The Lunar Observer

A Publication of the Lunar Section of ALPO

May 2023

In This Issue

Reiner Gamma, *Michel Deconinck, Aquarellia Observatory - Artignosc-sur-Verdon France. 2021 October 02 05:15 UT. Takahashi Mewlon 250 mm Dall-Kirkham telescope, 14 mm eyepiece, 267 x. See the Focus-On Mysterious Reiner Gamma for much more!*

Online readers, click on images for hyperlinks

Lunar Reflections

Wishing each of you a very pleasant month. Here in Mississippi we had some clear weather. Most interesting for me was attending the Mid-South Stargaze. At this conference, there were observers from across the southeastern USA. There were some nights of great weather. During one of the days, I gave a presentation about ALPO and tried to recruit new members. Hopefully, we added to our ranks!

This is quite an issue of *The Lunar Observer*. The highlight is the Focus-On article about Mysterious Reiner Gamma by Alberto Anunziato. This has wonderful text and images about this magnetic anomaly in Oceanus Procellarum. Also, Robert Hays, Jr. contributed a drawing and text about this region and David Teske looked at older Moon maps to see how Reiner Gamma was photographed in the past. Along with the Reiner Gamma material, we have great articles by Rik Hill about the Apollo 16 region, Guillermo Scheidereiter investigate pareidolia on the Moon, Robert Hays, Jr. investigates the crater Carrel, KC Pau explores the area around Diophantus and Delisle and Alberto Anunziato explores the crater Grove and a wrinkle ridge in Mare Nectaris. Along with this, the are many beautiful images and drawings of the Moon. As always, Tony Cook contributes his Lunar Geologic Change and Buried Basin and Crater articles. Many thanks to all who contributed!

Please remember to follow the future Focus-On topics and gather observations of these features. Next up is the very interesting Mons Rümker. Observations are due to Alberto and myself by June 20, 2023.

Clear skies,
-David Teske

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

The Moon and Clouds, *Fabio Verza, SNdR, Milan, Italy. 2023 April 04 20:35 UT, Cell phone camera. I hope this is NOT your typical view of the Moon!*

Lunar Topographic Studies

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Observations Received

Name	Location and Organization	Image/Article
Alberto Anunziato	Paraná, Argentina	Articles and drawings *Grove in the Terminator, A True Wrinkle Ridge and a False One,* drawing of Reiner Gamma and *Focus On: Mysterious Reiner Gamma*.
Sergio Babino	Montevideo, Uruguay, SAO-LIADA	Image of Cyrillus.
Juan Manuel Biagi	Paraná, Argentina	Images of Reiner Gamma (2).
Jairo Chavez	Popayán, Colombia	Images of the Waning Gibbous Moon (2).
Leonardo Alberto Colombo	Córdoba, Argentina	Image of Reiner Gamma.
Massimo Dionisi	Sassari, Italy	Images of Dorsa Smirnov, Lacus Mortis, Vitruvius, Jansen, Aristoteles and Cauchy (2).
Michel Deconinck	Aquarellia Observatory - Artignosc-sur-Verdon France	Drawing of Reiner Gamma (2).
Walter Ricardo Elias	AEA, Oro Verde, Argentina	Images of Plato and Alphonsus.
Diego Ferradans	Villa Maria, Argentina	Image of Theophilus.
István Zoltán Földvári	Budapest, Hungary	Drawings of Grimaldi, Chevallier, Promontorium Olivium, Nicollet, Davy and Berosus.
Marcelo Guarda	Santa Fe, Argentina	Image of the Waning Gibbous Moon.
Robert H. Hays, Jr.	Worth, Illinois, USA	Articles and drawings *Carrel* and *Reiner and Reiner Gamma.*
Rik Hill	Loudon Observatory, Tucson, Arizona, USA	Article and image *Apollo 16 Region*, images of Reiner Gamma (3).
Felix León	Santo Domingo, República Dominicana	Images of Reiner Gamma.

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

Lunar Topographic Studies

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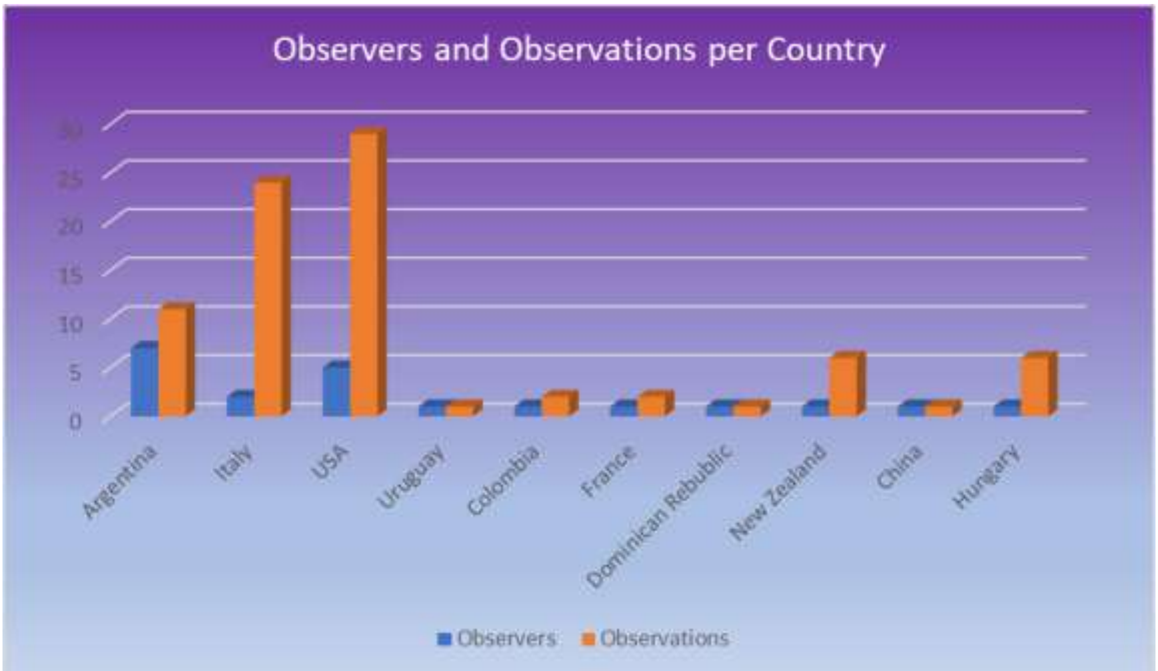
Observations Received

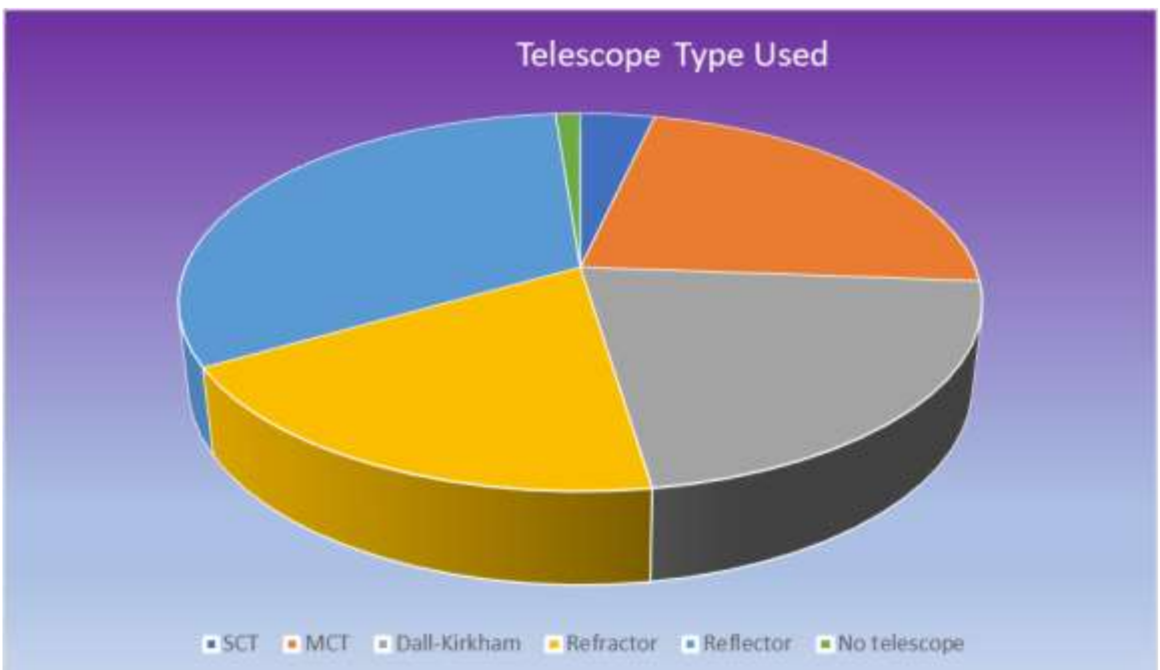
Name	Location and Organization	Image/Article
KC Pau	Hong Kong, China	Article and images *Study of Diophantus-Delisle Area with Earth Based Telescopic Photos.*
Guillermo Daniel Scheidereiter	LIADA, Rural Area, Concordia, Entre Ríos, Argentina	Article *Pareidolia, what do we see on the Moon?*
Gregory Shanos	Sarasota, Florida, USA	Image of Reiner Gamma and the two-day old Moon.
David Teske	Louisville, Mississippi, USA	Article *Reiner Gamma in the Golden Ages*, images of Reiner Gamma (12).
Larry Todd	Dunedin, New Zealand	Images of Schiller (2), Petavius, Langrenus, Messier and Mare Orientale.
Fabio Verza	SNdR, Milan, Italy	Images of the Moon in clouds, Capella, Cyrillus, Atlas, Abulfeda, Aristoteles, Janssen, Lacus Mortis, Maurolycus, South Pole, Petavius, Manilius, Neumayer, Posidonius, Rheita, Rheita E and Theophilus.
Paul Walker	Middlebury, Vermont, USA	Images of Reiner Gamma, Meton, Western Mare Serenitatis, Lade, Licetus, Rima Hyginus (2), Playfair (2) and Theophilus.

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

May 2023 *The Lunar Observer*
By the Numbers

This month there were 83 observations by 21 contributors in 10 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.

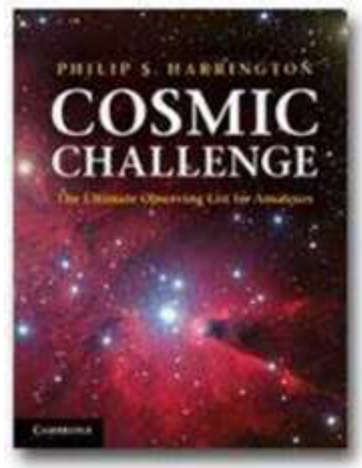
Information about paper presentations, the keynote speaker and other conference data will be published in this Journal and online as details are learned.

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

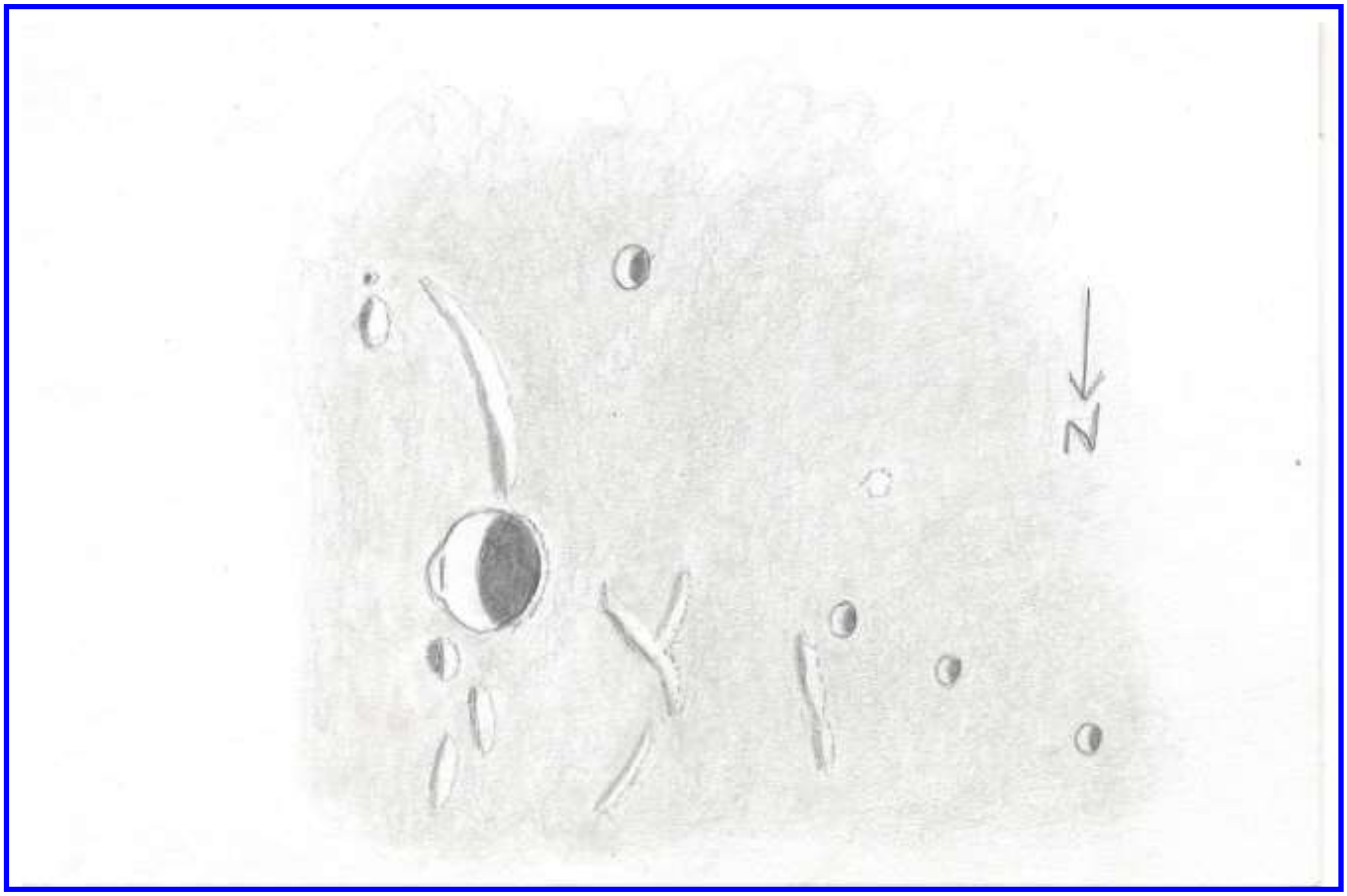


Note: The dates and times listed are based on calculations made with the Lunar Terminator Visualization Tool (LTVT) by Jim Mosher and Henrik Bonda. This useful freeware program may be downloaded from https://github.com/fermigas/ltvt/wiki.

Lunar Topographic Studies

Carrel

Robert H. Hays, Jr.



Carrel, *Robert H. Hays, Jr., Worth, Illinois, USA. 2022 November 13 09:52-10:12 UT. 15 cm reflector telescope, 170x. Seeing 8-6/10, transparency 6/6.*

I drew this crater and vicinity on the morning of November 13, 2022 after the Moon uncovered 47 Geminorum. This crater was formerly known as Jansen B. Carrel is in central Mare Tranquillitatis. It has a bulge on its east side, possibly from a slump or another impact. A bit of shadow partly separates the bulge from the main crater. A large mountain with dak shadow is just north of Carrel. Two other hills with lighter shadow are farther north. These three peaks may be part of a ghost ring shown on the Lunar Quadrant map. A curved ridge extends southward from Carrel, ending near a fairly large peak. This peak has a tiny companion just to its south. The isolated crater west of the curved ridge is Carrel G. Three small pits form a line west of Carrel. These are, from east to west, Ross G, F and E. A shadowless bright spot is south of Ross G, and a short ridge is northwest of this crater. Several more ridges lie between Carrel and Ross G.

Lunar Topographic Studies
Carrel

Pareidolia, what do we see on the Moon?
Guillermo Daniel Scheidereiter

"Es por la noche, cuando en éxtasis de blancura

El astro nocturno desciende macilento

Como un témpano de luz por la hondura

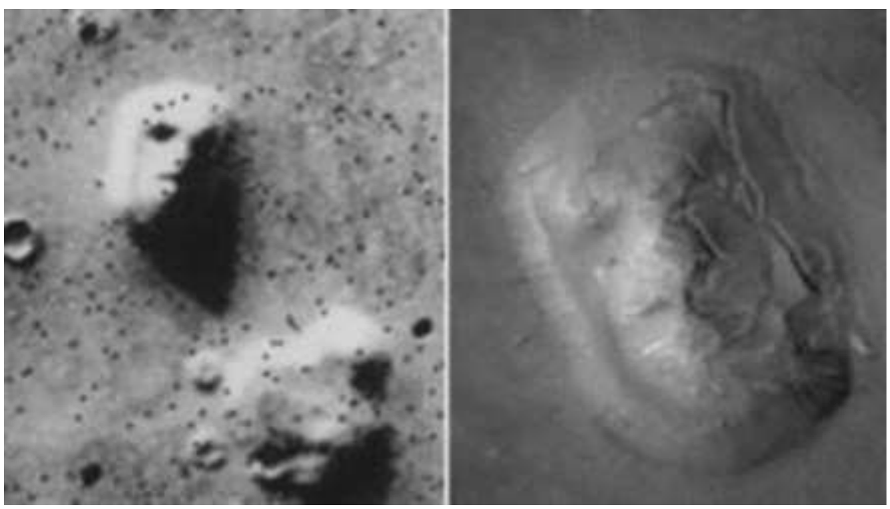
Líquida del firmamento."

Leopoldo Lugones, El pescador de sirenas, Lunario Sentimental, 1909.

Since ancient times, skywatchers have left the imprint of their imagination on the stars. Able to recognize a hunter, a scorpion or a bull, even gods and goddesses of mythology, man has not ceased in his desire to scrutinize, understand, unravel and interpret the mysteries of the universe.

The recognition of a pattern, such as a face, where such a thing does not exist, is called pareidolia and, according to some studies, the tendency to recognize faces and common shapes in things, is rooted in our genes, because we are genetically configured to recognize human faces and, probably, that is why we think we see them everywhere.

You, dear reader, will remember the famous and widespread photograph taken by the Viking 1 probe, of a plateau of Mars whose shape resembles that of a human face. While there were ufological interpretations that suggested that it was a sculpture built by an extraterrestrial civilization, science always explained that it is one of the many plateaus of the Cydonian region.

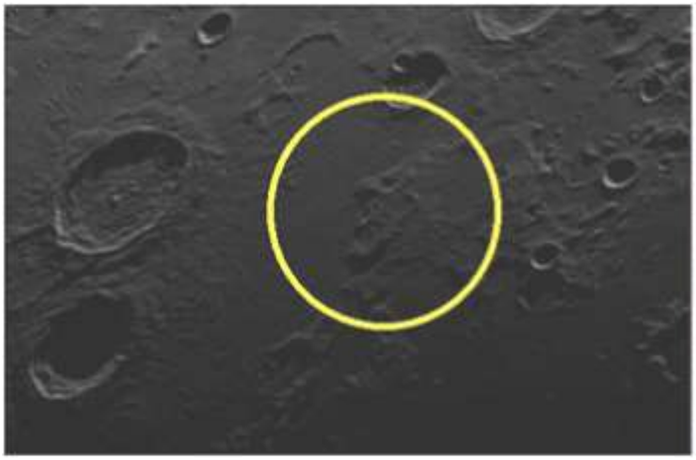


Left: Photograph taken by the Viking probe in 1976. Right: Later photograph where it is only seen as a usual feature of the terrain.

The Moon has not been exempted from pareidolia and, therefore, it is fair to ask, what do we see on the Moon? The natural satellite of the Earth fascinates our imagination since the beginning of our times and while the dance of its phases, transits, light and darkness are debated in an incessant game of shadows and clarities in the terminator that induce different forms in our sensitive perception.

For example, in the following image, below Cepheus and looking towards Atlas and Hercules, a figure similar to a human profile is clearly distinguishable. The curious picture is formed to the east of Lacus Somniorum, between the craters of Maury, namely Maury M, Maury N and Maury L, with chin directed towards Williams.

Is it a character from The Lord of the King or The Hobbit, by the British writer J.R.R. Tolkien? Is it the profile of "the witch of Rigel", the nebula IC 2118 (undoubtedly an emblematic case of pareidolia, much visited by astrophotographers around the world), which also has a presence on the Moon?



Left: Figure reminiscent of a human face, below the crater Cepheus, looking towards Atlas and Hercules. Right: Nebula IC 2118, next to the star Rigel; the profile of the witch is directed towards Rigel (in this image is also comet C/2022 E3 (ZTF), adorning the witch's hat).

If you are a reader tempted to think that a group of aliens visited our moon and, in the wild ways of the north, left their mark on a sculpture, perhaps your suppositions are quickly overturned. Indeed, see the following comparison with an image obtained from LROC:

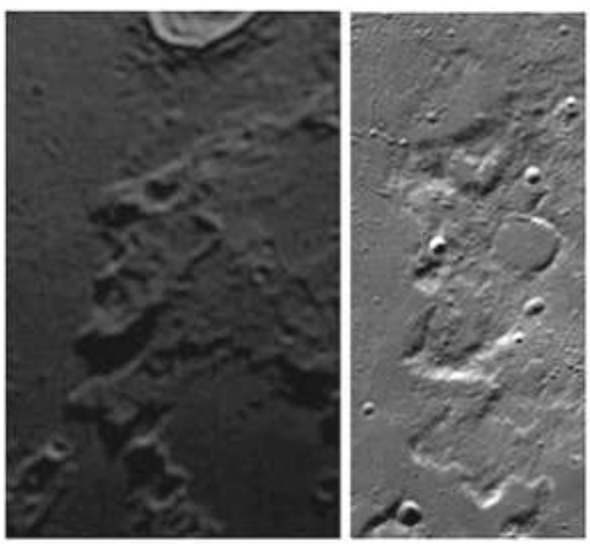
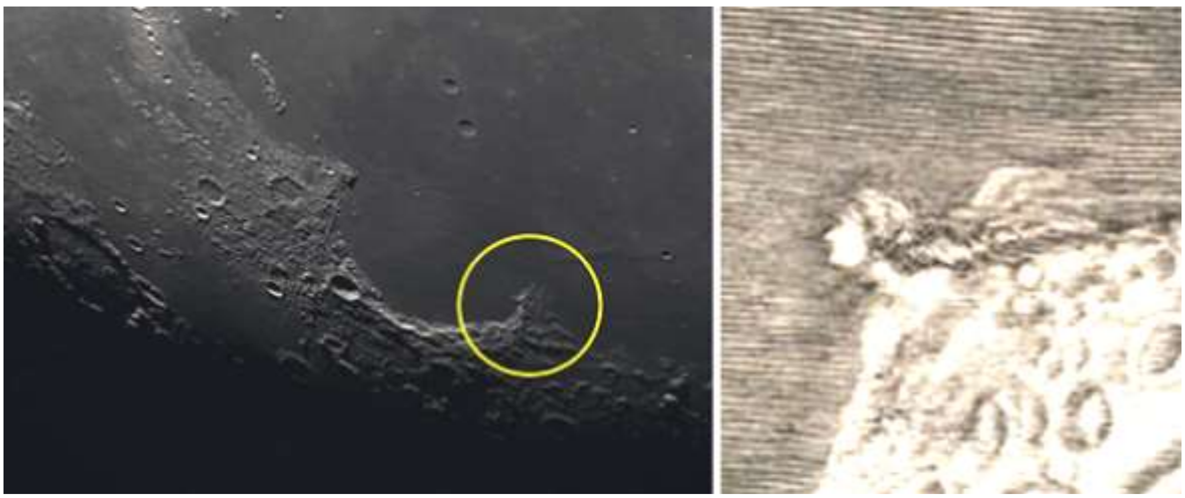


Image comparison. On the right is an imagen of LROC of the plateau that induces to think of a human face, according to the suggestive forms that the lights and shadows project on the surface

It is exactly the same lunar region where we see nothing but a kind of plateau with a few impact craters. We no longer see the profile of a dwarf from The Hobbit or a witch. The lighting conditions, five days after the new moon, make us see a face where there is none.

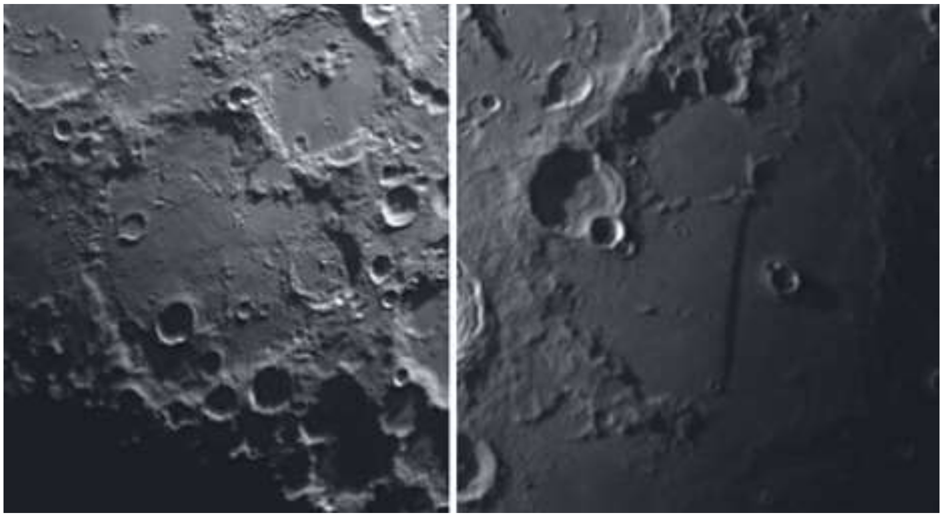
This is not the only face on the Moon. Indeed, Giovanni Domenico Cassini drew, on a lunar map dating from 1679, the face of a woman in the Promontorium Heraclides, who is known as "the maiden of the Moon". The profile faces Sinus Iridum and the terraced hills in the opposite direction form the abundant hair.

The Promontorium Heraclides is a mountainous cape that is located in the Mare Imbrium, one of the most beautiful and emblematic regions of the Moon. As soon as you observe this region through the telescope, you will feel that you go from seeing a hard and cold surface to perceiving the movement of the calm waters of the Rainbow Bay, where gentle waves join each other shaping the coasts. Is it hard to imagine a mermaid swimming in the shallow waters of the riverbank?



Left: Promontorium Heraclides. Right: Claude Mellan's engraving of "the Maiden of the Moon" imagined by Cassini.

But the above is still not enough to satisfy the human imagination. Have you seen the heart of the Moon? If not, do not miss the opportunity to visit the Deslandres crater with your telescope.



[Left](#): Deslandres crater, the heart of the Moon. [Right](#): Rupes Recta, the sword of the Moon.

Deslandres is a large crater located in the southern lunar highlands. For a long time, it went unnoticed, because it contained Hell, a conspicuous crater 33 km in diameter, to the point that was known as the Hell plain. Southeast of the Mare Nubium and boasting its 235 km in diameter, Deslandres is heart-shaped. Using a medical language, we could say that the ventricles are in the direction of the satellite craters of Ball, Gauricus and Pitatus, towards Lexell is the left atrium and towards the opposite side, the right atrium, while Walther W forms the entrance of the aorta and pulmonary arteries. This crater is in a region very visited by fans of the observation and photography of the Moon because, very close to there, following the terminator to the north, you will find the Rupes Recta: the sword of the Moon. Another curious case of Pareidolia where we recognize (or think we recognize), a familiar object: a sword. Towards the southern end (above in the image above), is the handle or hilt of the sword, which forms on the edges of Thebit P, while the blade of the sword is the 110 km fault that makes up the Straight Wall.

Image where you can see the shape of the rabbit on the Moon.

Lunar Topographic Studies

Pareidolia, what do we see on the Moon?

Surely, it is not alien to his knowledge that a rabbit dwells on the Moon. The Nectaris and Fecunditatis seas form the ears of the rabbit, the seas Tranquillitatis and Serenitatis form the head of the rabbit and the rest of the seas (Mare Vaporum, Mare Imbrium, Oceanus Procellarum, Mare Insularum, Mare Cognitum, Mare Nubium, Mare Humorum), form the body.

The Mayan and Aztec cultures report the existence of a rabbit on the Moon, which shows that pareidolia is present in all cultures throughout time. A legend tells that the rabbit would have been formed after a god considered it unfair that the arrogant Tucuciztécatl became a body as bright as Nanahuatzin, who was transformed into the Sun after throwing himself into a bonfire with full courage at the request of the gods, because it was necessary to illuminate the sky day and night. According to the story, Tucuciztécatl did not have the courage to sacrifice himself on the first attempt and only threw himself at the stake out of shame after Nanahuatzin did. The truth is that that god sacrificed a rabbit and threw it towards the Moon in which Tucuciztécatl had become, so that it would not be brighter than the Sun (Nanahuatzin).

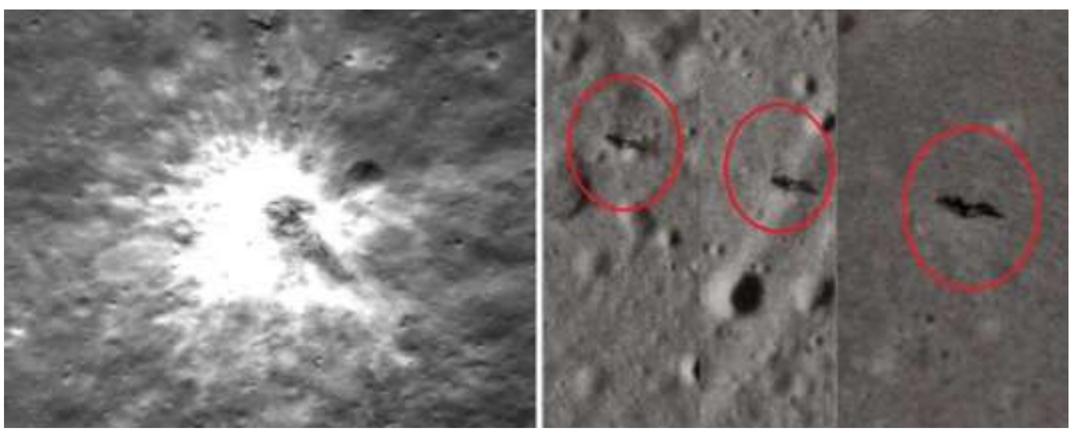
A second legend tells that the god Quetzalcoatl decided to visit the Earth turned into a man and after a long day of walking and admiring the beauties he found, already tired, he felt very hungry and had nothing to eat. A rabbit approached and after seeing that Quetzalcoatl could die of hunger, he sacrificed himself so that he could live. This is how Quetzalcoatl, grateful, lifted the rabbit to the moon leaving his figure stamped in his light.

Left: Indian culture depicts two hands on the Moon. The mother of all living things, Astangi Mata, sent her twin sons to heaven to be the sun and moon. The hands represent the farewell of their children. Center: In Hawaii they represent a tree on the Moon. This tree is used by a woman to make the clothes of the gods. She is called Hina which comes from Mahina which means Moon. Right: In Japan, they depict a rabbit with a mortar where it grinds rice to make a cake called Mochi. In China and Korea, the rabbit prepares an elixir of immortality. Fountain: https://www.nationalgeographic.com/culture/article/140412-moon-faces-brain-culture-space-neurology

The interesting thing is that the rabbit also appears in the millenary Japanese culture. Here, the legend is known as "Tsuki no Usagi", which means "The Rabbit on the Moon". The legend is very similar to that of the previous paragraph, because it is a rabbit that lights a bonfire and sacrifices itself so that a man does not die of hunger. The man in question is a god from Japanese mythology who, moved by the noble gesture of the animal, takes his remains and leaves them in perpetuity on the Moon so that his sacrifice is always remembered by men.

Left: In New Zealand they represent a Maori maiden named Rona who must fulfill a penance by staying on the Moon. Center: In Europe the image of a man carrying a bundle of sticks is frequent. Right: In North America, the representation of a human face is common. Fountain: https://www.nationalgeographic.com/culture/article/140412-moon-faces-brain-culture-space-neurology

Pareidolia turns the Moon into fertile ground for ufologists, conspirators and illusionists, who believe they recognize alien patterns in lunar accidents, but it has also been a source of inspiration and cultural richness for different peoples throughout the history of humanity. The human imagination as a form of representation of things that are not real, has found in the Moon a germ from which to nourish itself, and directly or indirectly, the Moon is a constituent part of the configuration of our culture. Hands on the Moon, a face, a Maori maiden, a tree, a man carrying a wad of sticks, the shapes and figures that the human mind has drawn on the Moon are the most varied.



Left: Image taken from LROC, where ufologists believe they see a reptiloid. Right: Three of the 42 humanoid silhouettes due to a spot on the lens of one of the cameras that took pictures using the Google Moon tool.

Upright in a sky of lights and shadows, the Moon embodies the most sublime and snowy deity of the night. Inspiring muse of aedos and poets is present in the very cradle of civilizations; adored and feared, personified and returned to its rocky reality, scientific, philosophical and artistic object, lullaby and light in the darkness, beacon for navigators and destiny of Apollos, the Moon continues to captivate us with its figure and mystery. Its interaction with the Earth since the beginning of time has configured and enriched a part of our entelechy and helps us understand our tiny place in the universe, our finiteness and contingency; and while she continues to dominate the night with her splendor, we will continue to imagine faces, animals and objects on her, in an attempt, perhaps unconscious and desperate, to reflect ourselves and remain in her silver and imposing figure. To be part of its surface and essence. You, dear reader, what do you see when you look at the Moon?

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Theophilus, *Fabio Verza, SNdR, Milan, Italy. 2023 April 27 18:09 UT. Takahashi Mewlon 250 mm Dall-Kirkham telescope, 1.3 x barlow, Astronomik ProPlanet IR642 filter, Player One Mars-M camera.*

Study of Diophantus-Delisle Area with Earth-Based Telescopic Photos
KC Pau

After reading the excellent article written by Barry Fitz-Gerald about the topographical study of Diophantus-Delisle area in the BAA LSC March 2023 issue, I have much interest to study this area especially the ray from a small crater Samir based on my own moon photos taken with a 250mm f/6 Newtonian reflector. In the past years, I mainly focused on the changes of Mons Delisle under various angles of illumination and neglected the other features in this area. What's a pity! I flipped through volume 2 of my "Photographic Lunar Atlas for Moon Observers", which is freely downloaded since 2016, to a section about crater Delisle (section 58, page 320~325). I am much grateful to Alberto Anunziato who frequently uses photos of the atlas in his visual observation reports published in "The Lunar Observer", which is a publication of the lunar section of ALPO. In page 322, I found a photo (fig.1) with the lighting condition quite match to Paul Abel's drawing and photos that taken by Bill Leatherbarrow but with Mons Delisle, Delisle and Diophantus much closer to the morning terminator. The line of craterlets and/or hummocks mentioned by Bill is clearly shown. What I perceive it is not a line of craterlets but a line of tiny hillocks, as some of them cast clear shadow. No trace of crater ray along that line is detected as it is prominently shown in Abel's drawing. Later, when I look through my moon photo archive, I find a photo of Delisle area that was taken on the same date as Paul's drawing but about 6 hours earlier (fig.2). However, there is still no trace of the ray detected on my photo. Is the ray really existing there? That is quite an interesting phenomenon. May be, the way of perception is different between the camera sensor and the human eye.

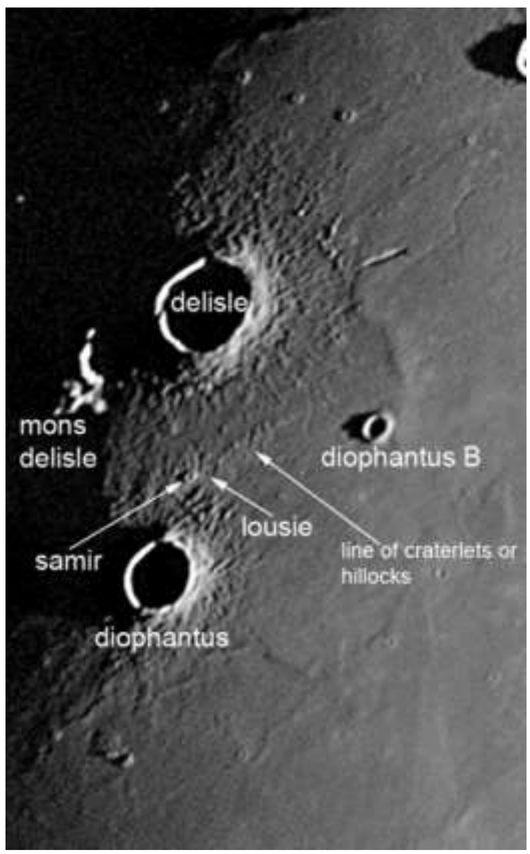
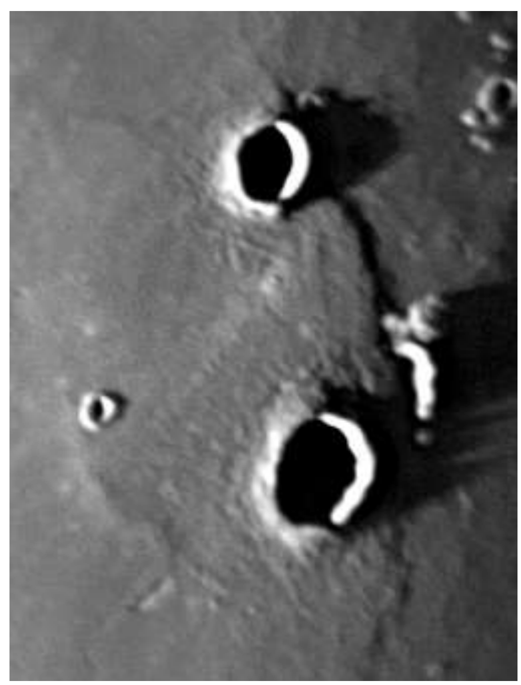


Fig. 1. A photo showing a line of craterlets or hillocks north-east of crater Samir. It may be the ray like feature mentioned in Paul Abel's drawing. This photo is taken on 22 March 2013, 11h48m UT, colongitude: 35.1^{o}, seeing: 6~7/10, transparency: 5/10.

Fig. 2. Side by side comparison of drawing and photo taken on the same date but different hours. Ray in the drawing is very prominent but no other detail shown. Not a trace of ray is shown in the photo but only hummocky terrain around crater Delisle and Diophantus. The line of hillocks is shown clearly.

Searching and searching, eventually another photo pops up (fig.3). This photo has almost the same colongitude (37.4^{o}) as Paul's drawing (37.8~38^{o}) but on a different date and time. Trace of ray now appears on the photo but all other detail is blurred due to poor seeing. I wonder if the seeing has played a role to intensify the appearance of the ray as the line of hillocks mentioned above may overlap or mix with one another under turbulent seeing.

Fig. 3. A photo has the almost the same colongitude 37.4^{o} as Paul's drawing taken under 4/10 seeing on 13 Oct 2005 13h33m UT. A trace of the ray is detected but all other details are blurred with poor seeing.



Another two photos (fig. 4 & 5) taken respectively on 7 December 2019 and 8 January 2017, a trace of ray is barely detected near the north-eastern portion of the line of hillocks as the sun is higher up and the detail of the features begin to wash away. A small halo is seen around crater Samir

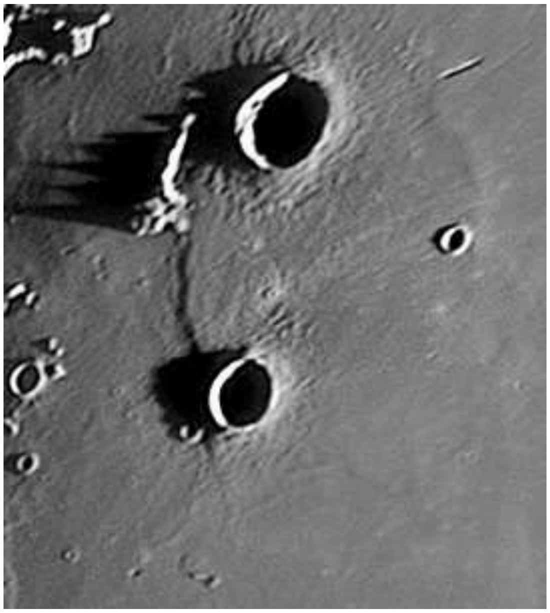


Fig.4 Photo taken on 7December2019, 12h43m UT, Colongitude: 37.8°, seeing: 6~7/10, transparency: 8/10

Fig. 5 Photo taken on 8 January 2017,13h35m UT, Colongitude: 38.8°, seeing:7/10, transparency: 6/10

When the sun is getting higher and higher, the rays from Samir appear prominently as a narrow fan of bright rays not just a single ray as shown in Paul's drawing and Leatherbarrow's photos (fig. 6).

