The Lunar Observer

A Publication of the Lunar Section of ALPO

David Teske, editor

Coordinator, Lunar Topographic Studies Section Program

AUGUST 2024

In This Issue

Lunar Reflections

A warm greeting to all readers. Hoping that this issue of *The Lunar Observer* finds you doing well. I had the chance to meet with some of you in late July at the 2024 ALPO virtual conference. If you have not seen it, please look at https://www.youtube.com/c/AssociationofLunarandPlanetaryObservers. The conference was well attended and had several very interesting talks and presentations. Presentations about the Moon were pretty numerous. Robert Garfinkle, of Luna Cognita fame, was the keynote speaker. He talked about the Moon in folklore and such. All very interesting!

The issue of The Lunar Observer though rather small is really strong with articles, 11 of them I believe! KC Pau leads us on q quest of a woodpecker (!), Alberto Anunziato leads us on wrinkle ridge topography, an investigation of the Mare Tranquillitatis pit and how his home country of Argentina has some pretty cool lunar features. Paul Walker explores the regions around Ptolemaeus, Greg Shanos looks at a recent lunar occultation of Spica and some beautiful craters, and Walter Ricardo Elias captures the ISS transiting the Moon, from his home balcony! Darryl Wilson discusses thermal imaging of the Moon, and how that is becoming more accessible for all. Jon Moore tells us about a newly named crater on the lunar far side. Also, Robert Reeves explores where humanity first touched the Moon with Luna 2. Turns out, it is a mystery! Besides these fascinating articles, there were many lunar images and drawings in the Recent Lunar Topographic Studies. As always, Tony Cook sent in very well researched articles on Lunar Geologic Change and Buried Basins. Many thanks to all who contributed this month!

Please remember to follow the future Focus-On topics and gather observations of these features. Next up is the very interesting Aristoteles and Eudoxus. Observations are due to Alberto and myself by August 20, 2024.

Clear skies,
-David Teske

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Online readers, click on images for hyperlinks

Lunar Topographic Studies

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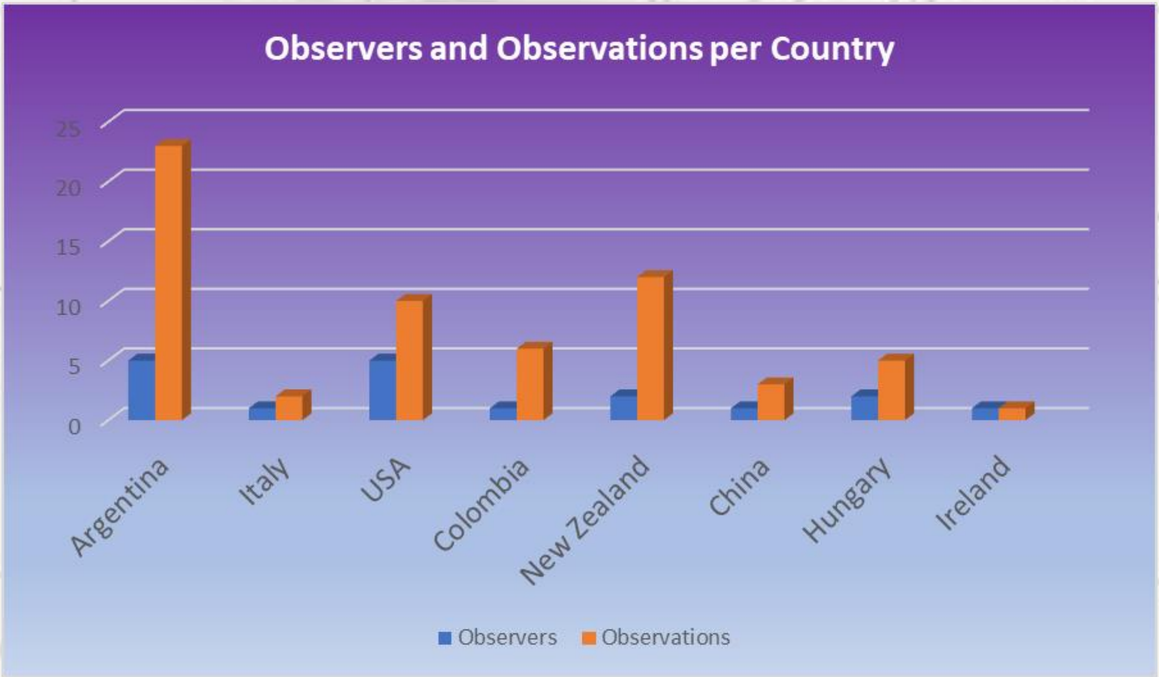
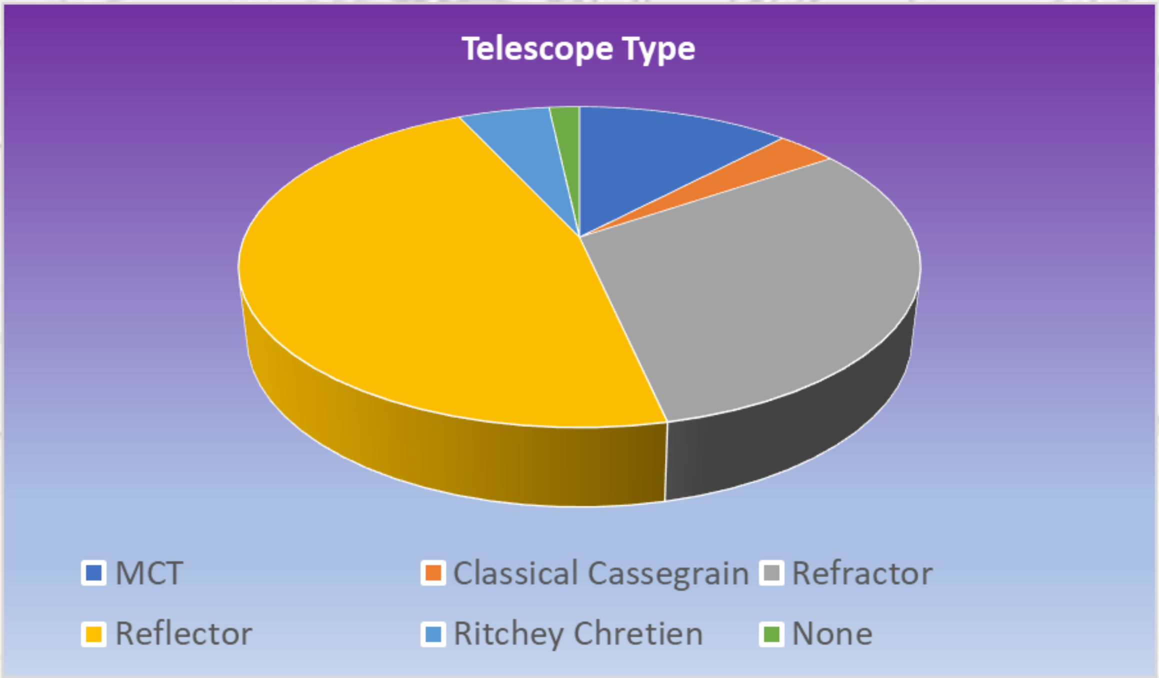
Observations Received

Name	Location and Organization	Image/Article
Alberto Anunziato	Paraná, Argentina	Article *Bajada Del Diablo and Gruithuisen's Mob: Parallel Crater Clusters in Patagonia and the Moon, Some Data About the Mare Tranquillitatis Pit, article and drawing The Wrinkle Ridge North of Nielsen* and *article and images Dorsum Frigoris: A Wrinkle Ridge Very Difficult to Observe.*
Francisco Alsina Cardinalli	Oro Verde, Argentina	Images of Aristarchus (2), Atlas, Bullialdus, Gassendi, Mons Pico, Shiller and Schickard.
Jairo Chavez	Popayán, Colombia	Images of the Waxing Gibbous Moon (3), Manilius, Full Moon and Plato.
Maurice Collins	Palmerston North, New Zealand	Images of the 2.3 day-old Moon (2), 3.3day-old Moon (2), 8.3 day-old Moon, 12.3 day-old Moon, Earthshine, Gassendi, Schickard and Aristarchus.
Massimo Dionisi	Sassari, Italy	Images of Fracastorius and Cauchy.
Walter Ricardo Elias	Oro Verde, Argentina	Images of images of the ISS across the Moon, Tycho, Alphonsus and Copernicus.
István Zoltán Földvári	Budapest, Hungary	Drawings of Borda and Magelhaens.
Attila Ete Molnar	Budapest, Hungary	Images of Mare Marginis, Mare Smythii and Mutus.
John Moore	Ireland	Article A Newly Named Crater Galimov.
KC Pau	Hong Kong, China	Article and three images *Yerkes Crater is Transformed into a Woodpecker when Under Specific Morning Sunlight.*
Raúl Roberto Podestá	Formosa, Argentina	Images of Alphonsus, Copernicus and Eratosthenes.
Robert Reeves	San Antonio, Texas, USA	Article *Where Did Luna 2 Strike the Moon?*
Gregory T. Shanos	Sarasota, Florida, USA	Image and article *Lunar Occultation of Spica on July 13, 2024* and *Proclus and Langrenus.*
Michael Sweetman	Sky Crest Observatory, Tucson, Arizona, USA	Images of Maginus and Tycho.
Larry Todd	Dunedin, New Zealand	Images of Aristoteles (2).
Gonzalo Vega	Oro Verde, Entres Rio, Argentina, AEA	Images of the Waning Gibbous Moon, Waxing Crescent Moon, Walter and Cassini.
Paul Walker	Middlebury, Vermont, USA	Article and image *Ptolemaeus, Alphonsus and Arzachel and Some Easy to see Pyroclastic Deposits but Hard to See Rilles.*
Darryl Wilson	Marshall, Virginia, USA	Article and images *Thermal Imaging of the Moon.*

August 2024 *The Lunar Observer*
By the Numbers

This month there were 62 observations by 18 contributors in 8 countries.





Lunar X Predictions for 2024

40°N-75°W, Eastern Time Zone

Date, 2024	358° Colongitude	Altitude/Azimuth	Cloudy Nights
January 18	5:15 am	–37° / 345°	4:05 am
February 16	7:40 pm	+66° / 236°	6:49 pm
March 17	10:22 am	–11° / 38°	10:10 am
April 15	11:08 pm	+43° / 268°	11:41 pm
May 15	11:01 am	–16° / 53°	12:13 pm
June 13	10:15 pm	+34° / 244°	11:49 pm
July 13	9:11 am	–43° / 58°	10:48 am
August 11	8:15 pm	+24° / 212°	9:31 pm
September 10	7:49 am	–65° / 65°	8:29 am
October 9	8:12 pm	+16° / 206°	8:09 pm
November 8	8:33 am	–49° / 79°	7:49 am
December 7	10:43 pm	+4° / 253°	9:36 pm

Note: The Lunar X is not an instantaneous phenomenon; rather, it appears and evolves over several hours, so the times above are fundamentally approximate and serve only as a guide. The ardent observer should look a little early to catch the initial visible illumination. A less-dramatic Lunar X against a fully illuminated background can still be seen at least several days later. Because of the Moon's nominal 29.5-day synodic period (phase-to-phase), favorable dates for a given location tend to occur on alternate months (unfavorable dates for 40°N-75°W are shaded gray in this table). The 358° colongitude value for the terminator reaching the Lunar X and making it visible (see this RASC paper) and the corresponding lunar altitude/azimuth for 40°N-75°W were determined with WinJUPOS, which is freeware linked from the WinJUPOS download page.

The Cloudy Nights comparative data, derived by a different method, was presented in this post.

Daylight Saving Time for 2024 begins on March 10 and ends on November 3. The listed times are EST/EDT as appropriate for the date.

Submitted by Greg Shanos.

Lunar X Predictions for 2024-2028

5 Year Lunar "X" and "V" Schedule * **

	2024	2025	2026	2027	2028
Jan	18: 0830	6: 1645	25: 1630	15: 0015	4: 0830
Feb	16: 2345	5: 0800	24: 0730	13: 1530	3: 0015
Mar	17: 1400	6: 2300	25: 2145	15: 0600	3: 1500
Apr	16: 0300	5: 1300	24: 1100	13: 1930	2: 0430
					1: 1700
May	15: 1600	5: 0130	23: 2245	13: 0730	31: 0400
Jun	14: 0400	3: 1330	22: 0945	11: 1830	29: 1430
Jul	13: 1430	3: 0015	21: 2000	11: 0500	29: 0030
		1: 1100			
Aug	12: 0130	30: 2130	20: 0630	9: 1530	27: 1100
Sep	10: 1230	29: 0900	18: 1730	8: 0200	25: 2245
Oct	10: 0015	28: 2115	18: 0530	7: 1400	25: 1130
Nov	8: 1245	27: 1045	16: 1900	6: 0300	24: 0145
Dec	8: 0230	27: 0115	16: 0930	5: 1730	23: 1645

* All times are listed as the day of the month and then the hour in **UT**

** All times are approximations based on LTVT calculations. They are accurate to ± 1 hour.

Submitted by Greg Shanos.

