The Lunar Observer

A Publication of the Lunar Section of ALPO

March 2023

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Rupes Recta, *Ken Vaughan, Cattle Point, Victoria, British Columbia, Canada. 2023 January 30 02:49 UT. Meade 12 inch LX200 GPS Schmidt-Cassegrain telescope, Astronomik 642 I-IR filter, ZWO ASI178mm camera. Seeing 4/10, transparency 8/10.*

Online readers, click on images for hyperlinks

Lunar Reflections

Wishing each of you a very pleasant month. As March arrives, spring (or autumn) arrive allowing for hopefully more observing opportunities. I hope that you can capture the Moon in your views! I hope that you will find this issue of *The Lunar Observer* interesting and beautiful. There is a most beautiful painting of the Moon, Venus and Jupiter by Michel Deconinck. Rik Hill, Robert H. Hayes, Jr., Alberto Anunziato and David Teske take us on tours of the lunar topography. Alberto Anunziato takes us on an Expedition to Mare Nubium for this months Focus-On topic. A great number of images, drawings and observations came in for this from across the globe. As always, Tony Cook discusses in depth Lunar Geologic Change and Buried Basins and Craters.

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

Clear skies,
-David Teske

Edited by David Teske: david.teske@alpo-astronomy.org
2162 Enon Road, Louisville, Mississippi, USA
Back issues: http://www.alpo-astronomy.org/

Mare Nubium, *Paul Walker, Middlebury, Vermont, USA. 2022 January 11 23:51 UT. 10 inch f/5.6 reflector telescope, focal length 1,407 mm, with Meade 2x barlow, (2.65x prime), Canon Rebel T7i camera.*

Lunar Topographic Studies

Coordinator – David Teske - david.teske@alpo-astronomy.org
Assistant Coordinator– Alberto Anunziato albertoanunziato@yahoo.com.ar
Assistant Coordinator-Wayne Bailey– wayne.bailey@alpo-astronomy.org
Website: http://www.alpo-astronomy.org/

Observations Received

Name	Location and Organization	Image/Article
Alberto Anunziato	Paraná, Argentina	Image of Mare Nubium, article and drawing *Bürg B, A View of Oceanus Procellarum* and *Focus-On An Expedition to Mare Nubium*.
Sergio Babino	Montevideo, Uruguay	Image of Gassendi.
Francisco Alsina Cardinalli	Oro Verde, Argentina	Images of Mare Nubium (6) and article and images (3) A View of Oceanus Procellarum.
Jairo Chevez	Popayán, Colombia	Images of the Waxing Gibbous Moon (2).
Leonardo Alberto Colombo	Córdoba, Argentina	Image of Mare Nubium .
Michel Deconinck	Artignoc-sur-Verdon - Provence - France	Drawings of Mare Nubium (2)
Walter Ricardo Elias	AEA, Oro Verde, Argentina	Images of Mare Nubium (3), Aristarchus, Timocharis, Atlas, Mare Crisium (2) and Janssen (2).
István Zoltán Földvári	Budapest, Hungary	Drawings of .Sinus Asperitatis, Rupes Altai, Torricelli, Lagrange and Pingré.
Desiré Godoy	Oro Verde, Argentina	Images of Mare Nubium (5).
Victoria Gomez	AEA, Oro Verde, Argentina	Images of Aristarchus and Copernicus.
Facundo Gramer	AEA, Oro Verde, Argentina	Image of Manilius.
Marcelo Mojica Gundlach	Cochabamba, Bolivia	Image of Mare Nubium (7).
Robert H. Hays, Jr.	Worth, Illinois, USA	Article and drawing of *Piton*.
Rik Hill	Loudon Observatory, Tucson, Arizona, USA	Image and article Reiner *Gamma: A Lunar*
Eduardo Horacek	Trapecio Austral-LIADA, Mar del Plata, Argentina	Images of Mare Nubium (4).
Evangelina Leguiza	AEA, Oro Verde, Argentina	Image of Herodotus.
Raúl Roberto Podestá	SLA, Formosa, Argentina	Image of Mare Nubium.
Pedro Romano	San Juan, Argentina	Image of Mare Nubium.

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

Lunar Topographic Studies

Coordinator – David Teske - david.teske@alpo-astronomy.org
Assistant Coordinator– Alberto Anunziato albertoanunziato@yahoo.com.ar
Assistant Coordinator-Wayne Bailey– wayne.bailey@alpo-astronomy.org
Website: http://www.alpo-astronomy.org/

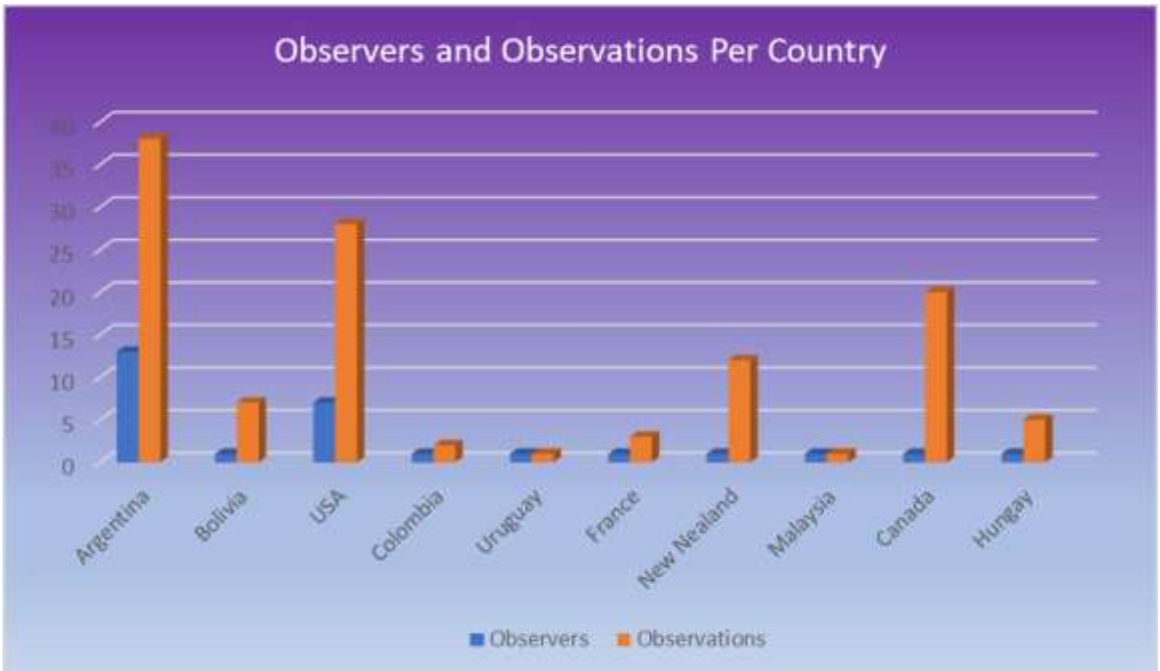
Observations Received

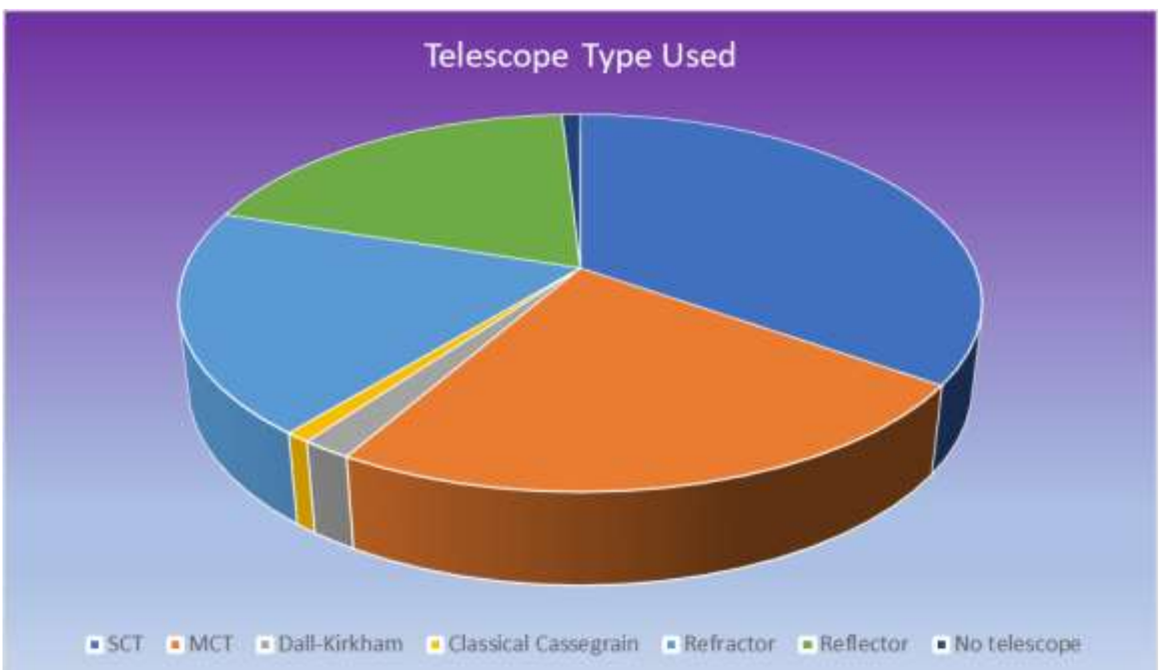
Name	Location and Organization	Image/Article
Gregory Shanos	Sarasota, Florida, USA	Images of Mare Nubium (3) and the January 31, 2023 Lunar Occultation of Mars
Fernando Surá	San Nicolás de los Arroyos, Argentina	Images of Mare Serenitatis, Mare Nectaris and Mare Nubium.
Michael Sweetman	Sky Crest Observatory, Tucson, Arizona, USA	Image of Mare Nubium.
Michael Teoh	Heng Fe Observatory, Penang, Malaysia	Image of Tycho and the Lunar South Pole.
David Teske	Louisville, Mississippi, USA	Article and image *The Southern Shore of Mare*
Larry Todd	Dunedin, New Zealand	Images of Mare Nubium (5), Mare Serenitatis, Plato, Mare Orientale, Schickard, Reiner Gamma, Herodotus and Billy.
Randy Trank	Winnebago, Illinois, USA	Image of Mare Nubium.
Ken Vaughan	Cattle Point, Victoria, British Columbia, Canada	Images of Mare Nubium (4), Alphonsus, Vallis Alpes, Arzachel, Cassini, Deslandres, Eastern Mare Imbrium, Pallas, Ptolemaeus, Ptolemaeus, Chain, Rupes Recta, Stöfler, Three A's, W. Bond, Werner and Aliacensis, Purbach and Albategnius.
Paul Walker	Middlebury, Vermont, USA	Images of Mare Nubium (9), The Clouded Out Lunar Occultation of Mars on January 31, 2023.

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

March 2023 *The Lunar Observer*
By the Numbers

This month there were 117 observations by 28 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.

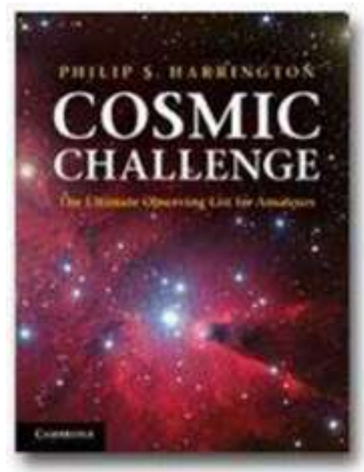
Information about paper presentations, the keynote speaker and other conference data will be published in this Journal and online as details are learned.

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

The Whole Moon as slideshow

Howard Fink

Here are the 144 Lunar Astronautical Charts done as 3D digital elevation models using Lunar Orbiter Laser Altimeter data and painted with the appropriate Wide Angle Camera images (The title above is the link). The poles are clay models.

You can also go to astrobin.com and type LAC XXX in the search box to reach an individual chart. Full resolution is 20-30 megapixels. All the Apollo landing sites have instructions to find the sites. If running the slideshow, clicking the chain icon at the upper left will go to the chart page where you can find the full resolution image.

The process used in creating the charts:

The Lunar Reconnaissance Orbiter has a laser altimeter that has been collecting data since 2009, the Moon LRO LOLA DEM 118m v1.

I downloaded the 16-bit tiff file where each number (0 - 65,535) in the array represents twice the height above a reference radius of the Moon. A computer program written in Mathematica allows me to select a particular area by latitude and longitude from the file to create a bump map from the data and then map it onto a sphere the size of the Moon. The surface of this bump map is textured with an image of the Moon selected from the Moon LRO LROC WAC Global Morphology Mosaic 100m v3 using the same coordinates as the bump map. The resulting surface is then oriented so the viewpoint is slightly oblique, as though in orbit looking forward. This is the snapshot posted on astrobin. There is a link in the description to the actual LAC Chart, which has an overhead image where the features are labeled accompanied by coordinate gridlines.

If theq link above doesn't work, try this:

https://urldefense.proofpoint.com/v2/url?u=https-3A__www.astrobin.com_users_finkh_-3Fpublic-3D-26sub-3Dtitle-26slideshow-3Dtrue-23hpk4r8&d=DwMFaQ&c=slrrB7dE8n7gBJbeO0g-IQ&r=FXOvYvAEhUD4dF3eSiVSakvdDyk6Djiwg0h0BIlH2tg&m=WviyAKmnxtNIg-JzKFSSvGiA0JjzQLaSFC8UFj8D3ovdPOIcXRiqIC5Xove0kOBe&s=prytOXzib8blcMLtlRuuKp-ZHsM_SKHeqUieIeR_DBY&e=

Lunar Topographic Studies

Book Announcement

David Darling, a very long-time member of the ALPO Lunar Section has some great lunar and planetary books that he is downsizing. If interested, please contact him at DOD121252@aol.com. If a book is chosen, please pay for postage.

The following is a listing of the books I wanted to give to A.L.P.O. Being I was a lunar and planetary observer myself most of these listed deal with that subject. Strike throughs have found a new home.

TO A ROCKY MOON / A Geologist's History of Lunar Exploration / Publish 1993 / Don E. Wilhelms

OBSERVING THE MOON / Published 2000 / Peter T. Wiasuk

THE MOON / Published 1981 / Patrick Moore

THE PLANET OBSERVER'S HANDBOOK / Published 1994 / Fred W. Price

OBSERVING THE MOON/ The Modern Astronomer's Guide / Published 2000 / Gerald North

~~THE NASA ATLAS OF THE SOLAR SYSTEM / Published 2000 / Ronald Greeley and Raymond Batson~~

NEW GUIDE TO THE MOON / Published 1976 / Patrick Moore

PHOTOGRAPHIC ATLAS OF THE MOON / Published 2002 / S.M. Chong, Albert C. H. Lim, P.S. Ang

HIGH RESOLUTION ASTROPHOTOGRAPHY / Published 1995 / Jean Dragesco

FULL MOON / Published 1999 / Michael Light

~~SOLAR SYSTEM EVOLUTION A New Perspective 2nd edition / Published 1992 / Stuart Ross Taylor~~

~~WORLDS BEYOND / Published 2002 / S. Alan Stern~~

~~PLANETARY LANDSCAPES / Published 1994 2nd edition / R. Greely~~

~~FOOTPRINTS ON THE MOON / Published 1969 / By the Writers and Editors of the Associated Press~~

THE CAMBRIDGE ENCYCLOPEDIA OF THE SUN / Published 2001 / Kenneth R. Lang

~~MOON DUST / Published 2005 / Andrew W. Smith~~

~~ENCYCLOPEDIA OF THE SOLAR SYSTEM / Published 1999 / Paul R. Weissman, Lucy-Ann McFadden, Torrence V. Johnson~~

~~SOLAR ECLIPSE The Path of Darkness: Apocalypse or Portent? / Published 1990?/ Thomas Crump~~

CHASING THE SHADOW / Published 1994 / Jeol Harris and Richard Talcott

THE ATLAS OF MERCURY / Published 1977 / Charles A. Cross and Patrick Moore

WONDERS OF THE UNIVERSE / Published 1989 / Staff of World Book

~~BEYOND Visions of the Interplanetary probes / Published 2003 / Michael Benson~~

~~GLORIOUS ECLIPSES Their Past, Present and Future / Published 2003 / Serg'e Brunier and Jean-Pierre Luminet~~

THE GEOLOGY OF MARS / Published 1976 / Thomas A Mutch and Raymond E. Arvidson and Jame W. Head, III and Kenneth L. Jones and R. Stephen Saunders

ADVANCE AMATEUR ASTRONOMY / Published 1991 / Gerald North

OBSERVERS GUIDE TO ASTRONOMY / Volume 1 & 2 / Published 1994 / Edited by Patrick Martinez

~~A MAN ON THE MOON / Three Volume Set / Published on 30th Anniversary of Apollo Landing / Andrew Chatkin~~

THE NEW ASTRONOMY AND SPACE SCIENCE READER / Published 1977 / Edited by John C. Brandt and Stephen P. Maran

Lunar Topographic Studies

The Lovely Venus, Moon and Jupiter

Michel Deconinck

The mountain to the left of the image is the here well known "Ventoux" (1900m), this isolated mountain is famous for the organization of cycling races. Painted on February 23, 2023.

So, this is a Jupiter-Moon-Venus-Ventoux conjunction with the local light pollution, ok this light is not too bad... sometimes clouds and light pollution help to make the view more pleasant.

We've had a weird winter here, not a single drop of rain or any snow since the beginning of October last year. At the beginning of February, we had the first forest fires, ... my neighbor is watering her cactus...

My watercolor was done just when clouds appeared on the right of the image, but no, no rain yet.

Inverted image made on rough Arche watercolor paper 300gr 100% cotton, with Winsor and Newton pigments.

Recent Topographic Studies

The Clouded Out Lunar Occultation of Mars on Jan 31, 2023

Gregory T. Shanos

The Northern part of the United States experienced an occultation of Mars with the Moon on December 8, 2022 when Mars was at opposition. The Southern states experienced merely a conjunction. The reverse happened on January 30-31, 2023 when the Southern part of the United States experienced an occultation and the Northern states a conjunction.

ALPO member Gregory T. Shanos was documenting the event. Greg had a SONY FDR-AX100 4K camcorder that took 15 second videos every 15 minutes of the event. A Meade 60mm refractor with a ZWO 178MM 6MP monochrome camera took 60 second videos every 15 minutes. A close-up of the event would have taken place with a Meade LX200GPS 10-inch GO-TO SCT and a ZWO ASI 290MM monochrome camera.

The skies were perfectly clear at sunset and remained that way until 12:30pm. Two friends of mine were photographing the event from Tampa, Florida and texted me that they were completely overcast at approximately 10:30 pm local time. The clouds took two hours to reach Sarasota. I saw a thick cloud band developing in the northeast region of the sky. The cloud bank quickly spread overhead and soon a quarter, then a half then three-quarters then the entire sky was completely overcast. Below is the last image I was able to obtain. Unfortunately, the moon was unable to be seen through the thick cloud cover. I only needed another 15 minutes for Mars to go behind the moon. So close and yet so far.

Overall, I witnessed a conjunction not an occultation of Mars with the moon. The next conjunction of Mars will occur on January 13, 2025 and will be visible throughout the entire United States. Let's hope we see this one.

The Moon and Mars, *Greg Shanos, Sarasota, Florida, USA. 2023 January 31 05:28 UT. Meade 60 mm refractor telescope, ZWO ASI178MM camera.*

Lunar Topographic Studies

Mars Occultation of December 8, 2022

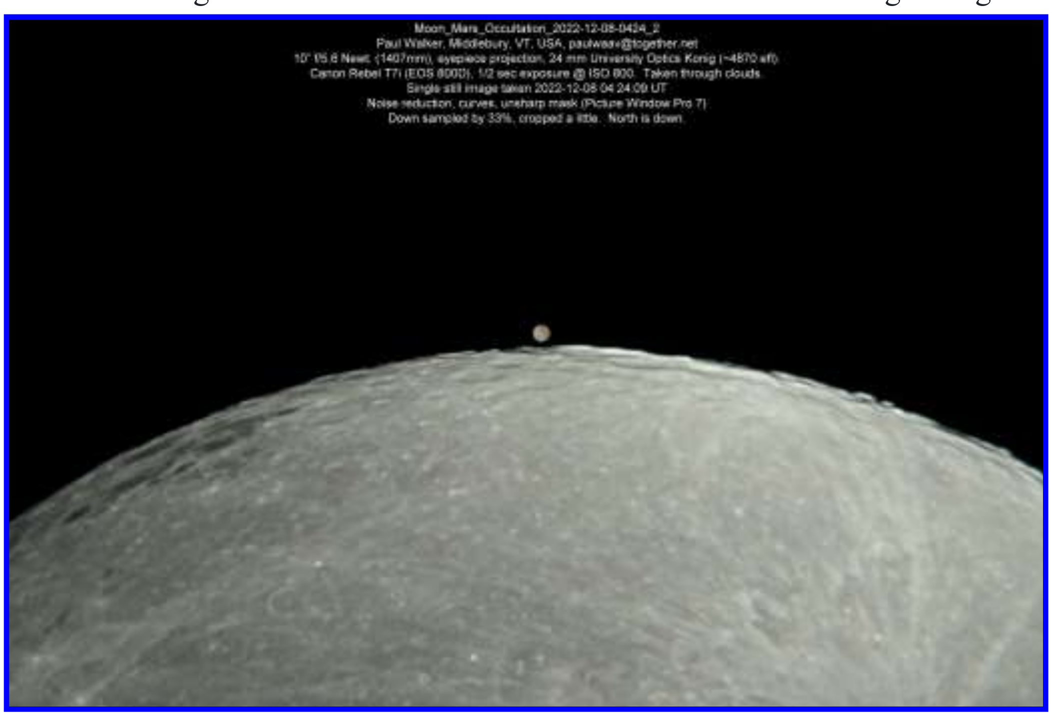
Paul Walker

Mars Occultation, *Paul Walker, Middlebury, Vermont, USA. 2022 December 08 04:24 UT. 10 inch f/5.6 reflector telescope, focal length 1,407 mm, with eyepiece projection, 24 mm Konig (focal length 4,870 mm), Canon Rebel T7i camera. North is down, west is right.*

*Paul adds: "*I manage to catch some glimpses of Mars and the Moon through heavy clouds starting moments after Mars emerged from behind the Moon.

I almost missed the event entirely. I was thinking the reappearance was not until about 11:45 EST. I had rechecked early in the evening with Starry Night Pro planetarium software for the exact time for the disappearance, but I did not recheck the time of the reappearance! (Which was 11:22:00 to 11:23:10 EST).

I lucked out on several counts in getting these images. I only went out what I thought was early, about 11:15 EST, to see if I could catch a enough sight of the Moon to get at least a rough focus on the camera so that I wasn't scrambling at the last minute. I managed to catch sight of the Moon dimly through thinner areas of the clouds. While waiting a good "hole" to verify the focus and identify the right place on the limb of the Moon, I was surprised to see Mars hovering next to the Moon. I could also see that I had managed to get a good focus and didn't have to spend time fine tuning it.



Though of course I would have loved to get shots or video of Mars emerging from behind the Moon, I did catch it at 11:24:09 EST, just moments after it had fully emerged. It was another 7 minutes before there was another "opening" at which time I got several more usable still shots but the first video was only one bright enough to use."

Recent Topographic Studies

Bürg B

Alberto Anunziato

IMAGE 1 does not do justice to the image I was able to see through the eyepiece. What made me decide to record the panorama of Bürg B, on the southern edge of Lacus Mortis, was the sawtooth-shaped relief that is visible towards the south of the crater. It's a pretty specific area, and it really did look very small in my little telescope, but let me tell you, it was very beautiful to see this series of what looked like peaks shining in the rising sun and casting shadows to the northeast. Lacus Mortis is one of the most interesting areas of the Moon, it is not very easy to draw, but beautiful to observe, and observing I realized that the landscape on the southern edge, around the small Bürg B crater (6 kilometers in diameter) it was very strange, because of the arrangement of the shadows and the bright parts. I didn't fully understand the topography around Bürg B, it seemed that the small crater was on an elevation. The bright spots lined with intermediate shadows appeared to be a series of peaks, the highest parts of a small mountain range. Looking at different atlases, including the Lunar Reconnaissance Orbiter Quickmap, the area around Bürg B seemed hilly but I couldn't quite interpret what I had seen as differences in brightness (the shadows evidently marked slopes in the terrain).

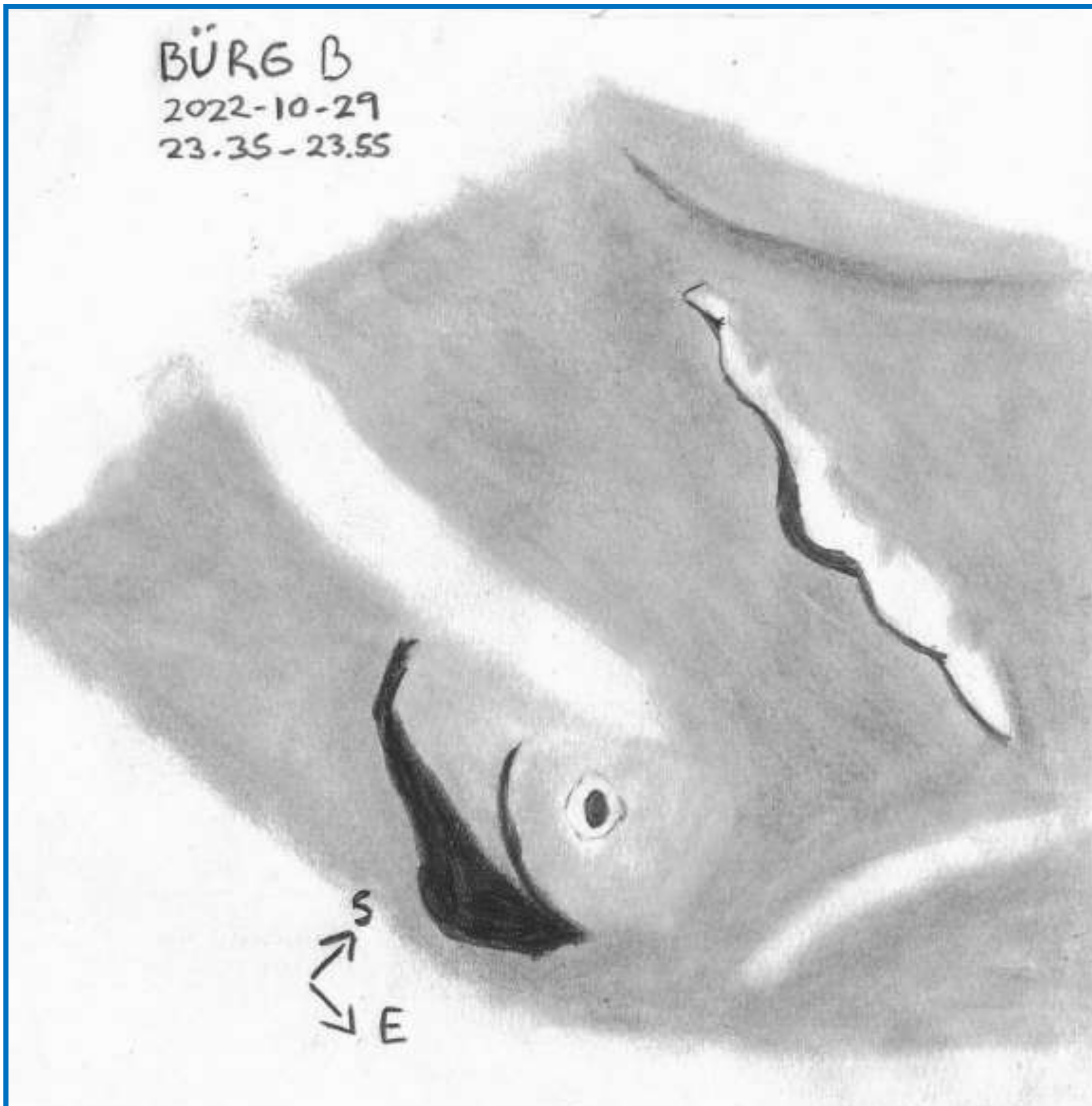
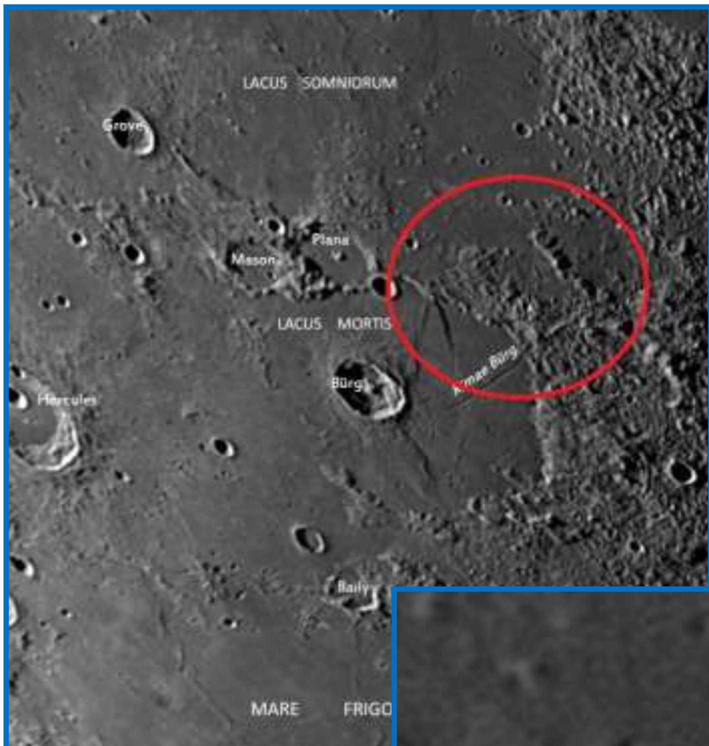
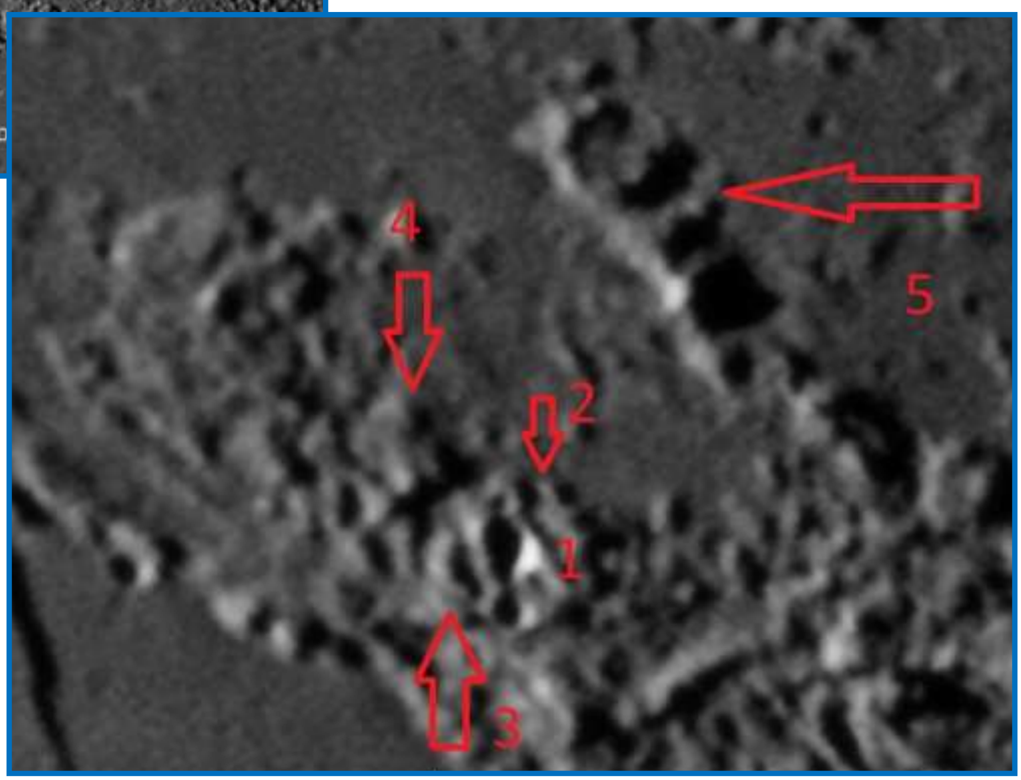


Image 1, Bürg B, Alberto Anunziato, Paraná, Argentina. 2023 October 29 23:35-23:55 UT. Meade EX105 Maksutov-Cassegrain telescope, 154 x.

When you can't finish interpreting what you see on a map, it's time to turn to the invaluable "Photographic Lunar Atlas for Moon Observers", by Kwok C. Pau, which has the unique feature: each important feature is presented under different illuminations, which brings it closer to what the visual observer actually observes on a given night. In the case of our observation, the image that allows us to decipher it is found on page 279 of the first Volume (IMAGE 2, area inside the red circle), if we enlarge the area (IMAGE 3) Pau allows us to identify the accidents in IMAGE 1 1: Bürg B in the center of an elevation (2). The whole of elevation 2 casts the thickest shadow (3), while the parallel and weaker shadow separates elevation 2 from the rest of the mountainous massif (4), which in IMAGE 1 we only perceive as a bright area; while the number 5 indicates the very peculiar mountain range that caught my attention. Conclusion: I will save money to have a telescope with a larger aperture, so I can distinguish the captivating lunar landscape with more precision.



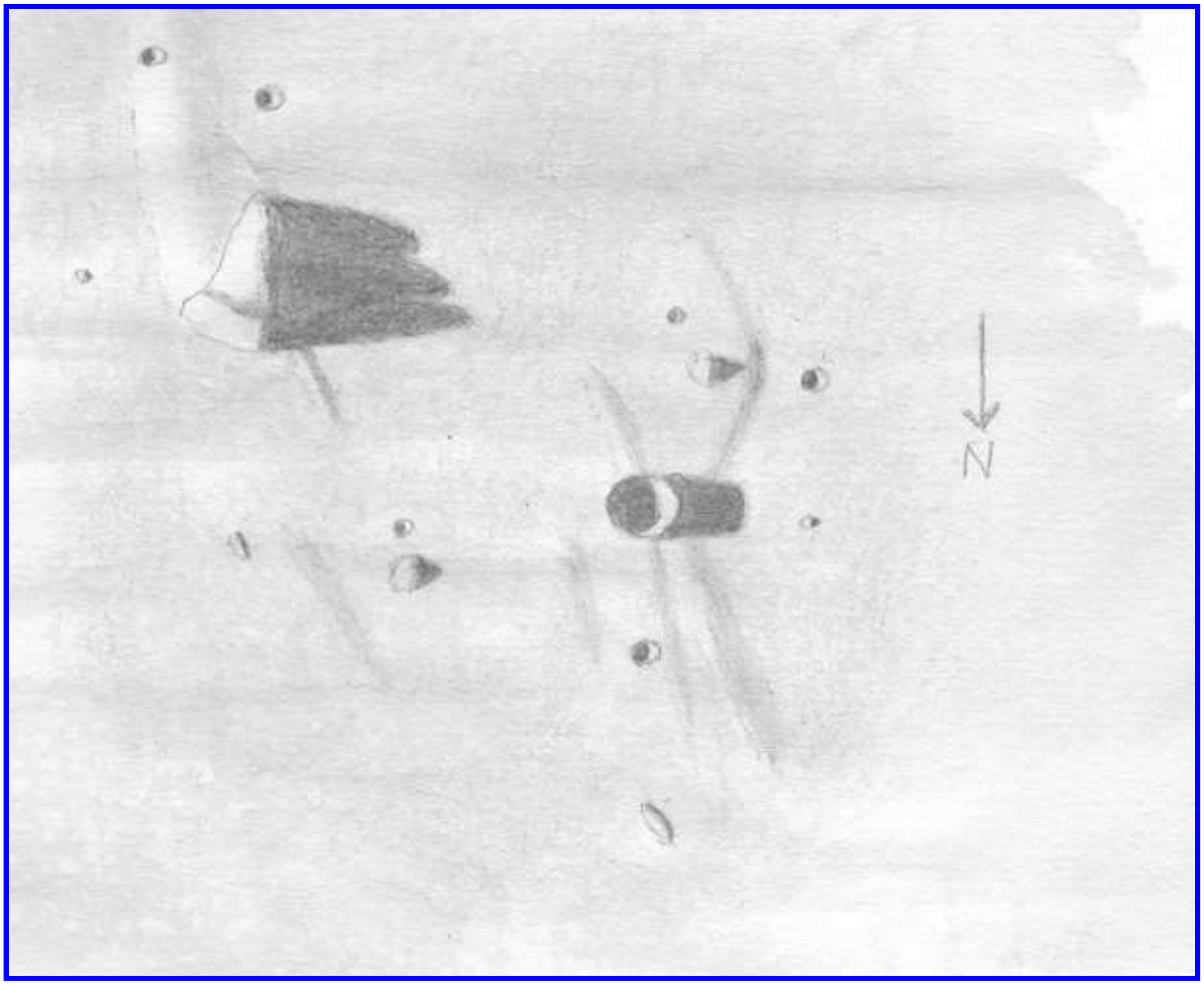
Images 2 (left) and 3 (below), Bürg B. *From the Photographic Lunar Atlas for Moon Observers by KC Pau, page 279. North is down, west is right.*



Lunar Topographic Studies

Piton

Robert H. Hays, Jr.



