floor. Arago’s wall terraces simply merge with its central peak” (The Modern Moon, page 86).

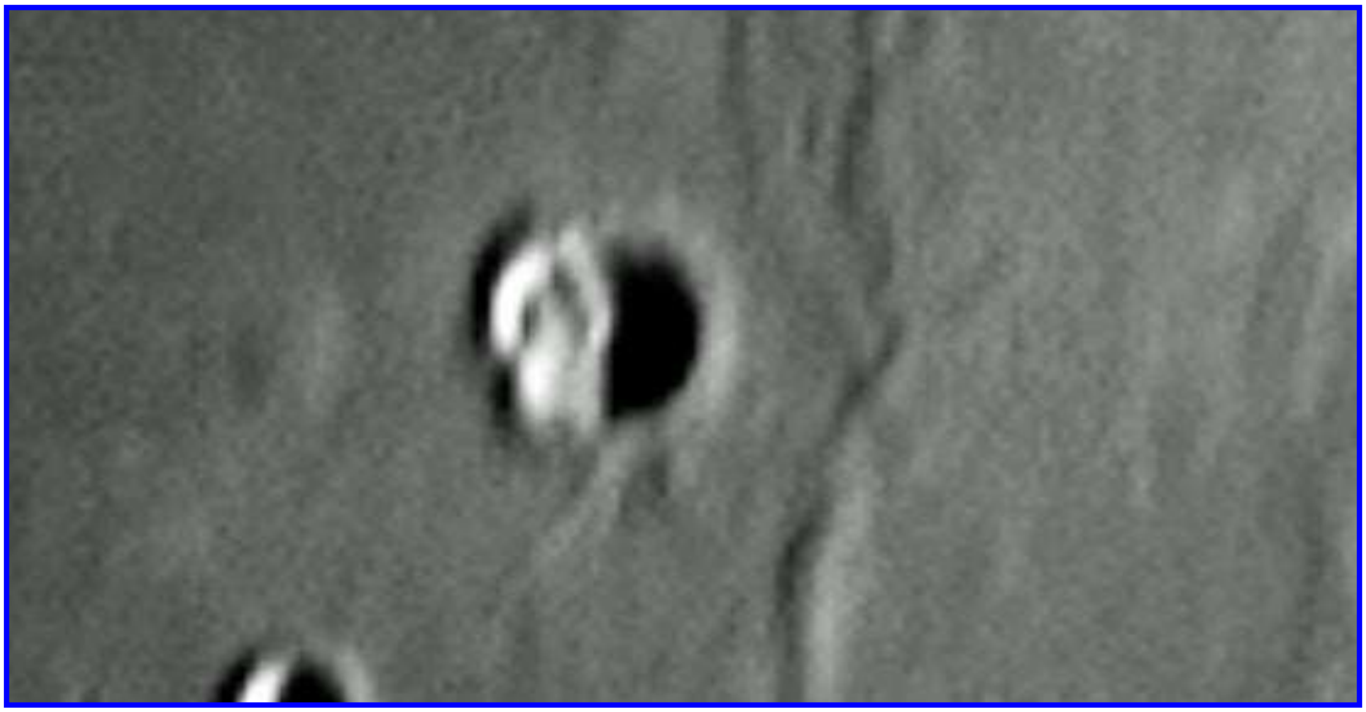


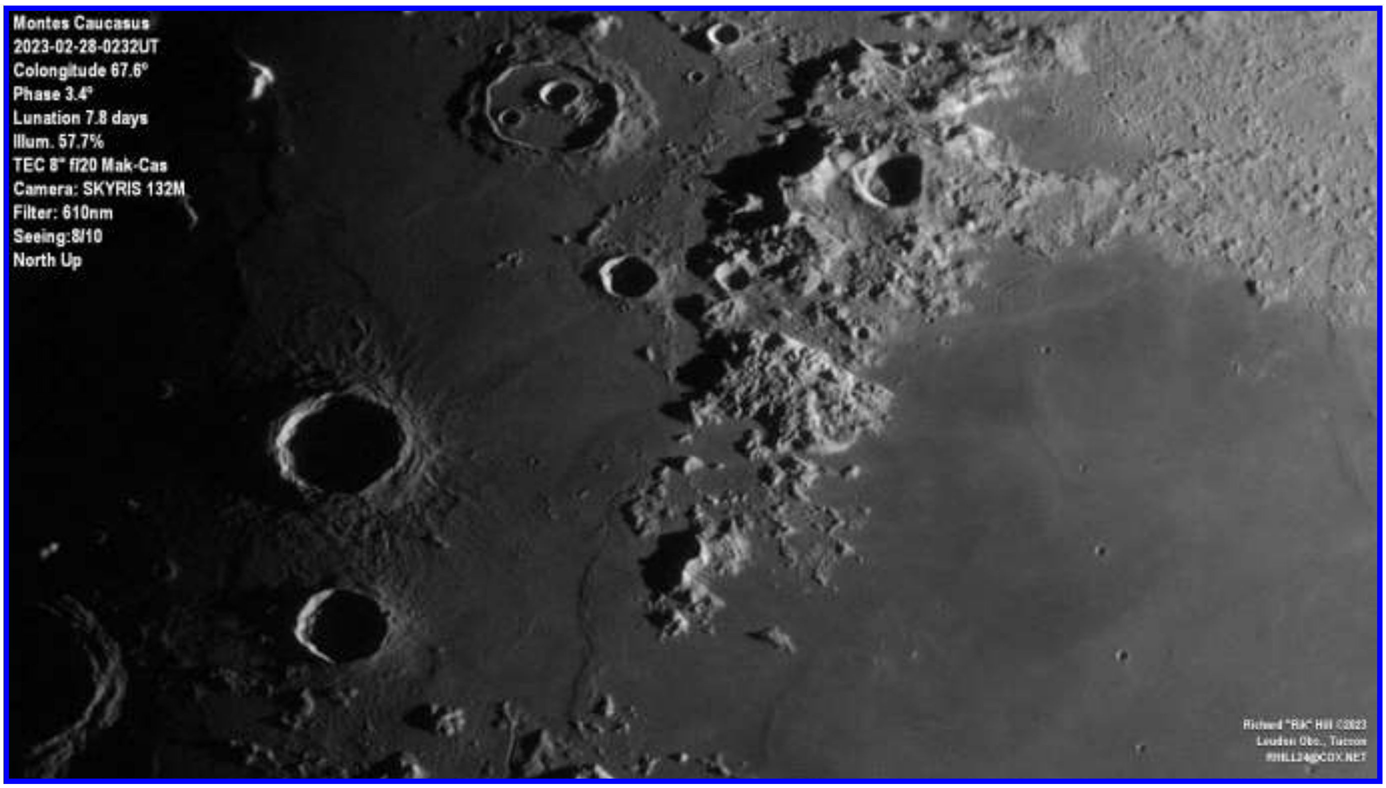
Image 4, Arago, *Luis Francisco Alsina Cardinalli, Oro Verde, Argentina. 2023 February 27 00:23 UT. 203 mm Newtonian reflector telescope, QHY 5L-II-M camera. Close-up of image 1.*

Dividing Mountains

Rik Hill

Dividing Mare Imbrium from Mare Serenitatis, is the triangular mass of peaks, the Montes Caucasus, my favorites of all the lunar mountains, running down the middle of this image. On the left side of this image, we see two large craters still in shadow, Aristillus (56 km dia.) above and Autolycus (41 km) below. Note the splash pattern of the ejecta about the larger crater and the tighter crosshatch pattern around Autolycus. To the right (east) of Aristillus up against the Montes Caucasus, is a mild swelling that is the dome Ari1 about 54x35 km in area and 85 m (±10 m) high. Rima Theaetetus can be seen on the eastern side of this dome. Then east of Autolycus is a large low circular swelling that is another dome, Au1 some 28 km diameter (±0.5 km) and only 75 m (±10 m) in height.

A small piece of the great crater Archimedes (85 km) can be seen in the lower left corner. In the upper left is the bright Mon Piton rising abruptly 2250 m above the surrounding plain of Mare Imbrium. What a sight that must be! Just right of that rampart is the very identifiable crater Cassini with Cassini A (15 km) and the smaller Cassini B (9 km) contained within its low walls. The ejecta blanket surrounding this crater is best seen on the right (east) side. Below Cassini is the odd shaped crater Theaetetus (24 km) and in the north of the Caucasus is another non-round crater Calippus (32 km). These two craters point north to a “U” shaped feature that is Alexander (85 km). Some references list this at 95 km but it’s hard to see a circular feature here at all!

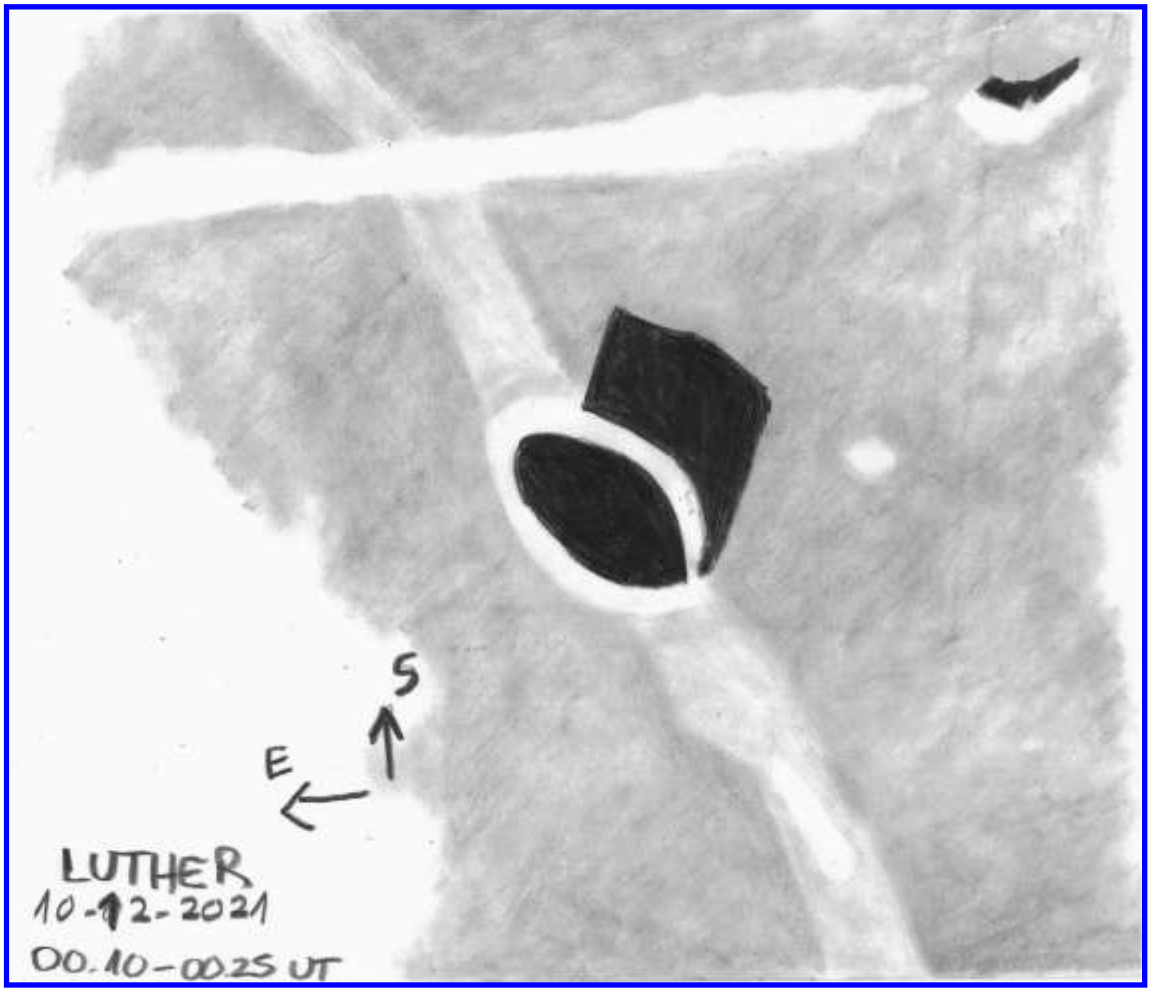


Montes Caucasus, *Richard Hill, Loudon Observatory, Tucson, Arizona, USA. 2023 February 28 02:32 UT, colongitude 67.6º. TEC 8 inch f/20 Maksutov-Cassegrain telescope, 610 nm filter, Skyris 132M camera. Seeing 8/10.*

Lunar Topographic Studies
Dividing Mountains

The Ghost Wrinkle Ridge Near Luther Revisited

Alberto Anunziato



Luther, *Alberto Anunziato, Paraná, Argentina. 2021 October 12 00:10-00:25 UT. Meade EX105 Maksutov-Cassegrain telescope, 154x.*

In the December 2021 issue of our magazine, we referred to a difficult-to-characterize area to the south of Luther crater, in the text that we titled "Bright Ray or ghost wrinkle ridge". Luther is a fairly small crater (10 km in diameter) but one that is very prominent due to its location on the northern edge of Mare Serenitatis, elevated above the lava of the mare, in the center of a dorsum that runs from north to south. In this text we discussed about nature a kind of bright strip that runs from east to west (that is, cutting transversally the dorsum that crosses Luther, and parallel to the segment of wrinkle ridge that ends in Posidonius Y, which is located on Dorsa Smirnov). Now, this bright strip (which we see in IMAGE 1, which already appeared in the aforementioned issue of December 2021) has a very peculiar appearance: 1) Its brightness, very slight, is uniform throughout the entire length of the strip; 2) it seems to overlap the terrain and, even, 3) covering the shadow cast by the dorsum that runs from north to south to the west, as if the wrinkle ridge were below and the bright stripe passed over it as if it were a bridge, as we see in IMAGE 2, which is a detail of page 243 of Volume 1 of the magnificent "Photographic Lunar Atlas for Moon observers" by Kwok C. Pau. It clearly shows the strip and its location, and IMAGE 3 is a detail that we obtained by enlarging IMAGE 2.

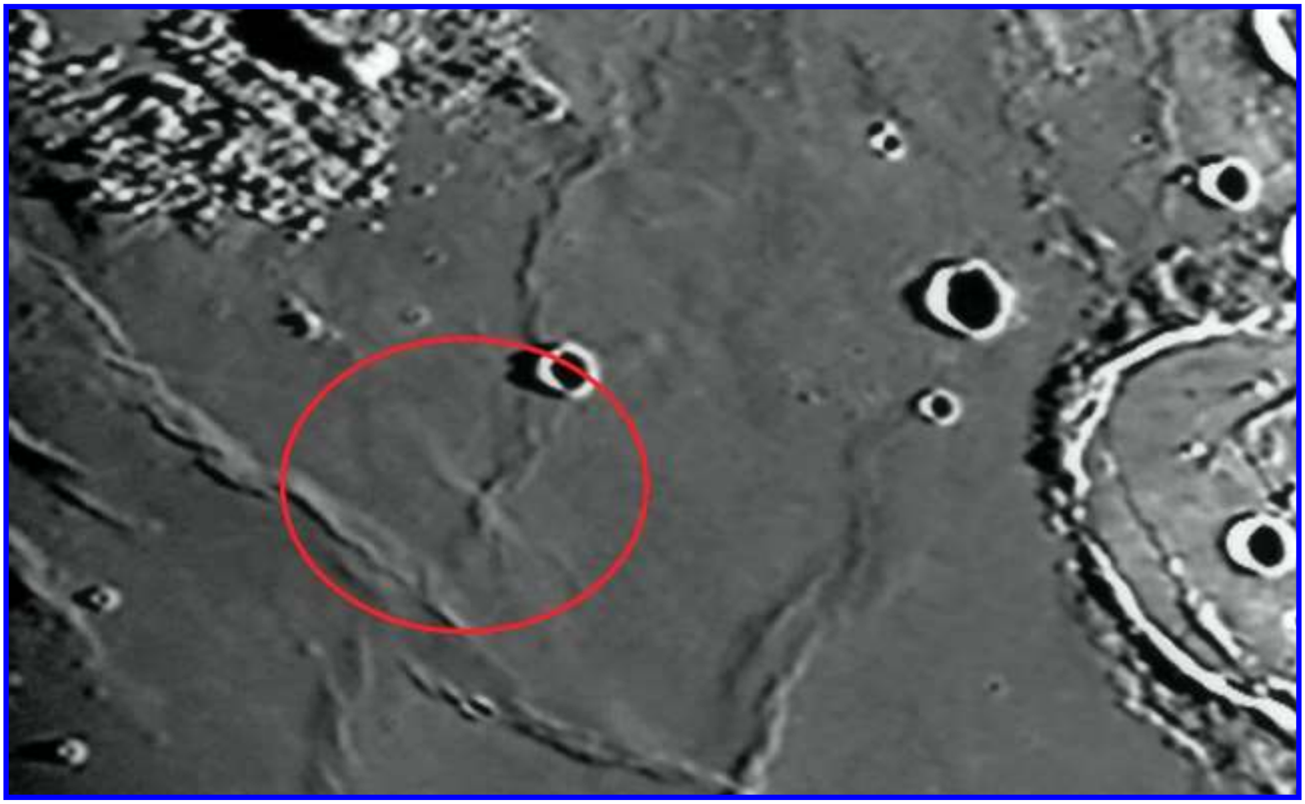
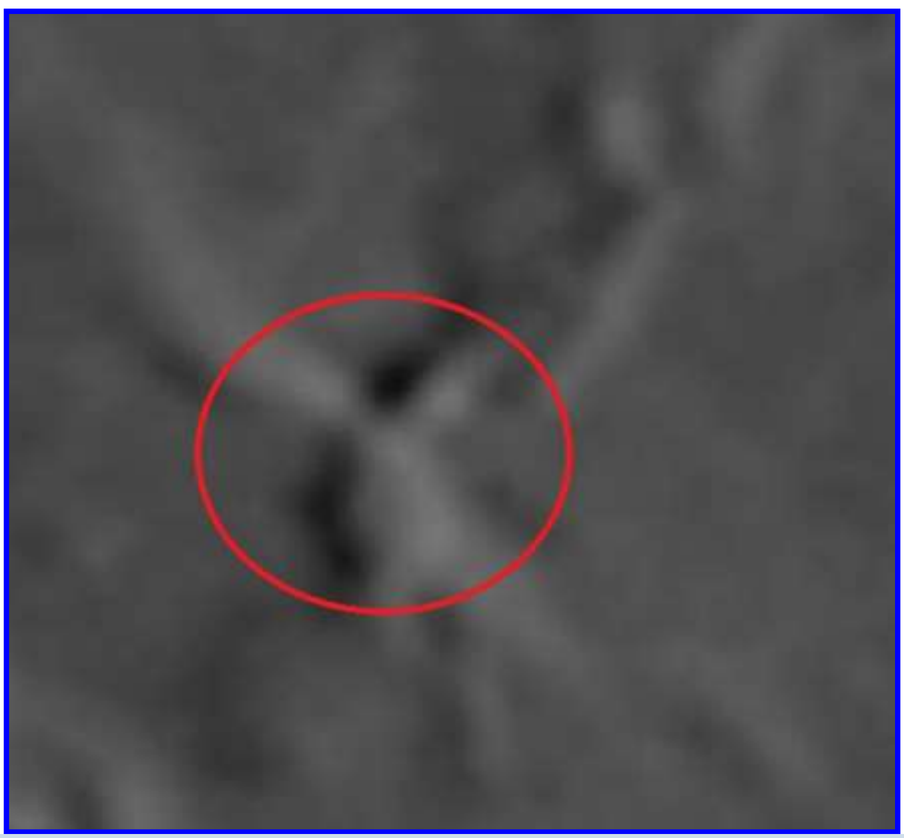


Image 2, Luther, *Photographic Lunar Atlas for Moon Observers, Volume 1, page 243 by KC Pau. Below,* ***Image 3****, a close-up of image 2.*



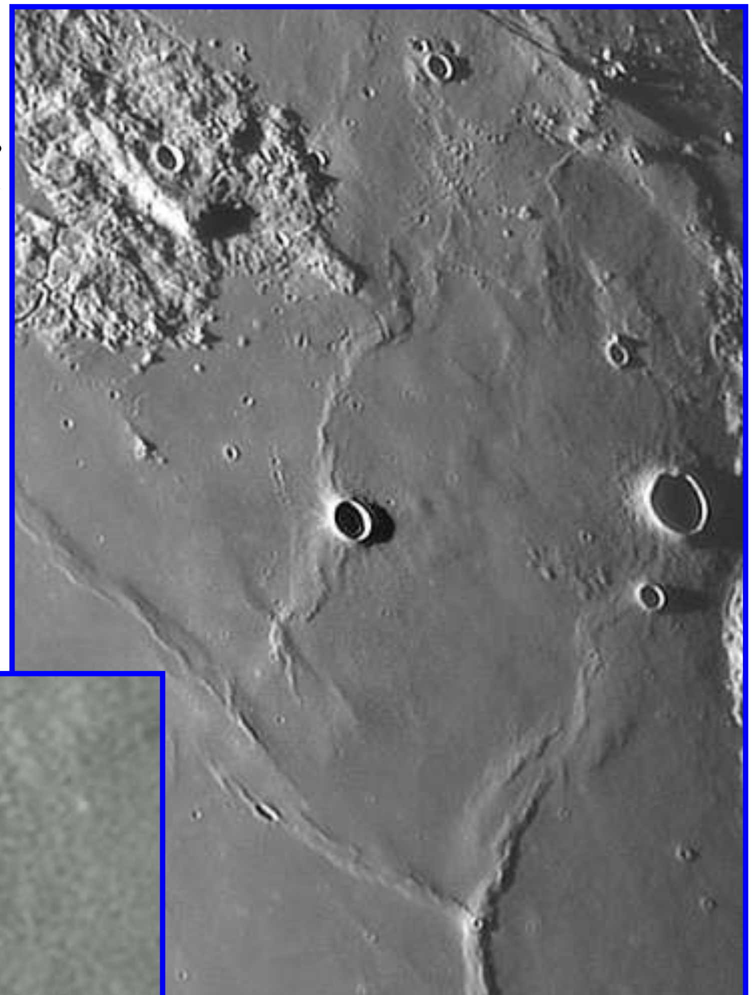
The similarity with a bright ray is a conceptual approximation that we can quickly rule out, since there are no craters with bright rays in the vicinity, it is clearly seen in illumination conditions not conducive to the observation of bright rays and, in addition, its brightness is more defined than a bright ray. Now, reflecting on this area (when you find yourself thinking about an area of the Moon while walking to work, perhaps you should consult a psychologist), I remembered that an image of the friends of Trapecio Austral de Mar del Plata in which you can see a Kepler or Copernicus ray passing over a dorsum (IMAGE 4) and clearly the appearance is very different. Here we have to make a comment, related to visual observation: the bright stripe seems to be uniform and without details behind the eyepiece of my small telescope, in the photographic images that we will see of the area in this text they show more detail, more resolution, and it is more difficult for them to show the bright stripe appearance that visual observation reveals.