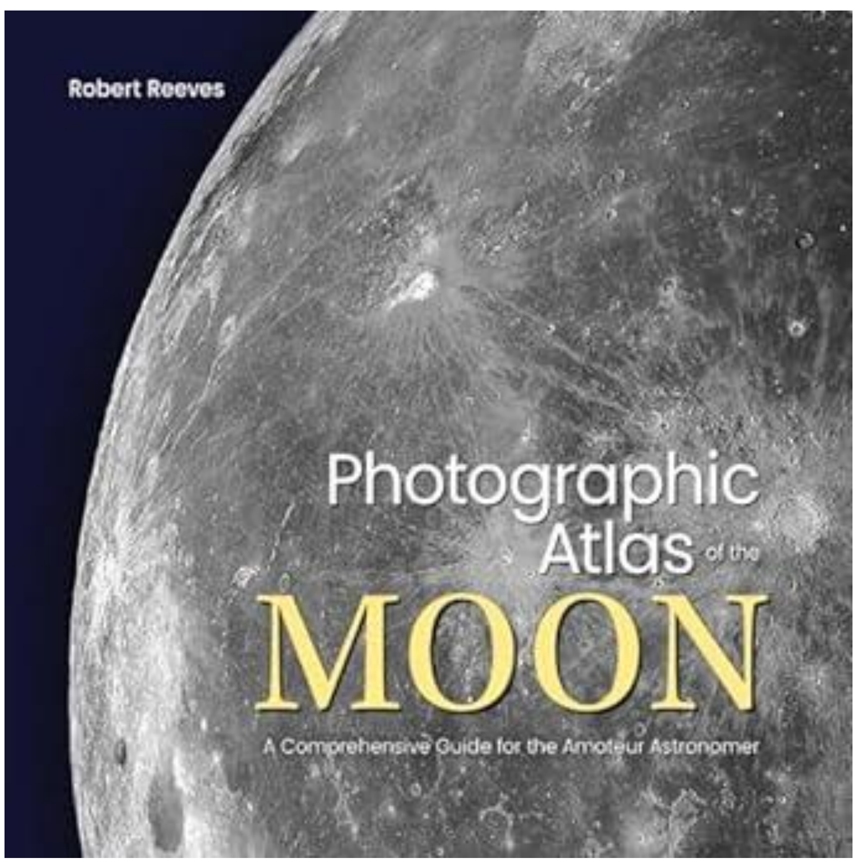
Photographic Atlas of the Moon: A Comprehensive Guide for the Amateur Astronomer, Robert Reeves, Hardcover – September 1, 2024

Written by a dedicated selenophile (a person who loves the Moon), this guide to Earth's celestial companion is a non-technical narrative that quickly elevates the lunar novice to lunar authority.

Photographic Atlas of the Moon explains how the Earth and the Moon are locked together in a co-dependent embrace, each affecting the other in ways that impact our lives. The reader will learn in comprehensible, jargon-free language about the Moon we see, its orbit, its creation and the differing geologic details of the Moon, some of which can be seen with the naked eye. All the photographs in this lavishly illustrated book were taken by the author, an internationally recognized authority on celestial photography. Reeves has perfected image processing techniques that allow the amateur astronomer, using modest equipment, to exceed the quality of Earth-based professional lunar photographs taken during the Apollo era.

Although Reeves is an accomplished deep-sky photographer, his current passion is re-popularizing the Moon within the amateur astronomy community. Momentum is building for a manned return to the Moon to continue the exploration started over half a century ago. Photographic Atlas of the Moon will provide even the most novice reader with an understanding of the Moon and its allure so they can appreciate the upcoming explorations by NASA's Artemis lunar program.

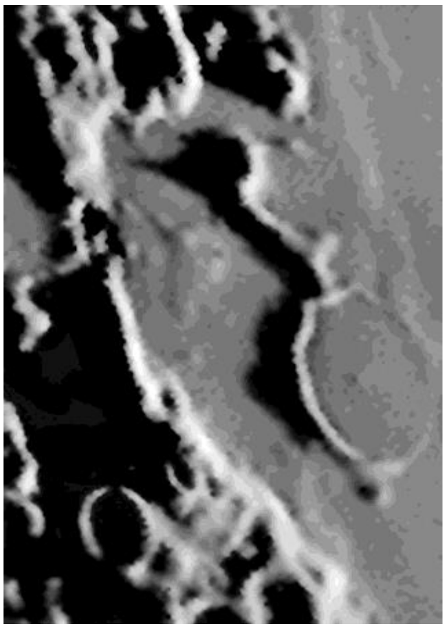
https://www.amazon.com/Photographic-Atlas-Moon-Comprehensive-Astronomer/dp/022810498X/ref=rvi_d_sccl_1/136-6077595-9611424?pd_rd_w=NTjEa&content-id=amzn1.sym.f5690a4d-f2bb-45d9-9d1b-736fee412437&pf_rd_p=f5690a4d-f2bb-45d9-9d1b-736fee412437&pf_rd_r=7XZ4992GTVJKS0K7P4F5&pd_rd_wg=WEmPb&pd_rd_r=310acd54-2b8b-4d1c-a84a-abe0a3d2034f&pd_rd_i=022810498X&psc=1



Yerkes crater is Transformed into a Woodpecker When Under Specific Morning Sunlight

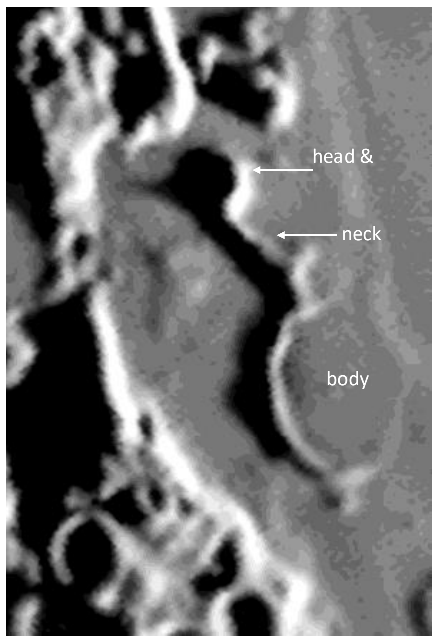
KC Pau

Whether you observe the lunar features visually or photographically, you will often encounter some rare light and shadow scenes. The three photos above show the Yerkes crater, Yerkes E and a short ridge, when under the specific lighting condition, they will transform into a cute woodpecker. The woodpecker is pecking at the tree trunk (crater rims) next to it until its beak is finally collapsed.



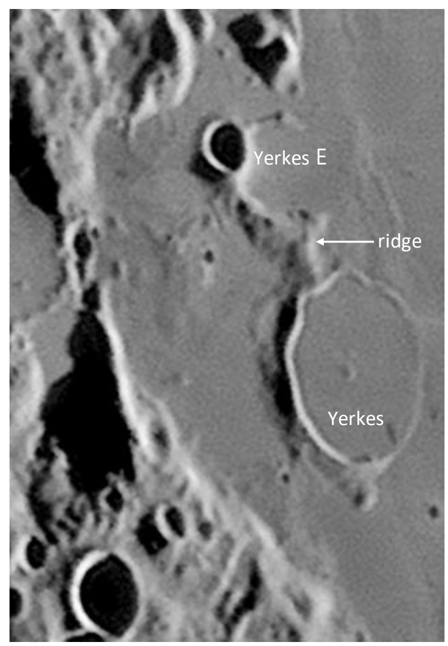
12apr2024_12h15m

colong: 313.8°



13feb2024_11h23m

colong: 314.7°



16feb2021_11h03m

colong: 322.2°

The Wrinkle Ridge North of Nielsen

Alberto Anunziato

Nielsen is a small crater 10 kilometers in diameter with the typical bowl shape of impact craters of that size. It is located in Oceanus Procellarum, north of the Aristarchus Plateau. To the north of Nielsen runs a very prominent wrinkle ridge that reaches Mons Rümker and is unnamed (like most dorsa), although it is unofficially named Dorsum Nielsen-Rümker. In IMAGE 1 we see the sinuous topography of the dorsum, inside which three bright areas were visible that are the highest parts of the highest part of the topography of a dorsum, that is, the highest areas of the ridge. A nice exercise to do is to compare the simplified topography of IMAGE 1 with the sophisticated topography revealed by IMAGE 2, once again extracted from the Photographic Lunar Atlas for Moon Observers by Kwok Pau (and frequent readers of our magazine will know that it is a work that I admire), which is found on page 390 of Volume 2. In said IMAGE 2 we see more clearly how the crest (upper, narrow and steep component) runs migrating from one margin to the other of the arch (lower, wide and bottom component) and we mark with 3 red arrows the highest areas of the crest, which we presume are the highest crests (since they were visible as brighter areas in IMAGE 1). Towards the east the terrain seems to descend, due to the slight shadow typical of sloping terrain, and we see a much less bright and prominent parallel ridge and two segments between both ridges.

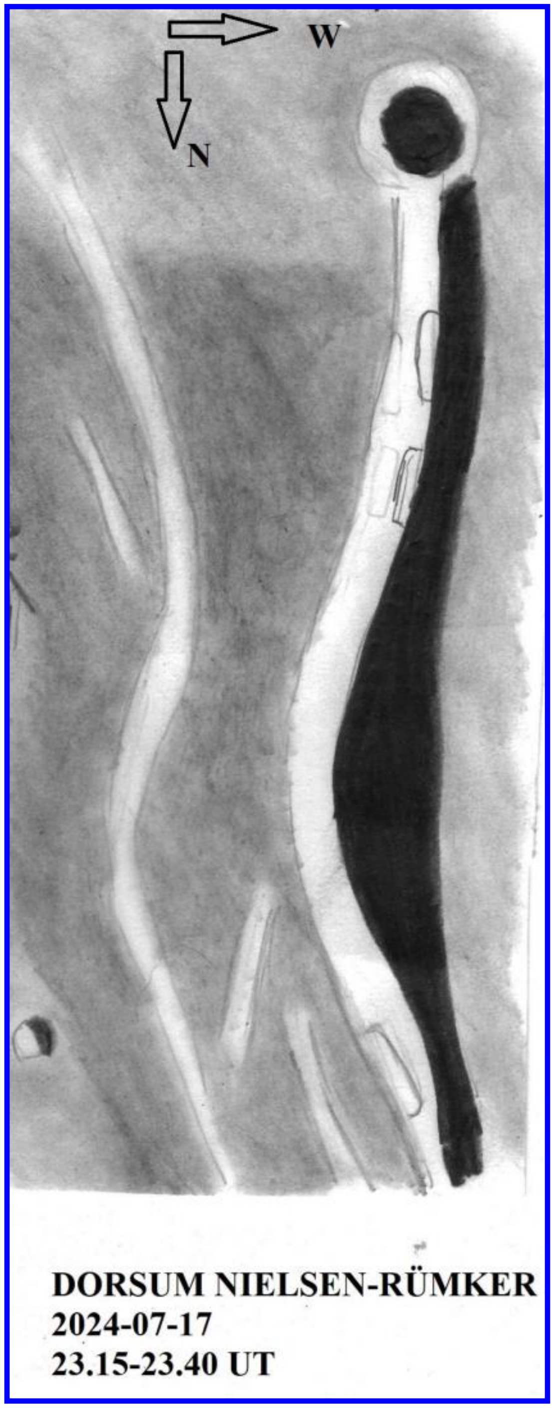


Image 1, Dorsum Nielsen Rümker, *Alberto Anunziato, Paraná, Argentina. 2024 July 14 23:15-23:40 UT. Meade 105EX Maksutov-Cassegrain telescope, 154x.*

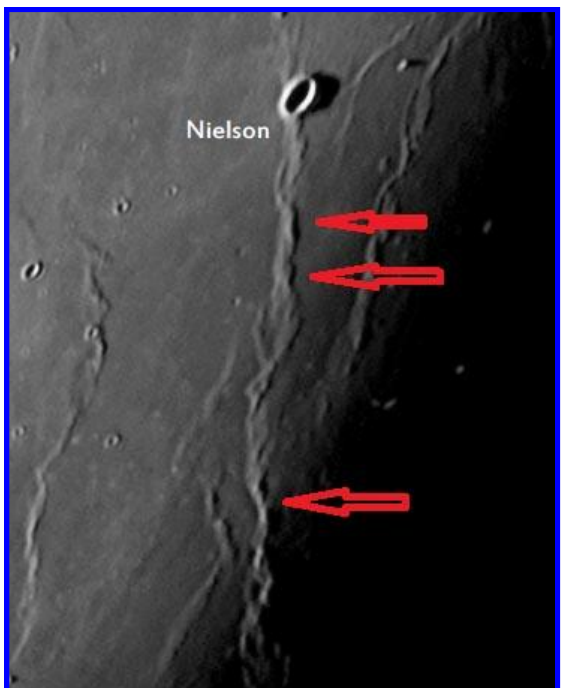


Image 2: *Kwok Pau, Photographic Lunar Atlas for Moon Observers, Volume 2, page 390.*

Where Did Luna 2 Strike the Moon?