Piton, *Robert H. Hays, Jr., Worth, Illinois, USA. 2022 November 02 01:54-02:26 UT. 15 cm reflector telescope, 170x. Seeing 7-8/10, transparency 6/6.*

I sketched this mountain and vicinity on the evening of November ½, 2022. Piton is a large, isolated peak in far northeast Mare Imbrium. Its sunlit side was split by a strip of shadow at this time. Piton's long shadow indicated three distinct points, the largest being toward the north end. Piton A is the small crater just south of Piton, and Piton B is the similar crater to the east. A wide, low ridge or wrinkle extends south from Piton, and contains Piton B. A narrow ridge is north of Piton, and a tiny peak is just east of the large mountain. Piazzi Smyth (P.S.) is the relatively large crater northwest of Piton. Piazzi Smyth alpha is the conspicuous peak east of P.S., and P.S. W is the tiny crater just south of alpha. The pit Piazzi Smyth Y is north of P.S., and the elongated peak P.S. pi is farther to the north. The craterlet south of Piazzi Smyth is P.S. B and P.S. V is the larger crater to its west. The large peak Piazzi Smyth beta is between P.S. B and V, and a tiny hill is just west of Piazzi Smyth. All lettered craters are similarly crisp. A series of low ridges or wrinkles in this area are aligned roughly north-northwest to south-southeast.

A View of Oceanus Procellarum

Luis Francisco Alsina Cardinalli and Alberto Anunziato

The extreme west of the Moon, dominated by the lava that makes up the Oceanus Procellarum, has always evoked in my imagination the Pacific Ocean of our planet, in its scarcity of land. The images that Luis Francisco took are very interesting, as they show three great attractions of the west of the Moon: one very prominent (Aristarchus and the Aristarchus Massif), one often overlooked (Reiner Gamma) and another very elusive Mons Rumker. IMAGE 1 appears dominated by Kepler's system of bright rays, but if we follow those bright rays to the terminator we will encounter the enigmatic Reiner Gamma Swirl, which will be the target of our next Focus On. If we go back to the north we will find Aristarchus, which is also a crater of bright rays, much more prominent in the opposite direction to Herodotus and the most important lava channel on the Moon, Vallis Schröteri.

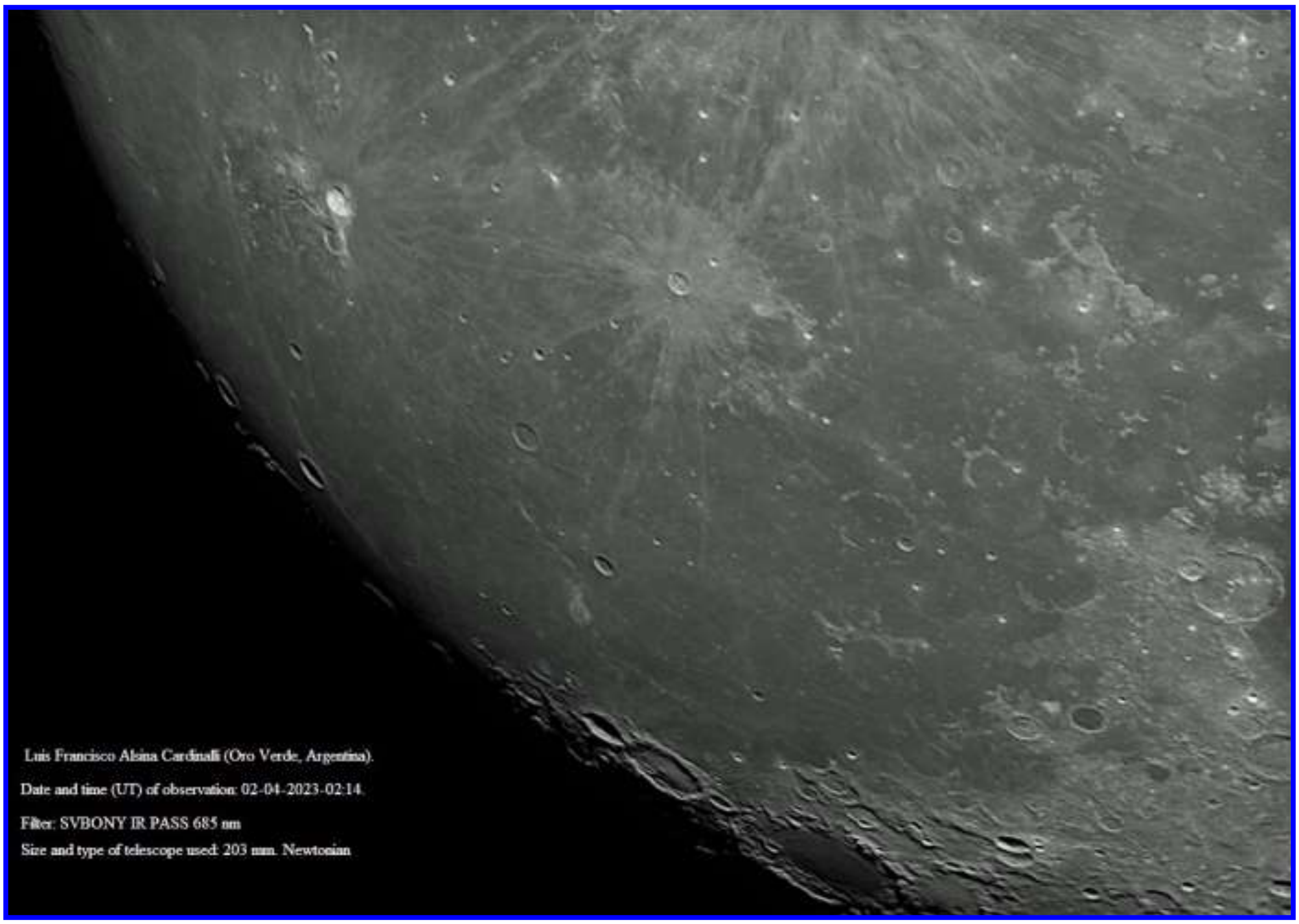
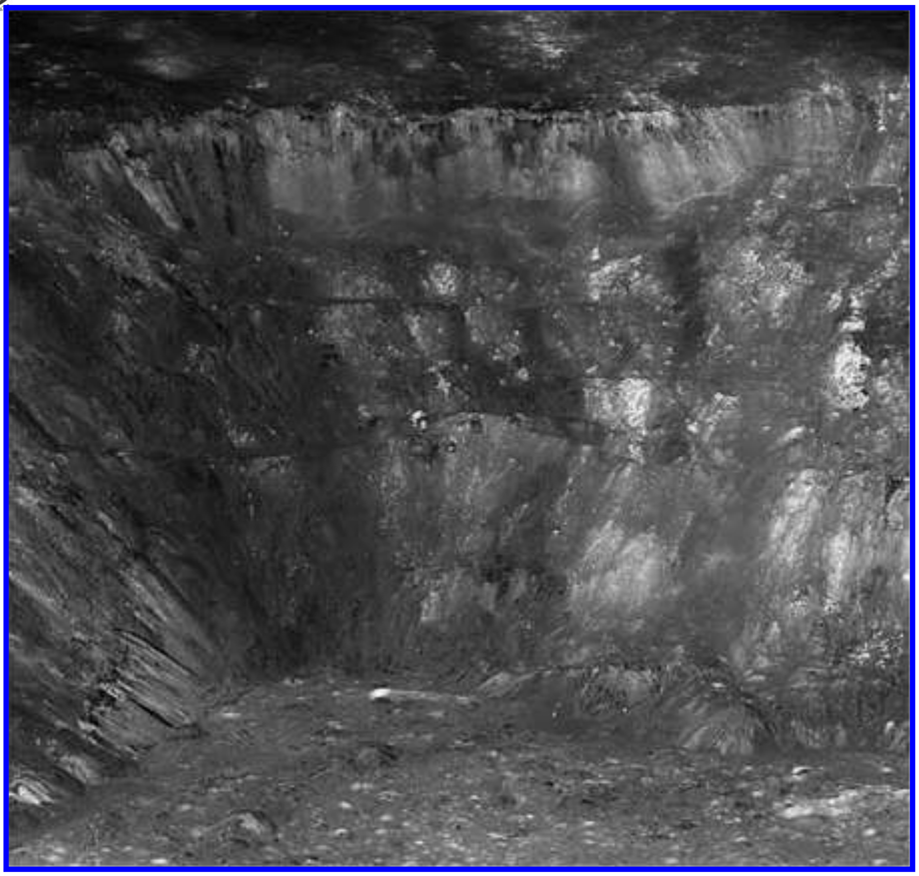


Image 1, Aristarchus, *Francisco Alsina Cardinalli, Oro Verde, Argentina. 2023 February 04 02:14 UT. 8 inch reflector telescope, SVBONY IR pass 685 nm filter, QHY5-II M camera.*

Lunar Topographic Studies

In IMAGE 2 we can see this set in more detail. It is an area of enormous scientific interest. In his wonderful book "The New Moon", Arlin Crotts describes Aristarchus as follows (page 285): “Aristarchus is among the youngest large lunar craters, 175 million years old, and the plateau adjoins south, east, and west some of the youngest lunar surfaces, evidenced by crater counts, 1 billion years old or less. The plateau is mantled by pyroclastic deposits from huge volcanic effusions evident in many volcanic rilles, on the plateau, in the flow off it, and in surrounding landscape”. The characteristic dark color of the Aristarchus Massif is thus explained in another wonderful lunar book (Modern Mysteries of the Moon, by Vincent Foster, Springer, 2016): “The Aristarchus plateau is one of the most geologically diverse places on the Moon; it has a mysterious raised flat plateau, a giant rille carved by enormous outpourings of lava, fields of explosive volcanic ash, and all this is surrounded by massive flood basalts. Scientists think the crater was created relatively recently, geologically speaking, when a comet or an asteroid smashed into the Moon, gouging out a hole in its surface” (page 90). According to Crotts, Aristarchus is 20 times younger than the Plateau. In IMAGE 2 its central peak appears shining brightly, as well as its west wall. Foster continues (page 95): “Aristarchus is considered the brightest of the large formations on the lunar surface, with an albedo nearly double that of most lunar features”, and besides his brilliance we all recognize Aristarchus by his dark bands, let Foster tell us his uncertain origin: “The high albedo material is most likely a common lunar rock type, anorthosite (…) we know the adjacent Aristarchus plateau is blanketed in dark pyroclastic deposits. “ Pyroclastic” derives from the Greek words for fire and broken, as in the small, hot broken rocks erupted in an explosive volcanic event. It is likely that the dark material is related to the nearby pyroclastics; perhaps the impact excavated a now solidified dike that once carried volcanic material to the surface” (pages 98/99).

Image 2, Aristarchus, *Francisco Alsina Cardinalli, Oro Verde, Argentina. 2023 February 04 02:20 UT. 8 inch reflector telescope, SVBONY IR pass 685 nm filter, QHY5-II M camera.*



Foster shares in his book an amazing image (IMAGE 3) of what the dark bands look like from inside the crater: "On November 10, 2011, the LRO made a low-altitude pass 42 miles to the east of Aristarchus Crater and took an amazing panoramic image of the western wall of the crater. The LRO was flying at just over 16 miles above the lunar surface at the time, which is about two times lower than normal, due to the LRO's current elliptical orbit. As a result, the image has incredible detail. The spectacular new view from the LRO is almost as good as being there" (page 97). In IMAGE 4 we travel further north and if we look at the terminator in a straight line from Aristarchus we see the rising sunlit eastern slope of Mons Rumker, one of the largest and most difficult mountains to observe, which will be the target of our Focus-On of July.

***Image 3 Aristarchus from LROC flyby**. See text for details.*

***Image 4, Aristarchus,** Francisco Alsina Cardinalli, Oro Verde, Argentina. 2023 February 04 02:26 UT. 8 inch reflector telescope, SVBONY IR pass 685 nm filter, QHY5-II M camera.*

Lunar Topographic Studies

Reiner Gamma: A Lunar Swirl Enigma

Rik Hill

People tend to think that since we have landed on the moon and bombarded our neighbor with countless spacecraft over the last 66 years, that we know all about it now. Nothing could be further from the truth! This is one of the features that represents "lunar swirls", a localized magnetic anomaly in Oceanus Procellarum. The crater in the center of the image is, appropriately, Reiner (31 km dia.). At the top, half of the crater Marius (43 km) is peeking down. To the left of Marius, you can see some of the Marius Hills, the famous field of lunar domes. Then on the left side of this image is the large crater, Cavalerius (60 km) still mostly in shadow. Above Reiner, on the terminator, is the crater Galilaei (15 km) and roughly halfway between these two and a little left is the crash site of Luna 8. Unfortunately, radio contact was lost with that spacecraft after two unsuccessful retro burns and it crash landed on 7 Dec. 1965 (Moscow date).

Reiner Gamma has no relief, and is a purely an albedo feature. Oblique views from the Lunar Orbiter 2 cameras show no topography at all, just a stain on the floor of Procellarum. Its magnetic field has been measured from spacecraft altitudes as low as 28 km and those measurements have shown it to be one of the strongest magnetic anomalies on the Moon. In the 17th century this feature was identified as a crater that was named Galilaeus to honor Galileo. This was honorarium was moved changed to the aforementioned Galilaei after the true nature of Gamma was learned. However, the cause of this and other lunar magnetic swirls is still a tantalizing enigma.

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

Lunar Topographic Studies

FOCUS ON: Expedition to Mare Nubium

Alberto Anunziato

Why would they have called our mare "the sea of clouds"? The names of all the lunar maria are related to the ancient hypothesis that the dark areas on the visible side were covered by water. Precisely, in Galileo's first observations, he realized that the lack of clouds and the sharpness of the images of the lunar surface indicate that there is no moisture on the Moon. Perhaps the small size and variegation of the features inside it suggested to certain observers the presence of clouds? Readers will be able to see in the images in which Mare Nubium appears complete whether this similarity to a sky with sparse clouds is viable. IMAGES 1 to 3.

Image 1, Mare Nubium, *Eduardo Horacek, Trapecio Austral-LIADA, Mar del Plata, Argentina. 2022 November 03 23:46 UT. 150 mm Maksutov-Cassegrain telescope, Canon EOS Rebel T5i. North is down, west is right.*

Image 2, Mare Nubium, *David Teske, Louisville, Mississippi, USA. 2022 March 13 02:29 UT colongitude 29.1°. 3.5 inch Questar telescope, ZWO ASI120mm/s camera. Seeing 8/10.*

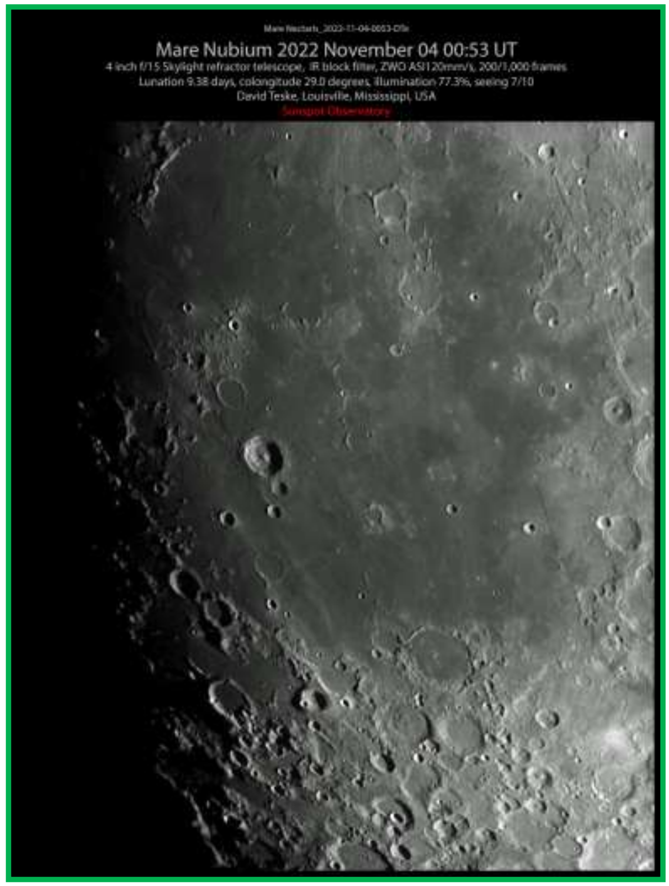


Image 3, Mare Nubium, *David Teske, Louisville, Mississippi, USA. 2022 November 04 00:53 UT colongitude 29.0°. 4 inch f/15 refractor telescope, ZWO ASI120mm/s camera. Seeing 7/10.*

In chapter 15 of "The Modern Moon. A Personal View", Charles Wood takes us on a wonderful tour of Mare Nubium, and begins with an ingenious hypothesis: "if the lunar mare of that name really shares any similarities with terrestrial clouds, it is because its boundaries are soft and ambiguous. The reason for Nubium's lack definition is easy to spot-it doesn't have the conspicuous surrounding rim of a typical impact basin". The Nubium Basin is more assumed than proven and would have nothing more than two rings. "A portion of a basin rim is apparent only in one location along the southern shore of Nubium, where a 130 km-long ridge stretches between the ruined crater Weiss and the lava-flooded crater Mercator" (Wood). In IMAGE 4 and CLOSE UP you can clearly see what would be the remnant of the Nubium Basin, in the lower left area (Mercator is the crater next to another identical one, called Campanus). See IMAGES 5-8.

Image 4, Mare Nubium, *David Teske, Louisville, Mississippi, USA. 2022 May 11 01:58 UT colongitude 28.5°. 4 inch f/15 refractor telescope, ZWO ASI120mm/s camera.*

Focus-On: Expedition to Mare Nubium

Image 5, Mare Nubium, *Greg Shanos, Sarasota, Florida, USA. 2023 January 03 02:15 UT. Meade LX6 8 inch Schmidt-Cassegrain telescope, Celestron f/6.3 reducer, ZWO ASI178MM camera.*

Image 6, Mare Nubium, *Eduardo Horacek, Trapecio Austral-LIADA, Mar del Plata, Argentina. 2022 November 03 23:57 UT. 150 mm Maksutov-Cassegrain telescope, Canon EOS Rebel T5i. North is down, west is right.*

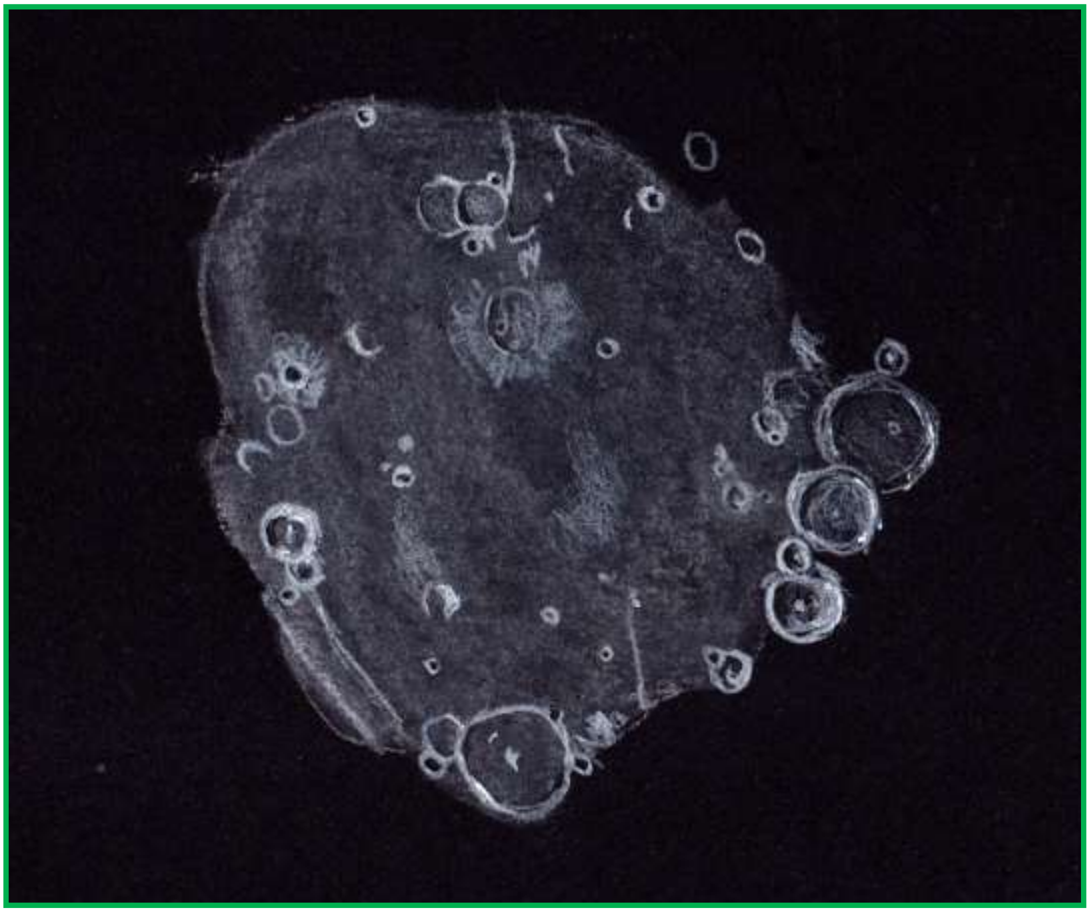


Image 7, Mare Nubium, *Michel Deconinck, Artignoc-sur-Verdon - Provence - France. 2019 June 24. Takahashi Mewlon 250mm f15 Dall Kirkham telescope, 12mm eyepiece.*

Image 8, Mare Nubium, *Walter Ricardo Elias, AEA, Oro Verde, Argentina. 2023 January 01 23:03 UT. 150 mm reflector telescope, QHY5-II-C camera.*

We are going to simulate an expedition to Mare Nubium. In IMAGE 9 we draw the stages of our imaginary expedition. We arbitrarily chose the southern edge to start our excursion. Says Peter Grego: “Mare Nubium is a roughly rectangular sea with an east–west diameter of around 600 km and a total surface area of 254,000 sq km. It is easily visible with the naked eye as a dark patch in the central southern part of the Moon (...) The mountain border of Mare Nubium is incomplete and largely submerged in the north, and where it exists from the west around the south to the east it is indented with craters, many of which are flooded”.

Image 9, Stage 1, Mare Nubium (labeled), *Greg Shanos, Sarasota, Florida, USA. 2023 January 05 13:57 UT. Meade LX6 8 inch Schmidt-Cassegrain telescope, Celestron f/6.3 reducer, ZWO ASI178MM camera.*

At Mare Nubium we do not have conspicuous bright ray craters, but we do enjoy rays from two of the brightest craters on the Moon: “The ray systems of Copernicus to the north and Tycho to the south overlap in Mare Nubium, but most prominent are Tycho’s rays, two of which streak across the western part of the mare” (Grego). See IMAGES 10-16A.

Image 10, Mare Nubium, *Walter Ricardo Elias, AEA, Oro Verde, Argentina. 2023 January 05 01:17 UT. 150 mm reflector telescope, QHY5-II-C camera.*

Focus-On: Expedition to Mare Nubium

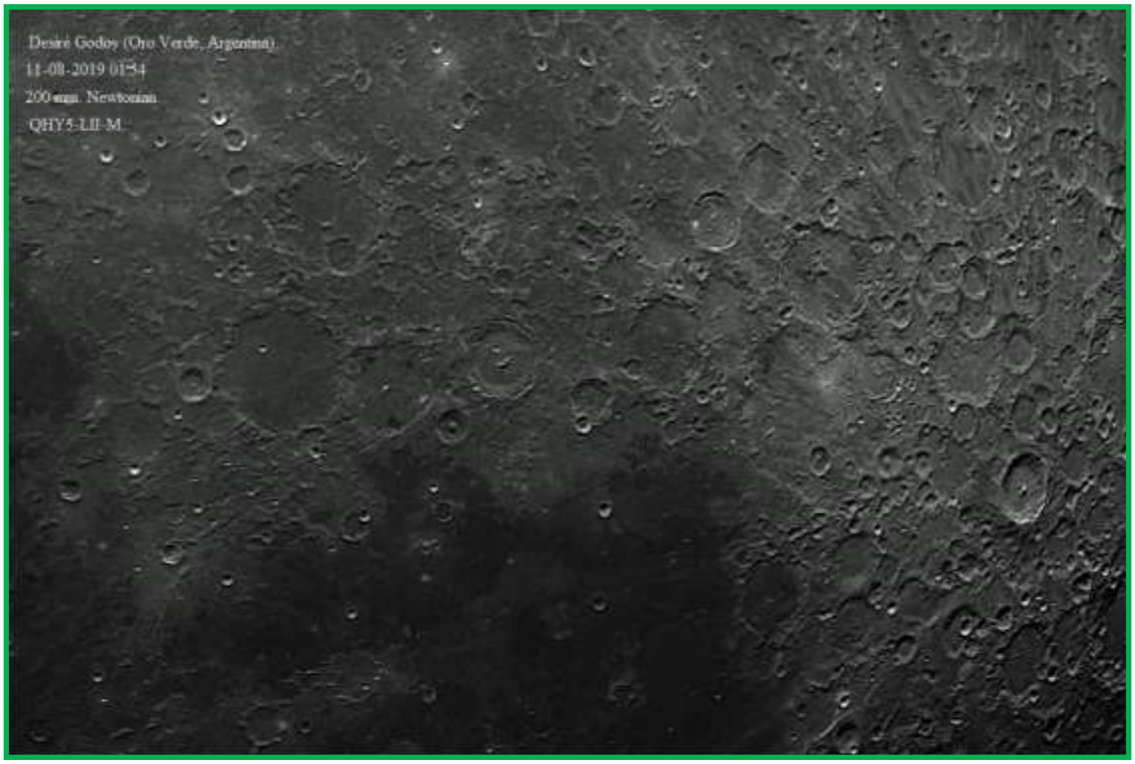


Image 11, Mare Nubium, *Desiré Godoy, Oro Verde, Argentina. 2021 November 08 01:54 UT. 200 mm reflector telescope, QHY5-LII-M camera. North is left, west is down.*

Image 12, Mare Nubium, *Desiré Godoy, Oro Verde, Argentina. 2021 November 08 02:10 UT. 200 mm reflector telescope, QHY5-LII-M camera. North is left, west is down.*

Focus-On: Expedition to Mare Nubium

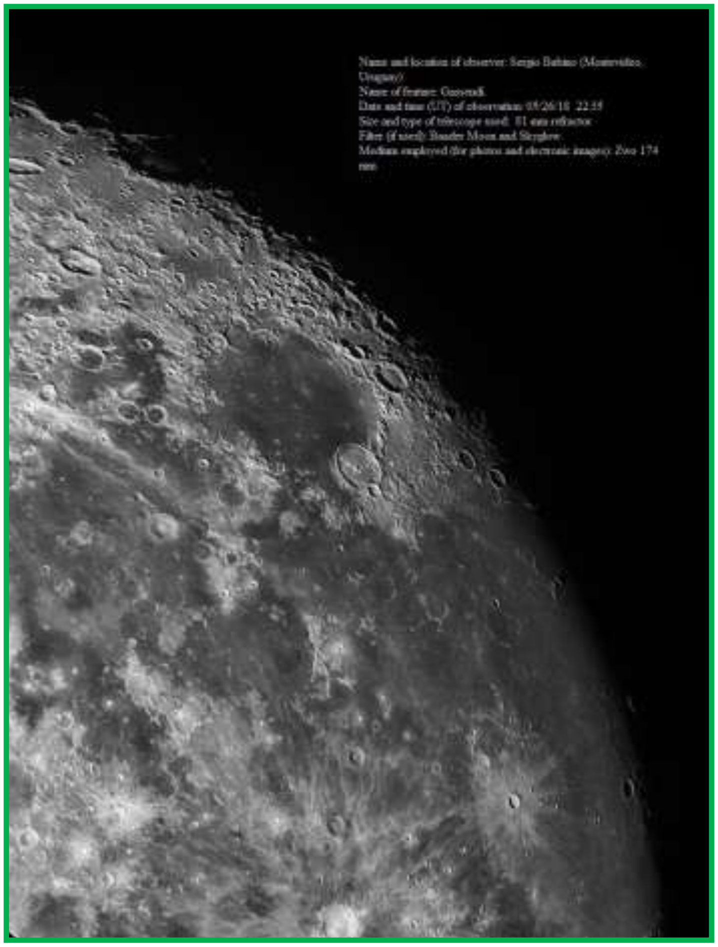
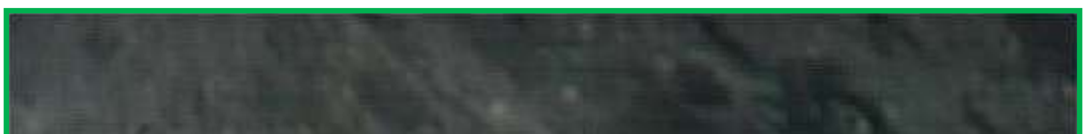


Image 13, Gassendi, *Sergio Babino, Montevideo, Uruguay. 2018 May 26 22:35 UT. 81 mm refractor telescope, Baader Moon and Skyglow filter, ZWO 174 mm camera.*

Image 14, Alberto Anunziato, *Oro Verde, Argentina. 2015 November 28 06:31 UT. Meade LX200 10 inch Schmidt-Cassegrain telescope, Phillips SPC900NC webcam. North is down, west is to the right.*



Focus-On: Expedition to Mare Nubium

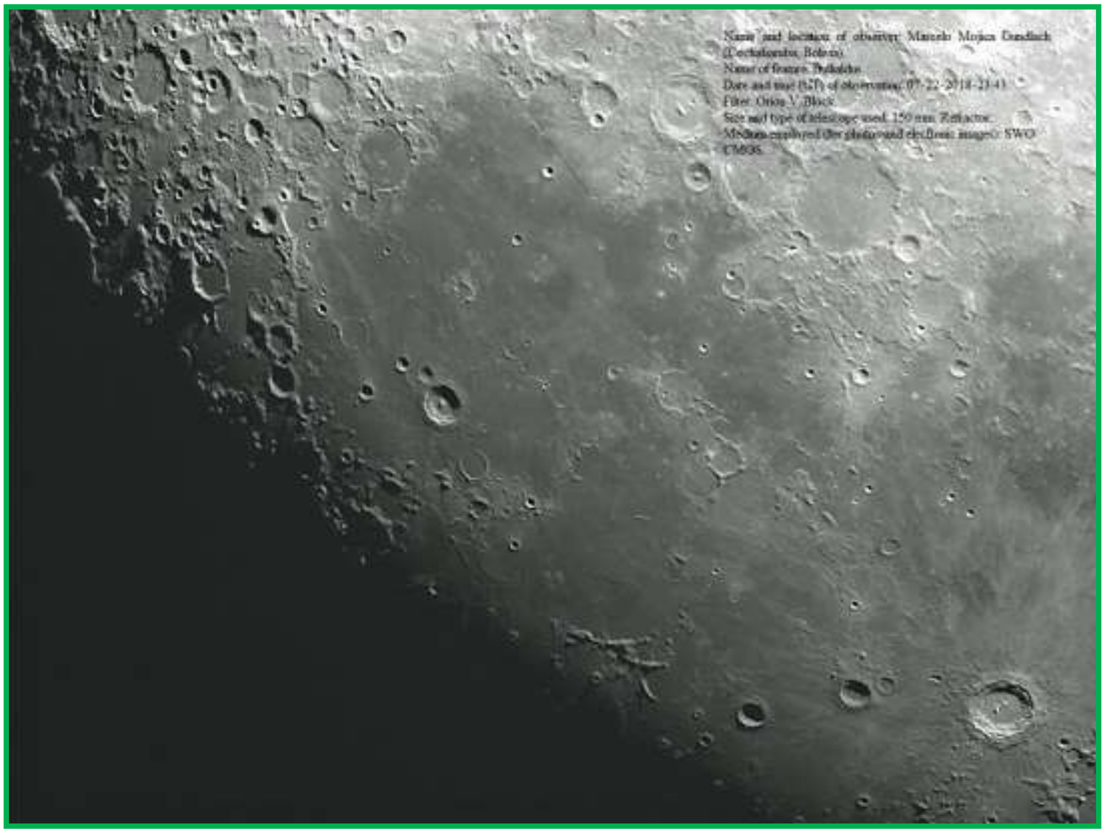


***Image 15, Bullialdus**, Marcelo Mojica Gundlach, Cochabamba, Bolivia. 2018 July 22 23:43 UT. 150 mm refractor telescope, Orion V-block filter, SWO CMOS camera. North is down, west is to the right.*

***Image 16, Mare Nubium,** Eduardo Horacek, Trapecio Austral-LIADA, Mar del Plata, Argentina. 2021 August 17 22:38 UT. 150 mm Maksutov-Cassegrain telescope, Canon EOS Rebel T5i. North is left, west is down.*

Image 16A, Mare Nubium, *Fernando Surá, San Nicolás de los Arroyos, Argentina. 2023 February 11 03:28 UT. 127 mm Maksutov-Cassegrain telescope, blue filter, Samsung A22 cell phone camera.*

Stage 1: From Pitatus to Rupes Straight. SEE STAGE 1 IMAGE (Image 9) (page 24)

We start, arbitrarily, with the southern edge of Mare Nubium and, also arbitrarily, with Hesiodus, the first "minor odds worth finding" in Wood's words, which "has an irregular outline, and for the most part linear walls, which on the S. are massive and lofty (4,000 feet), but on the N. very low, and broken by gaps", and if we see the detail of IMAGE 17 (CLOSE UP 1), it seems to be a concentric crater, since in its almost exact center we find Hesiodus D. "Concentric" is a play on words, since to the south of Hesiodus, attached to its edge is the concentric crater that is easier to observe, Hesiodus A. Mare Nubium is not very deep, although there is no water, its lava is not so thick and allows a glimpse of the submerged topography. If we go north we find two semi-submerged craters, of which only part of their walls are preserved (Hesiodus X on the left and Hesiodus S on the right), to the left of Hesiodus X we see a small mountain range. Between Hesiodus and the heart-shaped crater called Wolf, it is impressive how intricate the wrinkle ridges net is, which are clearly submerged relief and not the product of folds in the lava. "Nubium appears crossed by a number of wrinkle ridges that form no particular pattern. Many ridges clearly mark the rims of buried craters-examples include the five or six structures linking the ruined craters Opelt, Gould and Wolf. Other craters have completely lava-flooded interiors, but rims that are largely intact" (Wood).

Image 17, Mare Nubium, *David Teske, Louisville, Mississippi, USA. 2020 December 08 11:13 UT colongitude 188.1^{o}. 4 inch f/15 refractor telescope, 1.5x barlow, IR block filter, ZWO ASI120mm/s camera. Seeing 8/10.*

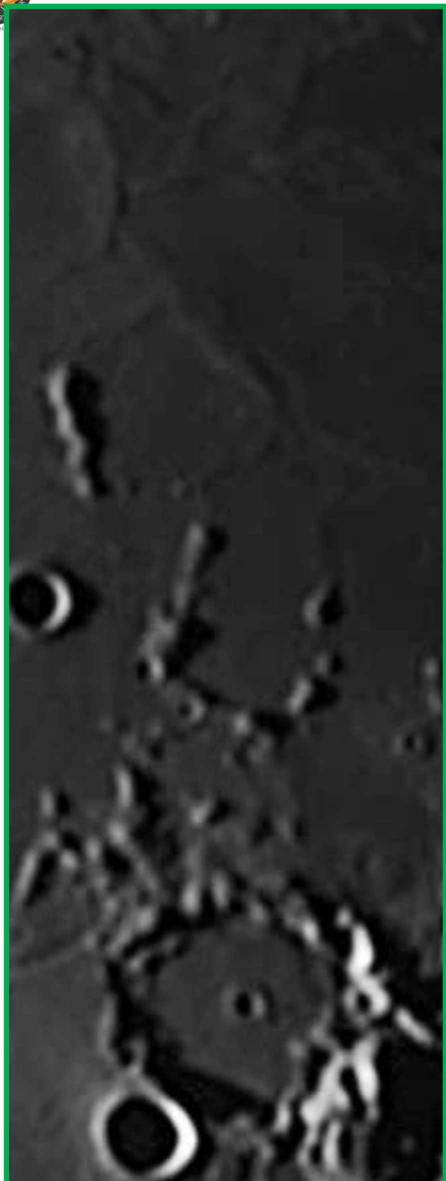
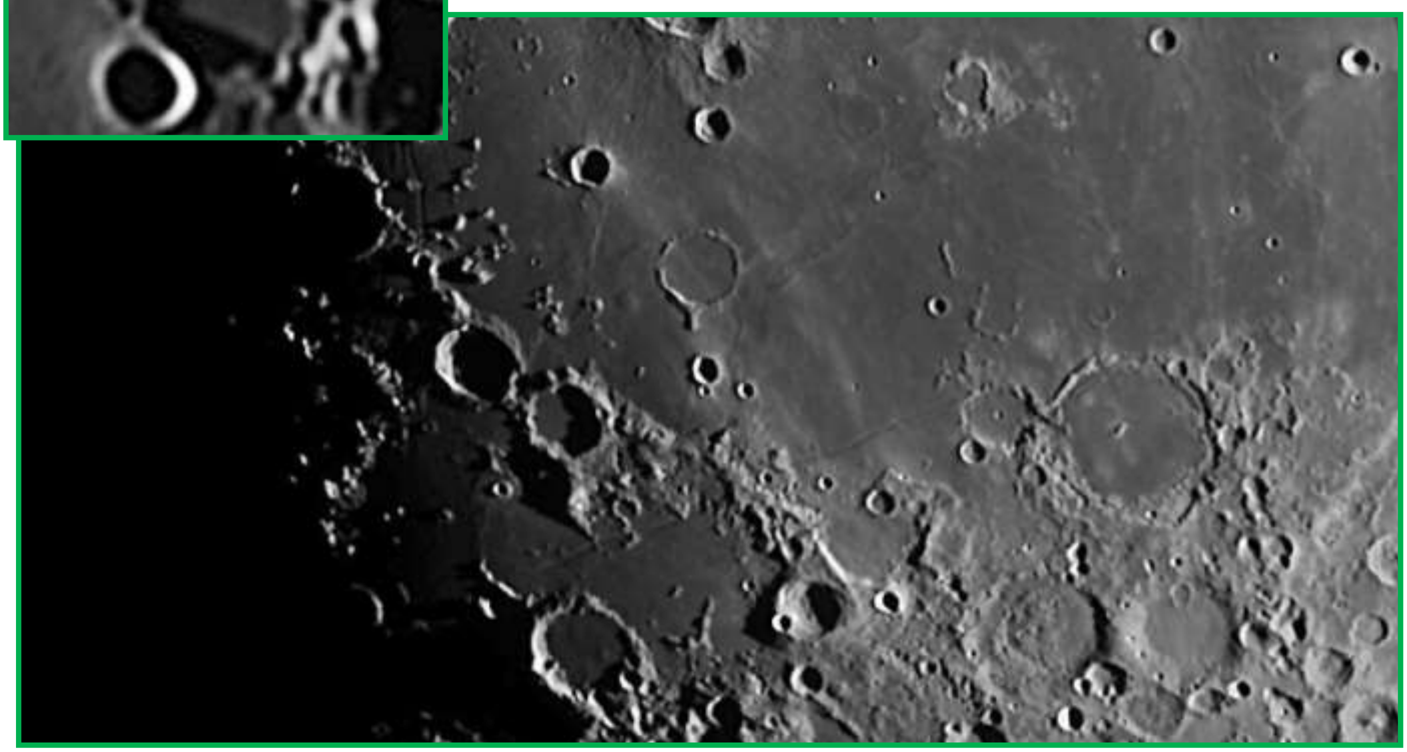


Image 17, Mare Nubium, *David Teske, Louisville, Mississippi, USA. 2020 December 08 11:13 UT colongitude 188.1º. 4 inch f/15 refractor telescope, 1.5x barlow, IR block filter, ZWO ASI120mm/s camera. Seeing 8/10. Close-ups.*

Pitatus (97 km diameter) is an extremely interesting crater with its "nearly pulverized rim and a floor completely covered by lava except for one lonely off-center peak, interestingly, a narrow rille skirts the inner wall of Pitatus" (Wood). See IMAGES 18 and 19.