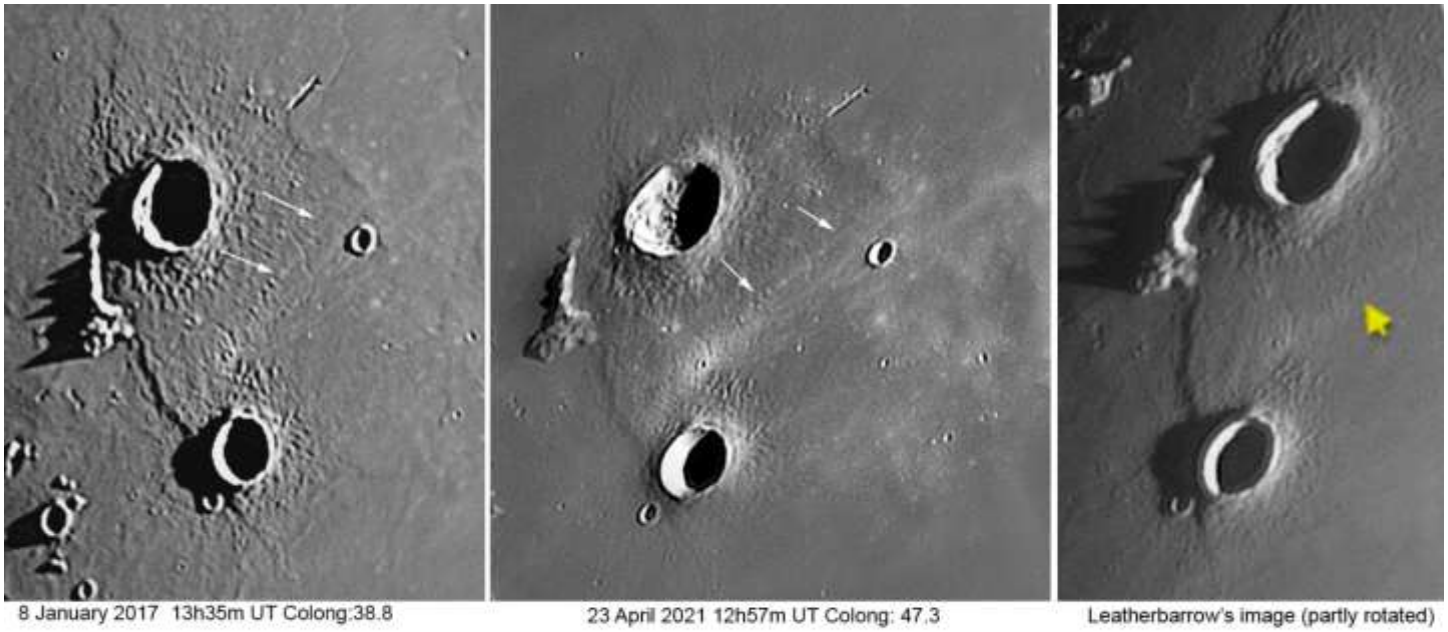


Fig. 6 Ray from Samir at different angle of illumination. In the middle image, the rays look like a search-light. The white arrows shown in the two left-sided photos correspond to ray indicated by yellow arrow from Leatherbarrow's photo.

The photo (fig.7) below is the side by side comparison of an enhanced image taken on 18 October 2021 with that of Barry's OMAT mosaic image. Coincidentally, two images look very similar. In his article, Barry stated that the middle ray (b) is what Paul and Bill recorded in their drawing and photo. When I compare all the photos that show the ray, I may not agree with Barry's view. I believe the ray labelled C should be the pick.

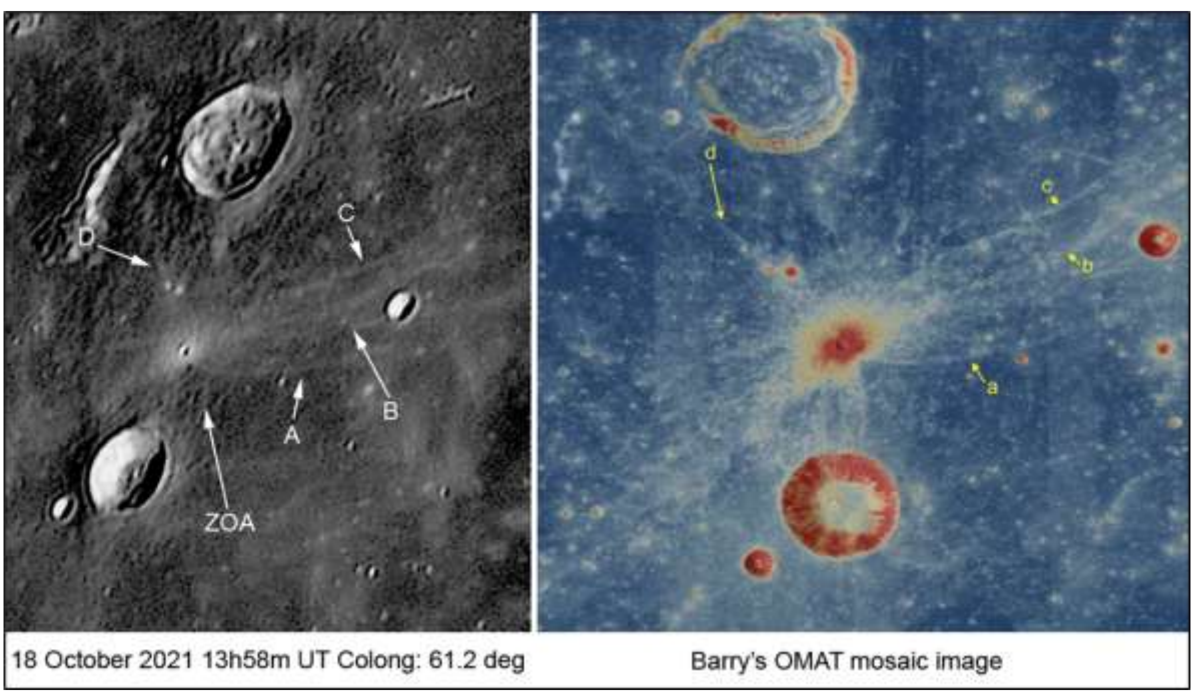


Fig. 7 Side by side comparison of a photo taken on 18 October 2021 with Barry's OMAT mosaic image.

Lunar Topographic Studies
Study of Diophantus-Delisle Area with Earth-Based telescopic Photos

Grove in the Terminator

Alberto Anunziato

At the moment of observing the vicinity of the terminator (colongitude 331.1) what caught my attention was the Grove crater (IMAGE 1), not by Grove itself, a crater almost 30 kilometers in diameter that Robert Garfinkle defines in Luna Cognita as a "smooth-rimmed Eratosthenian-age crater (…) Grove rises steeply from the rumpled ejecta blanket that surrounds it.

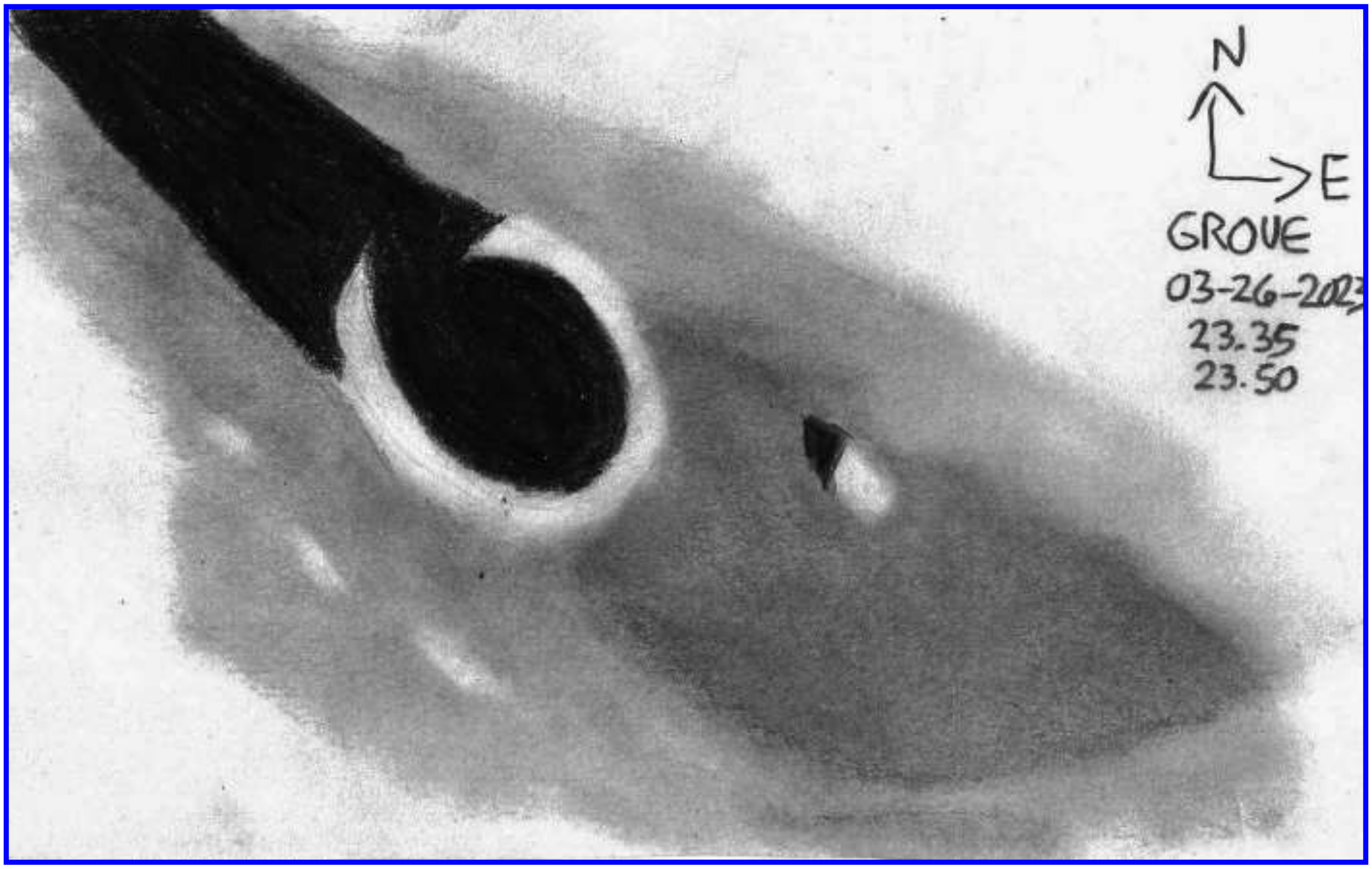


Image 1, Grove, *Alberto Anunziato, Paraná, Argentina . 2023 March 26 23:35-23:50 UT. Meade EX105 Maksutov-Cassegrain telescope, 154 x.*

The rim crests are sharp, the interior walls terraced, and there is a central peak on its dark flat floor". We can see very little of this near the terminator, when shadows completely inundate its interior and even part of its northern edge (the one facing Lacus Mortis), presumably lower than the rest. Two things caught my attention behind the eyepiece. The first is a bright area that clearly looked like a small spike, as it cast a shadow. And second, the dark area to the southeast. It had the appearance that slopes present when viewed visually, a very slight shadow that does not come from any direction but appears to be the color of the ground. For an inveterate visual observer like me, it is always important to decode highlights and shadows in order to know at the time of observation what topographic features they indicate. Of course, it always depends on a subsequent analysis with images that are more reliable than our sense of sight, so exposed to observational biases.

In this case it was the Lunar Reconnaissance Orbiter Quickmap. IMAGE 2 is a capture of the area in which it is clearly perceived that the bright area is a small elevation, which is parallel to two other similar ones (all three quite bright) that are radial to Lacus Mortis. And the verification that the dark area is a depression in the terrain is given in IMAGE 3, in which we mark the relief of the area with the data from the LOLA altimeter. Could it be a buried crater? We will follow the indications of Tony Cook to verify it (appearing in the previous issue of our magazine). Or will it be a slope, the extension of the "rumpled ejecta blanket" that Garfinkle mentions?

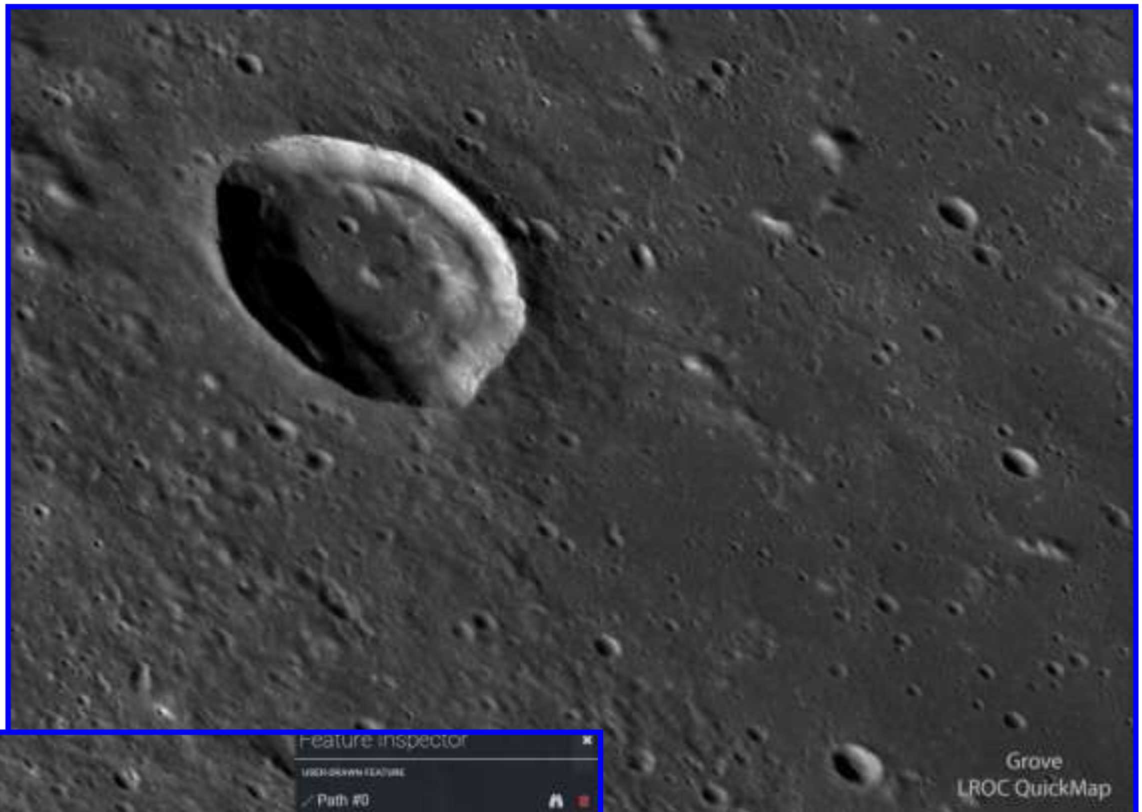


Image 2, Grove, *LROC QuickMap.*

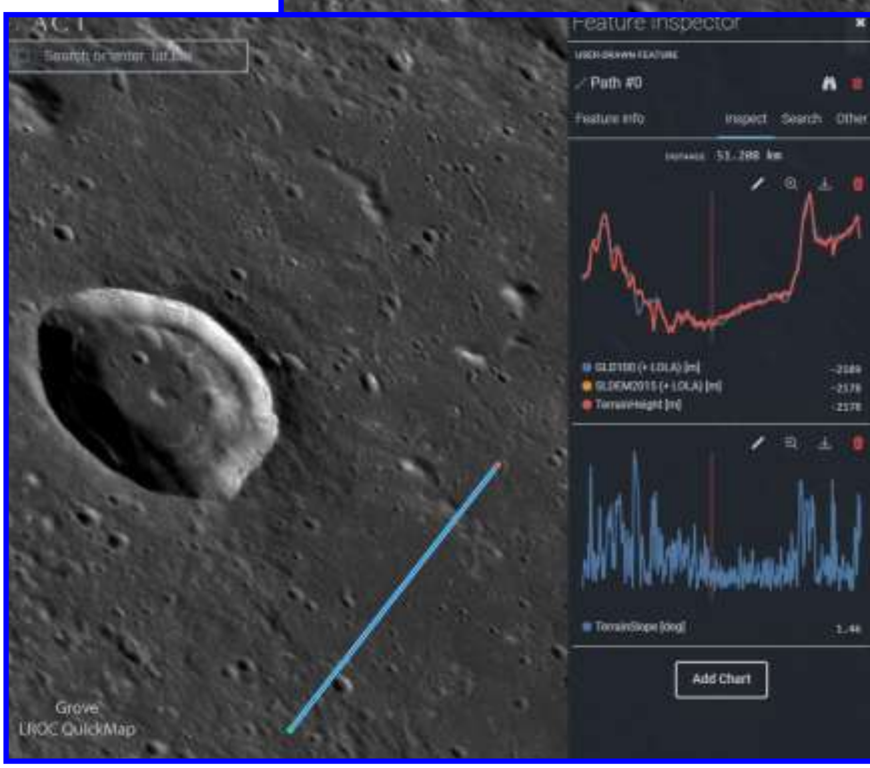


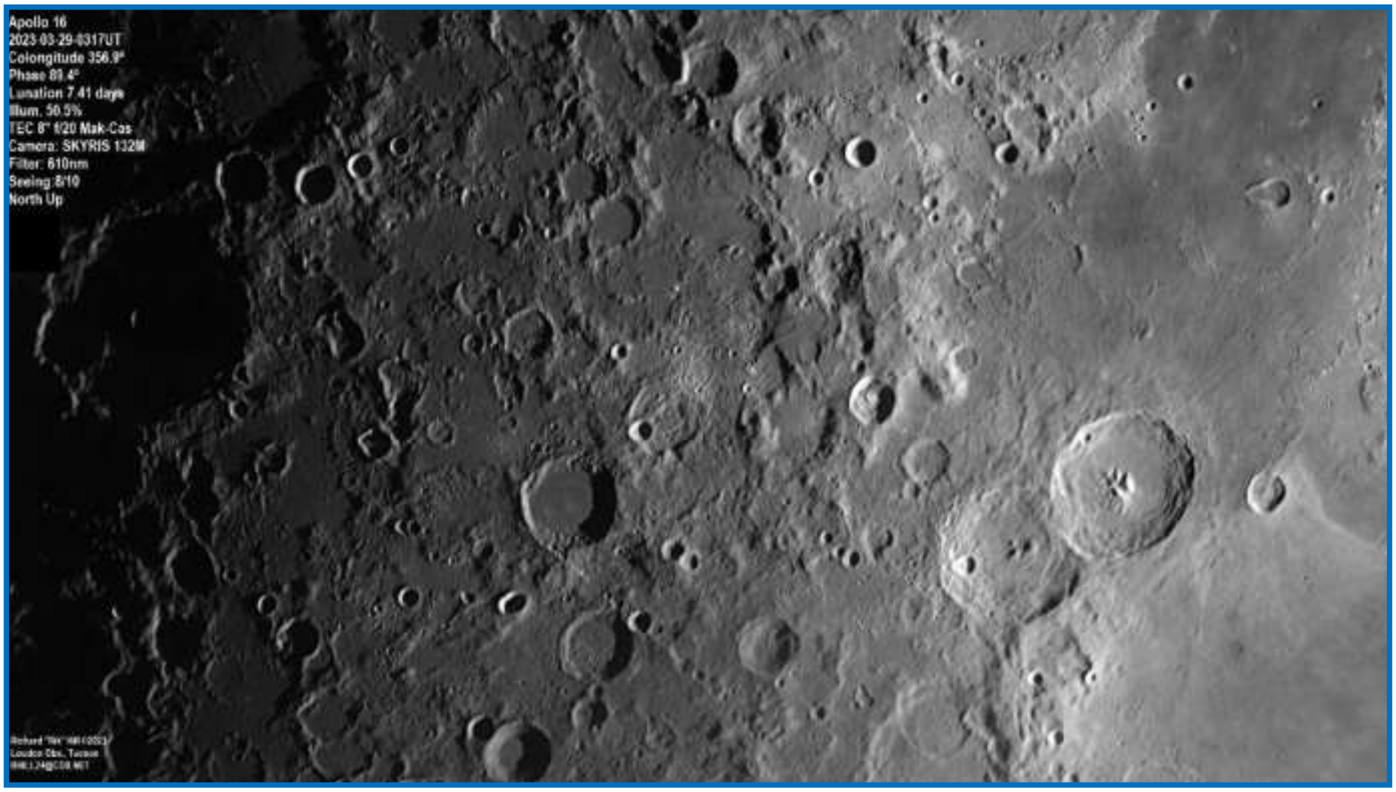
Image 3, Grove, *LROC QuickMap altimeter.*

Apollo 16 Region

Rik Hill

This image is full of goodies! There is the magnificent Theophilus crater (104 km dia.) on the right (lunar east) side of this image with its splendidly detailed central peaks. Below is the older and slightly smaller Cyrillus (100 km). To the east of Theophilus is Mädler with a fascinating ejecta splash surrounding. On the left side of this image (lunar west) is the huge shadow filled Albategnius (139 km). Between these two extremes of this image are several very interesting features. Almost dead center in the image you will see a small “o”. This marks the location of the Apollo 16 in the Descartes highlands. The little white spot just below the “o” is Stone Mountain that was explored by the astronauts and above are the Smoky Mountains. Below this region is the ruined crater Descartes (49 km) which has an interior ring and Descartes A (14 km) on the west side. Just below center is a large flat floored crater, Abulfeda (65 km). Tangent to the southeast wall of this crater and trailing off this image to the southwest is a chain of craters called Catena Abulfeda. The length is listed as 216 km running almost to Polybius with many of the larger craterlets being named as satellite craters of larger nearby craters but generally they are not named below the 5km diameter.

There is much more to see in this region, too much to detail here.



Apollo 16, *Richard Hill, Loudon Observatory, Tucson, Arizona, USA. 2023 March 29 03:17 UT, colongitude 356.9°. TEC 8 inch f/20 Maksutov-Cassegrain telescope, 610 nm filter, SKYRIS 132M camera. Seeing 8/10.*

Lunar Topographic Studies
Apollo 16 Region

A True Wrinkle Ridge and a False One

Alberto Anunziato

It is the third time that I have observed with some attention the solitary wrinkle ridge that runs to the east of Cyrillus F (IMAGE 1). At the time of observation, it was quite anodyne, just a bright band. What he forced me to draw, trying to retain the uniqueness of what I was looking at, is what looks like a second ridge.

Image 1, Dorsum East of Cyrillus F, *Alberto Anunziato, Paraná, Argentina . 2023 March 26 23:00-23:30 UT. Meade EX105 Maksutov-Cassegrain telescope, 154 x.*

In the July 2022 issue we published the second observation (colongitude 150) in a text called "Some Details on a Wrinkle Ridge in Mare Nectaris", in which the main focus was the details observed on the true wrinkle ridge, whose location we see in IMAGE 2 (obtained from the Lunar Reconnaissance Orbiter Quickmap). The "false wrinkle ridge" (which we call that because of its visual appearance) is further east, parallel to the "true wrinkle ridge". In the cited text we accompany another image from the LRO Quickmap, obtained with data from the LOLA altimeter, in which it was observed that there was a very small height parallel to the ridge included in the catalog of said Quickmap (and, therefore, "true").

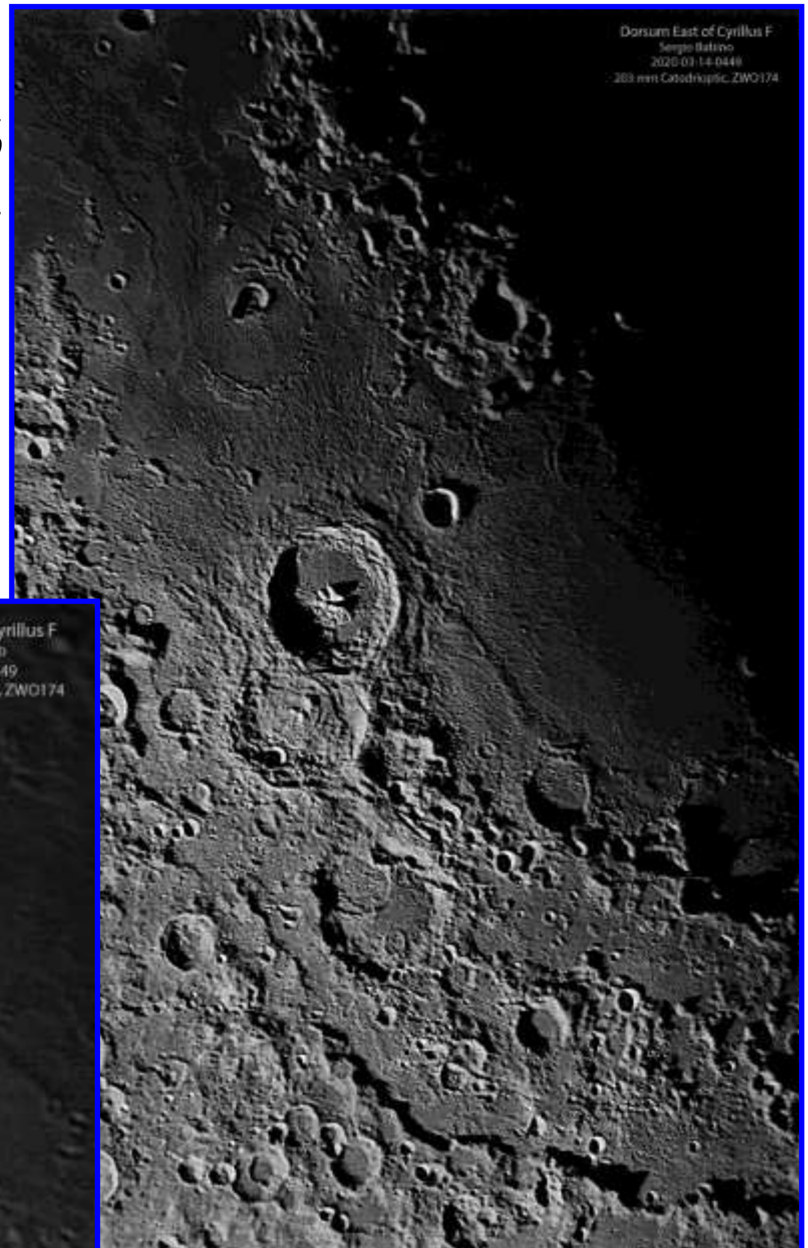
In the first observation (colongitude 335°) the ridge looked bright, without details or shadow, and only the shadow was visible from the parallel height. In the second, published in July 2022, both appear bright and the shadows narrow. In this third observation (colongitude 331°), the area is completely in shadow, the first rays of the Sun make the ridge shine brightly, while the parallel height shines less intensely and casts a less dark and peaky shadow, as if said parallel height were made up of small elevations. In my observation notebook I noted that it seemed like there were "crumbling rocks" at the foot of the height. I know, it would be impossible to see that level of detail, but that was the look.

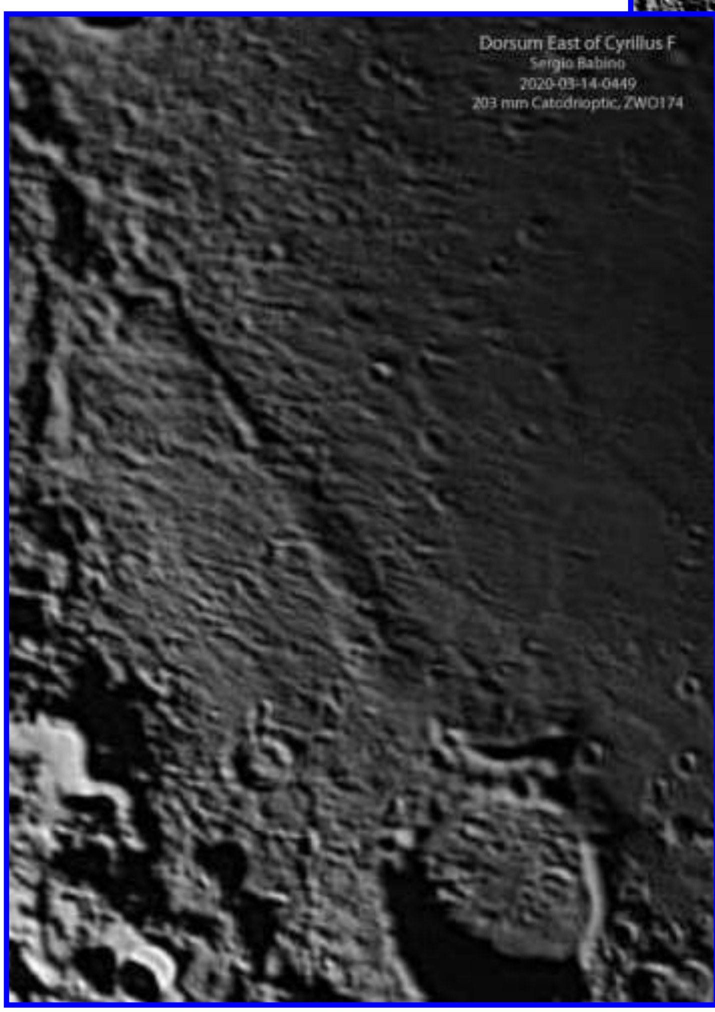
Image 2 Dorsum East of Cyrillus, *LROC.*

Lunar Topographic Studies
A True Wrinkle Ridge and a False One

I searched for images that the observers of the Sociedad Lunar Argentina had sent to Focus On whose objective were the selenographic features included from 1 to 10 of the Lunar 100 list and I found two in which the dorsum is very clearly observed. IMAGE 3 (and its detail IMAGE 4) belongs to Sergio Babino.

__Image 3, Dorsum East of Cyrillus F,__ Sergio Babino, Montevideo, Uruguay, SAO-LIADA. 2020 March 14 04:49 UT. 203 mm catadrioptic telescope, ZWO ASI174mm.. Below, __image 4__, a close-up of image 3.





Lunar Topographic Studies
A True Wrinkle Ridge and a False One

The wrinkle ridge is seen in incredible detail, but what is visually perceived as a parallel height is a tortuous relief, in which there appear to be no elevations. IMAGE 5 (and its detail IMAGE 6) belongs to Diego Ferradans, with other illumination small parallel elevations are noticeable which, however, are shorter than what is observed in IMAGE 1. Could it be a tortuous relief, a series of small hills, which my little telescope can't resolve and look like an unbroken series? The wonderful Rükl Atlas shows them as a rough relief, unfortunately this area is located between two charts and therefore it is not perceived so clearly. Once again, I left the final decision to the Photographic Lunar Atlas for Moon Observers by Kwok Pau, in the page 176 (Volume 1) is IMAGE 7. This image, with illumination quite similar to IMAGE 1 (with the Sun a little lower), shows the very tortuous relief to the east of the ridge (of which we only see the top), elevations wide enough to have craters on top, separated by gorges. An extremely interesting area, which deserves further study.

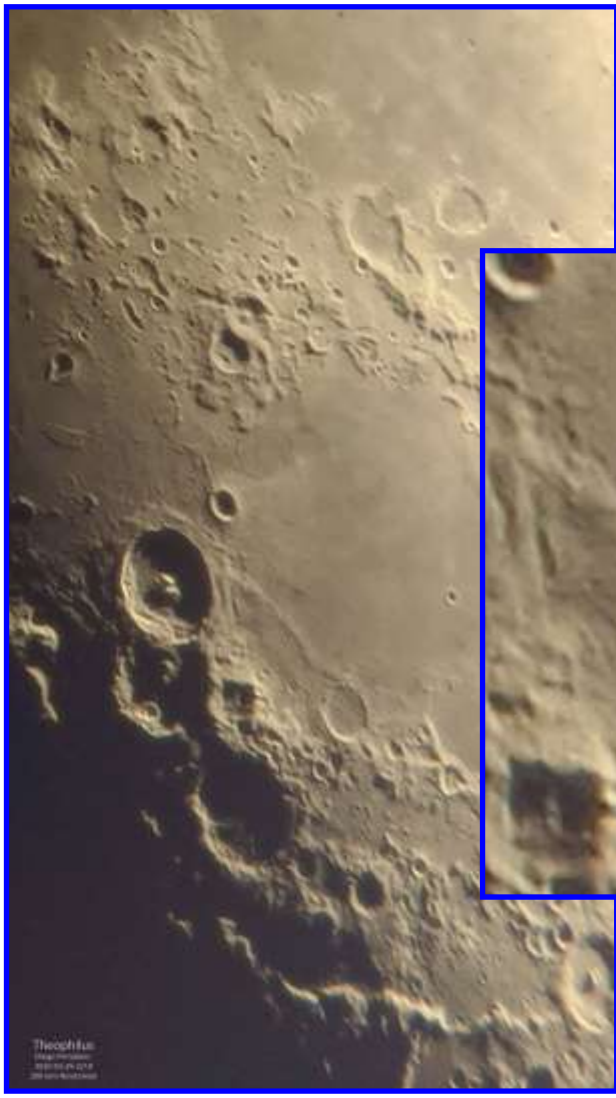


Image 5, Theophilus, *Diego Ferradans, Villa Maria, Argentina. 2020 March 29 22:18 UT. 200 mm Newtonian reflector telescope.* ***Image 6,*** *below, is a close-up of this image.*

Image 7 Dorsum East of Cyrillus F, *KC Pau, Photographic Atlas for Moon Observers page 176, Volume 1.*

Lunar Topographic Studies
A True Wrinkle Ridge and a False One

Focus On: Mysterious Reiner Gamma

Alberto Anunziato

Image 1, Reiner Gamma, *Juan Manuel Biagi, Paraná, Argentina. 2020 November 01 04:20 UT. 180 mm reflector telescope, QHY5-II camera.*

Reiner Gamma is, without a doubt, one of the most fascinating lunar features. It is easily visible with small telescopes, but even at high magnification it is easily mistaken for a crater with bright walls and bright ejecta pattern, except that it does not cast shadows or present relief, as if it were a crater painted on the surface, "as if visiting aliens took spray paint and left graffiti "Zord was here" (Foster, page 82). The mystery of the nature and origin of Reiner Gamma grew with centuries of observation. We can say that the more we know about the characteristics of Reiner Gamma, the more uncertain is its origin. Before learning about the existence of lunar swirls, in my first observations, I thought it was just another crater. The bright parts have an apparently similar geometry to a crater with bright rays, which is not so upon closer analysis and comparison with other swirls. For early lunar observers like Riccioli (who we should rather call lunar cartographer) it was Galileus crater. It was Mädler who realized that Reiner Gamma was an albedo feature and not a crater, so he moved the tribute to the nearby crater that now bears his name. We owe the discovery of the modern Moon, the Moon as a rocky body similar to our planet, to Galileo Galilei, and if Reiner Gamma with a dimension of about 70 kilometers was already a small tribute, the 15 kilometers of the Galilaei crater is almost ridiculous. The term "albedo feature" implies the lack of correlation of brightness with topographic characteristics of the area, but it is an empty signifier if we do not know the origin of those bright areas.

Image 2, Kepler, *David Teske, Louisville, Mississippi, USA. 2023 February 04 02:51 UT, colongitude 68.5°. 3.5 inch Questar telescope, ZWO ASI120mm/s camera. Seeing 8/10.*

Today we know that Reiner Gamma is a lunar swirl: "Light or dark, all features on the Moon can be interpreted in terms of their geologic associations except for one-swirls. These are bright, irregular markings that occur in only a few locations and appear to have no relation to their setting. Reiner Gamma, located in western Procellarum, is the only swirl on the Earth-facing side of the Moon. It appears as an oval patch of bright material with a discontinuous tail that points toward the Marius Hills. With high-Sun lighting, small splotches to the southwest are also visible" (Wood, page 171).

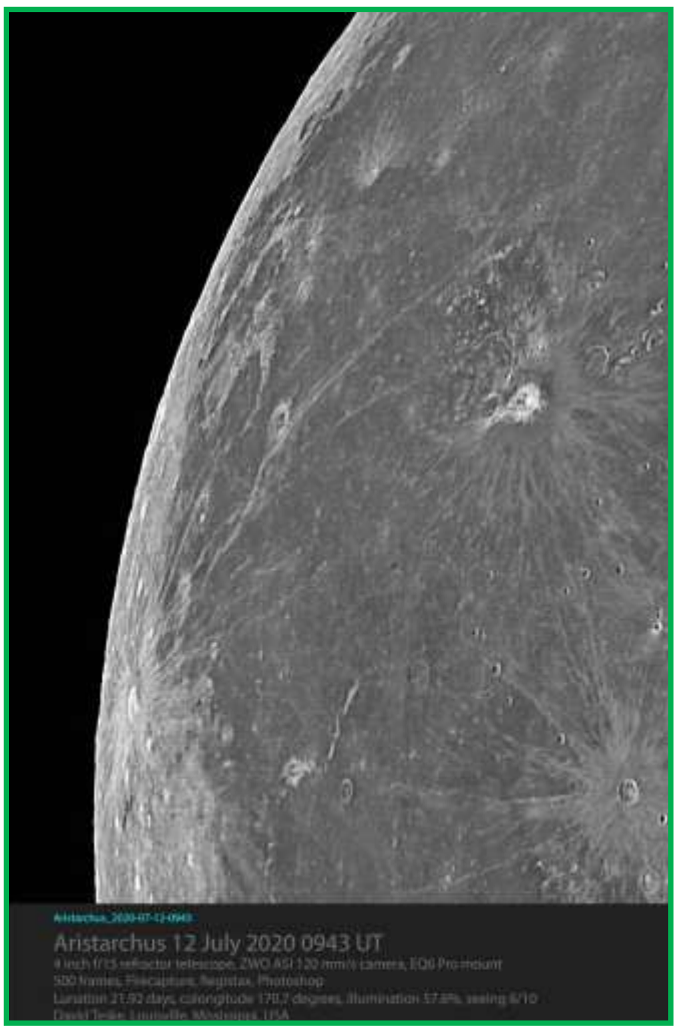


Image 3, Aristarchus, *David Teske, Louisville, Mississippi, USA. 2020 July 12 09:43 UT, colongitude 170.7°. 4 inch f/15 refractor telescope, ZWO ASI120mm/s camera. Seeing 6/10.*

Image 4, Reiner Gamma, *Michel Deconinck, Aquarellia Observatory - Artignosc-sur-Verdon France. 2023 March 12 04:45 UT. 152 mm Bresser f/8 refractor telescope, 13mm Tele Vue Ethos eyepiece, 267 x. Seeing 8/10, transparency 6/6.*

Garfinkle defines it as “a whitish, flat, tadpole-shaped, very high-albedo enigmatic feature (…) The main portion of Reiner Gamma is oval in shape with two oblong dark areas separated by a thin white area. A long narrow broken ribbon of material runs toward the northeast, ending among the southern domes in the “Marius Hills” area”. For Foster (pages 83/86) “The shape of the deposit is suggestive of the auroral curtains that can be seen in the skies of Earth’s polar regions. Reiner Gamma may be the result of similar activity by energetic streamers from the sun or another charged body (…) The central feature of Reiner Gamma does bear a resemblance to the dipolar formation created by iron filings on a surface with a bar magnet on the underside (…) It has an overall dimension of about 70 km. The feature has a higher albedo than the relatively dark mare surface, with a diffuse appearance and a distinctive swirling, concentric oval shape. Related albedo features continue across the surface to the east and southwest, forming loop-like patterns over the mare”, which also can be seen in the image and text by Robert Hays Jr. in this issue.