Robert Reeves

In September 1959, less than two years after the birth of the Space Age, the Russian Luna 2 spacecraft struck the Moon and symbolically announced that beings from Earth would soon arrive. Little did the world realize that in less than ten years Neil Armstrong would make his first "small step for a man" on the Sea of Tranquility.

Officially called the "Second Soviet Cosmic Rocket" by Moscow, the groundbreaking emissary from Earth was quickly dubbed "Lunik" by the press. After subsequent lunar probes were launched, the generic name "Luna" was applied to all unmanned Russian lunar spacecraft and Second Soviet Cosmic Rocket officially became Luna 2.

Initial Russian attempts to launch a lunar probe failed in September, October, and December of 1958. The booster used the same rocket that had lofted Sputnik 1 a year earlier with the addition of a second stage to boost the lunar payload to escape velocity. This same rocket would, two years later, place Yuri Gagarin in orbit.

A launch on January 2, 1959, succeeded in lofting a 156-kilogram (344-pound) spacecraft toward the Moon, but a two-degree error in the booster's radio navigation setting resulted in the probe, called "Mechta", or Dream, missing the Moon by 5,965 kilometers (3,706 miles) and entering solar orbit. Years later, the probe was renamed Luna 1.

A fifth launch toward the Moon in June 1959 also failed.

The sixth Russian attempt to reach the Moon succeeded when the second cosmic rocket departed Earth on September 12, 1959, on a direct ascent trajectory that would intercept our natural satellite 34 hours later. The new lunar probe was similar to the spherical Mechta launched eight months before, but its weight increased to 390.2 kilograms (860 pounds). In addition to a magnetometer and meteoroid, radiation, and ion detectors, the lunar craft contained a collection of titanium commemorative medallions that would scatter on the lunar surface upon impact.

After reaching escape velocity, Luna 2 detached from the booster rocket and slowly spun every 14 minutes on the way to the Moon. Three radio channels communicated with Earth; the RTS-12B radio system transmitted at 183.6 MHz, and the Jupiter radio system transmitted at 19.993 and 39.986 MHz.

Many western observers, particularly the jingoistic Lloyd Mallan who long professed that Russian space achievements were fake, doubted the reality of Mechta and questioned whether the Second Cosmic Rocket was real. To quash those ideas, the Luna 2 booster rocket released a sodium cloud 152,000 kilometers from Earth. The cloud was visible for several minutes as an "artificial comet" and established the rocket was on its way to the Moon.

The Russians also enlisted the aid of Britian's 250-foot radio telescope at Jodrell Bank to track Luna 2. To ally concerns by the press that the Russian lunar rocket was fake, Jodrell Bank director Bernard Lovell held his telephone to the receiver's loudspeaker so reporters in New York could hear the signal from Luna 2. The 250-foot radio telescope followed the final five hours of Luna 2's flight and recorded the radio signal's Doppler shift as the probe was accelerated by lunar gravity. Luna 2 accelerated to 3.3 kilometers per second (7,400 mph) and slammed into the Moon at a 60-degree angle. When the signals stopped at lunar impact at 21:02:24 GMT on September 13, 1959, the radio telescope was aimed directly at the Moon.

A half hour later, the Luna 2 booster's second stage also struck the Moon.

Data from Luna 2 revealed there was no lunar magnetic field and radiation in the lunar environment was no higher than in cislunar space.

But exactly where did Luna 2 strike the Moon? The location is one of the most historic locations in space exploration and should be considered an international heritage historic site. The truth is the exact impact site is unknown. Today, spacecraft location can be tracked within a kitten's whisker, but in the late 1950's deep space tracking capability was crude at best.

Three different tracking methods narrowed the accepted Luna 2 impact area to an approximately four-square degree region located between Archimedes and Autolycus craters on northeastern Mare Imbrium. Yes, Luna 2 socked the Man-in-the-Moon in his right eye!

Radio interferometry narrowed Luna 2's location on the Moon to within a one arc minute wide swath running northwest to southeast across the face of the Moon. For reference, the face of the Moon is about 30 arc minutes across, so this path covers a lot of territory.

Jodrell Bank's 250-foot radio telescope established that Luna 2 impacted within a seven-arc minute radius of the center of the Moon's disk.

Analysis of the Luna 2 booster's ballistic trajectory, aided by observations of the sodium cloud artificial comet, project an impact point bounded between 15 and 45 degrees north 15 degrees east and west of the lunar meridian.

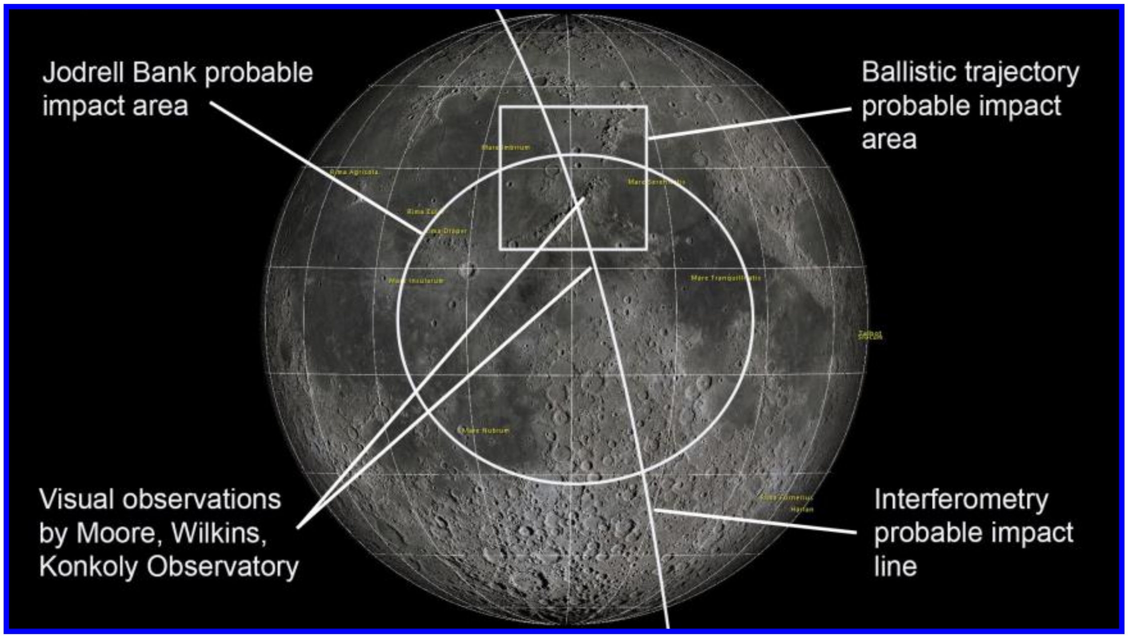
The center of the ballistic target box overlaps the northern boundary of the Jodrell Bank impact circle and the radio interferometry path bisects both zones.

Eleven visual telescopic observations supplement the tracking data, although most observations have been dismissed. However, three stand out. Britian's' Patrick Moore and Hugh Percy Wilkins independently saw a pinpoint of light at the impact time located at 11.2N and 4.97E. Another observation from the Konkoly Observatory in Hungary noted a dust plume at 25.7N and 4.97E. Although both locations are separated by 13 degrees of lunar latitude, they lie within the one arc minute radio interferometry swath.

The primitive tracking and scattered visual observations fail to nail down a definitive pinpoint location for Luna 2's impact site, but by general accepted convention, the historic location is assumed to be within a 2,500 square kilometer region between lunar coordinates 29 and 31 degrees north and between longitude 01 degree east and 01 degree west. Multiple sources, including the respected Virtual Moon Atlas, hopscotch the impact location, but all lie within this four-square degree area between Archimedes and Autolycus.

To commemorate the arrival of the first object from Earth to reach another world, the 80- x 80-kilometer region north of Palus Putredinis between Archimedes and Autolycus was officially designated Sinus Lunicus, the Bay of Lunik, in 1970 by the I.A.U. and assigned I.A.U. lunar feature I.D. number 5566.

To date, none of the high-resolution camera-carrying spacecraft in orbit around the Moon have identified the craters made by the impact of Luna 2 or its second stage rocket. Later spacecraft and boosters that either impacted or landed on the Moon benefitted from improved deep space tracking and their location on the lunar surface are known, with many now being heritage sites. Unfortunately, the precise spot where mankind's first robotic emissary struck the Moon may forever remain a mystery until a curious future explorer happens upon one of the Hammer and Sickle-bearing medallions scattered by Luna 2's explosive impact.