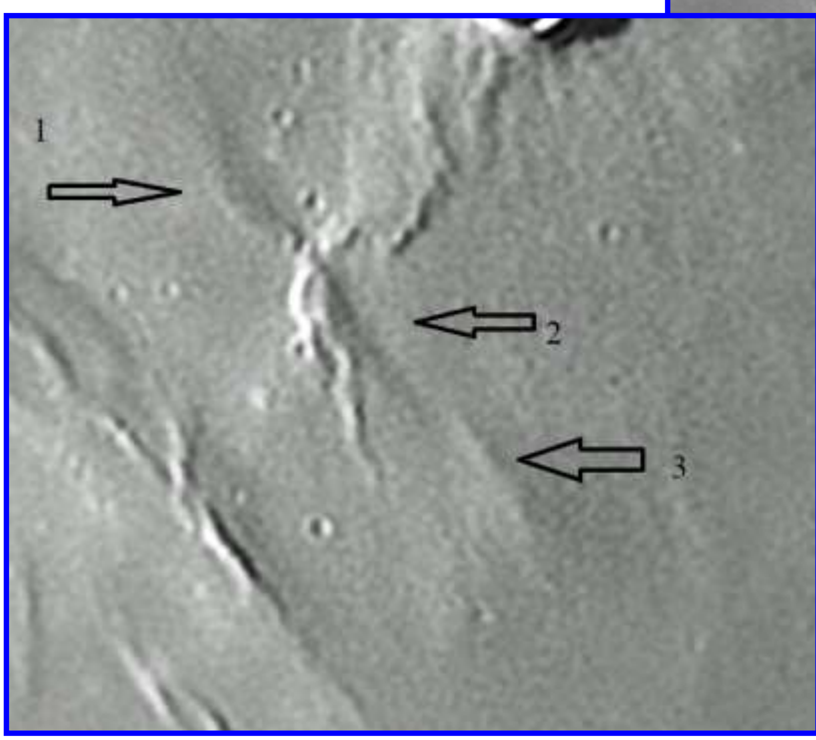
***Image 4, Herodotus,** Eduardo Horacek-Esteban Andrada, Mar del Plata, Argentina. 2021 August 20 00:22 UT. 150 mm Maksutov-Cassegrain telescope, Canon EOS Rebel T5i.*

So, it's a wrinkle ridge? To begin with, it does not appear in the catalog of the Lunar Reconnaissance Orbiter Quickmap (Map of lunar wrinkle ridges) of the LRO Quickmap, but if we look at IMAGE 2 and 3 of Kwok C. Pau, we notice that the relief of the "stripe" casts a shadow (especially in the western segment). Even so, although it casts a shadow, it does not have the appearance of a wrinkle ridge or dorsum, just compare it with the dorsum that intersects it in IMAGE 2. And, finally, the same brightness uniformity of the stripe, visually observed, is very different from the gradations of brightness that the highest areas of a typical dorsum present, the area does not seem to be so high as to appear with that brightness.

Reading the December 2021 issue by Kwok C. Pau provided us with IMAGE 5, which he sent me to my personal email and which broadened the vision of our area. Pau says: "It seems that the northern part of the bright ray is a ridge but the southern part looks like a linear depression or a light shadow casted higher terrain west of it. I checked with LROC QuickMap, it did not show any depression at that location". The Kwok's image allows for an enlargement, which is IMAGE 6. The northern segment referred to by Pau (1) casts a very slight shadow to the right and a very slight glow to the extreme left. In IMAGE 6 we see the details of the dorsum that Luther crosses and then the area that Pau rightly refers to as "a linear depression or a light shadow casted higher terrain west of it"; and then (3) follows what looks like a lift similar to the one marked 1.

__Image 5, Luther__, KC Pau, Hong Kong, China. 2018 September 29 21:14 UT. 10 inch f/6 reflector telescope, 2.5x barlow, QHYCCD290M camera. __Image 6__, below, is a close-up of image 5.





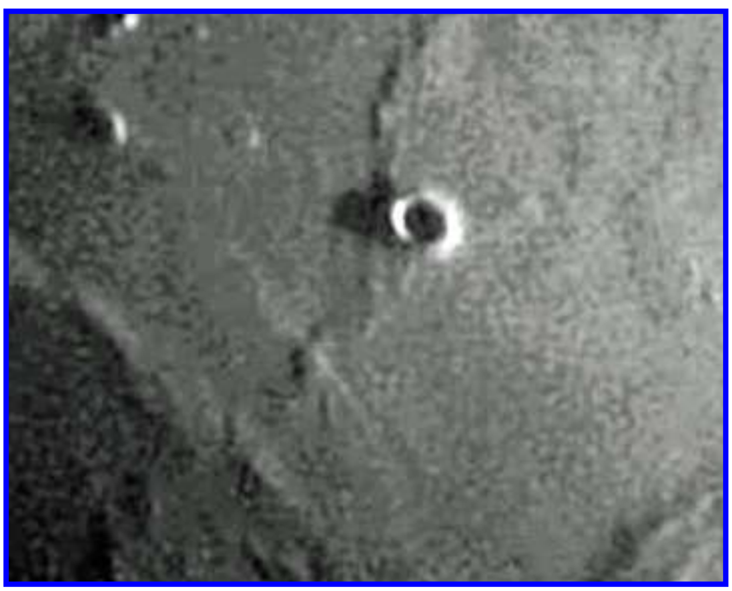
It was an immense pride that Kwok C. Pau, whom we admire, read our text and contributed to this little selenographic enigma, and another beautiful surprise would come later. At the 2022 ALPO Conference we presented our work “Is visual observation of the Moon still worthy?” and we use as an example the observation of the area to which we are now referring. And another person we admire emerged, Rik Hill, who after listening to our presentation sent us a series of images of the area to which we refer and which we will now analyze. I strongly recommend visiting the wonderful lunar gallery of the Jim Loudon Observatory at: https://www.lpl.arizona.edu/~rhill/moonobs.html

Let's look at Rik's seven images, and try to pay attention to our area and not to the real wonders around like the splendid Floor Fractured Crater Posidonius. In all of them our area is seen perfectly, but it is not always seen in the same way.

Image 7, Posidonius, *Richard Hill, Loudon Observatory, Tucson, Arizona, USA. 2008 June 10 02:49 UT. Celestron 14 inch Schmidt-Cassegrain telescope, 2x barlow, UV/IR blocking filter, SPC900NC camera. Seeing 8/10. Image 7 close-up of Luther below.*

Image 8, Posidonius, *Richard Hill, Loudon Observatory, Tucson, Arizona, USA. 2012 October 19 23:38 UT. TEC 8 inch f/20 Maksutov-Cassegrain telescope, 656.3 nm filter, DMK21AU04 camera. Seeing 7/10. Image 8 close-up of Luther below.*

In IMAGES 7, 8 and 9 Rik captured the appearance of the bright stripe very similar to how we could see it visually and in the details (especially the detail in IMAGE 2) you can see how it passes over the dorsum intersecting Luther, even about the shadows IMAGE 10 and its detail shows the complex network of dorsa of Mare Serenitatis, especially the beautiful Dorsa Smirnov, and it is very useful to analyze if our relief is similar or not to the wrinkle ridges that appear on it. It really is a very different relief, isn't it? Rik also provided us with images where we don't see a bright stripe but… a dark stripe! Let's see the panorama of IMAGE 11 and its detail, we see the same in IMAGE 12, less sharp than IMAGE 11, although its detail is sharper than the detail of the previous image. Are we getting closer to a possible solution related to the difference in height, which makes us see the shadows to the north or the highlights to the south depending on the illumination? From what we would see the area, the pseudo wrinkle ridge, as a bright stripe in crescent moon and as a dark stripe in last quarter, as in IMAGES 11 and 12.



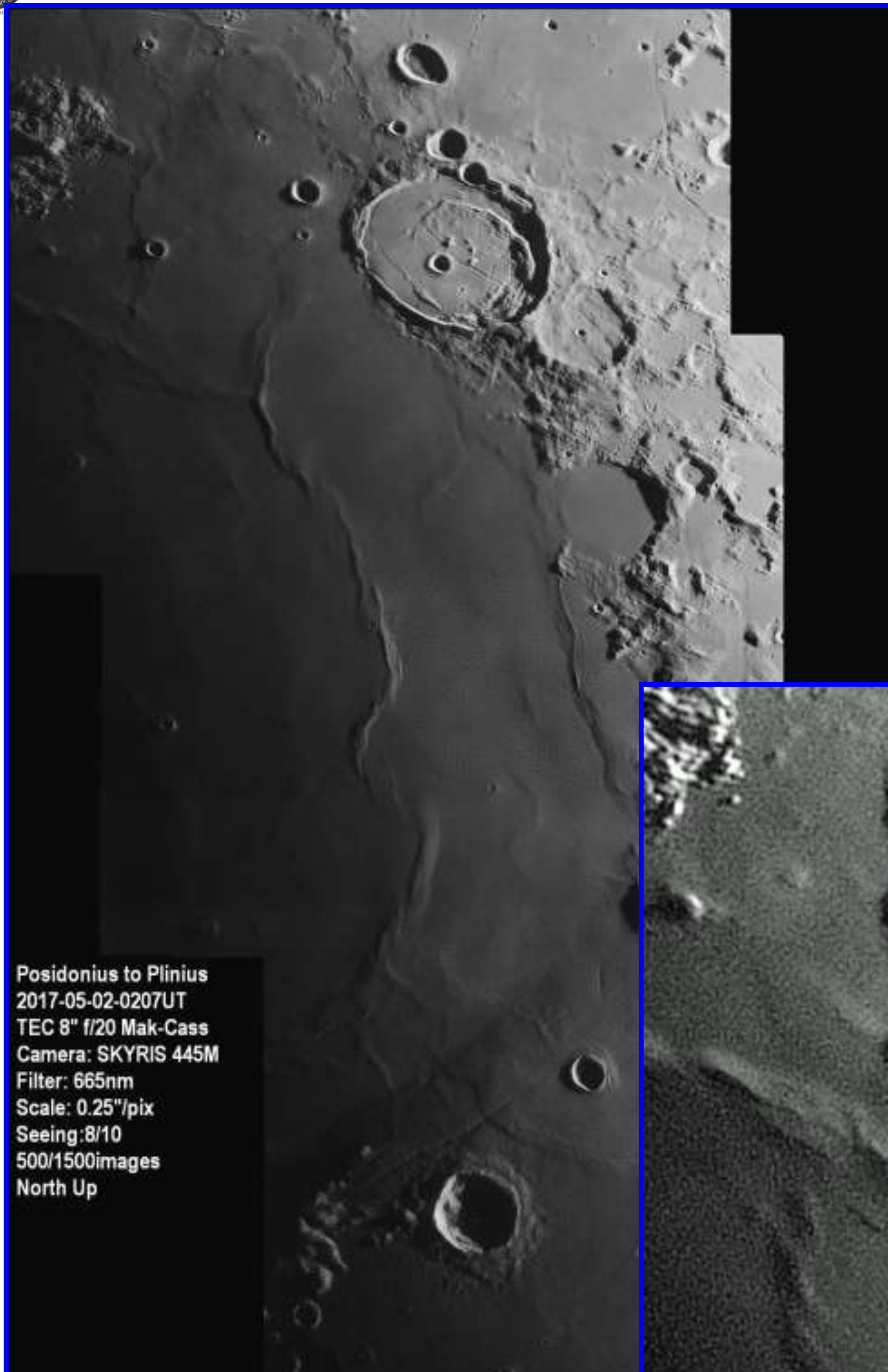
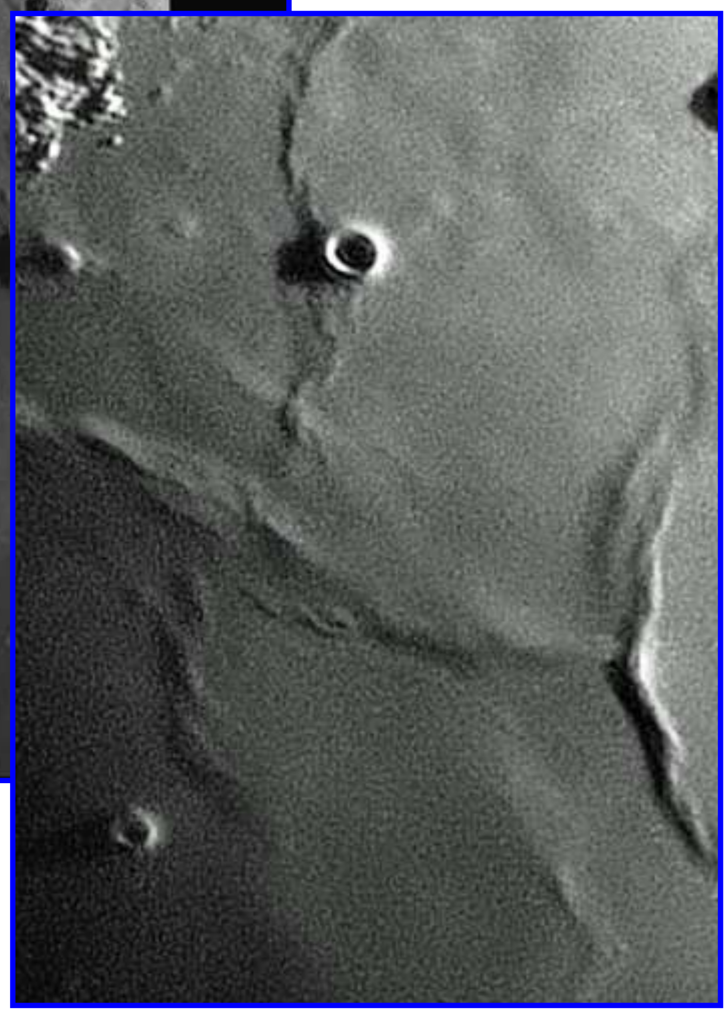


Image 9, Posidonius to Plinius, *Richard Hill, Loudon Observatory, Tucson, Arizona, USA. 2017 May 02 02:07 UT. TEC 8 inch f/20 Maksutov-Cassegrain telescope, 665 nm filter, SKYRIS 445M camera. Seeing 8/10. Image 9 close-up of Luther below.*



Lunar Topographic Studies
The Ghost Wrinkle Ridge Near Luther Revisited

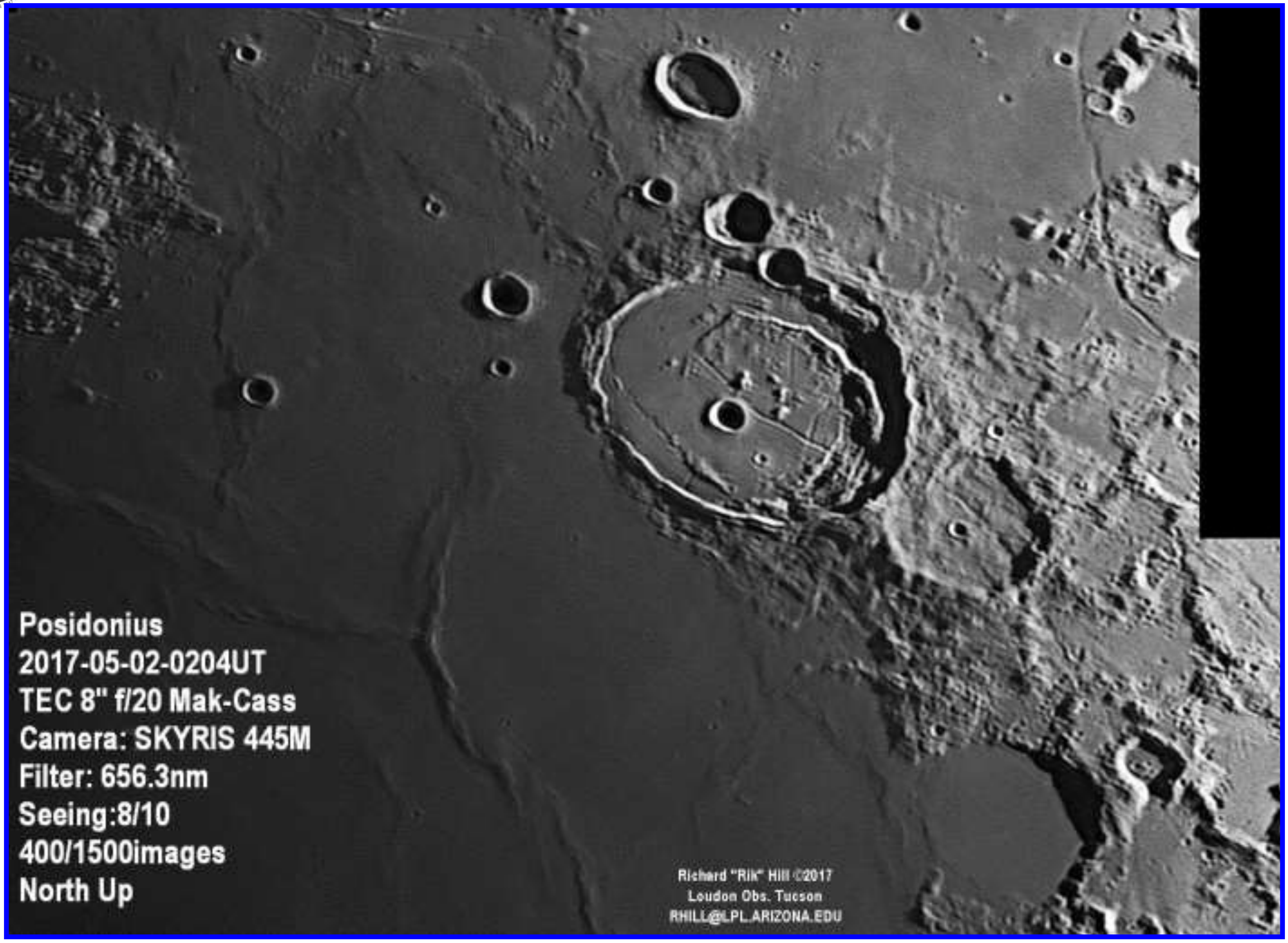
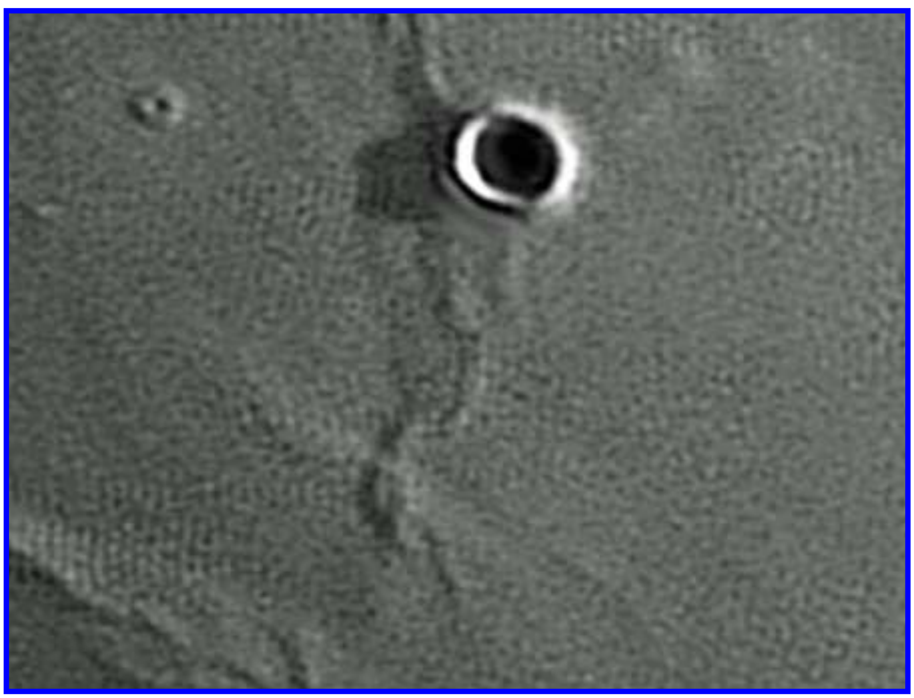


Image 10, Posidonius, *Richard Hill, Loudon Observatory, Tucson, Arizona, USA. 2017 May 02 02:04 UT. TEC 8 inch f/20 Maksutov-Cassegrain telescope, 656.3 nm filter, SKYRIS 445M camera. Seeing 8/10. Image 10 close-up of Luther to right.*