Image 18, Mare Nubium, *David Teske, Louisville, Mississippi, USA. 2022 May 11 01:38 UT, colongitude 28.3º. 4-inch f/15 refractor telescope, ZWO ASI120mm/s camera. Seeing 8/10.*



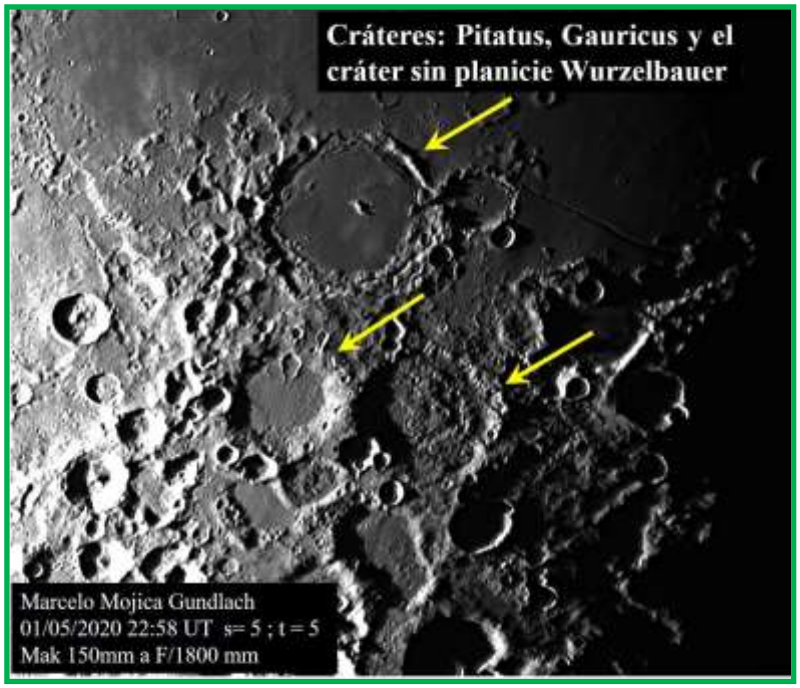


***Image 19, Bullialdus**, Marcelo Mojica Gundlach, Cochabamba, Bolivia. 2020 May 01 22:58 UT. 150 mm refractor telescope, Orion V-block filter, SWO CMOS camera. East is to the left, west is right.*

In IMAGE 20 the details of the interior formed by Pitatus volcanism are clearly perceived: "the eastern part of the rille appears to be outlined by whitish deposits and its northwestern portion appears to crack a low rise. Lunar Orbiter photographs show that a series of rilles encircle the entire floor and that tiny rilles connect the peak to the southwestern and southeastern rims. Clearly volcanism filled Pitatus and made the rilles. The white rille rims could be sulfur or other volcanic emanations like those that sometimes occur along lava channels in Hawaii. It would be very surprising, however, if such deposits survived 3 billion years of bombardment by solar wind and micrometeorites" (Wood), also the features that Elger points out are seen in the IMAGES 19 and 20: "On the N.E., the rampart includes many curious irregular depressions and craters, and gradually diminishes in height, till, for a space of about 12 miles on the N., there can hardly be said to be any border at all, its site being marked by some inconsiderable mounds and shallow hollows. There is a small bright central mountain on the floor, and, S. of it, two larger but lower elevations".

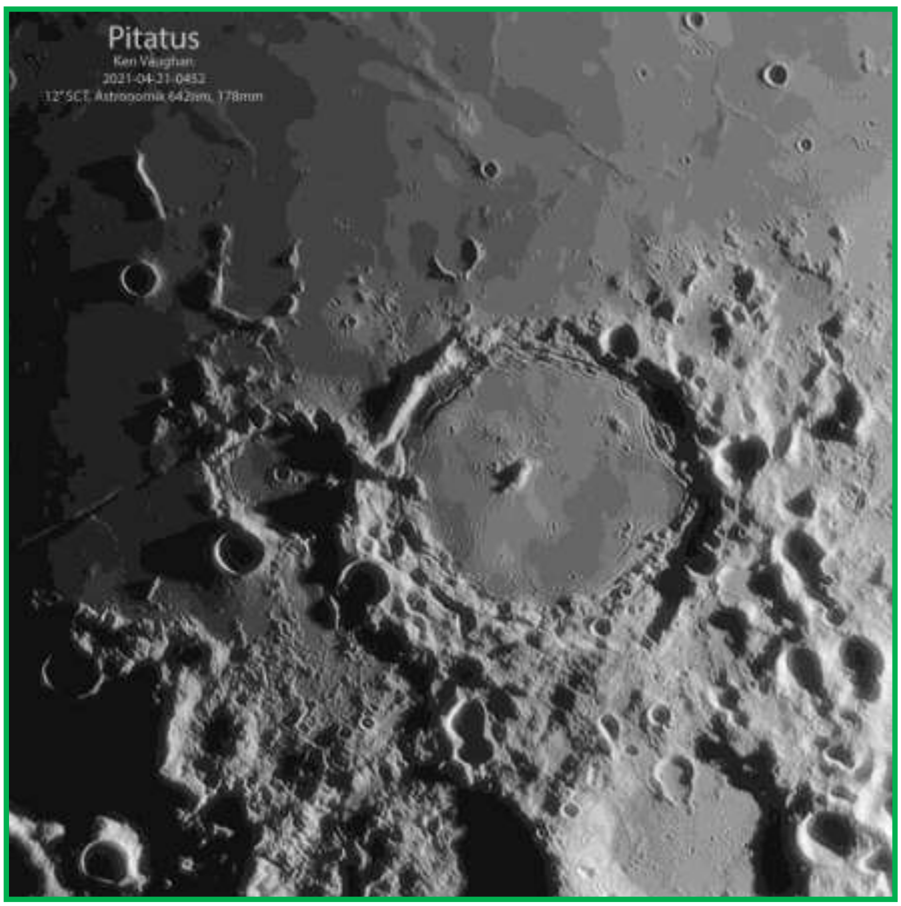


***Image 20, Pitatus,** Ken Vaughan, Cattle Point, Victoria, British Columbia, Canada. 2021 April 21 04:52 UT. Meade 12 inch LX200 GPS Schmidt-Cassegrain telescope, Astronomik 642 I-IR filter, ZWO ASI178mm camera.*

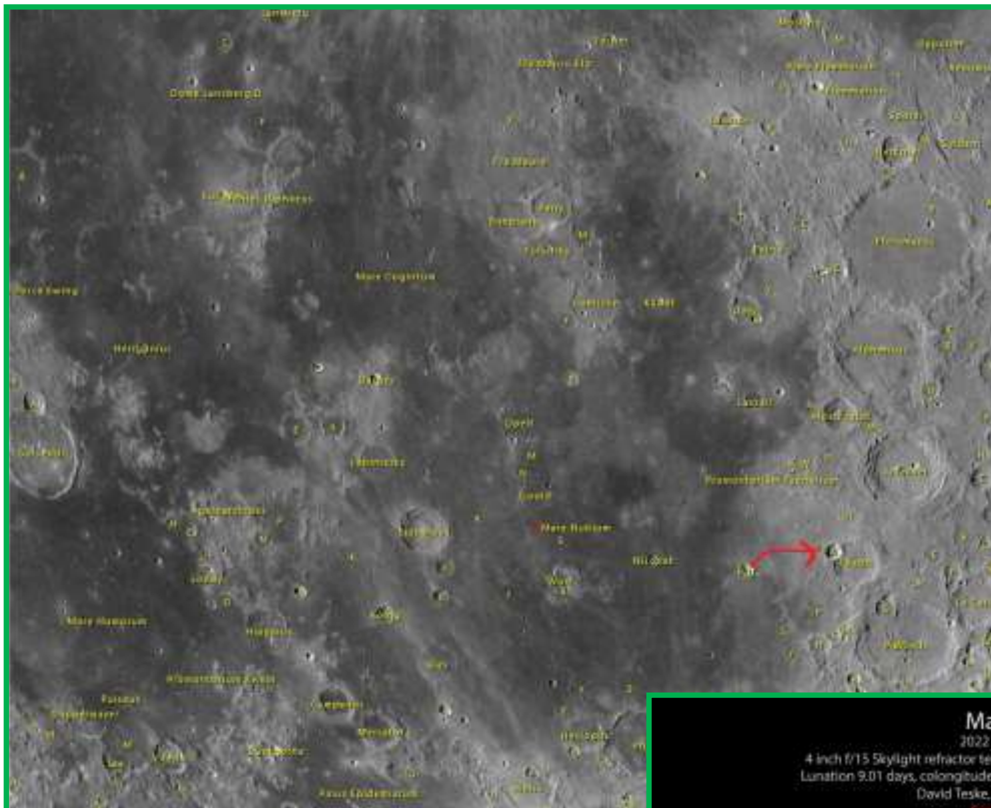
Focus-On: Expedition to Mare Nubium

If we continue our journey, also to the east of Pitatus (IMAGE 21) follow the partially flooded craters (as to the west). To the north we find two small craters, which stand out in the interior of the Mare Nubium for their isolation: Lippershey (7 kms diameter) and Lippershey T (5 kms diameter). Changing direction is worth it to get to know one of the most original craters on the Moon, Wolf: “This Pre-Imbrian-age silicic-rich volcanic crater erupted on a Nectarian-age plateau in Mare Nubium. The heart-shaped crater is about 25.74 km (15.99 miles) in diameter and 790 m (2592 feet) deep (…) The height of the walls is variable being sharp and steep in the east, low and broken in the north, missing in the west because of the impact of Wolf G (lat 22.60°S, long 16.86°W), and destroyed in the south by the creation of the oval satellite crater Wolf B (lat 23.18°S, long 16.51°W)” (Garfinkle). IMAGE 21 CLOSE UP From here we could travel northwest towards Nicollet: “Several wrinkle ridges in eastern Mare Nubium converge in the vicinity of the crater Nicollet (15 km). The ridges in the east appear to mark the position of the submerged western wall of a large, unnamed crater, around 200 km in diameter, whose eastern wall makes a deep semicircular bay on the eastern coastline of Mare Nubium” (Grego). This series of wrinkle ridges would be a major obstacle to reach the next stage: Rupes Recta.

***Image 21, Rupes Recta**, Larry Todd, Dunedin, New Zealand. 2022 June 09 06:18 UT. OMC200 mm Maksutov-Cassegrain telescope, Neptune C camera, mono mode. Right, close-up of the crater Wolf.*

Focus-On: Expedition to Mare Nubium

Stage 2: Rupes Straight. SEE STAGE 2 IMAGE



Stage 2, Mare Nubium (labeled), *Greg Shanos, Sarasota, Florida, USA. 2023 January 05 13:57 UT. Meade LX6 8 inch Schmidt-Cassegrain telescope, Celestron f/6.3 reducer, ZWO ASI178MM camera.*

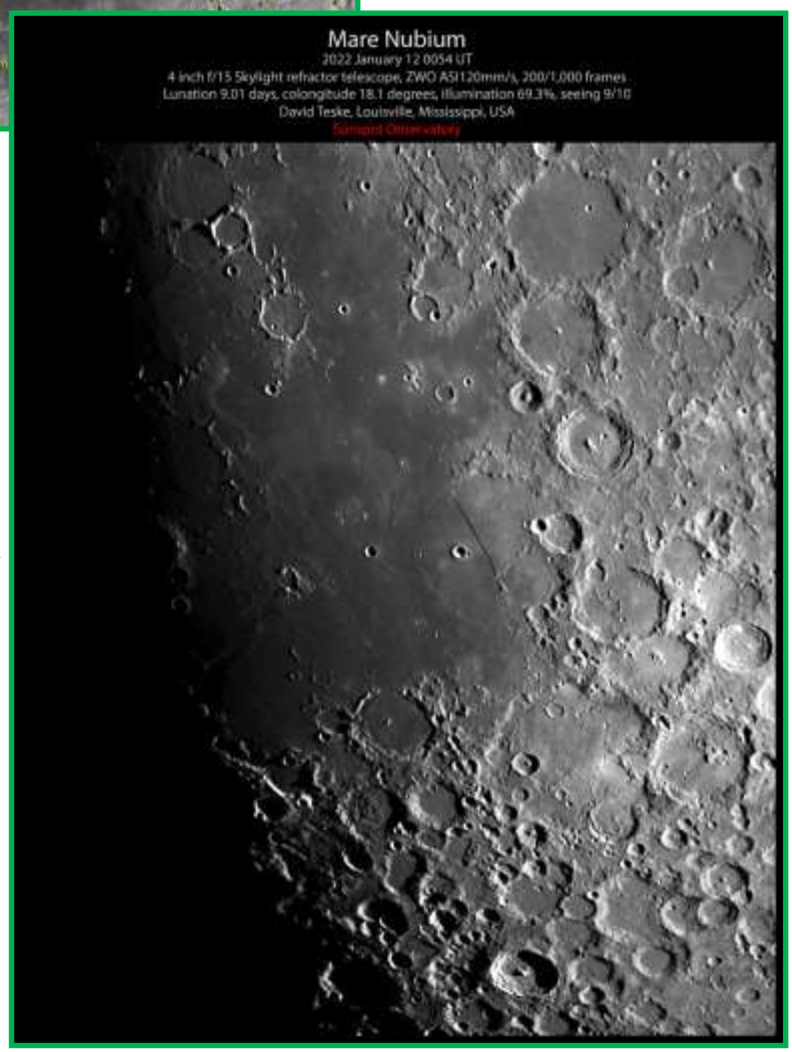


Image 22, Mare Nubium, *David Teske, Louisville, Mississippi, USA. 2022 January 12 00:54 UT, colongitude 18.1°. 4-inch f/15 refractor telescope, ZWO ASI120mm/s camera. Seeing 9/10.*

Traveling from Nicollet towards Birt B (a 5 km diameter craterlet), we enter one of the most spectacular areas on the near side of the Moon, which extends to Thebit. To get to Birt B we will also have to cross an intricate net of wrinkle ridges (IMAGE 23) and when we have overcome them we will find ourselves in an abyss 1500 meters wide: "Rima Birt, a prominent sinuous rille, commences from the summit crater of a low dome, the elongated crater Birt E (9 km long), and runs southwards for 50 km across the mare, terminating at the small crater Birt F (2.5 km) on Birt's western flanks" (Grego). The route taken by Rima Birt can be seen in IMAGE 24. "Each end of this rille, known as Rima Birt terminates in a tiny pit. The pit on the northern end sits on top of a dome that is noticeably darker than nearby mare (...) scientist who try to explain why it is there. Because the tiny pit at the rille's northern end is located near the rim of Ancient Thebit, we can speculate that fractures associated with the rim provided an easy path for lavas to erupt onto the lunar surface, producing a dome, collapse pits, a lava channel, and perhaps a small pyroclastic deposit" (Wood). Further east we find the Birt crater (17 km in diameter): "It has a brilliant border, surmounted by peaks rising more than 2,000 feet above the Mare, and a very depressed floor, which does not appear to contain any visible detail. A bright crater adjoins it on the S.E., the wall of which at the point of junction is clearly very low, so that under oblique light the two interiors appear to communicate by a narrow pass or neck filled with shadow" (Elger). See IMAGE 25.

***Image 23, Rupes Recta**, Larry Todd, Dunedin, New Zealand. 2020 August 27 09:44 UT. OMC200 mm Maksutov-Cassegrain telescope, Neptune C camera, mono mode.*

***Image 24, Rupes Recta,** Francisco Alsina Cardinalli, Oro Verde, Argentina. 2016 September 10 22:51 UT. Celestron 11 inch Edge HD Schmidt-Cassegrain telescope, QHY5-II camera. North is left, west is down.*

Focus-On: Expedition to Mare Nubium

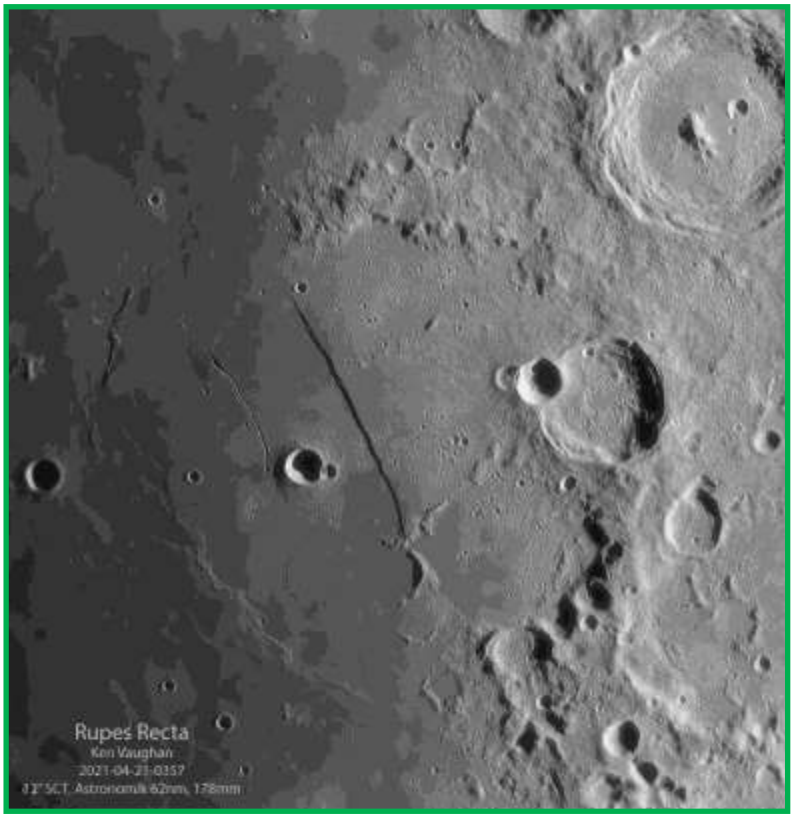


Image 25, Rupes Recta, *Ken Vaughan, Cattle Point, Victoria, British Columbia, Canada. 2021 April 21 03:57 UT. Meade 12 inch LX200 GPS Schmidt-Cassegrain telescope, Astronomik 642 I-IR filter, ZWO ASI178mm camera.*

We leave Birt and head to the main attraction: Rupes Recta, which we can also see in the previous images in its magnificent 110 kilometers long. It is the textbook example of a fault: "is a prime example of surface uplifting that results from a lunar thrust fault, or more likely it was created by subsidence of the mare surface west of the fault. This interesting feature cuts an escarpment that runs north to south for about 115.95 km (72.04 miles) across the center of the lava flow that filled an unnamed rectangular-shaped crater that forms a portion of the eastern shoreline of Mare Nubium" (Garfinkle).

Since I was little, the artistic representation of what the Rupes Recta would look like from the lunar surface has remained in my memory in a wonderful book: "Recreational Astronomy", by Jacob Perelman: "on the Moon is the so-called Straight Wall, a vertical step that cuts a of its plains. Looking at this wall on the map, we forget that it is 300 m high; located nearby, we would feel depressed by its grandeur. In the figure the artist tried to represent this vertical wall, seen from below: its end is lost far away, on the horizon, since it extends more than 100 kms" (IMAGE 26). But, "Through a telescope the scarp may appear as a steep slope, but it is not as precipitous as appearances might suggest: it has a gradient of about 7°, so gentle that it could be ascended without much difficulty" (Grego).

Image 26, Straight Wall, *from Perelman.*

Rupes Recta is one of the most spectacular lunar features, not only for obtaining incredible images, like the ones we will see, but also for mere observation. When illumination conditions allow, try showing the lunar surface to anyone, and you will be fascinated by the great sword on the Moon, as its discoverer Christina Huygens called it, Straight Wall or “The Railroad”, as the great selenographer engineer Thomas Elger: “There is a noteworthy cleft on the W., which can be traced from the foot of the W. wall to the hills on the N.W. It is a fine telescopic object, and, under some conditions, the wider portion of it resembles a railway cutting traversing rising ground, seen from above. It is visible as a white line under a high light”.

Let's see what kind of selenographic feature is a fault like Rupes Recta: “Normal faults are the most commonly observed types of fault on the Moon, and result from crustal tension; as the crust is pulled apart, the rocks may deform to a certain degree, but there comes a point when the crust cracks. Fault planes are usually inclined and rarely vertical. One side of the fault slips down in relation to the other, producing a freshly exposed rock face called a fault-scarp. Easily the best example of a normal fault on the Moon is Rupes Recta (often called “the ‘Straight Wall”) in southeastern Mare Nubium. At first view, Rupes Recta appears to be an impressively steep wall dividing a 126 km section of the mare, but in reality, the scarp face has a gentle gradient of 7°–30° and a height of around 500 m.” (Grego). It is clear that the height of Rupes Recta is a bit uncertain. For Perelman it is 300 meters, Wood maintains that “Various authors report that the scarp is 250 to 300 meters high, buy my measurements of its shadow length suggest that it may rise as much as 450 meters above the basin’s western floor. In spite of appearances, the Straight Wall is not a sheer cliff, though it is relatively steep-rising above the mare plain at an angle greater than 20°”. For Garfinkle too, the height of Rupes Recta reaches 450 meters.

Peter Grego said that Rupes Recta “Illuminated by a rising Sun, the fault casts a prominent broad, dark shadow onto the mare.”, as we can see in IMAGES 27 to 33, while “Under an evening illumination, the scarp face can be seen as a prominent thin bright line, but no trace of it can be discerned under a high angle of illumination”, as we can see in IMAGE 34 and 35.

***Image 27, Rupes Recta**, Larry Todd, Dunedin, New Zealand. 2022 June 09 03:47 UT. OMC200 mm Maksutov-Cassegrain telescope, Neptune C camera, mono mode.*

Image 28, Mare Nubium, *Eduardo Horacek, Trapecio Austral-LIADA, Mar del Plata, Argentina. 2021 September 15 01:32 UT. 150 mm Maksutov-Cassegrain telescope, Canon EOS Rebel T5i. North is to the right, est is up.*

Image 29, Rupes Recta*, Larry Todd, Dunedin, New Zealand. 2020 August 27 09:44 UT. OMC200 mm Maksutov-Cassegrain telescope, Neptune C camera, mono mode.*

Focus-On: Expedition to Mare Nubium

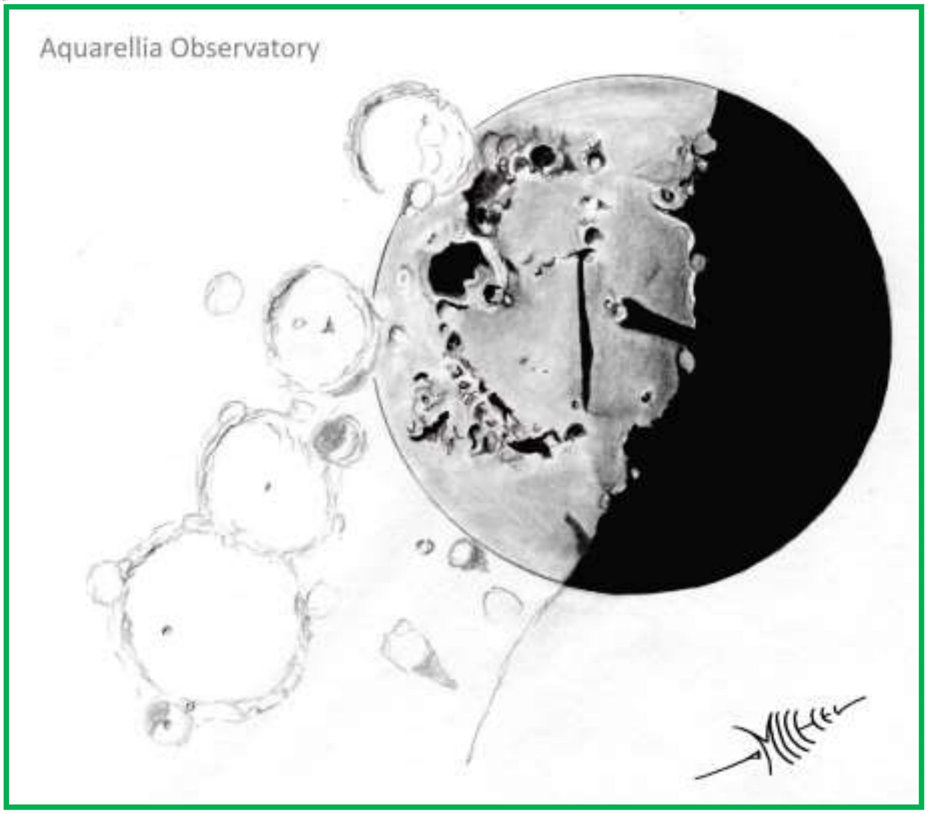


Image 30, The Straight Wall, *Michel Deconinck, Rocbaron - Provence-France. 2014 May 07 21:40 UT. 100 mm refractor telescope, 10mm eyepiece. North is down, west is to the right.*

Image 31, Rupes Recta to Werner, *Richard Hill, Loudon Observatory, Tucson, Arizona, USA. 2007 September 20 01:50 UT. Celestron 14 inch Schmidt-Cassegrain telescope, 1.6x barlow, UV/IR blocking filter, SPC900NC camera. Seeing 6/10.*

Focus-On: Expedition to Mare Nubium

__Image 32, Herschel to Rupes Recta,__ Richard Hill, Loudon Observatory, Tucson, Arizona, USA. 2007 January 27 02:53 UT. Celestron 14 inch Schmidt-Cassegrain telescope, Wratten 21 filter, SPC900NC camera.

__Image 33 Rupes Recta,__ Leonardo Alberto Colombo, Córdoba, Argentina. 2021 August 17 02:18 UT. 102 mm Maksutov-Cassegrain telescope, IR pass 650 nm filter, QHY5-IIM camera. North is to the right, west is up.

Focus-On: Expedition to Mare Nubium

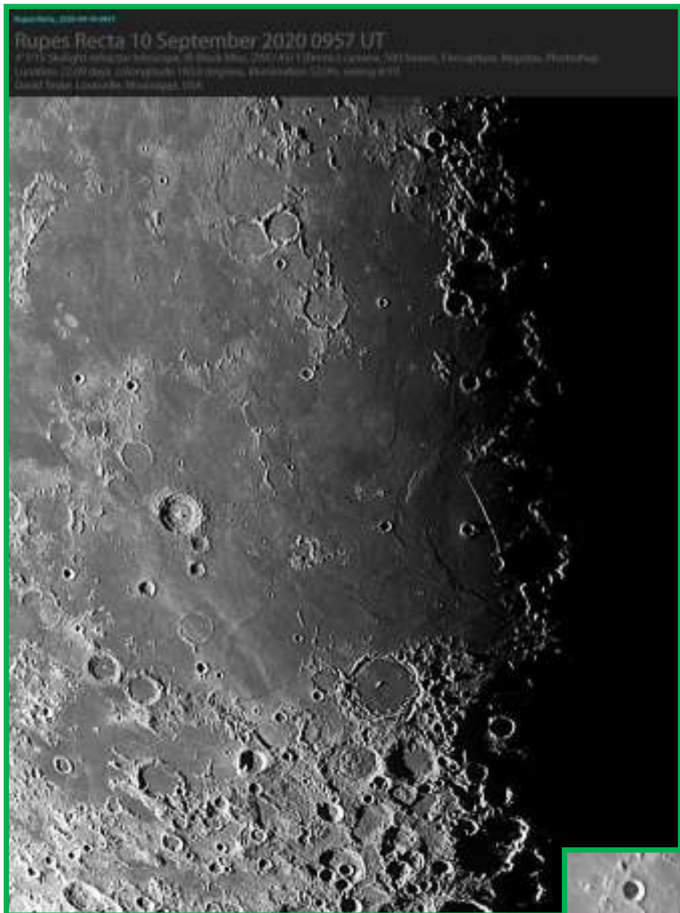


Image 34, ***Mare Nubium,*** *David Teske, Louisville, Mississippi, USA. 2020 September 10 09:57 UT, colongitude 183.8°. 4-inch f/15 refractor telescope, IR block filter, ZWO ASI120mm/s camera. Seeing 8/10.*

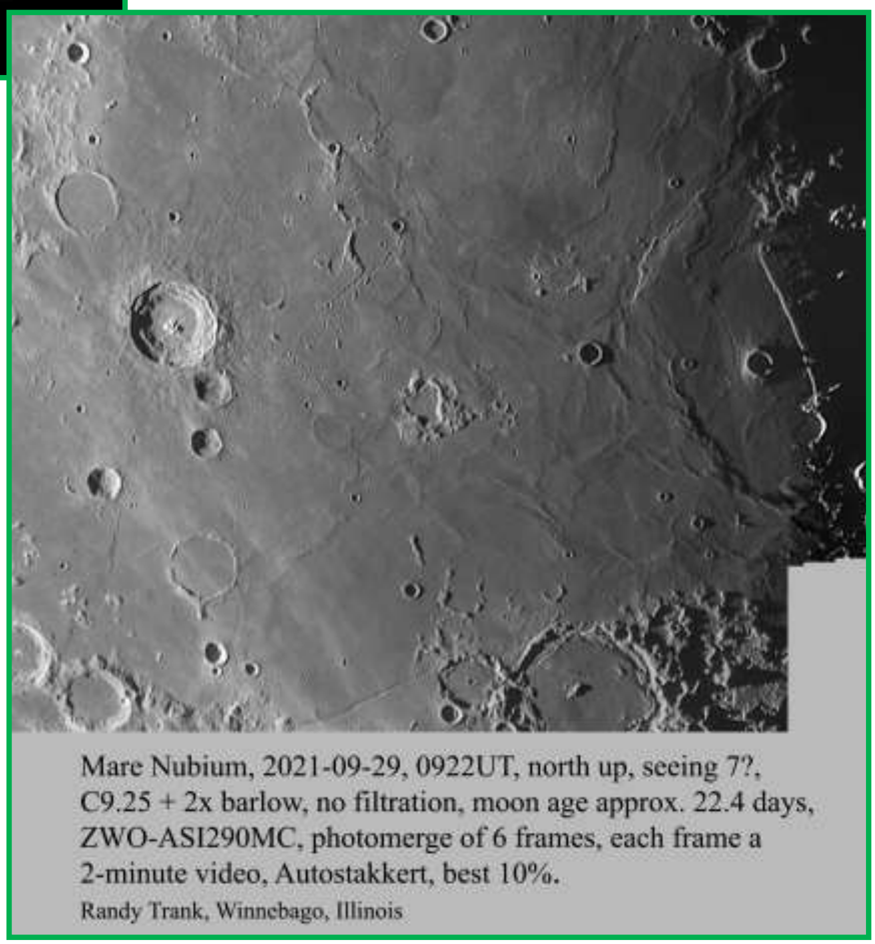
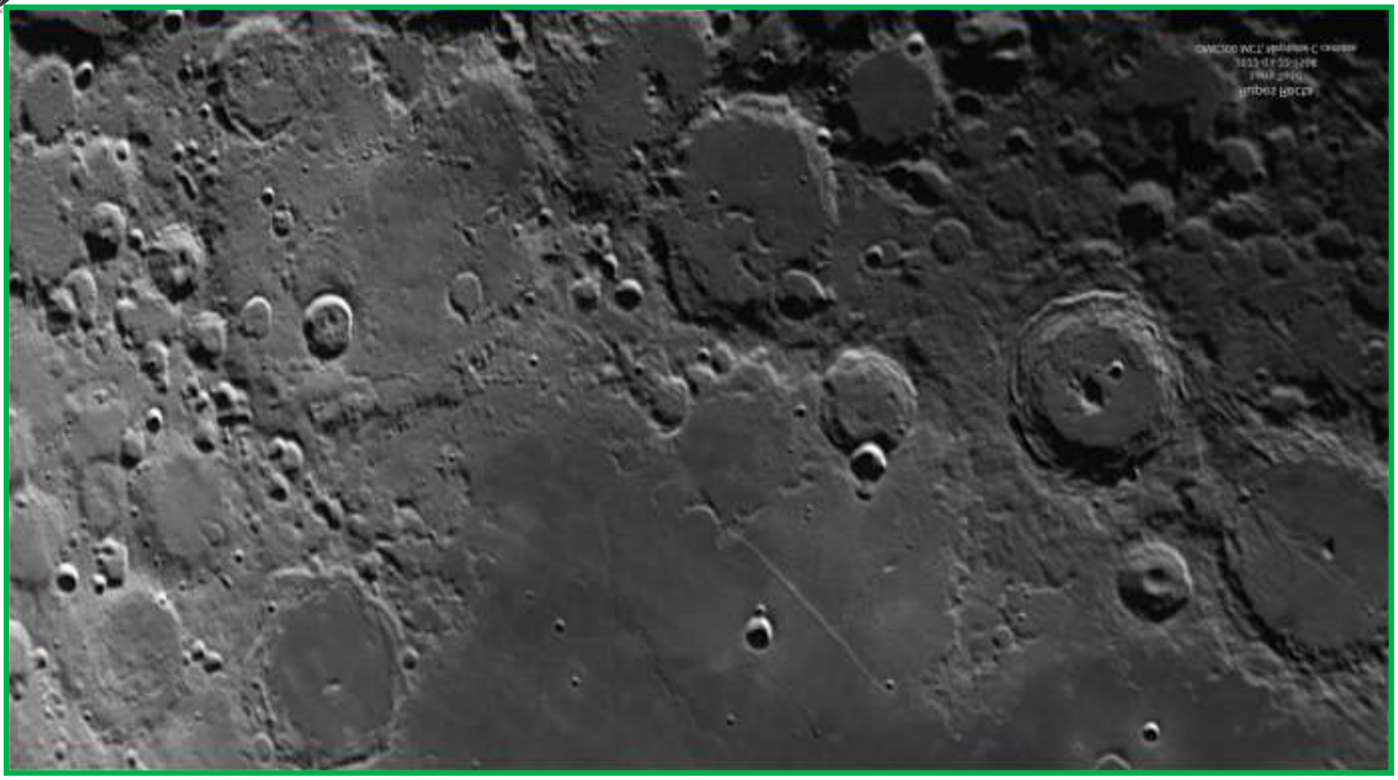


Image 35, Mare Nubium, *Randy Trank, Winnebago, Illinois, USA. 2021 September 29 09:22 UT. Celestron 9.25 inch Schmidt-Cassegrain telescope, 2x barlow, ZWO ASI290mm/s, mosaic of 6 images. Seeing 7/10.*

In these images, especially in 24 and 25, we can follow the Grego's description: "A small crater, Arzachel D (5 km), lies at the fault's northern end. In the south, the fault cuts through the southern components of a group of small peaks known (unofficially) as the "Stag's Horn Mountains". These mountains mark part of the disintegrated western rim of a flooded crater, Thebit P (65 km), whose western floor displays a distinct cluster of small, rounded dark patches".

Rupes Recta is, as we can see, is very important in the history of lunar geology: "some true faults are radial or subradial to Imbrium; those cutting the Apennine Bench, for example, probably formed in response to adjustments of Mare Imbrium and the Imbrium basin (...) Such radial or subradial faults as the Straight Wall (Rupes Recta), one leg of Rima Hyginus, the Cauchy set, and several parallel grabens in southwestern Mare Fecunditatis are more puzzling because they cut mare materials. They cannot be direct products of the Imbrium impact. If they are related to Imbrium, they may have formed by some sort of rejuvenation of radial fractures (…) The factors that localize the straight rilles are less clear but may be further effects of the Procellarum basin. The complex system along the west Procellarum shore comprises the grabens most likely to be related to this giant basin. Widespread extension of the Procellarum margin is suggested by the trends and extent of the fracture system, which are consistent with a broad regional uplift of the mantle under the basin. More speculatively, the many straight rilles on the central and east-central nearside may have a similar origin" (Wilhelms).

When we manage to cross the Rupes Recta, we will arrive at the very old and degraded Thebit crater (58 km in diameter): "Its irregular rampart is prominently terraced, and its continuity on the N.W. interrupted by a large deep crater (Thebit A), at least 9 miles in diameter, which has in its turn a smaller crater, of about half this size, on its margin, and a small central mountain within, which was once considered a good optical test, though it is not a difficult object in a 4 inch achromatic, if it is looked for at a favorable phase. The border of Thebit rises at one place on the N.E. to a height of nearly 10,000 feet above the interior, which includes much detail. The W. wall of Thebit A attains the same height above its floor, which is depressed more than 5,000 feet below the Mare" (Elger). See IMAGE 36. In IMAGE 37 we see Thebit shining in the terminator. From Thebit we can see that, as Wood says: "The Wall slices through the lava-flooded floor of and old, unnamed ruined crater that I call "Ancient Thebit (...) To the east the rim of 200 km-wide Ancient Thebit is well defined, but its west rim is marked only by arcuate wrinkle ridges". We can enjoy Ancient Thebit in IMAGES 38 to 42.