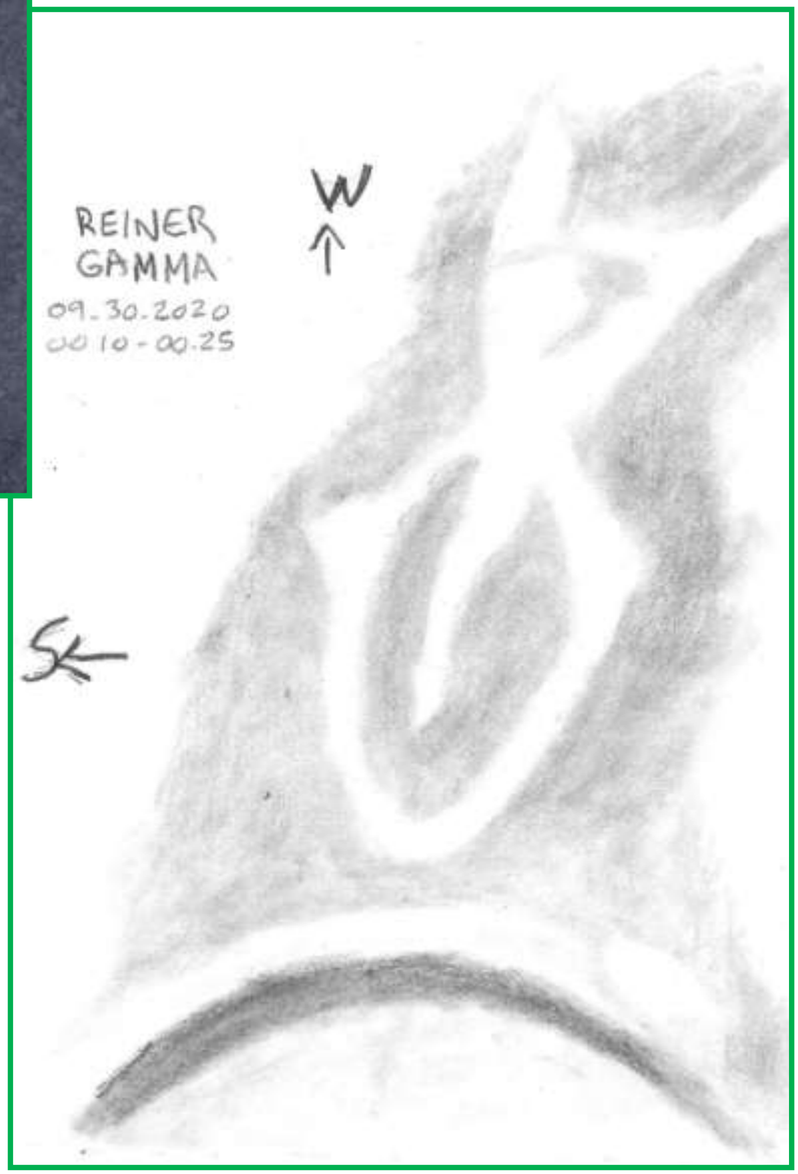
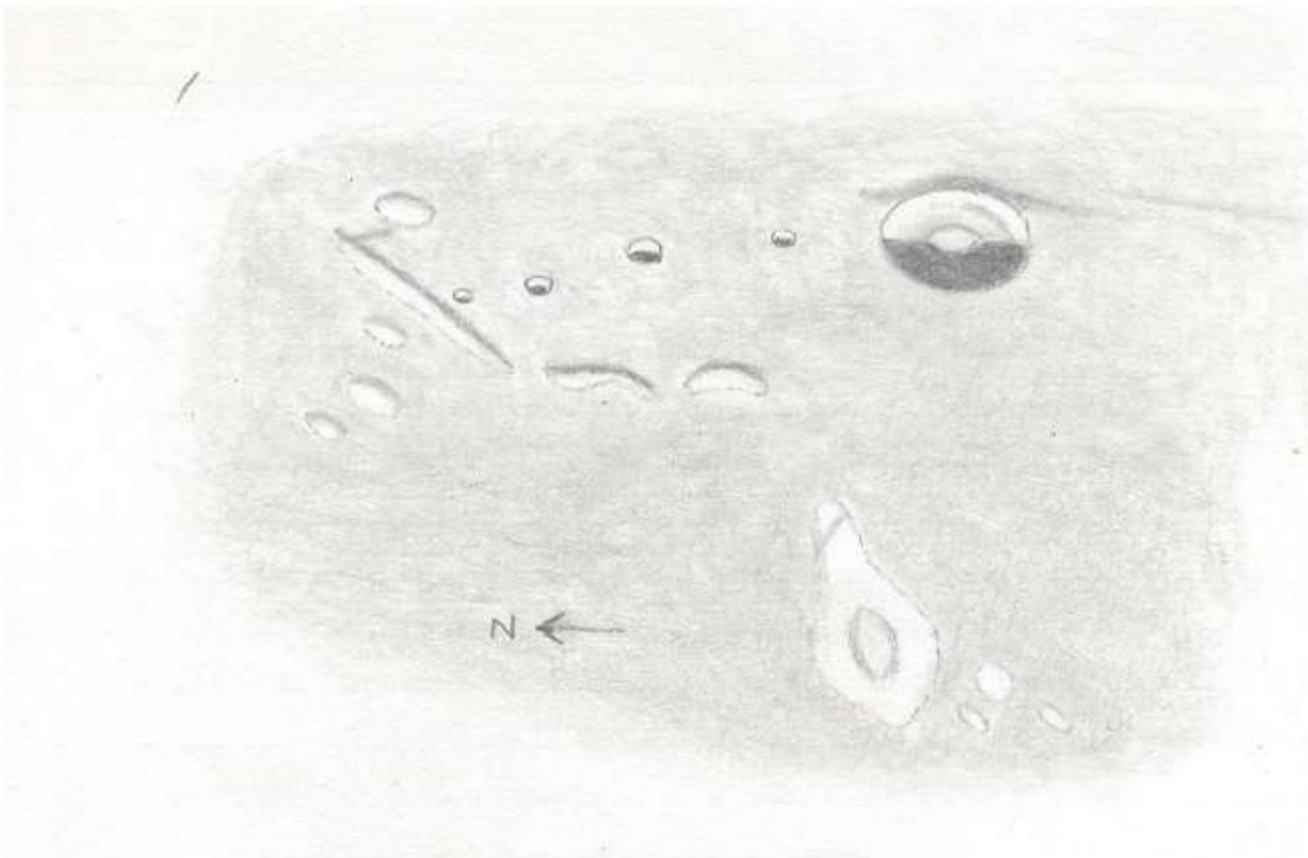


Image 5, Reiner Gamma, *Alberto Anunziato, Paraná, Argentina . 2020 September 30 00:10-00:25 UT. Meade EX105 Maksutov-Cassegrain telescope, 154 x.*

Focus-On: Mysterious Reiner Gamma

Reiner and Reiner Gamma

Robert H. Hays, Jr.

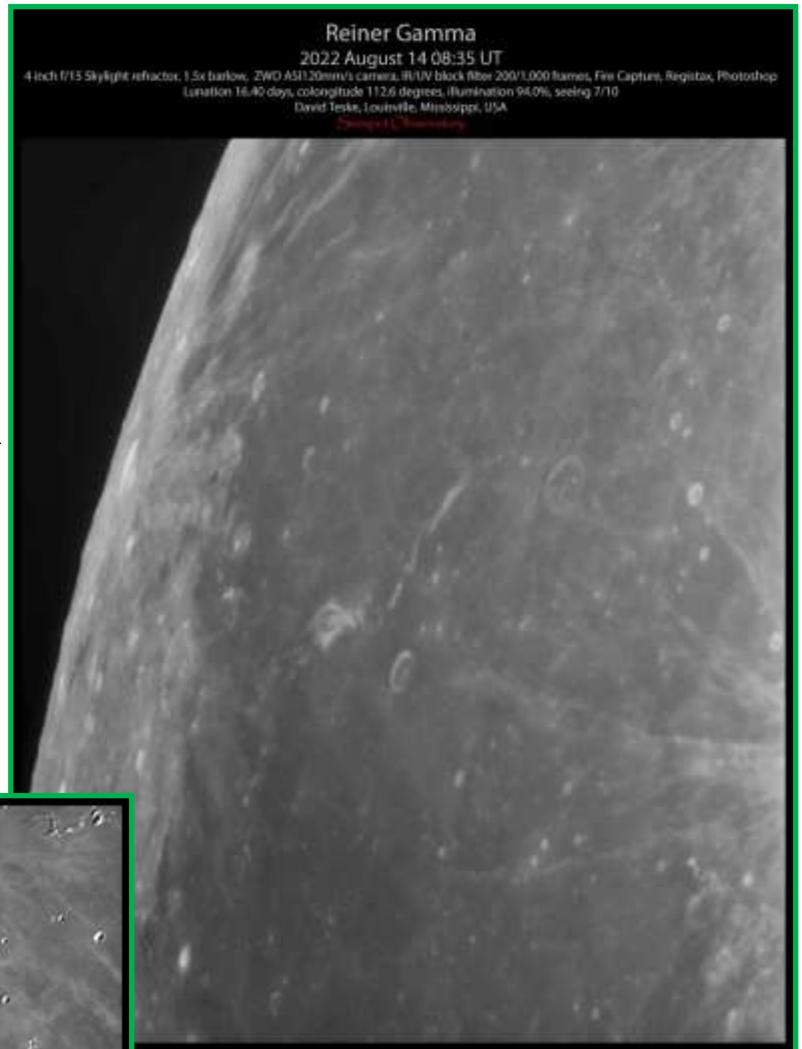


Reiner and Reiner Gamma, *Robert H. Hays, Jr., Worth, Illinois, USA. 2011 September 23 10:18-10:40 UT. 15 cm reflector telescope, 170x. Seeing 6-7/10, transparency 6/6.*

I observed this area on the morning of September 23, 2011. This area is in western Oceanus Procellarum. Reiner itself is a relatively large crater with a substantial central peak. The exterior shading on Reiner's east side does not look like ordinary shadowing, but may be from additional sloping. A long, straight strip of shadow is just south of Reiner near some of the east side shading. A chain of four small craters extends north from Reiner. The second and largest of them is Reiner H. The pit Reiner L is between Reiner H and Reiner, and Marius X is north of Reiner H. The craterlet north of Marius X is not shown on the Lunar Quadrant Map. A long, low ridge is just north of this pit, and there are several other low ridges and mounds in this area. The long ridge may be Marius tau, and the curved feature just to its south may be Marius sigma, according to the LQ map. The bright, diamond-shaped area Reiner gamma is to the west. This strange feature has a bright extension on its east side and a dusky oval in its middle. This oval has dark edges on its north and south sides. The eastward extension is crossed by a narrow, dark line, appearing like a crack. Three small bright patches are southwest of Reiner gamma, and, like this feature, appear shadowless. The main diamond area of Reiner gamma looks smooth with no mottling.

Focus-On: Mysterious Reiner Gamma

__Image 6, Reiner Gamma,__ David Teske, Louisville, Mississippi, USA. 2022 August 14 08:35 UT, colongitude 112.6°. 4 inch f/15 refractor telescope, 1.5x barlow, ZWO ASI120mm/s camera. Seeing 7/10.



For Grego (page 169) it is "an elongated oval splash, the core of which extends 60 km east–west. A lobe of bright material proceeds from its northeastern border in a prominent, though disjointed, line some 150 km north to the edge of the Marius Hills. Unlike many ray systems, Reiner Gamma is prominent even when illuminated by a low Sun". The images we see below show Reiner Gamma very close to the terminator and nonetheless very bright.

__Image 7, Reiner Gamma,__ David Teske, Louisville, Mississippi, USA. 2023 March 05 02:03 UT, colongitude 60.9°. 4 inch f/15 refractor telescope, ZWO ASI120mm/s camera. Seeing 6-8/10.

Focus-On: Mysterious Reiner Gamma

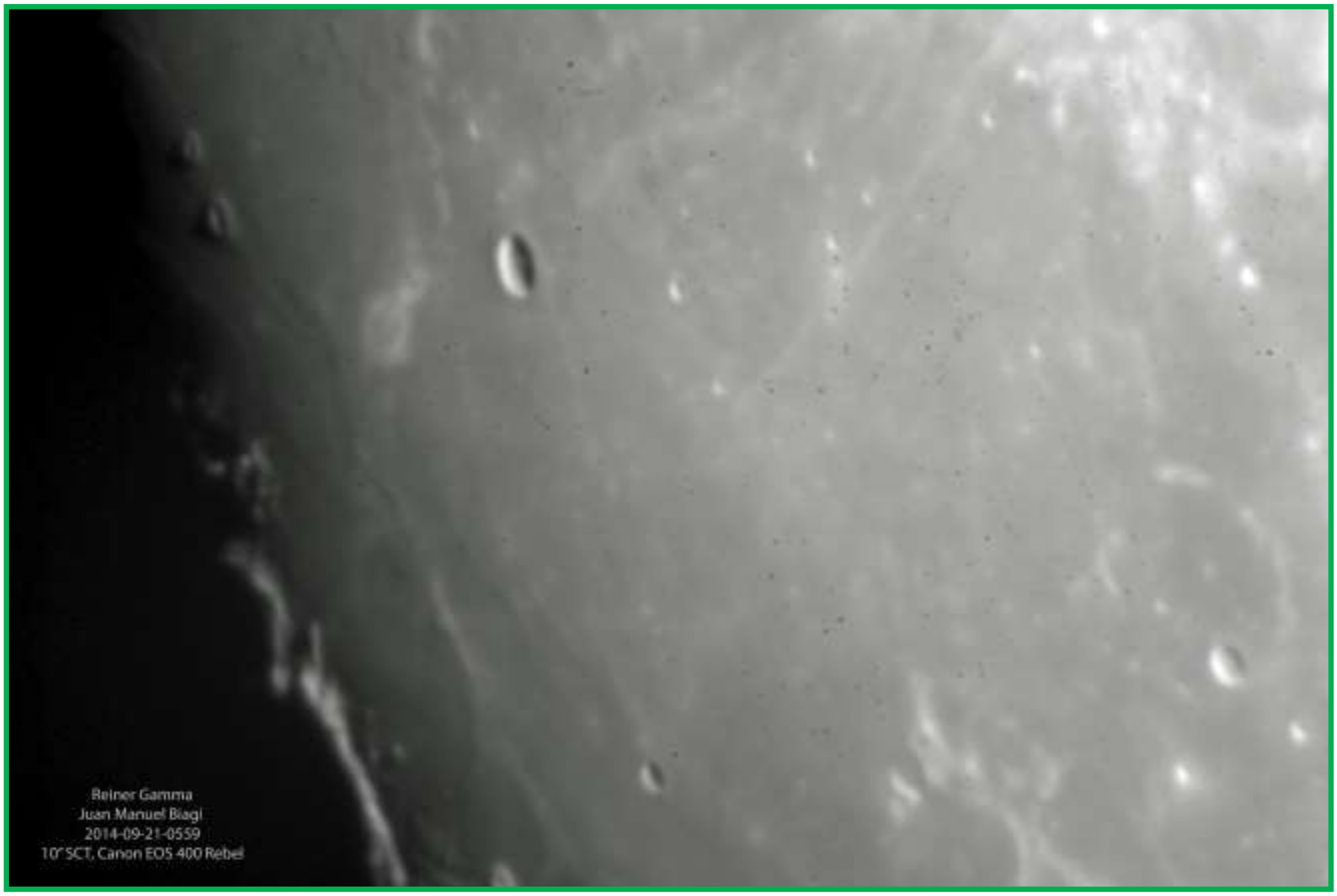


Image 8, Reiner Gamma, *Juan Manuel Biagi, Oro Verde, Argentina, SLA-LIADA. 2014 September 21 05:59 UT. 10 inch Meade LX200 Schmidt-Cassegrain telescope, Canon EOS 400 Rebel camera.*

These bright marks with twisted shapes and apparently unrelated to the topography of the place exist on other bodies in the solar system and also, obviously, on the Moon itself. Images from the Lunar Orbiter 2 mission showed a swirl in Mare Ingenii in 1966 and the first men to the Moon, the crew of Apollo 8, discovered another in Mare Marginis, both partially on the far side and only partially observable from Earth at moments of favorable libration. However, the swirls on the Moon present a great diversity among themselves.

All efforts to find traces of relief on the surface occupied by the bright marks of the most prominent swirl, Reiner Gamma, were in vain: "For decades telescopic observers hunted fruitlessly for some subtle topography that would indicate that Reiner Gamma was simply the peculiar pattern of an impact crater. But it seems to just be a splash on the mare surface" (Wood, page 171). Neither did the images obtained from lunar orbit show signs of relief related to the albedo that we observed as the pattern formed by Reiner Gamma: "Swirls of the same type are found elsewhere on the Eastern limb and farside; they generally show no relation to local topography and many represent only surficial alterations of the uppermost regolith" (Hood and Williams, page 99). It would not be the case of the swirls in Mari Ingenii, according to a recent study: "Our results support prior studies that suggest variations in composition and compaction of the optically active portion (top few micro-to-millimeters) do play a key role in the swirl albedo patterns, in addition to surface interactions with the local magnetic field. Topography can affect the compositional and size segregation of materials and sustain them for geologically significant timescales. The observed topographic correlation may be key in resolving and interpreting these observational properties and understanding the relative contributions of these swirl formation processes" (Domingue et al., page 2).

Image 9, Reiner Gamma, *Richard Hill, Loudon Observatory, Tucson, Arizona, USA. 2011 February 16 04:49 UT. Celestron 14 inch Schmidt-Cassegrain telescope, 2x barlow, f/22, UV/IR blocking filter, DMK21AU04 camera. Seeing 7/10.*

Let's see the interaction of Reiner Gamma with the topography of the area. Garfinkle highlights in "Luna Cognita" how an extension of the bright material from Reiner Gamma surpasses a dorsum to the southwest, which can be seen in IMAGE 9. In IMAGE 10 we also observe how the dorsum to the southwest of Reiner Gamma appears as "stained" by Reiner Gamma material. Would this indicate that Reiner Gamma is later than the dorsum, and therefore not very old in geological terms? It's a tempting deduction. The opposite occurs if we look at the upper part of IMAGE 10, it seems that the extension of Reiner Gamma to the north, towards Marius Hills, borders an elevated area, which is seen more clearly in IMAGE 11, as well as in IMAGE 12 and its detail (IMAGE 13).

Image 10, Reiner Gamma, *Richard Hill, Loudon Observatory, Tucson, Arizona, USA. 2023 January 05 01:23 UT, colongitude 67.6°. TEC 8 inch f/20 Maksutov-Cassegrain telescope, 610 nm filter, SKYRIS 132M camera. Seeing 7-8/10.*

Image 11, Reiner Gamma, *Richard Hill, Loudon Observatory, Tucson, Arizona, USA. 2015 September 26 04:24 UT. TEC 8 inch f/20 Maksutov-Cassegrain telescope, 656.3nm filter, SKYRIS 445M camera. Seeing 7/10.*

Focus-On: Mysterious Reiner Gamma

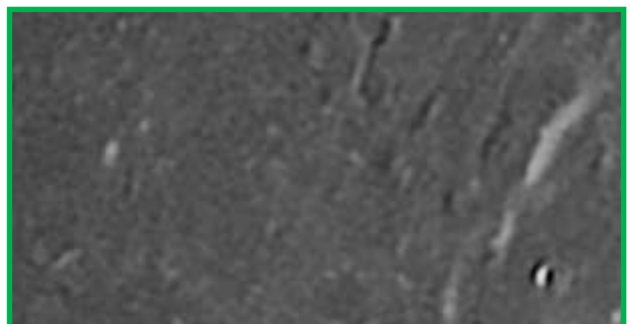


Image 12, Reiner Gamma, *Felix León, Santo Domingo, República Dominicana. 2021 March 27 00:35 UT. 127 mm Maksutov-Cassegrain telescope, DMK21618AU camera. North is right, west is up.*

Image 13, Reiner Gamma, *Felix León, Santo Domingo, República Dominicana. 2021 March 27 00:35 UT. 127 mm Maksutov-Cassegrain telescope, DMK21618AU camera. Close -up of image 12.*

Focus-On: Mysterious Reiner Gamma

Very close to Reiner Gamma is the area where two of the missions of the Soviet Luna series landed. The Luna 8 probe crashed southeast of Galilaei D on December 6, 1965. It was the first soft-landing attempt on the Moon for the Soviets, who succeeded on February 3, 1966 at Planitia Descensus, east of Reiner Gamma, with Luna 9, in IMAGE 14 we mark both sites.

Image 14, Reiner Gamma, *David Teske, Louisville, Mississippi, USA. 2020 October 01 03:39 UT, colongitude 77.0°. 4 inch f/15 refractor telescope, ZWO ASI120mm/s camera. Seeing 7/10.*

Reiner Gamma is located in a zone in which "Much of the surface experienced significant tectonic activity, resulting in flexing and faulting of the surface. In fact, several wrinkle ridges are prominent throughout

the Reiner Gamma region. However, further study is needed to determine the relative ages of the faulting and the albedo anomaly at Reiner Gamma. Specifically, did the compression stresses associated with the formation of wrinkle ridges deform the albedo anomaly, or is the albedo anomaly draped over pre-existing faults and folds? These questions (and more) about Reiner Gamma still remain unanswered" (Foster, page 89).

Image 15, Reiner Gamma, *Gregory Shanos, Sarasota, Florida, USA. 2023 January 05 01:15 UT. Meade 10 inch LX200 Schmidt-Cassegrain telescope, Astronomik L2 UV_IR cut filter, ZWO ASI290MM camera.*

The main characteristic of the lunar swirls, and specially Reiner Gamma, is its albedo: "The fundamental spectral observations that constrain the swirl forming process are: 1) Swirls are higher in albedo, 2) Swirls appear slightly enriched in a component that mimics highlands or feldspar rich material, 3) Swirl material apparently has higher band strength than the surrounding material" (Garrick-Bethell)**.**

So, we have bright areas that have no correlation with the topography of the place. Do they have a correlation with the materials present in the area? It would seem so: "the absence of dark halo craters on the Reiner Gamma swirls, which they expected to be present if the swirls represented thin surficial layers of highland anorthosite. Thus, they showed that Reiner Gamma is not dominantly composed of highland materials but instead is composed mainly of mare material and may represent only an alteration or disruption of the preexisting mare regolith" (Hood and Williams, page 111). It is logical that for decades the correlation of the bright areas with the topography of the place has been sought, since the swirls have dark areas inside, which by contrast enhance their brightness even more and simulate shadows cast by high areas.

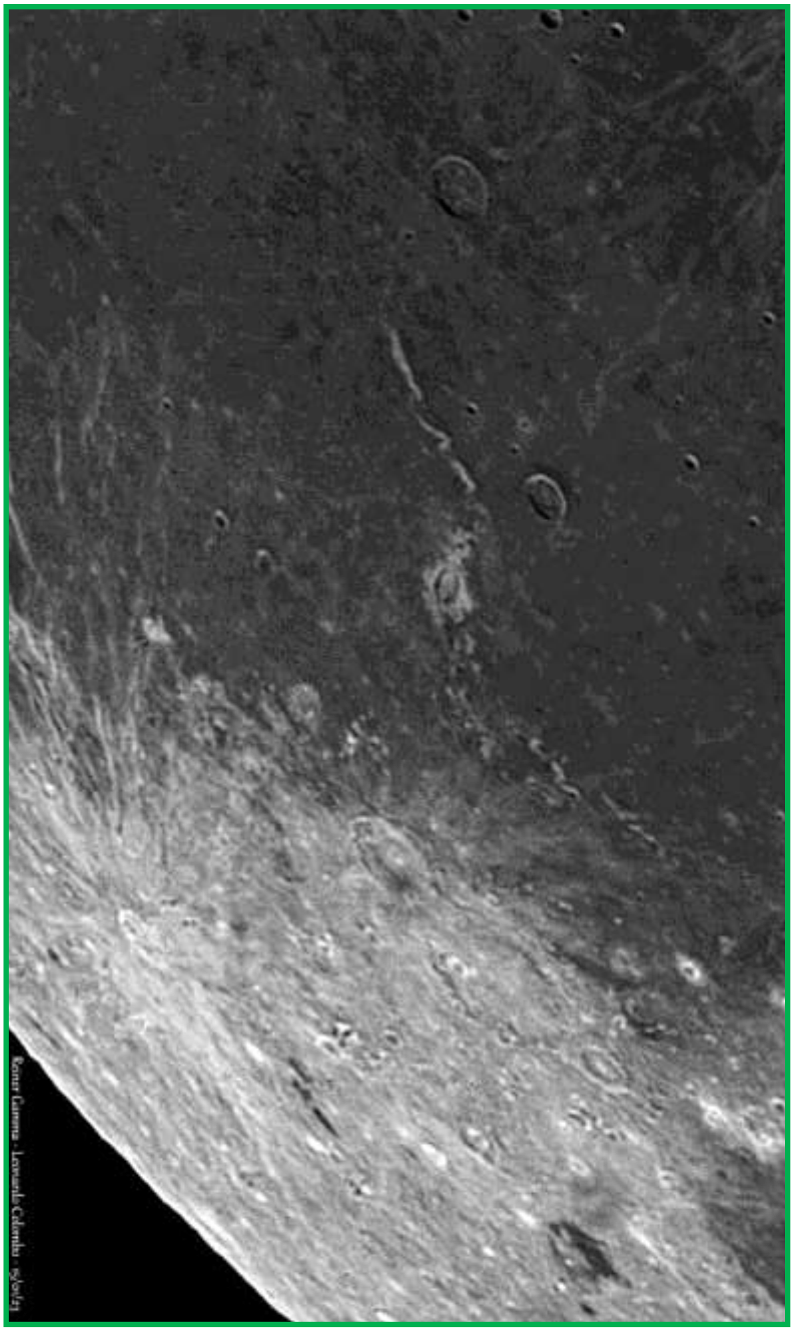


Image 16, Reiner Gamma, *Leonardo Alberto Colombo, Córdoba, Argentina. 2023 January 15 02:30 UT. 102 mm Maksutov-Cassegrain telescope, IR pass 685 nm filter, QHY5LII-M camera.*

It was in 1972 that data from sub-satellite magnetometers launched by the Apollo 15 and 16 missions revealed that swirls (the number of which had multiplied with all those discovered on the far side) had strong localized magnetic fields. And Reiner Gamma has the strongest magnetic field of all. After discovering these areas of intense magnetism (magcons) associated with swirls on the surface, a mechanism was also discovered to explain the bright areas: localized magnetic fields (an anomaly, since the Moon lacks a global magnetic field), and it is so that "The association between swirls and magnetic anomalies has led to the hypothesis that the magnetic anomaly protects the surface from the solar wind. Lacking solar wind sputtering and implantation, the swirl has not undergone the normal soil-darkening process to which unshielded areas are subjected. Thus, it may be that the presence of a magnetic anomaly specially preserves a high albedo, even though a magnetically shielded surface" (Blewett et al., 2007). It is what is known as the solar wind deflection model, that proposes that "the swirls represent exposed silicate materials whose albedos have been selectively preserved over time via deflection of solar wind ion bombardment by preexisting strong crustal magnetic fields.

According to this model, optical maturation of exposed silicate surfaces in the inner solar system is at least partly a function of the solar wind ion bombardment. This model suggests that swirl formation is a continuing process, which dates from the era of basin formation" (Kramer et al., 2009, page 3). This would be the model that would have the most consensus to explain the albedo anomalies that are lunar swirls, which would be related to mini-magnetospheres: "Mini-magnetospheres exhibit features that are characteristic of normal planetary magnetospheres namely a collisionless shock. Here we show that it is the electric field associated with the small scale collisionless shock that is responsible for deflecting the incoming solar wind around the mini-magnetosphere. These ions impacting the lunar surface resulting in changes to the appearance of the albedo of the lunar soil. The form of these swirl patterns therefore, must be dictated by the shapes of the collisionless shock". Collisionless shocks are a classic-phenomena in plasma physics, ubiquitous in many space and astrophysical scenarios (…) What is a surprise is the size of the mini-magnetospheres, of the order of several 100 km; orders of magnitude smaller than the planetary versions. The sharpness of the lunar swirl formations is enhanced by the contrast of "dark lanes" (suggesting locally enhanced solar wind proton bombardment) within the high albedo swirls (…) Evidence by in-situ measurements from space craft including Lunar Prospector (1998-1999), Kaguya (2007-2009), Chandrayaan 1 (2008-2009) and Nozomi (1998) spacecraft, are consistent with the presence of collisionless shocks and the formation of mini-magnetospheres" (Bamford et al., pages 1/ 2). The diversity of shapes of the lunar swirls, then, would be explained by the diversity of shapes of the mini-magnetospheres, at least in this theoretical model. The mini-magnetosphere of Reiner Gamma "spans 360 km at the surface, forming a 300 km thick region of enhanced plasma where the solar wind flows around the field" (Foster, page 89).

The presence of these mini-magnetospheres would act as a "shield" against the solar wind and thus prevent the "aging" of the regolith and would keep swirls like Reiner Gamma bright for billions of years. It is not "fresh" material, but it seems so due to the presence of the magnetosphere. Here 2 complications arise: 1) what is the role of the solar wind in the degradation of the lunar surface, as opposed to the other element that makes up space weather, the constant bombardment of micrometeorites, and 2) what is the cause of the presence of these mini magnetospheres?

The model of the mini-magnetosphere that protects the area from the degradation caused by the solar wind is complicated if we think that "a magnetically shielded surface would still experience micrometeorite bombardment. Melting, agglutinate formation, and vapor deposition among regolith grains as a result of micrometeorite impact are thought to play a major role in space weathering" (Blewett et al.,2007).

***Image 17, Reiner Gamma,** David Teske, Louisville, Mississippi, USA. 2020 September 10 10:02 UT, colongitude 183.8^{o}. 4 inch f/15 refractor telescope, ZWO ASI120mm/s camera. Seeing 8/10.*

Image 18, Reiner Gamma, *David Teske, Louisville, Mississippi, USA. 2020 October 03 07:37 UT, colongitude 103.2º. 4 inch f/15 refractor telescope, ZWO ASI120mm/s camera. Seeing 7-8/10.*

Image 19, Reiner Gamma, *David Teske, Louisville, Mississippi, USA. 2020 September 03 07:50 UT, colongitude 97.5º. 4 inch f/15 refractor telescope, ZWO ASI120mm/s camera. Seeing 8/10.*

Focus-On: Mysterious Reiner Gamma

Image 20, Reiner Gamma, *David Teske, Louisville, Mississippi, USA. 2021 January 04 11:09 UT, colongitude 156.3º. 180 mm Takahashi Mewlon Dall-Kirkham telescope, ZWO ASI120mm/s camera. Seeing 6/10.*

To answer the second question, about the origin of the mini-magnetospheres, the most accepted hypothesis seems to be that of the antipodal formation with the gigantic impacts that formed the basins in the early days of lunar geology. Mare Marginis is at the antipodes of the Mare Orientale basin and Mare Ingenii at the antipodes of the Imbrium basin, so the possibility arose “that the feature resulted from seismic energies generated by the impacts that created the maria” (Wood, page 87).

The text “The Lunar Swirls: Distribution and Possible Origins” explains this hypothesis in considerable detail: “the largest concentration of surface field detected by this method occur near the antipodes of the Orientale, Imbrium, Serenitatis and Crisium basins. Swirl-like albedo markings similar in morphology to Reiner Gamma are present in or near the same zones. Strong surface fields in these regions are statically associated with both swirl locations and unusual terrain interpreted to be the result of seismic modification occurring at the time of formation of the basin” (page 99/100), which would imply that the swirls are not randomly distributed but rather related to the pre-existing geology in the place. The formation of the magnetic anomaly antipodal to the impact would occur after said impact that “will produce partial vaporization and ionization of silicate projectile and target material leading to the formation of a thermally expanding plasma cloud. Because the cloud is ionized and is characterized plasma cloud. Because the cloud is ionized and is characterized by a relatively high internal energy density, any ambient magnetic field (such as solar wind magnetic field or a weak former lunar intrinsic field) will be excluded from the volume occupied by the impact plasma. As the cloud expands together with ballistically transported ejecta, lunar gravity will force the lower-energy components of the gas into trajectories that ultimately intersect at or above the basin antipode. Consequently, a compression of ambient plasma and magnetic field occurs in the antipodal zone leading to a magnetic field enhancement for a limited time interval (Hood and Williams. page 100). Another important fact in favor of the antipodal impact hypothesis is that “a variety of other sample and orbital data indicate that most of the magnetization that is preserved in the lunar crust was acquired at times >3.0 b.y. ago, consequently, we have been led to investigate causes other than relatively recent cometary impacts to explain the joint occurrence of strong magnetic anomalies and swirl-like albedo markings” (Hood and Williams, page 112). Now, our Reiner Gamma would continue to be an enigma, since it is not antipodal to any impact that has generated a basin, it could be the result of a not so significant impact, or of a basin today buried under Oceanus Procellarum. “This implies that the shielding has been operating since the time of basin formation (>~3.8 billion years), and hence that the swirls are very old features. However, over time crater-forming impacts could contribute new ejecta material to a magnetically shielded area, occasionally "refreshing" the swirl” (Blewett et al., 2007).

This hypothesis seems to have a rather wide consensus among the scientists: “Current evidence suggests that impact processes played a major role in producing the strongest magnetization that is preserved in the lunar crust. The largest concentrations of strong magnetization are found antipodal to the youngest and largest impact basins while fields within the youngest basins are relatively weak. Unusual terrain is found in the same antipodal regions that is interpreted to be a consequence of convergence of either seismic compressional waves or basin ejecta (or both) at the antipode (…) If magnetized materials are entirely surficial and consist, for example, of basin ejecta, then they could have formed quickly enough to have acquired their magnetization only in impact-generated transient fields. However, if sources are deeply buried in the crust, their formation times would be much longer, requiring a steady magnetizing field, i.e., presumably a core dynamo (…) This hypothesis is consistent with returned sample studies showing that impact-produced materials (e.g., breccias) contain more metallic iron and have much higher magnetization intensities than igneous materials (e.g., mare basalt)” (Hood, 2009).

Before the antipodal hypothesis, the formation of Reiner Gamma was attributed to a smaller impact, a “unusually magnetic secondary crater ejecta associated with the nearby crater, Cavalerius, or much less likely, with Olbers A. According to this model, the formation's magnetism was created when shocked and/or heated ejecta fragments with abundant Fe cooled in the presence of a strong magnetic field” (Bell and Hawke). O bien, “meteoroid impacts occurring in regions of strong crustal fields may deposit partially ionized ejecta or ejecta containing paramagnetic iron particles in swirl-like patterns because of magnetic forces on the ejected material” (Hood and Williams, page 112).

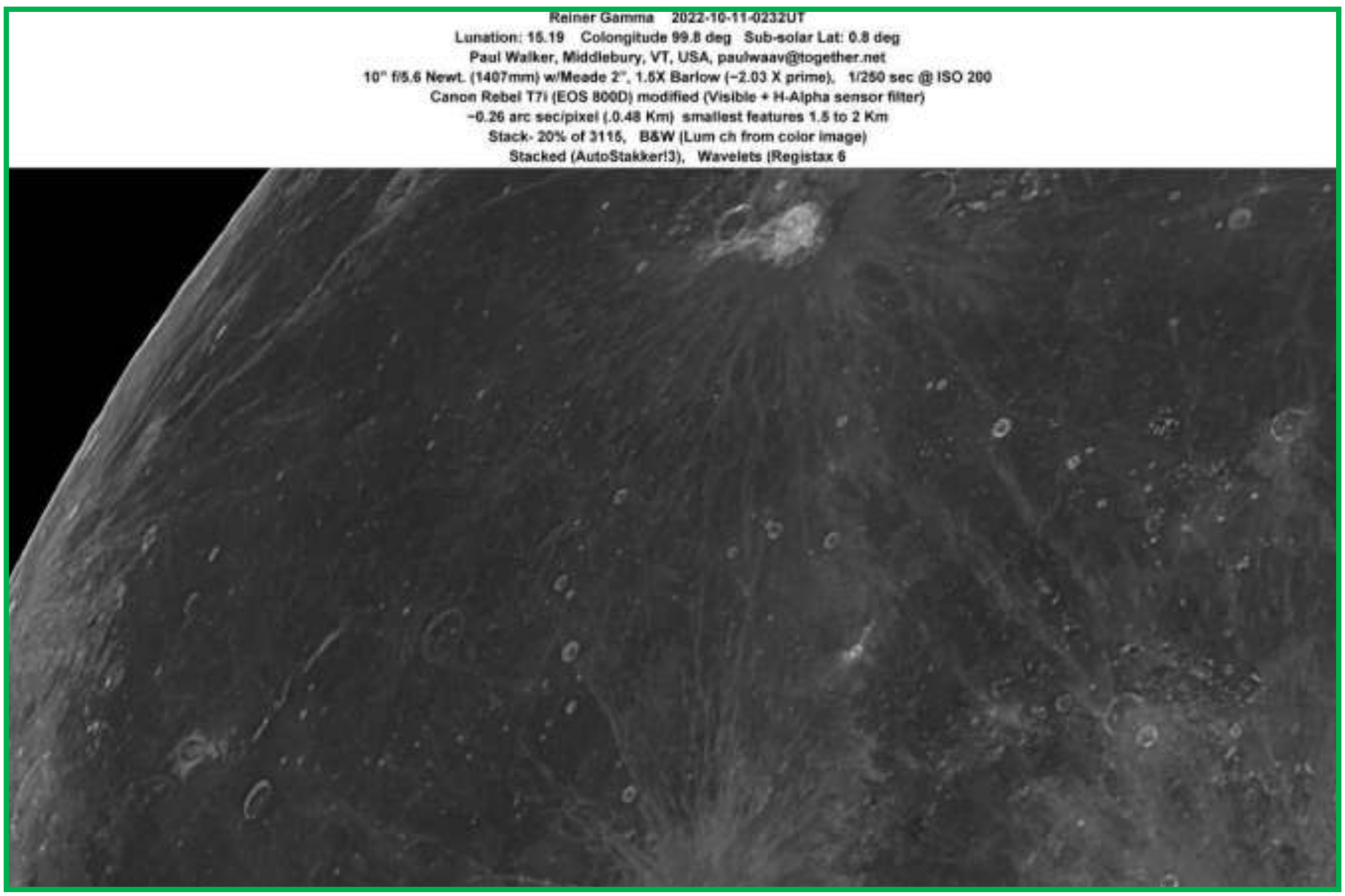


Image 21, Reiner Gamma, *Paul Walker, Middlebury, Vermont, USA. 2022 October 11 02:32 UT, colongitude 99.8^o. 10 inch f/5.6 Newtonian reflector telescope, 1.5x barlow, Canon Rebel T7i camera.*

Focus-On: Mysterious Reiner Gamma

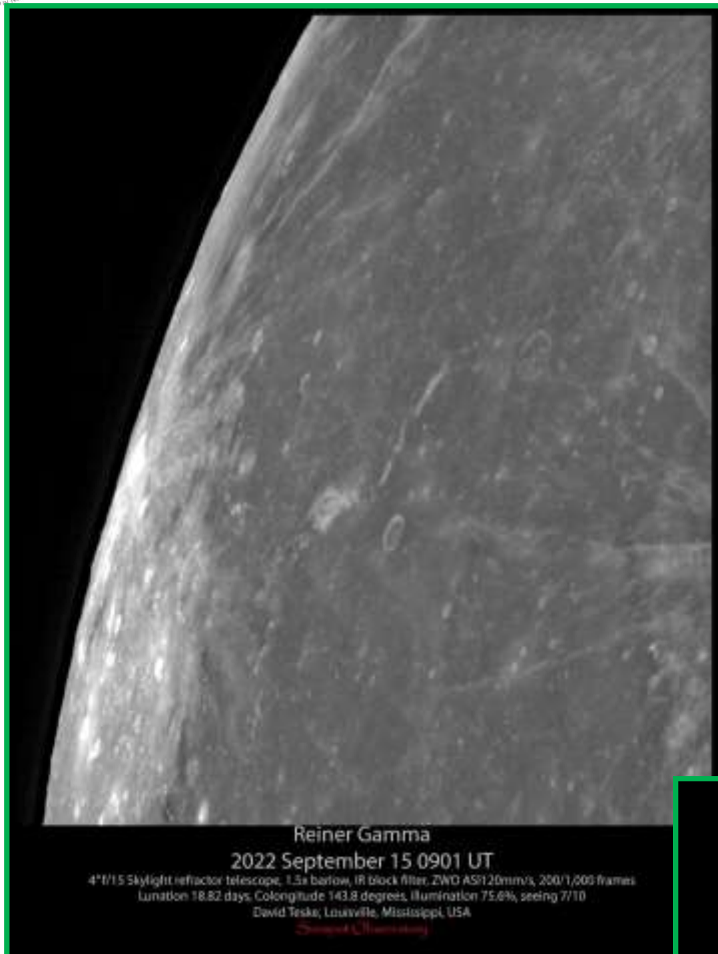


Image 22, Reiner Gamma, *David Teske, Louisville, Mississippi, USA. 2022 September 15 09:01 UT, colongitude 143.8°. 4 inch f/15 refractor telescope, ZWO ASI120mm/s camera. Seeing 7/10.*

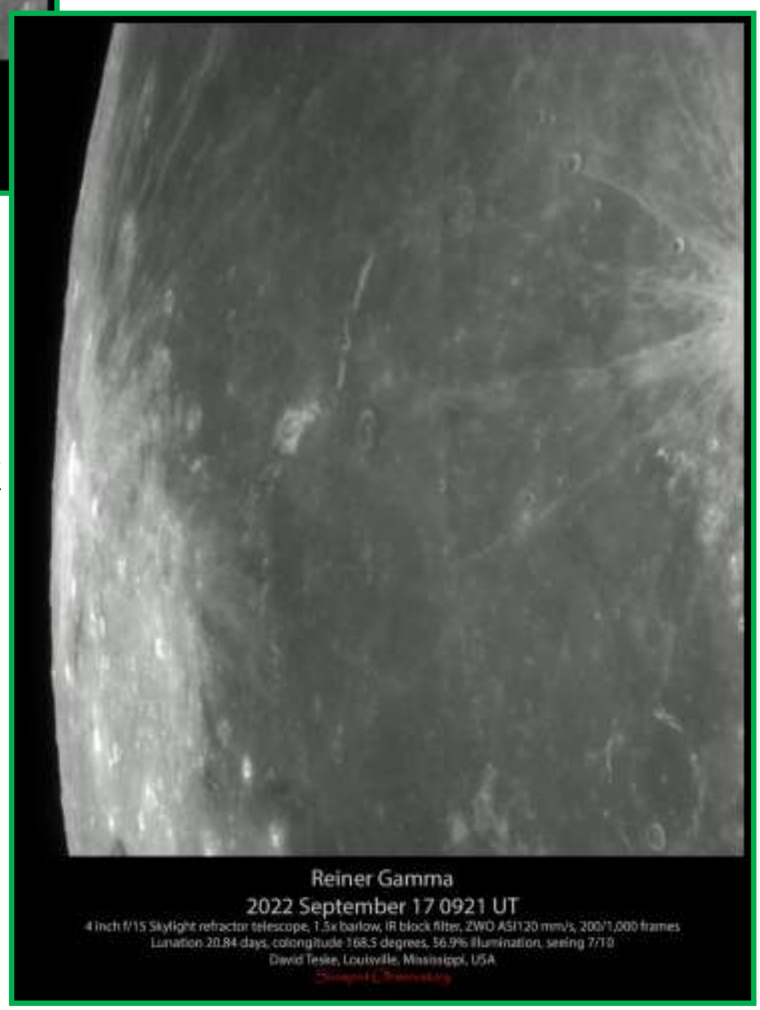


Image 23, Reiner Gamma, *David Teske, Louisville, Mississippi, USA. 2022 September 17 09:21 UT, colongitude 168.5°. 4 inch f/15 refractor telescope, 1.5x barlow, ZWO ASI120mm/s camera. Seeing 7/10.*

Focus-On: Mysterious Reiner Gamma

Older are the interpretations of Reiner Gamma derived from volcanic ash deposits, high albedo volcanic deposits, highlands debris placed as impact ejecta, or the one related to supposed fractures in the crust, to which Grego refers (page 169): “It may be an area where volcanic gases have vented, causing a change in the coloration of the surface materials”.