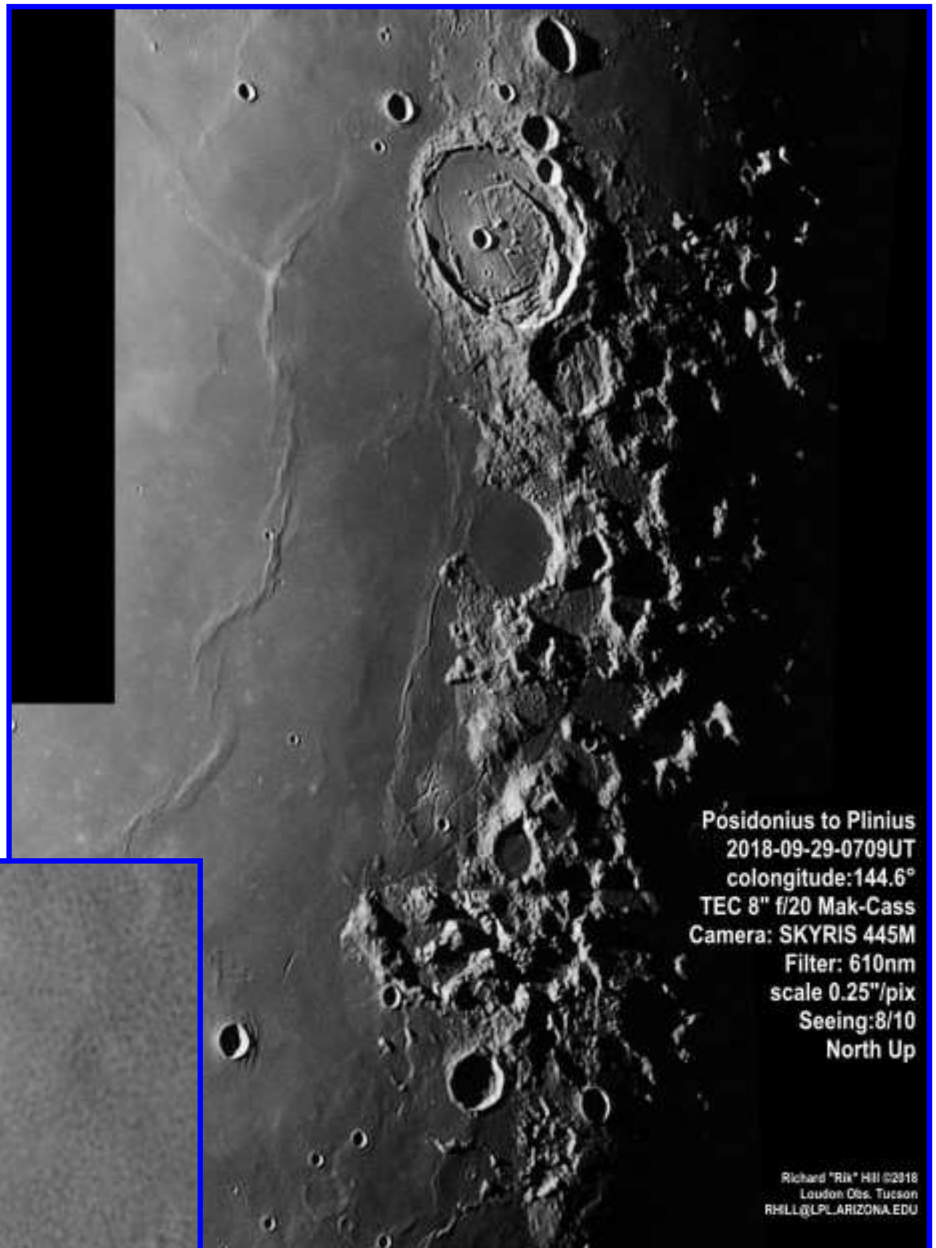
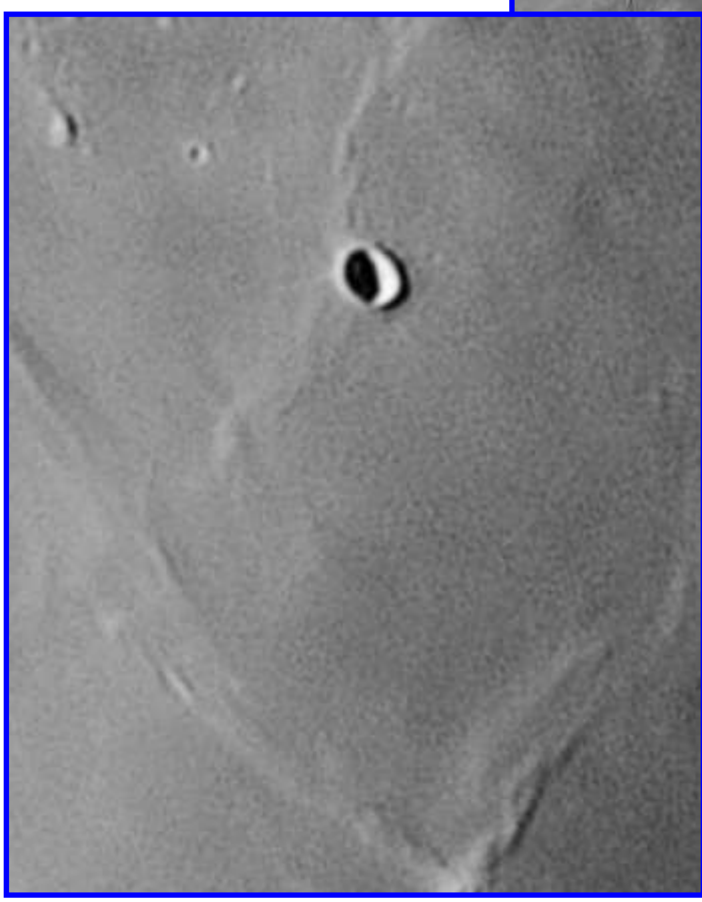
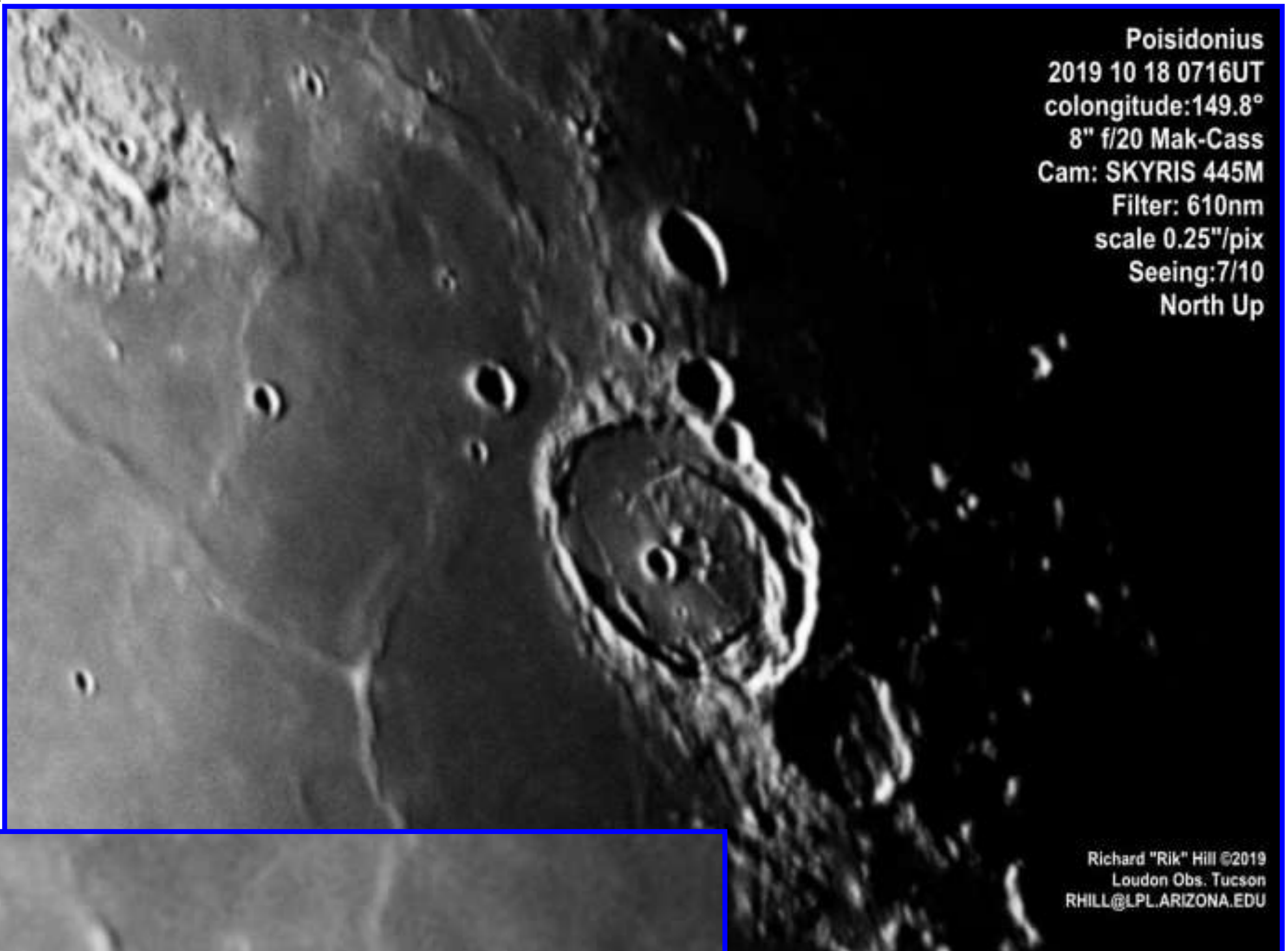


Image 11, Posidonius to Plinius, *Richard Hill, Loudon Observatory, Tucson, Arizona, USA. 2018 September 29 07:09 UT, colongitude 144.6°. TEC 8 inch f/20 Maksutov-Cassegrain telescope, 610 nm filter, SKYRIS 445M camera. Seeing 8/10. Image 11 close-up of Luther below.*



Lunar Topographic Studies
The Ghost Wrinkle Ridge Near Luther Revisited



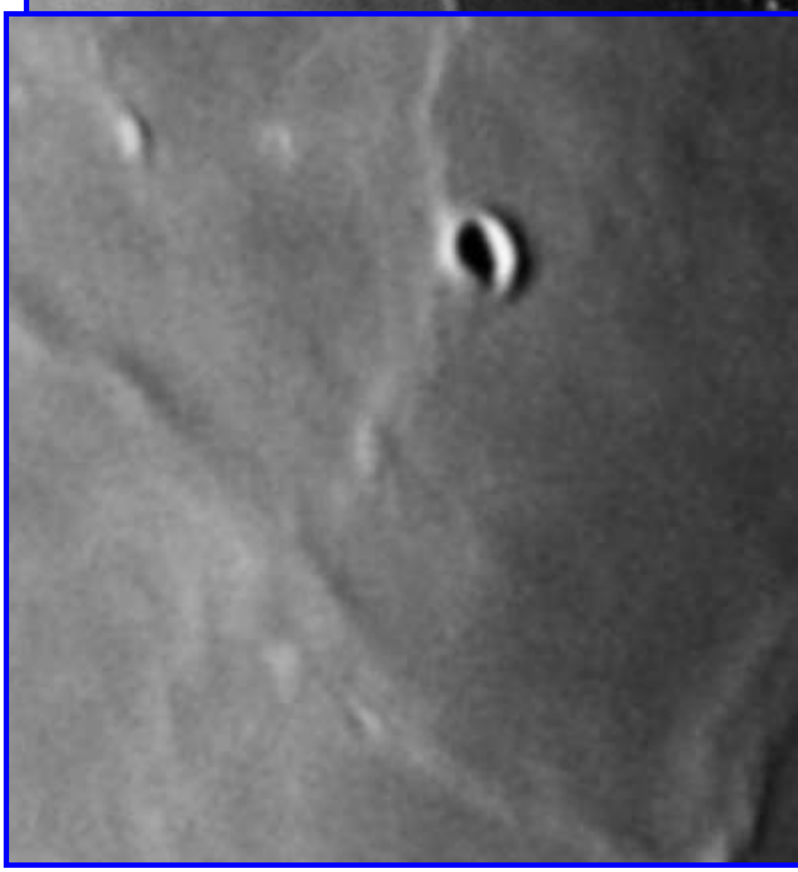


Image 12, Posidonius, *Richard Hill, Loudon Observatory, Tucson, Arizona, USA. 2019 October 18 07:16 UT, colongitude 149.8º. TEC 8 inch f/20 Maksutov-Cassegrain telescope, 610 nm filter, SKYRIS 445M camera. Seeing 7/10. Image 12 close-up of Luther to the left.*

Lunar Topographic Studies
The Ghost Wrinkle Ridge Near Luther Revisited

If we see the relief of the area, obtained from the data from the LOLA altimeter of the LRO probe (IMAGES 13 and 14), we clearly perceive that it has a strong slope towards the north, that is, towards Luther, which I had already observed towards a time visually in IMAGE 15, which would clearly help high areas to reflect light from the rising Sun and shadows from opposing lighting. So, have we solved the riddle? We could say that we have done it partially, based on the solution provided by Kwok Pau. It would be a pareidolia of a dorsum, composed of a low ridge to the west of the dorsum that intersects Luther and a linear depression that borders a very low ridge to the east. The brightness would be explained because the bright band (but dark in waning) indicates the edge of a steep slope of the terrain towards the Luther crater. What remains to be revealed is why the brightness of the strip overlaps the shadow projected by the dorsum that intersects Luther (as if it were a "bridge of light"), as can be seen in IMAGES 1, 2, 3 and with less intensity in IMAGES 7 to 10 and their details. Beyond this detail, which probably has to do with reflected light and the topography of the dorsum that intersects Luther, Pau's solution seems to be confirmed in Hill's images, especially IMAGE 16, in whose detail we even see certain details of the tiny ridge from the west, as shadow details on its south wall, which we mark with an arrow.

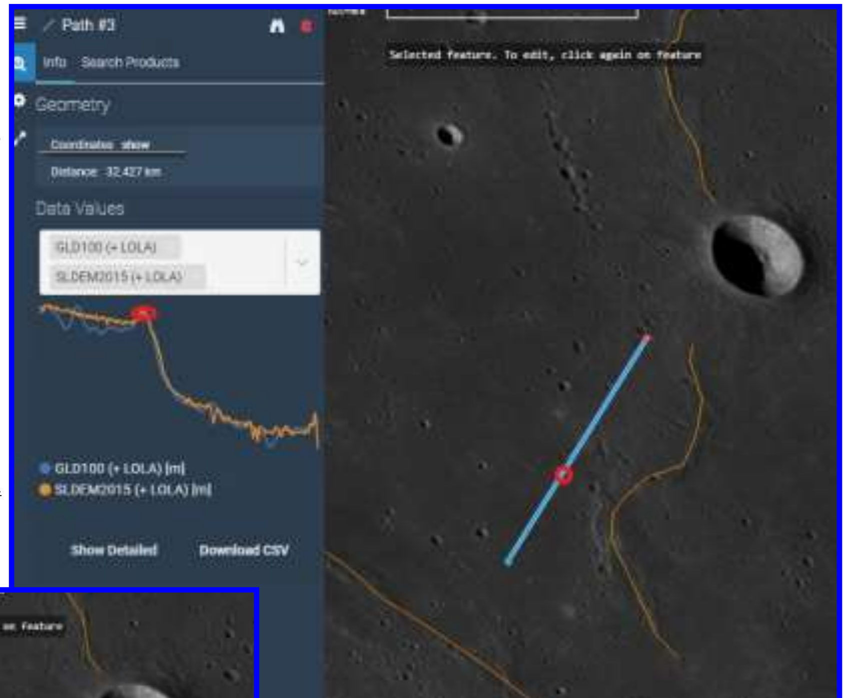
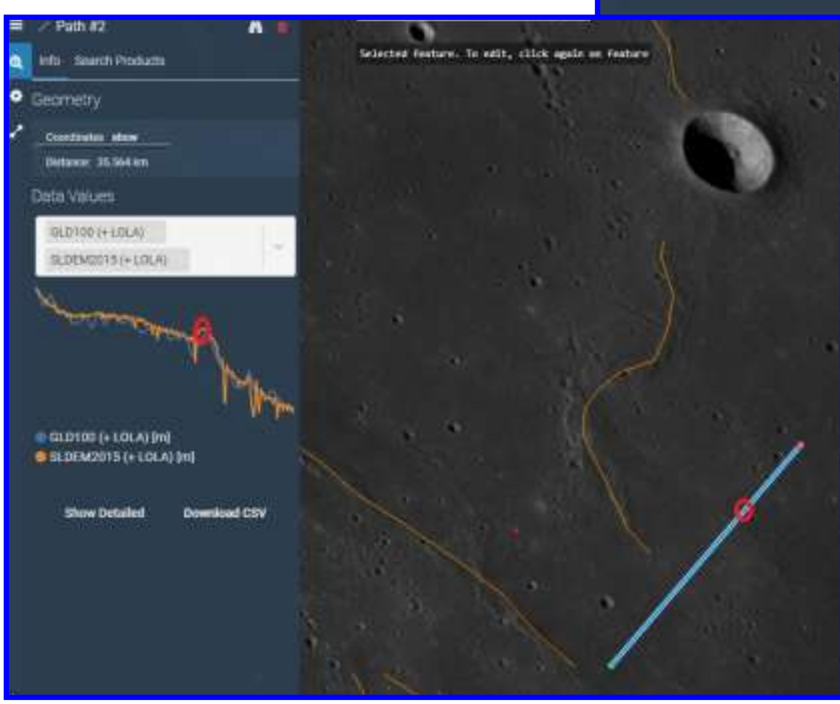


Image 13, right, Luther, *LRO LOLA southwest to northeast.*

Image 14, below, Luther, *LRO LOLA southwest to northeast.*



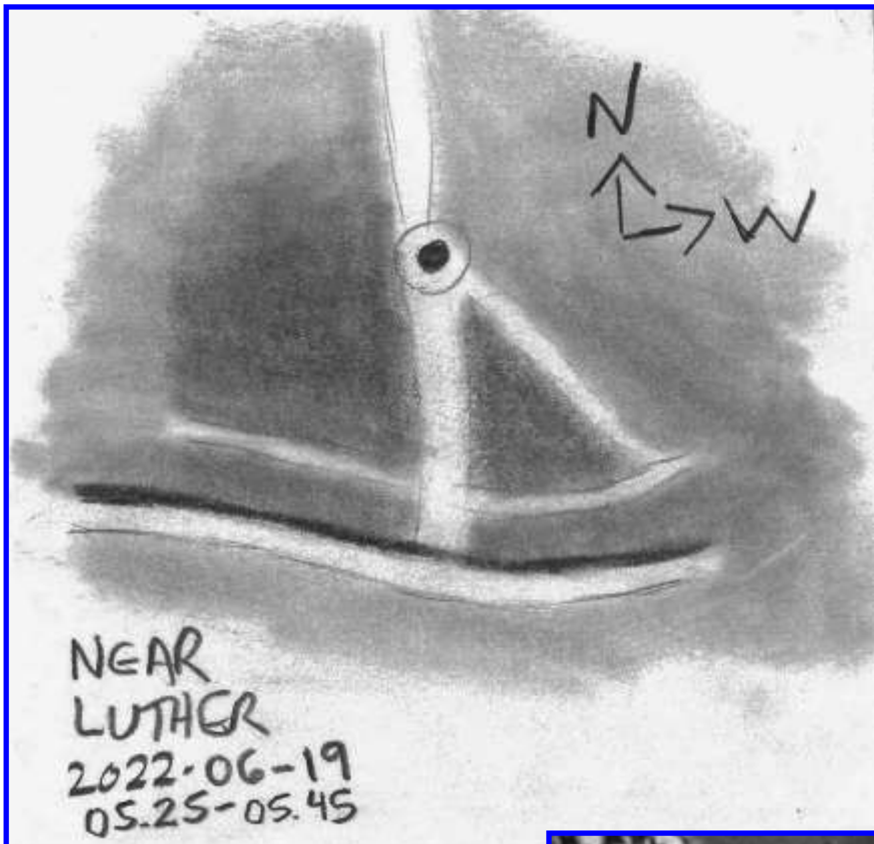


Image 15, Near Luther, *Alberto Anunziato, Paraná, Argentina. 2022 June 19 05:25-05:45 UT. Meade EX105 Maksutov-Cassegrain telescope, 154x.*

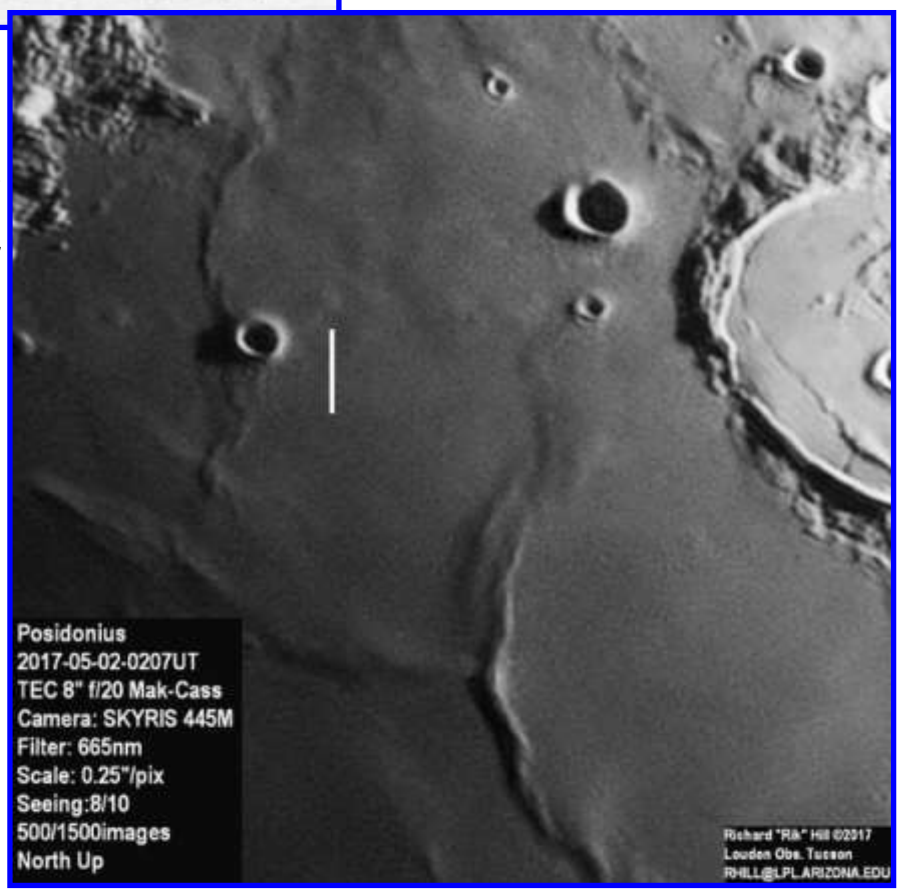


Image 16, Posidonius, *Richard Hill, Loudon Observatory, Tucson, Arizona, USA. 2017 May 02 02:07 UT. TEC 8 inch f/20 Maksutov -Cassegrain telescope, 665 nm filter, SKYRIS 445M camera. Seeing 8/10.*

Lunar Topographic Studies
The Ghost Wrinkle Ridge Near Luther Revisited

The most important conclusion, in my opinion, is to remark the importance of belonging to an association like ALPO, in which inexperienced but inquisitive observers, like me, are helped by expert and recognized observers like Kwok and Rik, creating an exchange that I hope, be interesting for the readers of our beloved *The Lunar Observer*.