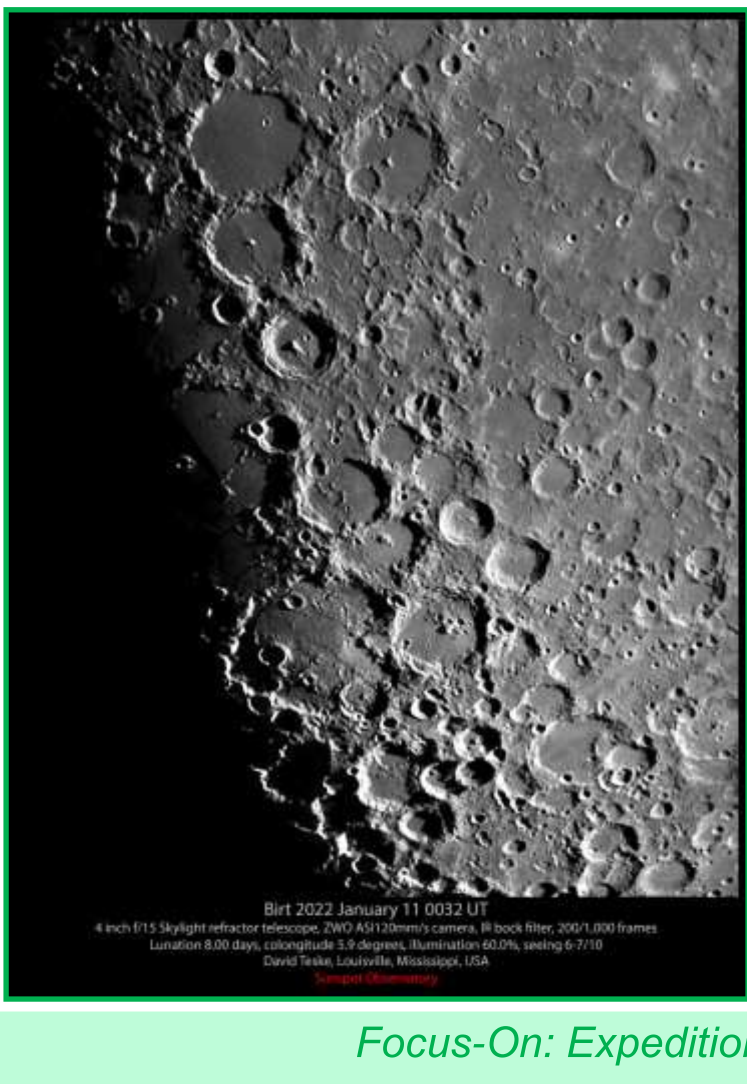


***Image 36, Rupes Recta**, Larry Todd, Dunedin, New Zealand. 2022 March 22 15:08 UT. OMC200 mm Maksutov-Cassegrain telescope, Neptune C camera, mono mode. North is to the lower right, west is to the upper right.*

***Image 37, Mare Nubium,** David Teske, Louisville, Mississippi, USA. 2022 January 11 00:32 UT, colongitude 5.9°. 4-inch f/15 refractor telescope, IR block filter, ZWO ASI120mm/s camera. Seeing 6-7/10.*

Focus-On: Expedition to Mare Nubium

Image 38, Rupes Recta, *Francisco Alsina Cardinalli, Oro Verde, Argentina. 2016 December 09 04:06 UT. Meade LX200 10 inch Schmidt-Cassegrain telescope, Astronomik ProPlanet 742nm IR pass filter.*

Image 39, Mare Nubium, *Francisco Alsina Cardinalli, Oro Verde, Argentina. 2015 December 20 02:30 UT. Meade LX200 10 inch Schmidt-Cassegrain telescope, Canon EOS Digital Rebel XS camera.*

Focus-On: Expedition to Mare Nubium

***Image 40, Rupes Recta**, Marcelo Mojica Gundlach, Cochabamba, Bolivia. 2020 May 01 22:59 UT. 150 mm refractor telescope, Orion V-block filter, SWO CMOS camera. Seeing 5/10, transparency 5/6. East is left, west is right.*

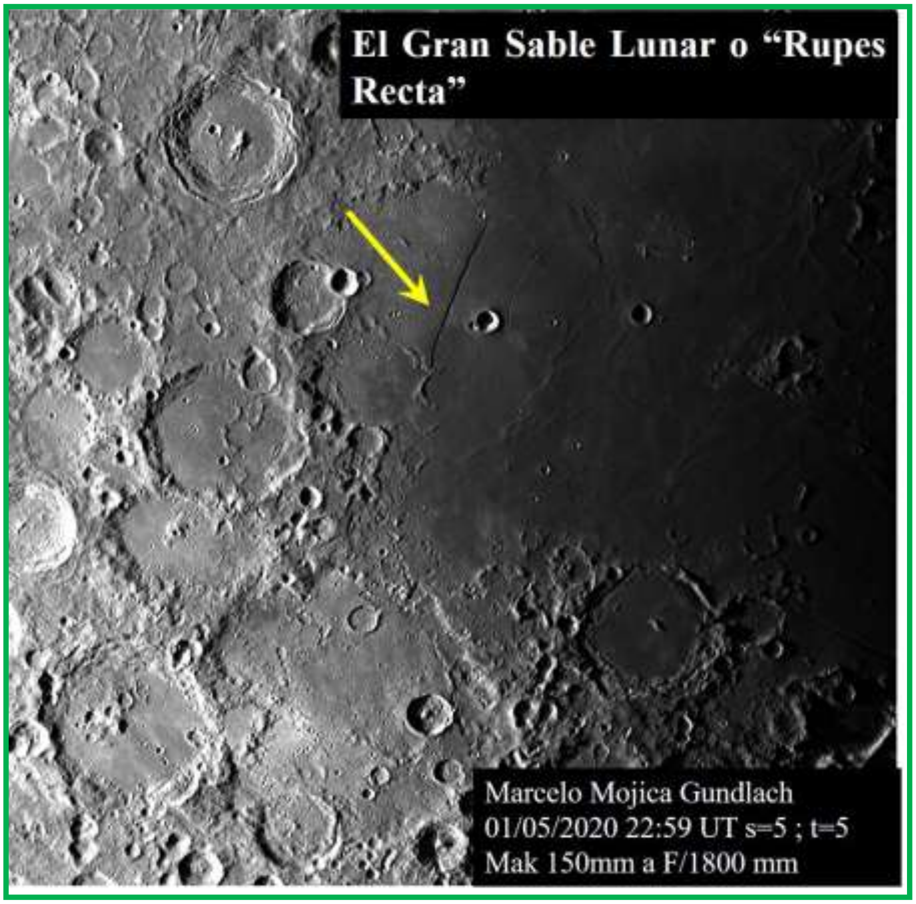


***Image 41, Mare Nubium,** Francisco Alsina Cardinalli, Oro Verde, Argentina. 2015 December 20 00:31 UT. Meade LX200 10 inch Schmidt-Cassegrain telescope, Canon EOS Digital Rebel XS camera.*

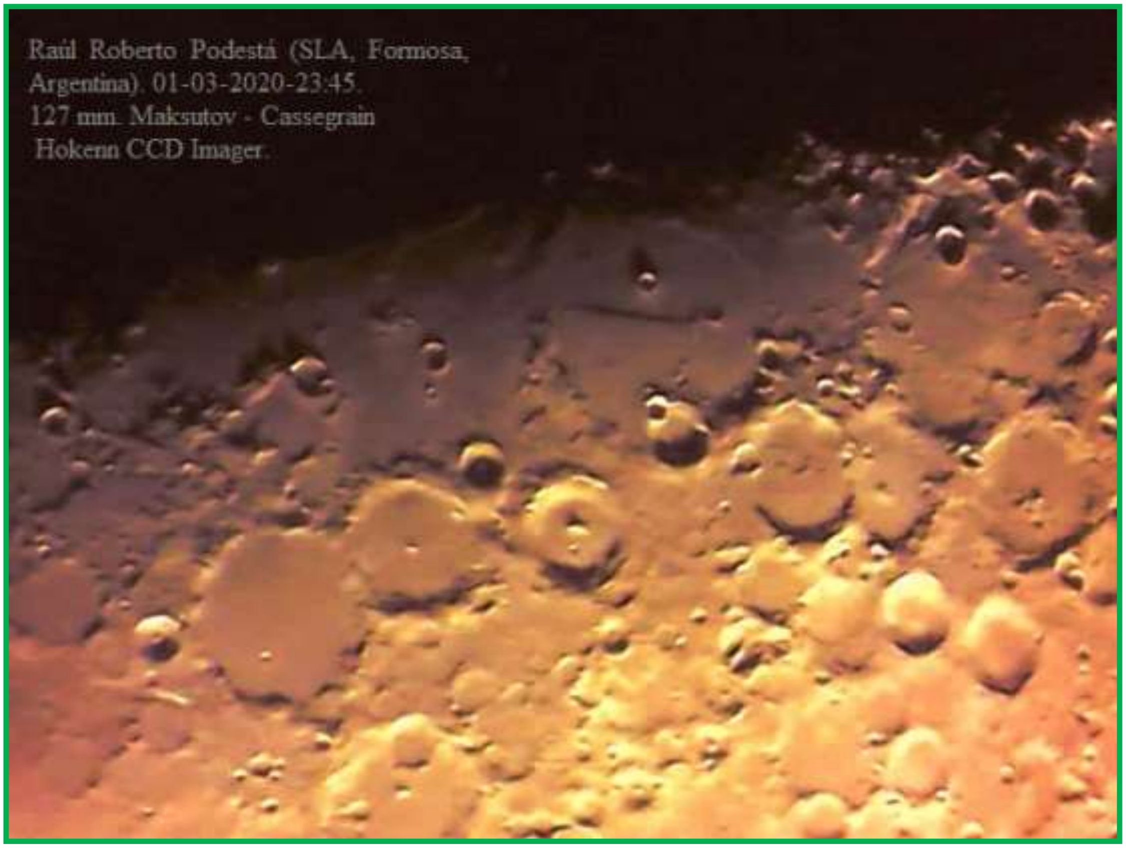


Image 42, Rupes Recta, *Raúl Roberto Podestá (SLA, Formosa, Argentina. 2020 January 03 23:45 UT. 127 mm Cassegrain telescope, Hokenn CCD imager. North is left, west is up.*

Stage 3: From Thebit to Bullialdus. See STAGE 3 IMAGE

See IMAGES 43-45.

Stage 3, Mare Nubium (labeled), *Greg Shanos, Sarasota, Florida, USA. 2023 January 05 13:57 UT. Meade LX6 8 inch Schmidt-Cassegrain telescope, Celestron f/6.3 reducer, ZWO ASI178MM camera.*

Focus-On: Expedition to Mare Nubium

Image 43, Mare Nubium, *Desiré Godoy, Oro Verde, Argentina. 2020 August 28 23:41 UT. 742nm filter, 200 mm refractor telescope, QHY5-LII camera.*

***Image 44, Rupes Recta,** Francisco Alsina Cardinalli, Oro Verde, Argentina. 2016 December 11 04:25 UT. Meade LX200 10 inch Schmidt-Cassegrain telescope, Astronomik ProPlanet 742nm IR pass filter. North is to the left, west is down.*

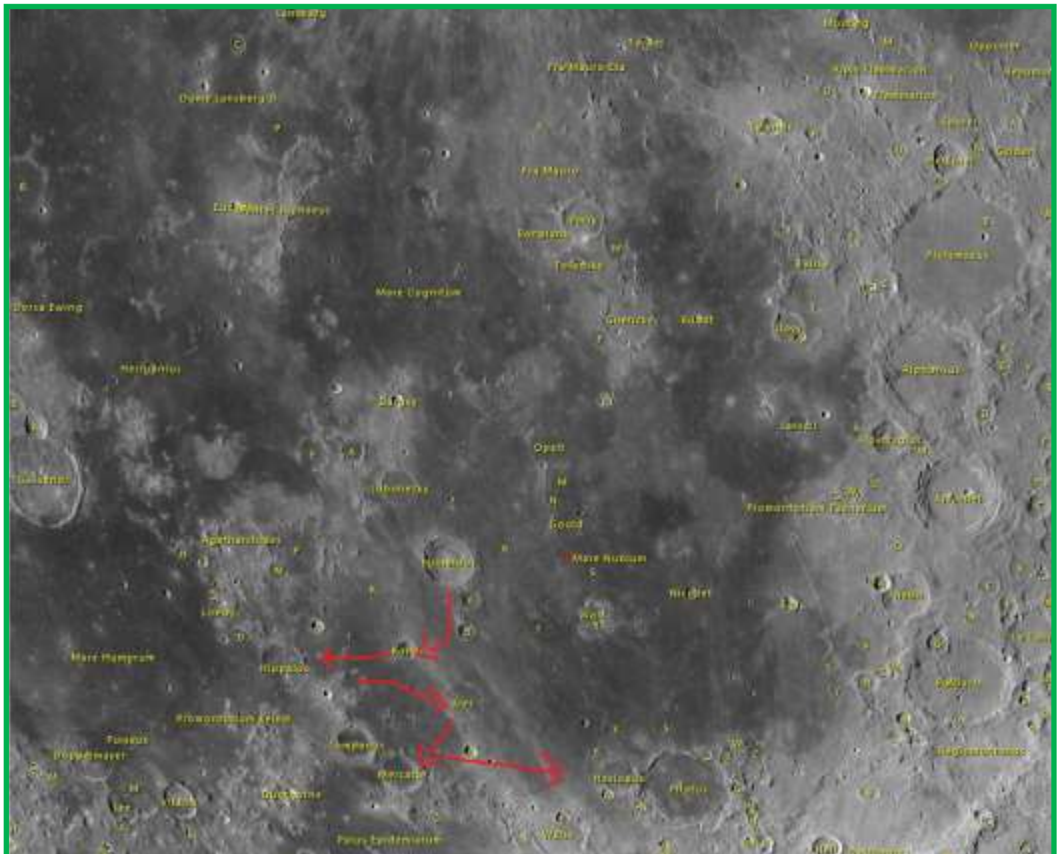
Focus-On: Expedition to Mare Nubium

Image 45, Mare Nubium, *Desiré Godoy, Oro Verde, Argentina. 2016 December 10 01:59 UT. Meade LX200 10 inch Schmidt-Cassegrain telescope, 742nm filter.*

From Thebit we go to crater Lassell (23 kms diameter), "The dark floor is also very hummocky. A bright ejecta blanket surrounds the crater. The bright rays spread mostly toward the north of the crater", Garfinkle), bordering Promontorium Taenarium ("a broad, squared-off headland, projects westwards along the northern part of the bay" according to Grego). And from Lassell, passing through its peculiar satellite craters to the west, we approached Bullialdus, but before... "Running down the center of Mare Nubium, east of Bullialdus, a chain of six flooded craters can be discerned, outlined in places by solid remnants of crater rims intertwined with wrinkle ridges. The chain proceeds south from an unnamed bay north of Opelt (49 km), through Gould (34 km), to the blocky cluster of peaks outlining Wolf (25 km) in the south – a distance of 285 km. These features are aligned radially to the Imbrian basin, and it is possible that they represent a submerged crater chain that was produced during the Imbrian impact. Under a high angle of illumination, close examination will reveal the darker flooded floors and some of the brighter walls along the crater chain, along with the bright peaks surrounding Wolf" (Wood). IMAGE 46. And if we continue to the east we will visit another crater that barely protrudes from the sea of lava, the huge (44 km in diameter) Lubiniezky, named after the author of one of the most fascinating books on astronomy ever written, the Polish astronomer who wrote "Theatrum Cometicum", published between 1666 and 1668.

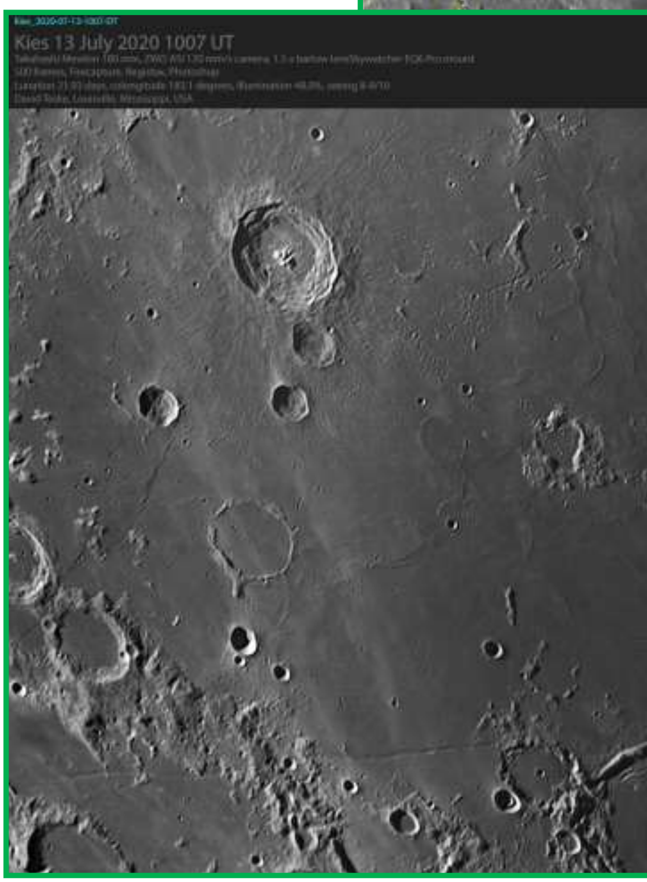
Image 46, Mare Nubium*, Marcelo Mojica Gundlach, Cochabamba, Bolivia. 2019 May 14 04:43 UT. 150 mm refractor telescope, ZWO 120 camera. North is down, west is left.*

Stage 4: Bullialdus. SEE STAGE 4 IMAGE



Stage 4, Mare Nubium (labeled), *Greg Shanos, Sarasota, Florida, USA. 2023 January 05 13:57 UT. Meade LX6 8 inch Schmidt-Cassegrain telescope, Celestron f/6.3 reducer, ZWO ASI178MM camera.*

From Lubiniezky we head south and soon we will reach the vicinity of Bullialdus (61 km in diameter and 3,300 meters deep):



"one of the finest Tycho-like craters in the southwest quadrant of the Moon (…) has the same morphology as Tycho-a wide terraced inner wall, flat floor, and a clump of central peaks-but it's much less bright and lacks rays. Thus, Bullialdus is early Eratosthenian to late Imbrian in stratigraphic age, with a probable age between 3.0 and 3.6 billion years" (Wood). See IMAGE 47.

Image 47, Mare Nubium, *David Teske, Louisville, Mississippi, USA. 2020 July 13 10:07 UT, colongitude 183.1°. 180 mm Takahashi Mewlon Dall-Kirkham telescope, 1.5x barlow, IR block filter, ZWO ASI120mm/s camera. Seeing 8-9/10.*

As we approach Bullialdus we will find the “exterior deposits, as lunar geologists describes them (…) linear ridges radiating away from Bullialdus. These filaments of ejected material give way to alignments of tiny secondary craters (…) the secondaries extend about 1 Bullialdus diameter away from the crater’s rim, except to the northwest. There the secondaries are covered by the same lavas that filled Lubiniezky and embayed the ejecta ridges from Bullialdus. These younger lavas are daubed by the much younger bright rays from Tycho” (WOOD). This can be seen in IMAGE 47 and also in IMAGE 48: “The rampart of Bullialdus rises about 8,000 feet above a concave floor, which sinks some 4,000 feet below the Mare on the W. With the exception of the fine compound central mountain, 3,000 feet high, there are few details in the interior” (Elger).

Image 48, Bullialdus, *Ken Vaughan, Cattle Point, Victoria, British Columbia, Canada. 2021 April 23 05:41 UT. Meade 12 inch LX200 GPS Schmidt-Cassegrain telescope, Astronomik 642 I-IR filter, ZWO ASI178mm camera.*

In IMAGE 49, in addition to the panorama that we describe around Bullialdus, and the one that we will see around König, we find another spectacular rille: Rima Hippalus (an arcuate rille). That passes alongside Hippalus B and crosses Hippalus to its full extent. Now let's talk about the spectacular banded craters seen in the image. The most spectacular is Agatharchides A (between Bullialdus and Hippalus). It is only 16 kilometers in diameter but its bands are clearly distinguished. Agatharchides gives name to the Group 5 in the ALPO Banded Craters Program typology: “Group 5 - (Agatharchides A type) One half of the floor is dull and the bands radiate from near the wall inside this dull section and are visible on the dull and bright parts of the floor”. Then follow Mercator A, to the right of Mercator. Its clear bands are so bright that they stand out despite their small diameter (9 kilometers). The Mercator A ejection mantle is very bright too, it must be a crater from the Copernican period. Kies A is also a crater with fairly marked bands and small diameter, south of Kies (above in our image). See IMAGES 50 and 51.

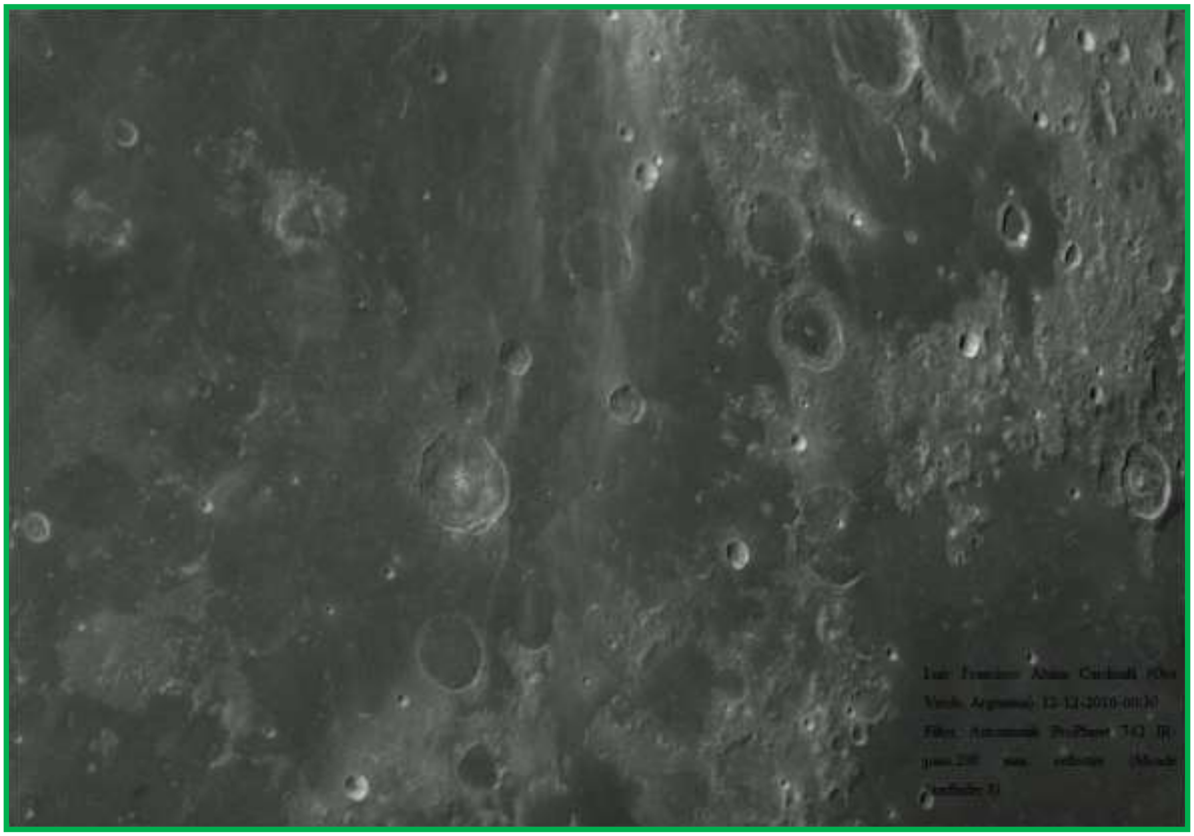


Image 49, Rupes Recta, *Francisco Alsina Cardinalli, Oro Verde, Argentina. 2016 December 12 00:30 UT. Meade Starfinder 8 inch reflector telescope, Astronomik ProPlanet 742nm IR pass filter. North is down, west is right.*

Image 50, Mare Nubium*, Marcelo Mojica Gundlach, Cochabamba, Bolivia. 2018 July 22 23:41 UT. 150 mm refractor telescope, ZWO CMOS camera. North is down, west is left.*

Focus-On: Expedition to Mare Nubium

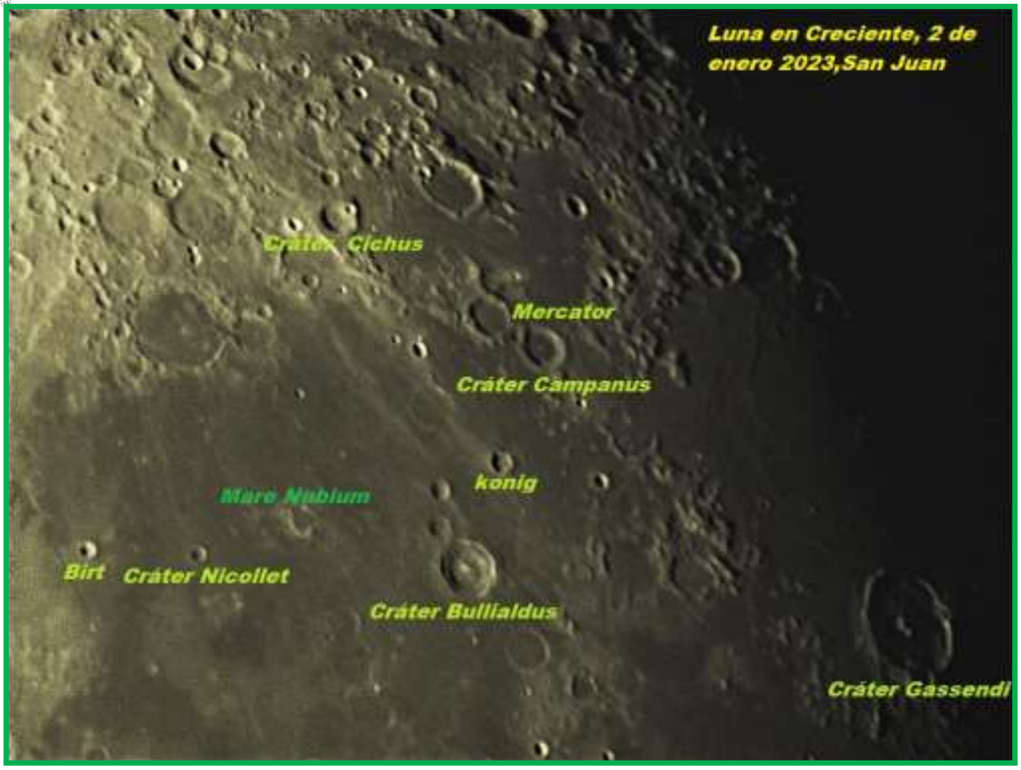


***Image 51, Mare Nubium**, Pedro Romano, San Juan, Argentina. 2023 January 02 23:08 UT. 102 mm Maksutov-Cassegrain telescope, ZWO ASI120 camera.*

Passing west of Bullialdus, Bullialdus A and Bullialdus B, we head to "König (23 km), a deep-impact crater with a hilly floor, lies halfway between Bullialdus and Campanus (48 km) on the southwestern mare border" and then towards Lubiniezky's twin, Kies, another 44 km diameter crater with its interior flooded, of which we see only the upper part of its rim protruding from the lava that formed Mare Nubium. Our path is marked by a very prominent bright ray from Tycho, but we could not see it on the surface of the Moon as we see it in IMAGE 52 and 53. "Kies is famous as the guidepost to one of the easiest volcanoes to find in the Moon. Just west of the crater is an 11-km wide dome called Kies Pi, which contains a tiny summit pit". Elger's description is curious, more than a century ago: "On the Mare W. of Kies is a curious circular mound, and farther towards Campanus two prominent little mountains". Have you seen Kies Pi in IMAGE 54 and 56? Well, take a look at the close ups.

***Image 52, Mare Nubium,** David Teske, Louisville, Mississippi, USA. 2020 July 13 10:07 UT, colongitude 183.1°. 180 mm Takahashi Mewlon Dall-Kirkham telescope, 1.5x barlow, IR block filter, ZWO ASI120mm/s camera. Seeing 8-9/10.*

Image 53, Mare Nubium, *David Teske, Louisville, Mississippi, USA. 2022 November 04 00:53 UT colongitude 29.0º. 4 inch f/15 refractor telescope, ZWO ASI120mm/s camera. Seeing 7/10. Close-up of Kies below.*

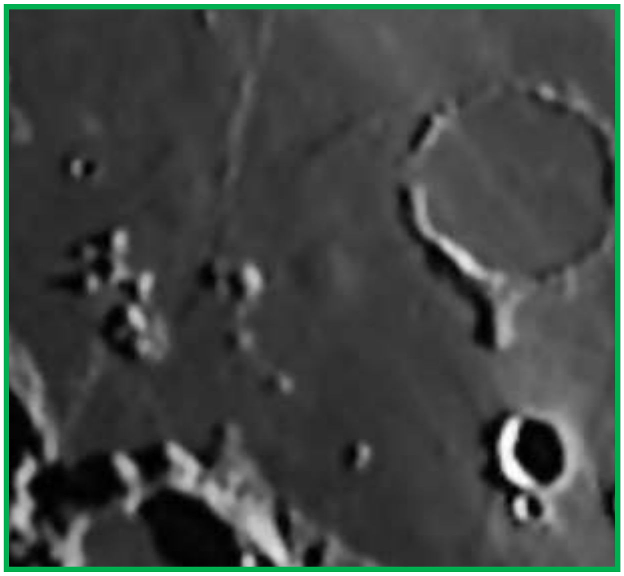
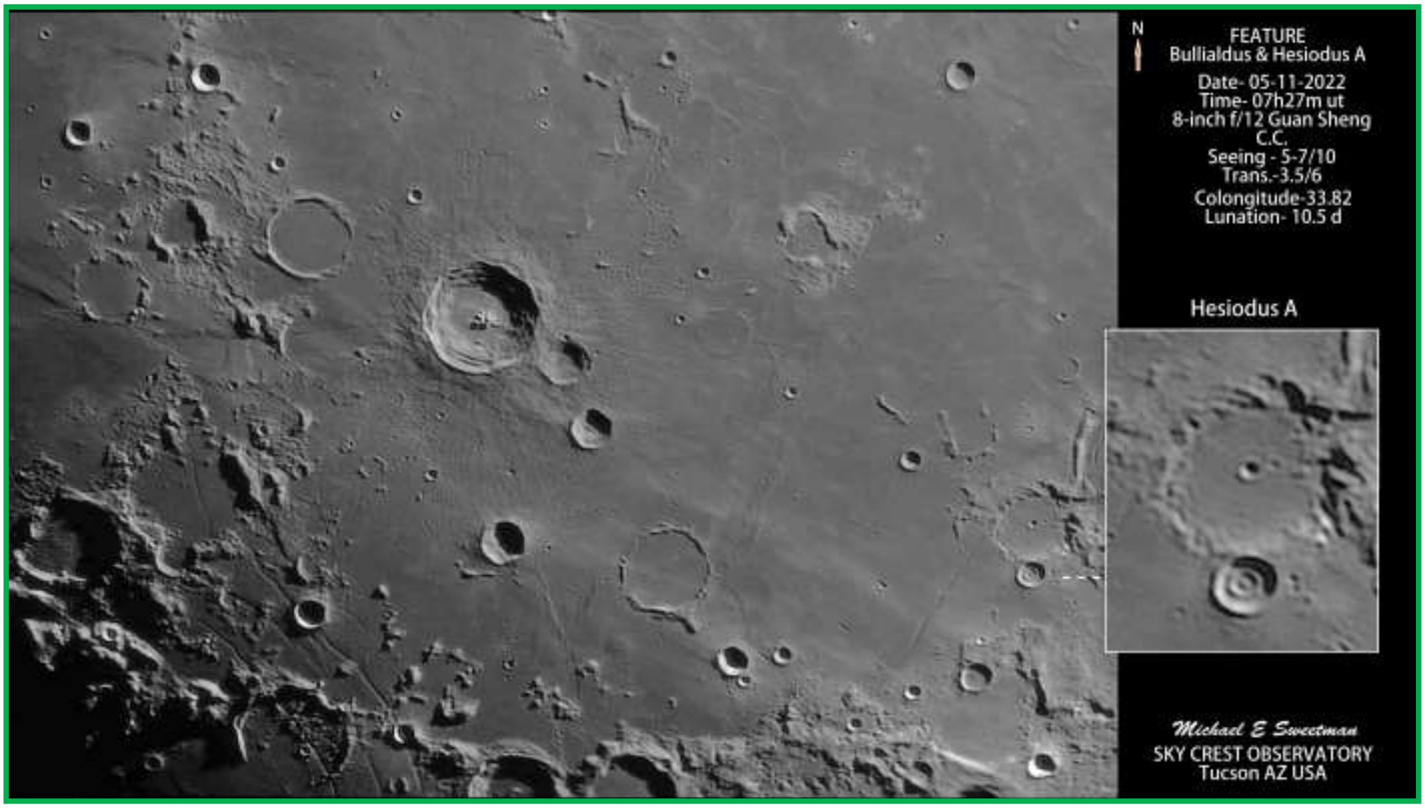


Image 54, Mare Nubium, *David Teske, Louisville, Mississippi, USA. 2022 May 11 01:38 UT colongitude 28.3º. 4 inch f/15 refractor telescope, ZWO ASI120mm/s camera. Seeing 8/10. Close-up of Kies above.*

Focus-On: Expedition to Mare Nubium

Image 55, ***Bullialdus to Hesiodus,*** *Michael Sweetman, Sky Crest Observatory, Tucson, Arizona, USA. 2022 May 11 07:27 UT, colongitude 33.82º. 8 inch f/12 Guan Sheng classical Cassegrain telescope. Seeing 5-7/10, transparency 3.5/6.*



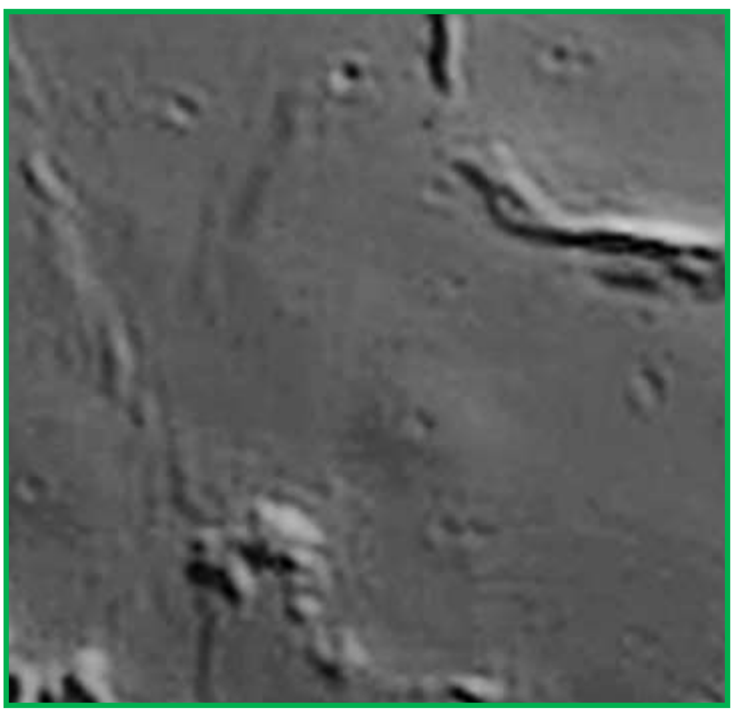


Image 55, Bullialdus to Hesiodus, *Michael Sweetman, Sky Crest Observatory, Tucson, Arizona, USA. 2022 May 11 07:27 UT, colongitude 33.82º. 8 inch f/12 Guan Sheng classical Cassegrain telescope. Seeing 5-7/10, transparency 3.5/6. Close-up.*

Focus-On: Expedition to Mare Nubium

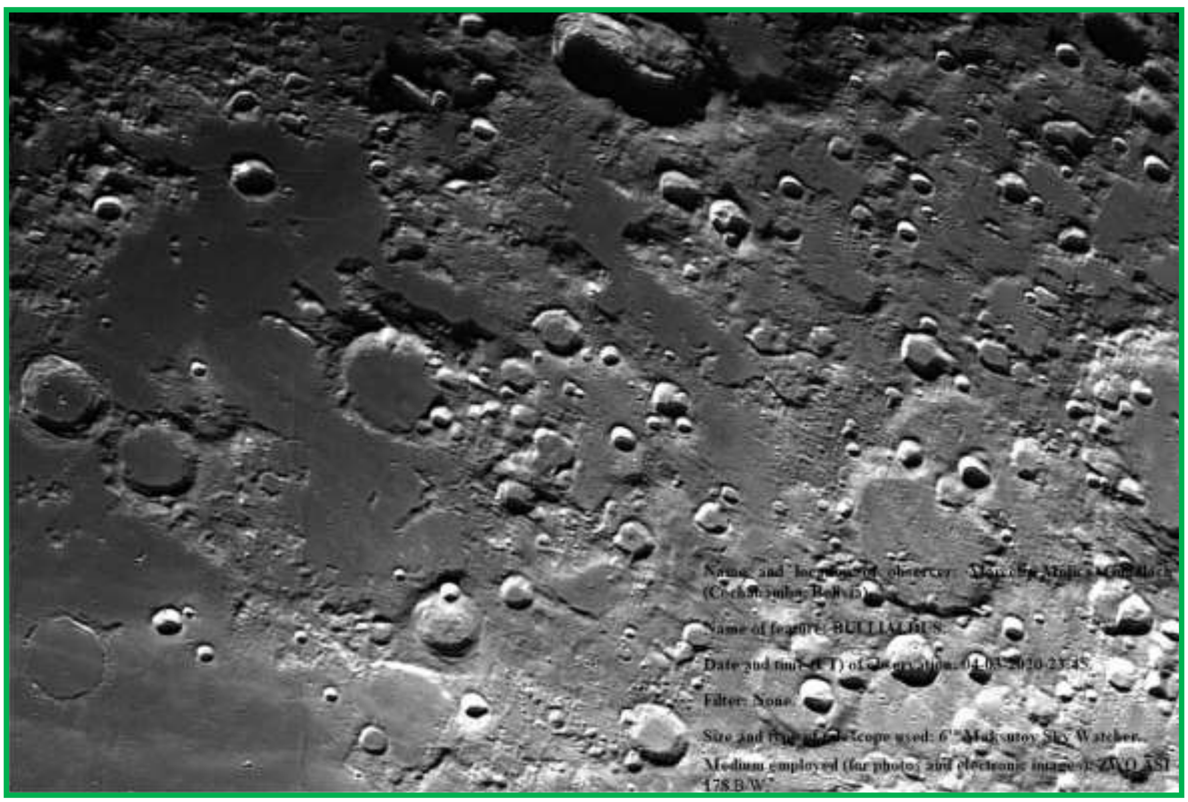
Image 56, Gassendi, *Desiré Godoy, Oro Verde, Argentina. 2016 December 10 02:04 UT. Meade LX200 10 inch Schmidt-Cassegrain telescope, 742nm filter. Close-Up to the right.*

Focus-On: Expedition to Mare Nubium

Now we are heading towards Palus Epidemiarum from König: "To its west, a low ridge connecting König with Campanus casts a prominent shadow under a low evening Sun, along with another domelike swelling near a scattered group of hills. Campanus and Mercator (47 km) are a prominent linked pair on the border between Mare Nubium and the small, irregular plain Palus Epidemiarum. Campanus has more developed internal terracing and a tiny central hill, while Mercator has a smooth, flat floor" (Grego). If we look at the center of IMAGE 57, we will see the description of Grego. See IMAGES 58 and 59.