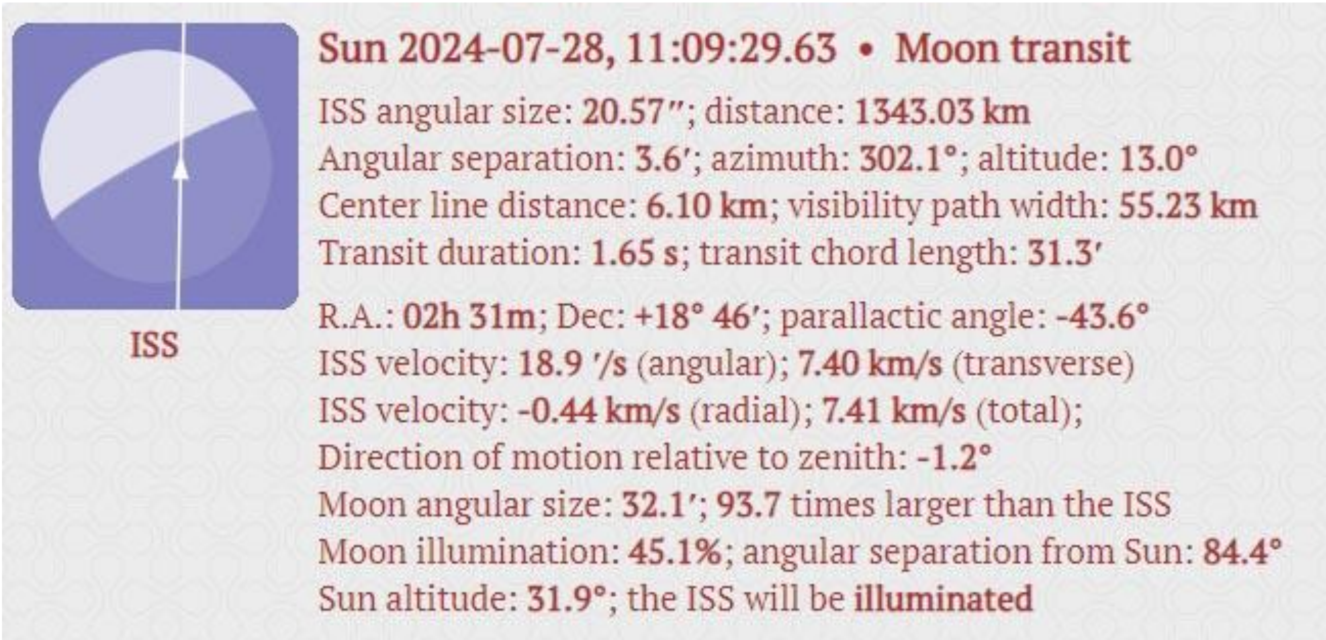


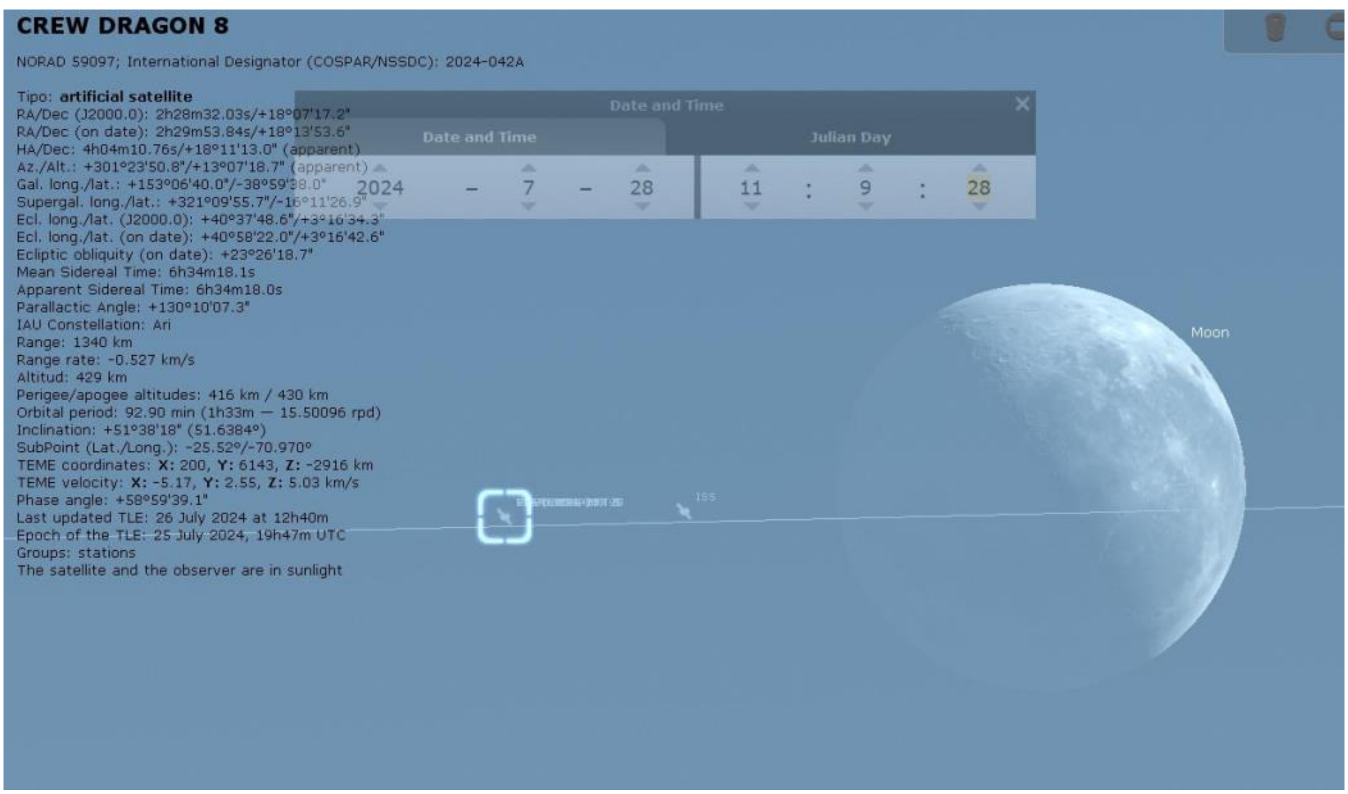
Probable impact zone
Four different tracking methods provide clues to the Luna 2 impact site. Jodel Bank radio telescope tracking places the site within a seven-arc minute radius of the center of the Moon's visible disk. Ballistic trajectory projections place it within a square region above the lunar equator. Radio interferometry places the impact along a narrow one arc minute wide swath traversing the face of the Moon. Possible visual observations place the impact site above the equator near the meridian. Graphic adapted from Virtual Moon Atlas by Robert Reeves

Sinus lunicus.jpg
Today, the accepted Luna 2 impact area is assumed to be within the triangle formed by Aristillus (top), Autolycus (right), and Archimedes craters within a region bounded by 29- and 31-degrees north latitude and one degree either side of the lunar meridian. The region was designated Sinus Lunicus, the Bay of Lunik, by the I. A. U. in 1970 to honor the achievement of the first man-made object to reach the Moon. Photo by Robert Reeves

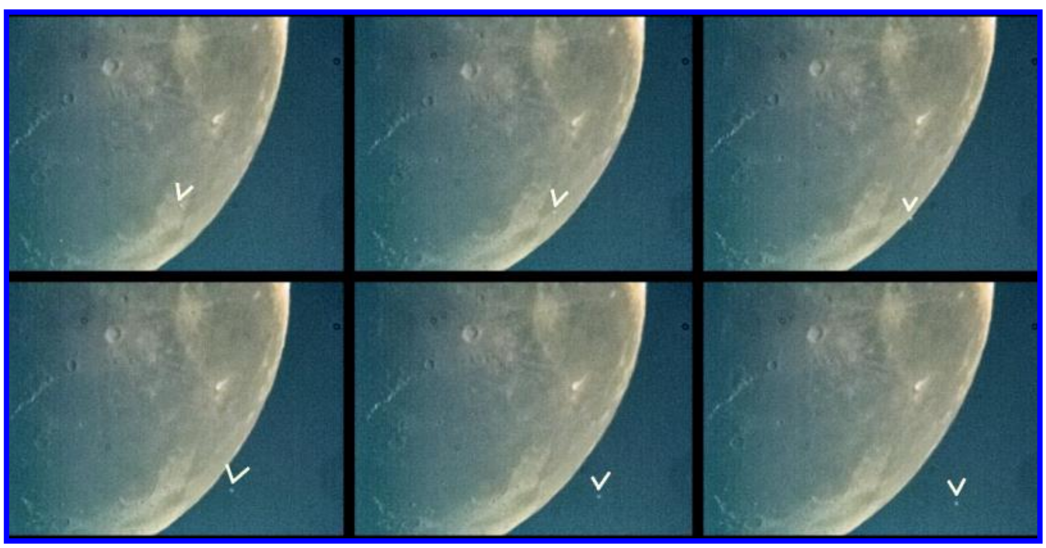
ISS Lunar Transit 2024 July 28

Images by Walter Ricardo Elias, images processed by Gonzalo Vega





From Stellarium



I was lucky with the capture!
I am sending you the sequence of the ISS transit, the capture from Stellarium where the date and time details are and the capture from
the page https://transit-finder.com/

Some details.
1- The capture was made during the **day**! (the ISS looks completely illuminated)
2- The Moon was already quite low over the western horizon (18º)
3- There was a lot of wind and bad seeing
4- The whole sequence lasts 1.3 seconds
I used the SkyWatcher 750x150 mm telescope with the QHY 5II C camera
in primary focus and the AstroDMx Capture and PIPP software.
I am sending three images with the captures in order and the ISS
marked with a yellow arrow.

Images by Walter Ricardo Elias, processing by Gonzalo Vega, Oro Verde, Argentina.

Lunar Topographic Studies
ISS Lunar Transit 2024 July 28

Newly Named Crater Galimov

John Moore

We have a newly-named crater, called Galimov, added to the lunar nomenclature on 4 June 2024. Coming in at 33.00 km in diameter, the crater lies on the farside of the Moon at Lat 64.30S and Long 126.53W.

Named in honor of the Russian geochemist Erik Mikhailovich Galimov (1936-2020), the crater seems to lie in an area that has seen the impact wars from craters nearby. From initial look, this crater may be one of those floor-fractured craters, and judging from the two obvious gashes (small crater chains mainly seen at its northern flanks) that cross its inner and outer regions, it may also have experienced the ejecta deposits from some major impact nearby, or possibly far from its surrounds.

The crater can be seen from a broader perspective here in LAC 142 (it lies at the top-right corner).

Image credit LROC

Lunar Occultation of Spica on July 13, 2024

Gregory T. Shanos

A lunar occultation of Spica was visible from Longboat Key, Sarasota, Florida (27° 20' 58.24"N and 82° 36' 19.04" W) on July 13, 2024 at 11:42:21.897 pm local time or July 14, 2024 03h 42m 21.897 sec Universal Time. The moon was a waxing gibbous at 52% phase and only 20 degrees above the horizon just before disappearance. The sky conditions were less than ideal with light clouds and haze which prevented a clear view of the earthshine. Fortunately, the seeing was above average. Telescope was a Meade 60mm refractor 260mm fl at f/4 with an Orion EQ tracking tripod. A ZWO ASI462MM monochrome camera with an Optolong UV-IR cut filter and Firecapture v2.7.14 software was utilized to acquire the video. The apparatus was connected to an MSI GF65 gaming computer. Individual frames from the video were extracted using DVD VideoSoft JPG converter v5.0.101 build 201. Slight sharpening with Photoshop CS4. The moon was slightly overexposed to emphasize the star. This frame is a mirror-image since the refractor utilized a diagonal prism. Gregory T. Shanos.

This is the next frame which occurred 0.047 seconds later when Spica was occulted by the moon. Note the accuracy of the embedded time 0.047 seconds! Unfortunately, the moon was below the horizon for the reappearance of the star. Gregory T. Shanos.

Dorsum Frigoris: A Wrinkle Ridge Very Difficult to Observe

Alberto Anunziato

Virtually almost all wrinkle ridges on the Moon have the same north-south orientation with an east-west stress direction; they were all formed in a common and continuous process that occurred in a short period of time, geologically speaking, after basalt emplacement. They are like a large net that covers almost the entire surface of the maria. And the few that have an east-west orientation are very difficult to see, since by definition their shadows cannot be that long, and the shadows are essential to observe those beauties, evanescent like all intense beauties, which are called dorsa. But east-west oriented wrinkle ridges are rare, except in the only mare that is as long as it is wide, Mare Frigoris, the only non-circular mare on the Moon, the only one that is not contained within a basin but is simply the outer part of the Imbrium basin, separated from the rest by the ejecta from the inner part, and deeper, ejecta that form the separation between Frigoris and Mare Imbrium. The wrinkle ridges inside Mare Frigoris exist, and in fact they are not few (which can be seen in the images that illustrate the Focus-On Section of the May 2022 issue dedicated to this mare), but (as we said) they are difficult to observe because of the illumination conditions and also because they are not very prominent. That's why I couldn't resist the temptation of drawing the most prominent wrinkle ridge of Frigoris, without a name (that's why I gave him a provisional one) when he seemed to escape from the shadows of the terminator, for me it was the first time I saw him (IMAGE 1).

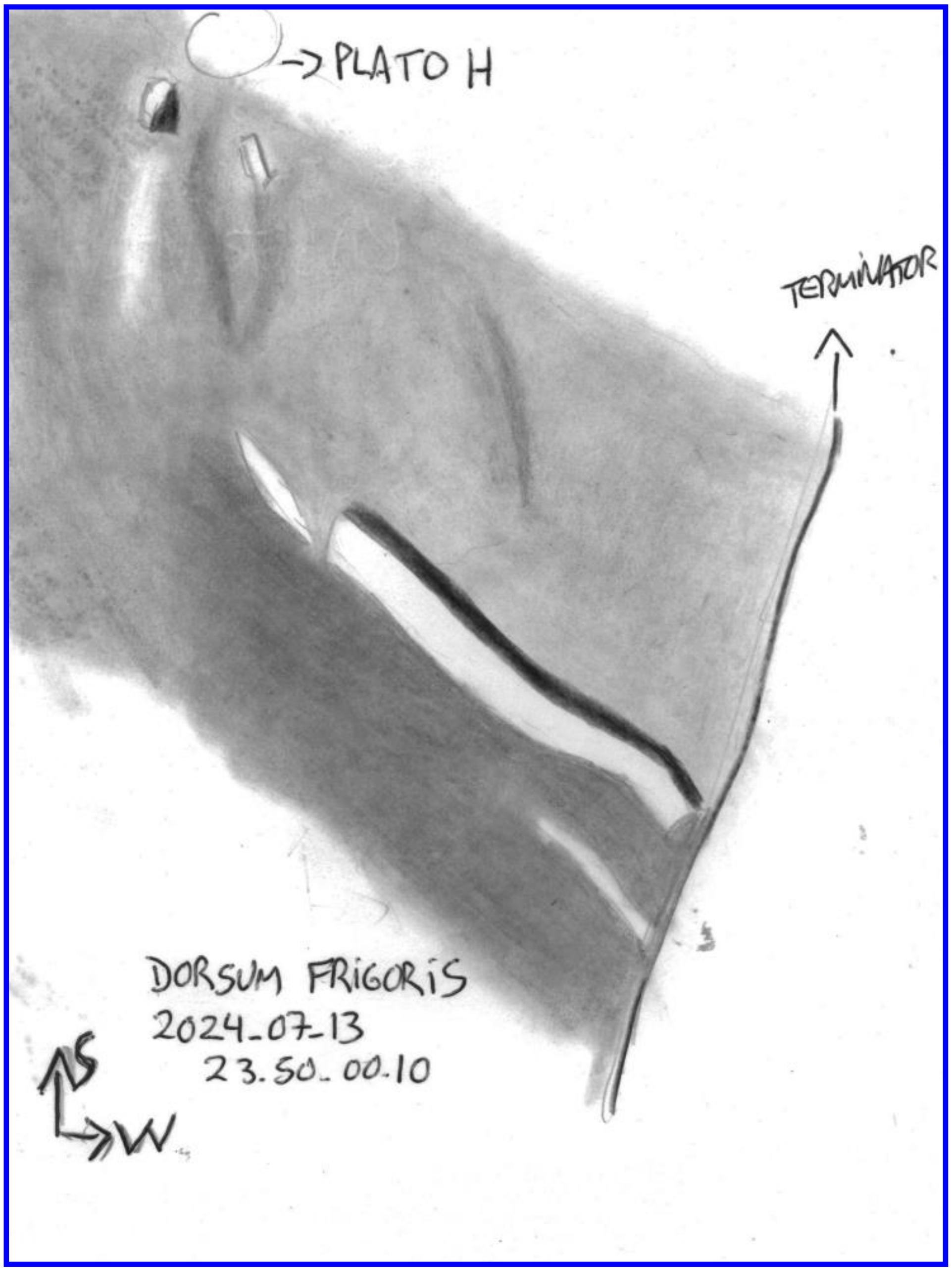


Image 1, Dorsum Frigoris, *Alberto Anunziato, Paraná, Argentina. 2024 July 13 23:50-00:10 UT. Meade EX 105 Maksutov-Cassegrain telescope, 154x. Seeing 7/10, transparency 7/10.*

It was not a great spectacle, compared to other ridges in the same oblique lighting conditions: a main segment, quite bright, but without any detail, which projected a thin shadow that did not show any irregularity of which lower higher areas, a segment shorter, less bright and low (no shadow). Towards the north loomed a short segment, less bright and without shadow. The Dorsum Frigoris seemed to separate two areas of different heights, since towards the north the terrain was slightly obscured, remember that the terrain always presents differences in elevation on both sides of a dorsum. The area can be seen in IMAGE 2, an image that we have used on several occasions because it has a very wide field and an incredible level of detail.