Even as a mere observer, it is fascinating to follow the debates about the causes of this lunar anomaly, witness how the hypotheses are argued and the moment in which none of the competing paradigms has gained an advantage over the others. For the models we have seen, the bright regions that make up Reiner Gamma are old areas that have been shielded from the solar wind by the mini-magnetosphere, but there are models that postulate that what appears to be fresh material due to its brightness is actually fresh material. For the most accepted exogenous explanation, Reiner Gamma owes its strange characteristics to the impact of a comet.

As “A high velocity comet impact would not have left a mere surface deposit of powdered debris. There would have been a sizeable impact crater, as well as large boulders and other rock deposits from the blast effect. Those features are missing (…) Some investigators have proposed that the coma of a comet—streaking in just above the surface—interacted with the lunar surface, changing the surface properties to the degree where the Reiner Gamma swirl could persist for millions of years” (Foster, pages 84/86). Now, a complete description of the cometary hypothesis: “The cometary impact model argues that the high albedo of the swirls depicts scouring of the topmost surface regolith and exposure of fresh material by relatively recent cometary impacts. According to this model, the associated strong magnetic anomalies are the result of magnetization of near surface materials heated above the Curie temperature through hyper-velocity gas collisions and micro-impacts. Proponents of the cometary impact model consider the occurrence of many swirls antipodal to relatively young, major basins to be coincidental or the result of incomplete mapping of swirl locations. Relatively recent cometary impacts at the Moon could leave unique traces of their origins: high impact velocities and volatile abundances, combined with the presence of a dust-and ice-laden coma, may thermally and mechanically process the lunar surface in ways distinct from the impact of an asteroid (…) The surface expression of such an event is expected to differ from the statistically dominant asteroid impacts, due to a combination of factors: greater impact velocities, differing acoustic impedance conditions, higher volatile content, and the presence of the encompassing gas and dust-enriched coma (…) The Reiner Gamma, Goddard A and Ingenii swirls may represent the most recent events, whereas faint patterns elsewhere could indicate remnants of older collisions”. (Schultz).

One interesting variant is the meteoroid swarm model: “the cometary nuclei are fragmented by tidal forces attributed to the Earth and/or Sun before they encounter the lunar surface. During and immediately after impact, inter-particle collisions in the cloud of debris and regolith particles of the ejecta collide with each other, forming the curvilinear swirl features. The final dust fragments of a swarm may form a halo with albedo and color differences from the substrate around the main part of the swirl” (Kramer et al., 2009, page 3).

“Traditionally, there have been two classes of hypotheses to explain swirls. The first suggests that impacts of comets or micrometeoroids scoured away the mature surface layers of lunar soil, leaving behind bright, immature material. The second hypothesis suggests that the magnetic fields associated with swirls stand off the solar wind, and prevent the maturation of the underlying soil. The first hypothesis has difficulty explaining the strong crustal magnetization observed at swirls, while the second cannot account for the apparent lack of micrometeoroid weathering at swirls, and the existence of swirls at locations with relatively modest magnetic fields (e.g., Mare Marginis)” (Garrick-Bethell). That is why a third hypothesis arose, related to the transport of charged fine dust across the lunar surface, a phenomenon known from the Surveyor probes at lunar dawn: “The Sun irradiates the lunar surface intensely with ultraviolet photons, many having sufficient individual energy to knock electrons from regolith grains photoelectrically. Losing electrons produces positive charge in sunlit areas, and charged dust grains are repelled from charged soil to actually levitate and fly to less positive, dark areas (…) Thin clouds of dust hug the terminator, seen when illuminated at low sun angles looking toward the rising or setting sun.

Seen throughout the 1966–1968 Surveyor program (by Surveyor 1, 5, 6, and 7), this horizon phenomenon went unexplained and unpublished in science journals, whereas similar observations of the solar corona (the Sun's extended atmosphere) were published. Horizon glows observed in 1973 by Lunokhod 2 were largely overlooked outside the Soviet Union. In 1972 David Criswell (Lunar Science Institute) theorized photoelectric dust levitation, and later that year Gene Cernan, Apollo 17's commander, was asked to draw from lunar orbit the setting Sun, to recreate the Surveyor observations. His results were shocking: one could not only see the corona but also huge light plumes stretching far beyond the Moon, even beyond the zodiacal light – dust in solar orbit in the inner Solar System. This implied dust elevated tens of kilometers, scattering sunlight toward Apollo, and was published (simultaneous to the Surveyor horizon glow paper) but garnered little prompt attention. Huge plumes were only reported visually, not seen on all missions (seen on Apollo 8, 10, 15, and 17, but not Apollo 16; no observations were attempted on 8, 11, 12, and 14)" (Crotts, page 270). This third model is the one that relates the anomalous brightness of Reiner Gamma with this recently considered phenomenon of the levitation of electrically charged dust: "We seek a model for swirl formation that permits micrometeoroid weathering, explains the association with magnetic fields, and explains the unique spectral properties. The model is based on the observations of weak electric fields at the crustal magnetic anomalies at the Apollo 12 and 14 sites. In a process that is unrelated to crustal magnetic fields, fine lunar dust is lofted above the surface by electric fields. This phenomenon has been observed by many spacecraft and instruments, at altitudes above the lunar surface ranging from centimeters to kilometers. The exact mechanics of lofting are not known, but a number of observations suggest it operates mainly in the terminator region. In our model we assume that charged fine dust is lofted twice a day at each terminator crossing. (…) Note that even if dust lofting is only active in the terminator region, the solar wind can still interact with the crustal magnetic field to produce the required electric field. Under the dust transport model, dark lanes may be regions where the net horizontal electric field is zero, and dust transport is halted (…) Horizontal dust transport is a viable mechanism to explain the unusual weathering trends at lunar swirls"; and therefore the "apparent highlands component is actually an enrichment in fine-grained feldspathic material. Unusually abundant fine-grained material could create such an feldspathic enrichment because the finest fraction of both mare and highland soils are naturally feldspar rich" (Garrick-Bethell).

It is interesting the proposal of testing the age of the swirls we find on Kramer (2010): "Impact craters of these sizes should be randomly distributed across the surface. However, if a magnetic field is continually shielding the swirls from solar wind ions, thereby retarding maturation, there should be a greater density of immature craters on swirl surfaces. The reason is that recent impacts onto the magnetically shielded swirl surfaces will be better protected from solar wind maturation, as opposed to contemporaneous impacts onto off-swirl locations. If Ingenii's swirls are from a recent meteoroid swarm or comet impact, which exposed fresh material, then subsequent impacts would be randomly distributed across the mare. In this case, the on-swirl immature crater density should be approximately equal to the density of immature craters off swirl. Our results show a clear propensity for immature impacts to be located on the high albedo swirls, supporting a model for continued shielding of the solar wind by the magnetic field".

Today we know that an event (whatever the hypothesis that ends up being imposed about its origin), happened millions of years ago (from more than 3000 million years ago to a few hundred million years) modified the magnetic properties of materials. surface, creating a mini-magnetosphere that prevents the solar wind from degrading them, differentiating them from surface materials outside the localized magnetic field. As we can see, there are more questions than certainties.

The importance of studying lunar swirls, and especially our Reiner Gamma, is essential, and is beautifully summarized in the paper for the 2009 NASA Decadal Survey "The Lunar Swirls": "Key questions in planetary science that can be addressed by surface measurements in a lunar magnetic/albedo anomaly include: 1. Lunar geoscience: the origin of lunar swirls. 2. Planetary magnetism: the source of the magnetizing field responsible for the crustal anomalies (a) early core dynamo, or (b) amplification of ambient fields by plasmas generated by basin forming impacts. 3. Space weathering: a process affecting interpretation of remote-sensing observations of all airless rocky Solar System bodies. Confirmation of solar-wind sputtering/implantation as a major contributor to the optical effects of space weathering would be a significant new step. 4. Fundamental plasma physics: the interaction of the solar wind with small-scale magnetic anomalies".

Reiner Gamma and other swirls are a fundamental tool to study the space weather: "The relative importance of solar-wind sputtering versus micrometeoroid impact has been a matter of debate. If lunar crustal magnetic anomalies, which can generate mini-magnetospheres, are responsible for protecting soils from the process(es) that produce the optical effects associated with maturation, then by implication the solar wind is the dominant agent of space weathering, because a magnetic anomaly would not screen out micrometeoroids. Such a process is supported by new results from the Japanese lunar mission, Kaguya, which has shown conclusively that solar wind ions are slowed and deflected, and largely reflected, above the strongest crustal magnetic anomalies" (Kramer et al., page 3).

The recommendation in 2009, to help solve this conundrum of lunar geoscience, was: "Significant progress toward resolving this puzzle could be made by a rover mission to measure the surface magnetic field and solar wind flux at various points within the bright and dark portions of a swirl. The ability to spatially resolve this level of detail is not possible with an orbiter. The rover should also be equipped with a spectrometer capable of characterizing the regolith elemental abundance" (Kramer et al., page 4). That is why Reiner Gamma was chosen as one of the "Regions of Interest on the Moon" of the "NASA Constellation Program Office".

The aforementioned NASA Decadal Survey of 2009 (page 4) recommended a surface mission: "The origin of the lunar swirls is a major outstanding puzzle in lunar geoscience. Significant progress toward resolving this puzzle could be made by a rover mission to measure the surface magnetic field and solar wind flux at various points within the bright and dark portions of a swirl. The ability to spatially resolve this level of detail is not possible with an orbiter".

We are very little away from knowing much more about Reiner Gamma, when in 2024 a NASA mission called VERTEX will reach this strange formation, selected as one of the first Payloads and Research Investigations on the Surface of the Moon (PRISM), consisting of a lander and a rover. Their goals are: "1) Investigate the origin of lunar magnetic anomalies; 2) Investigate the origin of lunar swirls; 3) Determine the structure of the mini-magnetosphere that forms over the RG magnetic anomaly. In the course of pursuing those goals, the mission will provide key data in evaluating the importance of micrometeoroid bombardment vs. ion/electron exposure in the space weathering of silicate regolith. These goals are traceable to the Planetary Decadal Survey" (Blewett, 2022). The lander will have three instruments: the Vertex Camera Array, for survey landing site geology and perform photometric modeling to yield information on regolith characteristics, the Vector Magnetometer-Lander, and the Magnetic Anomaly Plasma Spectrometer, a plasma analyzer that measures the energy flux, and direction of ions and electrons that reach the surface; the rover will have two instruments: the Vector Magnetometer-Rover and the Rover Multispectral Microscope.

David Blewett (author of several of the texts cited in this text) is the principal investigator of this project at the Johns Hopkins Applied Physics Laboratory (APL), which involves a 2-kilometer journey through different areas covered by the mini-magnetosphere that covers Reiner Gamma, for a period of 14 days (the duration of solar lighting in the area, since there will be no more energy than solar energy).

We are anxiously awaiting the arrival of Vertex at Reiner Gamma, an area that will be very important for future lunar colonization. Let's think that “Solar wind ions (hydrogen, helium, and other trace elements) implanted in the upper regolith are the primary source of lunar volatiles at most latitudes. The focusing effect of crustal magnetic fields may produce concentrations of these volatiles in areas peripheral to or between strong crustal fields (i.e., in the "overmatured" dark lanes). Regolith with enhanced solar-wind content could be useful from a resource extraction perspective. Similarly, it may be advantageous to locate an outpost in an area that experiences a low degree of solar wind bombardment. For example, levitation of electrically charged fine dust on the lunar surface has received considerable attention. It could be that areas protected from ion implantation are less susceptible to charging of the dust”. Will our children or our grandchildren visit Reiner Gamma, taking advantage of its "shield" from solar radiation?

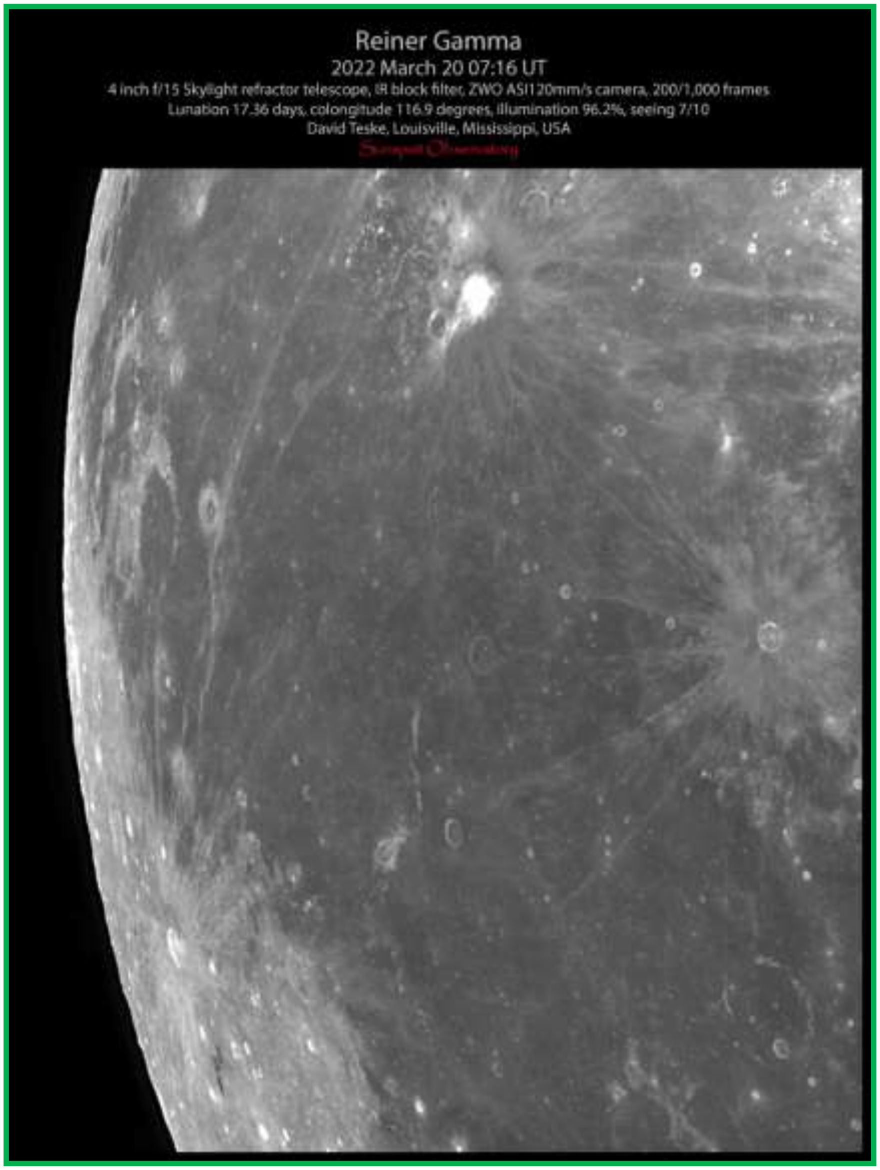


Image 24, Reiner Gamma, *David Teske, Louisville, Mississippi, USA. 2022 March 20 07:16 UT, colongitude 116.9^{o}. 4 inch f/15 refractor telescope, 1.5x barlow, ZWO ASI120mm/s camera. Seeing 7/10.*

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Reiner Gamma in the Golden Ages

David Teske

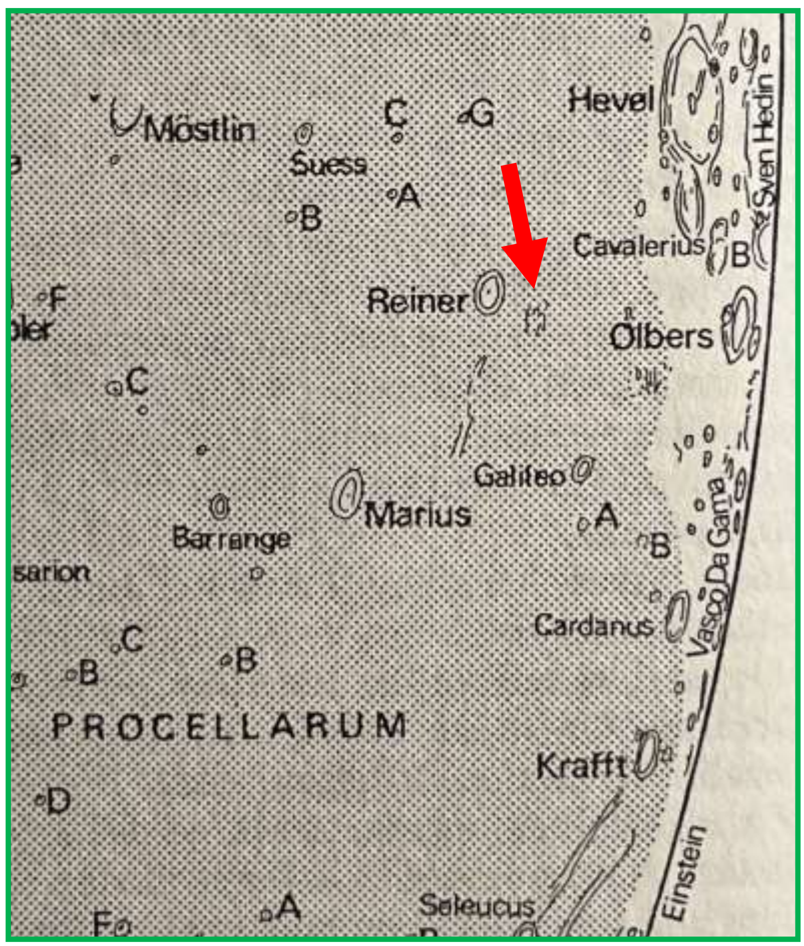
In the pages above, we have seen excellent images of Reiner Gamma, all taken by modern amateur astronomers using relatively modest telescopes. All of the images were taken using digital cameras or drawings. The largest telescope used was 350 mm (~14 inches) but most images were taken with much smaller telescopes, 4 to 8-inch range. They are truly remarkable images.

For this essay, I thought I would look back to my older Lunar atlases, to see what they showed of the Reiner Gamma area. Some of these older atlases are long out of print, but some still are in print. Some of these atlases were made at the time of great lunar exploration in preparation for the Apollo landings to come. Some dated prior to that time; other past that time. In a way, I see this as the golden age of lunar observing, when the many details of lunar topography were getting fully flushed out.

I start with where I started, in 1976 with Patrick Moore's book New Guide to the Moon. I was just a youngster then, and had this book ordered from a local bookstore. I guess now that started a trend in my life! After a few long weeks at the high price of $10.95, the book finally arrived. Image 1 is of the book cover, image 2 is Moore's map of Reiner Gamma. It is barely a spot on his map. I believe Patrick Moore did most of his lunar observing with a 12.5-inch reflector. Looking back, it certainly was not the best lunar book, but it did get me interested in lunar studies. In 2002, I purchased an updated edition of this book, Patrick Moore on the Moon, which I believe is still available. In both the 1976 and 2002 edition, Moore does not mention nor label Reiner Gamma, and barely shows it on his lunar map. Only in the 2002 edition is the concept of magnetic fields were found in some lunar samples mentioned.

Image 1, (above), New Guide to the Moon, Patrick Moore, 1976.

Image 2, (right) from New Guide to the Moon, map Section 8 showing Reiner and the location of Reiner Gamma (arrow). North is down, west is right.



In the book Map of the Moon by H. Percy Wilkens F.R.A.S., (image 4) is a hand-drawn map of the Moon based on a 100-inch diameter Moon. In Section XIX:IV, (page 77), (image 4) there is clear reference to the crater Reiner, but nothing where Reiner Gamma is found except craters "R" and "W". Back in 1951 when this map was copyrighted, features such as Reiner Gamma may have been regarded as insignificant as it clearly was not a crater.

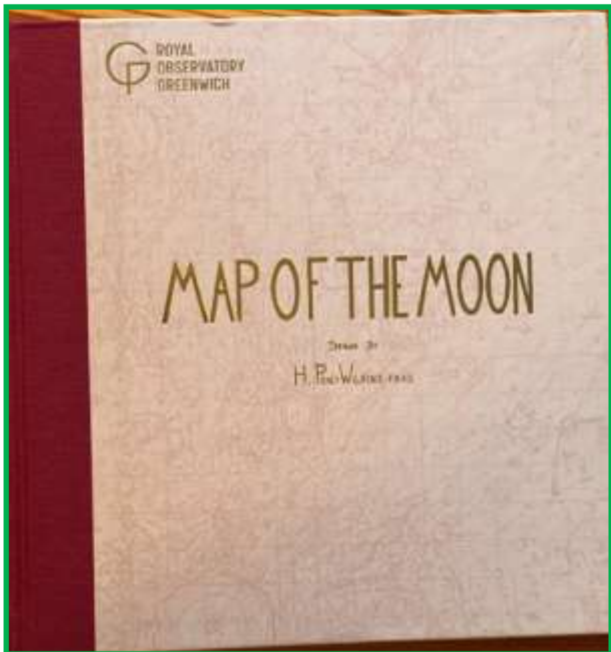


Image 3, left, Map of the Moon, H. Percy Wilkins F.R.A.S., 2019, National Maritime Museum, London.

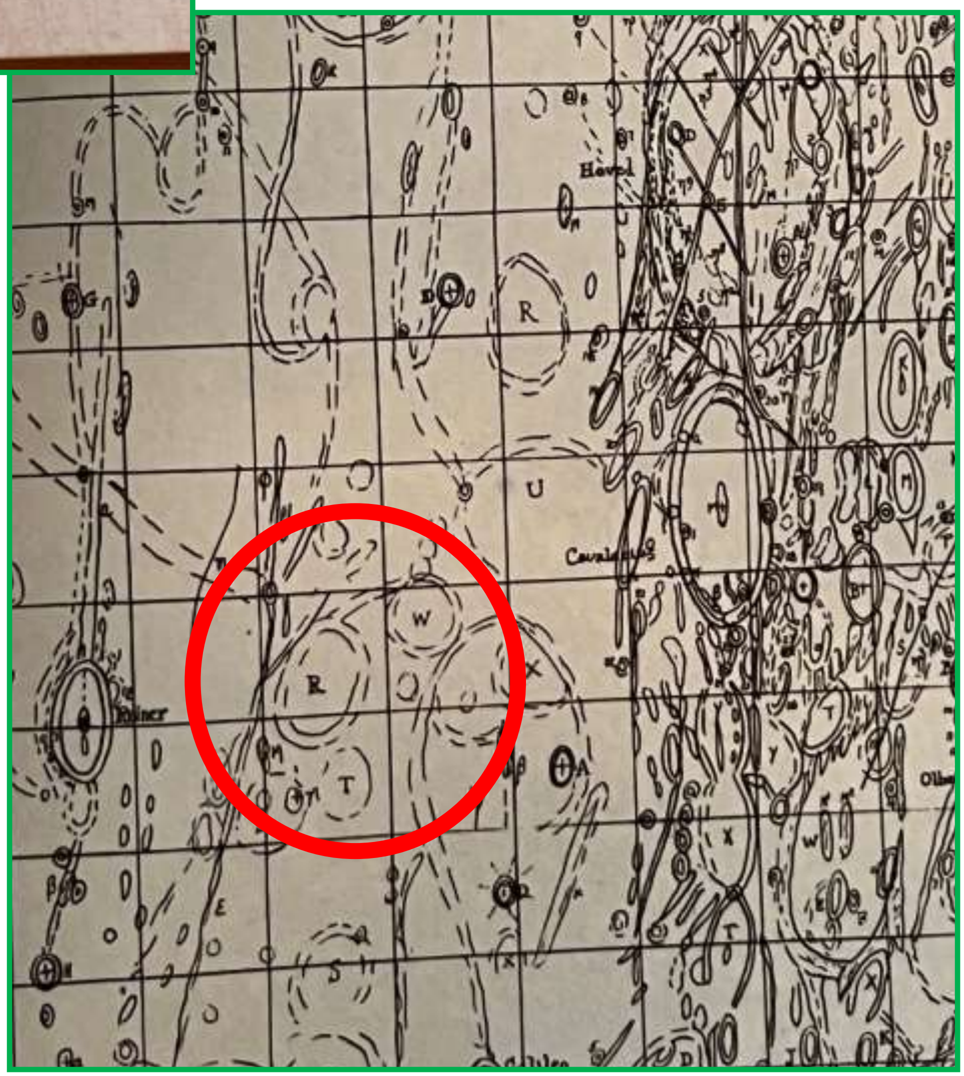


Image 4, right, the Reiner Gamma region from the Map of the Moon, Section XIX:IV. Reiner Gamma is inside the circled region. North is down, west is right.

Reiner Gamma in the Golden Ages

In the chart The Lunar Quadrant Map, 1964, Lunar and Planetary Laboratory, The Board of Regents of the Universities and State College of Arizona, there is only a light circle indicating the position of Reiner Gamma, though in the same area, many of the Marius Hills are depicted well (image 5).

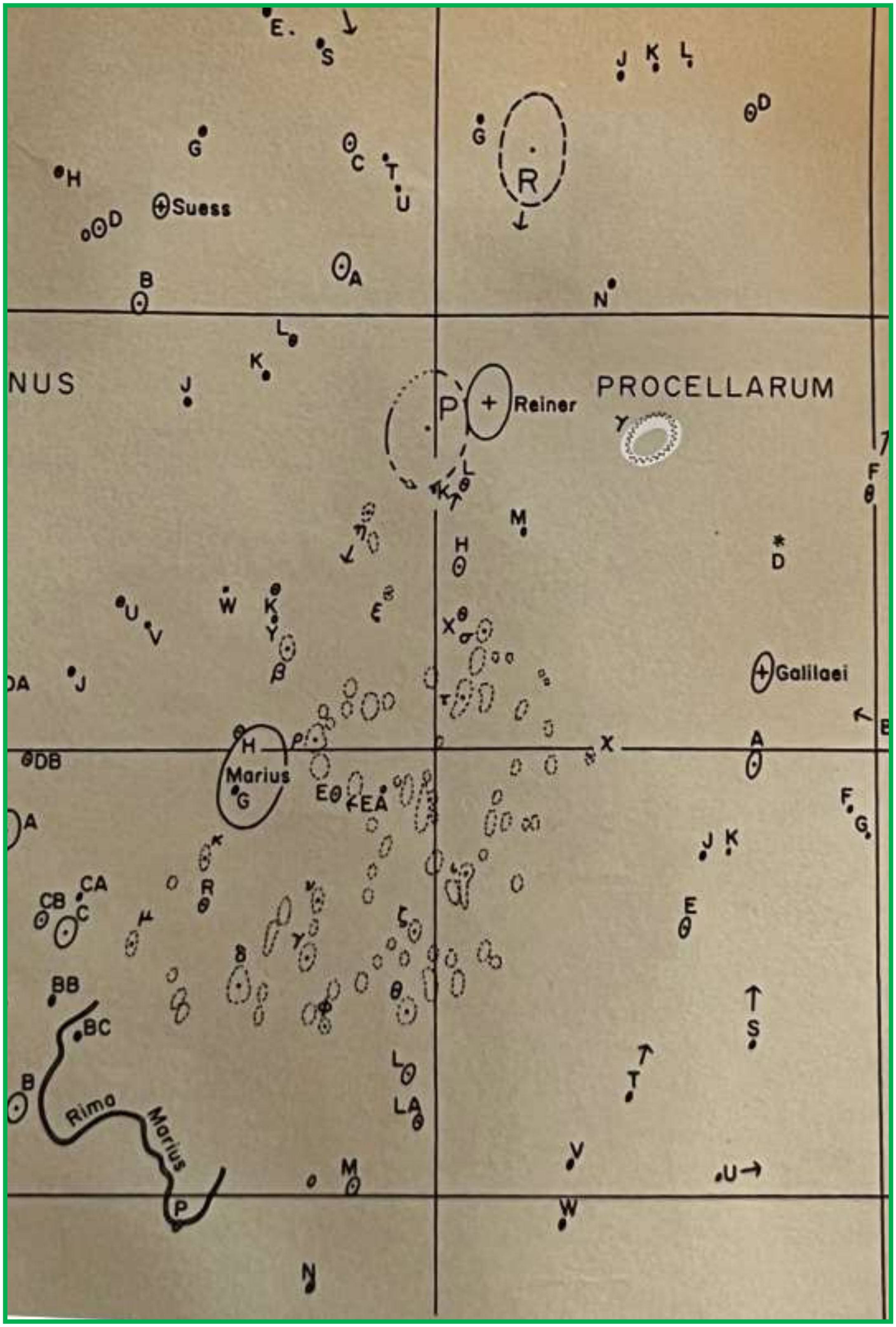


Image 5, right, the Reiner Gamma region from the chart Lunar Quadrant Map, Lunar and Planetary Laboratory. North is down, west is right.

A remarkable set of images is seen in the 1971 book A New Photographic Atlas of the Moon (image 6) by Zdeněk Kopal of the Moon, in this case, Reiner Gamma. Image 7 is of Plate 26 which features Reiner and Reiner Gamma. This particular image was taken with the 43-inch reflector at Observatoire du Pic-du-Midi. I find image 8 of Plate 38 most remarkable. This image was taken by Lunar Orbiter 2 on November 25, 1966 from an altitude of only 51 km. The subject of the image is the Marius Hills in the distance, but Reiner Gamma shows in the foreground in amazing detail. Notice how many small craterlets cover the region, indicating a somewhat advanced age and how the northern tail of the swirl trails to the Marius Hills. Plate 43 on image 9 shows Reiner Gamma as seem in an image taken on February 3, 1966 with a 74-inch reflector of Helwan Observatory at Kottamia, Egypt. The Lunar Orbiter 4 used its wide-angle lens to take Plate 44 (image 10) to image the region of Reiner Gamma on May 23, 1967 from an altitude of 2,720 miles.

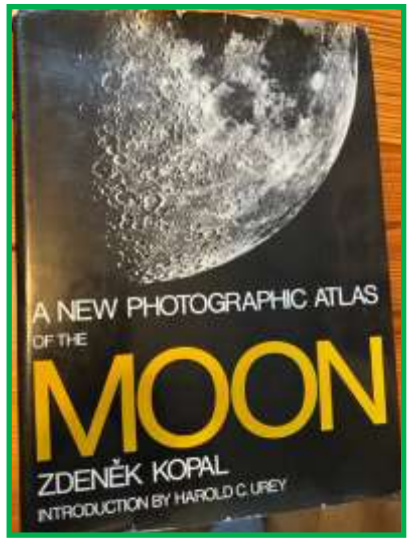


Image 6, A New Photographic Atlas of the Moon (image 6) by Zdeněk Kopal.

Image 7, Plate 26 of A New Photographic Atlas of the Moon by Zdeněk Kopal. Image taken by 43-inch reflector at Observatoire du Pic-du-Midi.

Reiner Gamma in the Golden Ages

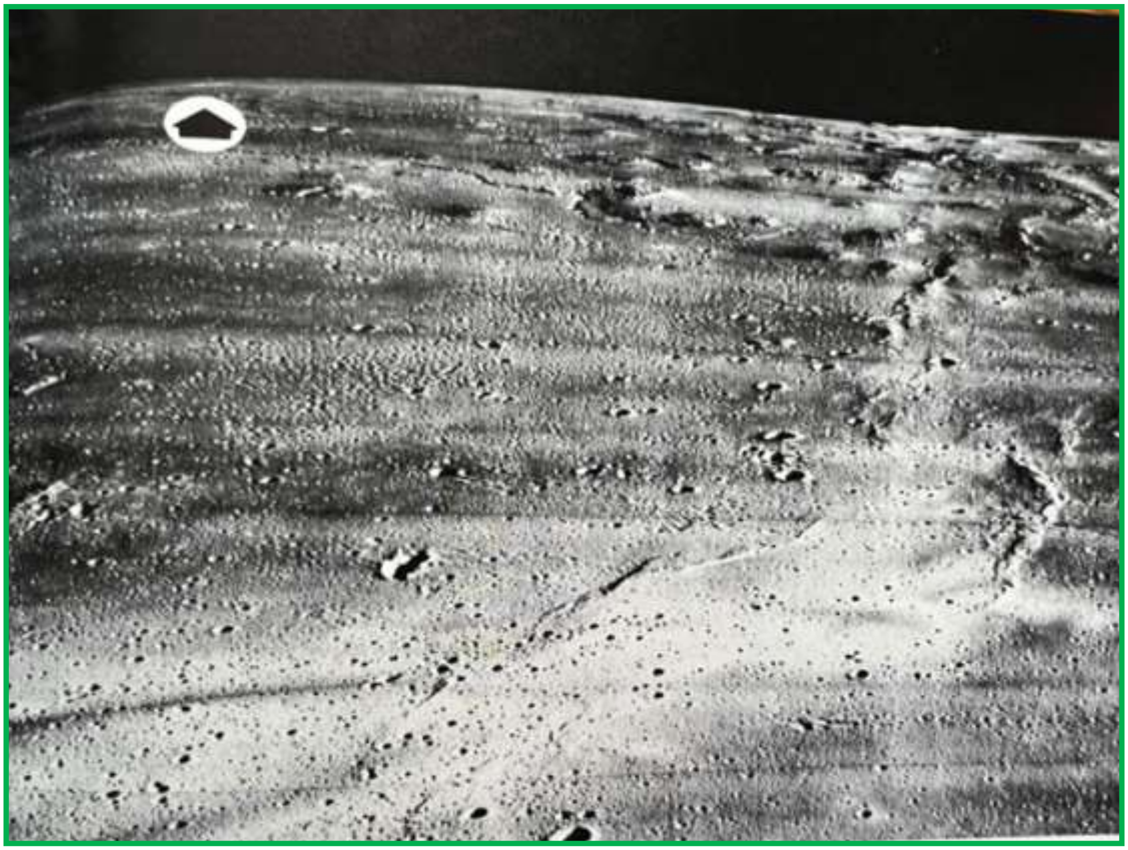
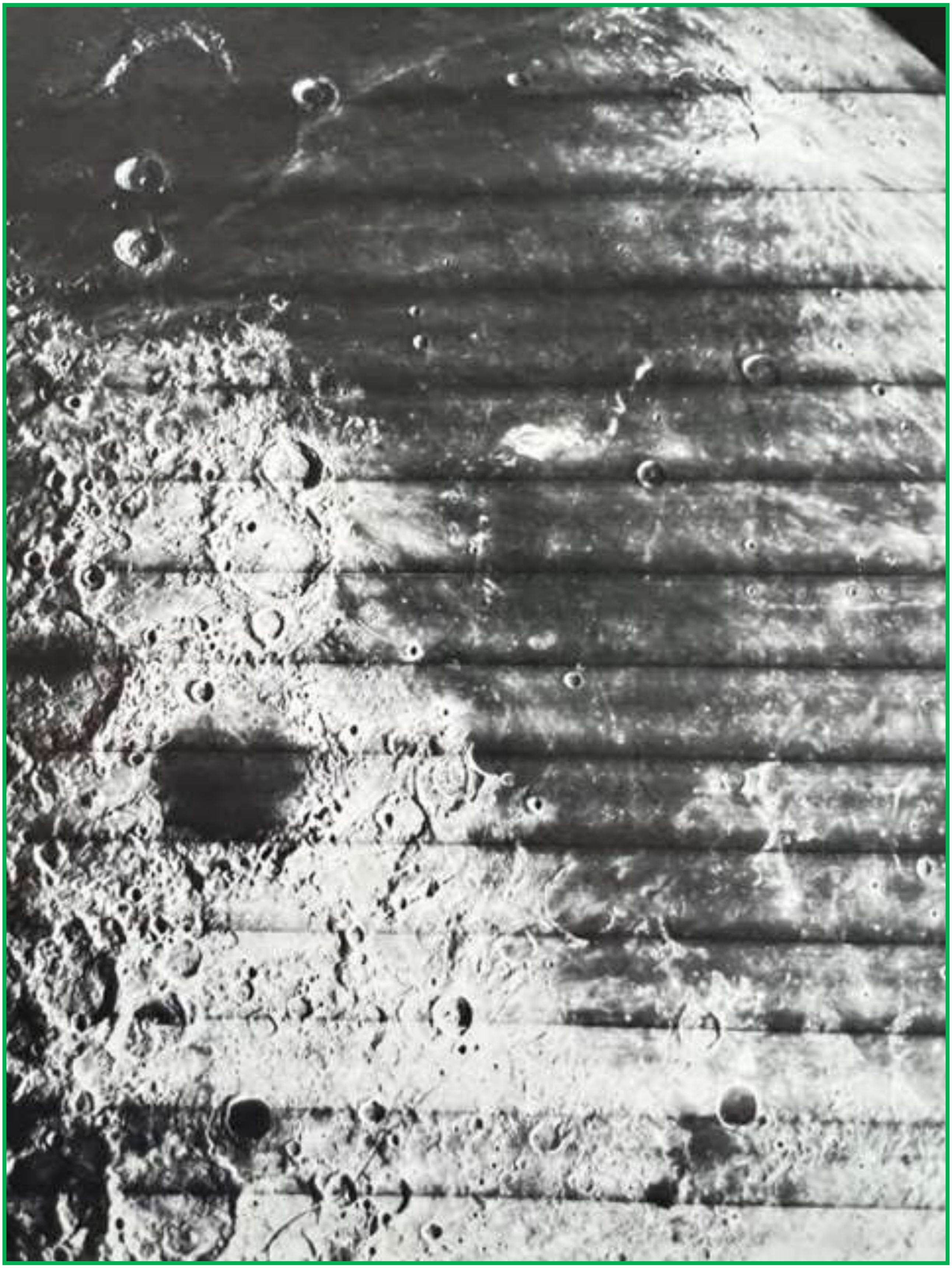


Image 8, Plate 38 of A New Photographic Atlas of the Moon by Zdeněk Kopal. This shows Reiner Gamma from an altitude of 51 km as seen by Lunar Orbiter 2.