***Image 57, Mare Nubium**, Marcelo Mojica Gundlach, Cochabamba, Bolivia. 2020 April 03 23:40 UT. 150 mm Sky Watcher Maksutov-Cassegrain telescope, ZWO ASI178B/W camera. North is down, west is left.*

***Image 58, Capuanus**, Marcelo Mojica Gundlach, Cochabamba, Bolivia. 2020 April 03 23:45 UT. 150 mm Sky Watcher Maksutov-Cassegrain telescope, ZWO ASI178B/W camera. North is left, west is up.*



Focus-On: Expedition to Mare Nubium

Image 59, Palus Epidemiarum, *Ken Vaughan, Cattle Point, Victoria, British Columbia, Canada. 2022 February 22 03:25 UT. Meade 12 inch LX200 GPS Schmidt-Cassegrain telescope, Astronomik 642 I-IR filter, ZWO ASI178mm camera.*

Finally, to go to the starting point of our circular expedition, Hesiodus, we would have to cross another crack, the, Rima Hesiodus: "a straight rille like those commonly found paralleling the edges of maria. But this independent-minded rilles slices through the rim of the Nubium basin (look to see the down-dropped blocks of highland material) and enters a backwater of mare material (Palus Epidemiarum) between Capuanus and Mare Humorum" (Wood). See IMAGE 17 Close up.

Image 17, Mare Nubium, *David Teske, Louisville, Mississippi, USA. 2020 December 08 11:13 UT co-longitude 188.1º. 4 inch f/15 refractor telescope, 1.5x barlow, IR block filter, ZWO ASI120mm/s camera. Seeing 8/10. Close-ups*

BIBLIOGRAPHY:

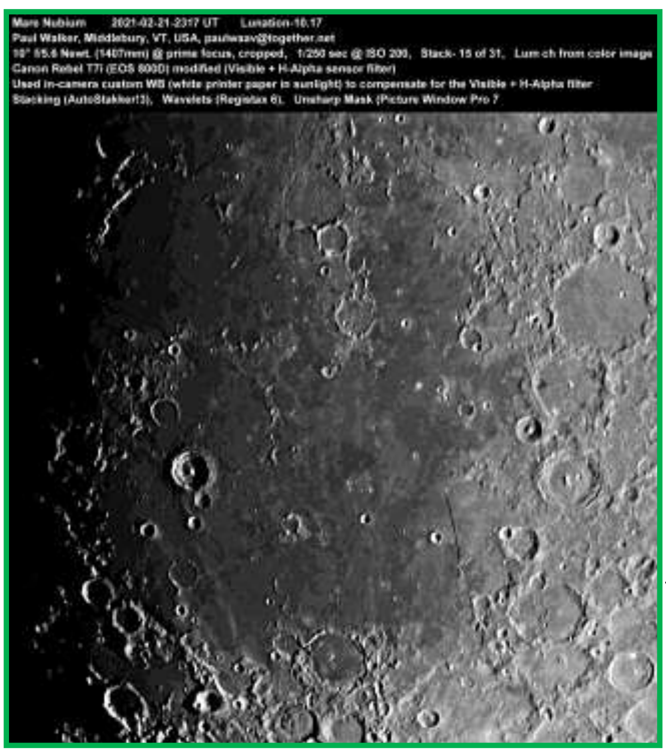
Elger, Thomas G. (1895), The Moon, George Philip & son, London.

Garfinkle, Robert (2020), Luna Cognita, Springer, New York.

Grego, Peter (2005), The Moon and How to Observe It, Springer.

Perelman, Jacob, Astronomía Recreativa, Editorial Cartago, Buenos Aires, 1964.

Wilhelms, Don (1987): “The Geological History of the Moon”, United States Government Printing Office, Washington, 1987.



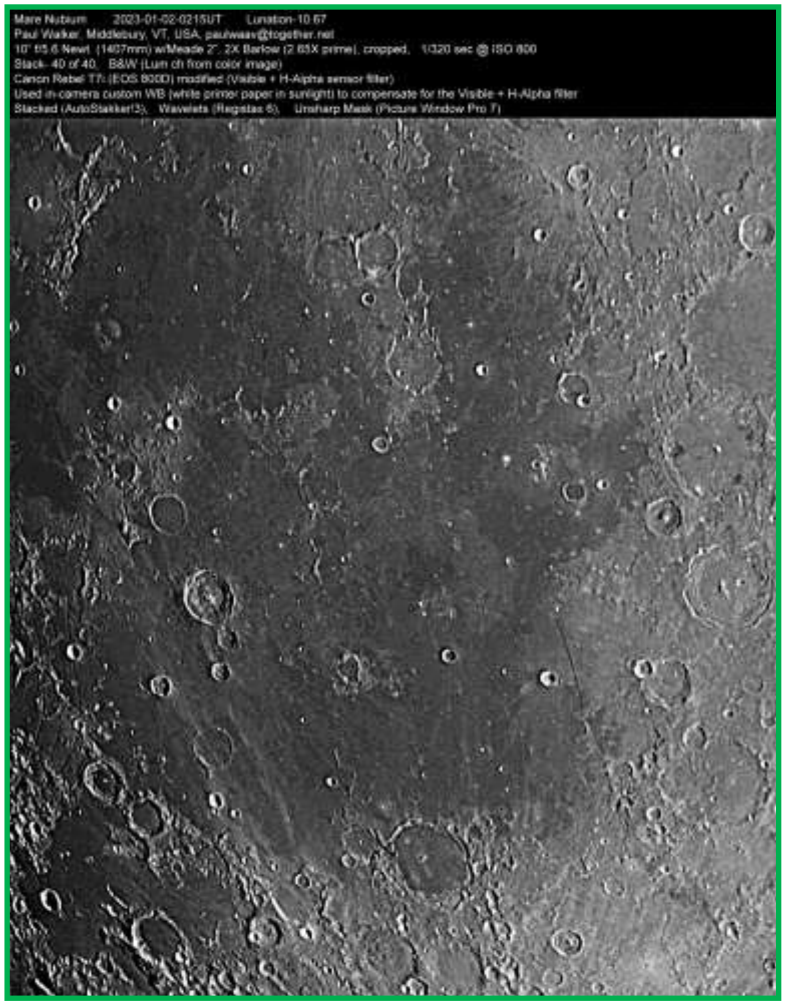
Wood, Charles A. (2003), The Modern Moon. A Personal View, Sky and Telescope, Cambridge

Perelman, Jacob, Astronomía Recreativa, Editorial Cartago, Buenos Aires, 1964.

Mare Nubium, *Paul Walker, Middlebury, Vermont, USA. 2021 February 21 23:17 UT. 10 inch f/5.6 reflector telescope, focal length 1,407 mm, Canon Rebel T7i camera.*

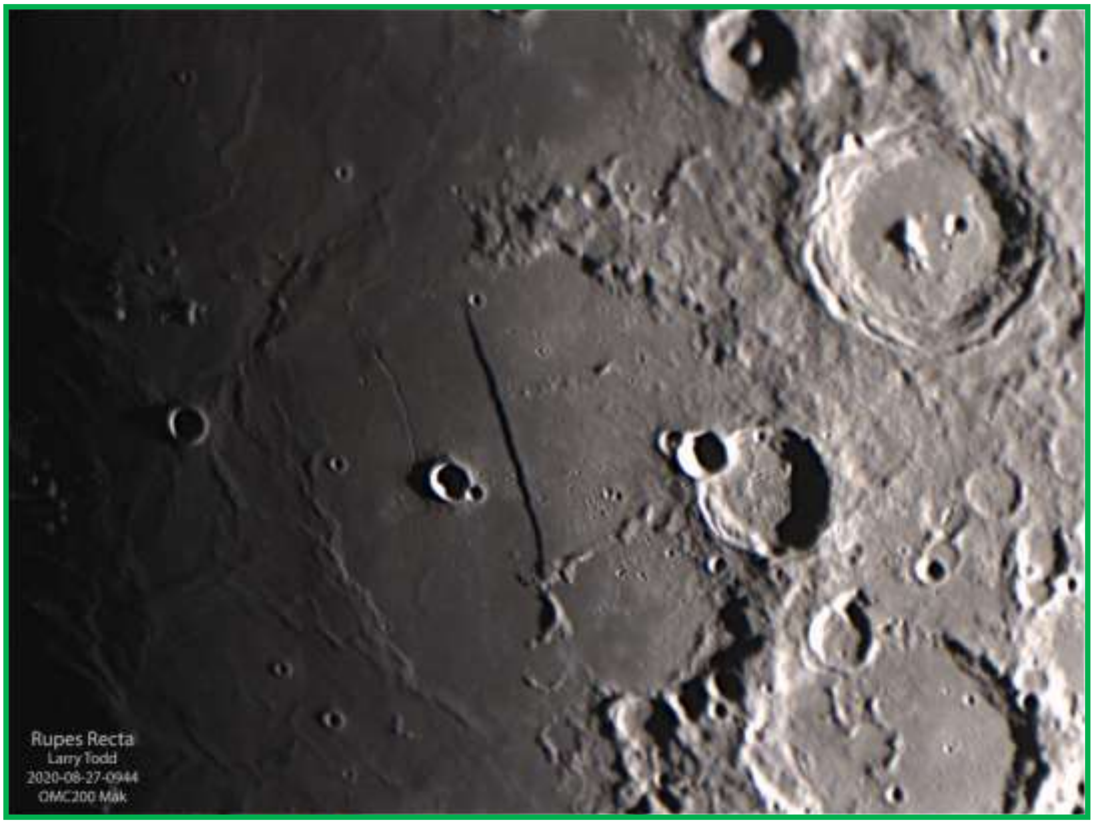
Focus-On: Expedition to Mare Nubium

Mare Nubium, *Paul Walker, Middlebury, Vermont, USA. 2023 January 02 02:15 UT. 10 inch f/5.6 reflector telescope, focal length 1,407 mm, with 2 inch Meade 2x barlow, (2.65x prime), Canon Rebel T7i camera.*

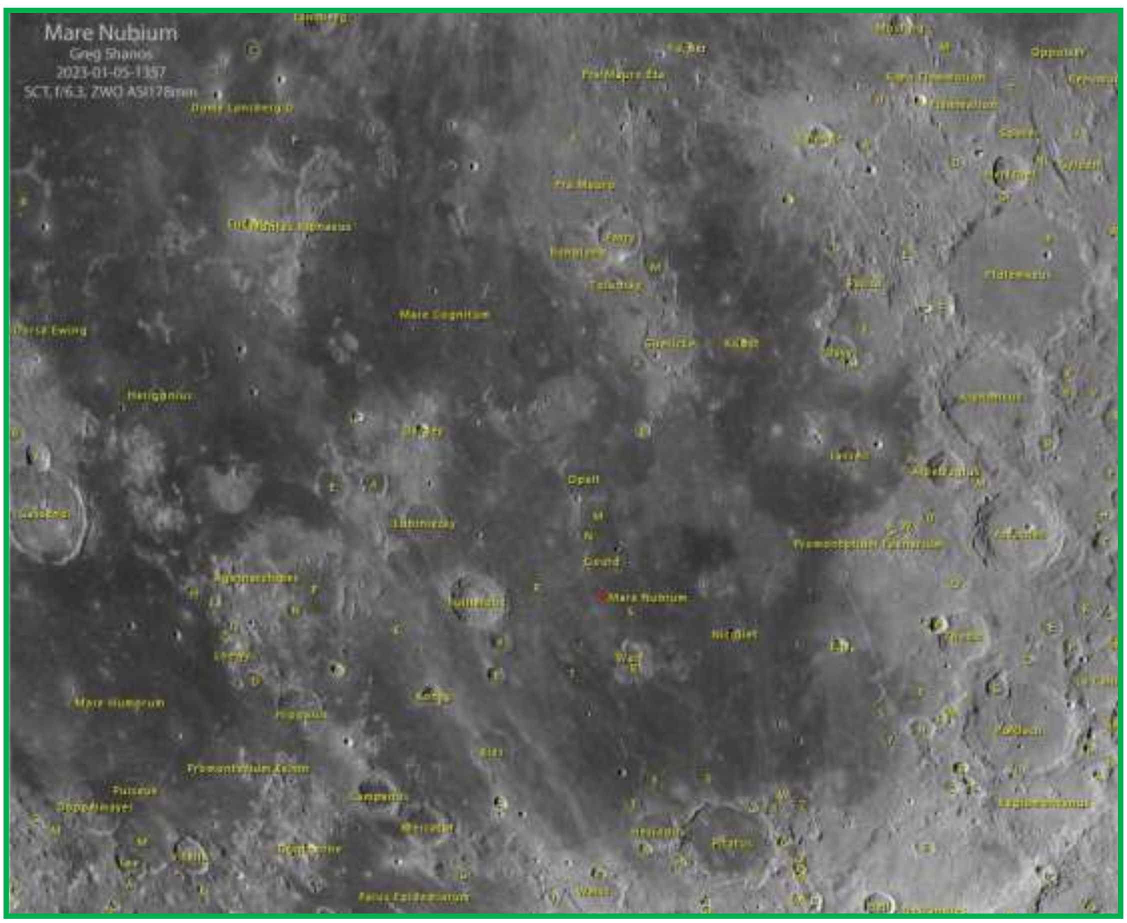


Mare Nubium, *Paul Walker, Middlebury, Vermont, USA. 2022 February 09 22:44 UT. 10 inch f/5.6 reflector telescope, focal length 1,407 mm, with 2 inch Wollensak 1.5x barlow, (2.03x prime), Canon Rebel T7i camera.*

Focus-On: Expedition to Mare Nubium



Rupes Recta, *Larry Todd, Dunedin, New Zealand. 2020 August 27 09:44 UT. OMC200 mm Maksutov-Cassegrain telescope, Neptune C camera, mono mode.*



Mare Nubium (labeled), *Greg Shanos, Sarasota, Florida, USA. 2023 January 05 13:57 UT. Meade LX6 8 inch Schmidt-Cassegrain telescope, Celestron f/6.3 reducer, ZWO ASI178MM camera.*

Mare Nubium, *Walter Ricardo Elias, AEA, Oro Verde, Argentina. 2023 February 06 01:47 UT. Celestron CPC1100 Schmidt-Cassegrain telescope, QHY5-IIC camera.*

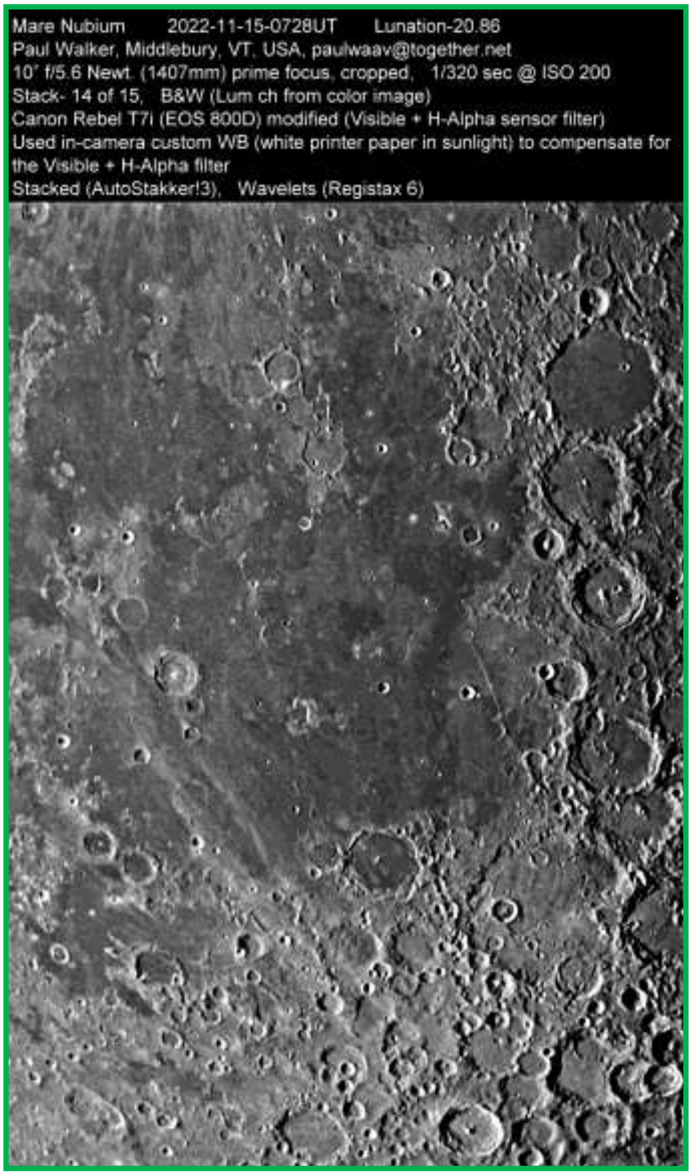
Mare Nubium, *Paul Walker, Middlebury, Vermont, USA. 2022 February 16 02:55 UT. 10 inch f/5.6 reflector telescope, focal length 1,407 mm, with 2 inch Wollensak 1.5x barlow, (2.03x prime), Canon Rebel T7i camera. This image was lightly processed to highlight craters.*

Focus-On: Expedition to Mare Nubium

Mare Nubium, *Paul Walker, Middlebury, Vermont, USA. 2022 August 20 00:02 UT. 10 inch f/5.6 reflector telescope, focal length 1,407 mm, with Wollensak 1.5x barlow, (2.03x prime), Canon Rebel T7i camera.*

Mare Nubium, *Paul Walker, Middlebury, Vermont, USA. 2022 August 20 08:37 UT. 10 inch f/5.6 reflector telescope, focal length 1,407 mm, eyepiece projection 15 mm Orion Expanse (5.75x prime), Canon Rebel T7i camera.*

Focus-On: Expedition to Mare Nubium



Mare Nubium, *Paul Walker, Middlebury, Vermont, USA. 2022 November 15 07:28 UT. 10 inch f/5.6 reflector telescope, focal length 1,407 mm, Canon Rebel T7i camera.*

Mare Nubium, *Paul Walker, Middlebury, Vermont, USA. 2022 August 20 08:47 UT. 10 inch f/5.6 reflector telescope, focal length 1,407 mm, with Wollensak 1.5x barlow, (2.03x prime), Canon Rebel T7i camera.*

Focus-On: Expedition to Mare Nubium

The Southern Shore of Mare Nubium

David Teske

Mare Nubium, *David Teske, Louisville, Mississippi, USA. 2022 May 11 01:38 UT, colongitude 28.3º. 4-inch f/15 refractor telescope, ZWO ASI120mm/s camera. Seeing 8/10.*

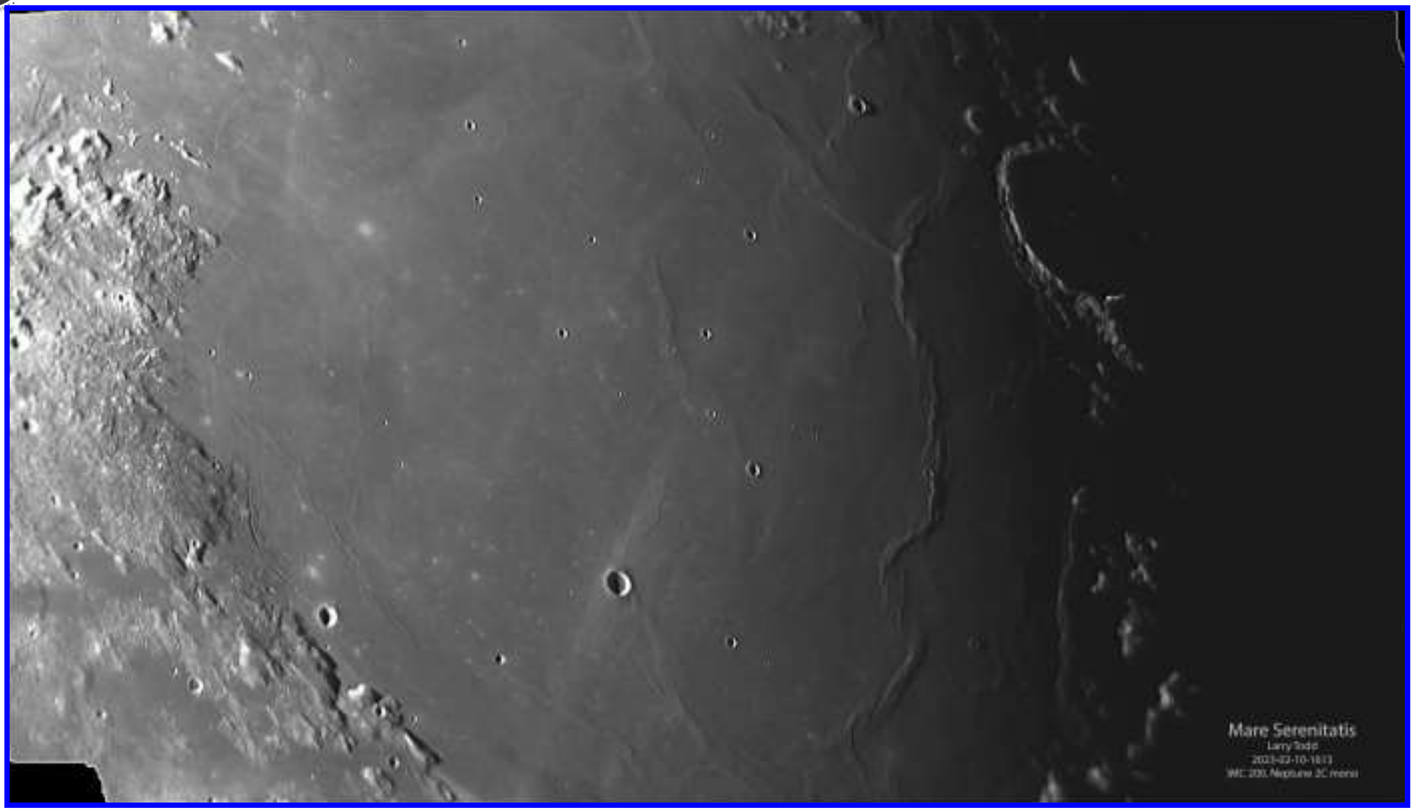
As the terminator sweeps past Mare Nubium, my 4-inch refractor is used to explore its southern shore, the shore of this Mare most easily visible. Just on the southern shore is the large degraded crater Pitatus (97 km). Its center peak is offset to the west (right) and with better lighting, rilles would be seen inside its lowered crater walls. Adjacent to the western wall of Pitatus is Hesiodus (43 km), again a rather degraded crater. At sunrise, it is fun to watch a shaft of sunlight that passes through a breach between Pitatus and Hesiodus that appears as a line across the dark floor of Hesiodus. Just southeast of Hesiodus is the remarkable concentric crater Hesiodus A, perhaps the best example of such on the Moon. It shows nicely in this image. South of this and just in the highlands is the very greatly eroded crater Wurzelbauer (88 km). Spot this and you are looking at very ancient lunar terrain! Stretching along part of the southern shores of Mare Nubium is Rima Hesiodus, a wide rille that is about 300 km long. North of it is the flooded crater Kies (44 km) with a small bit of a “handle” on its south side, perhaps the remains of an ancient crater wall. The southwest rim of Mare Nubium is well shown in this lighting condition with Rupes Mercator, a fault with a length of 180 km. This fault ends at the crater Mercator, (47 km), the lower right of two similar sized crater on the left center of the image. Just to its upper left in Campanus (48 km) with a shadow-filled floor presented here. South of this is Palus Epidemiarum the Marsh of Epidemics (avoid this one!). At the bottom left of center is the crater Capuanus (60 km). Look carefully and you will see three low domes on its floor. These three domes are not nearly as visible as the dome Kies pi, to the west of Kies. See if you can see a summit craterlet.

Focus-On: Expedition to Mare Nubium

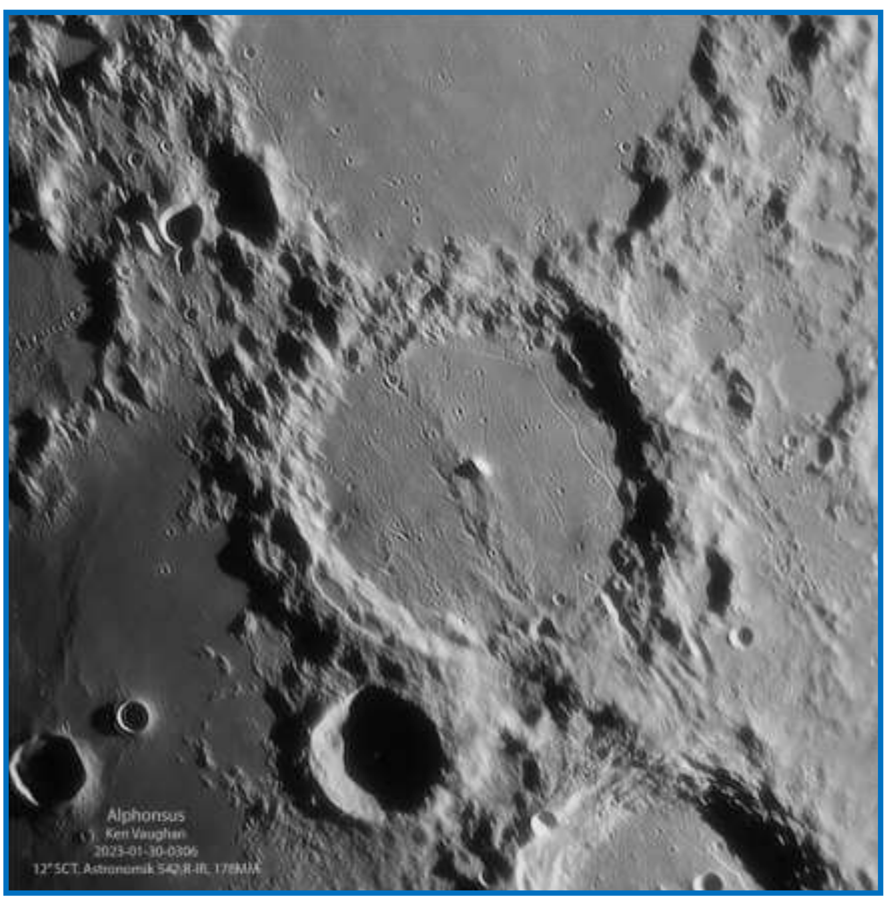
Ptolemaeus Chain, *Ken Vaughan, Cattle Point, Victoria, British Columbia, Canada. 2023 January 30 02:29 UT. Meade 12 inch LX200 GPS Schmidt-Cassegrain telescope, Astronomik 642 I-IR filter, ZWO ASI178mm camera. Seeing 4/10, transparency 8/10.*

Herodotus, *Evangelina Leguiza, AEA, Oro Verde, Argentina. 2023 February 06 02:14 UT. Celestron CPC1100 Schmidt-Cassegrain telescope, QHY5-IIC camera.*

Recent Topographic Studies



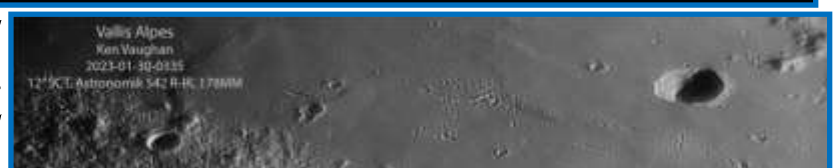
***Mare Serenitatis**, Larry Todd, Dunedin, New Zealand. 2023 February 10 16:13 UT. OMC200 mm Maksutov-Cassegrain telescope, Neptune C camera, mono mode.*



***Alphonsus,** Ken Vaughan, Cattle Point, Victoria, British Columbia, Canada. 2023 January 30 03:06 UT. Meade 12 inch LX200 GPS Schmidt-Cassegrain telescope, Astronomik 642 I-IR filter, ZWO ASI178mm camera. Seeing 4/10, transparency 8/10.*

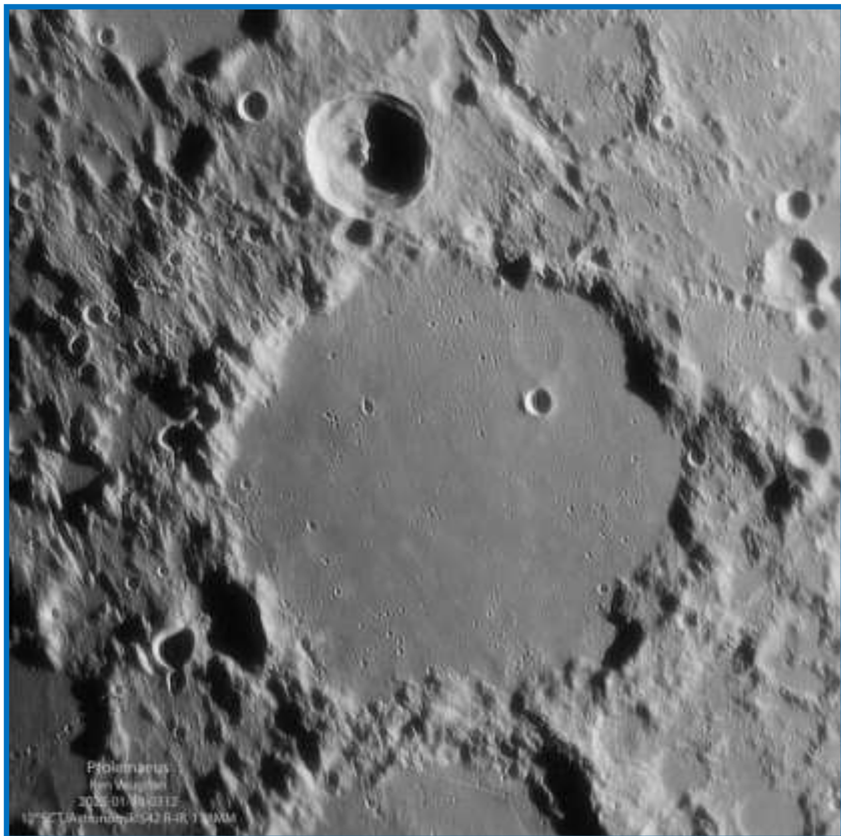
Recent Topographic Studies

Tycho and the Lunar South Pole, *Michael Toeh, Heng Fe Observatory, Penang, Malaysia. 2023 February 04 16:30 UT. APM-TMB 228/2050 refractor telescope, QHY5III178C camera, 2 panel mosaic.*



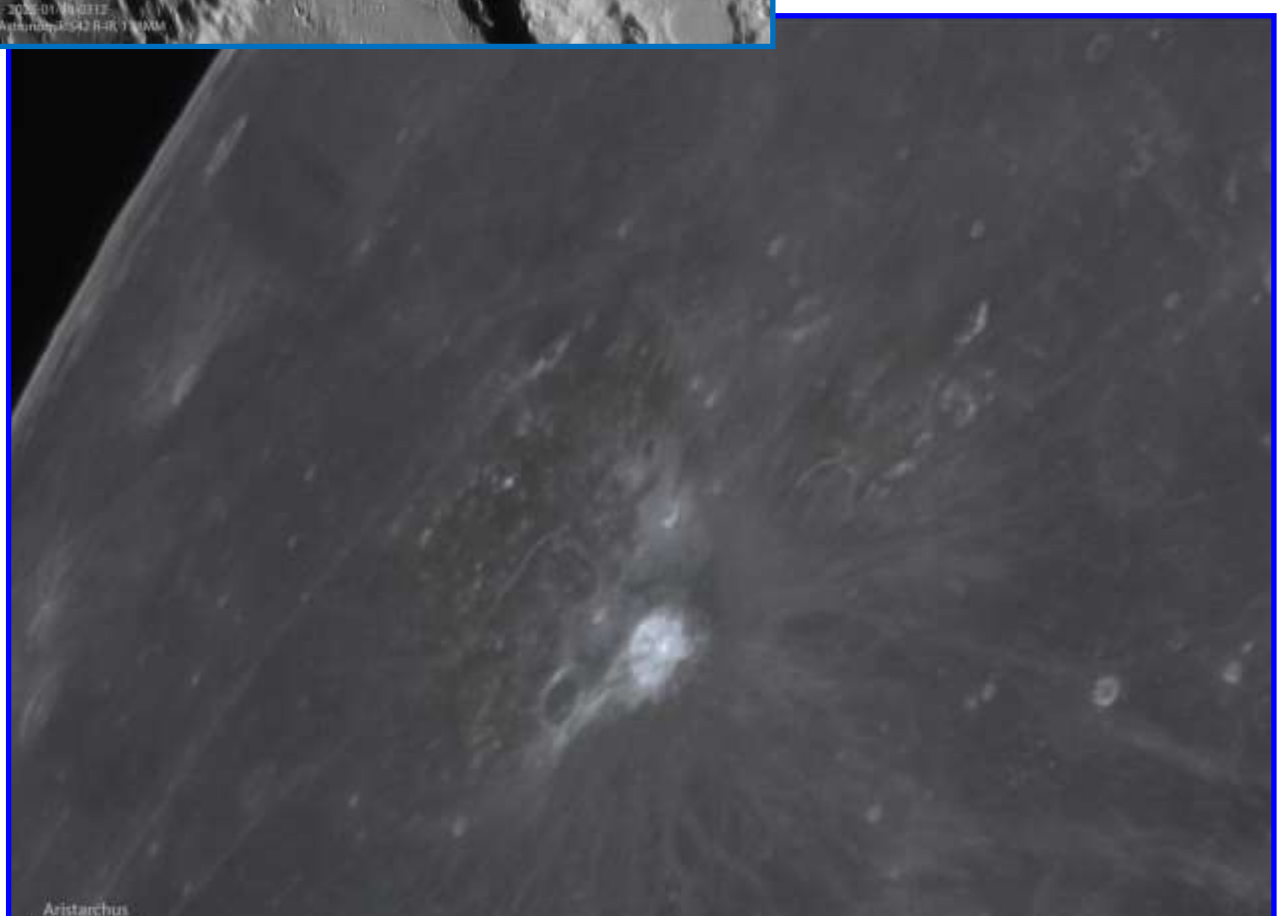
Vallis Alpes, *Ken Vaughan, Cattle Point, Victoria, British Columbia, Canada. 2023 January 30 03:35 UT. Meade 12 inch LX200 GPS Schmidt-Cassegrain telescope, Astronomik 642 I-IR filter, ZWO ASI178mm camera. Seeing 4/10, transparency 8/10.*

Recent Topographic Studies



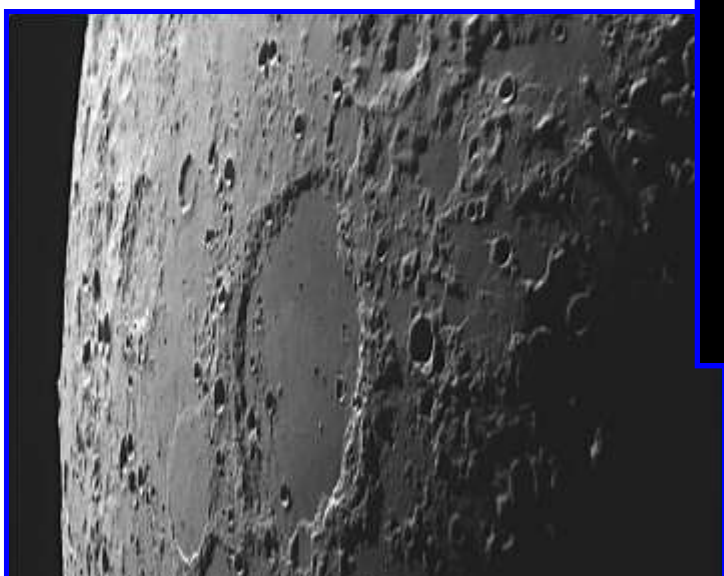
Ptolemaeus, *Ken Vaughan, Cattle Point, Victoria, British Columbia, Canada. 2023 January 30 03:12 UT. Meade 12 inch LX200 GPS Schmidt-Cassegrain telescope, Astronomik 642 I-IR filter, ZWO ASI178mm camera. Seeing 4/10, transparency 8/10.*