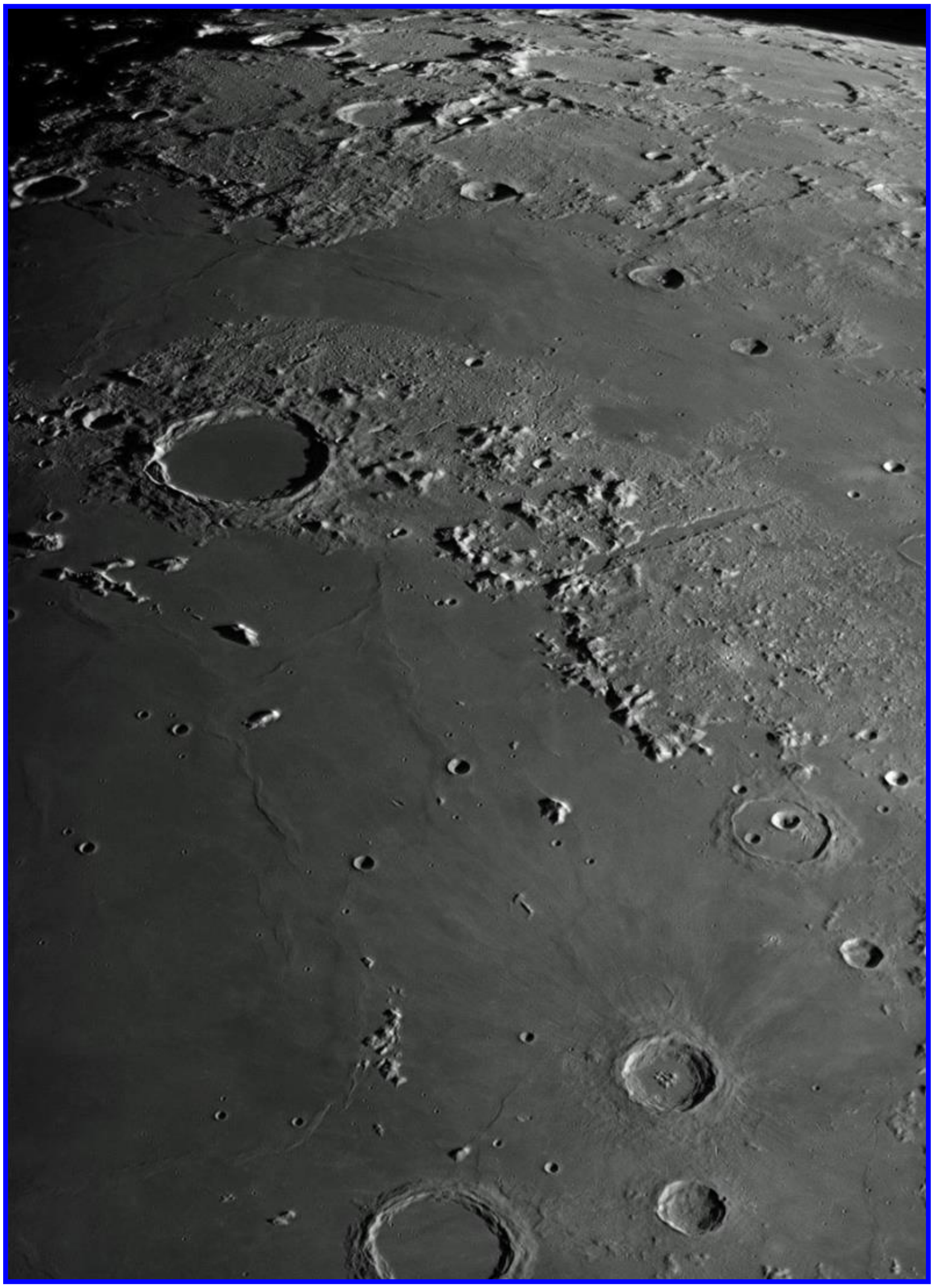


Image 2, Dorsum Frigoris, *Alberto Anunziato, Paraná, Argentina. 2016 September 10 23:12 UT. Celestron 11 inch Edge HD Schmidt-Cassegrain telescope, QHY5-II.*

The area we observe is between Plato and Timaeus and can be seen in the detail of IMAGE 3. The crater seen in IMAGE 3 is Plato H, which we simply indicate in IMAGE 1. Dorsum Frigoris appears in IMAGE 3 with a structure of several segments with echelon ridges (which we couldn't resolve with our small telescope). To the south of our ridge you can see three wrinkle ridges, much more indistinct. In IMAGE 1 you can see, from west to east, 1) a slight shadow, 2) a shadow with a complicated, double line, and 3) a very slight brightness; Of these, only segment 2) appears clearly in IMAGE 3. To the north of Plato H there are two intensely luminous areas that are peaks, probably the rocky material that makes up the entire area north of Mare Frigoris.

Image 3, Dorsum Frigoris, *Alberto Anunziato, Paraná, Argentina. 2016 September 10 23:12 UT. Celestron 11 inch Edge HD Schmidt-Cassegrain telescope, QHY5-II. This is a close-up of Image 2.*

Thermal Imaging of the Moon

Darryl Wilson

Previous Work (2019 – 2022), Current Status (July 2024), and Future Plans

Previous Work (2019 – 2022)

From September 2019 to December 2022, I presented numerous articles in "The Lunar Observer" and the "Journal of the Association of Lunar and Planetary Observers" that described how to collect, process, and analyze thermal images of the moon using equipment available at the time. With it, one can see many surface features that are never visible in the solar-reflective (ultraviolet, visible, near-infrared) region of the spectrum.

Some notable observables in lunar thermal images include the following:

Thermal Observable	Figure
1) Wrinkle ridges visible far from the terminator	1
2) Contrast reversal of crater rays	1
3) Young crater floors cooler than surroundings well into the lunar day	1
4) Small craters radiate strongly near and after sunset	1
5) Well defined crater walls far from the terminator even near full moon	1, 2
6) Hot spots that continued to radiate several earth days after lunar sunset	2, 3
7) Tycho radiates strongly after sunset	3
8) Cooling rates of hotspots vary during lunar eclipse	see Ref. 9

These eight, and several others, are discussed in detail in the references.

The articles included discussions of several relevant processes, including the following:

1) The effect of atmospheric temperature on thermal imagery
2) The effect of thermal wavelength on image resolution
3) The effect of wrinkle ridge slope on surface temperature
4) The effect of crater depth ratio on rate of cooling

An understanding of these processes is important if one wishes to interpret thermal imagery of the moon. For readers who do not wish to be dragged into the weeds of scientific detail, a short list of four rules for interpretation of these lunar thermal images was presented in Ref. 7.

A complete reference list of ALPO articles on this topic can be found at the end of this article for the convenience of any interested reader. One might make most effective use of time by reading Ref. 7 first, since it provides the most complete technical discussion of the subject matter. The other references offer higher resolution imagery and detailed descriptions of the thermal features that are visible in each scene.

Note that each of the articles in the reference list also includes its own reference list. These lists include topically relevant papers written by science teams from the Lunar Reconnaissance Orbiter and many other organizations. They offer more detailed technical insight into many of the concepts that are presented in the ALPO articles.

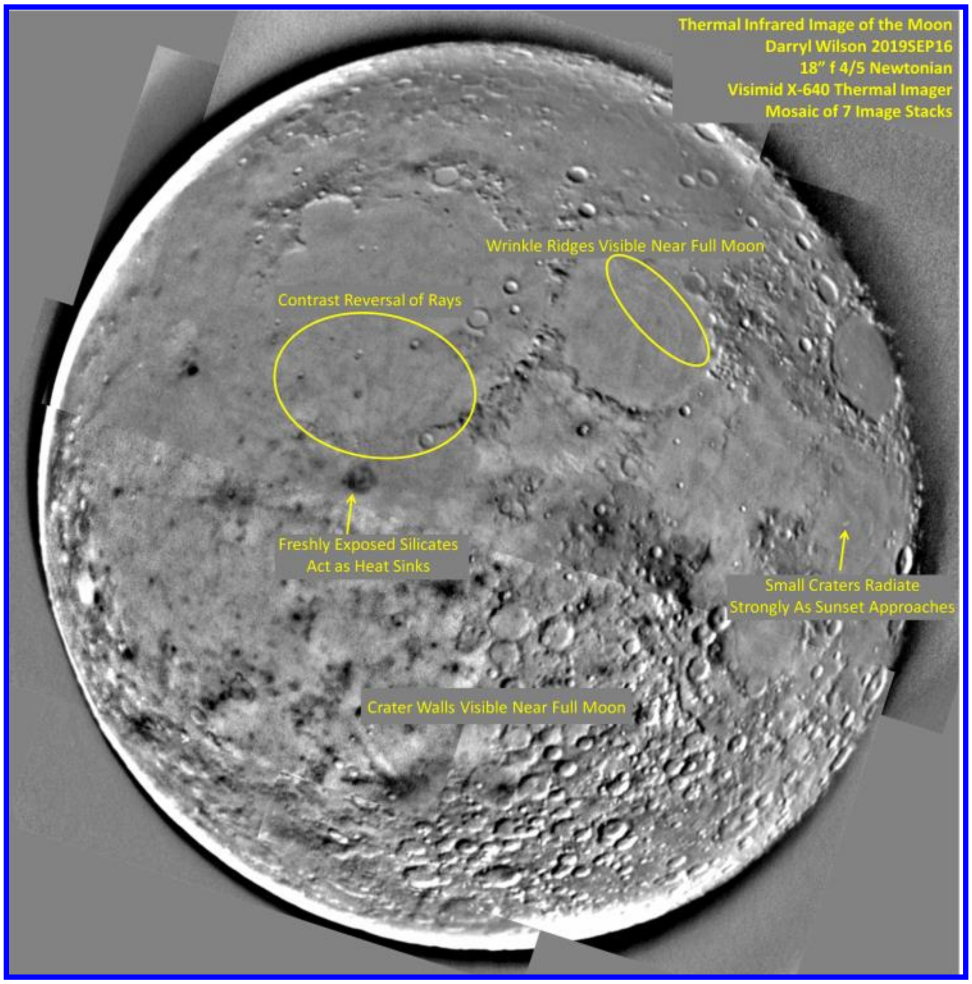


Figure 1

Present Status (2024)

A recent review of the current state of thermal imaging in the amateur astronomy community revealed that although no scientific articles are apparent, one English astronomer has posted thermal video of the moon on CloudyNights.com. The availability of thermal imagers is more widespread than it was 5 years ago, and the cost is lower. It is likely that, by the end of 2024, this author will no longer be the only one writing about lunar thermal imaging.

Recently revived efforts include the purchase of new thermal imaging and other astronomical equipment. Once acquired and configured, the new hardware and software should exceed all prior capabilities.