Image 9, Plate 43 of A New Photographic Atlas of the Moon by Zdeněk Kopal. Image taken 74-inch reflector of Helwan Observatory at Kottamia, Egypt.

Reiner Gamma in the Golden Ages

Image 10, Plate 44 of A New Photographic Atlas of the Moon by Zdeněk Kopal. This shows Reiner Gamma from an altitude of 2,720 km as seen by Lunar Orbiter 4.



Reiner Gamma in the Golden Ages

Likewise, in 1969 The Times Atlas of the Moon, (image 11) edited by H. A. G. Lewis, Reiner Gamma not labeled (image 12) as such, though Reiner and some of its satellite craters are labeled. Interestingly, the area surrounding the “head” of Reiner Gamma and its long, northeast tail are encircled by a contour line indicating equal elevation of 2,700 m. As I paged through this book, I was fascinated by future Apollo plans after Apollo 11. Apollo 12 would land in Oceanus Procellarum. Apollo 13 was to go to Fra Mauro. Apollo 14 was to land at Censorinus. Apollo 15 was scheduled to go to Littrow. Now it gets really interesting. Apollo 16 was to go to Tycho, Apollo 17 the Marius Hills, Apollo 18 to Schröter’s Valley, Apollo 19 to Hyginus Rille and Apollo 20 to Copernicus. What could have been.

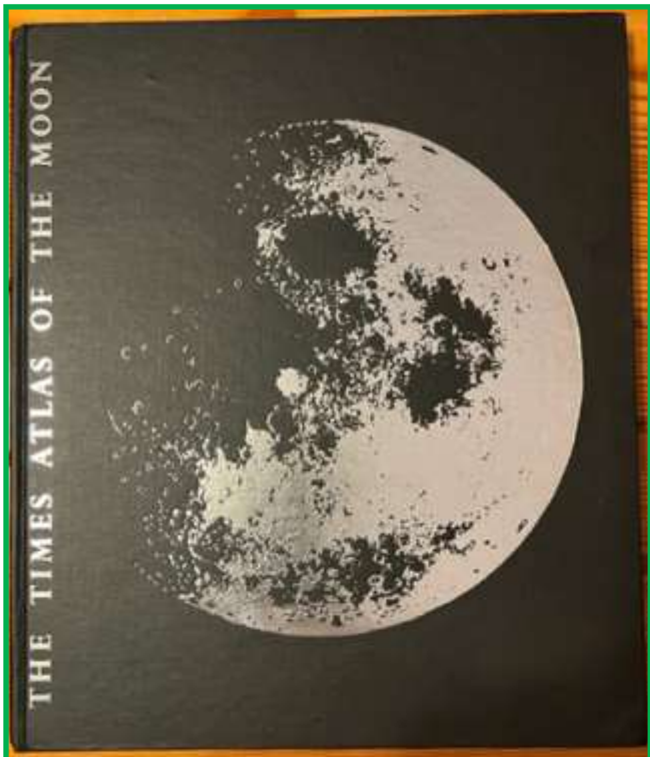


Image 11, The Times Lunar Atlas of the Moon, edited by H. A. G. Lewis.

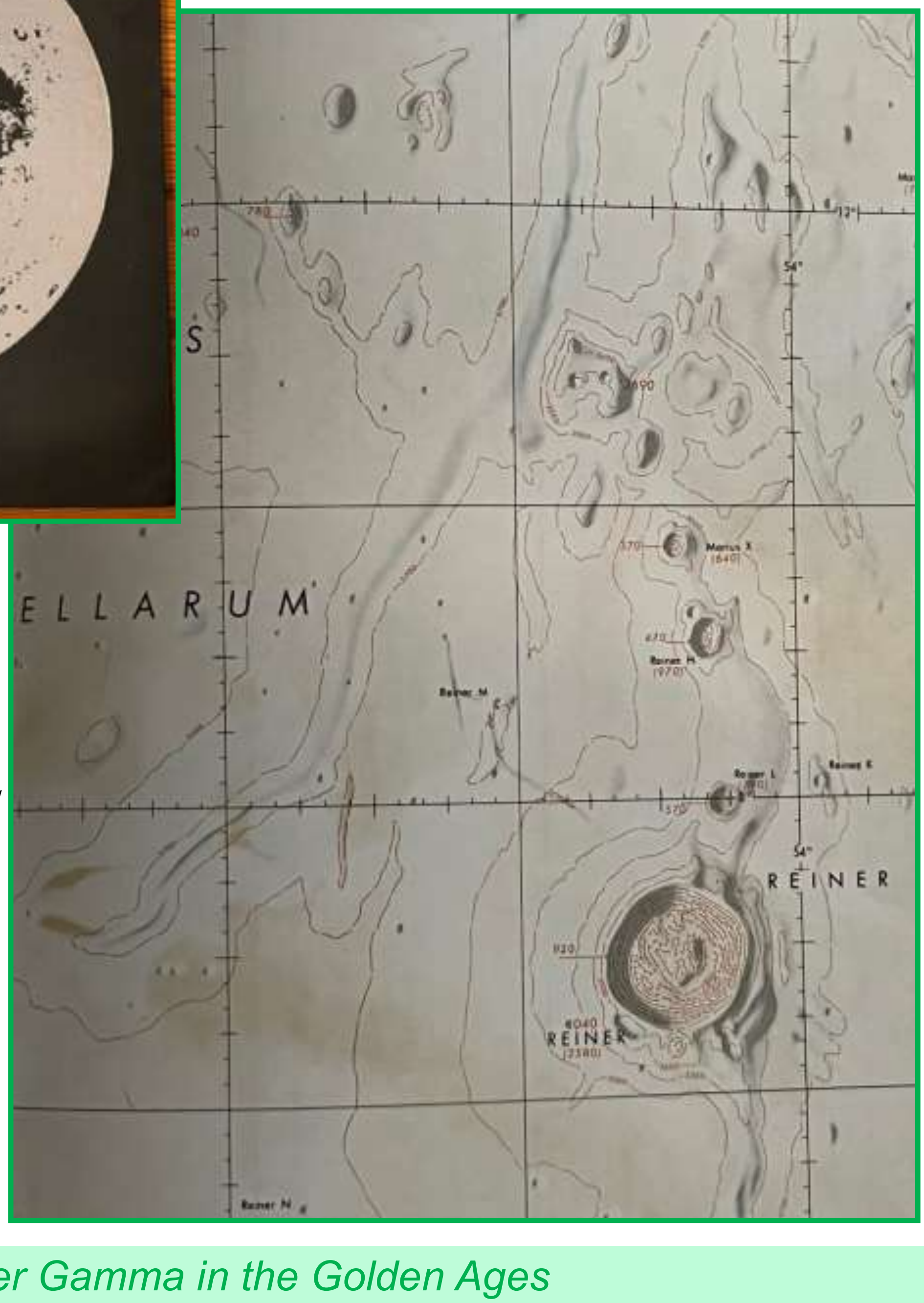


Image 12, Times Atlas of the Moon, edited by H. A. G. Lewis. Chart page 36 showing the region of Reiner and Reiner Gamma.

Through a very generous donation a few years ago, a fellow lunar observer sent to me some wonderful old lunar atlases. Looking at Reiner Gamma through these atlases was a pleasure. The first atlas investigated was the Lunar Crescent Sets (image 13), Copyright 1957, Sky Publishing Corporation, Harvard College Observatory, Cambridge 38, Mass. These large loose-leaf images were “Among the finest of all lunar photographs are those taken at Lick Observatory, University of California, by J. H. Moore and J. F. Chappell, with the great 36-inch refractor. They obtained the picture of the waxing Moon on June 2, 1938. The parts of the crescents … may be cut out and put together to form a mosaic in which the moon’s diameter is about two feet”. Image 14 is of Reiner Gamma taken on that date, 85 years ago.

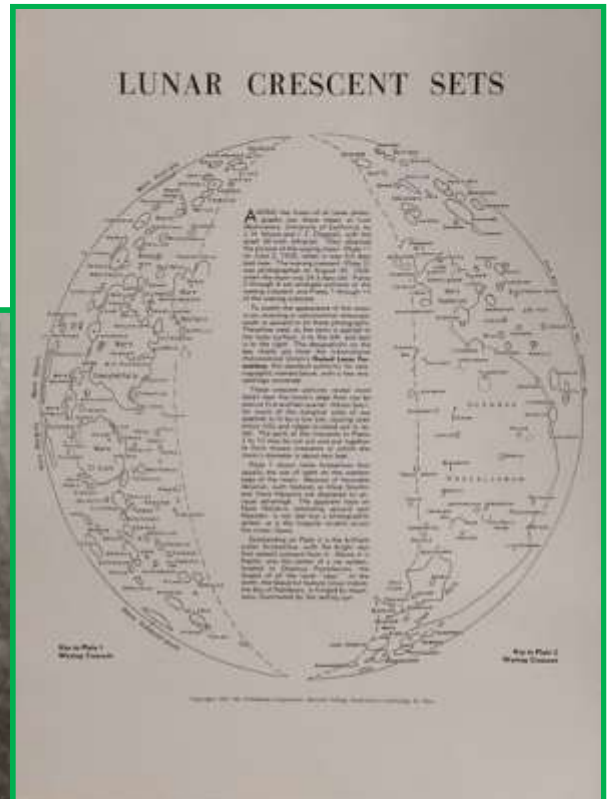


Image 13, Lunar Crescent Sets.

Image 14, Reiner and Reiner Gamma region, Lunar Crescent Set Plate 9, Waning Crescent Moon: northeast portion. Lick Observatory photograph. Photograph taken August 20, 1938, Moon age 24.3 days.

The next lunar atlas investigated for its view of Reiner Gamma was the Photographic Atlas of the Moon, (image 15) Mount Wilson, Pic du Midi, McDonald, Yerkes, Lick, Edited by Gerard P. Kuiper, University of Chicago Press 1960 University of Chicago. This was a large boxed set of loose-leaf lunar images (image 16-18).

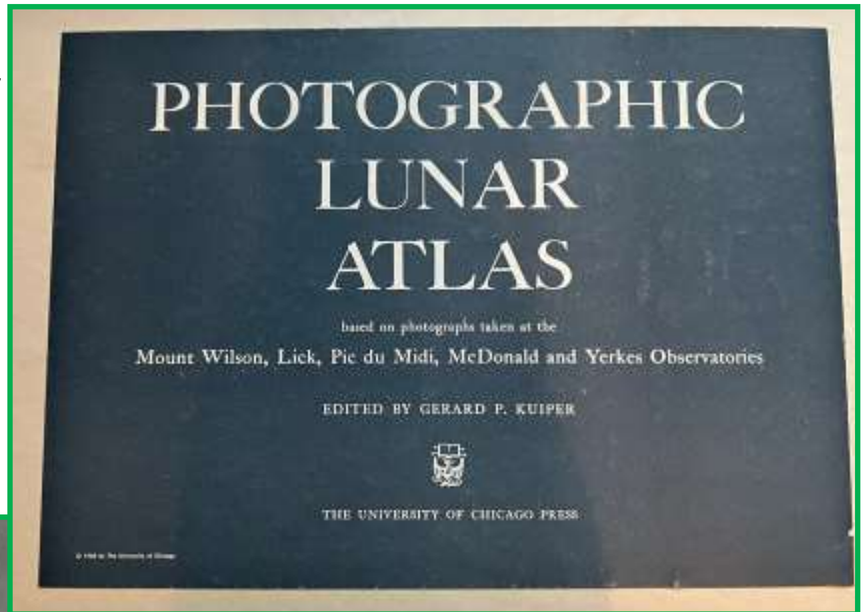


Image 15, Photographic Lunar Atlas, based on photographs taken at the Mount Wilson, Lick, Pic du Midi, McDonald and Yerkes Observatories. Edited by Gerald P. Kuiper, 1960, University of Chicago Press.

Image 16, Reiner Gamma Plate F4a1Y, Photographic Lunar Atlas, based on photographs taken at the Mount Wilson, Lick, Pic du Midi, McDonald and Yerkes Observatories. Edited by Gerald P. Kuiper, 1960, University of Chicago Press. Image taken at Yerkes Observatory.

Image 17, Reiner Gamma Plate F4bW, Photographic Lunar Atlas, based on photographs taken at the Mount Wilson, Lick, Pic du Midi, McDonald and Yerkes Observatories. Edited by Gerald P. Kuiper, 1960, University of Chicago Press. Image taken at Mount Wilson Observatory.

Image 18, Reiner Gamma Plate F4cW, Photographic Lunar Atlas, based on photographs taken at the Mount Wilson, Lick, Pic du Midi, McDonald and Yerkes Observatories. Edited by Gerald P. Kuiper, 1960, University of Chicago Press. Image taken at Mount Wilson Observatory.

Reiner Gamma in the Golden Ages

Another large, but this time bound lunar atlas was the Rectified Lunar Atlas, Supplement Number Two to the Photographic Lunar Atlas, E. A. Whitaker, G. P. Kuiper, W. K. Hartmann and L. H. Spradley, University of Arizona Press, Tucson 1963 (image 19). It shows Reiner Gamma in chart 10-b, Image taken March 24, 1959 05:05 UT as seen from above by the McDonald Observatory 82-inch reflector telescope (image 20).

Image 19, Rectified Lunar Atlas, Supplement Number Two of the Photographic Lunar Atlas by E. A. Whitaker, G. P. Kuiper, W. K. Hartmann and L. H. Spradley, University of Arizona Press, Tucson 1963.

Image 20, Reiner Gamma, from chart 10-b taken with the 82 inch reflector telescope at McDonald Observatory.

The space race was in full force in 1963 when the Orthographic Atlas of the Moon, Supplement Number one, Part One (Central Area) to the USAF Lunar Atlas, published by Aeronautical Chart and Information Center, United States Air Force, Second and Arsenal Streets, St. Louis 18, Missouri. Compiled by D. W. G. Arthur and E. A. Whitaker, Edited by Gerard P. Kuiper was published in 1960 (image 21). I enjoy the title of the United States Air Force Lunar Atlas. Here we see a detailed image (images 22) of Reiner Gamma.

Image 21, Orthographic Atlas of the Moon, Supplement Number one, Part One (Central Area) to the USAF Lunar Atlas, published by Aeronautical Chart and Information Center, United States Air Force, Second and Arsenal Streets, St. Louis 18, Missouri. Compiled by D. W. G. Arthur and E. A. Whitaker, Edited by Gerard P. Kuiper was published in 1960.

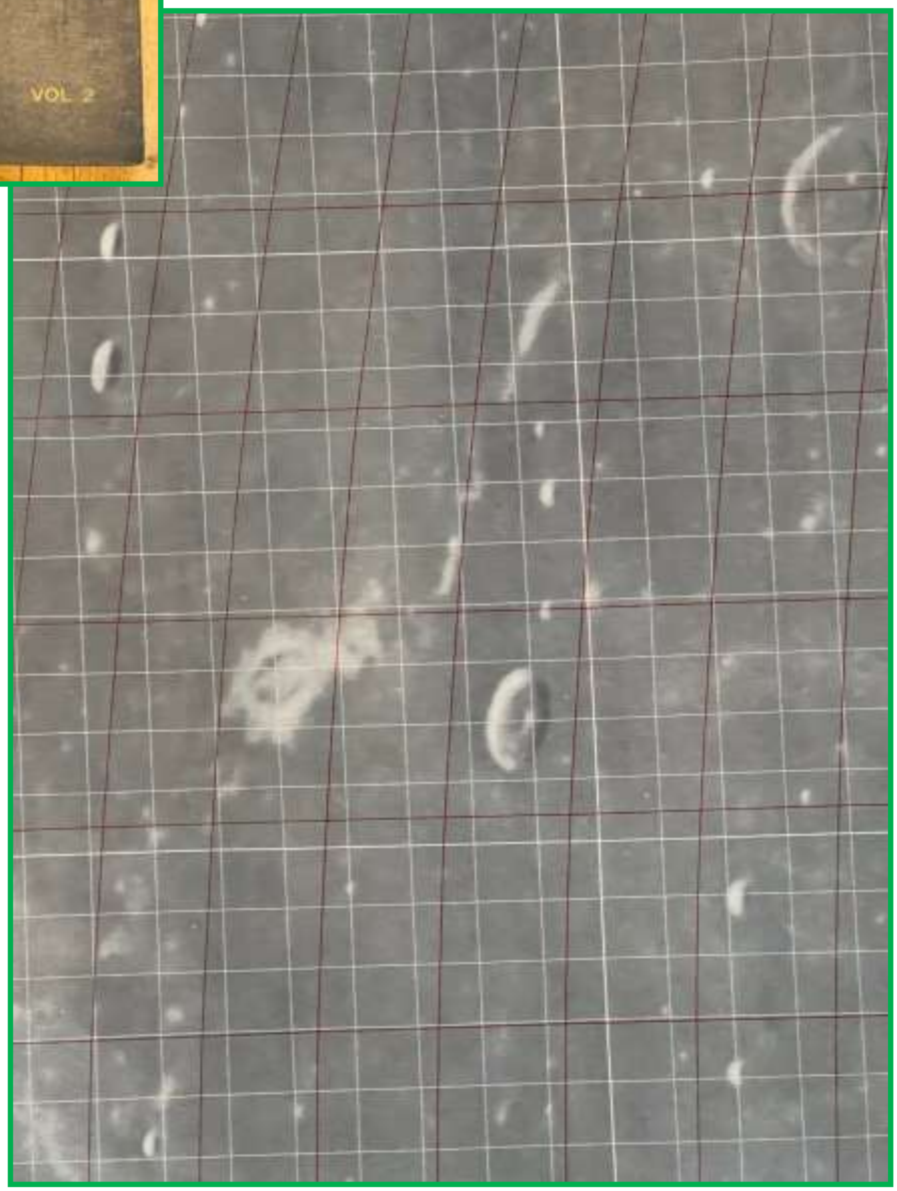
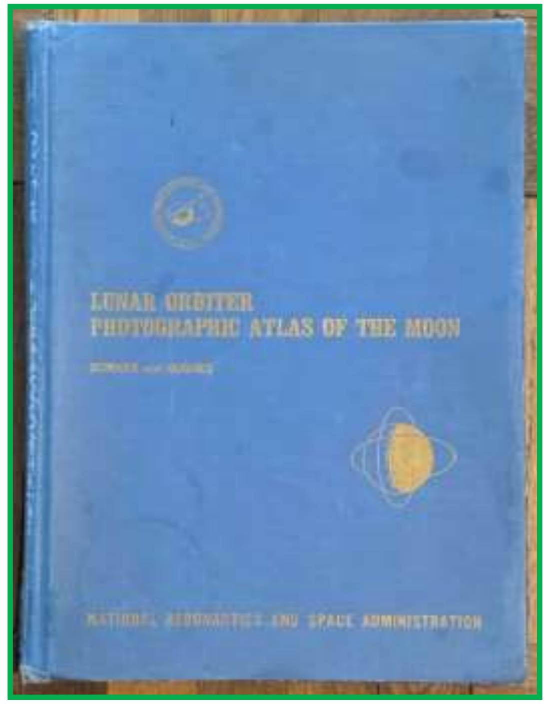


Image 22, Reiner and Reiner Gamma, from the Orthographic Atlas of the Moon, Supplement 2, Plate Reine F4-a.

Reiner Gamma in the Golden Ages

The Lunar Orbiter Photographic Atlas of the Moon by Bowker and Hughes, NASA 1971(image 23) gave us our first good in-orbit images of the Moon, including Reiner Gamma (images 24 and 25). Image 25 is especially impressive, though Reiner Gamma is at the corner of the field.

Image 23, Lunar Orbiter Photographic Atlas of the Moon NASA.



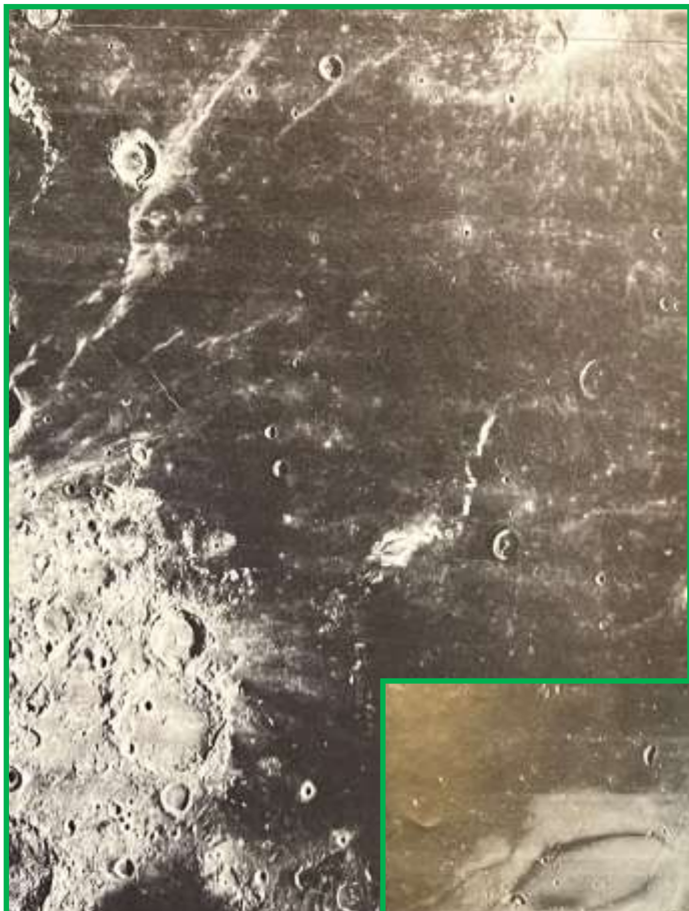


Image 24, Reiner Gamma, Plate 155 Lunar Orbiter Photographic Atlas of the Moon. Lunar Orbiter IV.

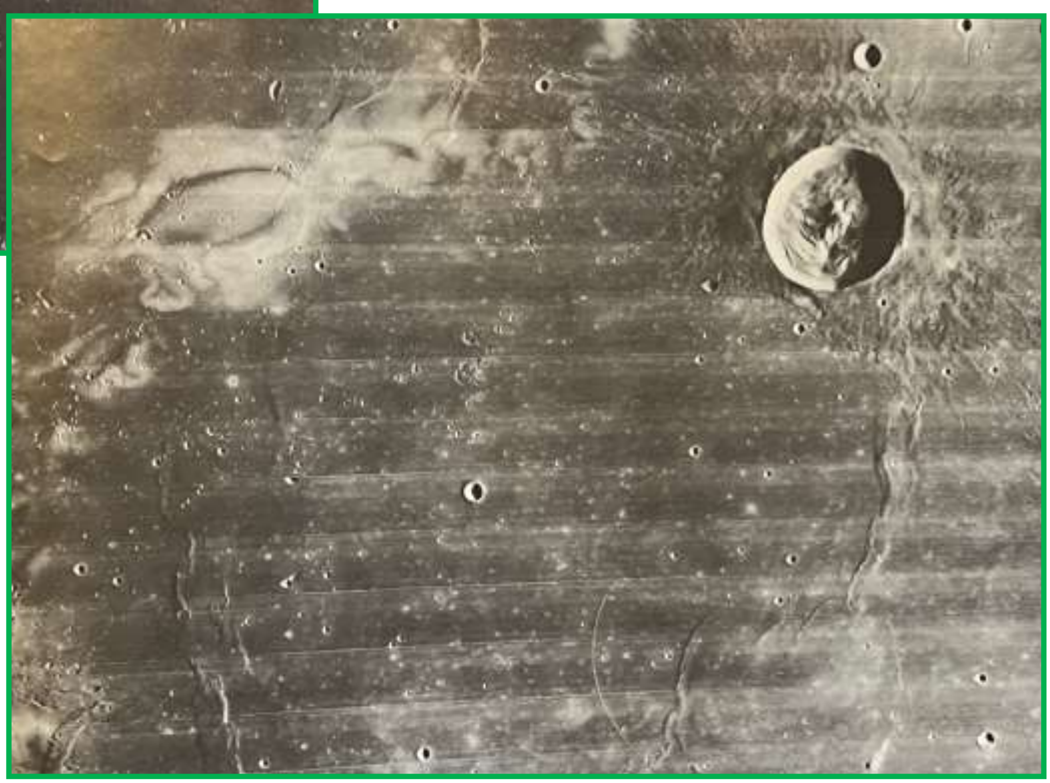


Image 25, Reiner Gamma, Plate 170 Lunar Orbiter Photographic Atlas of the Moon. Lunar Orbiter IV.

A much more commonly available lunar atlas is The Hatfield Photographic Lunar Atlas edited by Jeremy Cook, 1999, Springer (image 26). Henry Hatfield took these excellent images of the Moon in the 1960s with his home-made 12-inch Newtonian. Attached is image 7a-e (image 27-30) from his atlas.

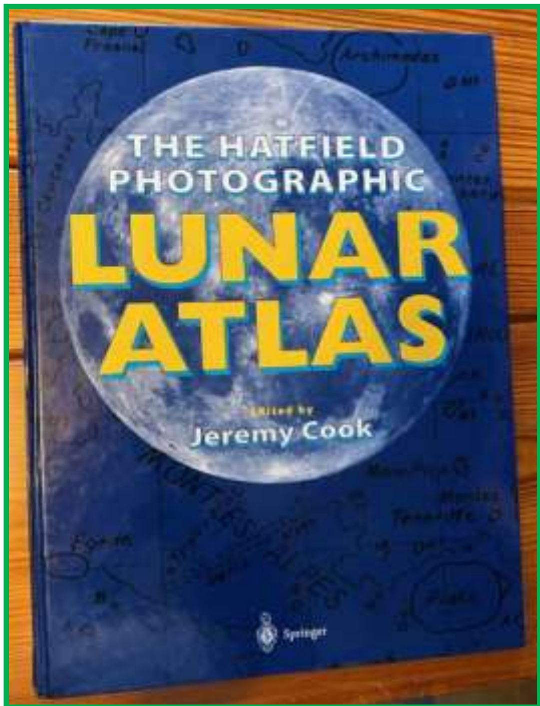


Image 26, The Hartfield Photographic Lunar Atlas, edited by Jeremy Cook.

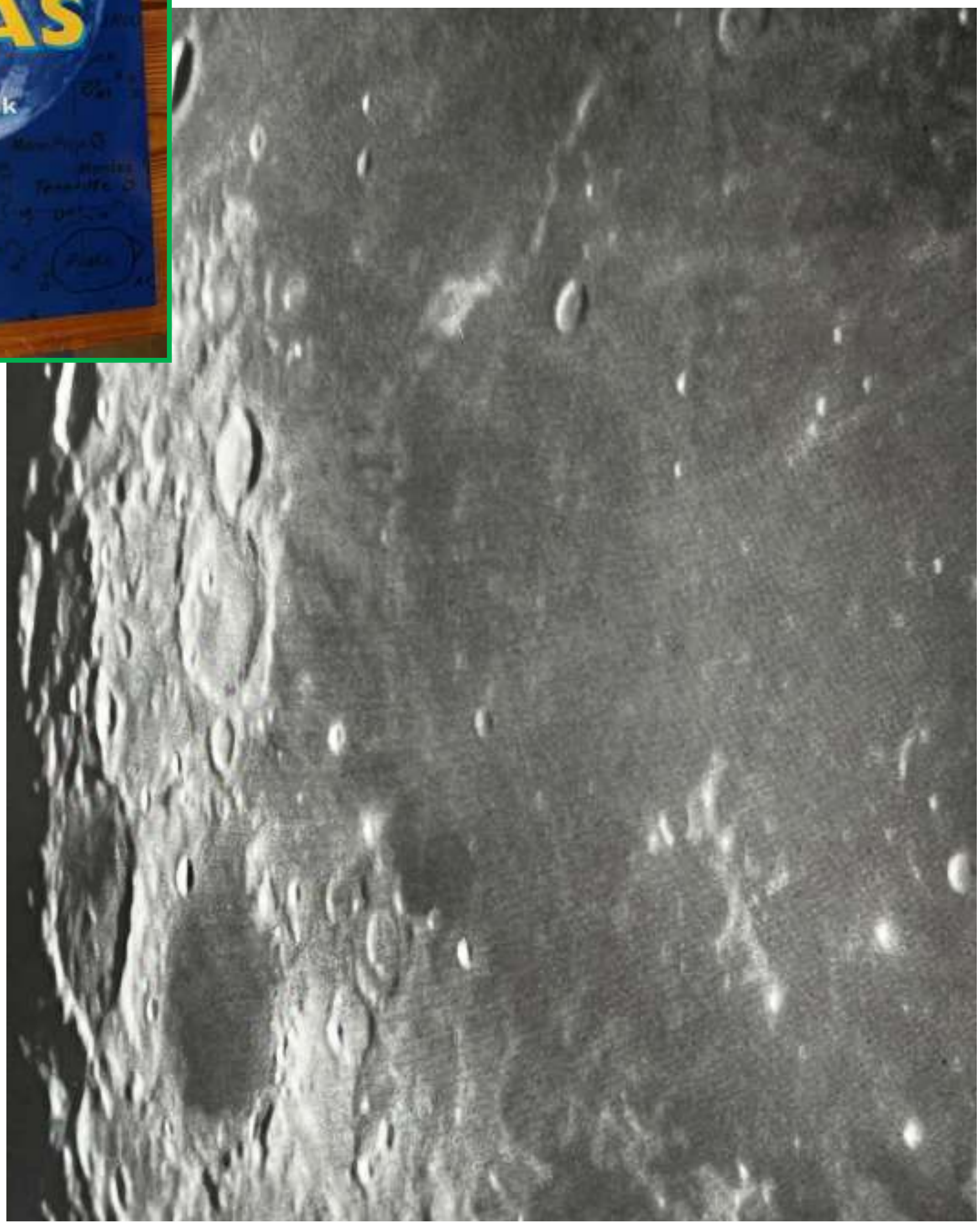


Image 27, Reiner Gamma, The Hartfield Photographic Lunar Atlas. Plate 7a, January 24, 1967.

Reiner Gamma in the Golden Ages

Image 28, Reiner Gamma, The Hartfield Photographic Lunar Atlas. Plate 7c, December 07, 1966.

Image 29, Reiner Gamma, The Hartfield Photographic Lunar Atlas. Plate 7d, December 25, 1966.

Reiner Gamma in the Golden Ages

Image 30, Reiner Gamma, The Hartfield Photographic Lunar Atlas. Plate 7e, October 10, 1966.

In the images above, all wonderful and mostly taken by professional astronomers with large professional telescopes (or even lunar orbit), it is interesting to compare these images to the images of Reiner Gamma submitted by amateur astronomers of today. It is amazing how much modern digital cameras have improved the ability to gather data from celestial objects in a relatively short amount of time. I attach one more image, an image of Reiner Gamma that I recently took with a 60 mm refractor. It compares pretty good with the monster telescopes of yesteryear. I wonder how data will be collected 85 years from now?

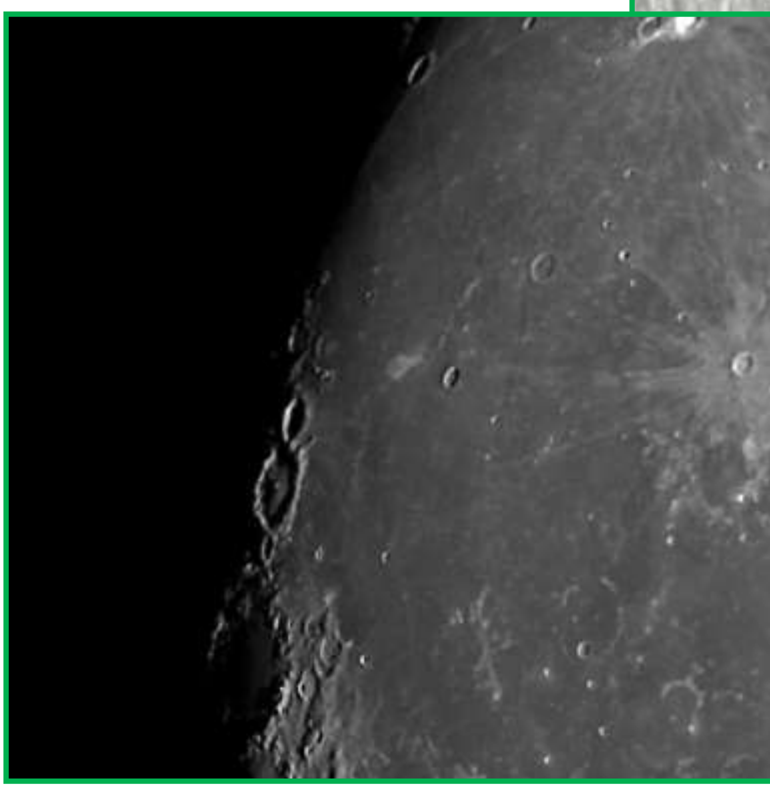


Image 31, Reiner Gamma, David Teske, Louisville, Mississippi, USA. 2023 April 04 01:39 UT, colongitude 66.5o. Takahashi FOA60Q refractor telescope, IR block filter, ZWO ASI120mm/s, seeing 7/10.

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Kuiper, Gerald P. (1960). *Photographic Atlas of the Moon, Mount Wilson, Pic du Midi, McDonald, Yerkes, Lick.* Chicago: University of Chicago Press, University of Chicago.