Aristarchus, *Walter Ricardo Elias, AEA, Oro Verde, Argentina. 2023 February 06 02:03 UT. Celestron CPC1100 Schmidt-Cassegrain telescope, QHY5-IIC camera.*



Recent Topographic Studies

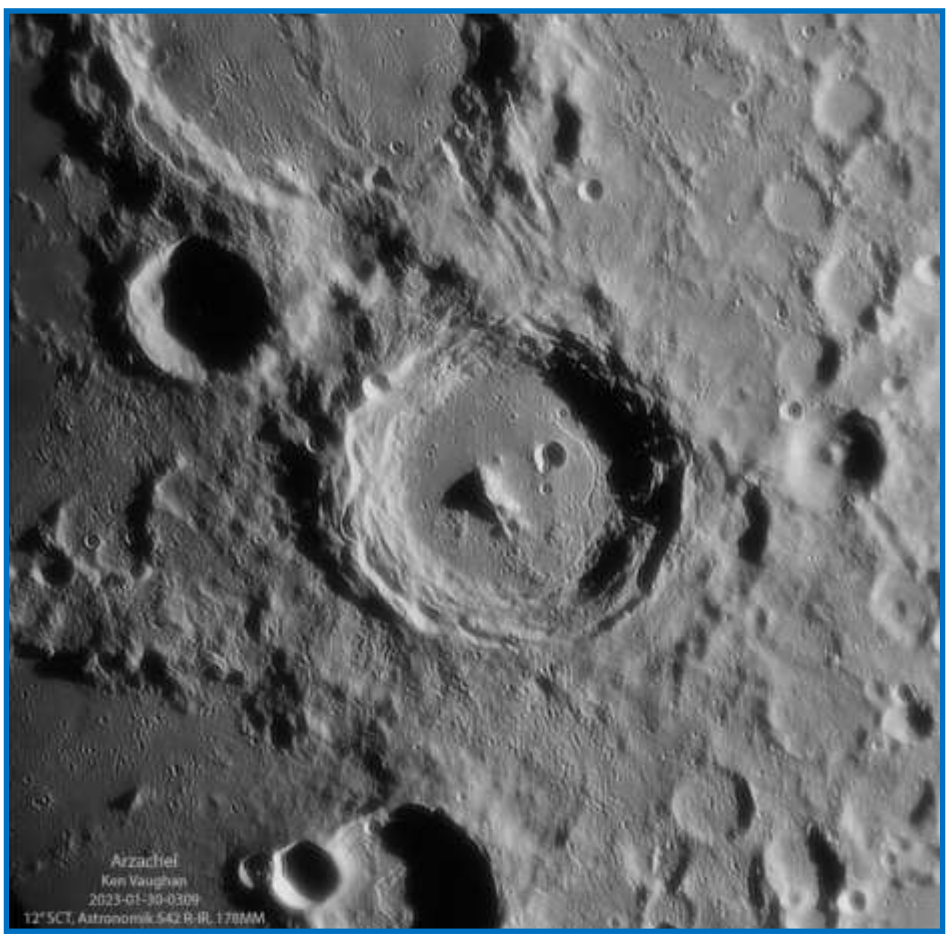
Rupes Altai, Lindenau and Rothmann, *István Zoltán Földvári, Budapest, Hungary. 2018 April 20, 19:00 UT, colongitude 331.8º. 70 mm refractor telescope, 500 mm focal length, 10 mm Plossl, 2x barlow. Seeing 8/10, transparency 5/6.*



Schickard, *Larry Todd, Dunedin, New Zealand. 2023 February 16 15:57 UT. OMC200 mm Maksutov-Cassegrain telescope, Neptune 11 C camera, mono mode.*

Recent Topographic Studies

Plato*, Larry Todd, Dunedin, New Zealand. 2023 February 10 16:18 UT. OMC200 mm Maksutov-Cassegrain telescope, Neptune C camera, mono mode.*

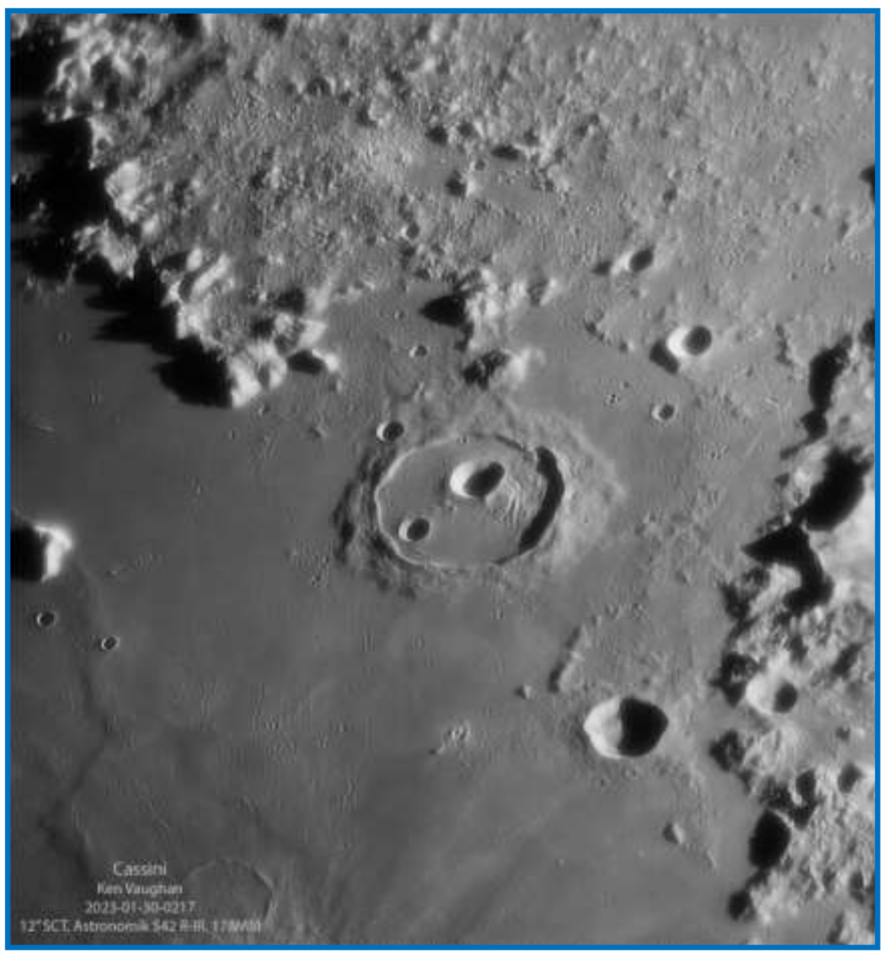


Arzachel, *Ken Vaughan, Cattle Point, Victoria, British Columbia, Canada. 2023 January 30 03:09 UT. Meade 12 inch LX200 GPS Schmidt-Cassegrain telescope, Astronomik 642 I-IR filter, ZWO ASI178mm camera. Seeing 4/10, transparency 8/10.*

Mare Orientale*, Larry Todd, Dunedin, New Zealand. 2023 February 10 16:27 UT. OMC200 mm Maksutov-Cassegrain telescope, Neptune C camera, mono mode.*

Maskelyne θ, Maskelyne ϕ and Sinus Asperitatis, *István Zoltán Földvári, Budapest, Hungary. 2018 April 20, 18:40 UT, colongitude 332.5º. 70 mm refractor telescope, 500 mm focal length, 10 mm Plossl, 2x barlow. Seeing 8/10, transparency 5/6.*

***Reiner Gamma**, Larry Todd, Dunedin, New Zealand. 2023 February 16 15:51 UT. OMC200 mm Maksutov-Cassegrain telescope, Neptune 11 C camera, mono mode.*



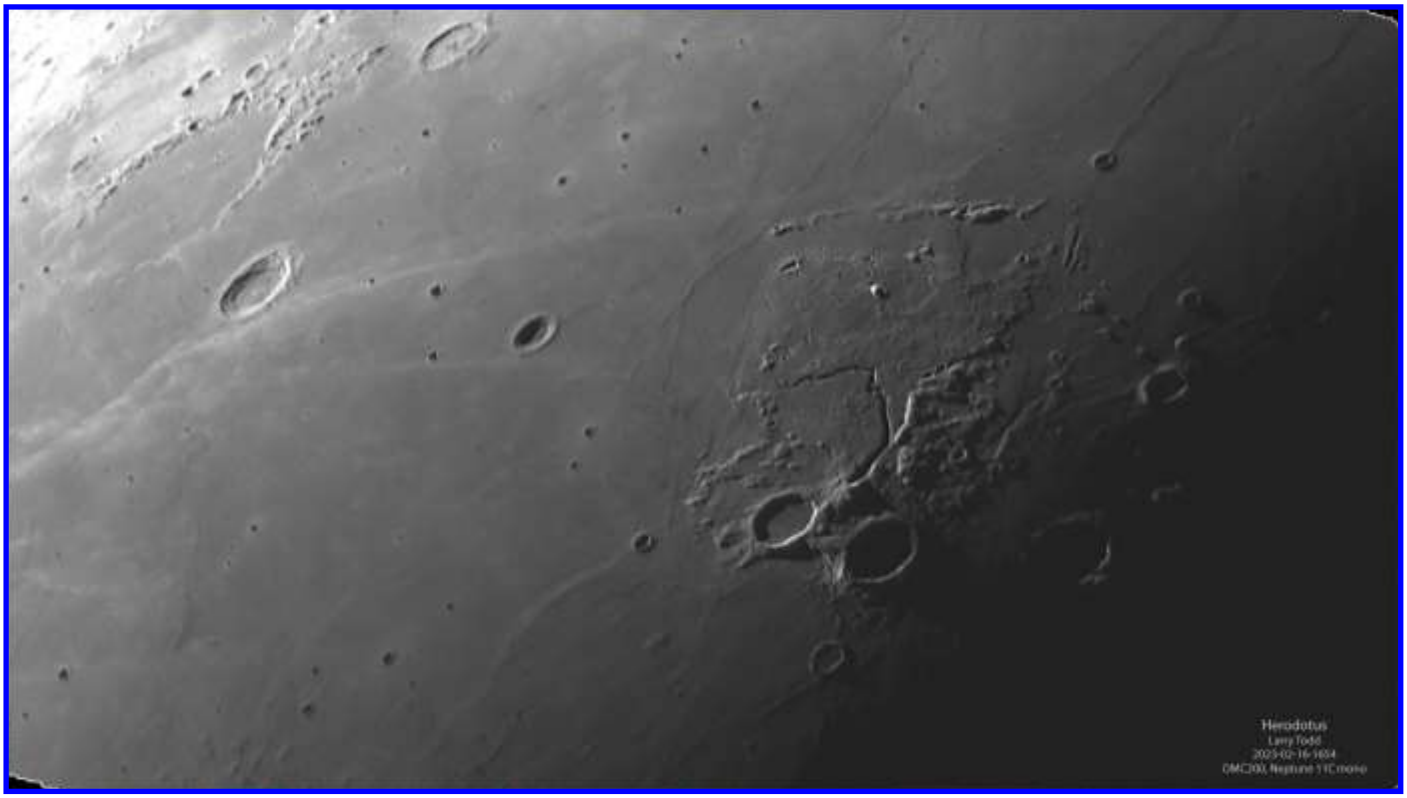
***Cassini,** Ken Vaughan, Cattle Point, Victoria, British Columbia, Canada. 2023 January 30 02:17 UT. Meade 12 inch LX200 GPS Schmidt-Cassegrain telescope, Astronomik 642 I-IR filter, ZWO ASI178mm camera. Seeing 4/10, transparency 8/10.*

Recent Topographic Studies

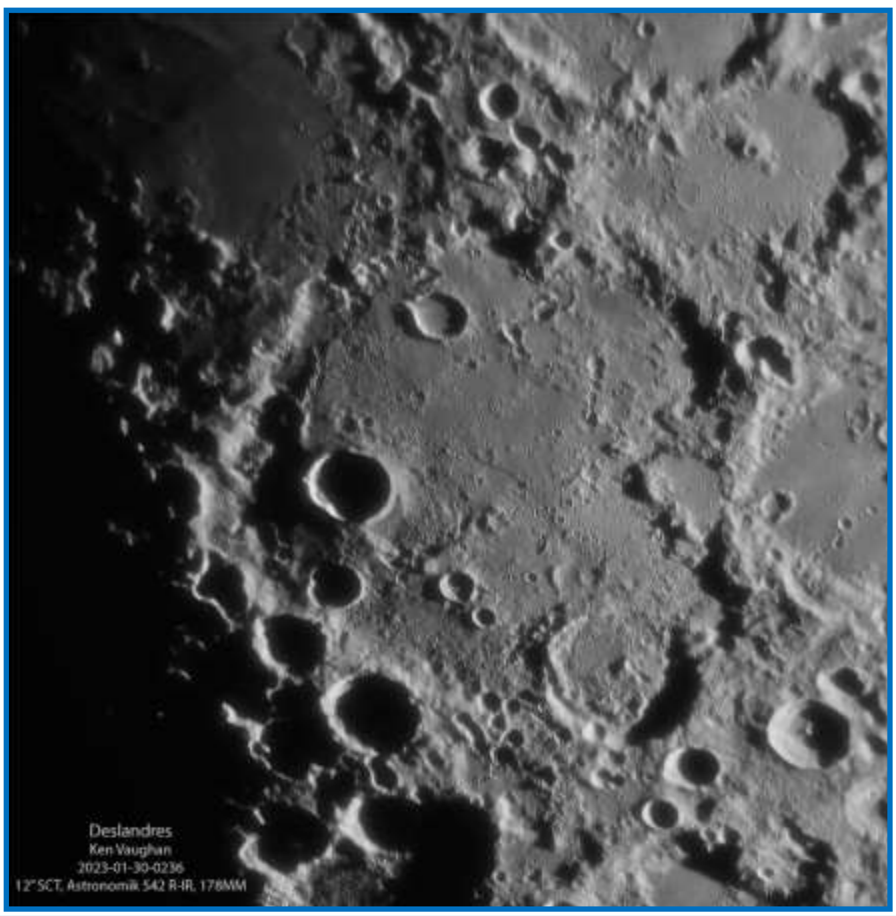
_Billy__, Larry Todd, Dunedin, New Zealand. 2023 February 16 17:01 UT. OMC200 mm Maksutov-Cassegrain telescope, Neptune 11 C camera, mono mode._

Torricelli, Torricelli R and Sinus Asperitatis, _István Zoltán Földvári, Budapest, Hungary. 2018 April 20, 19:20-19:39 UT, colongitude 332.943º. 70 mm refractor telescope, 500 mm focal length, 10 mm Plossl, 2x barlow, 100x. Seeing 7/10, transparency 5/6._

Recent Topographic Studies

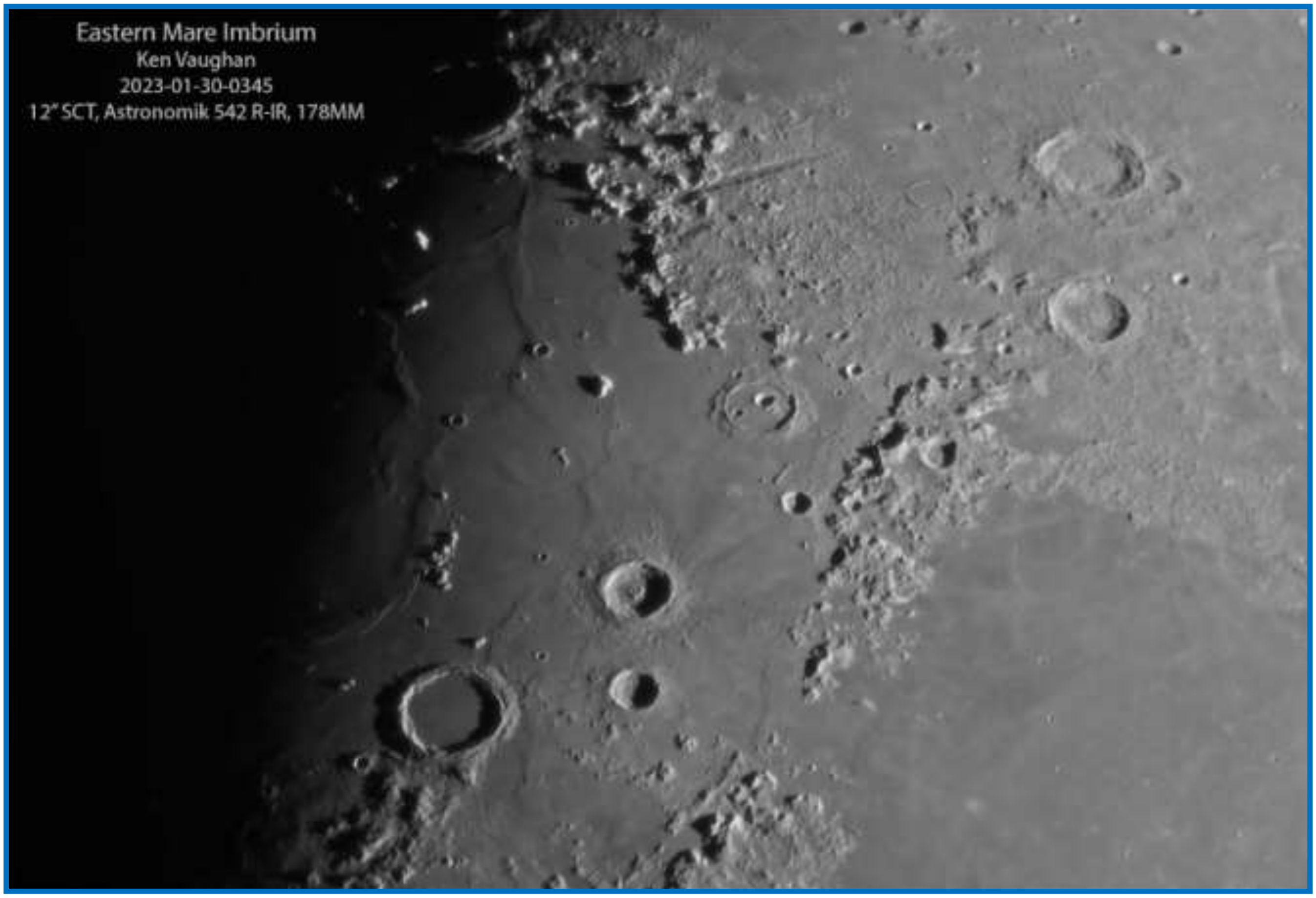


***Herodotus**, Larry Todd, Dunedin, New Zealand. 2023 February 16 16:54 UT. OMC200 mm Maksutov-Cassegrain telescope, Neptune 11 C camera, mono mode.*



***Deslandres,** Ken Vaughan, Cattle Point, Victoria, British Columbia, Canada. 2023 January 30 02:36 UT. Meade 12 inch LX200 GPS Schmidt-Cassegrain telescope, Astronomik 642 I-IR filter, ZWO ASI178mm camera. Seeing 4/10, transparency 8/10.*

Recent Topographic Studies

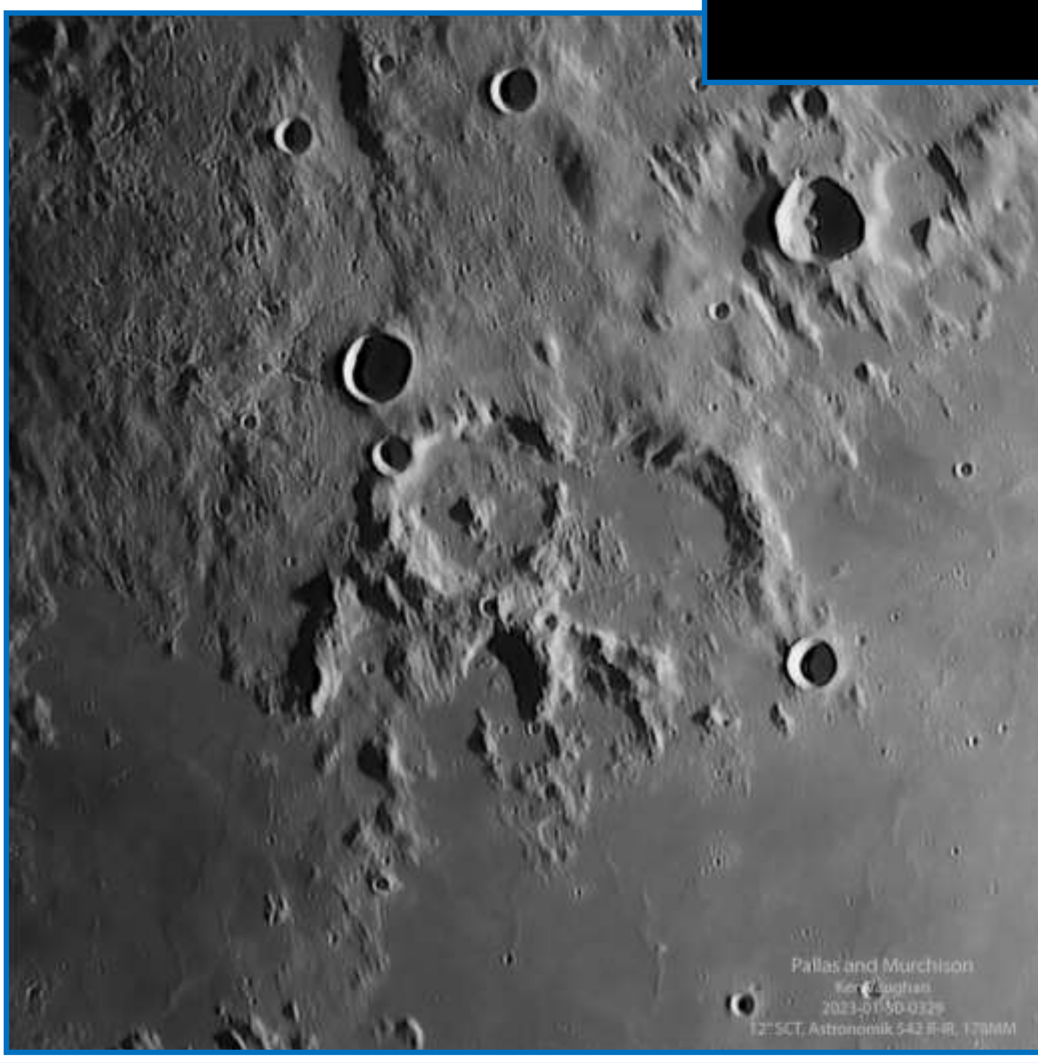


Eastern Mare Imbrium, *Ken Vaughan, Cattle Point, Victoria, British Columbia, Canada. 2023 January 30 03:45 UT. Meade 12 inch LX200 GPS Schmidt-Cassegrain telescope, Astronomik 642 I-IR filter, ZWO ASI178mm camera. Seeing 4/10, transparency 8/10.*

Aristarchus, *Victoria Gomez, AEA, Oro Verde, Argentina. 2023 February 06 02:11 UT. Celestron CPC1100 Schmidt-Cassegrain telescope, QHY5-IIC camera.*

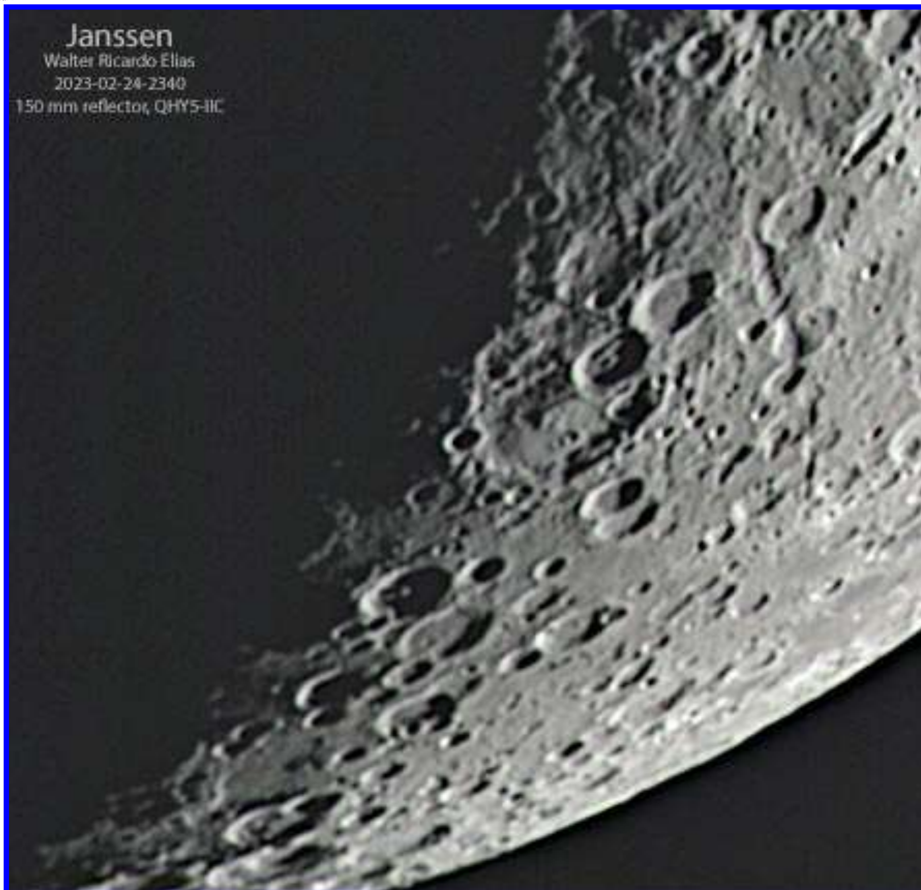
Recent Topographic Studies

Lagrange, Lagrange K and Piazzi, *István Zoltán Földvári, Budapest, Hungary. 2018 April 28, 20:52-21:09 UT, colongitude 71.2°. 70 mm refractor telescope, 500 mm focal length, 10 mm Plossl, 2x barlow, 100x. Seeing 5/10, transparency 3/6.*



Pallas and Murchison, *Ken Vaughan, Cattle Point, Victoria, British Columbia, Canada. 2023 January 30 03:29 UT. Meade 12 inch LX200 GPS Schmidt-Cassegrain telescope, Astronomik 642 I-IR filter, ZWO ASI178mm camera. Seeing 4/10, transparency 8/10.*

Recent Topographic Studies



Janssen, *Walter Ricardo Elias, AEA, Oro Verde, Argentina. 2023 February 24 22:40 UT. 150 mm Sky Watcher reflector telescope, QHY5-IIC camera.*

Timocharis, *Walter Ricardo Elias, AEA, Oro Verde, Argentina. 2023 February 06 01:41 UT. Celestron CPC1100 Schmidt-Cassegrain telescope, QHY5-IIC camera.*

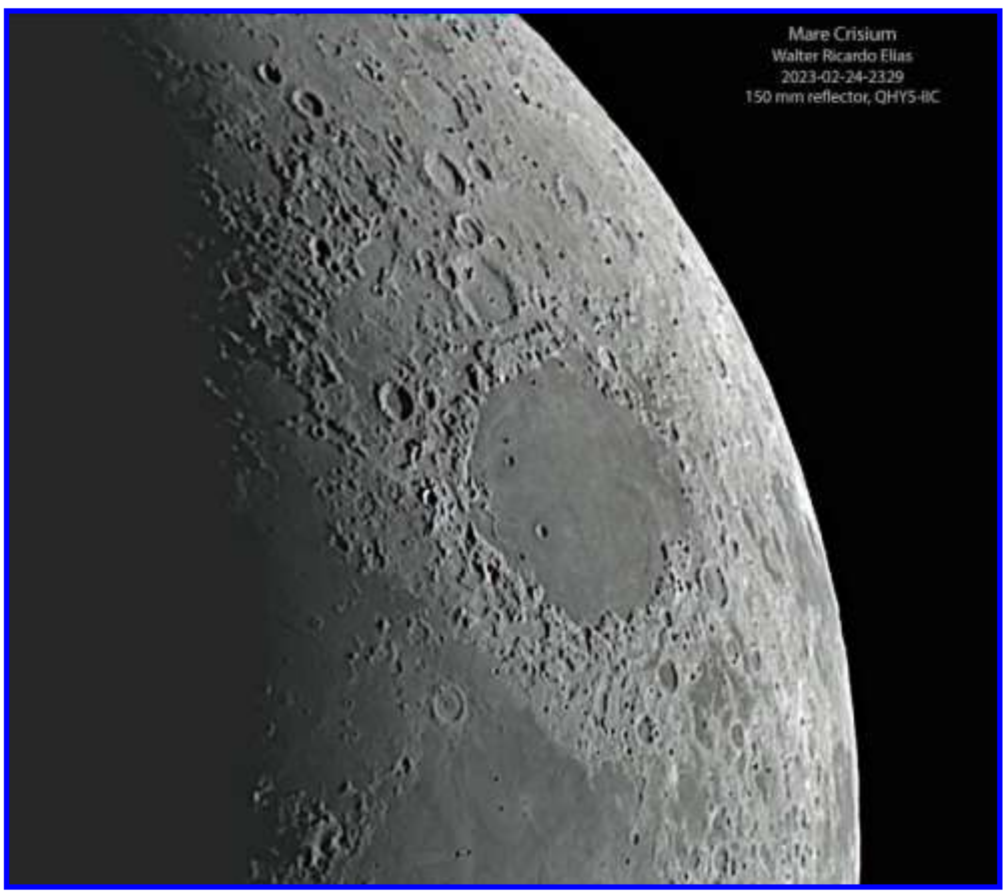
Recent Topographic Studies

Stöfler, *Ken Vaughan, Cattle Point, Victoria, British Columbia, Canada. 2023 January 30 03:22 UT. Meade 12 inch LX200 GPS Schmidt-Cassegrain telescope, Astronomik 642 I-IR filter, ZWO ASI178mm camera. Seeing 4/10, transparency 8/10.*

Pingré *István Zoltán Földvári, Budapest, Hungary. 2018 April 28, 21:10-21:30 UT, colongitude 71.4°. 70 mm refractor telescope, 500 mm focal length, 10 mm Plossl, 2x barlow, 100x. Seeing 4/10, transparency 3/6.*

Recent Topographic Studies

Three A's, *Ken Vaughan, Cattle Point, Victoria, British Columbia, Canada. 2023 January 30 02:26 UT. Meade 12 inch LX200 GPS Schmidt-Cassegrain telescope, Astronomik 642 I-IR filter, ZWO ASI178mm camera. Seeing 4/10, transparency 8/10.*



Mare Crisium, *Walter Ricardo Elias, AEA, Oro Verde, Argentina. 2023 February 24 22:29 UT. 150 mm Sky Watcher reflector telescope, QHY5-IIC camera.*

Recent Topographic Studies

W. Bond, *Ken Vaughan, Cattle Point, Victoria, British Columbia, Canada. 2023 January 30 02:21 UT. Meade 12 inch LX200 GPS Schmidt-Cassegrain telescope, Astronomik 642 I-IR filter, ZWO ASI178mm camera. Seeing 4/10, transparency 8/10.*

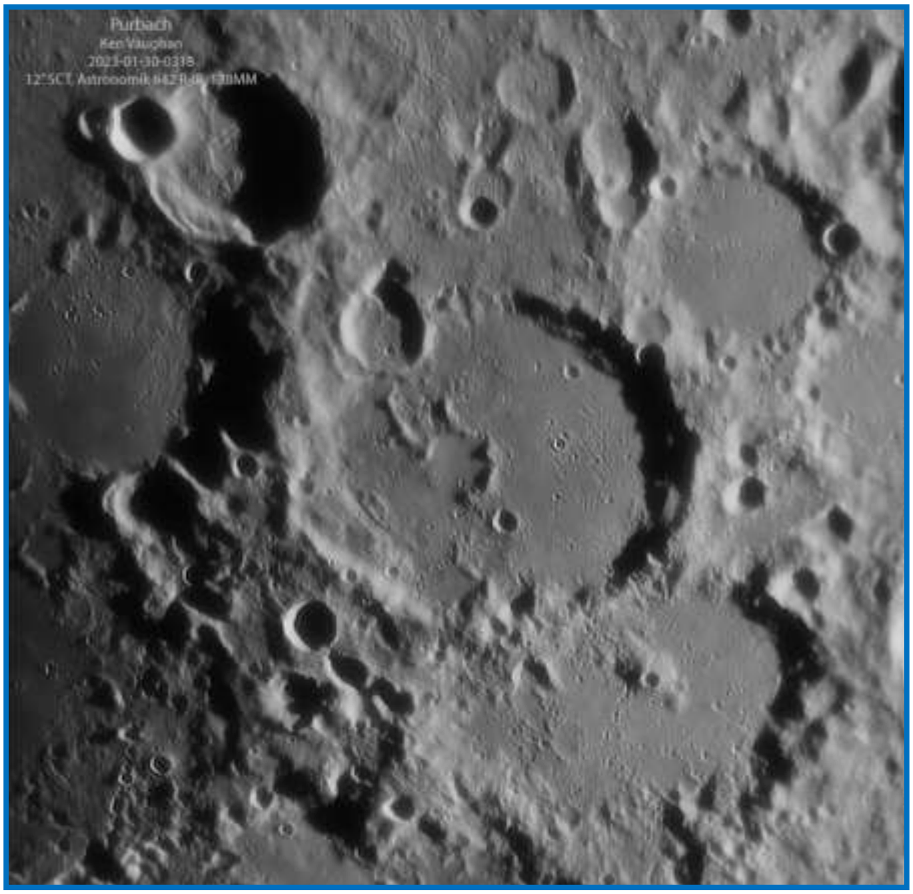
Copernicus, *Victoria Gomez, AEA, Oro Verde, Argentina. 2023 February 06 01:50 UT. Celestron CPC1100 Schmidt-Cassegrain telescope, QHY5-IIC camera.*

Recent Topographic Studies

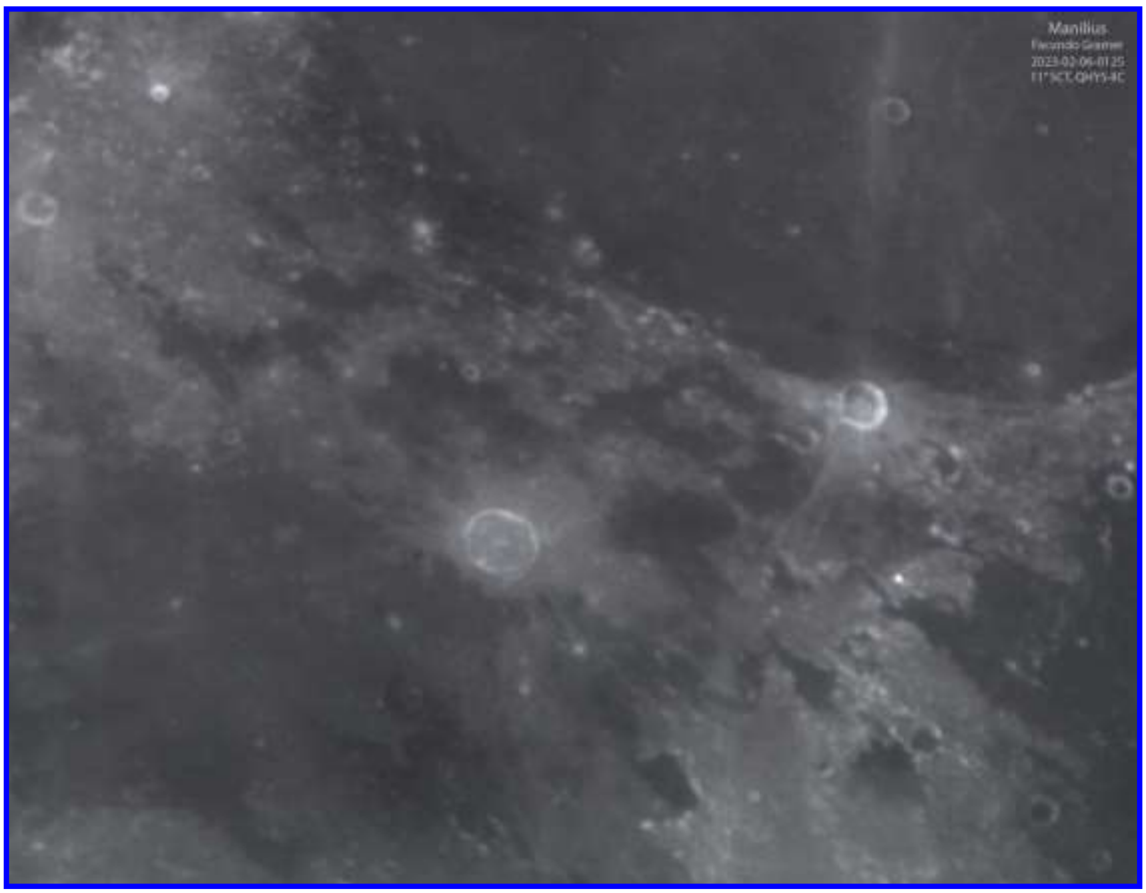
Werner and Aliacensis, *Ken Vaughan, Cattle Point, Victoria, British Columbia, Canada. 2023 January 30 03:24 UT. Meade 12 inch LX200 GPS Schmidt-Cassegrain telescope, Astronomik 642 I-IR filter, ZWO ASI178mm camera. Seeing 4/10, transparency 8/10.*

Waxing Gibbous Moon, *Jairo Chavez, Popayán, Colombia. 2023 February 04 01:36 UT. 311 mm reflector telescope, MOTO E5PLAY camera.*