Image 16, Posidonius-close-up, *Richard Hill, Loudon Observatory, Tucson, Arizona, USA. 2017 May 02 02:07 UT. TEC 8 inch f/20 Maksutov-Cassegrain telescope, 665 nm filter, SKYRIS 445M camera. Seeing 8/10.*

Lunar Topographic Studies
The Ghost Wrinkle Ridge Near Luther Revisited

The Northern Mountains

Rik Hill

Just south of the Montes Caucasus are the very dramatic northern peaks of the Montes Apenninus. At the top of the image is the shadow filled crater Autolycus (41 km dia.) and due south of that, in the shadow of the Montes is the Apollo 15, Hadley Rille base. Further south is the crater Conon (22 km) with Aratus (10 km) to the upper right of Conon. To the lower right from Autolycus there's the Rimae Fresnel. Just to the right of them is a shadow filled crater that appears to be sitting on top of a mountain. This is Santos-Dumont (8 km) a 2 km deep crater with Promontorium Fresnel just to the upper right of it casting a spectacular shadow back towards the Rimae. Below this crater is a double peaked mountain with the brighter peak on the right being Mons Hadley, a grand 4800 m high mountain. The reader is encouraged to identify all the peaks and features between Santos-Dumont and Conon using something like LROC Quick Map or Virtual Moon Atlas. It is a very rich area.

The large mare to the right is Mare Serenitatis. Along the south shoreline, at the bottom of this image, you can see more rimae, the Rimae Sulpicius Gallus. Above this are three parallel vertical "wrinkle ridges" or dorsa with Dorsum Von Cotta on the right, Dorsum Owen above and a bit left of it and finally Dorsum Gast on the left near the shore. On the southern end of Dorsum Owen, the shortest of these ridges, is a very strange and unique feature called Vallis Krishna combined with Rima Sung-Mai and on the left end Yoshi. You will need a good steady sky and high magnification for this feature as it is only 3 km across and 2 km high. I recommend visiting Vallis Krishna on *the-moon.us/wiki* website first to understand this area. It is well worth the time spent.

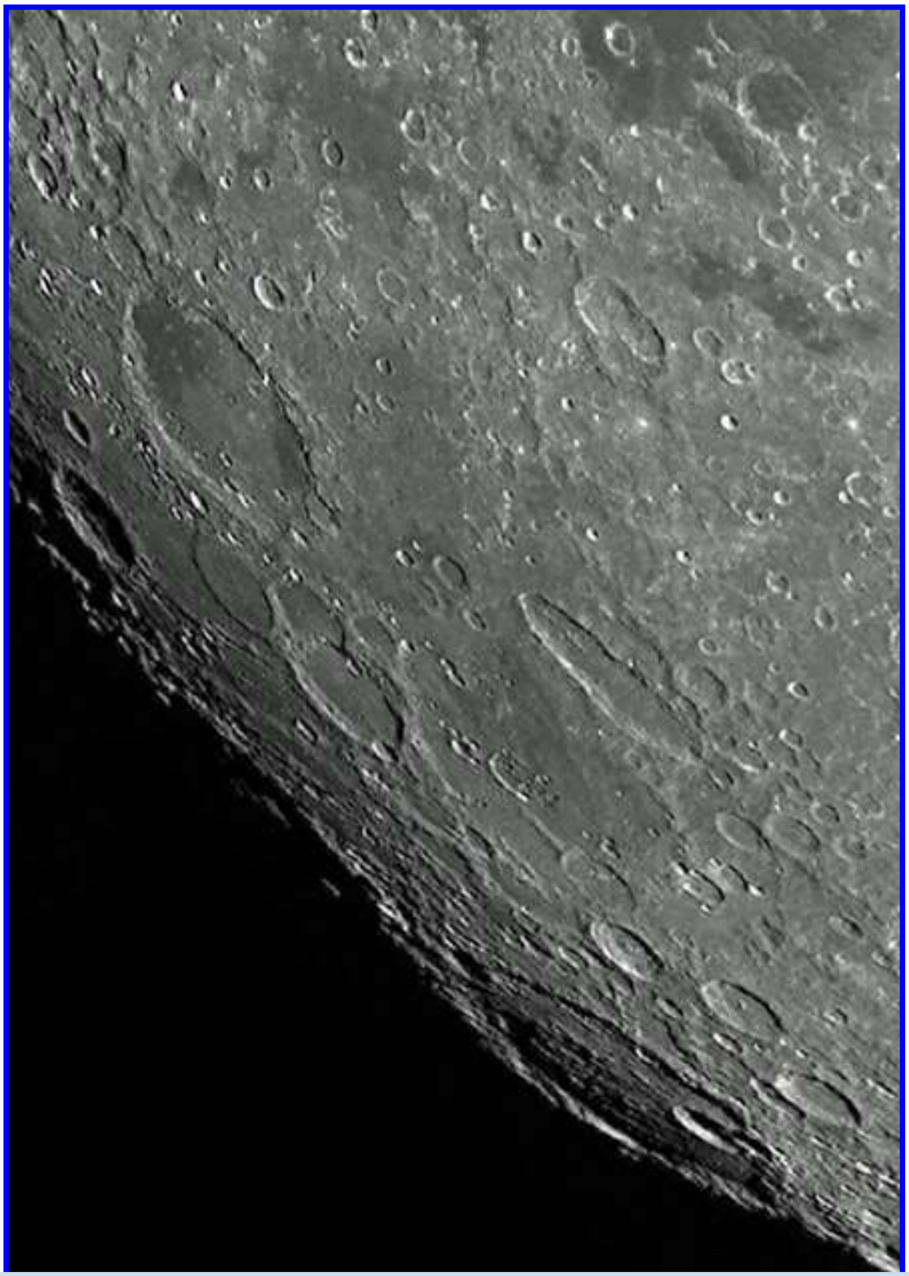
Lastly, Dorsum Von Cotta points due north to a white spot that is an ejecta blanket for the small crater Linné in the middle of the ejecta. This is the crater that had been observed in antiquity as ranging from 8 to 10 km diameter on different atlases, but was reported missing by J.F.J Schmidt in 1866 at the National Observatory of Athens using the 158 mm refractor, then the largest instrument they had. After much controversy and argument (that did include some observations!) it was been proven to be a 3 km diameter crater, which is difficult to see from Earth again requiring a good steady sky and high magnifications. Go and see for yourself, it's a delightful challenge!

Montes Apenninus, *Richard Hill, Loudon Observatory, Tucson, Arizona, USA. 2023 February 28 02:35 UT, colongitude 3.4°. TEC 8 inch f/20 Maksutov-Cassegrain telescope, 610 nm filter, Skyris 132M camera. Seeing 8/10.*

Lunar Topographic Studies
The Northern Mountains

Footprints of Giants
David Teske

Okay, I know that there are no footprints in this image, but… Whenever I see this region of the Moon, I see giant footprints. In the center left of this image, the large crater Phocylides (114 km) forms the 'sole' of a boot, while Nasymth (77 km) forms the 'heel' of that boot. Just west (left) of these two giant craters is the very unusual crater Wargentin (84 km) that has been filled to its rim with dark mare lava. Look carefully and you will even see wrinkle ridges on its surface. Only the southern end of Wargentin near Nasmyth is not overrun with flooding lava. West of Wargentin near the terminator is the crisp crater Inghirami (91 km). The giant crater to the northwest of center is Schickard (227 km). It has a much lighter hued mid-section compared to its northern and southern ends. This is likely due to impact ejecta from the formation of the Orientale Basin, just around the terminator. In the upper right of center is another 'footprint', that of the crater Hainzel. This very complex crater resulted from more than one impact forming an elongated crater. My last 'footprint' here is none other than the mighty crater Schiller. This very elongated crater is 179 x 71 km in size, again formed from multiple asteroid impacts long ago. With imagination, I see the north end of Schiller as the 'heel' and the larger end of it to the south as the 'sole'. It is oriented much like the Phocylides-Nasmyth pair. We can't leave this region without mentioning the real giant here, crater Bailly. At 303 km in diameter, this is the largest crater visible on the lunar nearside. When I observed this, libration was very favorable.



Schickard to Bailly, *David Teske, Louisville, Mississippi, USA. 2023 February 04 02:46 UT, colongitude 68.5º. 3.5 inch Questar Maksutov-Cassegrain telescope, ZWO ASI120MM/S camera. Seeing 8/10.*

Lunar Topographic Studies
Footprints of Giants

Aristarchus, *Fabio Verza, SNdR, Milan, Italy. 2023 March 04 20:46 UT. Takahashi 210 mm Mewlon Dall-Kirkham telescope, Astronomik ProPlanet IT 642 nm filter, Player One Saturn M camera.*

Copernicus, *Don Capone, Waxahachie, Texas, USA. 2023 March 04 02:37 UT. 16 inch Dobsonian reflector telescope, UV/IR filter, ASI 678MC camera.*

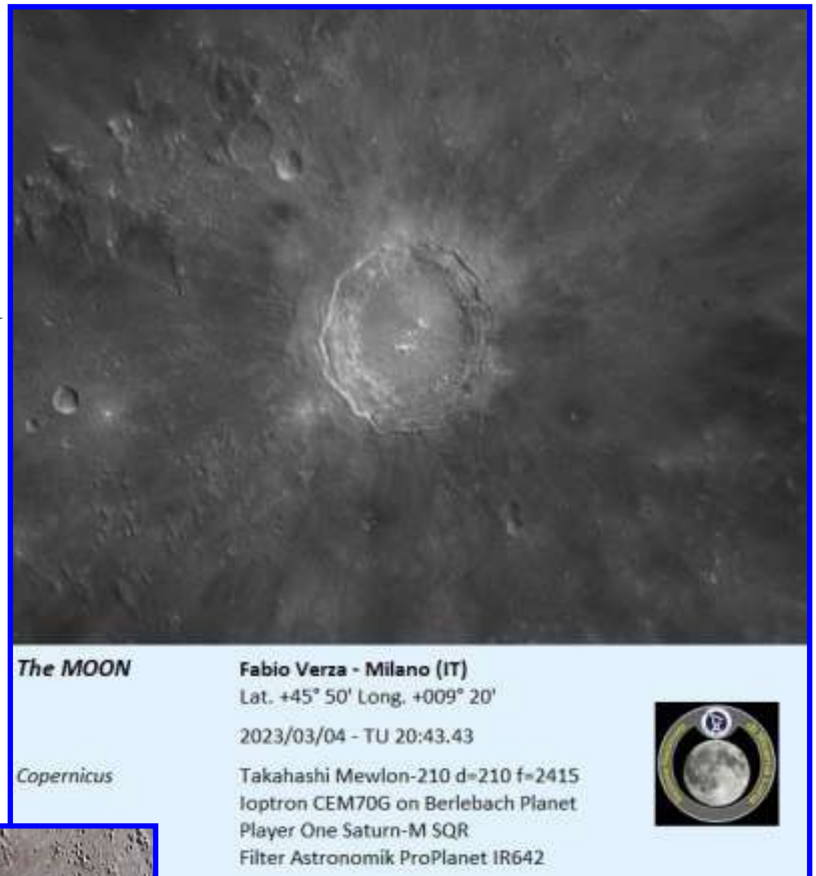
Recent Topographic Studies

Clavius, *Fabio Verza, SNdR, Milan, Italy. 2023 March 04 21:23 UT. Takahashi 210 mm Mewlon Dall-Kirkham telescope, Astronomik ProPlanet IT 642 nm filter, Player One Saturn M camera.*

Tycho, *Don Capone, Waxahachie, Texas, USA. 2023 March 04 03:59 UT. 16 inch Dobsonian reflector telescope, UV/IR filter, ASI 678MC camera*

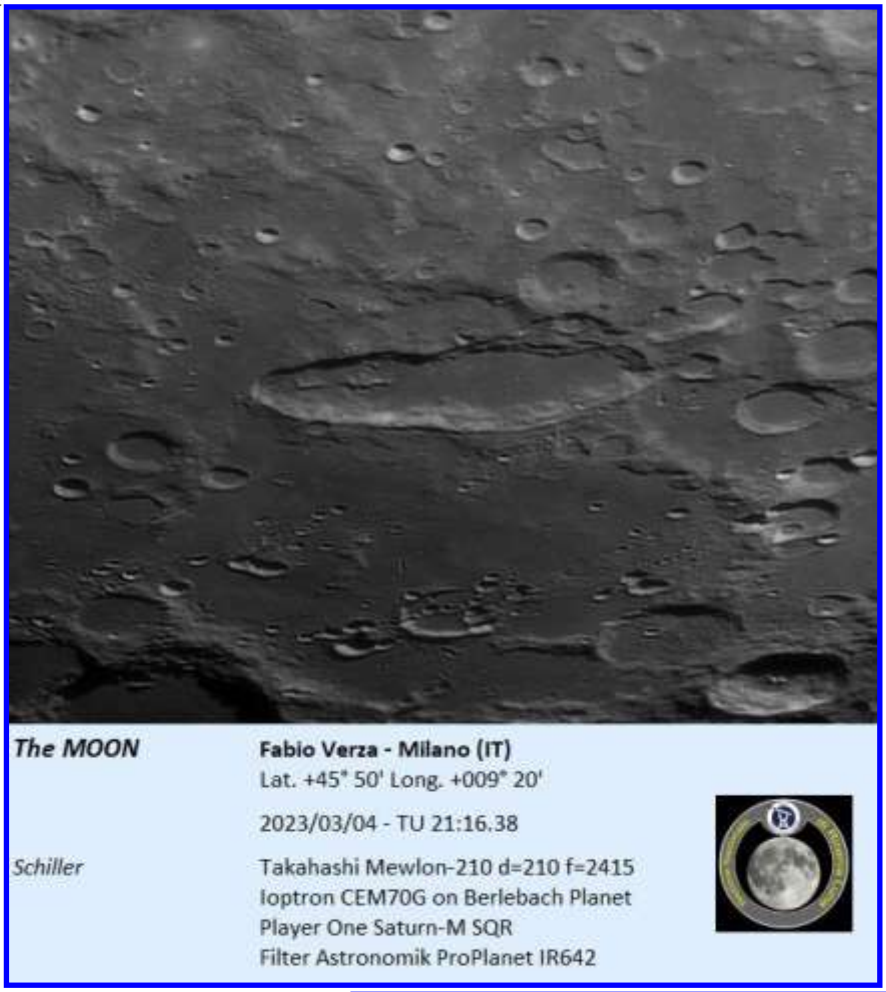
Recent Topographic Studies

Copernicus, *Fabio Verza, SNdR, Milan, Italy. 2023 March 04 20:43 UT. Takahashi 210 mm Mewlon Dall-Kirkham telescope, Astronomik Pro-Planet IT 642 nm filter, Player One Saturn M camera.*

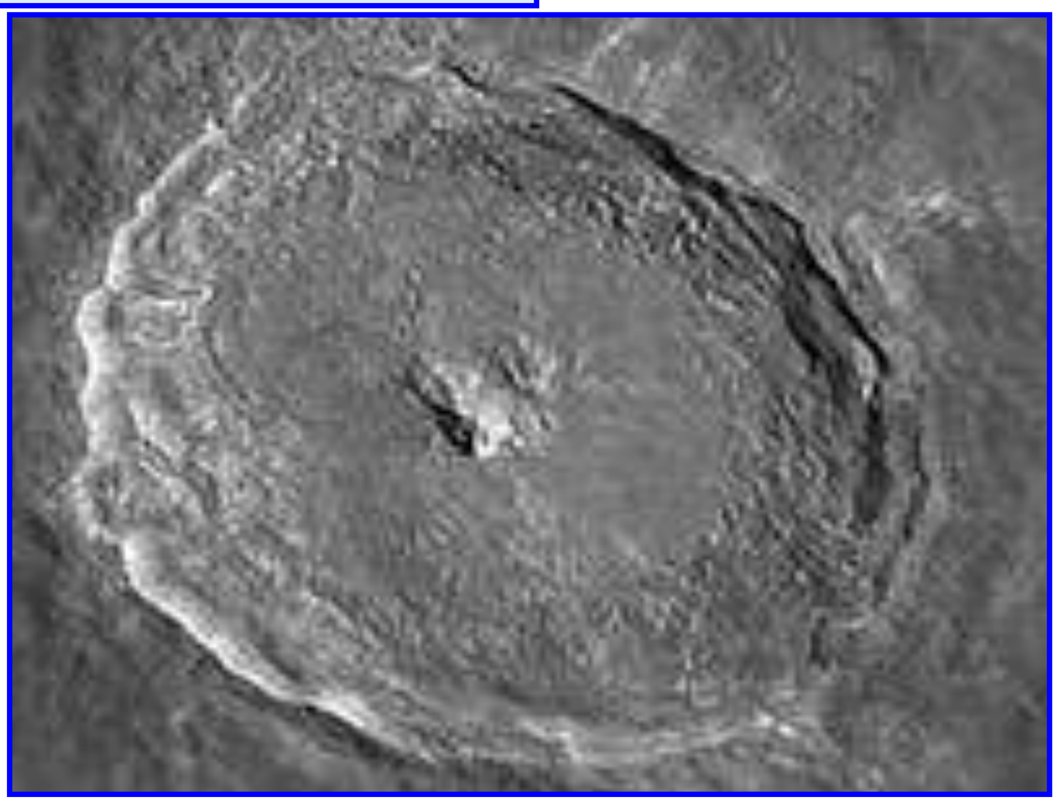


Kepler and Encke, *Don Capone, Waxahachie, Texas, USA. 2023 March 04 02:40 UT. 16 inch Dobsonian reflector telescope, UV/IR filter, ASI 678MC camera.*

Recent Topographic Studies



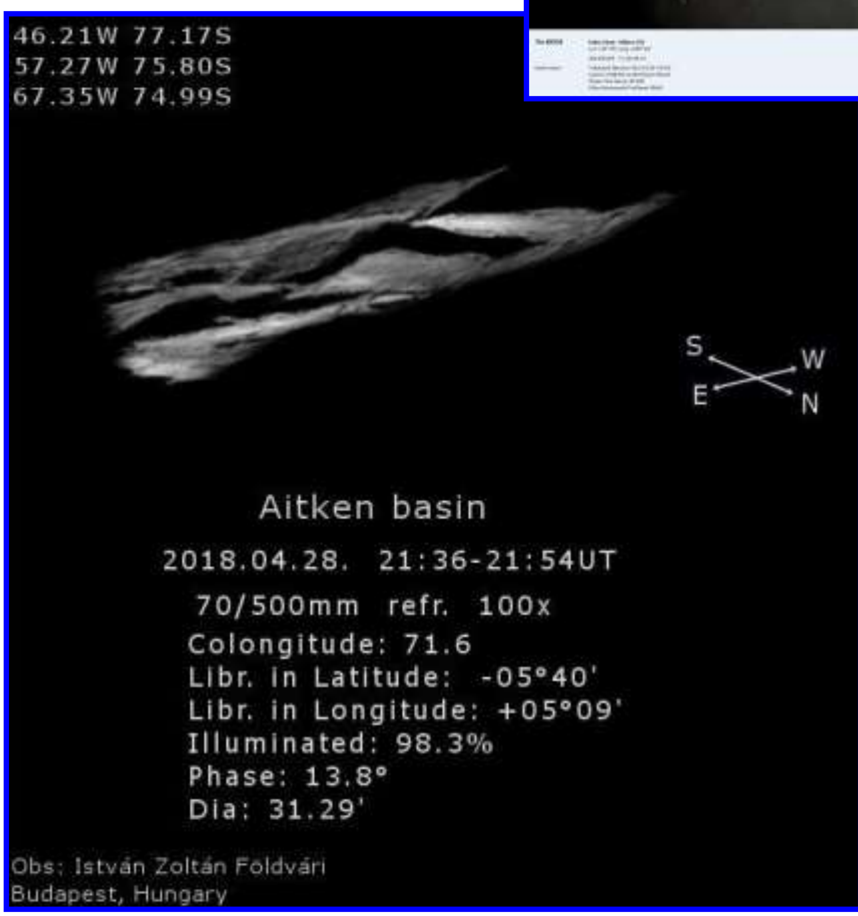
Schiller, *Fabio Verza, SNdR, Milan, Italy. 2023 March 04 21:16 UT. Takahashi 210 mm Mewlon Dall-Kirkham telescope, Astronomik ProPlanet IT 642 nm filter, Player One Saturn M camera.*



Tycho, *Massimo Bianchi, Milan, Italy. 2023 March 04 19:21 UT. Vixen VMC 260L Maksutov-Cassegrain telescope, Baader green filter, ASI178 MM camera. Transparency 3/6, seeing 7/10.*

Recent Topographic Studies

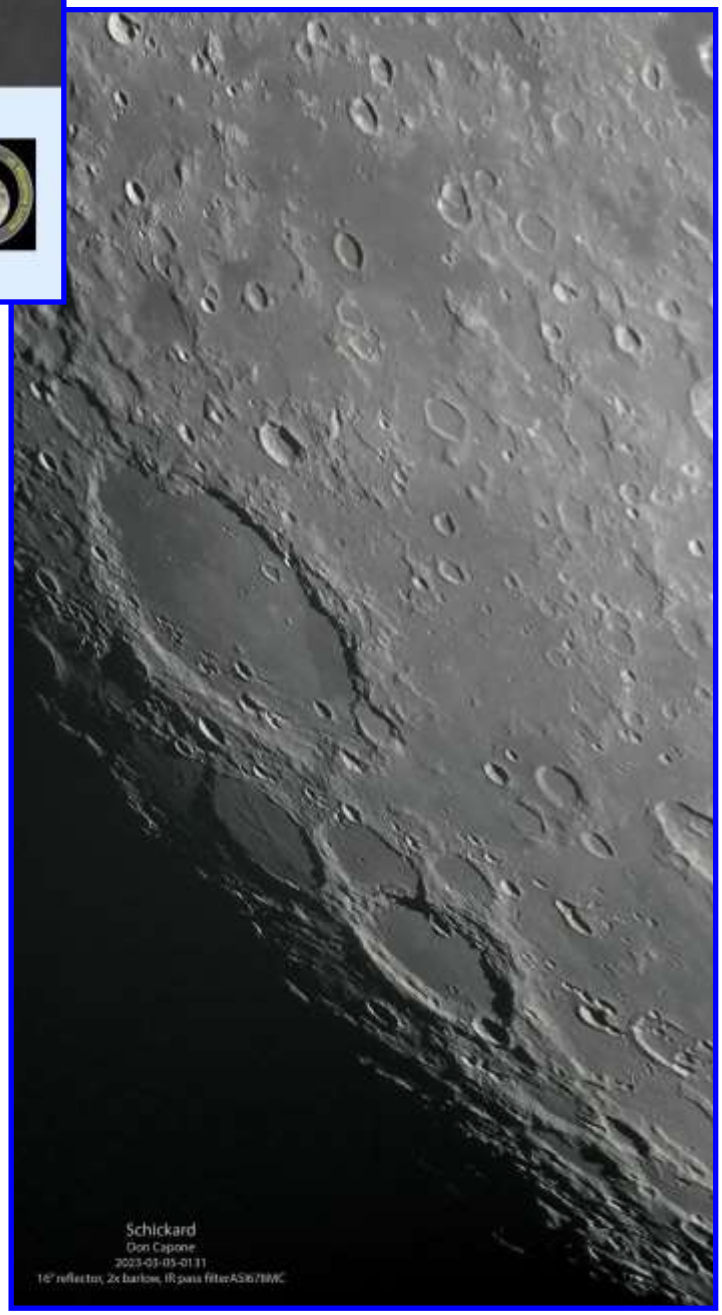
***Northern Moon,** Fabio Verza, SNdR, Milan, Italy. 2023 March 04 20:39 UT. Takahashi 210 mm Mewlon Dall-Kirkham telescope, Astronomik ProPlanet IT 642 nm filter, Player One Saturn M camera.*