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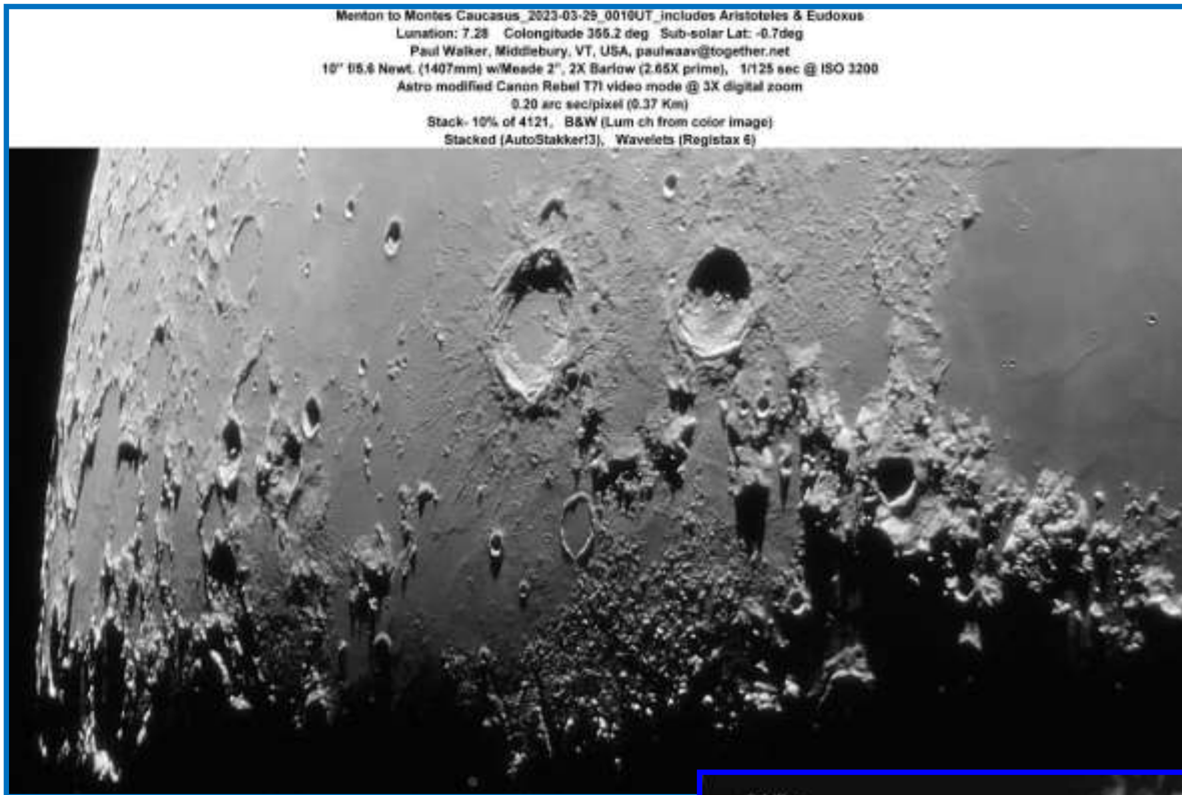
Whitaker, E. A., Kuiper, G. P. Hartmann, W. K. and Spradley, L. H. (1963). *Rectified Lunar Atlas, Supplement Number Two of the Photographic Lunar Atlas.* Tucson: University of Arizona Press. *https://www.amazon.com/Rectified-Lunar-Supplement-Number-Photographic/dp/B007BP3GH6/ref=sr_1_2?crid=1NB2VR912COEV&keywords=Rectified+Lunar+Atlas&qid=1680891949&sprefix=rectified+luna%2Caps%2C3620&sr=8-2*

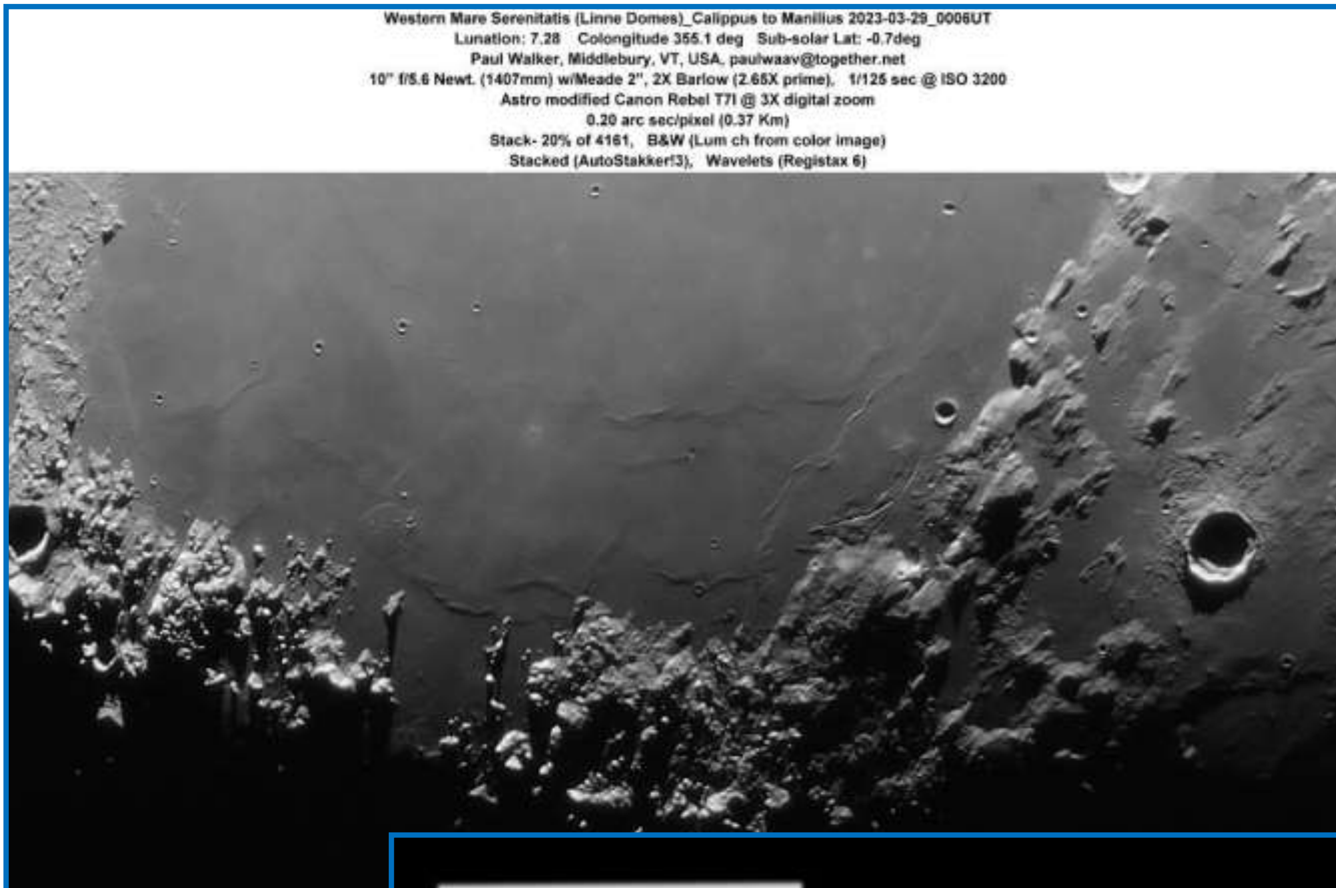
Focus-On: Mysterious Reiner Gamma



Meton to Montes Caucasus, *Paul Walker, Middlebury, Vermont, USA. 2023 March 29 00:10 UT, colongitude 355.2º. 10 inch f/5.6 Newtonian reflector telescope, 2x barlow, Canon Rebel T7i camera. North is left, west is down.*

Schiller*, Larry Todd, Dunedin, New Zealand. 2023 April 02 10:13 UT. OMC200 mm Maksutov-Cassegrain telescope.*

Recent Topographic Studies



Western Mare Serenitatis, *Paul Walker, Middlebury, Vermont, USA. 2023 March 29 00:06 UT, colongitude 355.1°. 10 inch f/5.6 Newtonian reflector telescope, 2x barlow, Canon Rebel T7i camera. North is left, west is down.*

Grimaldi, *István Zoltán Földvári, Budapest, Hungary. 2018 July 30, 21:32-21:55 UT, colongitude 127.726°. 70 mm refractor telescope, 500 mm focal length, 6 mm Plossl, 83x. Seeing 7/10.*

Recent Topographic Studies

Petavius, *Larry Todd, Dunedin, New Zealand. 2023 April 07 09:08 UT. OMC200 mm Maksutov -Cassegrain telescope.*

Aristoteles and Mitchell, *Massimo Dionisi, Sassari, Italy. 2023 April 09 22:04 UT. Sky Watcher 10 inch f/5 Newtonian reflector telescope, 5x Tecnosky Telextender, 685 nm IR pass filter, Uranus C camera. Seeing III-IV Antoniadi scale.*

Recent Topographic Studies

Rheita E, *Fabio Verza, SNdR, Milan, Italy. 2023 April 27 20:10 UT. Takahashi Mewlon 250 mm Dall-Kirkham telescope, 1.3 x barlow, Astronomik ProPlanet IR642 filter, Player One Mars-M camera.*

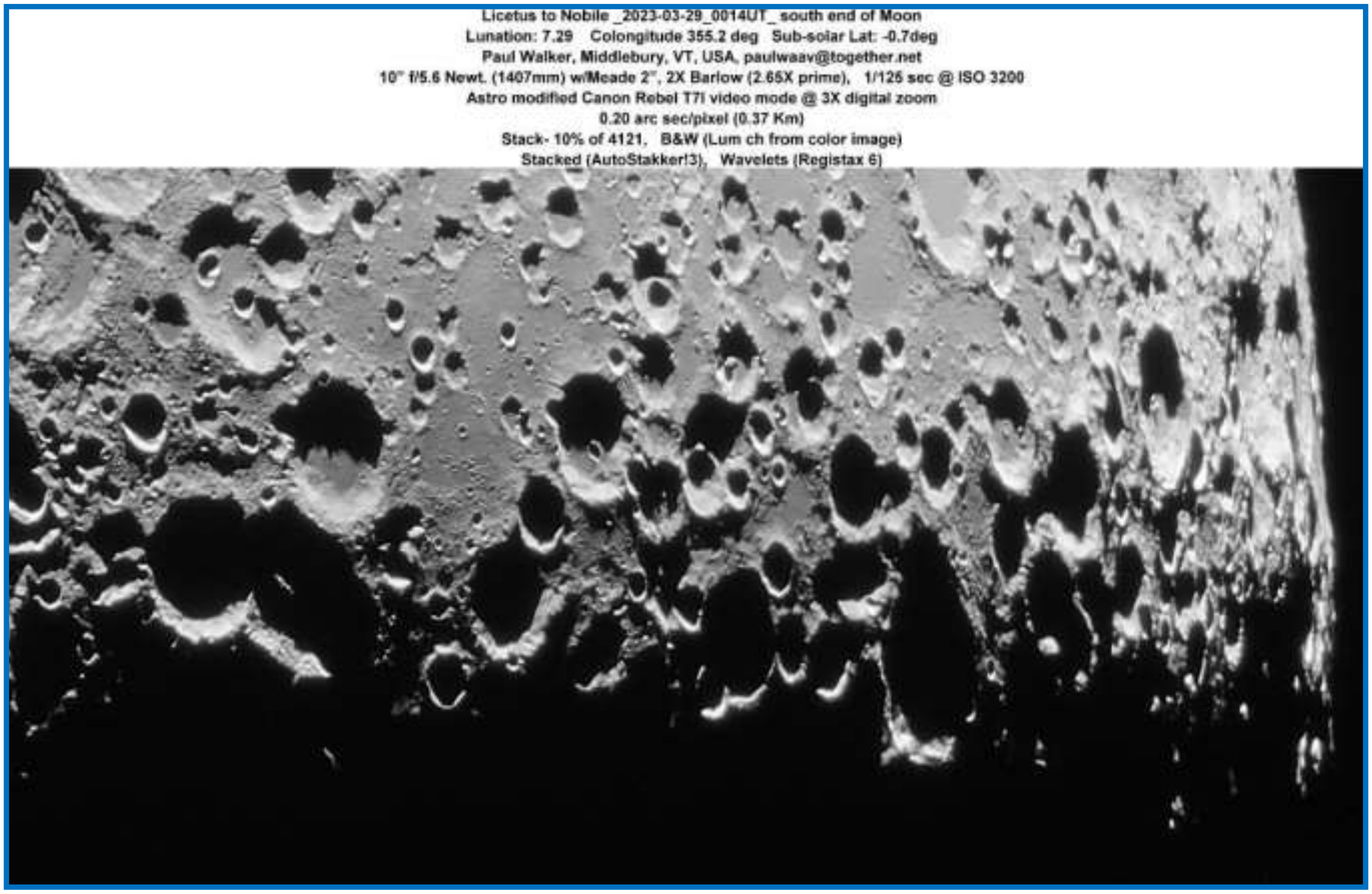
Schiller-Zucchius*, Larry Todd, Dunedin, New Zealand. 2023 April 02 10:11 UT. OMC200 mm Maksutov-Cassegrain telescope.*

Recent Topographic Studies

Lade to Abenerza, *Paul Walker, Middlebury, Vermont, USA. 2023 March 28 23:59 UT, colongitude 355.1°. 10 inch f/5.6 Newtonian reflector telescope, 2x barlow, Canon Rebel T7i camera. North is left, west is down.*

Rheita, *Fabio Verza, SNdR, Milan, Italy. 2023 April 27 20:06 UT. Takahashi Mewlon 250 mm Dall-Kirkham telescope, 1.3 x barlow, Astronomik ProPlanet IR642 filter, Player One Mars-M camera.*

Recent Topographic Studies

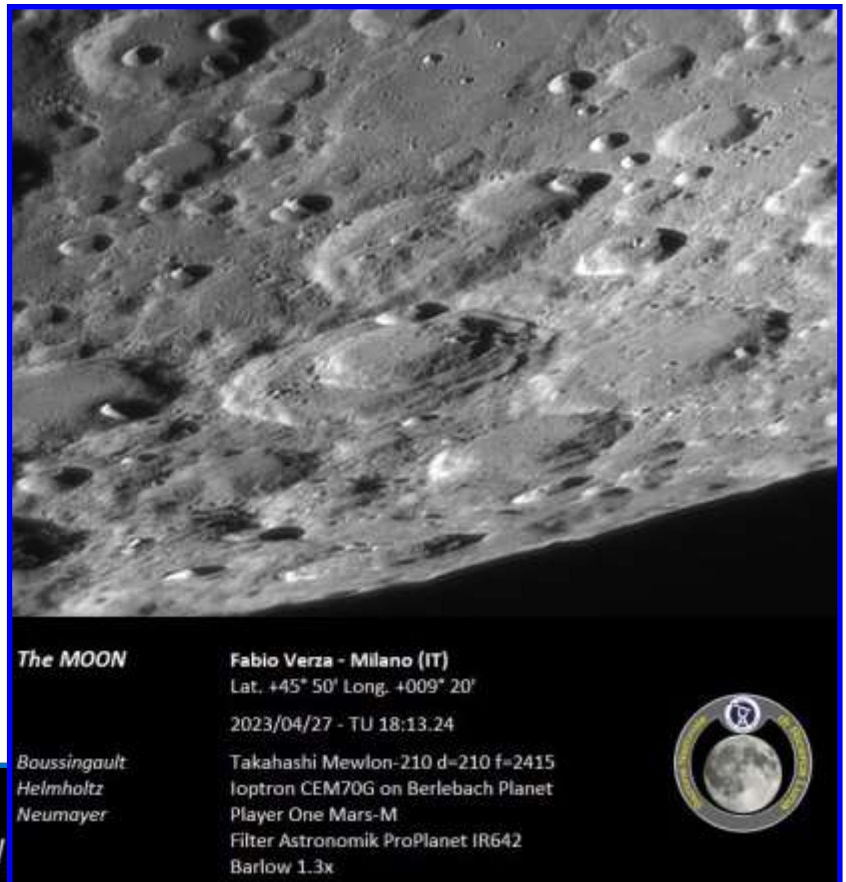


Licetus to Nobile, *Paul Walker, Middlebury, Vermont, USA. 2023 March 29 00:14 UT, colongitude 355.2º. 10 inch f/5.6 Newtonian reflector telescope, 2x barlow, Canon Rebel T7i camera. North is left, west is down.*

Langrenus*, Larry Todd, Dunedin, New Zealand. 2023 April 07 09:27 UT. OMC200 mm Maksutov-Cassegrain telescope.*

Recent Topographic Studies

Neumayer, *Fabio Verza, SNdR, Milan, Italy. 2023 April 27 18:13 UT. Takahashi Mewlon 250 mm Dall-Kirkham telescope, 1.3 x barlow, Astronomik ProPlanet IR642 filter, Player One Mars-M camera.*



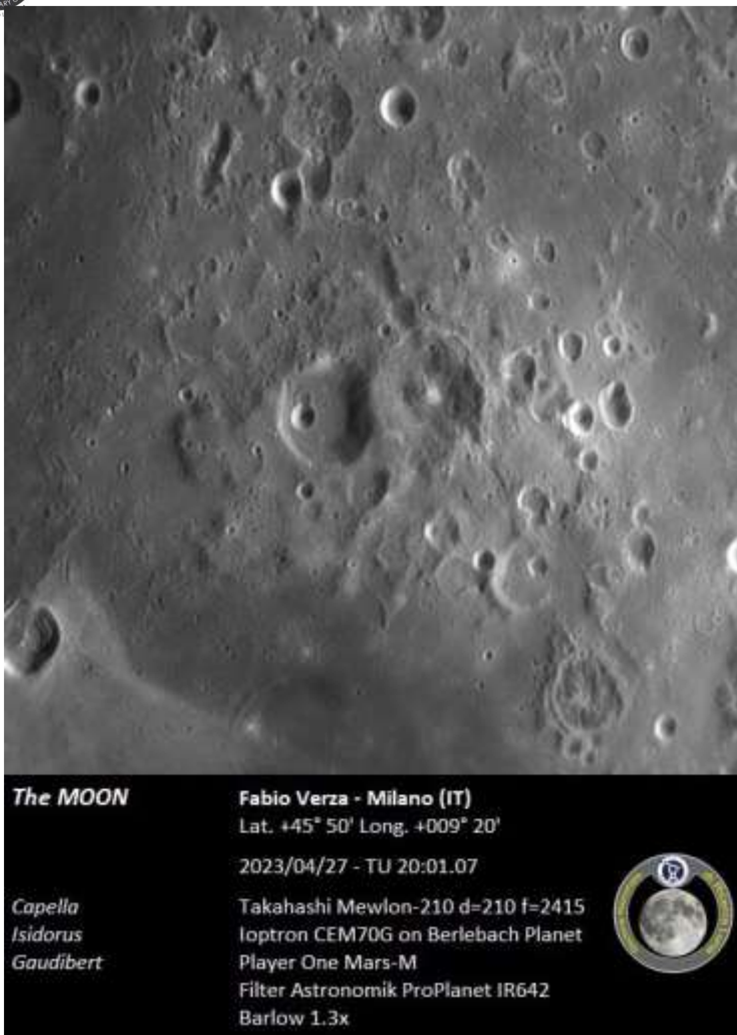
Chevallier, *István Zoltán Földvári, Budapest, Hungary. 2018 July 30, 22:10-22:39 UT, colongitude 128.0°. 70 mm refractor telescope, 500 mm focal length, 10 mm Plossl, GSO 2x barlow, 100x. Seeing 8/10, transparency 4/6.*

Recent Topographic Studies

Dorsa Smirnov, *Massimo Dionisi, Sassari, Italy. 2023 April 09 23:48 UT. Sky Watcher 10 inch f/5 Newtonian reflector telescope, 5x Tecnosky Telextender, 685 nm IR pass filter, Uranus C camera. Seeing III-IV Antoniadi scale.*

Posidonius, *Fabio Verza, SNdR, Milan, Italy. 2023 April 27 18:21 UT. Takahashi Mewlon 250 mm Dall-Kirkham telescope, 1.3 x barlow, Astronomik ProPlanet IR642 filter, Player One Mars-M camera.*

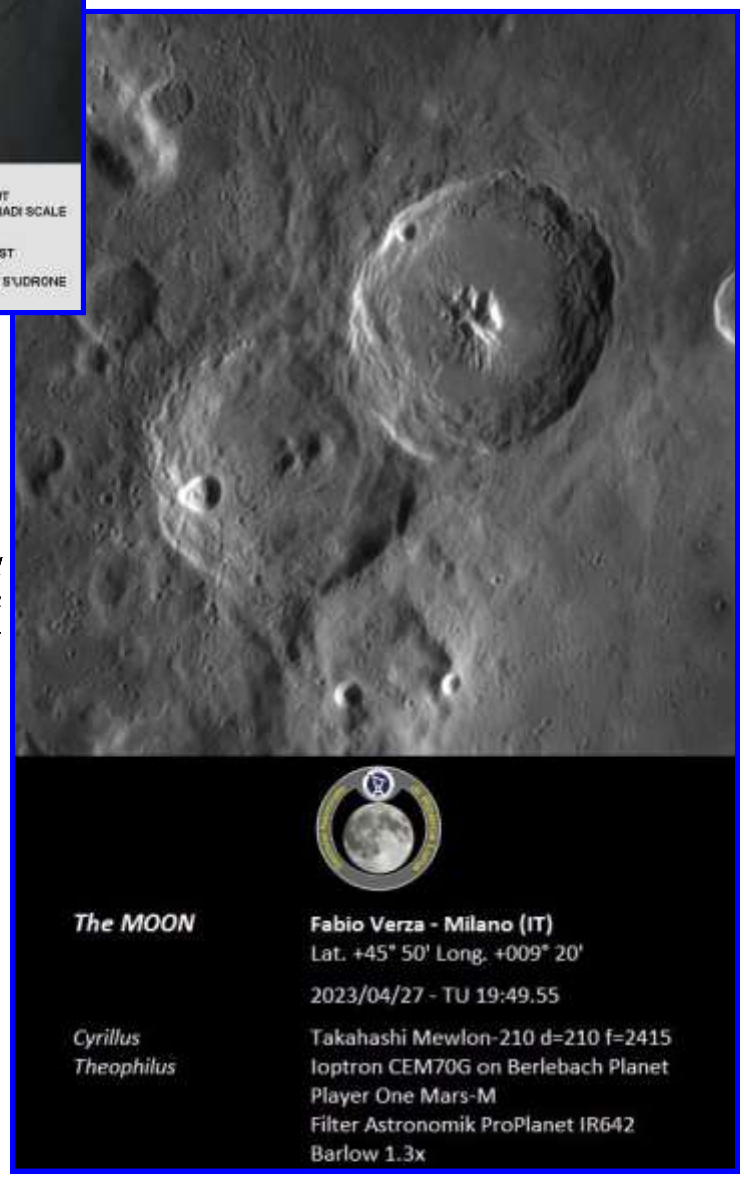
Recent Topographic Studies



Capella, *Fabio Verza, SNdR, Milan, Italy. 2023 April 27 20:01 UT. Takahashi Mewlon 250 mm Dall-Kirkham telescope, 1.3 x barlow, Astronomik ProPlanet IR642 filter, Player One Mars-M camera.*

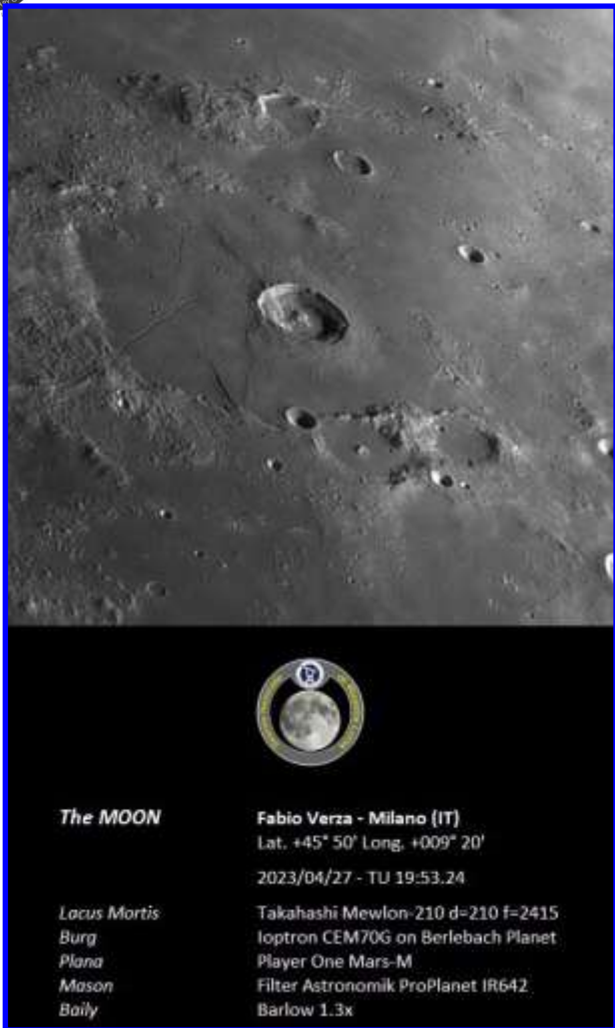
Promontorium Olivium and Promontorium Lavinium, *István Zoltán Földvári, Budapest, Hungary. 2018 July 30, 22:40-22:53 UT, co-longitude 128.2º. 70 mm refractor telescope, 500 mm focal length, 10 mm Plossl, GSO 2x barlow, 100x. Seeing 8/10, transparency 4/6.*

Cauchy, *Massimo Dionisi, Sassari, Italy. 2023 April 10 00:22 UT. Sky Watcher 10 inch f/5 Newtonian reflector telescope, 5x Tecnosky Telextender, 685 nm IR pass filter, Uranus C camera. Seeing III-IV Antoniadi scale.*



Cyrillus, *Fabio Verza, SNdR, Milan, Italy. 2023 April 27 19:49 UT. Takahashi Mewlon 250 mm Dall-Kirkham telescope, Astronomik ProPlanet IR642 filter, 1.3 x barlow, Player One Mars-M camera.*

Recent Topographic Studies

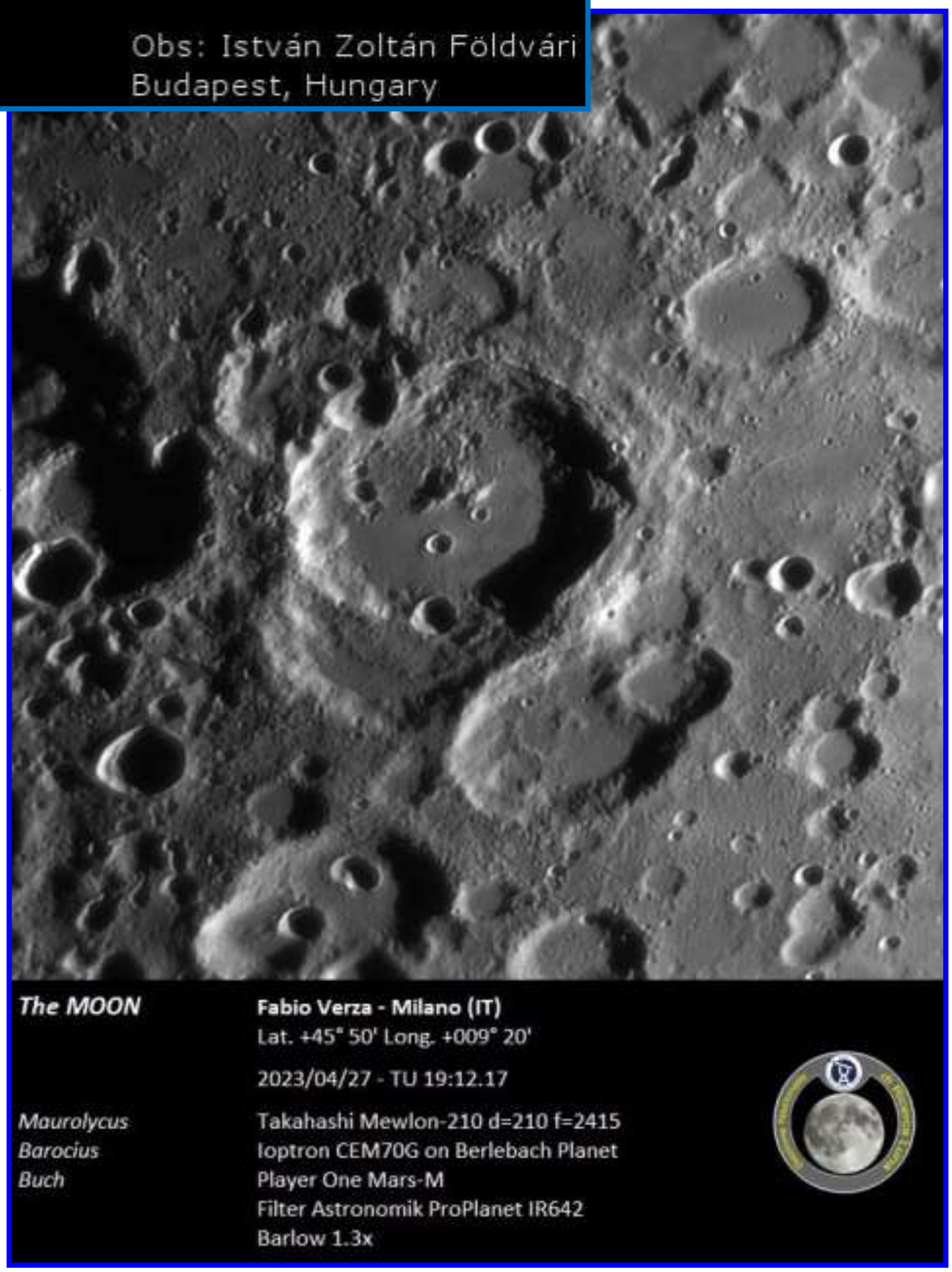


Lacus Mortis, *Fabio Verza, SNdR, Milan, Italy. 2023 April 27 19:53 UT. Takahashi Mewlon 250 mm Dall-Kirkham telescope, Astronomik ProPlanet IR642 filter, 1.3 x barlow, Player One Mars-M camera.*

Waning Gibbous Moon, *Marcelo Guarda, Santa Fe, Argentina. 2023 April 11 04:33 UT. 114 mm reflector telescope, Xiami Redmi Note 8 Cell phone camera.*

Recent Topographic Studies

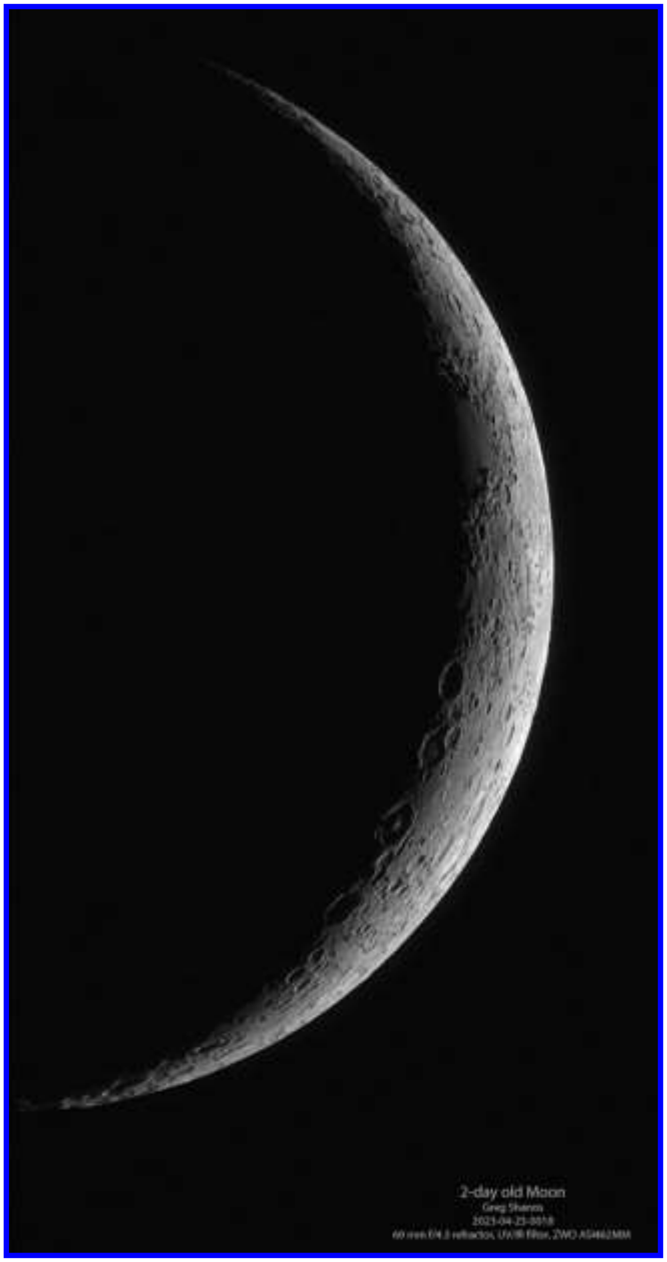
Nicollet, *István Zoltán Földvári, Budapest, Hungary. 2018 August 05, 00:06-00:23 UT, colongitude 190.0°-190.1°. 127 mm Maksutov-Cassegrain telescope, 1500 mm focal length, 15 mm Plossl, GSO 2x barlow, 200x. Seeing 8/10, transparency 5/6.*



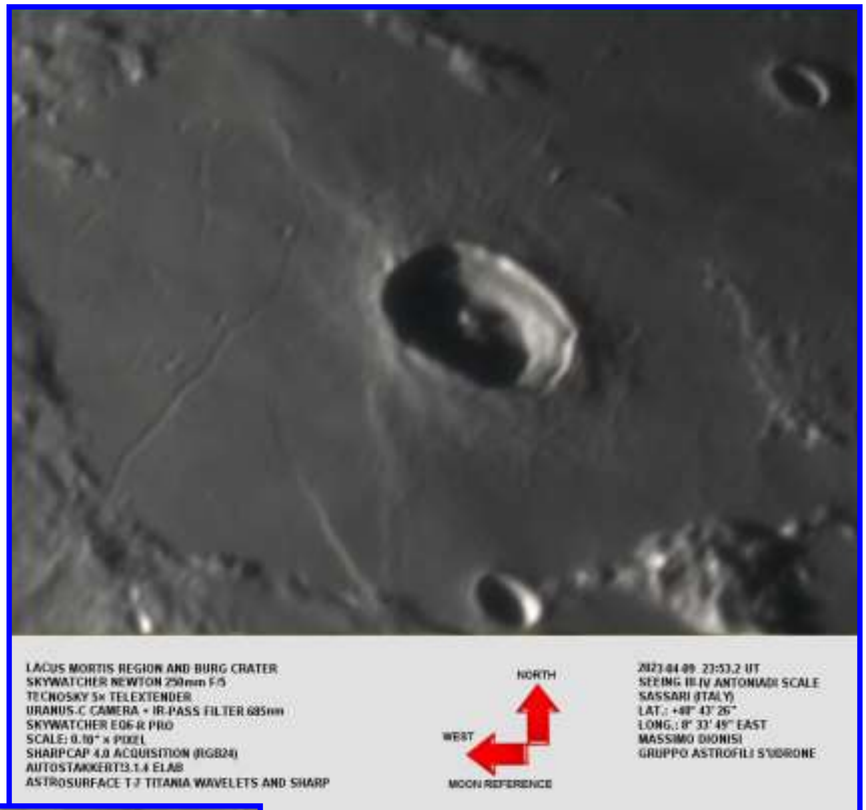
Maurolycus, *Fabio Verza, SNdR, Milan, Italy. 2023 April 27 19:12 UT. Takahashi Mewlon 250 mm Dall-Kirkham telescope, Astronomik ProPlanet IR642 filter, 1.3 x barlow, Player One Mars-M camera.*

Manilius, *Fabio Verza, SNdR, Milan, Italy. 2023 April 27 19:32 UT. Takahashi Mewlon 250 mm Dall-Kirkham telescope, Astronomik ProPlanet IR642 filter, 1.3 x barlow, Player One Mars-M camera.*

Two-day Old Moon*, Gregory Shanos, Sarasota, Florida, USA. 2023 April 23 00:18 UT. Meade 60 mm f/4.3 refractor telescope, Optolong UV-IR cut filter, ZWO ASI462MM camera. Greg adds: "Two-day old 9% phase crescent moon on April 22, 2023 at 8:18pm local time or April 23, 2023 0h 18m Universal Time. Sky was perfectly clear, with excellent transparency and very good seeing. Meade 60mm 260mm f/4.3 refractor tracking on an Orion mini-EQ mount and tripod. ZWO ASI 462MM camera with an Optolong UV-IR cut filter. The Moon is orientated as it appeared naked eye in the sky. (Note, it was flipped here with north up. In original image, east was at the bottom) Stack of the best 5000 images in Autostakkert and Sharpened in Registax and Photoshop CS4.*



Recent Topographic Studies



Lacus Mortis, *Massimo Dionisi, Sassari, Italy. 2023 April 09 23:53 UT. Sky Watcher 10 inch f/5 Newtonian reflector telescope, 5x Tecnosky Telextender, 685 nm IR pass filter, Uranus C camera. Seeing III-IV Antoniadi scale.*

Petavius, *Fabio Verza, SNdR, Milan, Italy. 2023 April 27 18:17 UT. Takahashi Mewlon 250 mm Dall-Kirkham telescope, 1.3 x barlow, Astronomik ProPlanet IR642 filter, Player One Mars-M camera.*

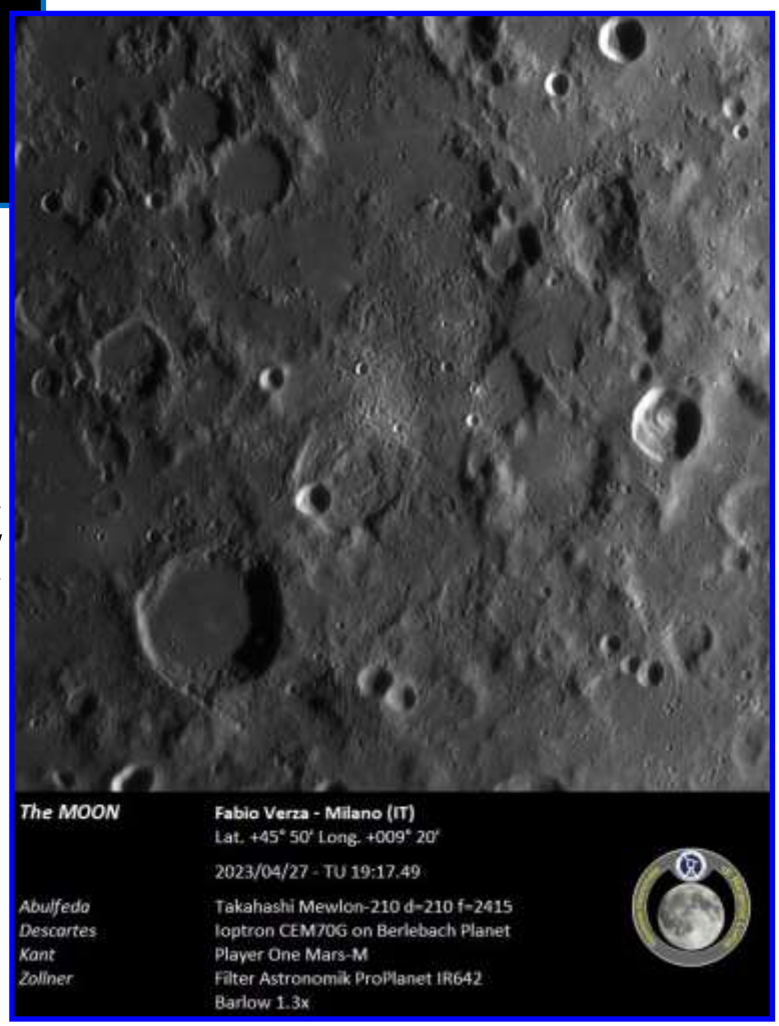
Recent Topographic Studies

Atlas, *Fabio Verza, SNdR, Milan, Italy. 2023 April 27 19:56 UT. Takahashi Mewlon 250 mm Dall-Kirkham telescope, 1.3 x barlow, Astronomik ProPlanet IR642 filter, Player One Mars-M camera.*

Plato, *Walter Ricardo Elias, AEA, Oro Verde, Argentina. 2023 April 28 18:38 UT. 150 mm Sky Watcher reflector telescope, QHY 5 IIC camera.*

Recent Topographic Studies

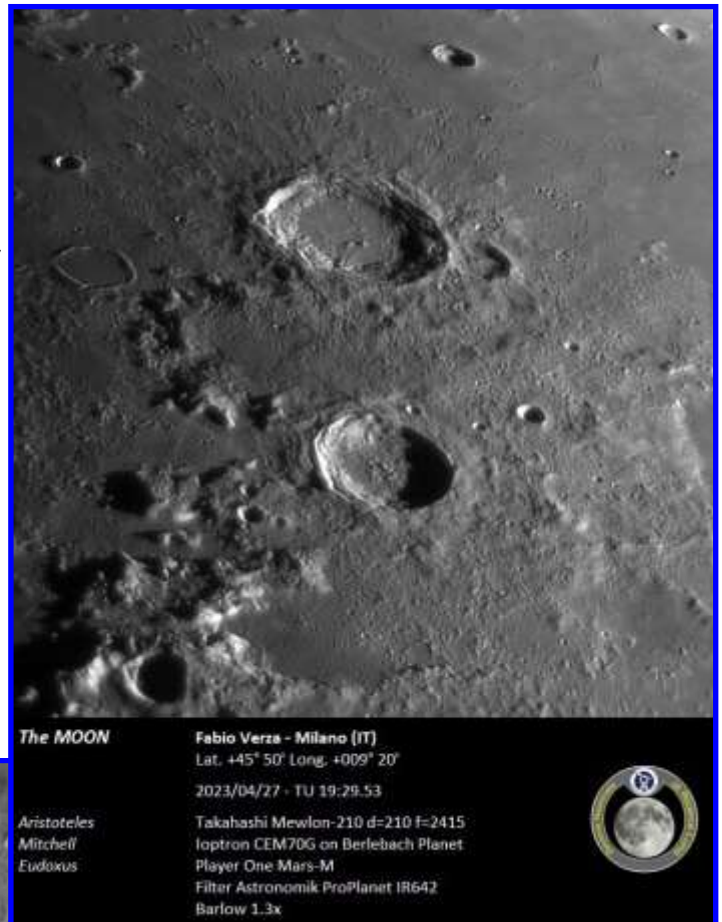
Davy, Guericke-E and Kundt, *István Zoltán Földvári, Budapest, Hungary. 2018 August 05, 00:23-00:48 UT, colongitude 190.1º-190.3º. 127 mm Maksutov-Cassegrain telescope, 1500 mm focal length, 15 mm Plossl, GSO 2x barlow, 200x. Seeing 8/10, transparency 5/6.*

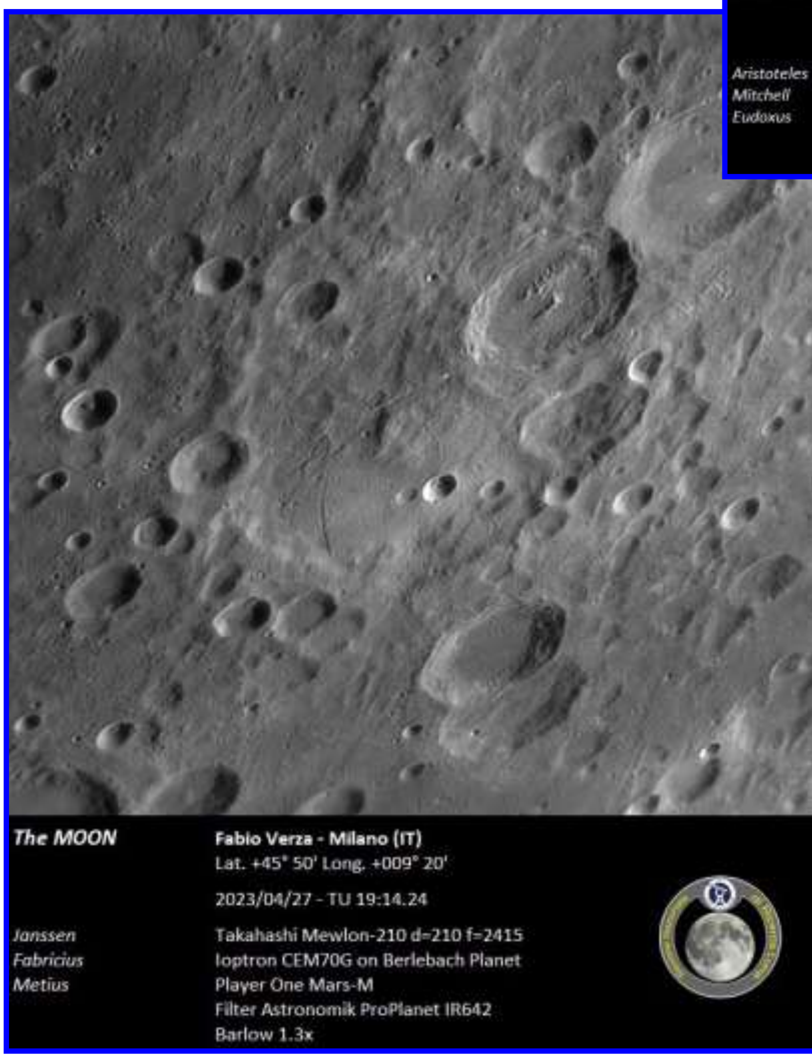


Abulfeda, *Fabio Verza, SNdR, Milan, Italy. 2023 April 27 19:17 UT. Takahashi Mewlon 250 mm Dall-Kirkham telescope, 1.3 x barlow, Astronomik ProPlanet IR642 filter, Player One Mars-M camera.*