Recent Topographic Studies

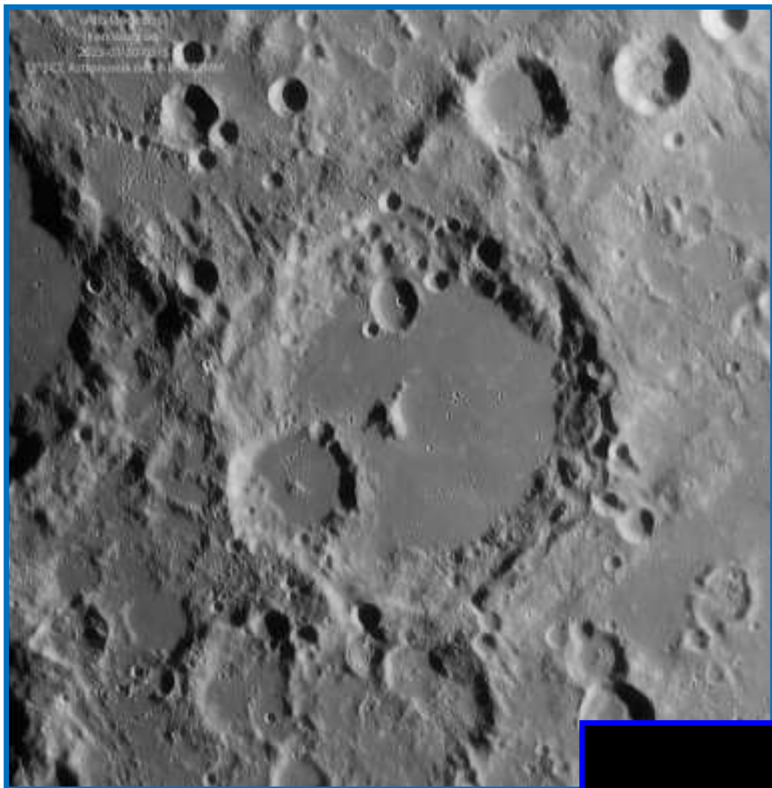


Purbach, *Ken Vaughan, Cattle Point, Victoria, British Columbia, Canada. 2023 January 30 03:18 UT. Meade 12 inch LX200 GPS Schmidt-Cassegrain telescope, Astronomik 642 I-IR filter, ZWO ASI178mm camera. Seeing 4/10, transparency 8/10.*

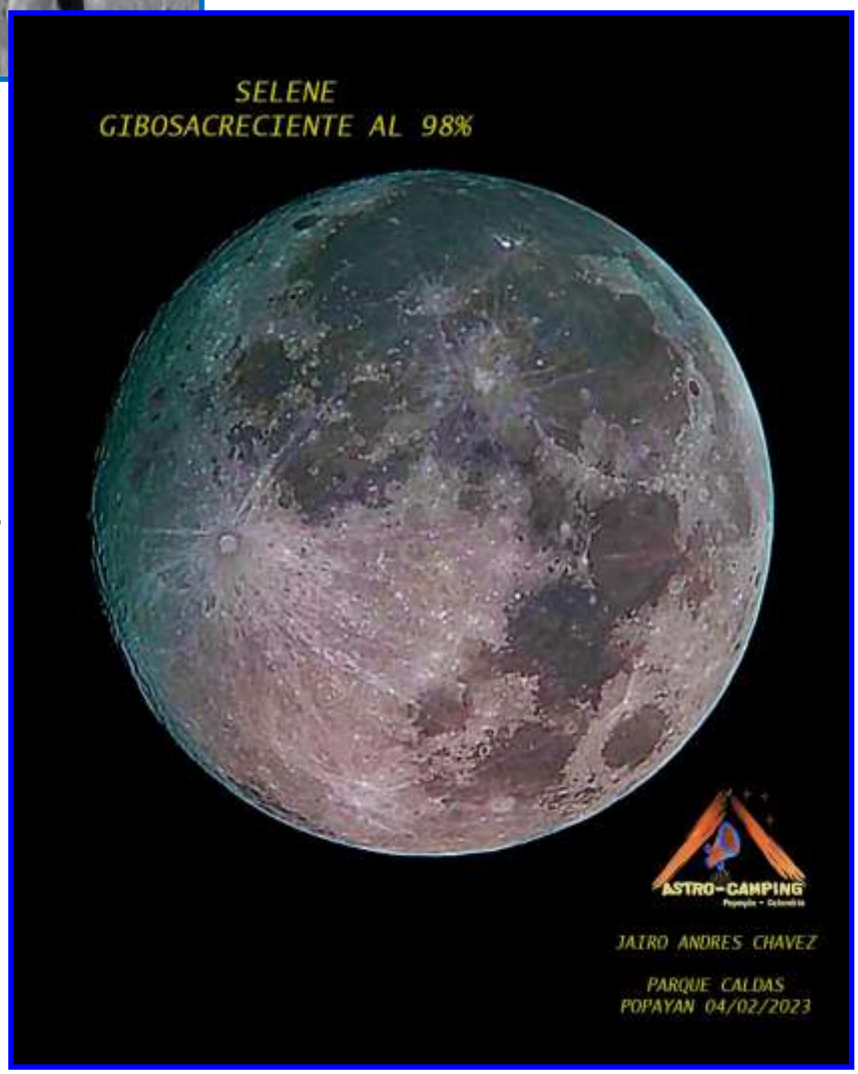


Manilius, Facundo Gramer*, AEA, Oro Verde, Argentina. 2023 February 06 01:25 UT. Celestron CPC1100 Schmidt-Cassegrain telescope, QHY5-IIC camera.*

Recent Topographic Studies



Albategnius, *Ken Vaughan, Cattle Point, Victoria, British Columbia, Canada. 2023 January 30 03:15 UT. Meade 12 inch LX200 GPS Schmidt-Cassegrain telescope, Astronomik 642 I-IR filter, ZWO ASI178mm camera. Seeing 4/10, transparency 8/10.*



Waxing Gibbous Moon, *Jairo Chavez, Popayán, Colombia. 2023 February 05 02:31 UT. 311 mm reflector telescope, MOTO E5PLAY camera. North is to the right, west is up.*

Recent Topographic Studies

Mare Serenitatis and the Crater Bessel, *Fernando Surá, San Nicolás de los Arroyos, Argentina. 2023 February 09 03:40 UT. 127 mm Maksutov-Cassegrain telescope, blue filter, Samsung A22 cell phone camera.*

Atlas, *Walter Ricardo Elias, AEA, Oro Verde, Argentina. 2023 February 24 22:55 UT. 150 mm Sky Watcher reflector telescope, 3x barlow, QHY5-IIC camera.*

Recent Topographic Studies

Mare Crisium, *Walter Ricardo Elias, AEA, Oro Verde, Argentina. 2023 February 24 22:52 UT. 150 mm Sky Watcher reflector telescope, 3x barlow, QHY5-IIC camera.*

Mare Nectaris, *Fernando Surá, San Nicolás de los Arroyos, Argentina. 2023 February 09 03:40 UT. 127 mm Maksutov-Cassegrain telescope, blue filter, Samsung A22 cell phone 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 March

Figure 1. *The 2021 May 26 lunar eclipse as photographed by Peter Anderson (BAA) and orientated with north towards the top. Tick marks indicate the crater Dionysius*

News: In the January newsletter I discussed the lack of archive observational data for a LTP observed by Grant Searle of Concord, Sydney, Australia, at 18:28-18:57UT during the 1978 Sep 16 total lunar eclipse. It took the form of a bright star-like point on the western shore of Mare Tranquillitatis. Apparently, Ken Wallace (Australia) had photographed the bright point earlier at 17:37.5 UT. I am very grateful to Peter Anderson for sending me a copy of the eclipse report from his local astronomical society. In this Peter mentions that Dionysius was a nebulous looking bright spot, and by far the brightest crater on the eclipsed part of the Moon before 18:40UT, but after this it had faded. By 18:50UT it was a faintly flickering spot in the poor seeing and by 18:58UT it could no longer be seen as a bright spot. Unfortunately, twilight prevented further studies. Apparently in an earlier eclipse in March of the same year, Peter noted that Dionysius had more of a star-like core to it. Although not from 1978, Fig 1 illustrates how prominent Dionysius can be. So, I suspect that what Grant Searle was referring to on the western shore of Mare Tranquillitatis was probably Dionysius.

LTP Reports: No LTPs were observed in January. I have no further news to report about an impact flash videoed on 2023 Jan 26 UT 20:33:30 by Luigi Zanatta (Italy – UAI) and confirmed by my PhD student, Daniel Sherwood (observing remotely from Observatory De La Côte D'azur, France). The flash was located a few hundred km east of Aristarchus. However detailed analysis is underway, and if you were observing earthshine at the time, either visually or with CCD, please do get in touch. I'll report back in due course.

Tim Haymes cc'ed me in on an email from a colleague, "MeterorDerek", who had seen a twitter report of an impact flash on the Moon made from Hiratsuka, Japan at 20:14:30.8 local time on 2023 Feb 23 or 11:14:30.8 UT. The flash (Fig 2) lasted about 1 second and has since been confirmed by another observer.

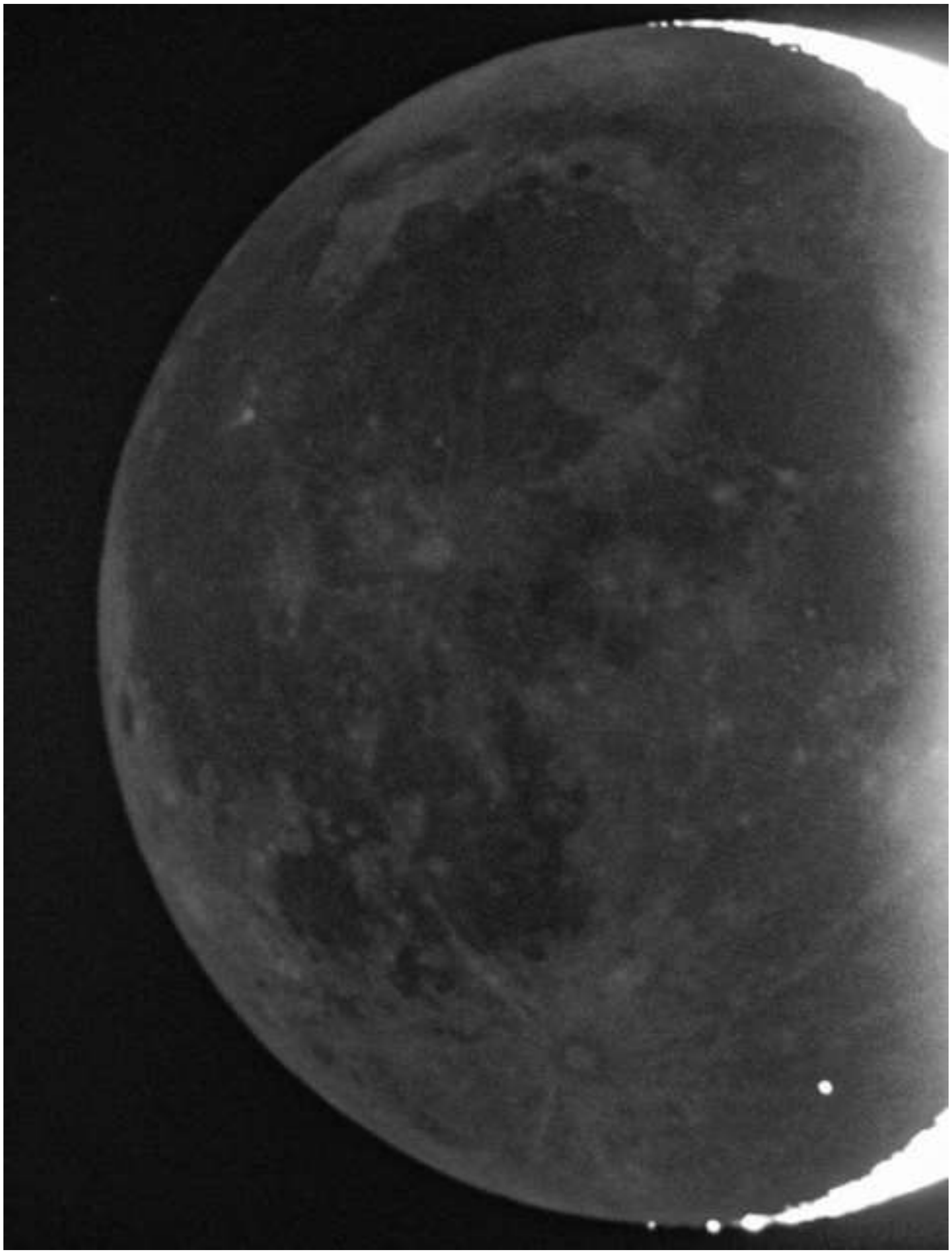


Figure 2. Image frame from a video of an impact flash recorded on 2023 Feb 23 UT 11:14:30.8 – image obtained from the following Twitter Page: https://twitter.com/dfuji1/status/1629259622619176961?s=20

Routine Reports received for January included: Jay Albert (Lake Worth, FL, USA – ALPO) observed: Aristarchus, Censorinus, Gassendi, and Plato. Alberto Anunziato (Argentina – SLA) observed: Aristarchus, Censorinus, and Vallis Schroteri. Maurice Collins (New Zealand – BAA) imaged the Moon. Anthony Cook (Newtown, UK – ALPO/BAA) imaged: several features in the Short-Wave IR (1.5-1.7 microns). Walter Elias (Argentina – AEA) imaged: Aristarchus, Censorinus, Cichus, Gassendi, Mare Nubium, Mare Tranquillitatis, Messier, Plato, Tycho and Vallis Schroteri. Les Fry (West Wales, UK – NAS) imaged: Alphonsus, Clavius, Dorsum Grabau, Fra Mauro, Hainzel, Mare Humboldtianum, Mare Smythii, Mare Underum, Milichius, Mons Piton, Montes Apenninus, Montes Carpatus, Montes Jura, Monte Riphaeus, Philolaus, Pitatus, Plato, Promontorium Kelvin, Stadius, Tycho and W. Bond. Massimo Giuntoli (Italy – BAA) observed: Cavendish E. Rik Hill (Tucson, AZ, USA – ALPO/BAA) imaged Reiner Gamma. Ken Kennedy (Scotland – BAA) imaged Bullialdus. Jeanmarc Lechopier (Teneriffe, Spain – IAU) imaged Kies. Eugenio Polito (Italy – UAI) imaged: Herodotus. Leandro Sid (Argentina – AEA) imaged: Aristarchus, Plato, Vallis Schroteri and several features. Trevor Smith (Codnor, UK – BAA) observed: Eimmart and Plato. Aldo Tonon (Italy – UAI) imaged: Kies. Luigi Zanatta (Italy – UAI) imaged Kies.

Analysis of Reports Received:

Censorinus: On 2023 Jan 01 UT 23:30-23:33 Walter Elias (AEA) imaged this crater under similar illumination to the following report:

Censorinus-Maskelyne 1927 Apr 11/12 UT 23:00-01:00? Observed by Druzdov (Russia) "2 luminescent pts. observed. Not vis. at same Sun angle on May 7 & 12th. Not vis. on photos of Barn in 5/23/63" NASA catalog weight=3. NASA catalog ID #393. ALPO/BAA weight=3.

Figure 3. *Censorinus as imaged in color by Walter Elias (AEA) on 2023 UT 23:30 and orientated with north towards the top.*

Walter's image (Fig 3) does seem to show two luminous points, but just east and adjacent to Censorinus. The original LTP report mentions Censorinus-Maskelyne, and the two points are not between these two craters. Cameron gives a UT of 23:00-01:00 – but is this estimated by her, or what Chernov wrote down? It would be really helpful to find the original report from 1927. Although I cannot find this LTP in the digitized Cameron cards, which went to make up her 1978 NASA catalog, looking at the reference in her catalog it says that the report was listed in a paper by Florenskiy, P. V. and Chernov, V. M. 1973, Astron. Herald VII(1), 38-44. Unfortunately I cannot locate this publication either, so if any members have access to it then please let me know. We shall leave the weight at 3 for now, but at least we have a good image showing what the area should look like under normal conditions.

Bullialdus: On 2023 Jan 02 Trevor Smith sketched, and Ken Kennedy imaged, this crater under similar illumination to the following report:

Bullialdus 1979 Jun 05 UT 22:00-23:00 Observed by Cook M.C. and J.D. (Frimley, UK, 12-inch reflector, Seeing III-IV, good transparency). MC Cook observed intermittently over this time period (due to cloud) and found the crater sharper in a blue filter than in a red filter. No obscuration seen apart from a darkish patch on the SW rim and spreading over onto an area surrounding the rim, which she took to be shadow, though the main shadow was along the east rim of the crater. JD. Cook observed an orange coloration seen on eastern and the cleft on the SW rim. Dark area seen on southern floor of crater, south of central peak. ALPO/BAA weight=1.

Figure 4. *Bullialdus on 2023 Feb 26, orientated with north towards the top.* ***(Left)*** *a sketch by Trevor Smith made from 19:48-20:20 UT.* ***(Right)*** *A color image by Ken Kennedy taken at approximately 19:15 UT.*

Trevor used an orange Wratten 21 filter and noted that the crater was clear and sharp. Upon using a blue Wratten 38A filter he found it to give a much poorer view and the crater was less sharp. No obscuration or orange color was seen. The interior of the eastern wall was covered with a grey (not black shadow). A greyish smaller patch was visible on the edge of the south west rim and this appeared to spread (not move) just over onto the SW rim. Six whitish patches could be seen on the floor of the crater. A significant amount of terracing could be seen on the eastern wall. Trevor's sketch (Fig 4 – Left) and Ken's image (Fig 4 – Right) complement each other in terms of the description and detail seen. So, the main difference between Trevor's observation and the 1979 report appears to be the orange color on the eastern rim, though there may be a hint of that in Ken's image – though it is present on other craters too and is presumably atmospheric spectral dispersion or chromatic aberration related? We shall keep the weight of the 1979 LTP at 1 for the moment, just in case the orange effect seen was not atmospheric or optics related, as a Moon Blink device was available at the time to check this kind of thing out.

Censorinus: On 2023 Jan 03 Jay Albert (ALPO) and Alberto Anunziato (SLA) observed this crater under similar illumination to the following report:

On 1985 Mar 02 at 20:00UT? Marshall (Medeline, Colombia, South America) measured some very low Crater Extinction Device brightness readings of Censorinus compared to Proclus. The Cameron 2006 catalog extension ID=261 and the weight=3. ALPO/BAA weight=2.

Alberto observed from 00:30-00:35 UT with a Meade EX 105 at x154 and noted that the brightness of Censorinus was very similar to Proclus. Jay, observing from 01:45-02:00UT, commented that Censorinus crater was clearly seen and also was as bright as the N wall of Proclus. He used an 11mm Nagler for 185x, Celestron NexStar Evolution 8" SCT, in order to comfortably fit Censorinus and Proclus in the same field of view.

I was able to look up the original Kevin Marshall observation and it seems that he observed from 1985 Mar 02 UT 23:50-00:30. I will correct this in the ALPO/BAA LTP database, nevertheless, a 4-hour discrepancy probably would not explain Censorinus appearing dull, so we shall leave the ALPO/BAA weight at 2.

Herodotus: On 2023 Jan 03 UT 23:30-00:15 Eugenio Polito (UAI) observed for the following Lunar Schedule Request:

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

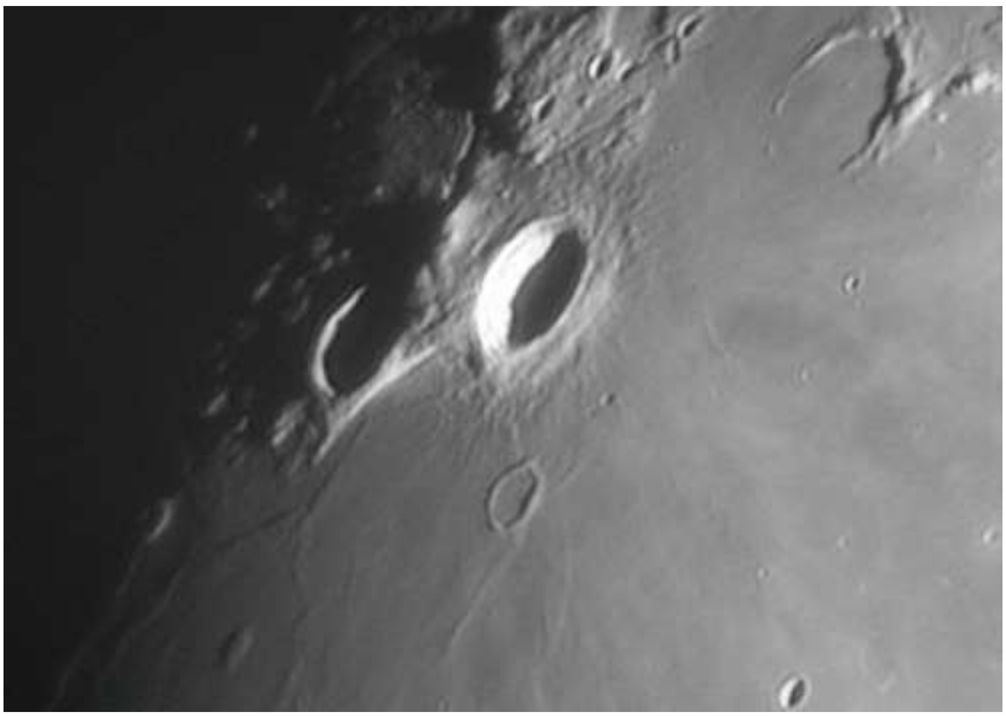


Figure 5. *Herodotus on 2023 Jan 03 UT 00:15 as imaged by Eugenio Polito (UAI).*

Despite an extensive imaging run, no sign of the pseudo-peak was visible during this Jan schedule, even in the last image (Fig 5) when the Sun was at its highest altitude. We shall keep on trying as on the rare occasions that the pseudo peak has been seen, it is over similar colongitudes.

Cavendish E: On 2023 Jan 04 and 05 Massimo Giuntoli (BAA), using a 100mm refractor, under Antoniadi IV seeing, observed this crater visually, trying to see if it repeated a large brightening that they had seen in the past. However, on 20:35 and 21:00 UT on these respective dates the crater looked normal.

Vallis Schroteri: On 2023 Jan 05 AEA observers Leandro Sid and Walter Elias observed this area under similar illumination to the following report:

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

Figure 6. *Aristarchus as imaged by AEA members on 2023 Jan 05.* ***(Left)*** *Imaged by Walter Elias UT 01:20.* ***(Right)*** *Imaged by Leandro Sid at UT 02:43.*

Despite the resolution of the images, if there had been any flashing spot, bright or otherwise at the end of Vallis Schroteri, then it would have shown up clearly on them (Fig 6). However, what did the original report mean by "at the end of SV"? Which end – the one at the Cobra's Head or the where the valley fizzles out on the mare to the north? Alas we have nothing in the archives to help here. There is a white spot/bright crater on the NW rim of Herodotus and a bright craterlet NW of the northern end of Vallis Schroteri. Either of these could flash, or scintillate, if the atmospheric seeing conditions were right. The Cobra's Head blue color, mentioned in the LTP description is about right as it is a fresh crater – the scintillating bright spot is reported as bright in red. I think that we shall lower the weight from 3 to 2 as scintillation could account for the flashing effect.

Montes Carpatus: On 2023 Jan 30 UT 19:10 Les Fry (NAS) took an image of the Stadius area that was under similar illumination to the following possible lunar impact flash event from 1955:

On 1955 Aug 27 at UT 01:51 McCorkle (Memphis, Tennessee, USA, 6.5" reflector, x200) observed a 2nd magnitude bright flare on the dark side of the Moon. This remained steady, fading slightly before abruptly disappearing. Cameron suggests that this might have been a meteor. The Cameron 1978 catalog ID=604 and weight=0. The ALPO/BAA weight=1.

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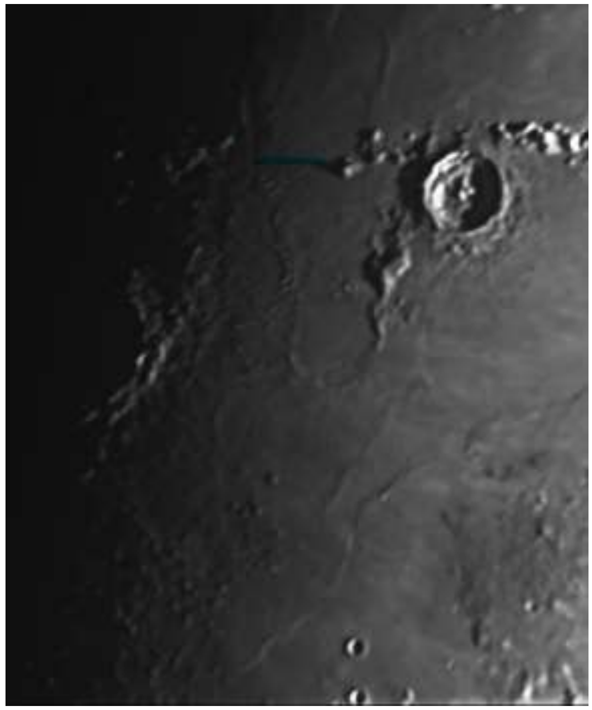


Figure 7. *Montes Carpatus (mostly in the dark) located in top left quadrant of the image. Taken by Les Fry (NAS) on 2023 Jan 30 UT 19:10 and orientated with north towards the top.*

Les' image (Fig 7) confirms that Montes Carpatus was mostly un-illuminated, apart from some of the tallest peaks, and so agrees with the original observation. Whether McCorkle's description of a 2nd mag flare corresponds in brightness to a 2nd mag star next to the Moon, or what a 2nd mag star would look like to the naked eye is uncertain? If the former then it would have been quite bright and the "flare" description very apt. If the latter then there is still a chance that it might have been a brief moment of exceptional seeing, making a point-like sunlit mountain peak brighten up. Another possibility is that McCorkle observed an impact flash? Either way Fig 8 shows quite clearly what the Moon would have looked like at the time if everything was normal. We shall leave this at a weight of 1 for now.

Kies: On 2023 Jan 30 UT 03:05-03:25 UAI observers: Jeanmarc Lechopier, Aldo Tonon, and Luigi Zanatta, imaged this crater and the surrounds, for the following Lunar Schedule request, and a little before and after the requested times:

ALPO Request: A report was made on 1984 Jun 09 UT 04:55-05:15 of a bright point poking out of the shadow a few km east of Kies, that looked unusual to the observer concerned. Unfortunately, at this illumination the terminator is well to the west of Kies. It is possible that the observer meant 1984 Jun 08 instead of the 9th and may be mis-identified another crater as Kies. Please try to image / sketch / visually study this area to see if indeed there are any Kies look-a-likes in the area with a bright point to the east? Any sized scopes can be used for this observation. All observations should be emailed to: a t c @ a b e r. a c. u k

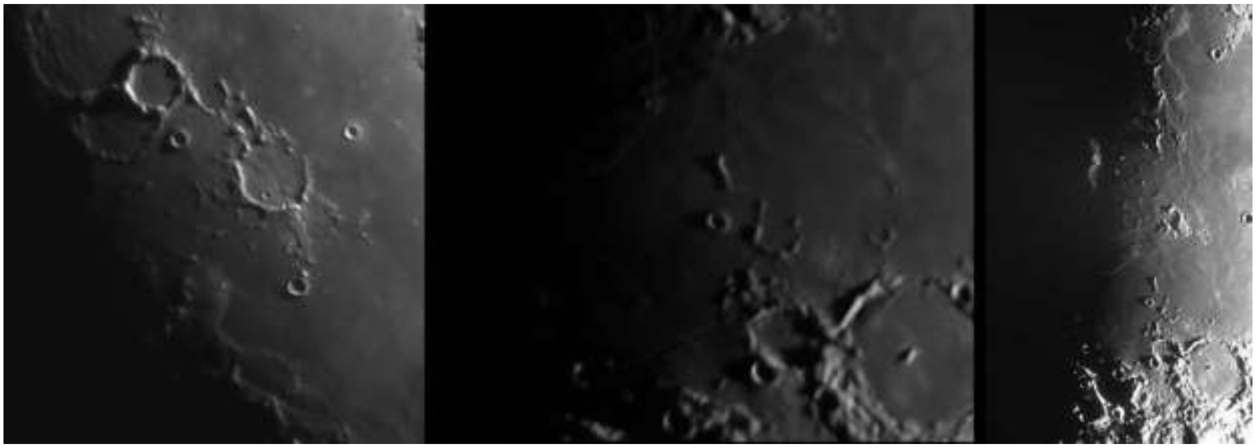


Figure 8. *Images of the area in the vicinity of Kies, photographed on 2023 Jan 30 by UAI observers.* ***(Left)*** *As imaged by Luigi Zanatta at 19:11 – just before the lunar schedule request window.* ***(Center)*** *As imaged by Aldo Tonon at 20:02 UT, during the lunar Schedule Request.* ***(Right)*** *As imaged by Jeanmarc Lechopier at 20:03 UT, during the Lunar Schedule Request window.*

Examining Fig 8, perhaps the only bright object poking out of the terminator in this hypothetical date error scenario is the east rim of Bullialdus. Perhaps it's not a date error but a UT error back in 1984. We shall investigate further.

General Information: For repeat illumination (and a few repeat libration) observations for the coming month - these can be found on the following web site: http://users.aber.ac.uk/atc/lunar_schedule.htm . By re-observing and submitting your observations, only this way can we fully resolve past observational puzzles. If in the unlikely event you do ever see a LTP, firstly read the LTP checklist on http://users.aber.ac.uk/atc/alpo/ltp.htm , and if this does not explain what you are seeing, please give me a call on my cell phone: +44 (0)798 505 5681 and I will alert other observers. Note when telephoning from outside the UK you must not use the (0). When phoning from within the UK please do not use the +44! Twitter LTP alerts can be accessed on https://twitter.com/lunarnaut .

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

Basin and Buried Crater Project

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

I have received two communications about basins/buried craters. The first was forwarded to me by David Teske, ALPO Lunar Section coordinator, and the latter is a pretty much self-contained article by Guillermo Daniel Scheidereiter.

The Schiller-Zucchius Basin?

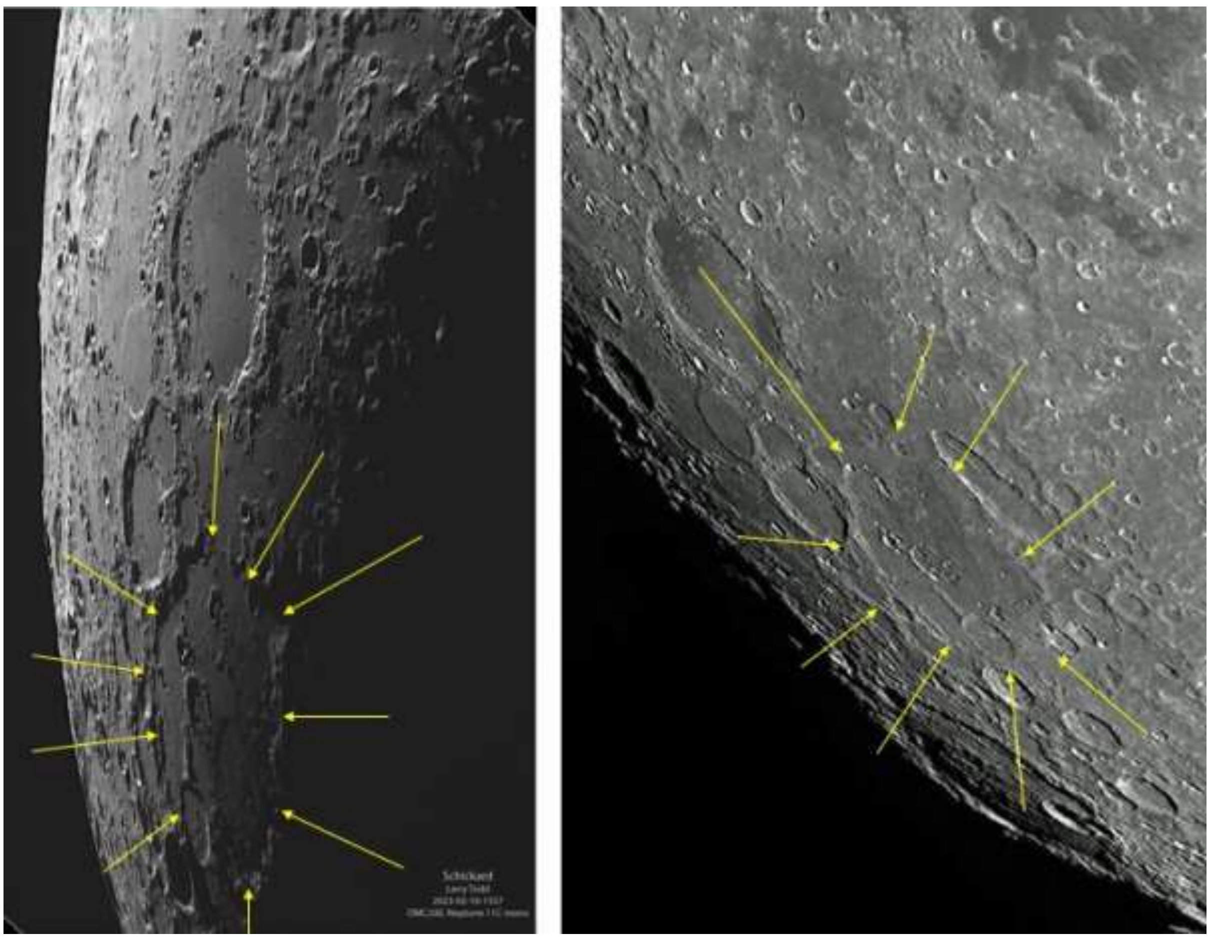


Figure 1. *A basin suspected by Larry Todd and David Teske, located in the SE quadrant of the Moon.* ***(Left)*** *Taken by Larry Todd (Dunedin, New Zealand) on 2023 Feb 16 UT 15:57.* ***(Right)*** *taken by David Teske (USA) on 2023 Feb 04 UT 02:46.*

Larry notes that there is a basin south of Schickard, Wargentin, Nasmyth, and Phocylides (Fig 1 Left), and David Teske, who took another image (Fig 1 Right) but under different lighting suggests that it is a large oval that is dark color going from Phocylides to near Hainzel. I have added yellow arrows to both images following a rough overlay of the suggested basin outline that David Teske sent me in a follow up email.

The first thing I decided to do was to find the approximate location and diameter of the basin suspected by Larry and David, using the NASA LROC Quickmap tool. A slope azimuth plot helped here enormously (Fig 2). It shows more clearly the region arrowed in Fig 1.

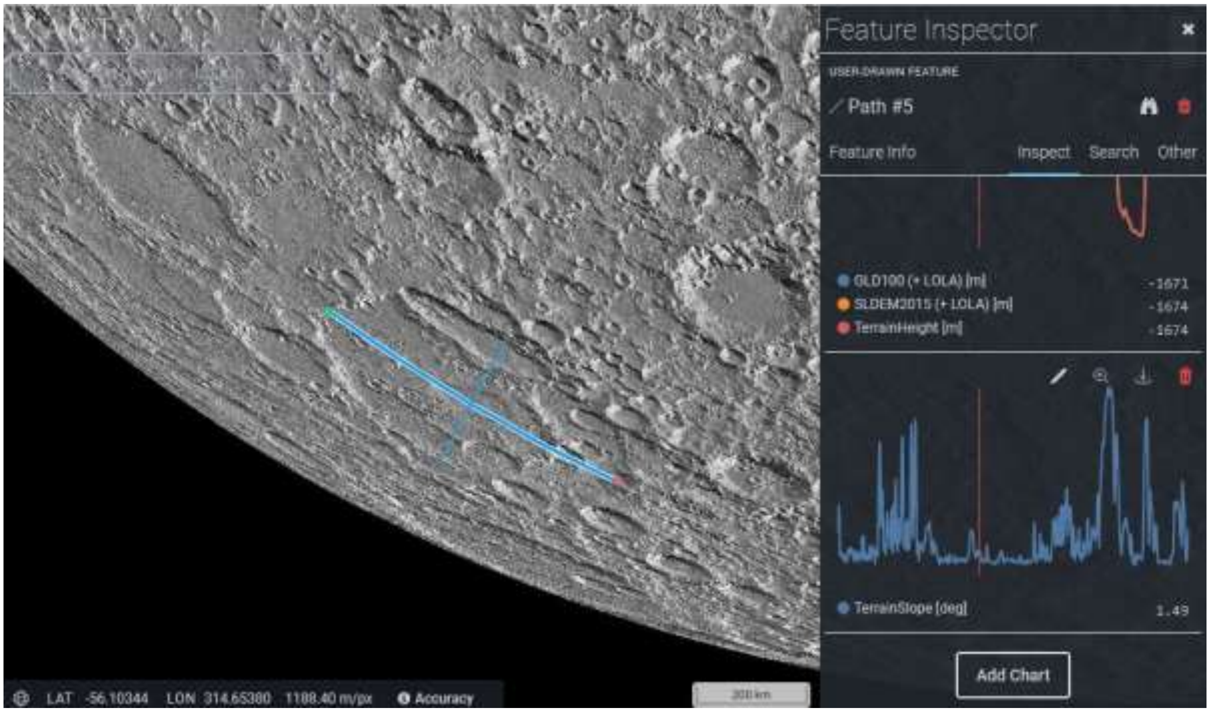


Figure 2. *A N/S topographic cross-section through the Schiller-Zucchius basin using NASA's Quickmap website.*

In Larry and David images (Fig 1) the basin center is at 45˚W 55˚S, and the N-S transect of the basin seems to be about 277 km in length and the E-W transect about 295 km wide. Looking in the ALPO/BAA basin database, the closest basin to this is the Schiller-Zucchius basin at 45˚W 56˚S and 335 km in diameter. Is this a coincidence of a newly discovered basin and the Schiller-Zucchius basin almost being on top of one another? Possibly not? I think what is happening here is that the southern edge of what we see in Fig 1 Left, although well defined, does not include details further south as the image is clipped here. In Fig 1 Right the lack of hill shaded terrain makes it difficult to really define the southern edge of the suspected basin, so it could be a larger diameter. Likewise on the west, could the basin in Fig 1 be a little further west than the arrows? On the eastern flank of the suspected basin we have the unusual elongated Schiller crater, which is shadow filled in the left image. Suppose the basin ring were going along its eastern edge of Schiller (actually in shadow in Fig 1 – Left), then the E-W diameter would be bigger still. Schiller even has an elongated and offset central set of peaks on its northern floor – could this alternatively be the rim of the basin? The actual diameter of the Schiller-Zucchius basin is 335 km – so I think the basin that Larry and David imaged is probably one and the same. However, I would welcome readers to prove me wrong. At least with Larry's image I can add a selenographic colongitude of 223.7˚ of when it is best to see the basin under evening illumination.