***Aitken Basin,** István Zoltán Földvári, Budapest, Hungary. 2018 April 28, 21:36-21:54 UT, colongitude 71.6°. 70 mm refractor telescope, 500 mm focal length, 10 mm Plossl, 2x barlow, 100x. Seeing 4/10, transparency 5/6.*

Recent Topographic Studies

Sinus Iridum, *Fabio Verza, SNdR, Milan, Italy. 2023 March 04 20:38 UT. Takahashi 210 mm Mewlon Dall-Kirkham telescope, Astronomik Pro-Planet IT 642 nm filter, Player One Saturn M camera.*



Schickard, *Don Capone, Waxahachie, Texas, USA. 2023 March 05 01:31 UT. 16 inch Dobsonian reflector telescope, 2x barlow, IR pass filter, ASI 678MC camera.*

Recent Topographic Studies

Lunar South Pole, *Fabio Verza, SNdR, Milan, Italy. 2023 March 04 21:26 UT. Takahashi 210 mm Mewlon Dall-Kirkham telescope, Astronomik ProPlanet IT 642 nm filter, Player One Saturn M camera.*

Sinus Iridum, *Massimo Bianchi, Milan, Italy. 2023 March 04 19:16 UT. Vixen VMC 260L Maksutov-Cassegrain telescope, Baader green filter, ASI178 MM camera. Transparency 3/6, seeing 7/10.*

Recent Topographic Studies

Tycho, *Fabio Verza, SNdR, Milan, Italy. 2023 March 04 21:12 UT. Takahashi 210 mm Mewlon Dall-Kirkham telescope, Astronomik ProPlanet IT 642 nm filter, Player One Saturn M camera.*

Fabio Verza and the new Mewlon

Recent Topographic Studies

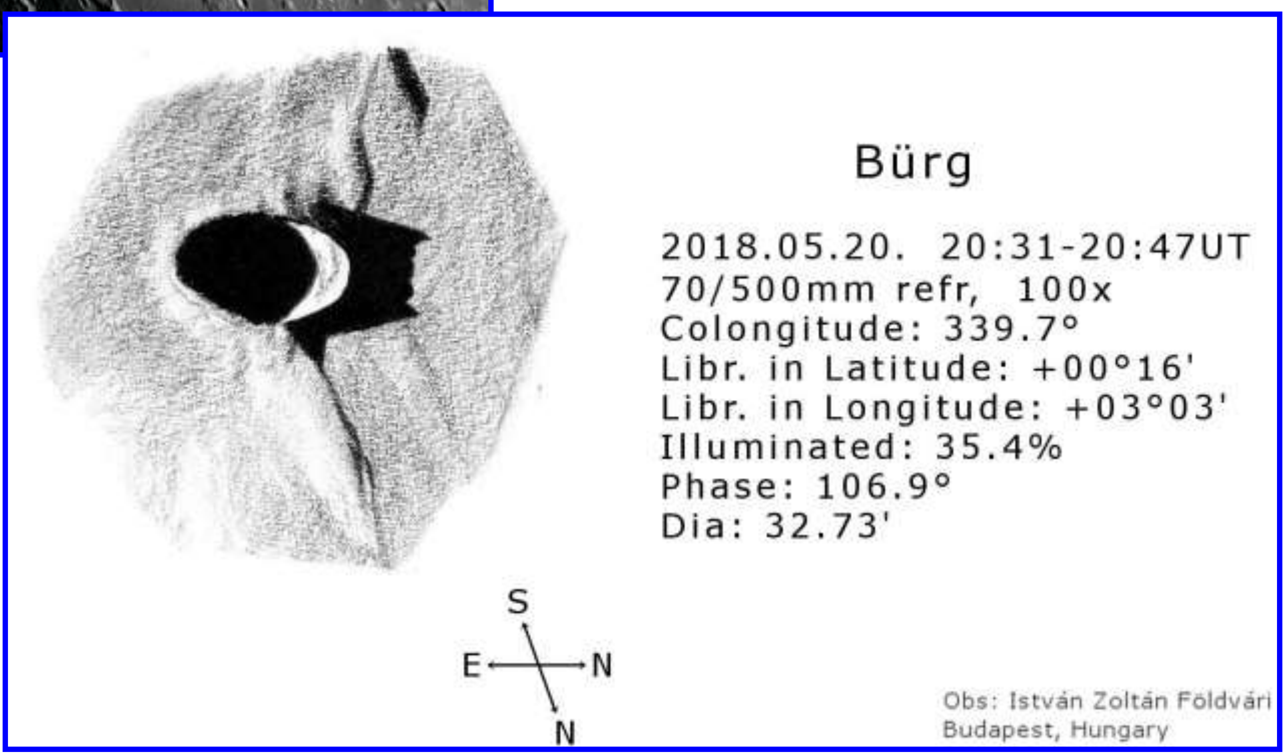
Copernicus to Kepler, *Don Capone, Waxahachie, Texas, USA. 2023 March 04 00:44 UT. 16 inch Dobsonian reflector telescope, UV/IR filter, ASI 678MC camera.*

Clavius, *Massimo Bianchi, Milan, Italy. 2023 March 04 19:28 UT. Vixen VMC 260L Maksutov-Cassegrain telescope, Baader green filter, ASI178 MM camera. Transparency 3/6, seeing 7/10.*

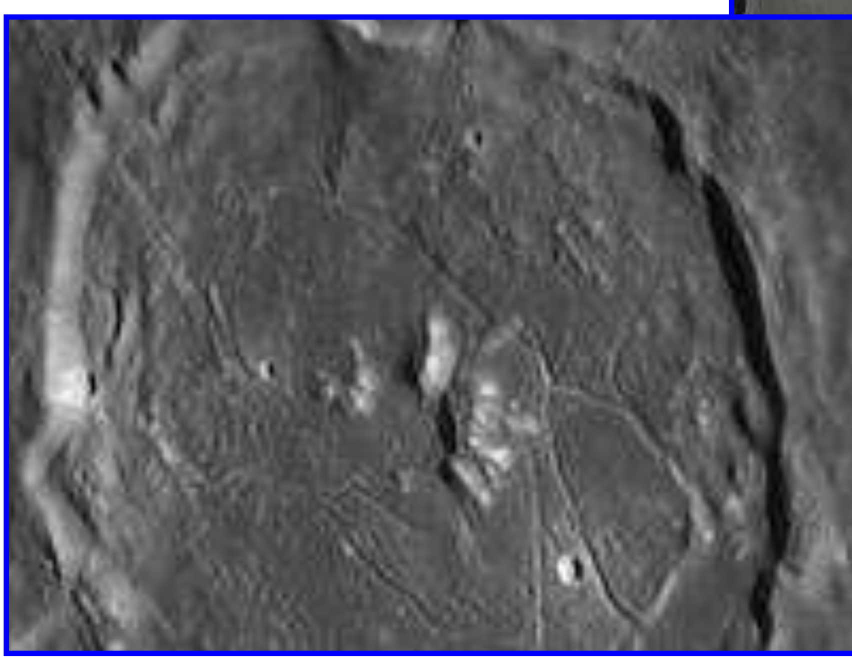
Recent Topographic Studies

Gassendi, *Don Capone, Waxahachie, Texas, USA. 2023 March 05 01:46 UT. 16 inch Dobsonian reflector telescope, 2x barlow, IR pass filter, ASI 678MC camera.*

Bürg, *István Zoltán Földvári, Budapest, Hungary. 2018 May 20, 20:31-20:47 UT, colongitude 339.7°. 70 mm refractor telescope, 500 mm focal length, 10 mm Plossl, 2x barlow, 100x. Seeing 6/10, transparency 4/6.*



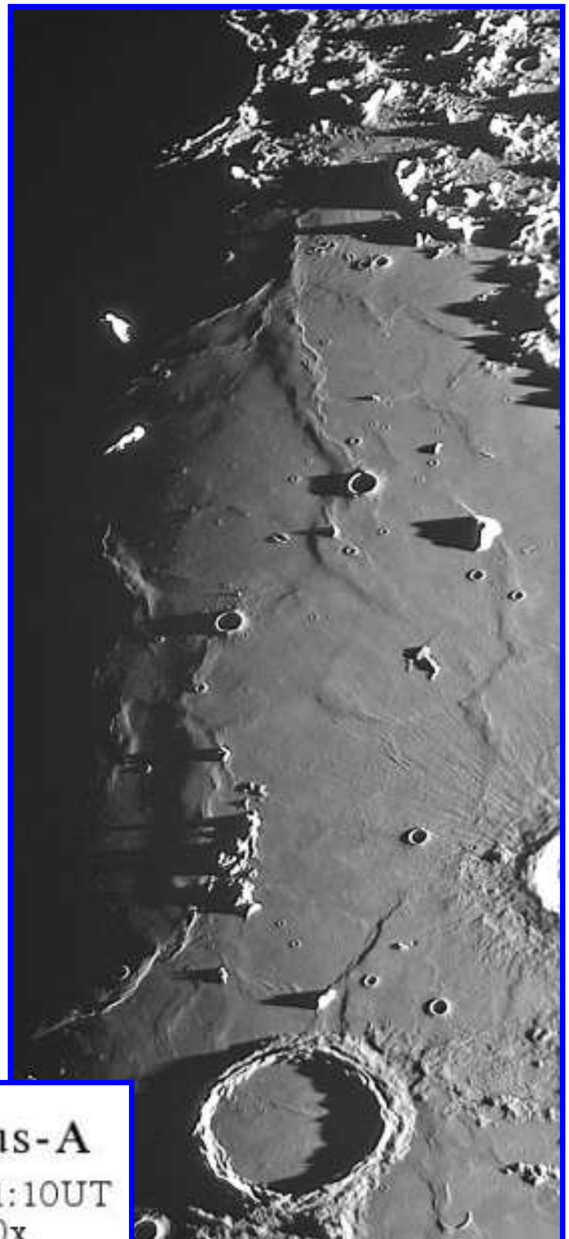
Aristarchus, *Don Capone, Waxahachie, Texas, USA. 2023 March 05 01:49 UT. 16 inch Dobsonian reflector telescope, 2x barlow, IR pass filter, ASI 678MC camera.*



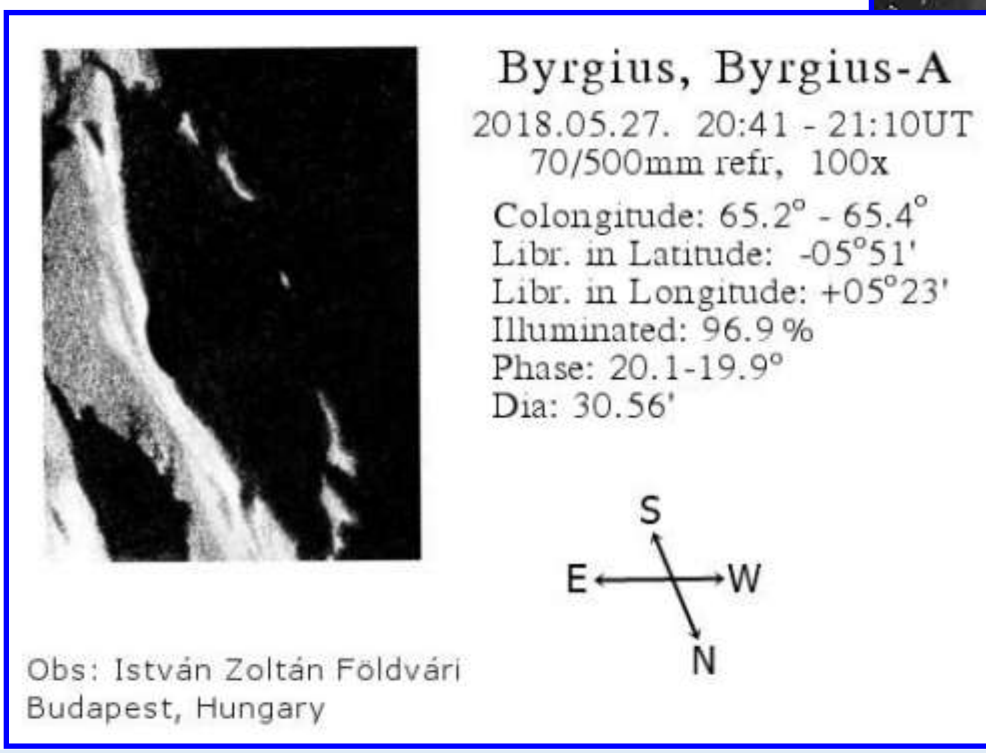
Gassendi, *Massimo Bianchi, Milan, Italy. 2023 March 04 19:18 UT. Vixen VMC 260L Maksutov-Cassegrain telescope, Baader green filter, ASI178 MM camera. Transparency 3/6, seeing 7/10.*

Recent Topographic Studies

Recent Topographic Studies



Archimedes, *KC Pau, Hong Kong, China. 2023 February 28 12:51 UT. 250 mm f/6 Newtonian reflector telescope, 2.5x barlow, QHY-CCD290M camera. KC adds:* "This photo showing the area north of Archimedes under early morning sunlight. All features such as Archimedes, Montes Spitzbergen and Mons Piton cast fantastic shadows. The eastern rim of Plato is lit up with morning sun-light."



Byrgius, *István Zoltán Földvári, Budapest, Hungary. 2018 May 27, 20:41-21:10 UT, colongitude 65.2° -65.4°. 70 mm refractor telescope, 500 mm focal length, 10 mm Plossl, 2x barlow, 100x. Seeing 7/10, transparency 4/6.*

Recent Topographic Studies

Langrenus, *KC Pau, Hong Kong, China. 2023 March 09 14:42 UT. 250 mm f/6 Newtonian reflector telescope, QHYCCD290M camera. KC adds*: "The photo shows the area between Petavius and Langrenus under evening sunlight. Langrenus is completely filled with shadow and only the rims are lit up by evening sunlight. The central massif of Petavius cast shadow touching the eastern rim. Petavius is almost filled up with shadow with the western flank of the central massif still receiving sunlight."

Theophilus, Catherina and Cyrillus, *Guido Santacana, San Juan, Puerto Rico, USA. 2023 March 28 00:36 UT. 3.5 inch Questar Maksutov-Cassegrain telescope, 2 x barlow, SVBony SV305 camera. Seeing 8/10, transparency 4/6. North in right, west is down.*

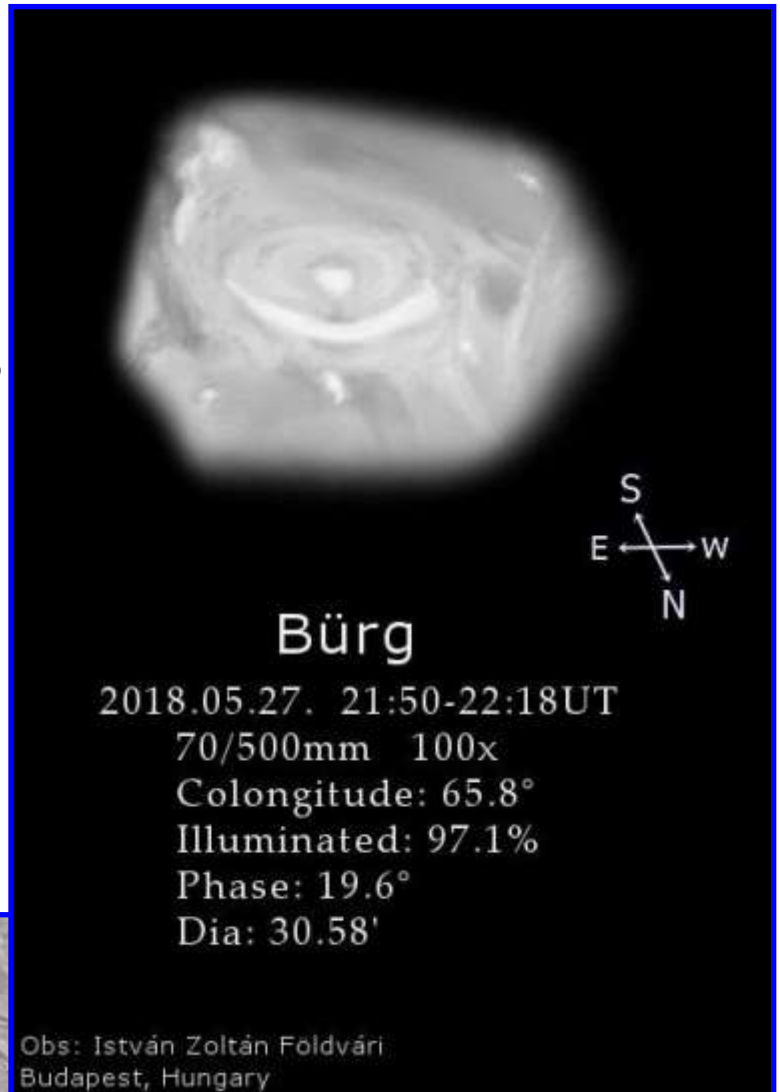
Recent Topographic Studies

Lunar North Pole, *Massimo Bianchi, Milan, Italy. 2023 March 04 19:23 UT. Vixen VMC 260L Maksutov-Cassegrain telescope, Baader green filter, ASI178 MM camera. Transparency 3/6, seeing 7/10.*

Santbech, *István Zoltán Földvári, Budapest, Hungary. 2018 July 01, 22:53-23:25 UT, colongitude 133.9º-134.2º. 127 mm Maksutov-Cassegrain telescope, 1500 mm focal length, 6 mm Plossl,250 x. Seeing 4/10, transparency 6/6.*

Recent Topographic Studies

Bürg, *István Zoltán Földvári, Budapest, Hungary. 2018 May 27, 21:50-22:18 UT, colongitude 65.8º. 70 mm refractor telescope, 500 mm focal length, 10 mm Plossl,2 x barlow, 100 x, Baader contrast booster. Seeing 4/10, transparency 6/6.*



Theophilus, Catherina and Cyrillus, *Guido Santacana, San Juan, Puerto Rico, USA. 2023 March 28 00:33 UT. 3.5 inch Questar Maksutov-Cassegrain telescope, SVBony SV305 camera. Seeing 8/10, transparency 4/6. North in right, west is down.*

Recent Topographic Studies

Aristarchus, *Walter Ricardo Elias, AEA, Oro Verde, Argentina. 2023 March 18 01:55 UT. SkyWatcher 150 mm reflector telescope, QHY5-II C camera.*

Lansberg and the Apollo 12 landing site, *István Zoltán Földvári, Budapest, Hungary. 2018 May 27, 21:12-21:41 UT, colongitude 65.5°-65.7°. 70 mm refractor telescope, 500 mm focal length, 10 mm Plossl, 2x barlow, 100x. Seeing 7/10, transparency 4/6.*

Telescopes of István Zoltán Földvári in Budapest, Hungary

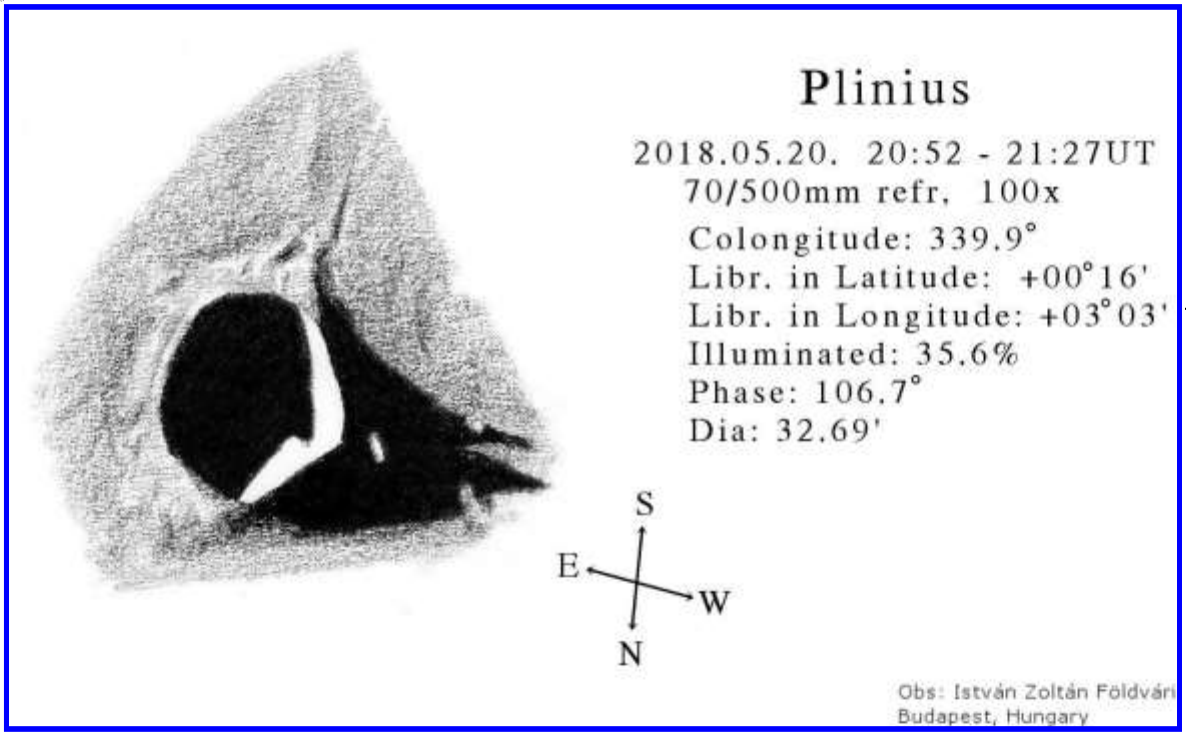
1 (left): 80/900mm refractor. I used it for open clusters in general and for observing the Moon.