Recent Topographic Studies

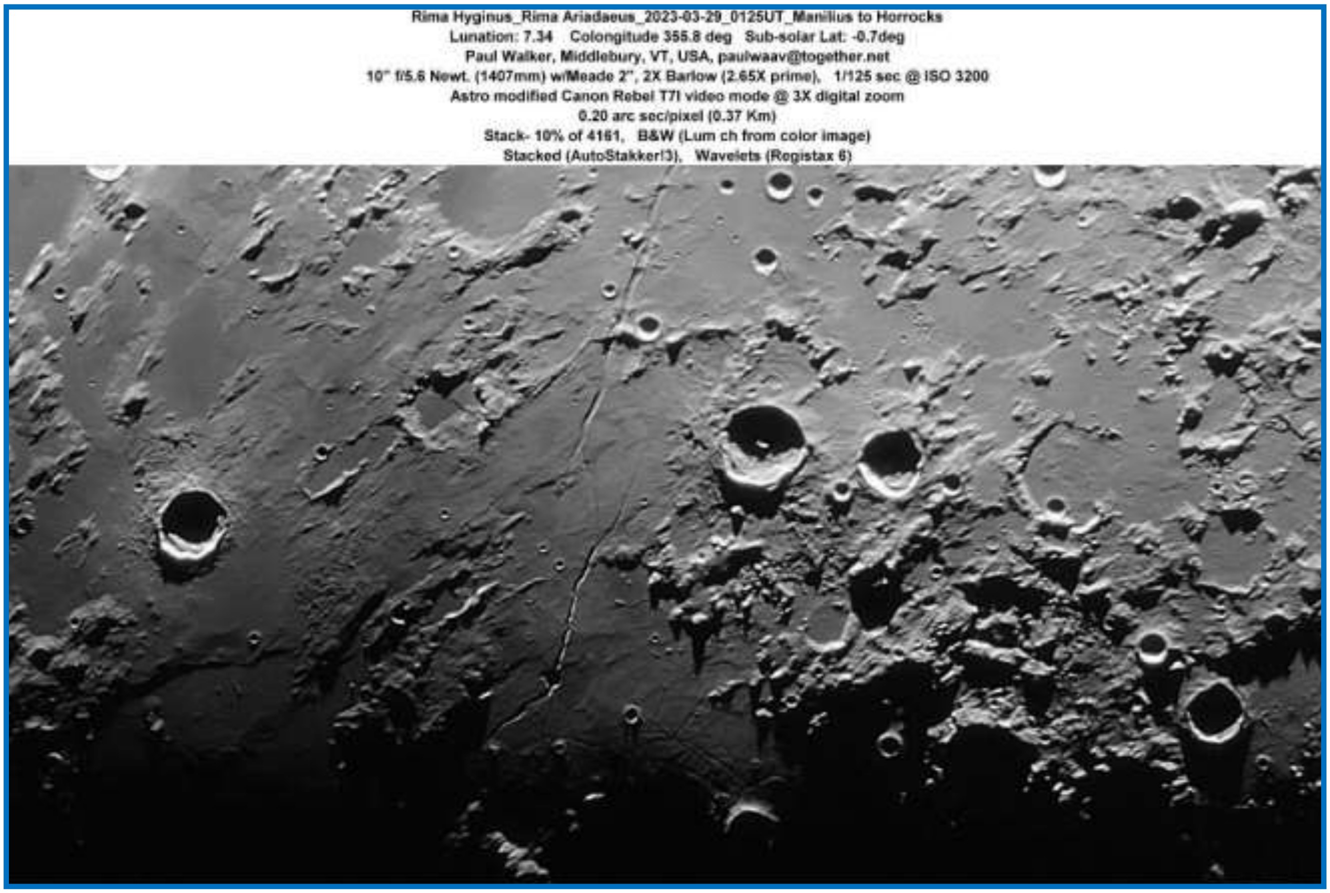
Aristoteles, *Fabio Verza, SNdR, Milan, Italy. 2023 April 27 19:29 UT. Takahashi Mewlon 250 mm Dall-Kirkham telescope, 1.3 x barlow, Astronomik ProPlanet IR642 filter, Player One Mars-M camera.*





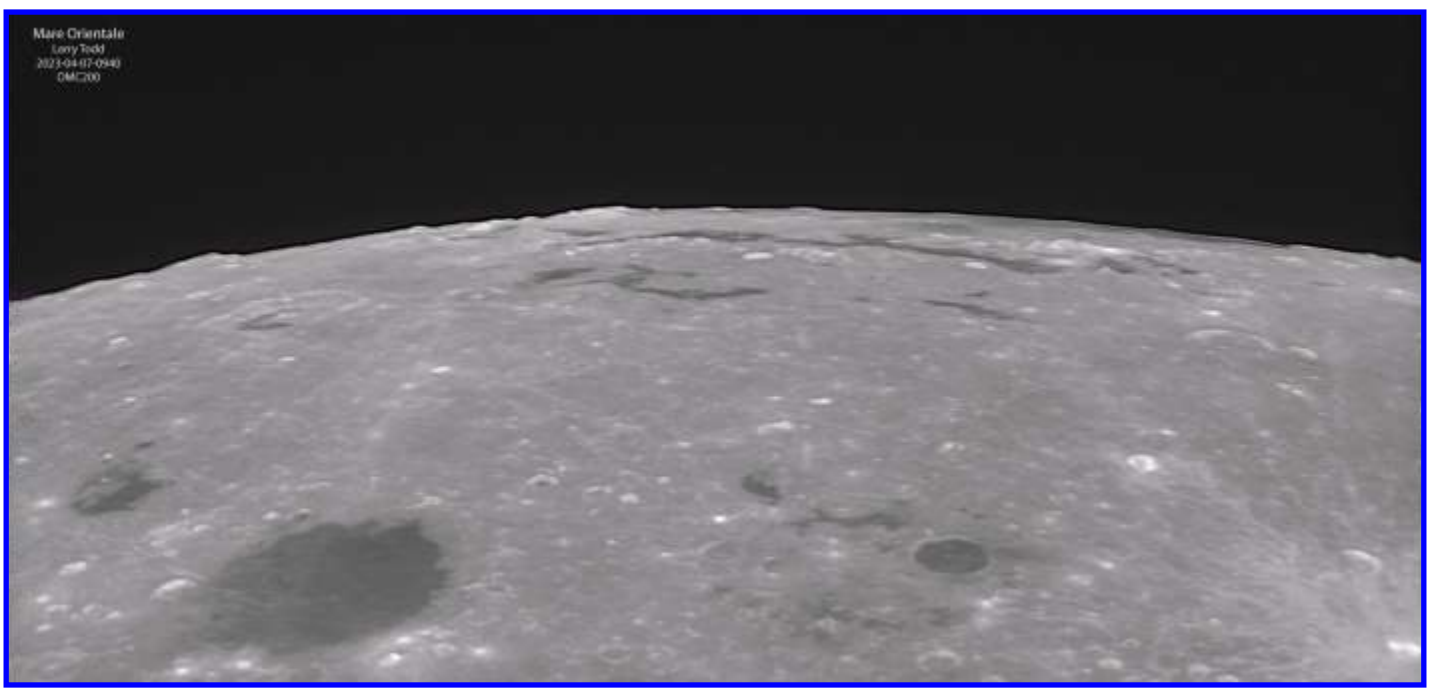
Janssen, *Fabio Verza, SNdR, Milan, Italy. 2023 April 27 19:14 UT. Takahashi Mewlon 250 mm Dall-Kirkham telescope, 1.3 x barlow, Astronomik ProPlanet IR642 filter, Player One Mars-M camera.*

Recent Topographic Studies



Rima Hyginus and Rima Ariadaeus, *Paul Walker, Middlebury, Vermont, USA. 2023 March 29 01:25 UT, colongitude 355.8º. 10 inch f/5.6 Newtonian reflector telescope, 2x barlow, Canon Rebel T7i camera. North is left, west is down.*

Mare Orientale*, Larry Todd, Dunedin, New Zealand. 2023 April 07 09:40 UT. OMC200 mm Maksutov-Cassegrain telescope. North is left, west is up.*



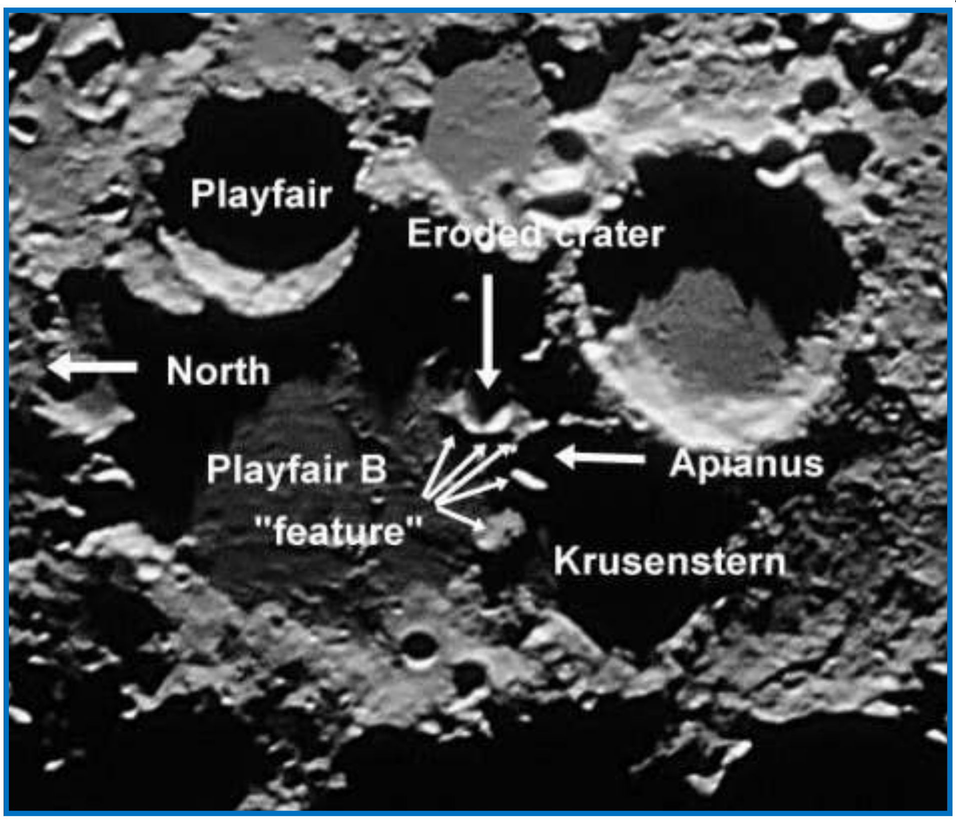
Recent Topographic Studies

Messier, *Larry Todd, Dunedin, New Zealand. 2023 April 07 09:22 UT. OMC200 mm Maksutov-Cassegrain telescope.*

Vitruvius, *Massimo Dionisi, Sassari, Italy. 2023 April 10 00:14 UT. Sky Watcher 10 inch f/5 Newtonian reflector telescope, 5x Tecnosky Telextender, 685 nm IR pass filter, Uranus C camera. Seeing III-IV Antoniadi scale.*

Recent Topographic Studies

Playfair to Stöfler, *Paul Walker, Middlebury, Vermont, USA. 2023 March 28 23:56 UT, colongitude 355.1°. 10 inch f/5.6 Newtonian reflector telescope, 2x barlow, Canon Rebel T7i camera. North is left, west is down. A crop of Playfair B is below. Paul adds: "*Before taking images on this night I had viewed the Moon and noticed striking feature that I have not seen before. It reminded m of half of a pot holder on the burner of a kitchen gas stove. It is on the south side of the large 94 Km eroded crater Playfair B (lower left in this image). It was readily visible at 106x but better at 174x. It was more striking visually then in the image. Looking at the Virtual Moon Atlas, it looks like it is formed from the rim of a relatively fresh crater, Apianus A (14 Km), a highly eroded crater just to the NE (only half its wall left) and a piece of maybe Playfair B's wall just to the NW (between Playfair B and 48 Km Krusenstern). These craters are more visible in the 2nd image (taken at 0120 UT). "



Recent Topographic Studies

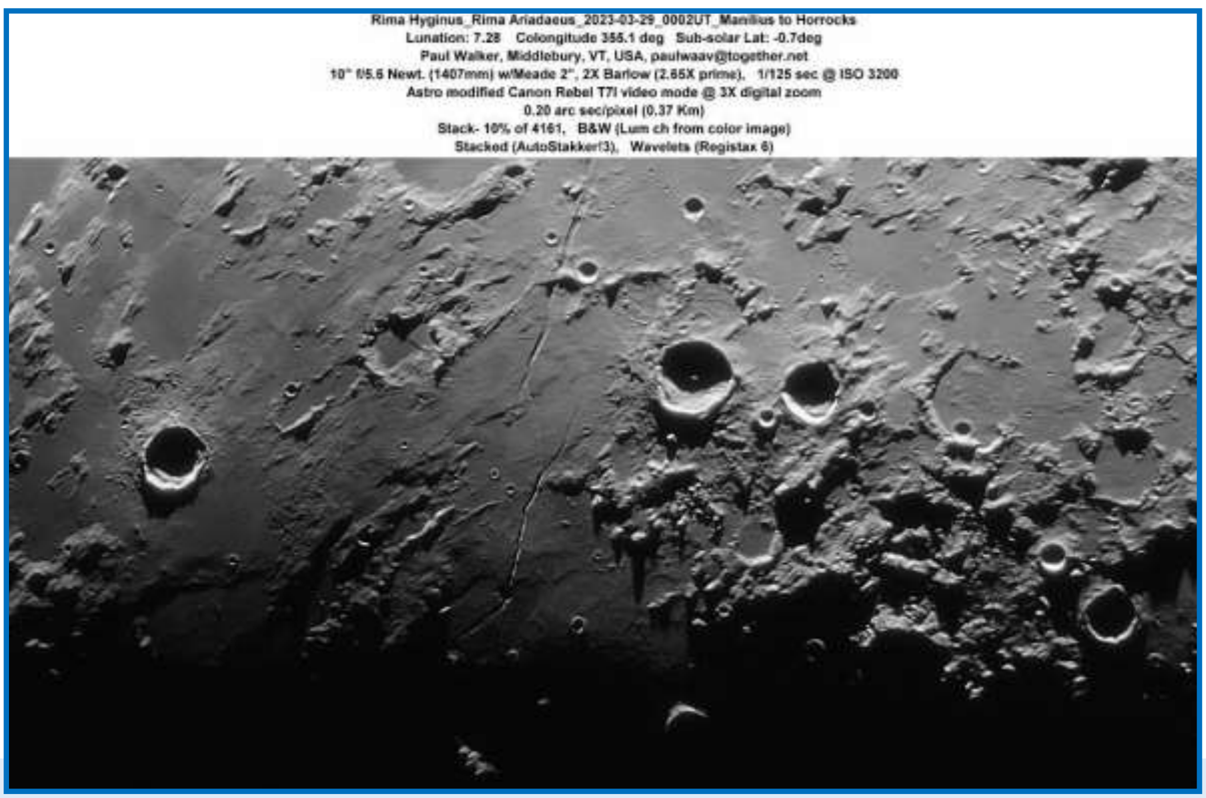
Jansen, *Massimo Dionisi, Sassari, Italy. 2023 April 010 00:20 UT. Sky Watcher 10 inch f/5 Newtonian reflector telescope, 5x Tecnosky Telextender, 685 nm IR pass filter, Uranus C camera. Seeing III-IV Antoniadi scale.*

Alphonsus, *Walter Ricardo Elias, AEA, Oro Verde, Argentina. 2023 April 28 18:40 UT. 150 mm Sky Watcher reflector telescope, QHY 5 IIC camera.*

Recent Topographic Studies

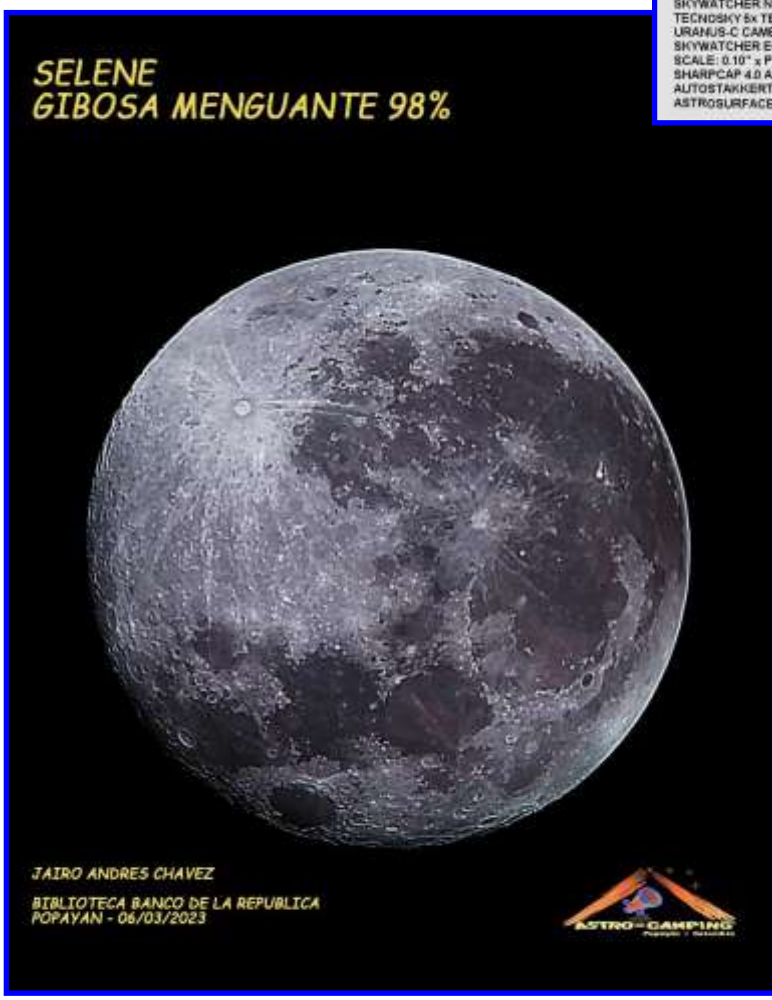
Playfair to Stöfler, *Paul Walker, Middlebury, Vermont, USA. 2023 March 29 01:20 UT, colongitude 355.8^{o}. 10 inch f/5.6 Newtonian reflector telescope, 2x barlow, Canon Rebel T7i camera. North is left, west is down.*

Rima Hyginus and Rima Ariadaeus, *Paul Walker, Middlebury, Vermont, USA. 2023 March 29 00:02 UT, colongitude 355.1^{o}. 10 inch f/5.6 Newtonian reflector telescope, 2x barlow, Canon Rebel T7i camera. North is left, west is down.*



Re- cent

Cauchy, *Massimo Dionisi, Sassari, Italy. 2023 April 010 00:27 UT. Sky Watcher 10 inch f/5 Newtonian reflector telescope, 5x Tecnosky Telextender, 685 nm IR pass filter, Uranus C camera. Seeing III-IV Antoniadi scale.*



Waning Gibbous Moon, *Jairo Chavez, Popayán, Colombia. 2023 April 04 02:01 UT. 311 mm reflector telescope, MOTO E5PLAY camera. North is down, west is right.*

Recent Topographic Studies

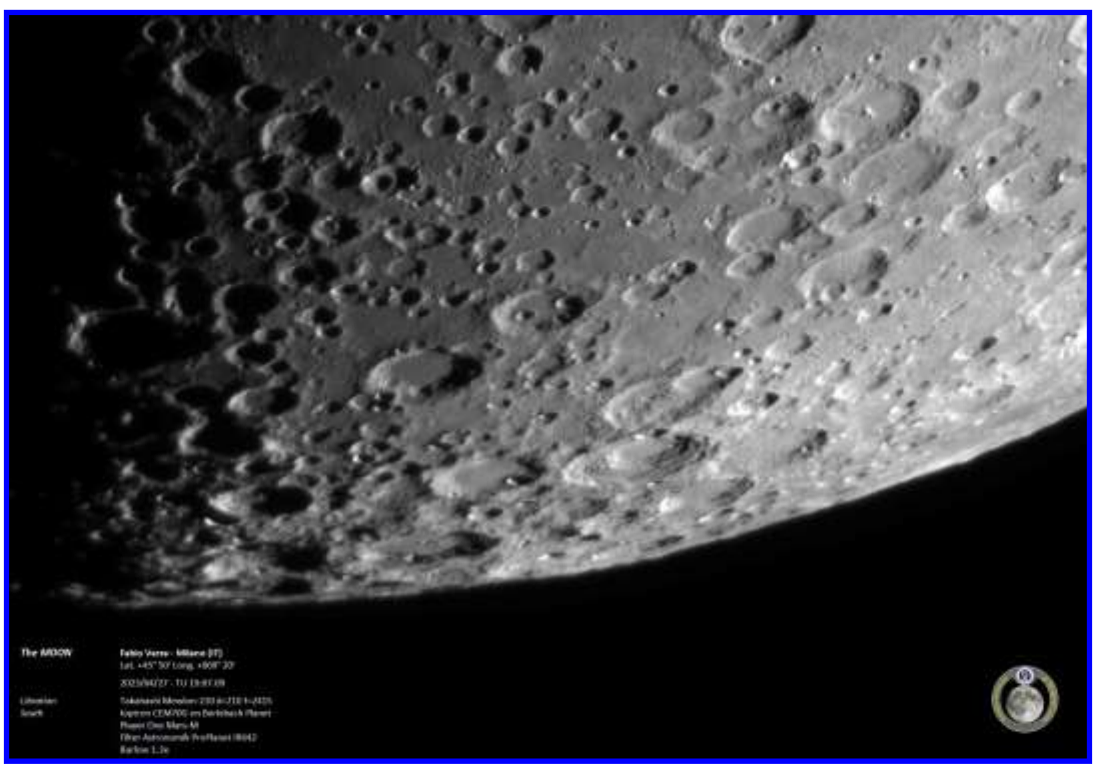
Berosus and Berosus A, *István Zoltán Földvári, Budapest, Hungary. 2018 August 27, 21:12-21:33 UT, colongitude 109.5º. 70 mm refractor telescope, 500 mm focal length, 10 mm Plossl, GSO 2x barlow, 100x. Seeing 410, transparency 5/6.*

Waning Gibbous Moon, *Jairo Chavez, Popayán, Colombia. 2023 April 10 02:21 UT. 311 mm reflector telescope, MOTO E5PLAY camera.*

Recent Topographic Studies

Theophilus, *Paul Walker, Middlebury, Vermont, USA. 2023 March 29 01:29 UT, colongitude 355.8°. 10 inch f/5.6 Newtonian reflector telescope, 2x barlow, Canon Rebel T7i camera. North is left, west is down.*

Libration Zone South, *Fabio Verza, SNdR, Milan, Italy. 2023 April 27 19:07 UT. Takahashi Mewlon 250 mm Dall-Kirkham telescope, 1.3 x barlow, Astronomik ProPlanet IR642 filter, Player One Mars-M 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 May

News: There will be a 4th Europlanet Workshop on Fireballs/Lunar Impact Flashes on 12-13th May that is free to attend and completely on-line. If you want to get into lunar impact flash observing then this will be especially useful. You can register and then join from the following web site: https://www.europlanet-society.org/4th-europlanet-workshop-on-fireballs-lunar-impact-flashes/

Brian Cudnik (ALPO Lunar Impact Flash coordinator) has emailed (bmcudnik @ gmail.com) in: *"I read in the March issue of Sky & Telescope magazine an article by Thomas Dobbins about looking for Venus fireballs this summer. The optimal time in the Northern Hemisphere is from June 16 to July 7, when a combination of favorable elongation, large apparent size and fraction of unilluminated / nightside hemisphere is presented toward Earth. The techniques and technology used for these are similar to those in existing lunar meteor monitoring setup. Please spread the word in the BAA to those who may be interested in videotaping, or visually observing, the night side of Venus during this interval. Also e-mail me at the above address with questions or if you'd like more details."*. Although this is not lunar related, the technology, software and observing is very similar for lunar impact flash work, so it might be worth a go.

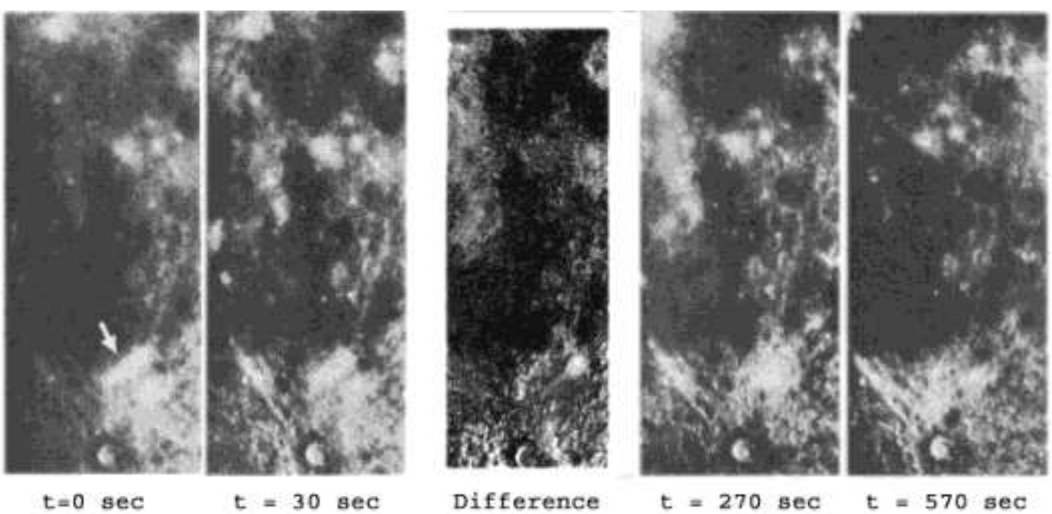


Figure 1 *The Lunik 5 upper stage rocket possible impact cloud of unspent fuel(?) from a paper by Geake and Mills: Possible Physical Processes Causing Transient Lunar Phenomena Events, Physics of the Earth and Planetary Interiors, 14 (1977) p299-320. Note that the central image is not from this paper but is a subtraction of the t=270 and t=30 sec images.*

I was contacted by veteran planetary cartographer: Dr Phil Stooke, assistant Professor in Geography at the Center for Planetary and Science Exploration, Western University Ontario, Canada, regarding the Luna 5 Crash site(s) (Fig 1) mentioned in a previous newsletter: *"This concerns the note by Tony Cook regarding a paper by Ksanfomality (2018). The two locations mentioned were said at the time to be different objects. The Lansberg object was the Luna 5 lander. The Mare Nubium object was said (in New Scientist) to be the upper stage of the launch vehicle. The latter is the one with a very large apparent dust cloud. If this is a real observation it suggests to me that a substantial amount of residual propellant was released as the tanks ruptured on impact, creating a vapor cloud which could lift and spread dust, not just a ballistic ejection of dust. We don't really know all the facts, but I think the two objects explain the two locations."* I would like to thank Phil for correcting us on this and the LTP description(s) will be updated accordingly.

LTP Reports: No LTP reports were received for April, though Brazilian amateur Passos Pereira, from João Pessoa, Brazil, videoed a candidate impact flash close to Mare Vaporum at 21:52:19UT on 2023 Apr 22. According to a preliminary analysis by Marcelo Zurita, the location was close to Marco Polo F crater. If anybody was imaging/videoing earthshine at the time, please get in touch.

Routine reports received for March included: Alberto Anunziato (Argentina – SLA) observed: Grove. Anthony Cook (Newtown, UK – ALPO/BAA) imaged: several features in the Short-Wave IR, Long Wave IR, and in visible light. Walter Elias (Argentina – AEA) imaged: Apianus, Aristarchus, Faraday. Les Fry (West Wales, UK – NAS) imaged earthshine. Massimo Giuntoli (Italy – BAA) observed: Cavendish E. Michael Hather (Sheffield, UK – BAA) observed several features. Rik Hill (Tucson, AZ, USA – ALPO/BAA) imaged the surroundings of the Apollo 16 landing site. Jean Marc Lechopier (Teneriffe, Spain – UAI) observed: Aristarchus. Eugenio Polito (Italy – UAI) imaged: Plato and several features. Mark Radice (Swindon, UK – BAA) imaged: Clavius, Sinus Iridum, and Tycho. Trevor Smith (Codnor, UK – BAA) observed: Aristarchus, Proclus and Torricelli B. Bob Stuart (Rhayader, UK – BAA) imaged: Alphonsus, Archimedes, Clavius, Longomontanus, Plato, Tycho, Vallis Alpes, and several features. Franco Taccogna (Italy – UAI) imaged: earthshine, the Moon, and several features. Aldo Tonon (Italy – UAI) imaged: the Moon. Luigi Zanatta (Italy – UAI) videoed earthshine.

Analysis of Reports Received:

Plato: On 2023 Mar 02 UT 16:57 Bob Stuart (BAA) imaged the crater under similar illumination and similar topocentric libration to within ±1.0° to the following report:

Plato 1981 Jun 12: P. Moore at 21:10 found the southern wall (and onto the southern floor) of the crater to be indistinct. Elsewhere in the crater everything was sharp. The effect was still seen at 21:42UT, but less strong. A check was made for color with a Moonblink device, but none was seen. There was still a trace of this effect at 21:44UT, although detail was now becoming visible. By 21:48UT vertical streaks were seen crossing the floor from the obscuration area and these were more visible in the red filter and not in the blue. Cameron comments that undefined patches on the floor of Plato are not normal. By 21:55UT some craterlets on the floor started to become visible and the LTP for Moore ended by UT22:23. P. Foley was alerted by Moore and saw a "massive dense obscuration on the south wall, south floor and south outer glacis to the Mare". Foley noted that by 21:50UT the effect was fading and finished by 22:03UT. Foley reported an orange translucent haze covering half of the floor, but floor craterlets could be seen on and off - however his atmospheric seeing conditions were IV. At 22:00 UT Foley reported the floor close to the north wall to be "milky or misty". No detail was visible at 21:15UT and variability in the floor continued until 23:10UT. Hedley-Robinson was alerted at 21:35UT and found no difference between red and blue views of the area, however he did find that the south rim was indistinct although this effect had lessened by 22:00 UT and was normal by 22:17UT. M. Mobberley saw a white spot on the floor at 21:20 UT, whereas he normally would have expected to see craterlets. Mobberley was alerted at 21:40 UT and took some color photos. He also made sketches that showed variability in the floor and dark lines and patches in the north west corner. However, the altitude of the Moon was low. Cameron mentions that two of the photos show loss of detail at the south wall and beyond and also a change in the floor markings. The north wall at 21:50UT was strangely reddish (didn't think this was spurious color). The rest of the wall was sharp at 22:20UT through a yellow filter. Large bright patch in the center and rest of the floor was apparently of the same shading as Mare Imbrium. The above notes are based upon the Cameron 2006 catalog extension LTP ID 145 and weight=4. ALPO/BAA weight=3.

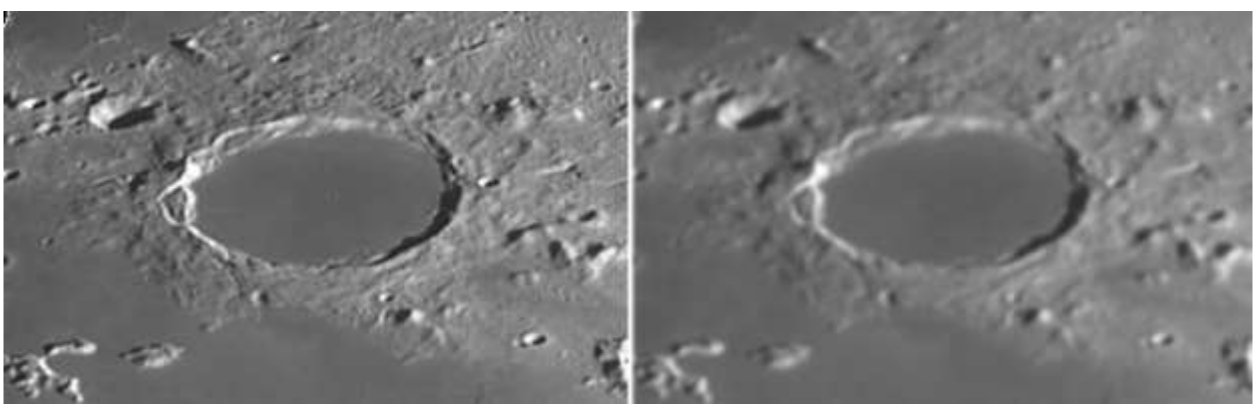


Figure 2 (Left) *Shows the view of Plato that Bob Stuart (BAA) took on 2023 Mar 02 at 16:57 UT, orientated with north towards the top.* ***(Right)*** *A simulated atmospheric blurred (1.5 pixels) version.*

Bob's image (Fig 2) is one of those, very rare moments in time when both illumination and viewing angles match closely to the original LTP report. One does not have to wait 18.6 years, or the Saros cycle, for this to happen, due to libration varying depending upon where we view on the Earth's surface, but nevertheless the wait can be several months or even years. Why is this important? Well, if there was some form of specular reflection from crystals e.g., exposed semi-parallel mica crystals (unlikely due to space weathering), or refraction from volcanic glass beads, then matching the optical geometry to what it was in 1981 should reproduce the results reported by Patrick Moore and others. As you can see in Fig 2 (Right) the southern rim is indeed indistinct, but so too part of the north eastern rim. The Foley description of obscuration outside the rim on the crater exterior has a ring of truth in it for Fig 2 (Right), but we cannot say that the southern floor, inside the rim, had an obscured appearance too as all of the floor of Plato looks obscured under poorer seeing.

Other aspects of the 1981 report to consider are the craterlets and shadings on the floor that Moore and others reported. So, Fig 3 (Top Left) in a highly contrast stretched version of Bob's image, in order to bring out such floor detail. I have inverted it with north towards the top so you can compare with three sketches made back in 1981 by Foley, Robinson, Mobberley.

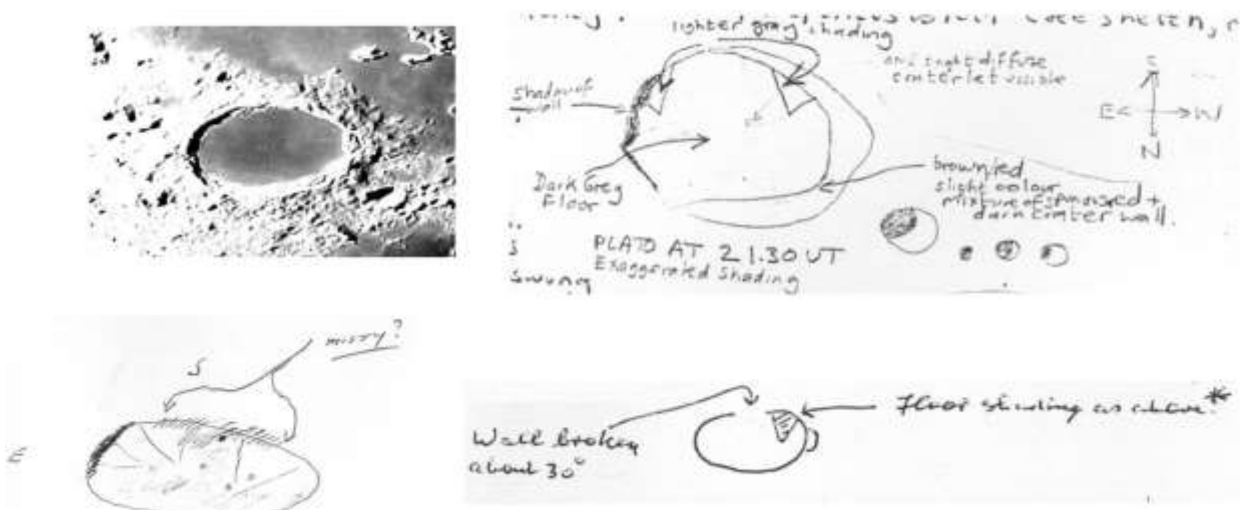


Figure 3 *Plato orientated with north towards the bottom.* ***(Top Left)*** *A contrast stretched version of an image taken by Bob Stuart (BAA) on 2023 Mar 02 at 16:57 UT.* ***(Top Right)*** *A sketch by Martin Mobberley made on 1981 Jun 12 UT 21:30.* ***(Bottom Left)*** *A sketch by Peter Foley (BAA) made on 1981 Jun 12 sometime between UT 21:15-21:51.* ***(Bottom Right)*** *A sketch by Hedley Robinson (BAA) made on 1981 Jun 12 sometime between UT 21:41-21:53.*

Although the slightly lighter triangular sector on the SW floor of Plato is consistent in all the sketches, there is a fair amount of variability in other features depicted, in particular Peter Foley's location of the floor craterlets (Fig 3 – Bottom Left) has some geometry issues. The inconsistency in the visual sketches lowers confidence in the reports. I checked the Moon's altitude for the Moore observation and it varies from 32 to 17 degrees above the horizon – the high value at the start should not explain the obscure nature of the southern rim, unless the seeing was bad. In view of the sketch inconsistencies, I will lower the weight of this report from 3 to 2.

Aristarchus: On 2023 Mar 03 UT Jean Marc Lechopier (UAI) observed this crater under similar illumination to the following lunar schedule request:

BAA Request: Is there a bright spot on the west interior wall of this crater? Compare it to other features and note if it varies in brightness over time. Please send all reports or images.

This actually refers to a LTP report from 2006 Feb 09 UT17:45-23:59:

J. Armitage noted a bright spot on the interior west wall that seemed brighter than what they would have expected. Unfortunately, the precise time of this observation was not recorded so the moon-rise and midnight UT values are used to place a limit on the time of observation. Images by Shaw taken at UT 1754, 18:45 and 23:13 do not exhibit the effect. ALPO/BAA weight=2.