Future Plans (2024 -)

The quality of the data collected by the new imaging system in the coming months will determine the types of analysis that can be done. Two possibilities are mentioned below.

If video capture capability is adequate, the camera may be able to detect meteoroid impacts on the lunar surface. Although amateurs have images a number of meteoroid strikes on the moon with visible light cameras in recent years, the duration of the flash is a fraction of a second – usually only one or two video frames. If it can be detected, the thermal signal should last much longer, possible offering the opportunity to analyze the thermal decay curve and constrain the kinetic energy of the impactor.

Thorough coverage of a lunar eclipse may now be possible, to include observations of the cooling rate of several locations at multiple points in time. If a temperature curve exists, a cooling rate can be calculated. Once cooling rates from several locations have been measured, they could be correlated with the thermal inertia of the surface materials at those locations.

For amateur astronomers, thermal imaging is more affordable than ever before. With the newest equipment, it may also be much easier than it was 5 years ago. Coupling a new technology with a familiar activity offers new experiences similar to those we all enjoyed when we had a look through our first telescope. Interesting findings should be plentiful in the coming months.

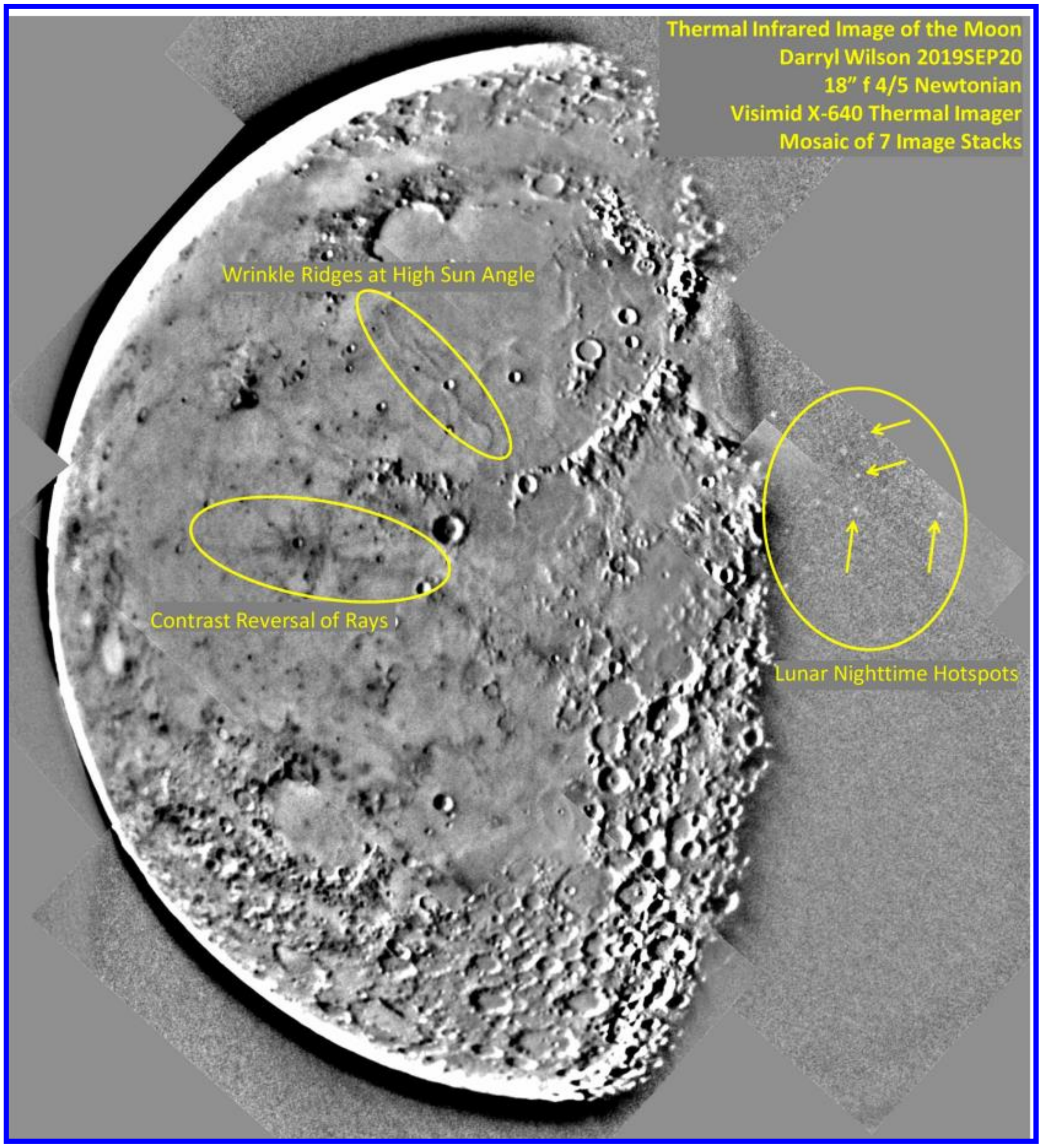


Figure 2

ALPO Lunar Thermal Imaging Articles 2019 – 2022

1 Wilson, Darryl G., "Thermal Imaging of the Moon", September 2019, "The Lunar Observer", p. 36-38.

2 Wilson, Darryl G., "Mosaic Analysis", November 2019, "The Lunar Observer", p. 21-24.

3 Wilson, Darryl G., "Lunar Nighttime Thermal Analysis", November, 2019, "The Lunar Observer", p. 25-31, http://moon.scopesandscapes.com/tlo_back.html. http://www.alpo-astronomy.org/gallery3/index.php/Lunar/The-Lunar-Observer/2019

4 Wilson, Darryl G., "Lunar Nighttime Thermal Analysis", p. 47 JALPO, Spring 2020, Vol. 62, No. 3.

5 Wilson, Darryl G., "Thermal Observations of Tycho: A First Look", March 2020, "The Lunar Observer", p. 21-29.

6 Wilson, Darryl G., "Introduction to Thermal Imaging of the Moon", p. 57-65 JALPO, Summer 2020, Vol. 62, No. 4.

7 Wilson, Darryl G., "Basic Interpretation and Analysis of Lunar Thermal Images", p. 52 JALPO, Spring 2021, Vol. 63, No. 2.

8 Wilson, Darryl G., "The Straight Wall Imaged at Visible and Thermal Infrared Wavelengths", April, 2021, "The Lunar Observer", p. 25-29.

9 Wilson, Darryl G., "Thermal Imagery of the November 2021 Lunar Eclipse", October, 2022, "The Lunar Observer", p. 32-39.

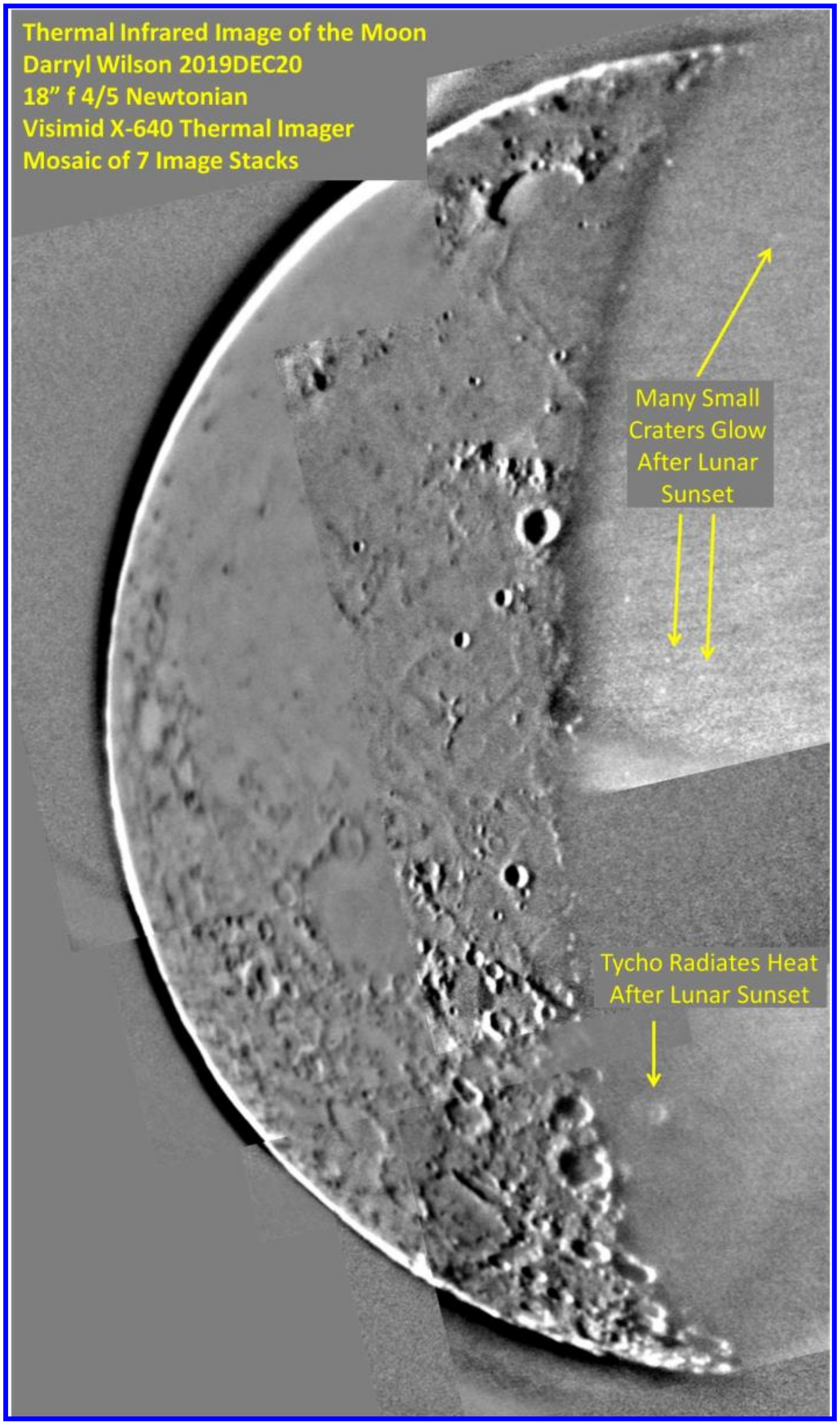


Figure 3

Lunar Topographic Studies
Thermal Imaging of the Moon

Proclus and Langrenus

Gregory T. Shanos

The moon on January 21, 2024 at 00h 44m UT or January 20, 2024 7:44pm local time was at a 79% waxing gibbous phase at 74 degrees above the horizon. The seeing was above average with perfectly clear skies. Image was taken with a Meade LX200GPS 8-inch ACF with an Optec Lepus 0.62X focal reducer. A ZWO ASI 178MM monochrome camera with an Optolong UV-IR cut filter along with Firecapture 2.7.14 were utilized to obtain the video. An MSI GF65 gaming computer was utilized to obtain the video and post-process. The AVI was aligned and stacked with Autostakkert 4.0.11 beta and Registax 6.1.0.8. Further processing in Photoshop CS4. Image by Gregory T. Shanos

The bright rayed crater between Mare Crisium and Mare Tranquillitatis is called Proclus which stands out in high relief. Proclus is a relatively small crater 27 km (16.8 miles) in diameter with very steep walls. The rim of Proclus is distinctly polygonal in shape and does not rise far above the surrounding terrain. It has a high reflectivity (albedo). The floor of the crater is uneven with the interior wall displaying some slumping. The crater has a notable system of rays that extend for a distance of over 600 km (372.8 miles). The rays display an asymmetry of form, with the brightest rays being to the northwest, north-northeast, and northeast. There is an arc with no ejecta to the southwest. These features suggest an impact at a low angle. (Wikipedia)

The other prominent crater bordering Mare Fecunditatis is called Langrenus. The inner wall of Langrenus is wide and irregularly terraced, with an average width of about 20 km (12.4 miles). The outer rims are irregular and hilly, and there is a bright, fragmented rays that spread across the mare to the west. The interior of the crater has a higher albedo than the surroundings, so the crater appears bright. The central peaks rise about a kilometer (0.6 miles) above the floor, and a peak on the eastern rim ascends to an altitude of 3 km (1.9 miles). (Wikipedia)

Bajada Del Diablo and Gruithuisen's Mob: Parallel Crater Clusters in Patagonia and the Moon

Alberto Anunziato

Some time ago I commented on a blog about comets the existence of a field of impact craters in the province of Chubut, in Patagonia, in my country Argentina, presumably of cometary origin (IMAGE 1).