The Hind-Almanon Impact Basin* – an Analysis by Guillermo Daniel Scheidereiter

** Note that the measurements and analysis described below were sent in by Guillermo Daniel Scheidereiter before I had a chance to check the on-line basin catalog. So alas it turns out not to be a newly discovered basin (or proto-basin). However, the article illustrates very well much of the procedure needed to establish the presence of a basin. We also have an improved estimate of the center of the basin, the ring diameters of the primary and inner rings, and the associated errors. The Hind-Almanon basin would also provide an interesting target for lunar photographers so that we can find at what range of colongitudes it is best presented on the morning and evening terminators. Anyway Guillermo's article follows (with some edits)...*

In these notes, observations are made of a lunar a crater/basin that has almost disappeared due to subsequent impacts after its formation. The region of interest contains a few craters such as Abulfeda, Ritchey, Andel, Burnham, amongst others.

The aim was to inspect images and determine approximately the circular contour of the suspected crater (or basin), establish coordinates of some points that possibly delimit the edge approximately, estimate the diameter and examine topographic profiles that may reveal an interior depression.
The procedures and results established according to the proposed objectives are listed below:

1) Inspection of images using computer tools
An initial inspection of images was carried out, of which two sample images are shown in Fig 3 and 4.

Figure 3: *Arrow indicates the region of interest.*

Figure 4 Arrow indicating the region of interest.

In addition, the area was studied using LROC QuickMap and Virtual Moon Atlas.

2) Delimitation of the area of interest

To delimit the observation area, we begin by listing the main craters that are around, or even superimposed, on what is presumed to be the rim of the suspected crater/basin.

a) Major craters surrounding the area:

North:	Halley, Hind, Hipparchus C, Hipparchus L.
Northwest:	Albategnius.
West:	Burnham.
Southwest:	Argelander.
South:	Airy B and edge of the Werner-Airy basin.
Southeast:	Abulfeda (overlapping the edge).
East:	Descartes.
Northeast:	Lindsay.

b) Approximation of the contour

Based on sections 1 and 2a, a series of points were drawn that could mark the outline of the crater (or basin). For this the drawing tool of LROC QuickMap was used. The guide points were arranged in a circular pattern following the relief that suggests the shape of the supposed crater or basin. The location is imperfect and approximate (Fig 5).

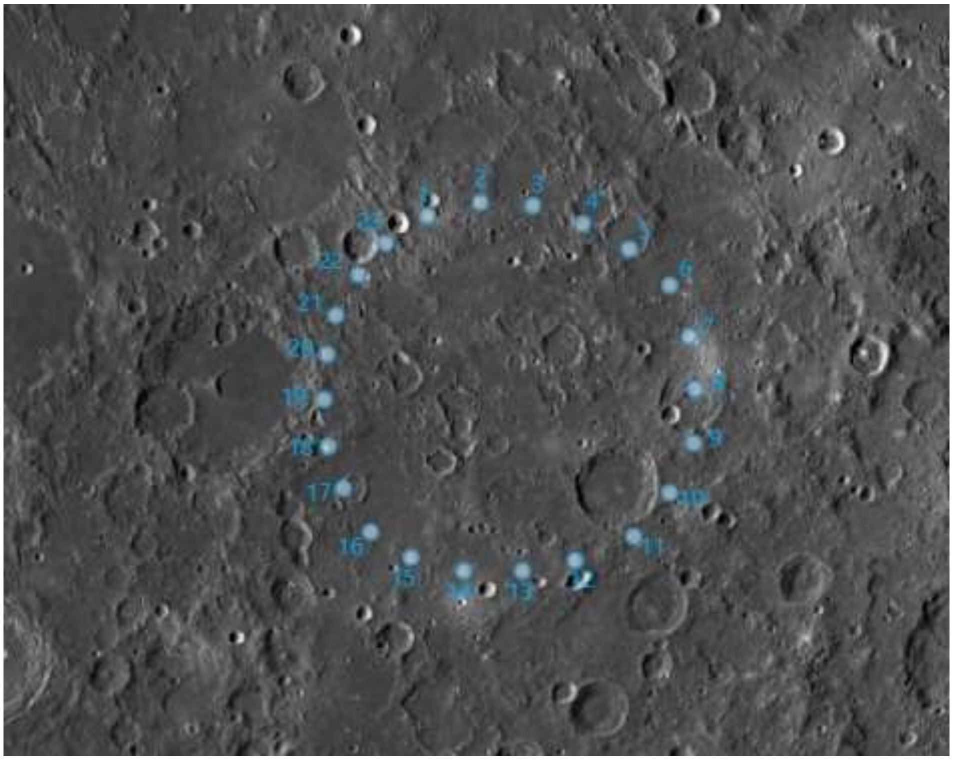


Figure 5. Contour estimation of the basin/buried crater primary ring.

Once an approximate contour of the area was established, a record of the latitude and longitude of each point was taken, which are organized in table 1.

Point	LAT	LON	Point	LAT	LON	Point	LAT	LON
1	-7.25332	8.92807	9	-12.81511	15.79564	17	-13.92574	7.00259
2	-6.93876	10.19746	10	-14.02471	15.26091	18	-12.87402	6.61234
3	-7.01133	11.52930	11	-15.11633	14.41209	19	-11.71291	6.48978
4	-7.42278	12.75363	12	-15.71411	12.96531	20	-10.61822	6.52720
5	-8.05282	13.94450	13	-15.98868	11.62831	21	-9.68084	6.70885
6	-8.95111	15.00726	14	-15.98776	10.13432	22	-8.69247	7.25119
7	-10.16861	15.54287	15	-15.63929	8.79550	23	-7.91286	7.90689
8	-11.46425	15.76457	16	-14.99201	7.71320	-	-	-

Table 1: Latitude and longitude for estimated points. Note that a +ve longitude means east and +ve latitude means north.

3) <u>Diameter Estimation</u>
In order to estimate the diameter of the circular area, a series of straight lines between points on the suspected rim were drawn in LROC QuickMap, and with the Feature Inspector tool a record of the distances (in kilometres) that they cover themselves on the Moon. The average of the distances was then calculated and a diameter of 281.1 ± 5.0 km was found.

4) <u>Topographic Profile inspection</u>

Twenty-one profiles of the area were plotted using LROC QuickMap to see if there was evidence of a circular depression with higher edges. The fact that central peaks may be part of later formations should be taken into considerations. The diameters were numbered from smallest to largest in a clockwise direction, and lines were drawn from the numbers toward the opposite end to maintain the same order of relief in the profiles. The following figures were associated with each of the twelve drawn diameters. Each of them is a profile of the cross section established by the plotted diameter. The number in the circle is associated with the number assigned to the diameters.

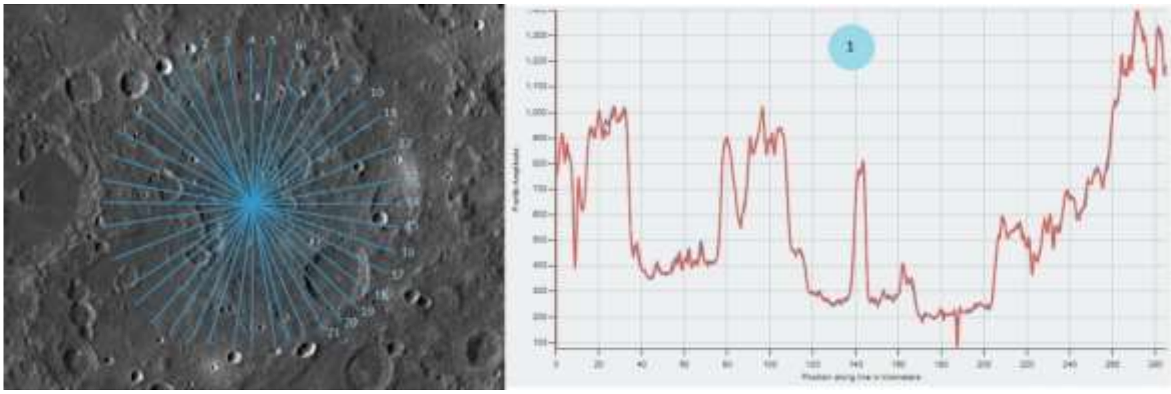


Figure 6. *Diameter rate (left) and first profile (right).*

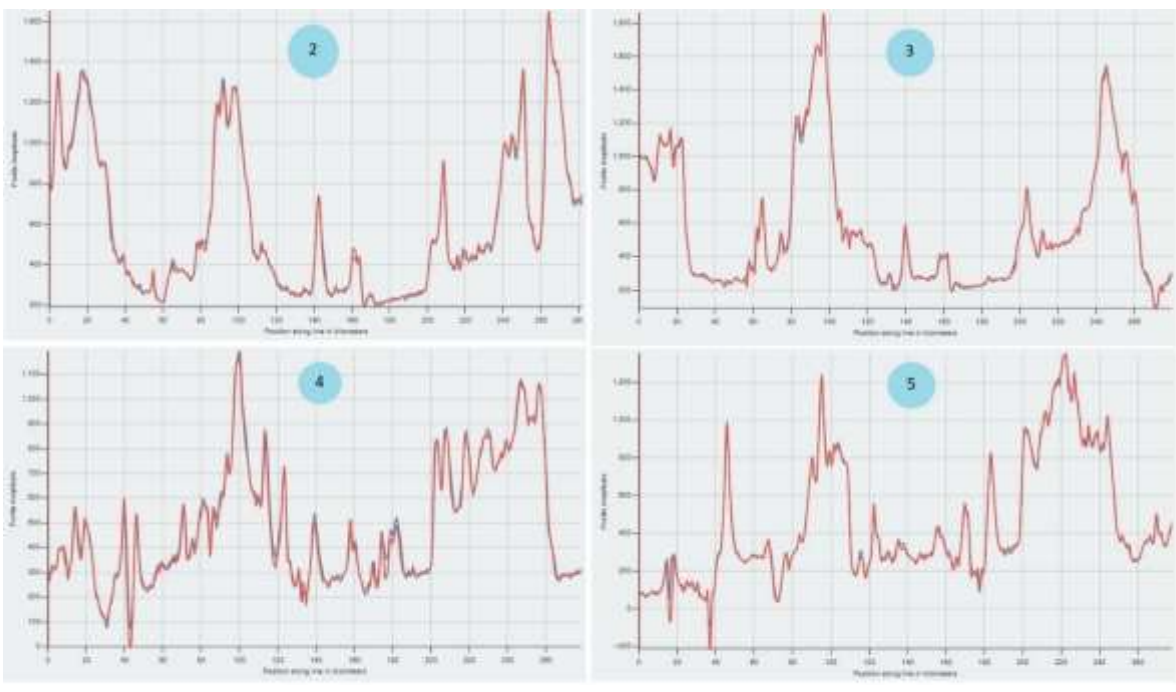


Figure 7. *Four profiles following Figure 6 (numbers are associated with numbered diameters in the Fig 6 - Left), LROC QuickMap.*

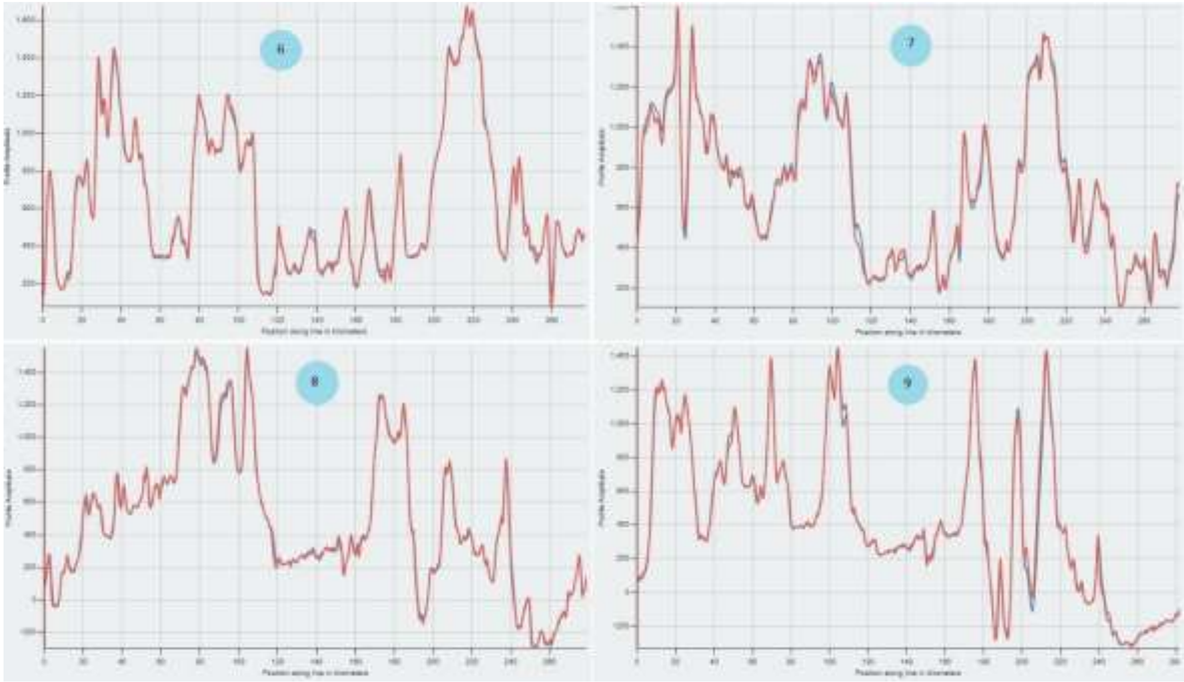


Figure 8. *Intermediate profiles from six to nine (numbers are associated with numbered diameters in the Fig 6 - Left, LROC QuickMap.*

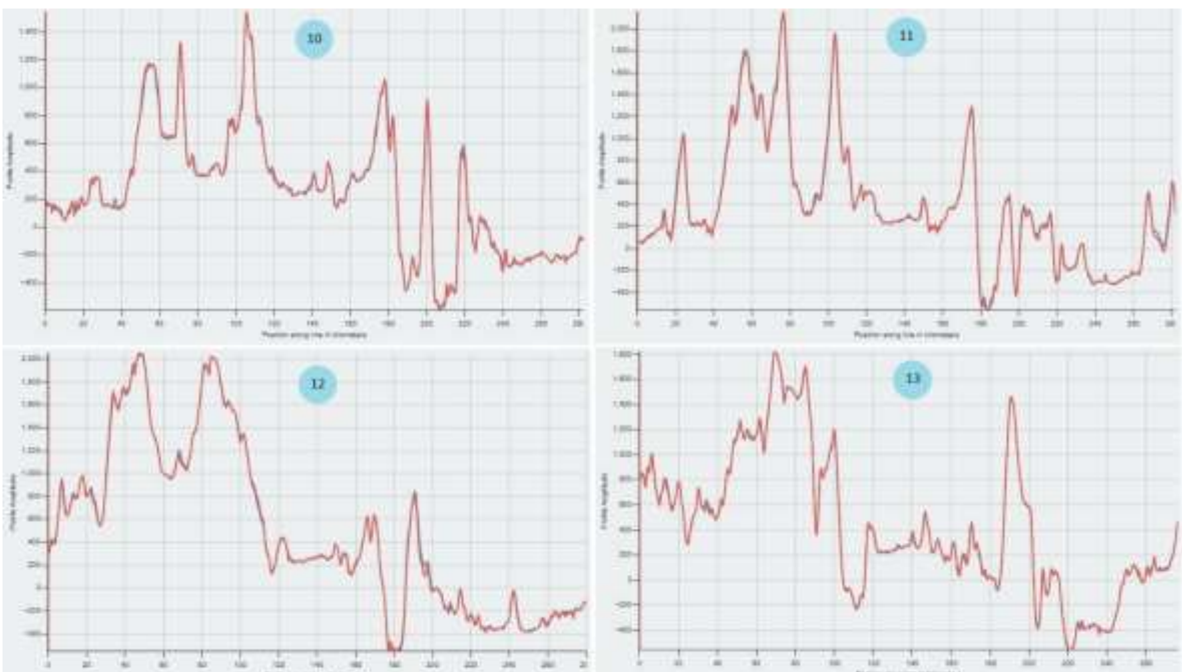


Figure 9. *Intermediate profiles from ten to thirteen (numbers are associated with numbered diameters in the Fig 6 - Left), LROC QuickMap.*

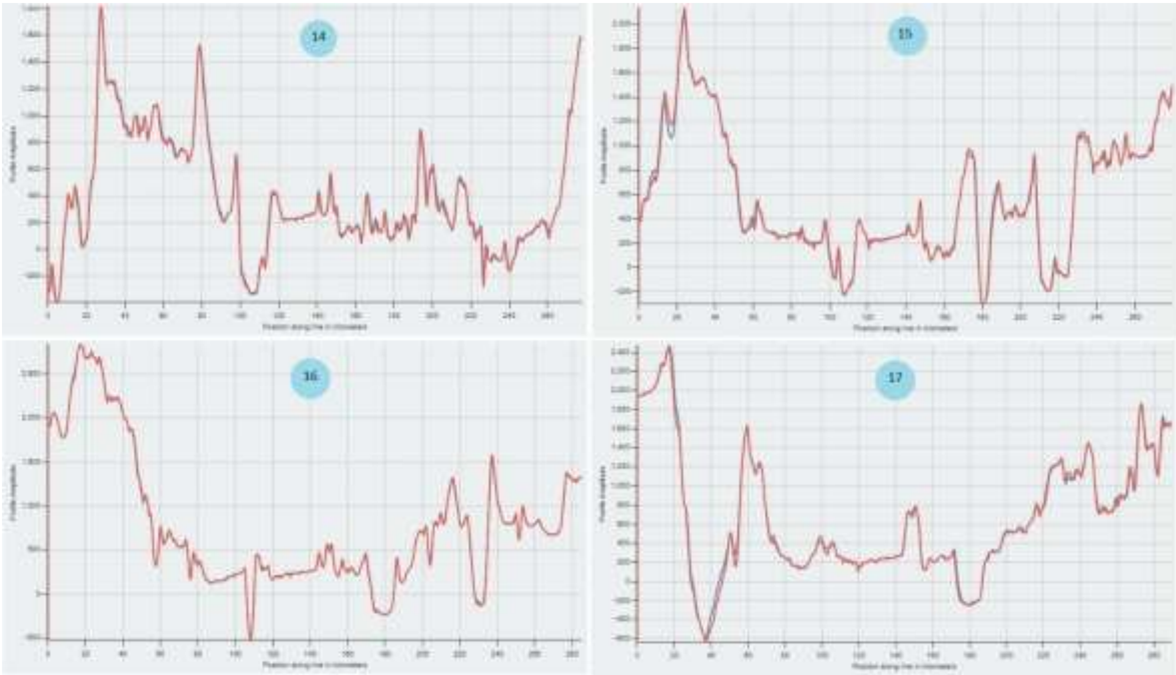


Figure 10. *Intermediate profiles from fourteen to seventeen (numbers are associated with numbered diameters in the Fig 6 - Left), LROC QuickMap.*

Figure 11. *Last four profiles (numbers are associated with numbered diameters in the Fig 6 - Left), LROC QuickMap.*

5) <u>Concentric region observation</u>

The image of the area shown by LROC QuickMap (Fig 6 – Left) and the inspected photographs (Figs 3 and 4) allows us to infer a darker concentric shape, with a crescent-like appearance, inside the delimited contour in Fig 12.

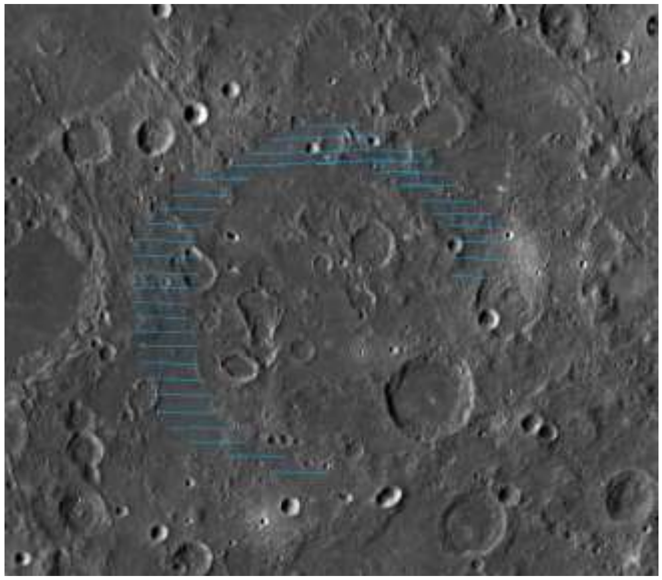


__Figure 12.__ Shading depicting a probable concentric region.

Examination of some profiles seems to support this idea, suggesting a depression in the terrain. The following image illustrates the assumption. The interior between the yellow segments corresponds to the part of the profile associated to the right also between yellow vertical lines.

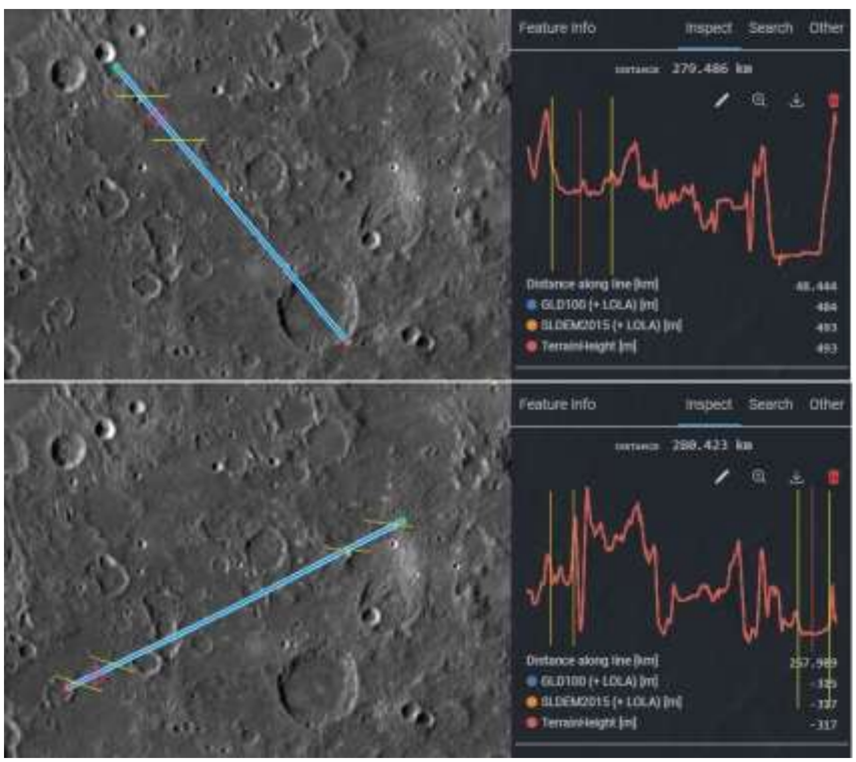


__Figure 13.__ Two profiles that probably support the idea of concentric rings.

The circular area that is inferred measures about 177.6 ± 6.4 km in diameter and Fig 14 illustrates the interior area.

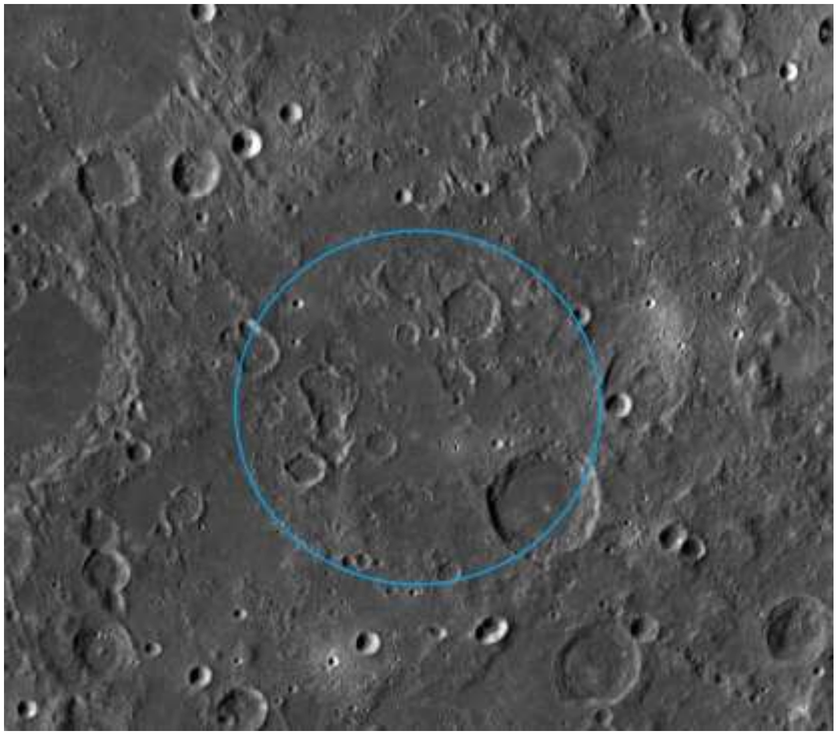


Figure 14. *Probable inner circular region.*

6) Final comments

The inspected images suggest a highly degraded circular area, with almost erased topographic contours, on which subsequent craters were overlaid. The points drawn, to roughly delimit the outline of the candidate crater/basin have negative latitude coordinates, which places the region toward the Moon's southern near-side hemisphere. Using LROC, a diameter of about 281 km was estimated, the traced profiles do not conclusively favour of a crater or a basin. However, the profiles determined by the lines that join diametrically opposite points in the southeast-northwest direction of the circular depression may have a representation approximately similar to the profile of a crater. There is some visual evidence from the photographs examined that there could be a concentric circular area, that is, one circular area inside another. Observation of the cross sections seems to support this interpretation, but is by no means conclusive. For the supposed interior region, a diameter of about 178 km was estimated.

Based upon the exploration carried out, it is not possible to conclude that the area of interest is definitely an ancient crater or basin. The images and methods used are only suggestive and are not sufficient to establish any conclusion. Clearly more in-depth studies are needed to determine the true nature of this depression.

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 March 2023

Date	UT	Event
2		Greatest northern declination +27.6°
3	0300	Pollux 1.7° north of Moon
3	1800	Moon at apogee 405,888 km
4		South limb most exposed -6.7°
7	1240	Full Moon
11	0853	Moon at descending node
13		West limb most exposed -6.3°
15	0208	Last Quarter Moon
16		Greatest southern declination -27.8°
18		North limb most exposed +6.7°
19	1500	Saturn 4° north of Moon
19	1500	Moon at perigee 362,696 km
21	1723	New Moon lunation 1240
22	2000	Jupiter 0.5° north of Moon, occultation Polynesia, South America, Caribbean
24	0208	Moon at ascending node
24	1000	Venus 0.1° north of Moon, occultation South Africa to Philippines
25		East limb most exposed +6.2°
25	0100	Uranus 1.5° south of Moon
26	0000	Moon 1.9° south of Pleiades
28	1300	Mars 2° south of Moon
29	0232	First Quarter Moon
29		Greatest northern declination +27.9°
30	1000	Pollux 1.6° north of Moon
31		South limb most exposed -6.8°
31	1100	Moon at apogee 404,919 km

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

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

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

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

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

SUBMISSION THROUGH THE ALPO IMAGE ARCHIVE

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

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

It is helpful if the filenames follow the naming convention :

FEATURE-NAME_YYYY-MM-DD-HHMM.ext

YYYY {0..9} Year

MM {0..9} Month

DD {0..9} Day

HH {0..9} Hour (UT)

MM {0..9} Minute (UT)

.ext (file type extension)

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

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

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

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

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

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

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

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

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

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

Digitally submitted images should be sent to:
David Teske – david.teske@alpo-astronomy.org
Alberto Anunziato–albertoanunziato@yahoo.com.ar
Wayne Bailey—wayne.bailey@alpo-astronomy.org

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

CALL FOR OBSERVATIONS:
FOCUS ON: Expedition to Reiner Gamma

Focus on is a bi-monthly series of articles, which includes observations received for a specific feature or class of features. The subject for the May 2023, will be Reiner Gamma. Observations at all phases and of all kinds (electronic or film based images, drawings, etc.) are welcomed and invited. Keep in mind that observations do not have to be recent ones, so search your files and/or add these features to your observing list and send your favorites to (both):

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

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

FUTURE FOCUS ON ARTICLES:

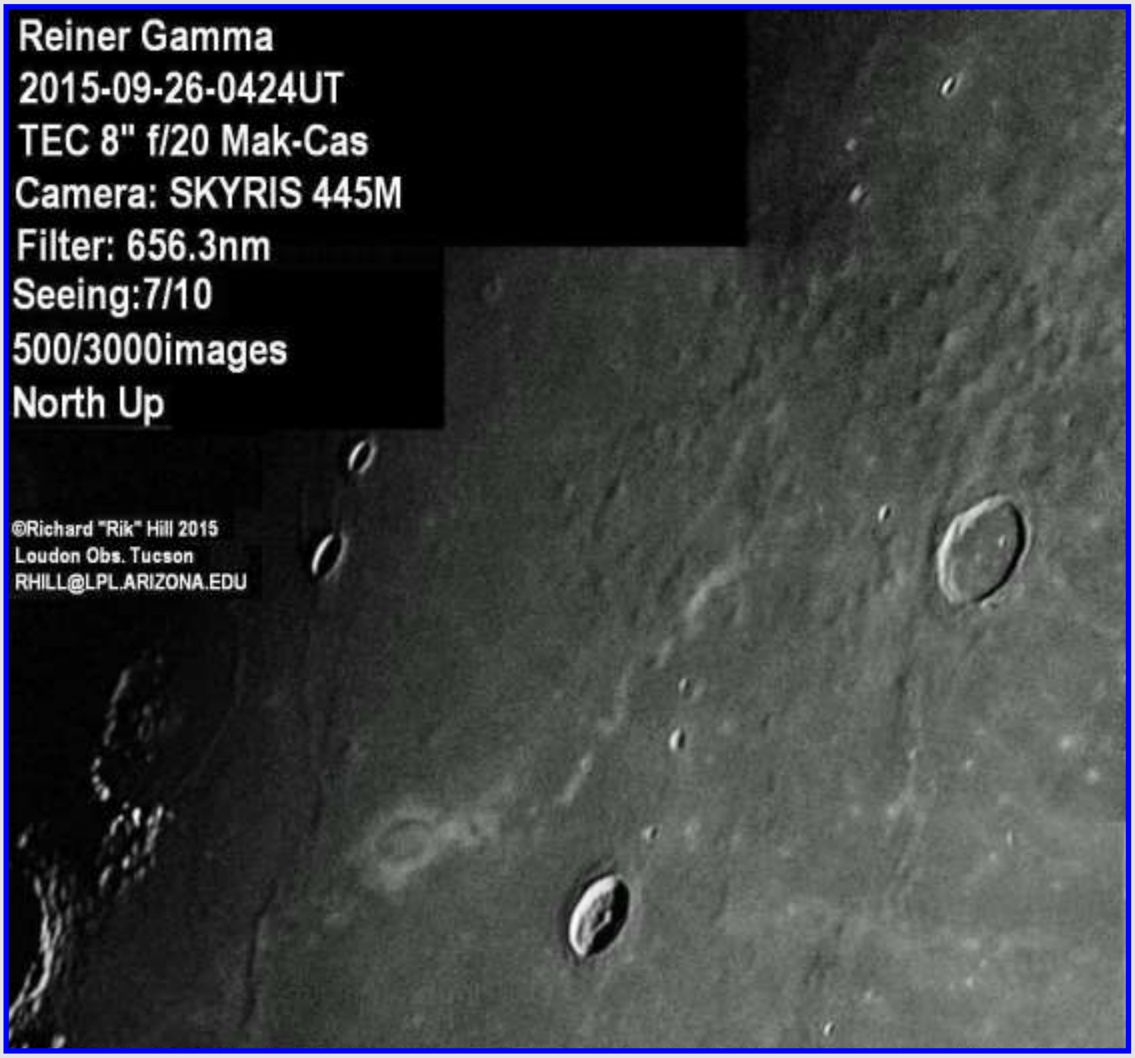
In order to provide more lead time for contributors the following future targets have been selected:

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

Focus-On Announcement
Mysterious Reiner Gamma

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

MARCH 2023 ISSUE-Due February 20, 2023: MARE NUBIUM
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



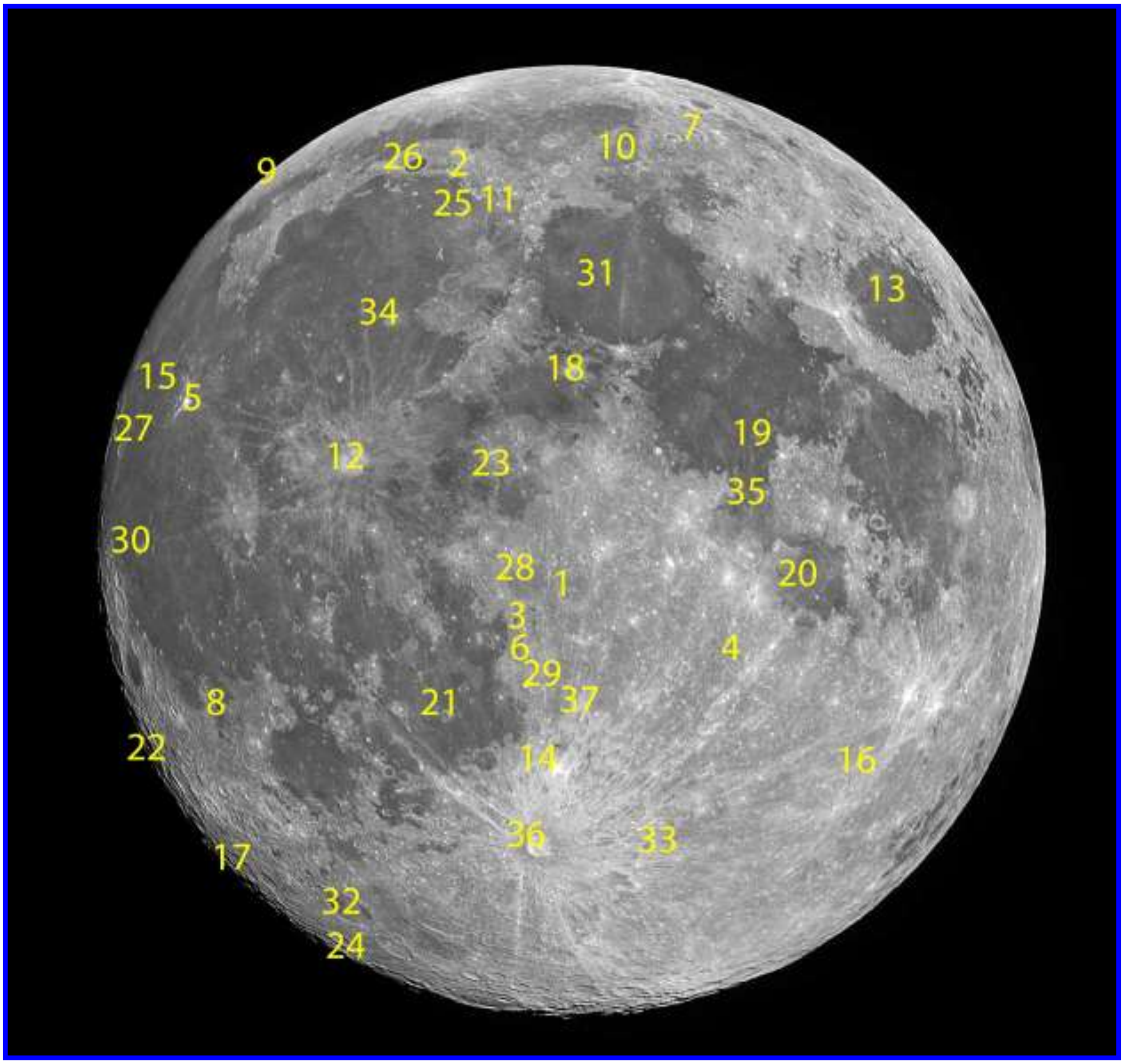
Rik Hill

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

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

MAY 2023 ISSUE-Due April 20th, 2023: REINER GAMMA
JULY 2023 ISSUE-Due June 20th, 2023: MONS RÜMKER
SEPTEMBER 2023 ISSUE-Due August 20th 2023: FLOOR FRACTURED CRATERS

Key to Images In This Issue



1. Albategnius
2. Alpes, Vallis
3. Alphonsus
4. Altai, Rupes
5. Aristarchus
6. Arzachel
7. Atlas
8. Billy
9. Bond, W.
10. Bürg
11. Cassini
12. Copernicus
13. Crisium, Mare
14. Deslandres
15. Herodotus
16. Janssen
17. Lagrange
18. Manilius
19. Maskelyne
20. Nectaris, Mare
21. Nubium, Mare
22. Orientale, Mare
23. Pallas
24. Pingré
25. Piton
26. Plato
27. Procellarum, Oceanus
28. Ptolemaeus
29. Purbach
30. Reiner Gamma
31. Serenitatis, Mare
32. Schickard
33. Stöfler
34. Timocharis
35. Torricelli
36. Tycho
37. Werner