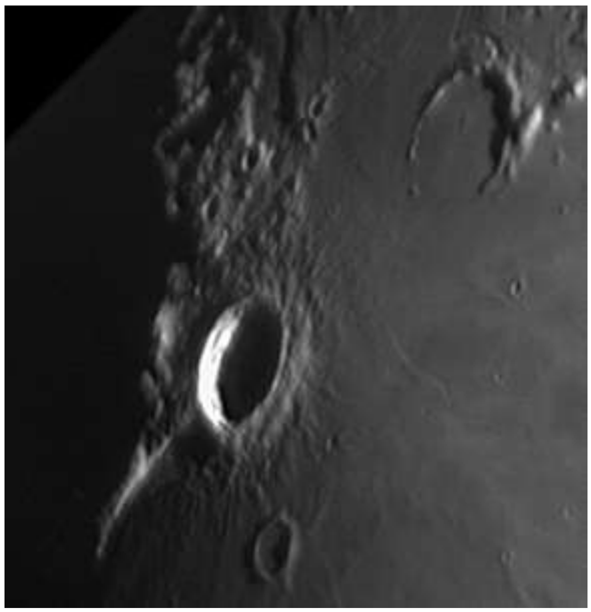


Figure 4 *Aristarchus as imaged by Brendan Shaw (BAA) on 2009 Feb 09 UT 23:13 and orientated with north towards the top.*

Jean Marc commented: *"The inner western wall of Aristarchus looks like a sickle of fairly uniform light. Looking more closely, a dark and subtly jagged line divides the sickle into two equal parts from horn to horn of the sickle. That dark line appears as a fault line or as a succession of aligned terraces receiving less sunlight. The black of that line is less dense than Aristarchus' background. In the southwest part (according to the equatorial directions of the telescope) of the inner wall of Aristarchus, in the luminous sickle, a very white spot appears, of a more intense whiteness than the sickle of light. It is resolved as a small crater set in the walls, or rather, as a cavity or indentation in the terraces. It has an elongated shape, parallel to the circular edge of Aristarchus, about twice its width. Its northern part seems wider than its southern part. It is almost in contact with the dark fracture line at a slightly higher altitude. The seeing of the evening did not allow to reach the resolving power of the instrument (0.8"/arc) but the observed detail was perfectly resolved at 300x magnification. At 375x it gained in apparent size without being able to take advantage of it. I estimate its size in three/four arcseconds long and 1.5"/2" wide. Seeing it, I didn't doubt for a moment that it was the object of the LTP as its whiteness stands out with the surrounding areas. A handful of "/arc further south two other particularly white spots were visible, not resolved, very close to each other, at slightly different altitudes from each other but very close to that dark fracture line. One was a little bigger than the other. The southern horn of the sickle of light allowed to see less luminous reliefs, well contrasted and detailed, at the same level as the dark line, with dimensions of a few "/arc. All the observed and transcribed details are undoubtedly accessible to a good 120mm refractor and good seeing. To evaluate the seeing I carefully observed the Gruithuisen Gamma dome, whose surface was rough but I did not see the summit crater."*

Fortunately, we have images from the night of John Armitage's LTP report, despite the fact that he did not record the UT. One of the images, by Brendan Shaw, is shown in Fig 4. The rim of the crater is a bit over-exposed, but it may help to interpret Jean Marc's written description above. In view of the fact that Jean Marc saw a white spot-on western wall, I think we shall lower the weight of the 2009 LTP report from 2 to 1.

Cavendish E: On 2023 Mar 04 UT 21:10 Massimo Giuntoli (BAA) continued his studies of this crater which occasionally can be very bright. On this occasion, using a 10cm refractor, x312 under Antoniadi III seeing conditions, the crater was perhaps little brighter than usual, but nothing that Massimo considered as abnormal. Selenographic Colongitude = 62˚ and sub-solar longitude -1.2˚. Topographic libration (sub-observer viewing point): -0.67˚ colongitude and -6.13˚ latitude.

Aristarchus: On 2023 Mar 06 UT 20:21-20:32 collectively Franco Taccogna and Aldo Tonon imaged the Moon for the following lunar schedule request:

ALPO Request: Try taking hand held digital SLR telephoto shots of the Moon at an image scale capable of detecting Aristarchus. Do not use the digital zoom feature. What we are attempting to do here is to mimic a report from 2011 where the images showed variations in the brightness of Aristarchus - possibly due to vibrations when pressing the camera shutter? We would like a new set of images, at the same illumination, to check out this theory. All images should be sent to me on the email address below: a t c @ a b e r . a c. u k

I had a look to see what the 2011 report refers to, and it turns out that 2011 was a typographical error and it should read 2009 Sep 03 observation by Barry Gibbs. This I have now corrected for future lunar schedule predictions. So, the report referred to was:

On 2009 Sep 03 at UT23:15-23:17 B. Gibbs took some hand held digital SLR images of the Moon (Sky conditions clear). Four images were taken at: 23:14:53, 23:15:59, 23:16:05 and 23:17:23 (uncertainty +/-15 sec offset from actual UT). These showed some apparent variation in the brightness of Aristarchus. However, there are ways to explain this through image motion blur when the images were taken. However, we cannot be absolutely sure. The ALPO/BAA weight=1.

This does not affect the repeat illumination observations sent in, and we can now compare them to the correct 2009 observations. You can see Barry Gibbs image sequence in Fig 9.

Figure 5 *The original images taken by Barry Gibbs on 2009 Sep 03 with annotation added by the observer. UTs running from left to right are: 17:17, 17:19, 17:20, 17:21.*

For comparison you can see Franco and Aldo's more modern-day images in Fig 6.

Figure 6. The Moon on 2023 Mar 06 UT 20:21 by UAI observers. ***(Left)*** *Taken by Franco Taccogna using a Nikon D7100 with 300mm telephoto.* ***(Right)*** *Taken by Aldo Tonon using a Canon EOS 2000D with 400mm telephoto.*

There are lots of ways we can analyse the images, in great depth, or just a glance to get a feel for the image brightness statistics. We will choose the latter. Figure 7 is a plot to compare two sets of images to look for variations which could be due to image resolution, image noise, or positional errors on where we are sampling the digital image brightness (varies from 0 to 255). Ideally, we would fit a line through these points and any points that deviate from the line the most are worth looking at in more detail – but I think you can plainly see for the 2009 observation that Aristarchus is an outlier here and for the 2023 observations Proclus has not departed from the diagonal, but has swapped positions, with Tycho and Hell, compared to the 2009 observations.

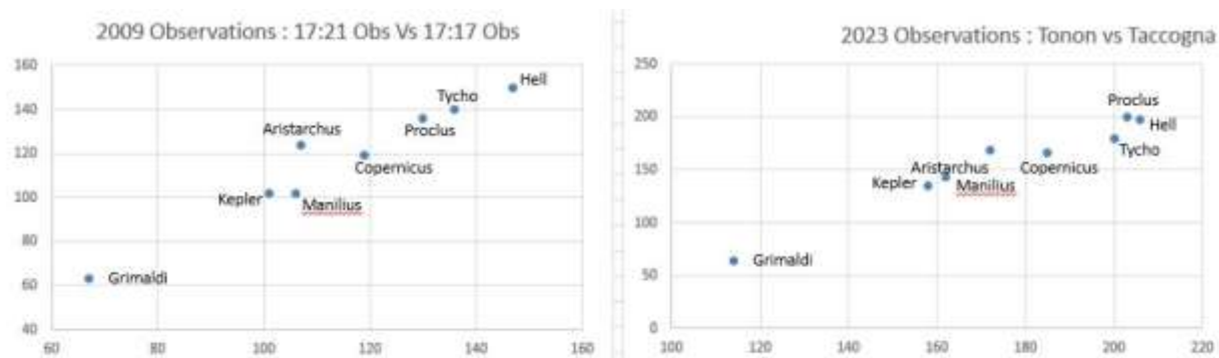


Figure 7 (Left) *A plot of measurements of brightness values of 8 lunar craters from 2009 Sep 03. The Y axis values are from 17:21UT and the X axis values are from 17:17UT.* ***(Right)*** *A plot comparing the brightness of the same 8 lunar craters, taken at the same time of 20:21UT on 2023 Mar 06, with the Y axis measurements from Aldo Tonon's image and the X axis from Franco Taccogna's image.*

The real problem of low-resolution photometry attempts, with DSLR cameras are issues like camera shake and image resolution on point-like objects. Take a look at Fig 5 (Right) and Fig 5 (Far Right). The former has some camera shake and as a result point-like features like Aristarchus appear significantly blurred and lose their peak brightness, where as more extended features like Kepler do suffer extra blurring. Likewise, the difference in resolution between a 300mm and a 400 mm telephoto lens in Fig 6 (Left and Right) can have a similar effect on point-like features.

I think its appropriate to remove the 2009 report from the ALPO/BAA LTP database – it has been said by Moore, Middlehurst and Cameron that LTP reports using small aperture equipment are a bit more dubious.

Aristarchus: On 2023 Mar 07 UT 20:39 Eugenio Polito (UAI) imaged the Moon under similar illumination and similar topocentric libration to within ±1.0˚ to the following report:

On 1978 May 22/23 UT 22:00-00:15 Aristarchus was not normal, but all the following features were: Mare Crisium, Proclus, Sinus Iridium, Grimaldi, and Tycho. Observed by Mellor and Fitton, UK. Observer notes that Aristarchus is brighter than Tycho when normal. Estimated variation was 25%. However, the Moon was low and the Moon was yellow. Despite this the observer decided that the effect was real. Cameron 2006 extension catalog ID=32 and weight=2. ALPO/BAA weight=1.

It turns out that the observation was published in p55 of the July 1978 BAA Lunar Section circular, and the observer was Lawrence Fitton (not Mellor), using a photoelectric photometer with approximately 7x7 km effective coverage footprint on the lunar surface. He recorded Aristarchus as being initially brighter than Tycho, when normally it is less bright at this phase, however later Aristarchus became less bright than Tycho with the variation as discussed above. Figure 8 (Left) shows the appearance before the repeat illumination, and (Right) during the repeat illumination/libration. To the eye Aristarchus looks brighter than Tycho in both images, and maybe brighter in the earlier one – however what we are seeing here are contrast effects with respect to the background. So instead, I took some digital number value readings, then normalized them.

Figure 8 *The Full Moon on 2023 Mar 07.* ***(Left)*** *As imaged by Franco Taccogna (UAI) at 19:14UT.* ***(Right)*** *As imaged by Eugenio Polito (UAI) at 20:39UT.*

In the 19:14 UT image (Fig 8 – Left), Aristarchus has a brightness of 201 and Tycho a brightness of 171. In the 20:39 image, Aristarchus has a brightness of 161 and Tycho a brightness of 149. The background sky in both image has a brightness of 1. Normalizing the 20:39 image (Fig 8 – Right) to the 19:14 one, using Tycho as a reference would give the 19:14 image an Aristarchus brightness of 184 and a Tycho brightness of 149. Now 184 is about 14% brighter than what it was at 20:39UT. However, this all depends upon where on Aristarchus we do the photometry. Aristarchus, being such a small feature, compared to Tycho presents problems for measuring, and I would quite imagine that back in 1978 it would have been quite tricky to place Aristarchus centrally over the photodiode (or photo transistor) that Lawrence Fitton was using. I think we shall leave the weight at 1 for now as it is not clear that this was an instrumental effect or not, but I suspect the latter. It would have been helpful to have had results from some other observing runs to compare against.

Proclus: On 2023 Mar 27 UT 18:48-19:00 Trevor Smith (BAA) observed visually this crater under similar illumination to the following report:

`Proclus: 1985 Apr 25 UT 21:50 M. Cook (Frimley, UK). Almost certainly the following was spurious color and not a LTP. Proclus was found to be brighter than Censorinus. Red was seen on the northern inner floor and blue on the edge of the external north rim NNE-NW. The rim to the SW could not be seen. ALPO/BAA weight=1.`

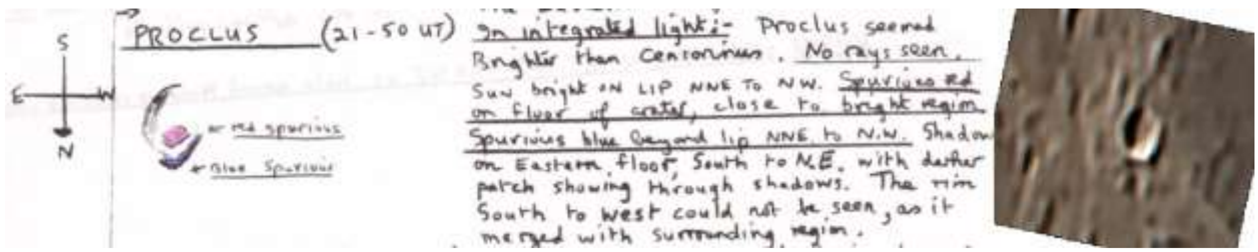


Figure 9 *Proclus orientated with north towards the bottom.* ***(Left)*** *A sketch by Marie Cook (BAA) mad on 1985 Apr 25 UT 21:50.* ***(Right)*** *An image by Walter Elias (AEA) from 2020 Jan 30 UT 23:04.*

Trevor, using a 16-inch telescope under Antoniadi III-IV conditions, found that Proclus was much brighter than Censorinus, and the latter seemed to be fainter than what he regarded as usual. No real detail seen inside Proclus due to light sky conditions. No color seen.

Fig. 9 (Left) shows the original report. In view of the fact that: Trevor saw Proclus brighter than Censorinus and that matches the original report, the original report was rather specific that it was spurious color (atmospheric spectral dispersion (the Moon was at an altitude of 25˚ at the time though) and/or chromatic aberration), and a color image by Walter Elias (AEA) in Fig 9 (Right) also shows spurious color roughly in the same place, I think we can safely lower the weight from 1 to 0 and remove it from the ALPO/BAA database of LTP.

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

The Schiller-Zucchius Basin

Following on from the March "BBC" project about the Schiller-Zucchius basin, I was pleased to receive a sketch from Dr Paul Abel (Fig 1), and then an image (Fig 2) from Prof Bill Leatherbarrow.

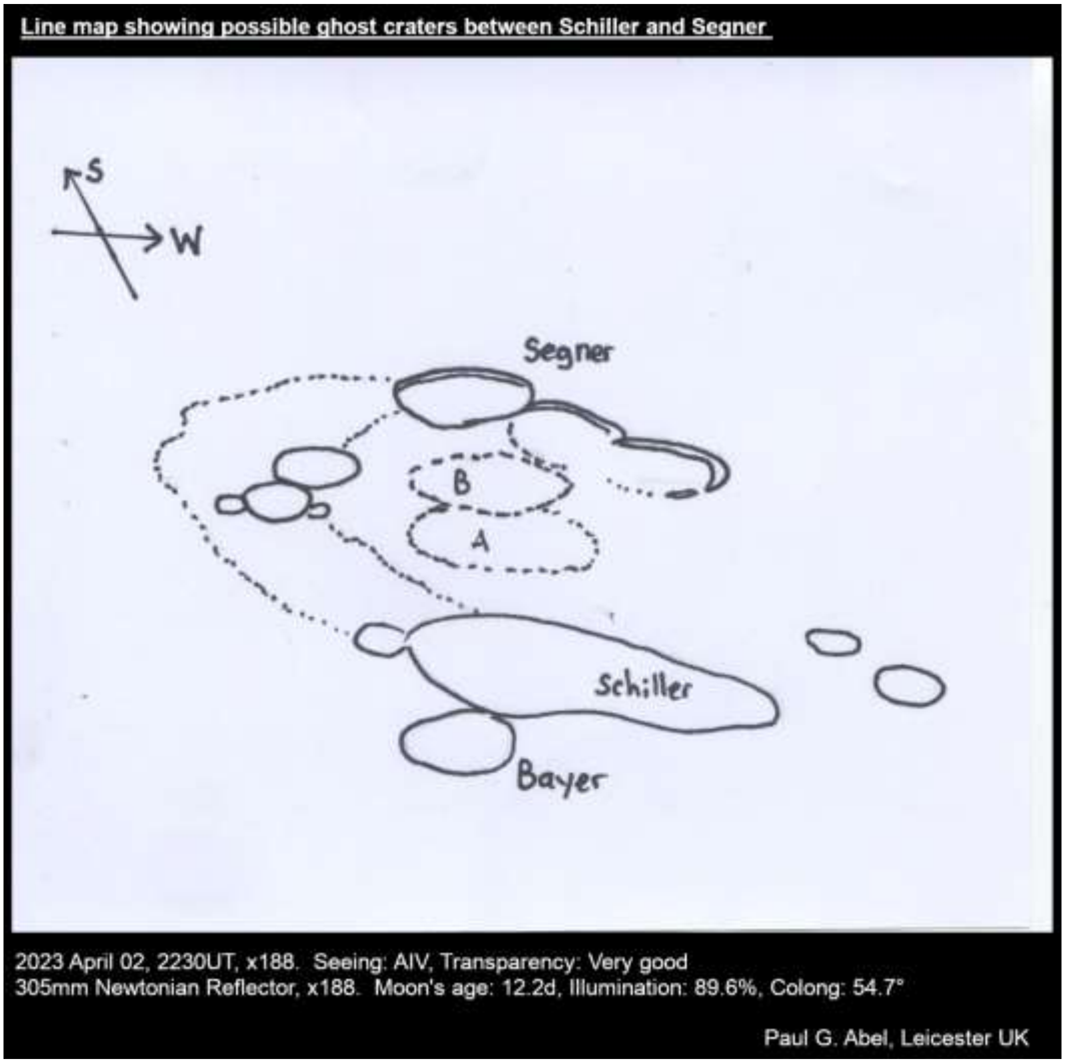


Figure 1. *Outline sketch by Dr Paul Abel (BAA) of ghost craters, designated A and B, seen on the floor of the Schiller -Zucchius multi-ring impact basin.*

Paul writes: *"Bill suggested if I see I could see any ghost craters in the mare region between Schiller and Segner crater. I had a look on 2nd April (in rather poor seeing) and I've attached a line drawing showing what seemed to me to be the approximate position of two definite ghost like craters. I wonder how they change depending on different angles of illumination?"*.

Figure 2. *The Schiller-Zucchius multi-ring basin as imaged by Prof Bill Leatherbarrow on the night of 2023 April 02, close to the time of the sketch in Fig 1. Note orientation is with north to the right.*

In reply to Paul and myself, Bill writes: *"I also observed these areas at around the same time under reasonable seeing, and I attach my images for comparison (copied to Tony). The 'ghost craters' you mention near Schiller are probably part of a buried 3rd inner ring of the Schiller-Zucchius multi-ring basin. The two outer rings are much more obvious. This basin was the subject of a paper by John Rogers in the BAA Journal some years ago, I seem to recall."* The paper that Bill refers to is: "The Largest Crater on the face of the Moon", 1976, JBAA, Vol 86, p471-474, and if you read that you can see that John Rogers refers to two previous publications : Lowman, P.D., *Lunar Panorama*, Zurich, 1969. & Stuart-Alexander, D.E., and Howard, K.A., *Icarus*, 12, 440 (1970). The paper by John Rogers has an early hand drawn chart, based upon Lunar Orbiter images of the basin, reproduced here in Fig 3 – he gives ring diameters of 340km and 180km.

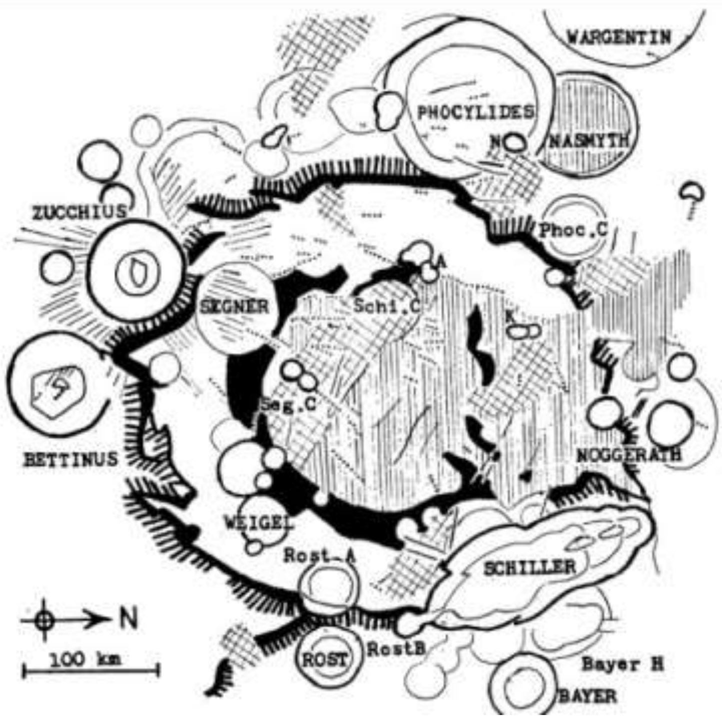


Figure 3. *The Schiller-Zucchius basin as depicted as the then named "Schiller Annular Plain" (SAP) from a 1975 JBAA paper by John Rogers.*

I was grateful to receive another image of this basin via David Teske, the ALPO Lunar Section director, taken by Larry Todd (ALPO) from New Zealand (Fig 4).

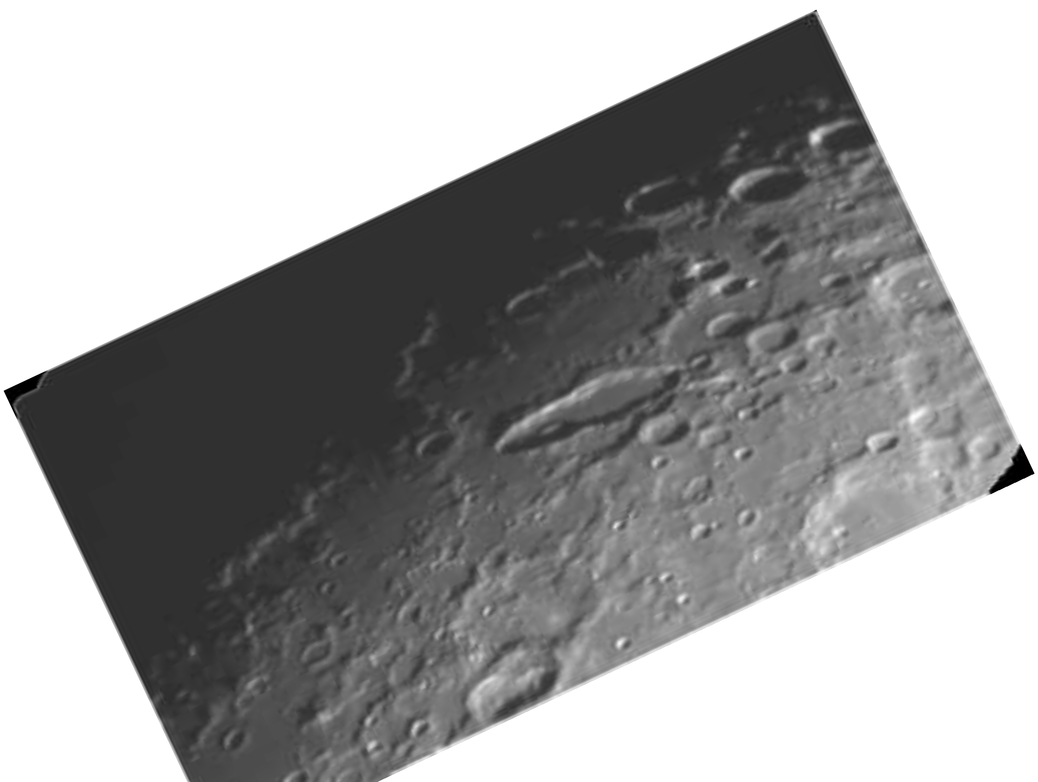


Figure 4. *The Schiller-Zucchius multi-ring basin as imaged by Larry Todd (ALPO) on 2023 Apr 02 UT 10:12 and orientated with north towards the right.*

I think it's debatable whether there is a degraded inner rim (or peak ring) near the center (making the basin a 3-ring basin), or if its collection of two or more buried craters, as Paul has spotted (two). We certainly have some great imagery to continue out studies with.

Buried Crater(?) South East of Grove Crater

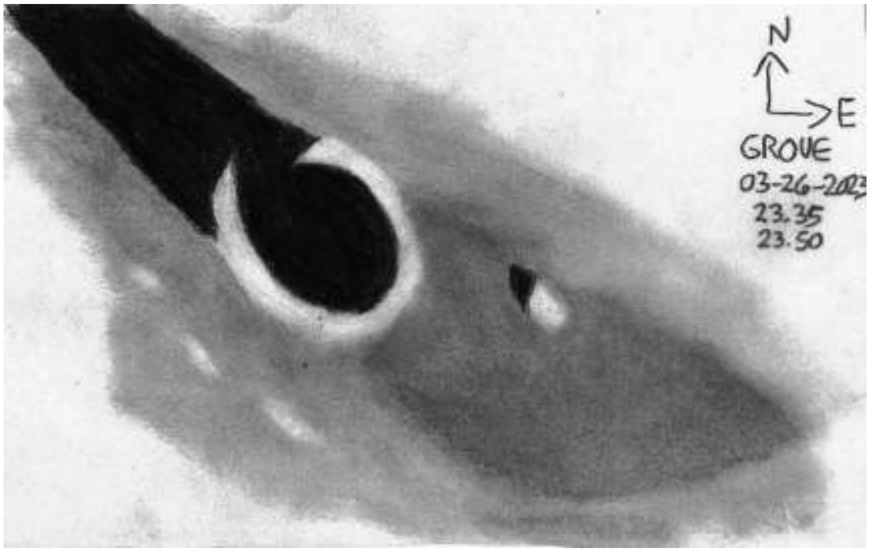


Figure 5. *Grove crater as sketched by Alberto Anunziato for the date and UTs given.*

Alberto Anunziato (SLA) has emailed in a sketch (Fig 5) and some LROC Quick Map hill shaded LOLA terrain views (Fig 6). His sketch shows an oval darker albedo area, adjoining to the south east of Grove crater, which prompted him to look for evidence in the LOLA hill shaded DEM.

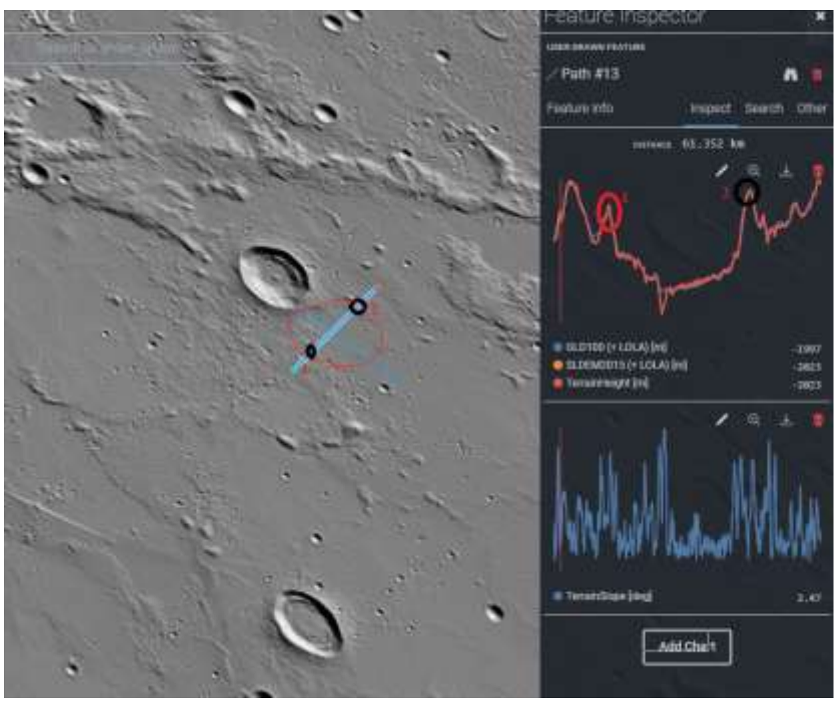


Figure 6. *Alberto's attempt to measure a possible buried crater SE of Grove.*

Using a more contrasty (lower sun angle illumination) virtual view (Fig 7), one can see a possible arc of hillocks. However, taking diameter measurements (Fig 8) gives a longest diameter of 28 km and a shortest diameter of 20 km, so if there really is a buried crater here (33.8E, 39.6N) then it is elliptical, inferring a shallow angle impactor. It is certainly smaller than the dark patch that Alberto noticed. If I had a systematic way of assigning weights (I have not figured the most sensible way to do this yet) to buried craters then this one would get a low weight of 1 out of 10. Obviously, we have to be careful not to jump to conclusions for every single thing that looks like a circular or arc of a circle/ellipse, as the hillocks could be volcanic in origin, but anyway it probably won't do harm to put this one into the database, pending further investigation.

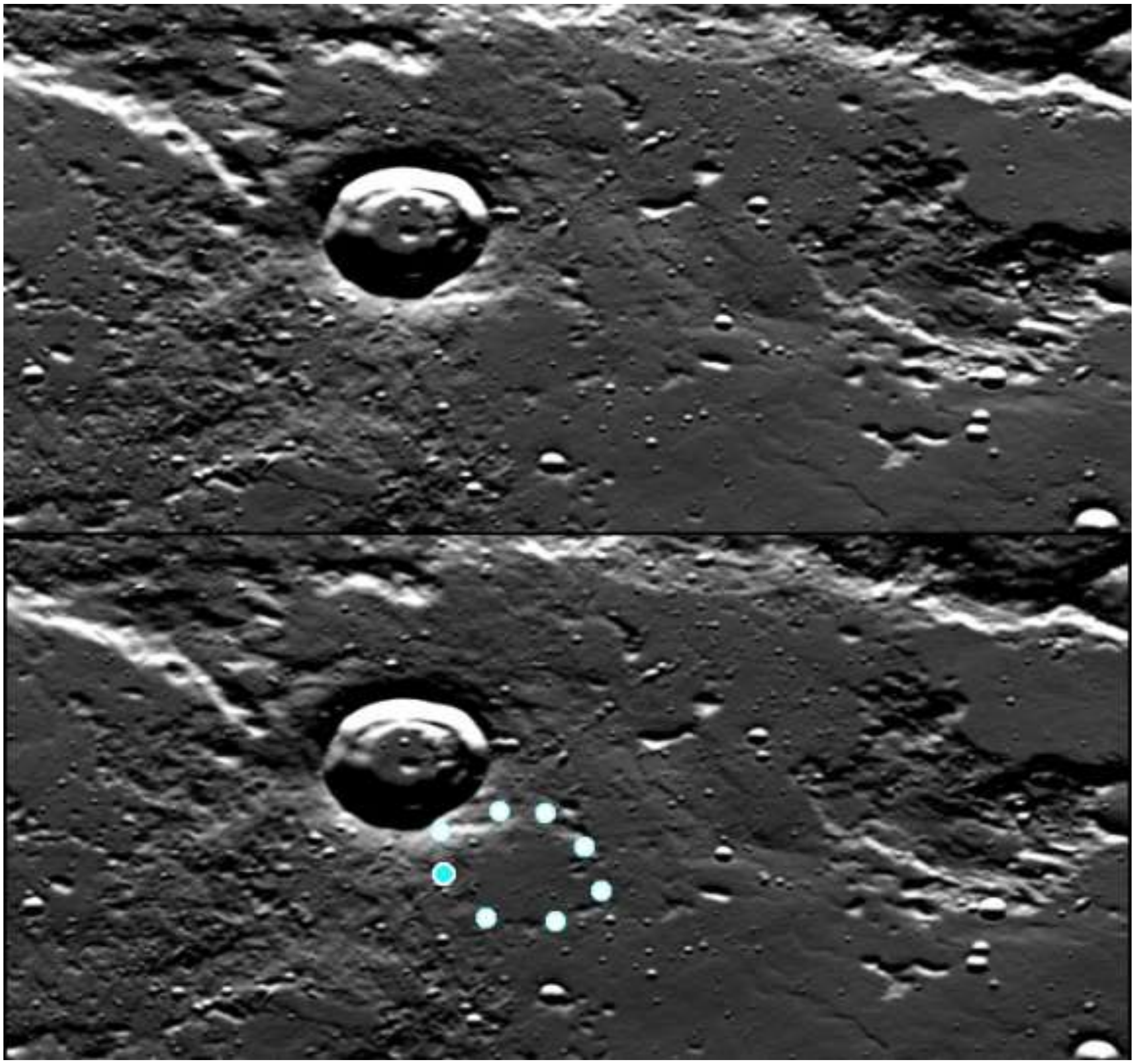


Figure 7. *Tony's attempt to define the position of the candidate buried crater SW of Grove. ACT Layers (Experimental) / TerrainHillShade (Zenith Angle = 86.4˚ and Azimuth=181.0˚).*

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.

Alternatively, if you want an observational challenge, try to see if you can image one of more of the basins or buried craters at sunrise/set and establish what colongitude range they are best depicted at. Or you can even do this "virtually" with LTVT software. As you can see from the tables on the web sites there are lot of blank cells to fill in on the sunrise and sunset colongitude columns – so a good opportunity for you to get busy!

Lunar Calendar May 2023

Date	UT	Event
4	2157	Moon at descending node
5		West limb most exposed (-5.3°)
5	1042	Full Moon, Penumbral lunar eclipse visible East Europe, Africa to New Zealand
9		Greatest southern declination (-27.8°)
11	0500	Moon at perigee 369,343 km
11		North limb most exposed (+6.7°)
12	1428	Last Quarter Moon
13	1300	Saturn 3° north of Moon
15	0100	Neptune 2° north of Moon
17	1936	Moon at ascending node
17	1300	Jupiter 0.8° south of Moon, occultation Central America, North America, Iceland
19		East limb most exposed (+4.7°)
19	1553	New Moon, lunation 1242
23	1200	Venus 2° south of Moon
23		Greatest northern declination (+27.8°)
24	0200	Pollux 1.6° north of Moon
24	1800	Mars 4° south of Moon
25		South limb most exposed (-6.8°)
26	0200	Moon at apogee 404,509 km
27	1522	First Quarter Moon

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: Mons Rümker, the Olympus of the Moon

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 July 2023, will be Mons Rümker. 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 Mons Rümker Focus-On article is June 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
Mons Rümker	**July 2023**	**June 20, 2023**
Floor-Fractured Craters	**September 2023**	**August 20, 2023**
Dorsa Smirnov	**November 2023**	**October 20, 2023**
Sinus Iridum	**January 2024**	**December 20, 2023**
Lacus Mortis	**March 2024**	**February 20, 2024**

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.

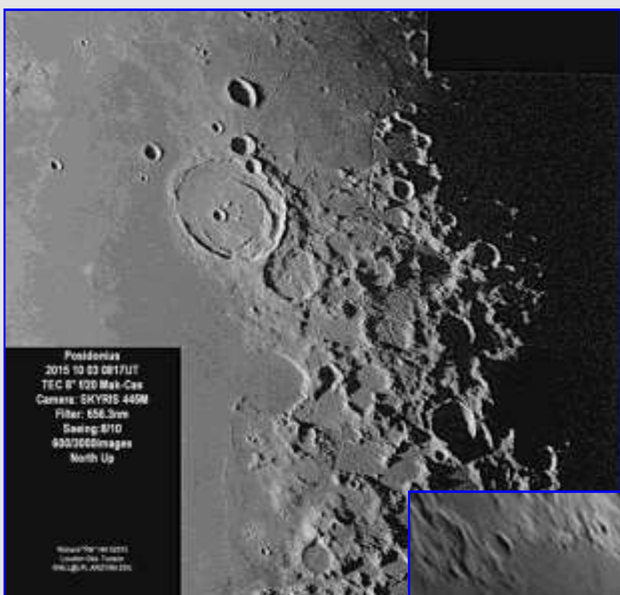
MAY 2023 ISSUE-Due April 20th, 2023: REINER GAMMA
JULY 2023 ISSUE-Due June 20th, 2023: MONS RÜMKER
SEPTEMBER 2023 ISSUE-Due August 20th 2023: FLOOR FRACTURED CRATERS
NOVEMBER 2023 ISSUE-Due October 20th 2023: DORSA SMIRNOV
JANUARY 2024 ISSUE-Due December 20th 2023: SINUS IRIDUM
MARCH 2024 ISSUE: Due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

Rik Hill

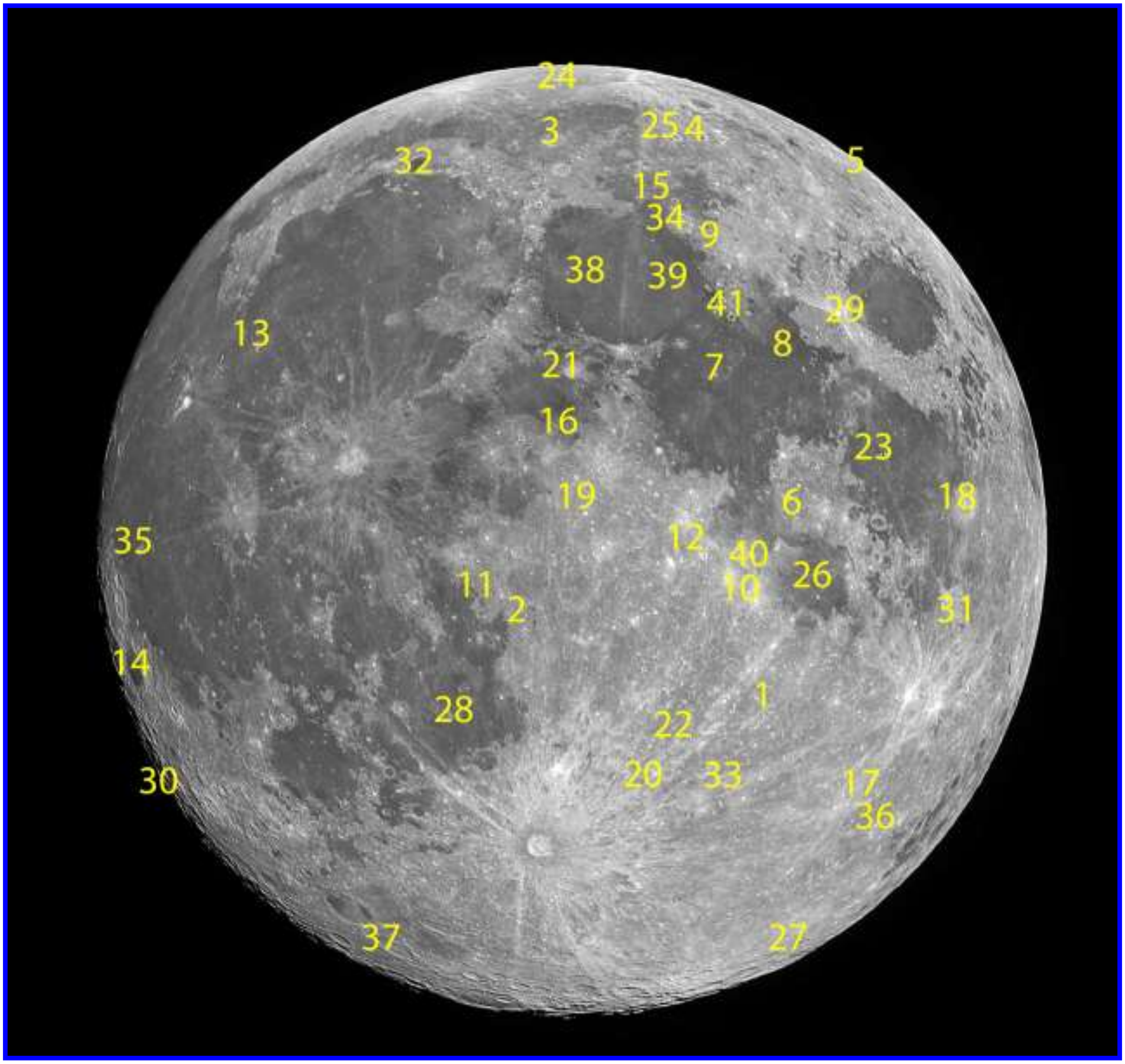
Focus-On Announcement
Floor-Fractured Craters

Floor-Fractured Craters are a relatively recent category of craters, which have undergone a modification of their floor after their formation by an impact: their higher floors are smooth, with fractures, ridges, hills and other features. We have spectacular craters like Posidonius or Taruntius or lesser known craters like Le Verrier or Letronne. We will use Robert Garfinkle's "Luna Cognita" catalog and typology for a monograph on these very special and diverse craters. Please check your files for images of these spectacular craters and forward them by August 20, 2023 to Alberto Anunziato and David Teske.

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



Key to Images In This Issue



1. Abulfeda
2. Alphonsus
3. Aristoteles
4. Atlas
5. Berosus
6. Capella
7. Carrel
8. Cauchy
9. Chevallier
10. Cyrillus
11. Davy
12. Descartes
13. Diophantus
14. Grimaldi
15. Grove
16. Hyginus, Rima
17. Janssen
18. Langrenus
19. Lade
20. Licetus
21. Manilius
22. Maurolycus
23. Messier
24. Meton
25. Mortis, Lacus
26. Nectaris, Mare
27. Neumayer
28. Nicollet
29. Olivium, Promontorium
30. Orientale, Mare
31. Petavius
32. Plato
33. Playfair
34. Posidonius
35. Reiner Gamma
36. Rheita
37. Schiller
38. Serenitatis, Mare
39. Smirnov, Dorsa
40. Theophilus
41. Vitruvius