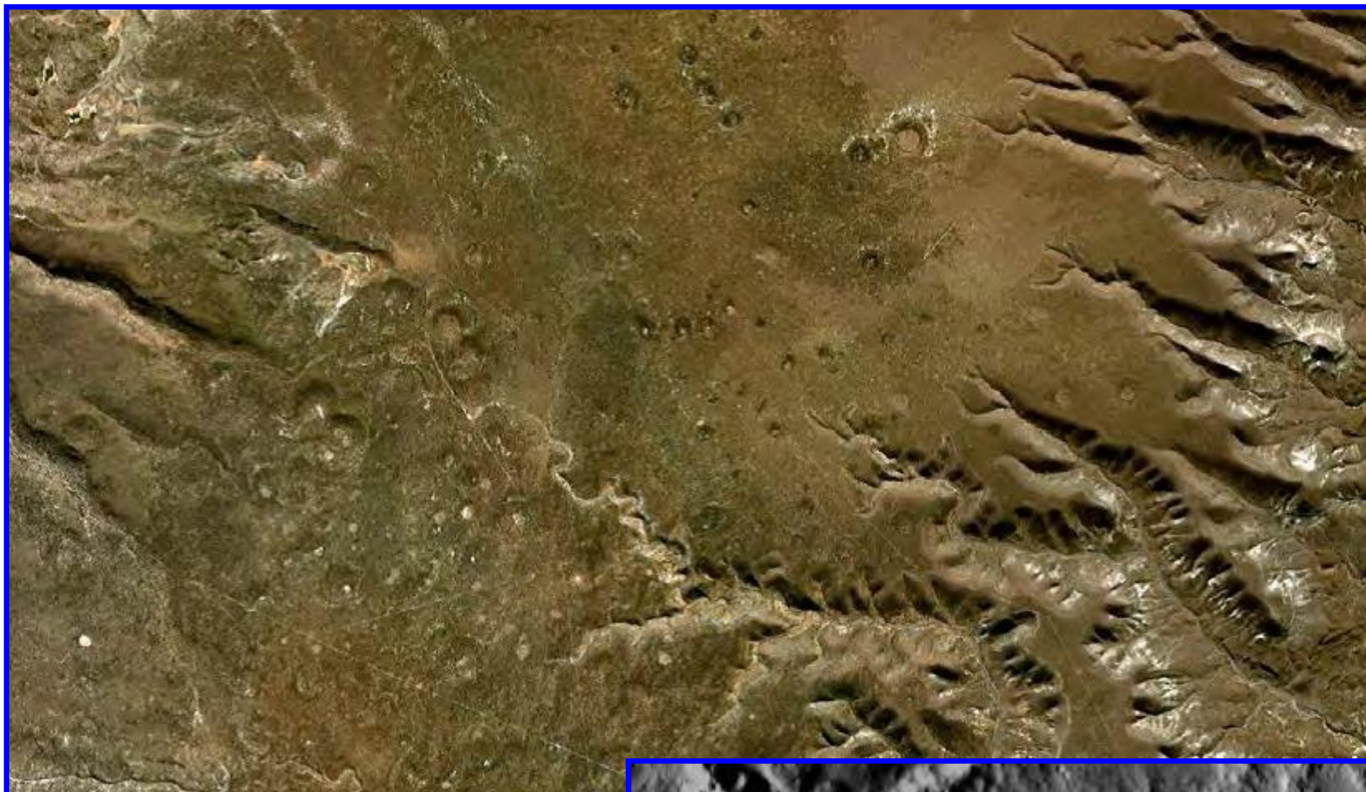


Image 1, Bajada Del Diablo *crater cluster in Argentina.* Page 8 of "A very unusual cluster of multiple small impact craters probably created by the impact of a split cometary nucleus in Patagonia. Bajada del Diablo craters field, Chubut, Argentina: the impact of a small split comet?" (Rocca Maximiliano and Acevedo Rogelio, Historia Natural, Tercera Serie, Volumen 9 (1), 2019).

And I was wondering if there was any similar selenographic feature, like there is on Mars (Ma'adim Vallis, IMAGE 2).

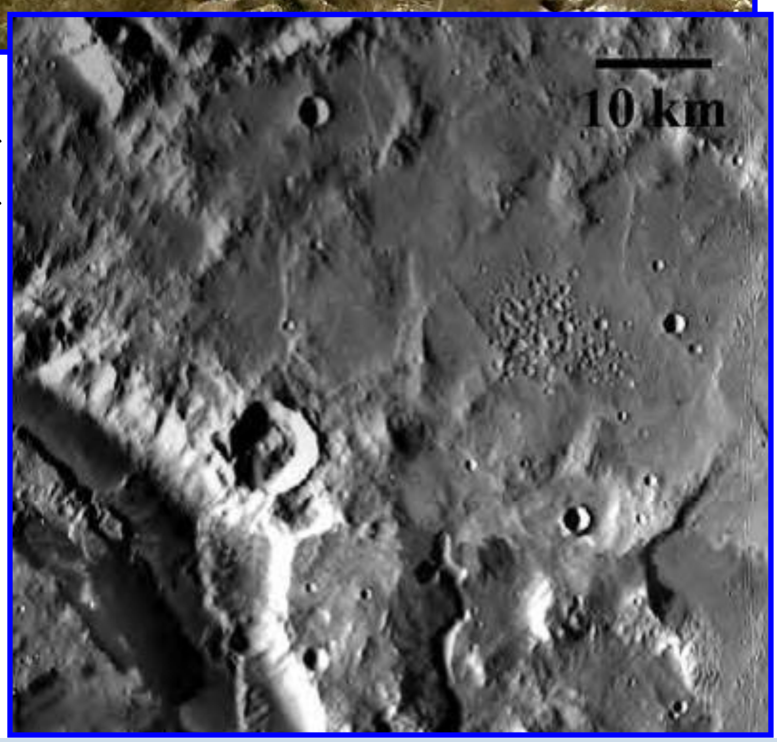


Image 2, Ma'adin Vallis on Mars *with a crater cluster. Page 14 of sited text.*

Lunar Topographic Studies

Bajada Del Diablo and Gruithuisen's Mob: Parallel Crater Clusters

And reading Scott Smith's great article “Quick study of the Gruithuisen regio (south of Mons Delta)” in the July edition of *The Lunar Observer* I found what is known by the unofficial name of “Gruithuisen's Mob” (according to https:/ /the-moon.us/wiki/Gruithuisen), which we see in IMAGE 3 (LRO QUICKMAP) and is located north of the Gruithuisen crater.

Image 3, Crater Cluster Near Gruithuisen *LROC.*

Charles Wood characterizes this cluster as “a tight cluster of secondary craters. They mostly do not overlap and each looks remarkably like a primary impact - only by seeing the cluster do we know that they must have formed from a slightly disaggregated clump of debris. How many secondaries do we mistake for primaries? (https://www.lpod.org/wiki/March_10,_2013). Now let's look at IMAGE 1. It belongs to the text “A very unusual cluster of multiple small impact craters probably created by the impact of a split cometary nucleus in Patagonia. Bajada del Diablo craters field, Chubut, Argentina: the impact of a small split comet?”, which can be read here: https://ri.conicet.gov.ar/handle/11336/119487?show=full. They have a certain resemblance. Let me tell you some facts about this little-known wonder. Bajada del Diablo (S42º 45', W 67º 30') is a crater field in which at some point in the Middle Pleistocene (780,000 to 130,000 years ago), about 550 impact craters less than 400 meters in diameter were formed simultaneously within an area of 480 square kilometers. Today, after so many millennia of erosion, about 200 craters are distinguishable. What makes the Bajada del Diablo craters unique is that there is no elliptical pattern of impact distribution, which is the typical pattern of impacts related to fragmentation in the atmosphere of a meteorite. Which implies that the fragmentation of the fragments that impacted Bajada del Diablo occurred before entering the Earth's atmosphere. At the site, no meteorite fragments were found, which would imply the probability that the body of origin was a comet, or perhaps a very loosely cohesive asteroid. The craters do not form a chain among themselves, although they have raised walls (and the ejecta blankets of the larger craters indicate a somewhat oblique impact from the southwest), which distinguishes it from the chains of craters seen in the Moon and other bodies in the solar system, formed by fragments of a body that entered the atmosphere united. From the number of craters and their size it has been deduced that the nucleus of the comet would be about 200 meters in diameter.

Were both clusters of craters formed by the same cause? Is the comparison valid? At first glance they appear quite similar: they do not form a chain nor are they dispersed in an elliptical area. The dispersion area of the Bajada del Diablo crater cluster is larger (480 square kilometers versus approximately 250 square kilometers for Gruithuisen Mob). The most important difference is that some of the craters of the lunar cluster overlap each other, not all of them are separated from each other (hence Woods' explanation as unusual secondary craters), as those of Bajada del Diablo are separated, which have impacted in free fall, as the smallest fragments of a meteorite do on Earth. Both crater clusters are a rarity. It is strange to think of an object entering Earth's dense atmosphere and fragmenting into as many pieces as Bajada del Diablo and for those pieces to generate as many significant impacts (most craters are in the range between 200 and 300 meters in diameter). It is also strange that there are not so many crater clusters on the Moon similar to IMAGE 3, coming from bodies that can fragment due to the not so strong lunar gravity. It is true that sometimes you can observe clusters of similar craters, which seem contemporary and not the result of random impacts, but they are always in much smaller areas (and there are not as many as those at Gruihuisen Mob).

Perhaps I went too far in the analogy, but I wanted to share this curious formation in my country, Argentina, already quite fertile in craters and meteorites. A few years ago we mentioned in this same magazine (October 2019) the oblique craters of Rio Cuarto, the first of this type to be discovered on Earth (comparing them with Rheita E). And Argentina has a wonder called “Campo del Cielo”, in the Province of Chaco, where 4000 years ago about 900 tons fell from a metallic meteorite, in hundreds of fragments, including the third and fourth largest meteorites in the world.

Ptolemaeus, Alphonsus and Arzachel and Some Easy to See Pyroclastic Deposits but Hard to See Rilles

Paul Walker

Top to bottom, the largest craters are Ptolemaeus, Alphonsus and Arzachel. The two eastern lobes of Mare Nubium are at center left and bottom left with the triangular mountains, Promontorium Taenarium, between them. In the bottom Nubium lobe is the popular feature Rupes Recta (The Straight Wall). I'll cover some features inside Alphonsus and Arzachel a little later.

First some other interesting features. Cantina Davy is a string of 22 or more craters, mostly in Davy crater. Located on the left, ~1/4 the way down from the top and just above Nubium's upper lobe. The image shows 4 small craters in the 2.5-4 km (1.5-2.5 mi) range with the rest less than 1.7 km (1 mi). Easily hidden in poor seeing but effectively being a linear feature improves its visibility. For a much better image of Catena Davy see Jeff Grainger's image in the June 2024 TLO, page 19. Davy itself is interesting as it has a distinctly rectangular shape and must have a complicated history.

Another, apparently unnamed, string of craters is in the upper right. Just outside the rim of Ptolemaeus, at about the 2:00 position. It is made up of at least 5, ~5 km (3 mi) craters. All of which are visible in the image. There is 1 crater slightly offset between the 1st and 2nd craters from the left end, which may or may not be associated. There is the impression of more, smaller craterlets beyond each end but it may be no more than an impression.

An interesting set of craters I have not noticed before are 3 overlapping craters just east of the Straight Wall and protruding into Mare Nubium. I probably hadn't noticed them because I have never viewed this area with this particular Sun angle before. Or, more likely my attention is more on the Straight Wall. Named Thebit, Thebit A and Thebit L, the diameters decrease in size by approximately ½, from 55 km to 20.6 km to 10.7 km. Now, if only they were formed by size sequence!

The oddest-looking crater here is probably is Alpetragius with its relatively large rounded central peak. Probably fairly well known in these circles but another crater I was not familiar with. It reminded me of something but I couldn't think what, then it struck me--- It reminds me of the Foucault knife edge test on a telescope mirror. Especially with the lighting here. I think I'll call it the Foucault Test Crater or maybe just the Foucault Crater. I expect others have noticed this. Its figure looks a bit rough to make a good mirror though.

Alphonsus is a fractured floor crater. 3 dark areas are the easiest to see features. They are large enough and have enough contrast to see them easily with most any telescope. They stand out best under full sunlight. These are the halos around dark halo craters. They are believed to be pyroclastic deposits from volcanic vents, which are the craters. The dark halo on the left (west side) appears to have been created by at least 2 vents. This image picked up 6 craters and their darks halos. LROC QuickMap (https://quickmap.lroc.asu.edu/) shows at least 7 craters (6 halos). Along the eastern wall is the largest rille of Rimae Alphonsus. The width of this north-south part is ~1 km (0.6 mi). This is slightly narrower than Rima Hadley at 1.25-1.6 km (0.8-1.0 mi) which, at least where I live is hard to see most times.