2 (above): 60/750mm ref. an old small Japanese lens, I redesigned the focusing part myself, it gives a surprisingly good image with a simple Plossl eyepiece. Especially my Sun observation telescope.

3 (left): 70/500mm ref. The original owner sold this to me for the price of a Plossl eyepiece.... I felt that I might have problems with chromatic aberration, but as it turned out, this problem is negligible, and as my most portable telescope, I use it for open clusters and binary stars, but even on Jupiter it easily showed the GRS! I liked using it best on the Moon, but most recently I used it on Comet ZTF.

4 (right): 127/1500 Maksutov-Cassegrain. My newest telescope is a real spaceship window experience. Its main use is the Moon, and sometimes the planets, closer doubles. The stand is a Zeiss theodolite with a very strong leg. It is interesting that, by chance, it was possible to design the telescope and its scaffolding with the national colors of my country. :)

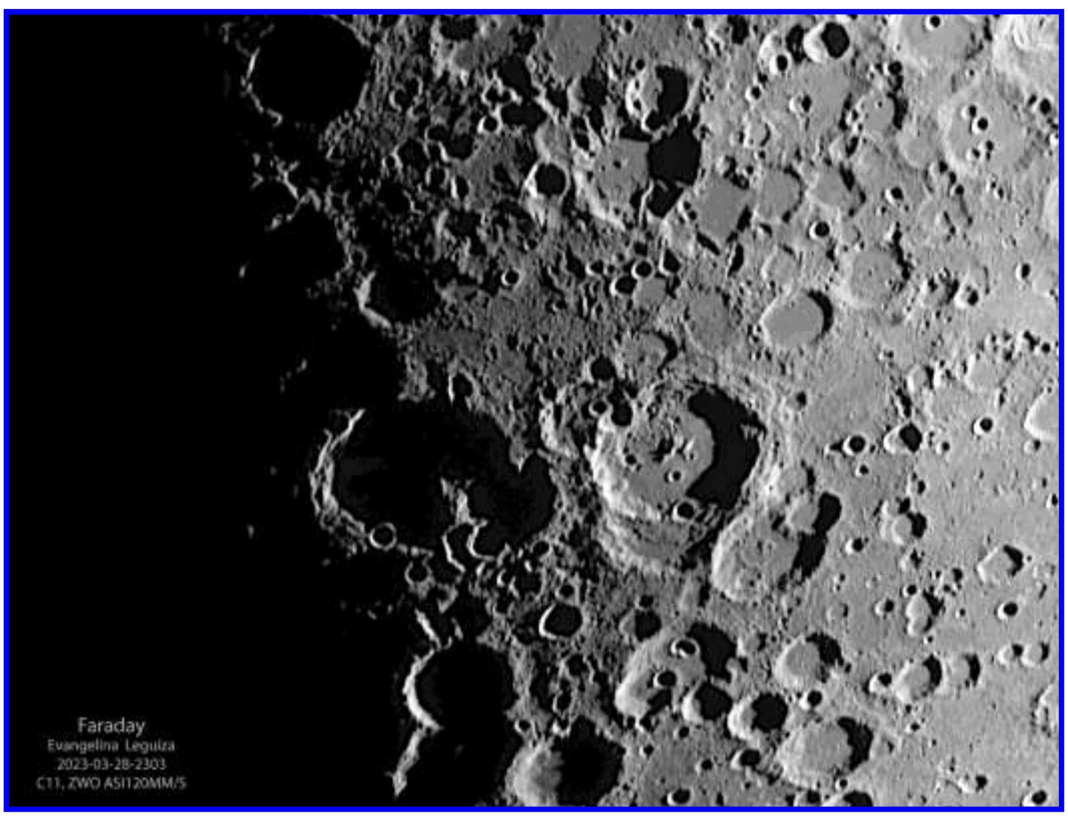
Recent Topographic Studies



Plinius, *István Zoltán Földvári, Budapest, Hungary. 2018 May 20, 20:52-21:27 UT, colongitude 339.9°. 70 mm refractor telescope, 500 mm focal length, 10 mm Plossl, 2x barlow, 100x. Seeing 6/10, transparency 4/6.*

Montes Haemus, *Guido Santacana, San Juan, Puerto Rico, USA. 2023 March 28 00:53 UT. 3.5 inch Questar Maksutov-Cassegrain telescope, 2 x barlow, SVBony SV305 camera. Seeing 8/10, transparency 4/6. North in down, west is left.*

Armstrong, Aldrin and Collins, *Guido Santacana, San Juan, Puerto Rico, USA. 2023 March 28 01:31 UT. 3.5 inch Questar Maksutov-Cassegrain telescope, 2 x barlow, SVBony SV305 camera. Seeing 8/10, transparency 4/6. North in down, west is left.*

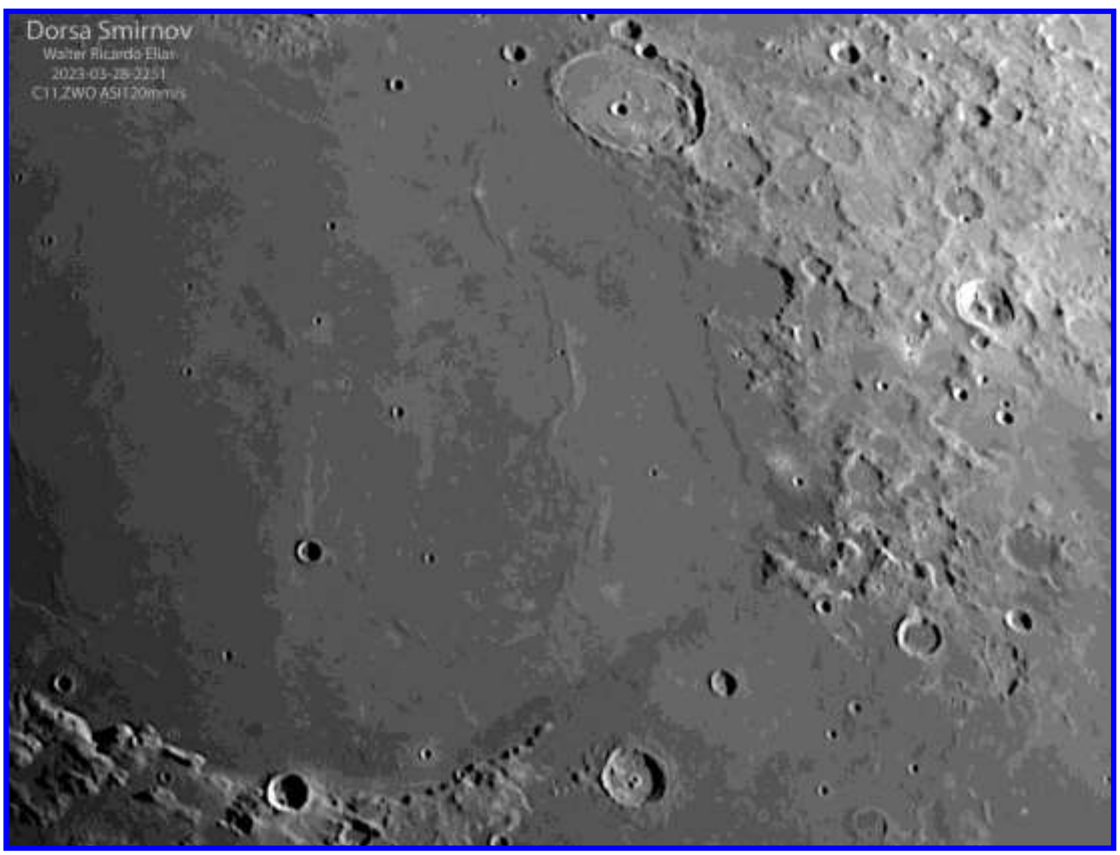


Faraday, *Evangelina Leguiza, AEA, Oro Verde, Argentina. 2023 March 28 23:01 UT. Celestron CPC 1100 11 inch Schmidt-Cassegrain telescope, ZWO ASI 120mm/s C camera.*

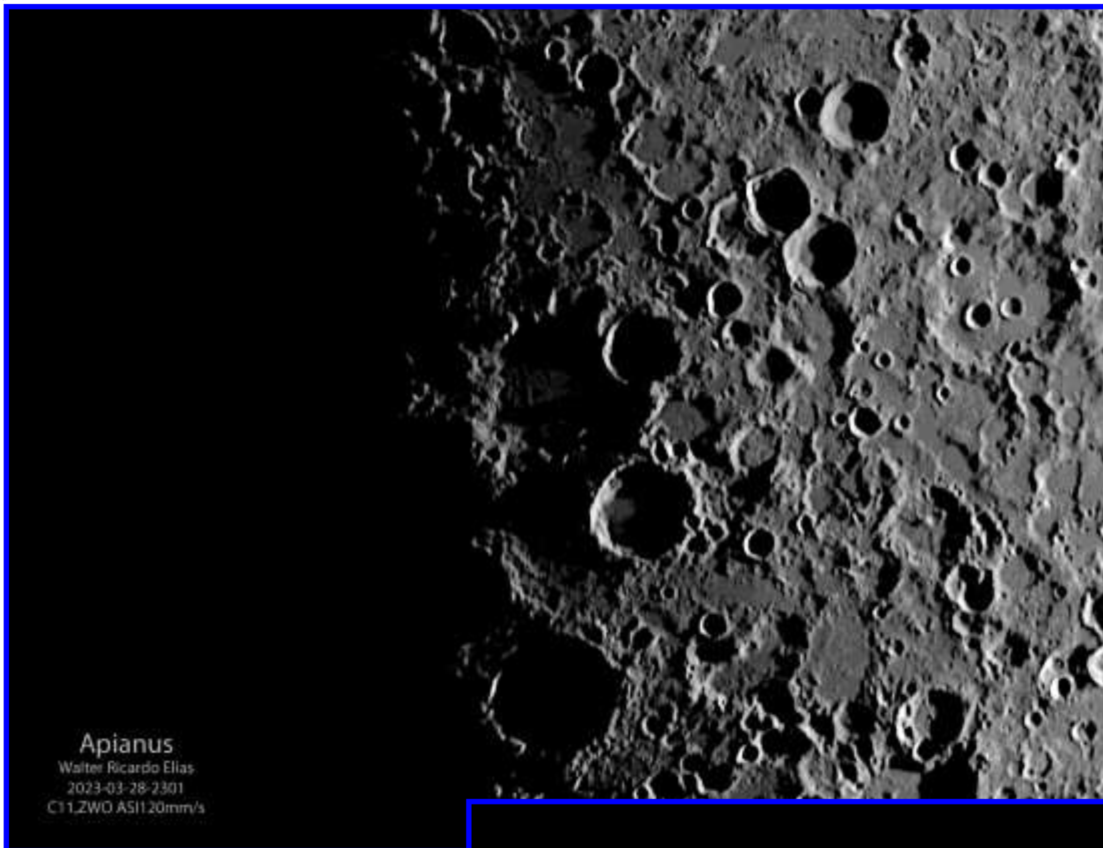
Recent Topographic Studies

Mare Serenitatis, *Guido Santacana, San Juan, Puerto Rico, USA. 2023 March 28 00:46 UT. 3.5 inch Questar Maksutov-Cassegrain telescope, SVBony SV305 camera. Seeing 8/10, transparency 4/6. North in lower right, west is lower left.*

Dorsa Smirnov, *Walter Ricardo Elias, AEA, Oro Verde, Argentina. 2023 March 28 22:51 UT. Celestron CPC 1100 11 inch Schmidt-Cassegrain telescope, ZWO ASI 120mm/s C camera.*



Recent Topographic Studies



Apianus, *Walter Ricardo Elias, AEA, Oro Verde, Argentina. 2023 March 28 23:01 UT. Celestron CPC 1100 11 inch Schmidt-Cassegrain telescope, ZWO ASI 120mm/s C camera.*

First Quarter Moon, *Evangelina Leguiza, AEA, Oro Verde, Argentina. 2023 March 28 22:28 UT. Celestron CPC 1100 11 inch Schmidt-Cassegrain telescope, Moto One Vision camera.*

Recent Topographic Studies

Lunar Geologic Change Detection Program

Coordinator Dr. Anthony Cook- atc@aber.ac.uk
Assistant Coordinator David O. Darling -DOD121252@aol.com

2023 April

Figure 1. *The LUMIO spacecraft from the opening slide of the LUMIO Scientific Workshop (Image Credits: Politecnico Milano, ESA, ASI)*

News: On February 13th, a workshop (See Fig 1) was held by the Italian Space Agency in Rome (and online) on the upcoming Italian LUMIO CubeSat mission. LUMIO stands for "Lunar Meteoroid Impact Observer" and is planned to launch in 2025/26 on a 1.5-year mission to a safe halo orbit whereby it can monitor the Moon's far side for impact flashes for 14 days per month. It contains two cameras and a beam splitter. One camera can work in visible light and the other in the near IR – so this would allow for blackbody temperature determination of impact flashes and the ability to automatically exclude cosmic ray events (these would be in one camera image and not in the other at the same location on the Moon). Theoretical predictions suggest that the camera may be able to capture nearly a quarter of a million impact flashes over its planned lifetime. What is currently uncertain (from the documents that I have seen) is the frame rate of the camera, so it may not be able to do a light curve of the flash over time if the exposure is too long?

Another impact flash related piece of news is that the Greek NELIOTA people (ESA funded impact flash observatory in Greece) have released software that you can use at your telescope, with FireCapture software, to detect impact flashes in real time. Or, you may be able to run previously recorded video of earthshine through and detect old candidate impact flashes. The software may also work for detecting impacts on Mars and Jupiter as well. If you have the ability to video earthshine at say faster than 10 frames per sec, then please give the software a go by downloading it from the following website: https://kryoneri.astro.noa.gr/en/flash-detection-software/

LTP Reports: No LTPs were observed in February apart from the impact flash videoed from Japan on 2023 Feb 23 – see last month's newsletter. However, Walter Elias sent me an email concerning images he took showing Faraday and Apianus craters in March (See Fig 2 inserts). It caught his attention that despite being dark, reflections can be seen at the base of the craters. He notes that it is as if the wall reflected on the surface of the base. He wondered if this was normal? Just as a check I found a similar illumination image by Maurice Collins (Fig 2 background).

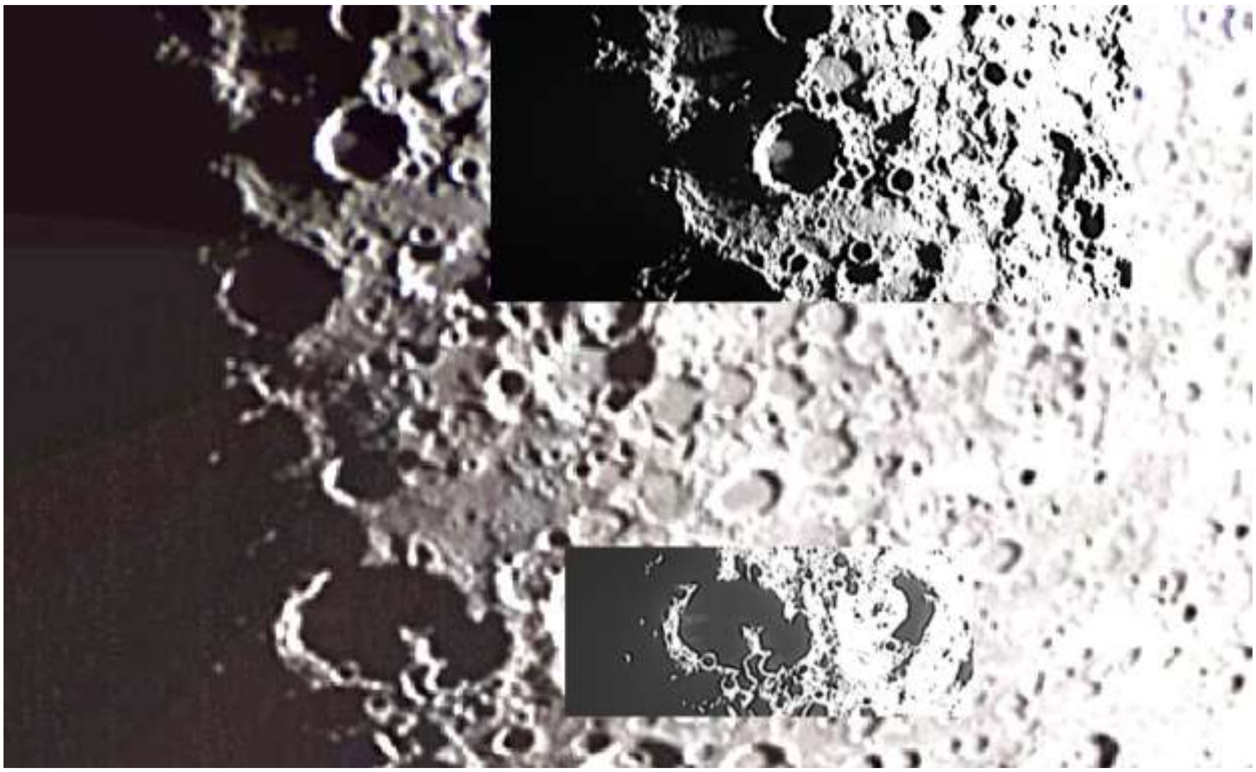


Figure 2. *Apianus and Faraday craters, with contrast enhanced to bring out details in shadowed areas – orientated with north towards the top.* ***(Background)*** *Image captured by Maurice Collins (ALPO/BAA/RASNZ) on 2016 Apr 14 UT 07:42.* ***(Top Insert)*** *Apianus crater as imaged by Walter Elias (AEA) on 2023 Mar 28 UT 23:01****. (Top Insert)*** *Faraday crater, to the south east of Stöfler, as imaged by Walter Elias (AEA) on 2023 Mar 28 UT 23:03.*

Although the Maurice's imagery, from a camera era of seven years ago, confirms the shadows are in the same location, the resolution and contrast are not quite up to what Walter was achieving with his imagery. In the contrast stretched inserts in Fig 2 we can see some lighter areas inside the shadows contouring the illuminated rims for Apianus and more so for Faraday. However it is not just confined to these craters, take a look at Maurolycus, to the east of Faraday as you can see some detail in the shadow on the inner eastern slopes too. There is a possibility that this lighter shading inside shadows, adjacent to illuminate areas could be an artefact of the image processing being done on the images, as there is evidence for "ringing effects" on bright/dark boundaries. I think that we shall put this onto the "Lunar Schedule" web site and see if we can obtain repeat colongitude images that show the same effect? If so then we will know for sure that its due to scattered light off illuminated rims.

Routine Reports received for February included: Alberto Anunziato (Argentina – SLA) observed: Apianus D, Censorinus, and Ross D. Massimo Alessandro Bianchi (Italy – UAI) imaged Herodotus. Luis Francisco Alsina Cardinalli (Argentina – SLA) imaged: Aristarchus and its surrounds. Anthony Cook (Newtown, UK – ALPO/BAA) imaged: several features in the Short-Wave IR (1.5-1.7 microns) and color imagery at optical wavelengths. Alan Clitherow (UK – BAA) made a 1st quarter Moon mosaic. Walter Elias (Argentina – AEA) imaged: Aristarchus, Copernicus, Herodotus, Manilius, Mare Crisium Proclus and Timocharis. Les Fry (West Wales, UK – NAS) imaged: Endymion and Lacus Bonitatis. Rik Hill (Tucson, AZ – ALPO/BAA) imaged: Montes Apenninus and Montes Caucasus. Ken Kennedy (Scotland – BAA) imaged: Maurolycus and Theophilus. Jean Marc Lechopier (Teneriffe, Spain – UAI) imaged Montes Teneriffe. Eugenio Polito (Italy – UAI) imaged: earthshine, Herodotus, Montes Teneriffe, Plato, Sulpicius and Gallus M. Mark Radice (Swindon, UK – BAA) imaged: Mare Crisium, Mare Tranquilitatis, Littrow, Plinius, Posidonius and Triesnecker. Franco Taccogna imaged earthshine.

Analysis of Reports Received:

Herodotus: On 2023 Feb 02 UAI observers imaged this feature; Massimo Alessandro Bianchi at 17:39-17:42UT and Eugenio Polito, at intervals from 18:27-19:23 for the following lunar schedule request:

BAA Request: Some astronomers have occasionally reported seeing a pseudo peak on the floor of this crater. However, there is no central peak! Please therefore image or sketch the floor, looking for anything near the center of the crater resembling a light spot, or some highland emerging from the shadow. All reports should be emailed to: a t c @ a b e r. a c. u k

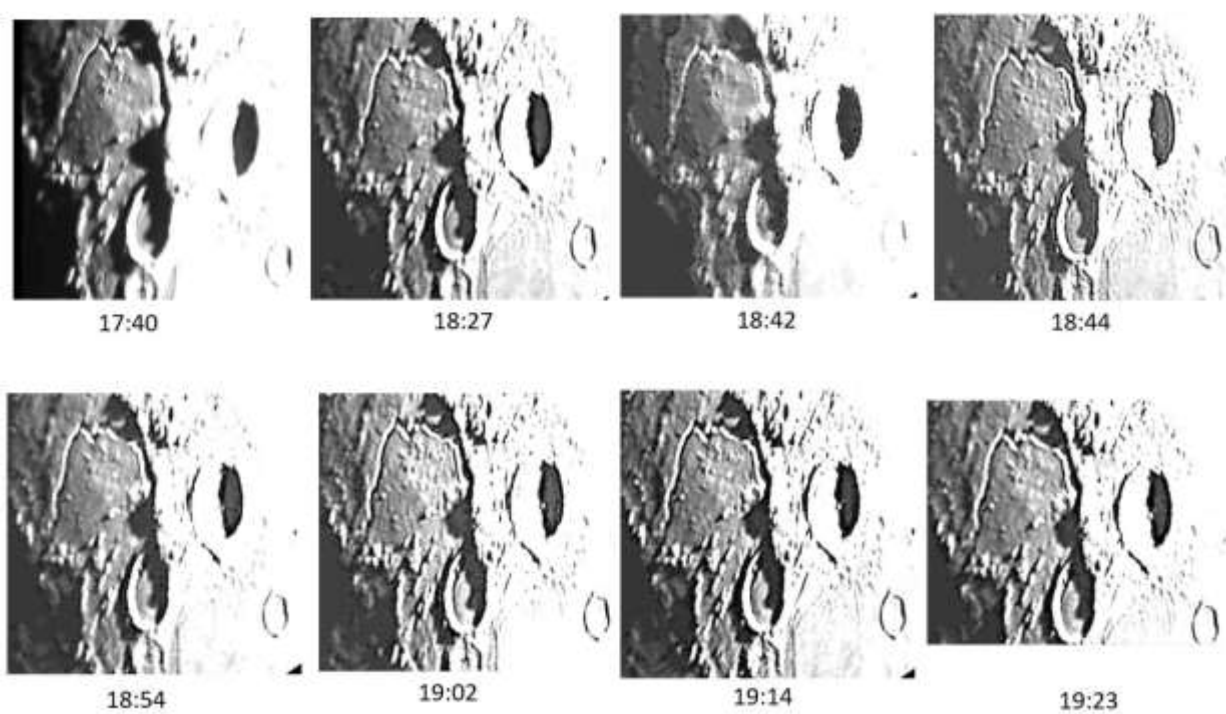


Figure 3. *Contrast stretched versions of images of Herodotus taken by UAI observers on 2023 Feb 02. The times quoted under each image are in UT. The 17:40 image is by Massimo Alessandro Bianchi and the others are by Eugenio Polito.*

At last, we may have some evidence of a central pseudo peak (spot) on the floor of Herodotus, after all these years of imaging! Though, we must be a little careful as pushing the image contrast so high can lead to noise artefacts. To avoid mistaking these noise artefacts, one has to look at trends in the time sequence in Fig 3. Firstly at 17:40 UT we see a small light arc on the NW floor of the crater, this is on all the images, so must be real, but of course is nowhere near the center. Between 17:40 and 19:02 UT there is a white spot is on the southern part of the floor, sandwiched between the rim and the blob-like part of the shadow. This is known about and has been discussed by Raffaello Lena many years ago and sketched by Peter Grego. It may have faded slightly by 19:23 UT but again that might be related to the contrast stretching? A white spot, slightly NW of the center is visible in the 18:42 UT image, but the original image had some noise in it, however it may be present in the 18:27 and 18:44 UT images. By 18:54-19:23 UT there is a diffuse light spot that is more central and hugging the dimple in the floor shadow. Indeed, maybe it even consists of two white spots in the 19:23 UT image – but there again that could be image noise for one of them? So, have we found the famous pseudo peak that is sometimes there but mostly not visible, according the Bartlett, Haas, Hill, Firsoff etc? Maybe, though as you can see it is fairly faint, the southern floor spot is brighter – but the observers never mentioned this (only the central spot). Also, would visual observers have really been able to see such faint detail as CCDs can image?

We need more time lapse imagery of the caliber that was shown in Fig 3 to see if the effect repeats itself and identify what sub-solar longitudes and latitudes are needed to see it. Anyway, congratulations to the UAI team for achieving these current time sequence images.

Aristarchus: On 2023 Feb 04 UT 02:25 Luis Francisco Alsina Cardinalli (SLA) imaged the crater under similar illumination to the following report:

Aristarchus 1989 Oct 13 UT 21:00 Observed by Cook (Frimley, Surrey, UK, 20cm reflector (visual and video) "Aristarchus had what appeared to be outline of a ghost crater on it's eastern side - quite large and bright". Cameron 2006 extended catalog LTP ID No=378 and weight=5.ALPO/BAA weight=3.

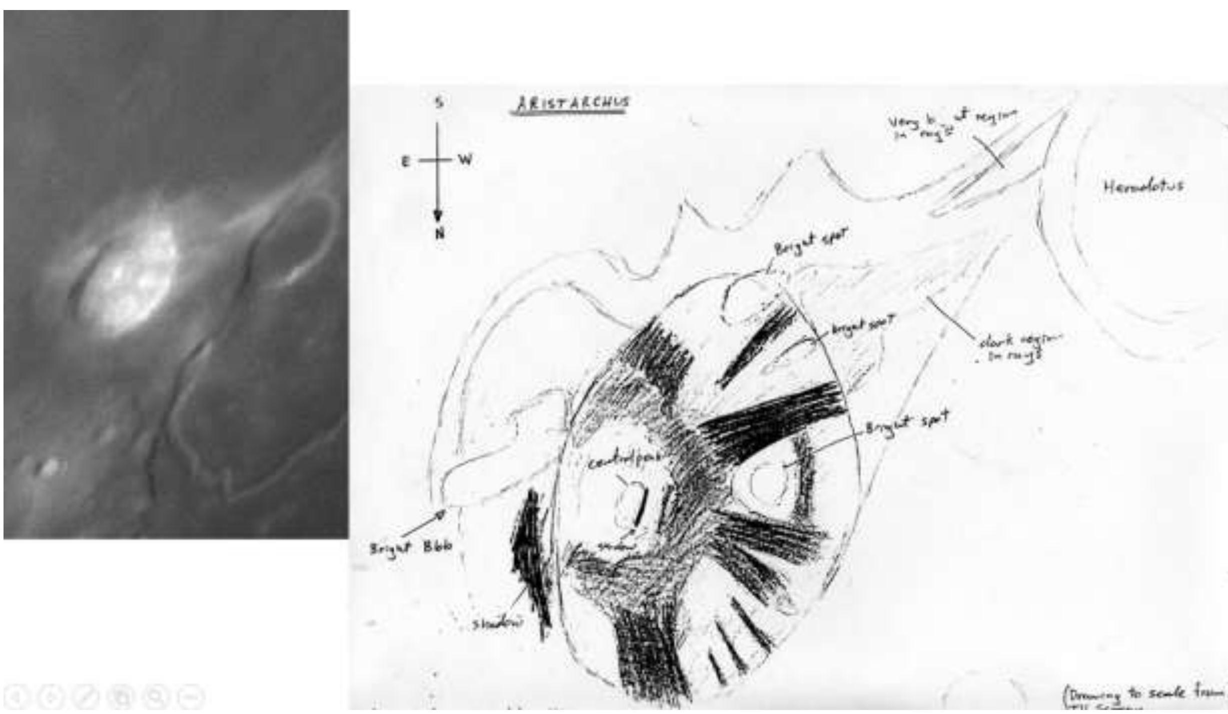


Figure 4. *Aristarchus orientated with north towards the bottom.* ***(Left)*** *An image by Luis Francisco Alsina Cardinalli (SLA) taken on 2023 Feb 04 UT 02:25.* ***(Right)*** *A sketch made off the TV screen from video feed from the telescope during a LTP seen by Tony Cook on 1989 Oct 13, after the original visual detection.*

The LTP I saw in 1989 was a very interesting one. It was detected visually by myself, and would like to quote from my report: "*On examining Aristarchus my attention was drawn by a very bright blob on the east. This was much brighter than I had ever seen before and was comparable in brightness to the central peak of Aristarchus. Also, a lot of fine detail was seen in and around this blob, including a bright arc to the south east of the crater, (attached to the blob and continued north of this). This was so prominent that it gave the impression that there was a second crater attached to the South East of Aristarchus. I began to set up the CCD video equipment for monitoring of Aristarchus and began operating this at 21:02UT. Unfortunately, the video recorder was in "Play" rather than "Record" mode and this fault was not discovered until sometime later. Successful recordings were obtained at the following times: 22:04-22:08 UT, 22:13:10-22:22:26UT, 22:25:02-22:32:12UT. Observations ceased after 22:32UT due to cloud. A drawing of Aristarchus based on the video recordings appears on the next sheet. The bright blob was certainly not as bright on the video than it was at 21:00UT*". The sketch I made by tracing over the TV screen can be seen in Fig 4 (right). The general appearance is very similar to Luis' image in Fig 4 (Left) in terms of interior detail though the blob on the east exterior, in his image, is significantly not as bright as it was in the 1989 visual LTP nor the CCD sketch i.e. much fainter than the central peak in Luis' image. The ghost crater effect that I saw initially visually, had faded by the time the successful video recording was captured and is not at all visible in Luis' image. We shall leave the weight at 3 for now, but it is good that we have a more modern context image.

Aristarchus: On 2023 Feb 06 UT 02:11 Walter Elias (AEA) imaged the crater under similar illumination and similar topocentric libration (both to within ±1˚) to the following report:

Aristarchus-Herodotus 1969 Jan 04 UT 03:00-03:45 Observed by Taboada (Mexico) & Corralitos Observatory (Organ Pass, NM, USA, 24" reflector + Moon Blink) "Brightness increased slightly around Herod. & cleft (S.V?) became darker than previous day. The dark gray & pink formed yellowish at 0345h in whole region of Aris. Bluing around crater in Corralitos MB (photos?) confirm. of activity at Aris.?)" NASA catalog weight=5. NASA catalog ID #1115. ALPO/BAA weight=3.

Figure 5. *Aristarchus orientated with north towards the top – a monochrome image taken by Walter Elias (AEA) taken on 2023 Feb 06 UT 02:11*

Although Fig 5 is in monochrome, it nevertheless is a useful context image in that the bright spots and bands, and general shape of Aristarchus and Herodotus are what the craters should have looked like Taboada in 1969. We shall leave the weight at 3 for now.

N.B. for those of you who also receive the BAA Lunar Section circular will note that Walter's image was attributed to the wrong prediction – this will be corrected in the May BAA Lunar Section circular.

Earthshine: On 2022 Feb 21 UAI observers: Eugenio Polito (17:21 and 17:27 UT) and Franco Taccogna (17:35UT) imaged the crater for 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 do not attempt if the Sun is still above the horizon. 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 6. *Earthshine as imaged by UAI observers on 2023 Feb 21.* ***(Left)*** *Taken by Eugenio Polito at 17:21 UT from San Pancrazio Sal. (Italy) using a Skywatcher SkyMax 102/1300 with an ASI 178 MM cameras and a 0.5x focal reducer.* ***(Right)*** *Taken by Franco Taccogna at 17:35 UT from Gravina in Puglia (BA), Italy using an EVO Guide 50 ED (f:240mm) with a ASI 120 MC camera.*

Neither of the images in Fig 6 show an obvious bright rim to the SW-NW limb of the Moon that Dr Martin Hoffmann was suggesting might be evidence of forward scattering of light from a dusty exosphere in his 2017 EPSC conference poster. Now there is a high albedo highland part of the Moon that libration sometimes brings more across onto the nearside of the Moon that might offer an explanation to what was suggested at EPSC back in 2017, but I think we need more examples, closer to New Moon before we can rule this out.

A couple of important points about Fig 6. Eugino and Franco were observing from different locations, and so different observing conditions may explain the variation in color and detail visible. Secondly note how bright Aristarchus appears like to your eyes in Fig 6 (Left) – it looks like the brightest feature on the Moon! However, in Fig 6 (Right) it is similar to Kepler and Copernicus. This illustrates perfectly how visual observers may have been tricked in the past into thinking that Aristarchus has varied in brightness in the matter of minutes (14 minutes in the case of the observations above) as it all depends upon what atmospheric observing conditions and imaging resolution and contrast are doing to the seeing disk, or point spread function (PSF). A large PSF will make small contrasty bright features "blur" out into less bright features, hence why Aristarchus appears similar in brightness to nearby Copernicus and Kepler in Fig 6 (Right). Another aspect to consider when visually judging brightness is the background a ray crater is seen against – this is "relative brightness". However, if one takes some CCD digital number (DN) values then in Fig 6 (Left) Aristarchus is DN=209, Copernicus is DN=197, Proclus DN=224, Tycho DN=183, bright Spot near Hell DN=218, and you can quite clearly see that in an absolute sense, Aristarchus is not the brightest feature on the Moon, but in a relative sense (what your eye/brain sees) it could be regarded as the most "contrasty" feature.

Theophilus: On 2023 Feb 26 UT 19:30 Ken Kennedy (BAA) imaged this crater under similar illumination to the following report:
Theophilus 1964 May 18 UT 01:05-01:15 Observed by Dieke (Baltimore, MD, USA, 6" refractor, x125) "Crescent of crimson color on SW between rim & floor. Was not present at 0500, nor did it reappear from 0115 to 0245h" NASA catalog weight=3. NASA catalog ID #812.

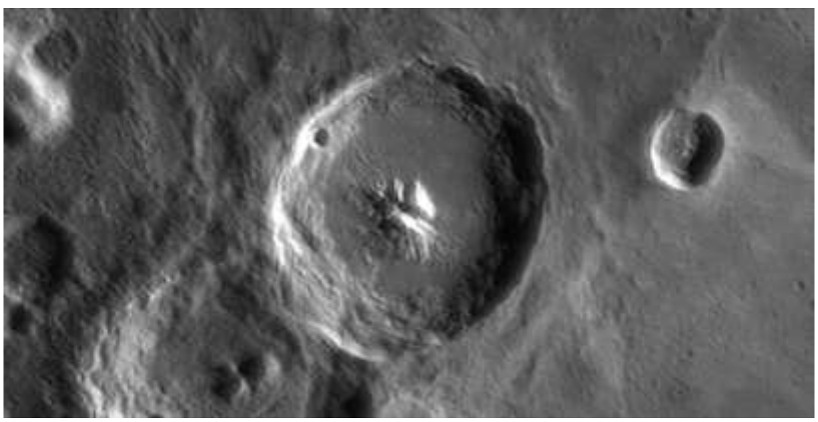


Figure 7. *Theophilus as imaged by Ken Kennedy (BAA) in monochrome and with north towards the top.*

Although Ken's image (Fig 7) is in monochrome, it is a good context image of what the crater should have looked like back in 1964. The only difference of note between the SW area of the crater is that there is a lot more obvious terracing between the SW rim and the SW floor than visible elsewhere in the crater.

Apianus D: On 2023 Feb 27 UT 00:10-00:15 Alberto Anziato (SLA) observed visually this crater under similar illumination to the following report:
Apianus D On 2011 Oct 03 UT 21:00-21:20 F. Power (Meath, Ireland, 11" SCT) observed changing colors (blue, white, and red) on the inner western rim of this crater. He changed eyepieces and moved the scope around to look at different parts of the Moon, but nowhere else exhibited anything similar. As another test he asked his wife to have a look without telling her what he was seeing. She confirmed the same effect. 5 digital camera images had been taken. Most of these were out of focus and the first one was saturated, however one of them showed a approximately 35 km long, by 11 km wide (at the north) lopsided carrot shaped orange color to the western rim of Apianus D. No similar strong color could be seen anywhere else on the image, nor on the other 4 images. This LTP is being given an ALPO/BAA weight of 1 as the Moon was low, but an image taken looks interesting.

Figure 8. *A sequence of images (enhanced) of the Apianus D and its surrounds captured by Fran Power (Meath, Ireland) on 2011 Oct 03 sometime during UT 21:00-21:20 UT. North is towards the top.*

Alberto, using a Meade EX 105 at x154, reported that no colors were seen and Apianus D looked normal. This is in contrast to the appearance of the crater in Fig 8 (4th image from left), but more like the appearance of the craters in the other images in Fig 3. However, we still cannot rule out the most likely explanation that it was due to the Moon being low on the horizon – on the other hand, no similar color was exhibited elsewhere? We shall keep this at a weight of 1 for now.

Montes Teneriffe: On 2023 Feb 28 UAI observers Jean Marc Lechopier observed visually and Eugenio Polito imaged this region according to 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. Please note that we are especially interested in the appearance of the individual peaks of the Montes Teneriffe, when the Moon is at a low altitude e.g., flaring and colors seen. Any visual descriptions, sketches or images should be emailed to: a t c @ a b e r. a c. u k

Figure 9. *Montes Teneriffe to the bottom left of Plato as imaged by Eugenio Polito on 2023 Feb 28 UT 19:35 and orientated with north towards the top.*

Jean Marc, using a SkyWatcher 150/1200ed refractor found that Montes Teneriffe Mons had not emerged properly from the terminator. Jean Marc observed from 21:45-22:15 UT (not yet emerged from the terminator) with the SkyWatcher 150/1200ed refractor (x300) on February 28, 2023. The atmospheric seeing was average i.e., the Airy disk of Polaris was visible but agitated and the first diffraction ring was difficult to detect, but nevertheless the lunar surface through the eyepiece was satisfying to look at with lots of detail. Transparency was very good too. Three peaks of Montes Teneriffe were visible, standing out the darkness of the night side as very white points slightly dilated and agitated by the turbulence. This gave the impression that they were being enveloped in a mist (just an effect – not real). The three visible peaks were perfectly white, as indeed were other features in the area. The altitude of the Moon above the horizon was 67° and so no atmospheric dispersion colors were seen, and the peaks did not change color like they did in the LTP description. Jean Marc focussed their attention on possible perception of colors, due to: instrumental chromaticism, atmospheric refraction or lunar characteristics, but did not find anything.

Jus as a reference image, Eugenio captured what we see in Fig 9. You can compare this with other observations of the Montes Teneriffe LTP as discussed in the 2018 Jun, 2019 Feb, 2020 Aug, 2021 Jan, and 2022 Dec newsletters. We shall leave the original LTP report at a weight of 1 for now, and await new repeat illumination reports, maybe at lower altitudes above an observer's horizon, in order to see how atmospheric effects might mimic what was described in the original LTP report.

Sulpicius Gallus M: On 2023 Feb 28, between UT 20:00 to 20:30 (and one image earlier) Eugenio Polito (UAI) took images of this feature for the following Lunar Schedule request:

UAI Request: Franco Taccogna (UAI) would like to know at what colongitude range does this feature start to brighten up dramatically. Please send in any images taken with a telescope size of at least 6 inches to: a t c @ a b e r. a c. u k.

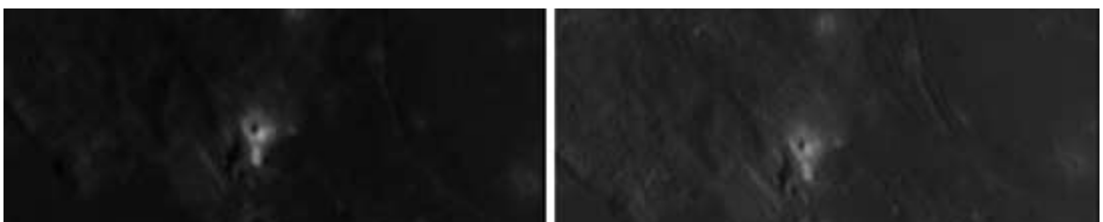


Figure 10. *Sulpicius Gallus M with north towards the top.* ***(Top)*** *Images by Eugenio Polito (UAI), taken on the date and UT as indicated by the text in the images.* ***(Bottom)*** *A NASA LROX Quickmap WAC mosaic closeup of Sulpicius Gallus N*

Although not a LTP, the feature is quite strikingly bright and could cause false LTP reports from untrained observers, so it is important to know when it starts to brighten up. The 19:56UT image (Fig 10 – Top Left) is at a selenographic colongitude of 12.0˚, however I think it is important to have a wider area covered so it can be compared to other bright craterlets. Just out of interest I have enclosed a closeup image mosaic from LROC in the lower part of Fig 10 to show the volcanic and other rilles in the vicinity, which make it quite an interesting area to study.

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

Dr Anthony Cook, Department of Physics, Aberystwyth University, Penglais, Aberystwyth, Ceredigion, SY23 3BZ, WALES, UNITED KINGDOM. Email: atc @ aber.ac.uk

Basin and Buried Crater Project

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

No emails or observations have been received specifically about impact basins or buried craters this month, so I thought that I would take the opportunity to specifically address how one goes about picking a buried crater from the on-line catalog, trying to confirm the best selenographic colongitudes to see it at sunrise or sunset, and how to measure its position and diameter.

Step 1 – Find a buried crater in the catalog

https://users.aber.ac.uk/atc/basin_and_buried_crater_project.htm

Import bookmarks... Home - BBC News Calendar | Microsoft T... Images from the Mars ... Horizons System Transit Finder

Table 2 – Buried Craters

Version:	2022 Jul 05

Crater	Far/Near Side	Lon	E/W	Lat	N/S	Diam (km)	Status	Age	Col-SR1	Col-SR2	Col-SS1
QCMA 1	N	17.9	W	74.4	N	48	Proposed				
PFC 39	N	23.6	W	66.6	N	60	Uncertain				
QCMA 2	N	9.8	W	63.7	N	146	Proposed				
PFC 38	N	18.9	W	63.4	N	36	Uncertain				
QCMA 3	N	23.6	W	62.1	N	82	Proposed				
PFC 37	N	27.6	W	61.8	N	40	Uncertain				
PFC 40	N	9.7	W	61.1	N	39	Uncertain				
QCMA 4	N	1.7	W	58.9	N	167	Proposed				
QCMA 5	N	11.4	E	58.3	N	121	Proposed				
QCMA 6	N	20.2	E	55.7	N	181	Proposed				
PFC 49	N	68.0	W	55.6	N	56	Uncertain				
QCMA 7	N	31.4	W	55.4	N	101	Proposed				
QCMA 8	N	6.0	W	54.3	N	143	Proposed				
PFC 51	N	28.3	W	53.5	N	38	Uncertain				
PFC 11	N	43.5	W	52.7	N	40	Uncertain				
QCMA 9	N	1.9	W	52.6	N	34	Proposed				
QCMA 10	N	21.4	E	51.8	N	65	Proposed				
PFC 13	N	9.4	W	51.7	N	100	Uncertain				
PFC 10	N	73.6	W	48.8	N	128	Uncertain				
QCMA 11	N	30.5	E	48.7	N	129	Proposed				
QCMA 13	N	60.2	W	47.8	N	114	Proposed				
PFC 22	N	55.0	E	47.7	N	98	Uncertain				
Ancient Newton	N	8.4	W	47.3	N	125	Uncertain				
QCMA 14	N	55.6	W	47.3	N	92	Proposed				

Figure 1. *The top of the table of suspected buried craters from the basins and buried craters website: https://users.aber.ac.uk/atc/basin_and_buried_crater_project.htm .*

The first thing you need to do is to look at the table on the basins and buried crater web site (Fig 1). You can pick any crater – but it is more helpful to pick one that hasn't been measured i.e., there are blank cells in the table that we need to fill in. As you can see, currently there are a lot of unfilled cells as we have just started!

The buried craters are sorted by latitude amount, but look at the N or S (next column to the right) to see which hemisphere they are in. If you plan to observe and take images, or sketch at the eyepiece, then pick one that will be on either the sunrise or sunset terminator on the lunar near side. Alternatively, if its cloudy then you can use your old archive images, VTLT (Virtual Terminator Lunar Toolkit) software or the LROC NASA/ACT Quickmap website.

The crater names can sometimes seem strange such as PFC and QMCA, followed by numbers. The QMCA stands for Quasi-Circular Mass Anomalies. These are essentially found by looking for circular or elliptical arcs in free-air gravity and Bouguer anomaly data as well as gravity gradient versions of these datasets. PFC stands for Partly Filled Crater and have already been visually identified to some extent. The QMCA and PFC's have come from a Geophysical Research Letters paper by A.J. Evans *et al.* (2016): *"Identification of buried lunar impact craters from GRAIL data and implications for the nearside maria"*. You will find the QMCA's more of a challenge to locate, if visible at all, but are worth looking for in case Evan's *et al* didn't spot some clues that you spot?

Step 2 – Finding the crater on the Moon

Figure 2. Searching for the approx. location of PFC22 on NASA's Quickmap website: https://quickmap.lroc.asu.edu . The white cross indicates the published location in the table.

You have three choices here: (1) use an atlas with lon/lat grid lines, (2) use the cursor, with lon/lat readout, on LTVT (https://github.com/fermigas/ltvt/wiki) to search for it virtually, or (3) use the cursor, with lon/lat readout, to look for it on the LROC NASA/ACT Quickmap website.

As, by definition, the crater is buried, or highly degraded, it is unlikely that you will see it on the atlas, LTVT or LROC Quickmap, but the important thing is to find neighbouring features that you can recognize that you can use as landmarks or sign posts to help you look for the buried crater in question. In the case of PFC22 we see that it lies on the northern part of Lacus Temporas, and has other signposts such as Endymion to the north, Atlas and Mercurius to the west and east, and Shuckburgh to the south.

Step 3 – Finding the best visibility sunrise/sunset selenographic colongitudes
This is relatively straight forward, you just need to pick a selenographic colongitude that corresponds to the longitude, treating west as positive. So, for PFC22 which has a quoted longitude of 55.0˚E, the selenographic colongitude at sunrise would be 360˚-55˚=305˚. The sunset colongitude would be 305˚-180˚=125˚. You should observe for a few hours after local lunar sunrise and a few hours before local lunar sunset, in order to find the time that the buried crater is most easily seen – if at all? LTVT can help you with these times. As to when you find the buried crater is best visible – this is going to be very subjective. Its best that we receive lots of observations and then an average or range or selenographic colongitudes can be derived and added to the database.

If you don't fancy observing, then LTVT by itself can simulate the appearance of the surface and you can test out lots of selenographic colongitudes until you find the buried craters best appearance at sunrise or sunset.

Step 4 – Measuring the longitude and latitude and diameter of the crater

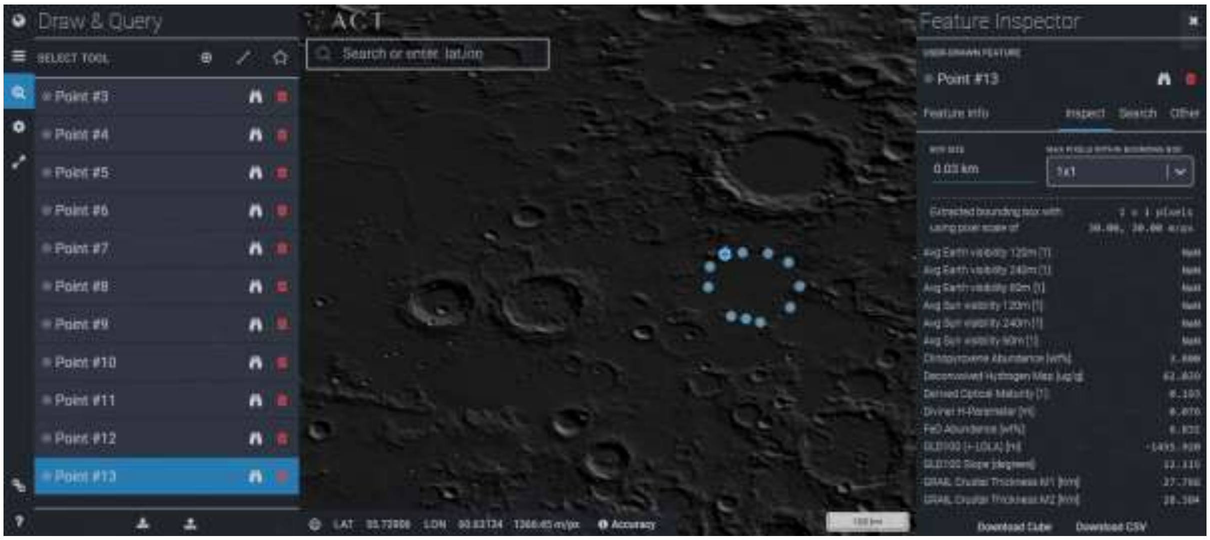


Figure 3. Using the "Draw and Query – Point Tool" to measure the rim of a buried or degraded crater.

This should utilize NASA's Quickmap web site, or LTVT, and/or whatever imagery you have taken, to find the rim of the crater, or whatever parts are left of it. In the NASA Quick map tool. You can place some points on the rim (see Fig 3), and then when you have finished just click on "Download CSV" on the bottom right corner. Please make sure you have a uniform distribution of points and not all bunched up in one area. The resulting file: *"features.geojson"* looks horrible (Fig 4), but you can clearly see the longitudes and latitudes of the points you measured on the rim. You could take an average of longitudes and average of latitudes, to find the center of the crater, or just email it to me and I'll computer the longitude, latitude and best fitted diameter for you and then add it to the database.

{"type":"FeatureCollection","features":[{"type":"Feature","geometry":{"type":"Point","coordinates":[54.59295541843199,49.39777084624839]},"properties":null,"id":3},{"type":"Feature","geometry":{"type":"Point","coordinates":[55.89976899052947,49.35270830927951]},"properties":null,"id":4},{"type":"Feature","geometry":{"type":"Point","coordinates":[56.93620734081368,48.90208293959072]},"properties":null,"id":5},{"type":"Feature","geometry":{"type":"Point","coordinates":[57.5220203214091,47.685394441431]},"properties":null,"id":6},{"type":"Feature","geometry":{"type":"Point","coordinates":[55.494206157809565,45.83783042570697]},"properties":null,"id":7},{"type":"Feature","geometry":{"type":"Point","coordinates":[54.00714243783657,46.15326818448912]},"properties":null,"id":8},{"type":"Feature","geometry":{"type":"Point","coordinates":[52.925641550583485,48.67677025474632]},"properties":null,"id":9},{"type":"Feature","geometry":{"type":"Point","coordinates":[52.83551647664573,47.64033190446212]},"properties":null,"id":10},{"type":"Feature","geometry":{"type":"Point","coordinates":[54.77320556630751,46.01808057358249]},"properties":null,"id":11},{"type":"Feature","geometry":{"type":"Point","coordinates":[57.02633241475144,46.60389355417791]},"properties":null,"id":12},{"type":"Feature","geometry":{"type":"Point","coordinates":[53.691704679054425,49.307645772310636]},"properties":{"selected":true},"id":13}]}

Figure 4 *The "features.geojson" file for the points measured in Fig 3.*

Alternatively, if you just want to attempt to measure the diameter you can use the Draw & Query / Path (or line) tool on Quickmap (Fig 5). This time place one point on one side of the crater, and then double click on the opposite side. It then tells you the length of the line i.e., diameter of the crater. Take at least 2 transects through the crater and take an average. If you take several measurements, you can obtain both an average and a standard deviation (Using Excel) and the latter will give you an uncertainty on the crater rim, potentially telling us how eroded it is – though be careful because if the crater is elliptical this would also show up in the standard deviation. If in doubt just send me some diameter measurements and I will do the calculations myself.

Figure 5 *Measuring crater diameters with NASA's Quickmap web site.*

Step 6 – Looking for other evidence for the crater

The NASA Quick map web site has a whole host of remote sensing datasets and imagery that you can investigate. Try going through as many of these as possible, using the available layers to see if anything lines up with the crater rim, or secondary ejecta craters. I sometimes find the SLDEM2015 Azimuthal plot, found under the LRO LOLA option, can be useful, and more so: TerrainHillshade (with a zenith illumination angle of more than 85˚) under the ACT layers (Experimental). But you can also look at gravity data, rock abundance maps etc. Indeed, PFC22 shows up exceedingly well in the mineralogical Clementine color ratio map in Fig 6 (look at the location where the diameter transects were in Fig 5). But you will have to experiment to see which layer works and which doesn't.

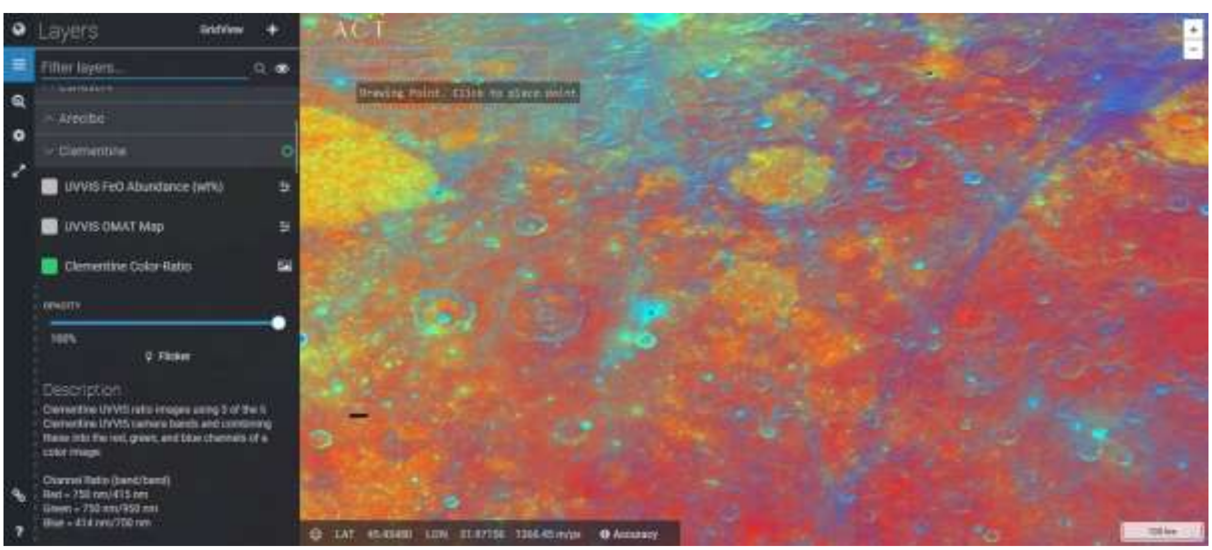


Figure 6 *The "Clementine Color Ratio" layer from NASA's Quickmap web site.*

Step 7 – Report
Don't just keep your findings to yourself, please email them to me e.g.: images, sketches, screenshots from VTLT or the Quickmap website and some text in the email of what you found and measured. I look forward to reporting this and updating our database.

If you think that you have discovered a new impact basin, or unknown buried crater, please check whether it has been found previously on the following web site, and if not email me its location and diameter so that I can update the list.

https://users.aber.ac.uk/atc/basin_and_buried_crater_project.htm.

Lunar Calendar April 2023

Date	UT	Event
6	0434	Full Moon
7	1351	Moon at descending node
8		West limb most exposed -5.3°
10	0600	Antares 1.5° south of the Moon
12		Greatest southern declination -27.9°
13	0911	Last Quarter Moon
14		North limb most exposed +6.8°
16	0200	Moon at perigee 367,968 km
16	0400	Saturn 3° north of Moon
17	1700	Neptune 2° north of Moon
20	0412	New Moon, lunation 1241
20	1132	Moon at ascending node
21	0700	Mercury 1.9° north of Moon
21	1300	Uranus 1.7° south of Moon
22	1000	Moon 1.8° south of Pleiades
22		East limb most exposed +5.1°
23	1300	Venus 1.3° south of Moon
25		Greatest northern declination +27.9°
26	1800	Pollux 1.5° north of Moon
27	2120	First quarter Moon
28	0700	Moon at apogee 404,299 km
28		South limb most exposed -6.8°

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 non-member 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.

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
Alberto Anunziato–albertoanunziato@yahoo.com.ar
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: Mysterious Reiner Gamma

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 May 2023, will be Reiner Gamma. 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):

Alberto Anunziato – albertoanziato@yahoo.com-ar
David Teske – david.teske@alpo-astronomy.org

Deadline for inclusion in the Reiner Gamma Focus-On article is April 20, 2023

FUTURE FOCUS ON ARTICLES:

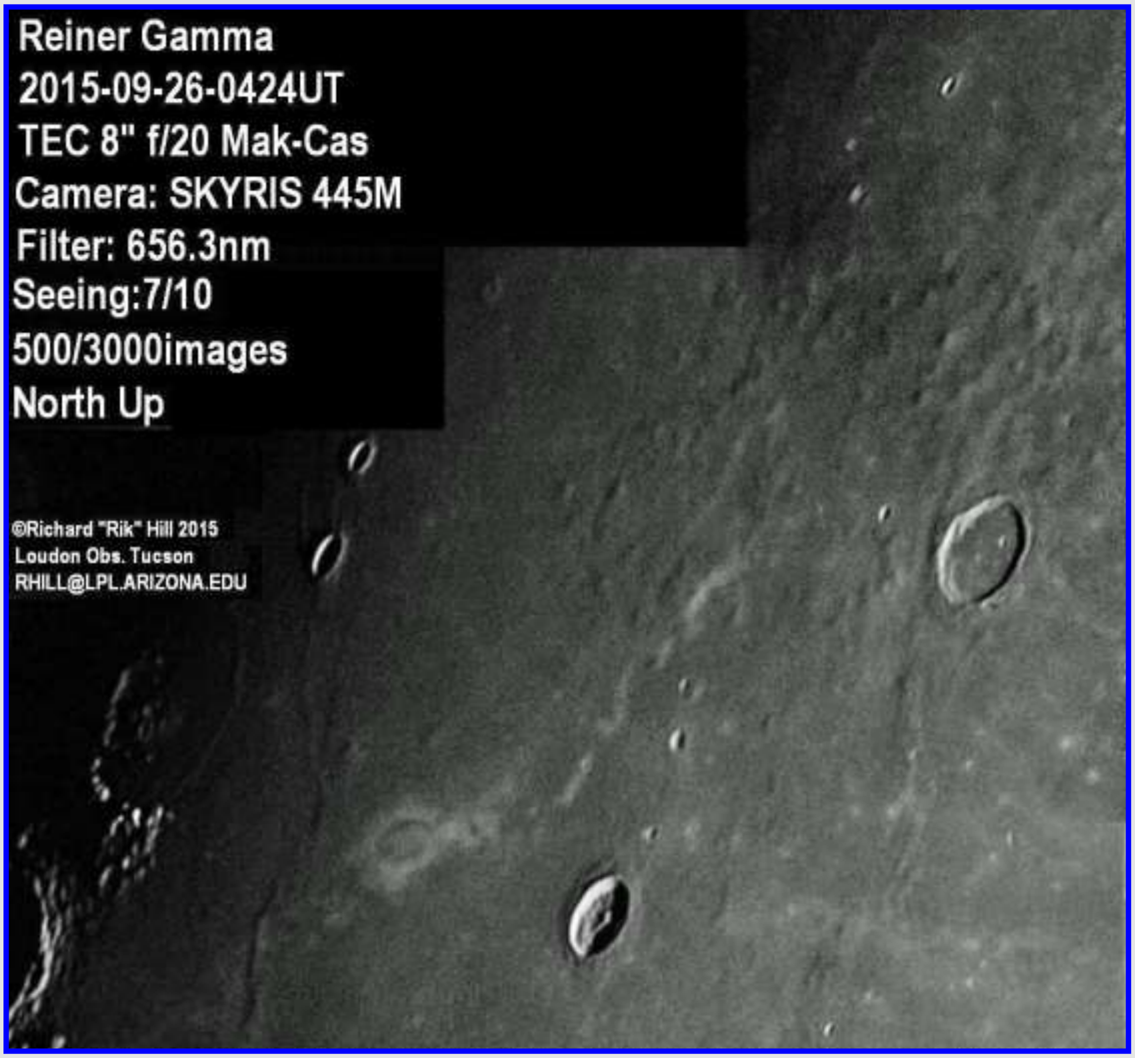
In order to provide more lead time for contributors the following future targets have been selected:

Subject	TLO Issue	Deadline
Reiner Gamma	**May 2023**	**April 20, 2023**
Mons Rümker	**July 2023**	**June 20, 2023**
Floor-Fractured Craters	**September 2023**	**August 20, 2023**
Dorsa Smirnov	**November 2023**	**October 20, 2023**

Focus-On Announcement
Mysterious Reiner Gamma

Reiner Gamma deserves the name anomaly with honors. There are other lunar swirls, but Reiner Gamma is the only one visible to us, amateurs. It shares the near side with the swirls of Mare Marginis and Mare Ingenii, which we can only partially glimpse under favorable libration conditions. There are different theories about the nature of Reiner Gamma, everyone has a transitory moment of reign, but we are not completely sure what caused our anomaly. We will ask ourselves about its nature and we will try to provide images that make us better understand the topography of the area.

MAY 2023 ISSUE-Due April 20th, 2023: REINER GAMMA
JULY 2023 ISSUE-Due June 20th, 2023: MONS RÜMKER
SEPTEMBER 2023 ISSUE-Due August 20th 2023: FLOOR FRACTURED CRATERS
NOVEMBER 2023 ISSUE-Due October 20th 2023: DORSA SMIRNOV
JANUARY 2024 ISSUE-Due December 20th 2023: SINUS IRIDUM
MARCH 2024 ISSUE: Due February 20th 2024: LACUS MORTIS



Rik Hill

Focus-On Announcement
MONS RÜMKER, THE OLYMPUS OF THE MOON

Because of its location near the western limb, Mons Rümker is very hard to observe. What better reason to add it to our Focus On Section? Mons Rümker is a volcanic complex, on the surface of which numerous individual domes can be distinguished, a unique selenographic feature, as we can see in Rik Hill's image. We will try to elucidate as many details of this fascinating mountain in our July issue.

MAY 2023 ISSUE-Due April 20th, 2023: REINER GAMMA
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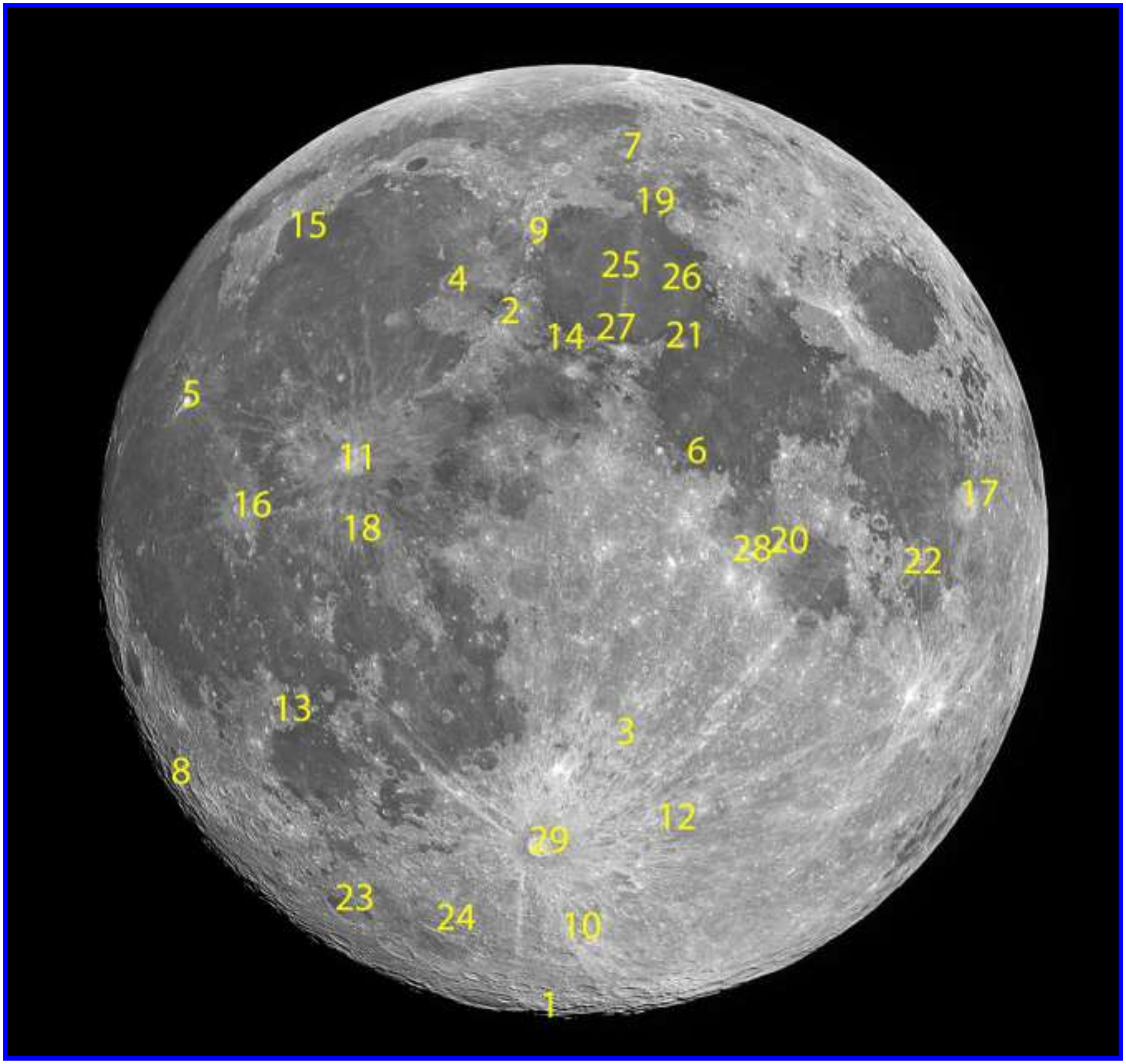
JANUARY 2024 ISSUE-Due December 20th 2023: SINUS IRIDUM
MARCH 2024 ISSUE: Due February 20th 2024: LACUS MORTIS

Rik Hill

Key to Images In This Issue



1. Aitken Basin
2. Apenninus, Montes
3. Apianus
4. Archimedes
5. Aristarchus
6. Armstrong
7. Bürg
8. Byrgius
9. Caucasus, Montes
10. Clavius
11. Copernicus
12. Faraday
13. Gassendi
14. Haemus, Montes
15. Iridum, Sinus
16. Kepler
17. Langrenus
18. Lansberg
19. Luther
20. Mädler
21. Plinius
22. Santbech
23. Schickard
24. Schiller
25. Serenitatis, Mare
26. Smirnov, Dorsa
27. Sulpicius Gallus
28. Theophilus
29. Tycho