I have not seen this rille visually nor the craters (~2 km, 1.3 mi) within the dark halos, but then I have only tried a few times. This rille T's into another rille at its north end, just to the lower right (southeast) of the dark halo crater there. A bit of this other section of rille can be seen to the upper left of this crater. This rille extends to the southeast then south going "through" a larger halo crater. The dark halo crater in the southeast of Alphonsus is also on a section of rille. With a close look you can see that the crater is slightly elongated. The rille is aligned in the same direction. Only a hint of the rille is detectable here on the NW side of the crater even though its width is about the same as the main N-S rille. An unusual feature is what appears to be a flow of material across the center of Alphonsus from south to north. Seeming to have come from Arzachel (which is clearly the younger of the 2 craters). This material is roughly 200 m thick at the south side, 200 m near the central peak and 100 m thick at the north side of Alphonsus. Though the amount of material clearly diminishes from south to north the thickness is surprisingly consistent. One other thing I saw using LROC QuickMap. Alphonsus' floor is slightly tilted with the east side higher by about 400 m (over 90 km) than the west side. Of course, this is not exactly unusual for a crater but what may be unusual is that the tilt is all on the western half, little to none in the eastern half. Alphonsus is also tilted north to south with the south side 300 m higher. This tilt is constant all the way across.

Ptolemaeus, Alphonsus, Arzachel, Paul Walker, Middlebury, VT, USA.
2024 May 17 01:38 UT
Lunation: 8.93 Colongitude: 15.6 deg Sub-solar Lat: 1.0 deg
10" f/5.6 Newt, 2x Barlow + 2" ext. (3.39x), efl=4765mm, no filter, 0.16"/px org. image,
Canon T7i , HD video @3x digital zoom, 1/500 sec @ ISO 3200
paulwaav@together.net
Stack-40% of 9357, North up, smallest visible craters ~1.5km (0.9mi)
Processing: AutoStakker!3, Registax 6 (wavelets), Picture Window Pro 8

Arzachel is also a fractured floor crater with its main rille clearly visible in the image. Its central peak is significantly offset from center. The rille is ~1 km (0.6 mi) across. Though the same width as the one in neighboring Alphonsus, it is more prominent. Taking a closer look with the draw tool in LROC QuickMap I see the reason. The ground on west side of the rille is 100 m higher than the east side verses ~40 m for Alphonsus' main rille providing a larger surface for the morning Sun to illuminate. Arzachel's floor rises 800 m N to S and 100 m W to E across a distance of 60 km.

Lastly check out the irregular troughs scattered around the region, made by material flung out of Imbrium basin. They are aligned slightly CCW from N-S.

Some Data About the Mare Tranquillitatis Pit

Alberto Anunziato

On July 15 we learned of news of fundamental importance for future lunar exploration and for topographical knowledge of the Moon. The magazine “Nature” published the paper “Radar evidence of an accessible cave conduit on the Moon below the Mare Tranquillitatis pit”, in the words of one of its authors, Lorenzo Bruzzone (from the University of Trento): “the first direct evidence of an accessible lava tube under the surface of the Moon.”

We want to share some topographic and geological characteristics of the Mare Tranquillitatis Pit, which a study that we have already cited in previous issues of The Lunar Observer have characterized as one of the most promising for future exploration and as one of the sites that could host a lunar base underground. The first text is a catalog of pits made with the Lunar Reconnaissance Orbiter images, it is the LROC Pits Atlas, available at https://www.lroc.asu.edu/pits, in the form of an atlas and a catalog. It is a relatively recent and fascinating tool, in which we find images with different illumination and detailed information about 278 pits. The second, Habitability Potential of Lunar Pit Craters, is a work in which 4 of these 278 were chosen as the best candidates for an inhabited lunar base.

Let us remember that until now the existence of lava tubes on the Moon had not been proven (the evidence is almost overwhelming, but always indirect). And a pit is not necessarily a skylight into an underground lava tube.

The study by López-Martínez et al. analyzed the 278 pits with criteria related to the feasibility of them being the conduit to a hypothetical lava tube and that this was hypothetically interesting for scientific exploration and suitable for a future base. And Mare Tranquillitatis Pit was among the first four, second more specifically (the first was Marius Hill Pit). It has some advantages: it is located in a terrain rich in Fe and Ti, which ensures that the hypothetical lava tube would be structurally robust and it is located in a magnetic anomaly (which would probably indicate a mass deficit compared to the surrounding terrain) . The big disadvantage would be that it is not located on top of a volcanic channel. It is located in a rather anodyne position in the middle of Mare Tranquilitatis (coordinates are latitude 8.3355°N, longitude 33.2220°E), without any selenographic features nearby related to volcanism. But let us keep in mind that “In principle, although this pit is not coincident with any volcanic channel or rille observed on the surface, so if any sublunarean lava tube exists, it could be invisible to the cameras (López-Martínez)”. And the great advantage that the cited study pointed out is that “this pit is one of the two only lunar pits that has presented a thermal signature measured thanks to the Diviner instrument data from LRO. Even though this is not evidence to prove the connection with a sublunarean lava tube, this pit is still the second most preferred candidate because it is the one that has the biggest inner space, with a sublunarean soil extending up to 20 meters below the ceiling. Its ceiling width is 47 meters”.

Now, the study cited is related to the Nature publication. Basically, because it was said that the lack of relationship with a rille complicated the possibility that the underground space that would be empty (being a gravitational anomaly) was a lava tube, and that if there was a lava tube it would be large, although difficult to capture, by the cameras. Well, the advance of the Nature study is that through a new analysis of radar observations, it was proven that the radio return signal is consistent with an initial bounce off the Moon's surface and a second bounce from the floor of a subsurface chamber. With the data from LRO's Miniature Radio Frequency, a 3-D modeling of the radar signal was made that indicates that an underground conduit extends west of the pit and the collapsed rock pile at its center. Therefore, once the existence of the void beneath the Mare Tranquillitatis Pit is proven, it would be very extensive (and surely extends much further to the west and even to the east).

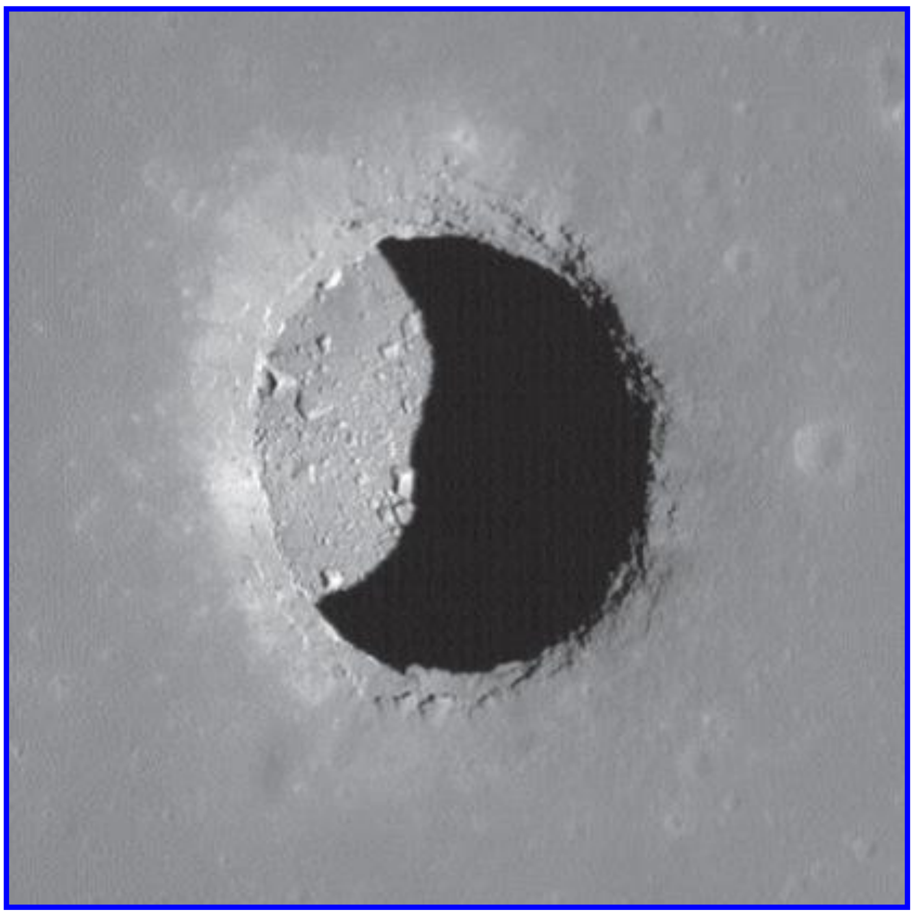
The image accompanying this text belongs to the LROC Pits Atlas, at the entrance to Mare Tranquillitatis Pit on page 13 (NAC M126710873R). As we can see, it is not going to be an easy cave to access, since it lacks an entrance ramp. Readers of our magazine will remember the Lacus Mortis Pit, which we referred to in the March 2024 issue, which had a wonderful access ramp, easily accessible (but we do not know if it is accessible to a lava tube). The robots first and the astronauts later will have to manage to enter the Mare Tranquillitatis Pit if the base is built inside it. This is the description of the LROC Pit Atlas: “Elliptical pit with vertical walls. The type example for cylindrical pits. Funnel is ~20 m deep, inner pit depth of 105m is measured from bottom of funnel. Walls are vertical and are visible to ~80m depth, although there is a recess all the way around the pit at ~40m depth below the surface. Floor that is not overhung is flat and covered in boulders, floor under the E wall slopes downward. There are over-hangs of at least 10-15 m on E, W, and N sides. No notable surface features in the area”. As can be seen visually, the entrance is narrower, that is, visually we knew that the land extends inward, what has just been confirmed is that it extends beyond what we see.

References:

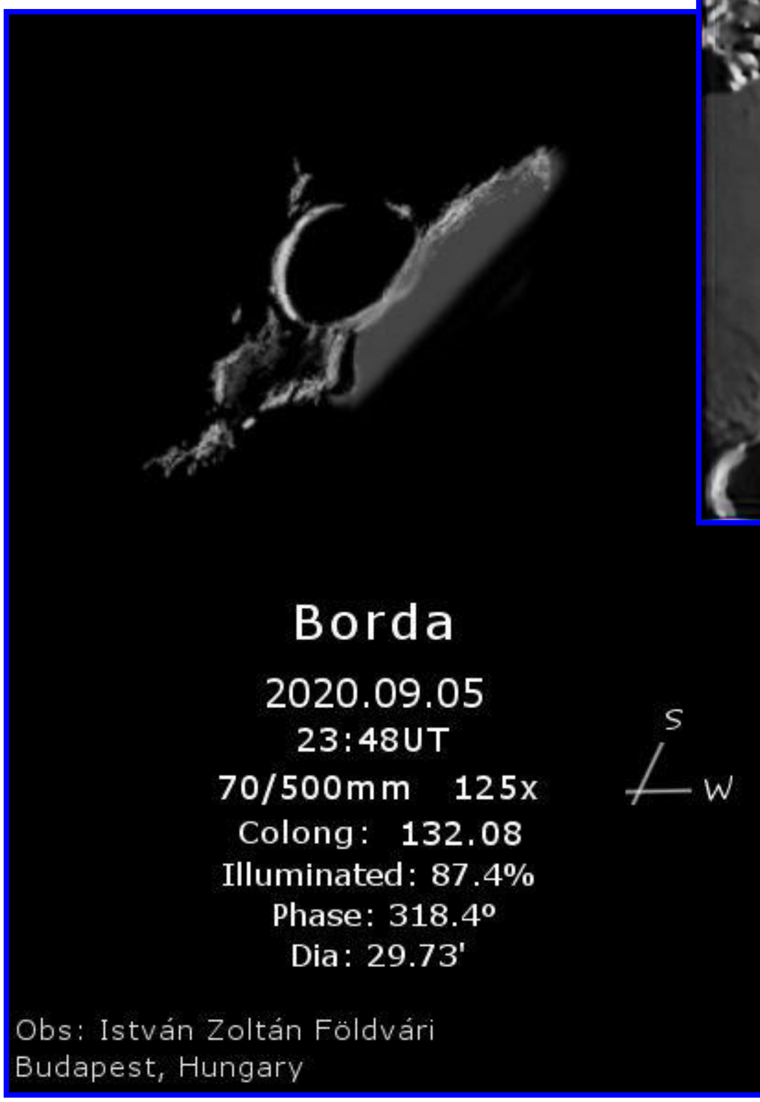
López-Martínez G. et al. (2023), Habitability Potential of Lunar Pit Craters: Marius Hills, Mare Tranquilitatis, Lacus Mortis and Mare Ingenii Pit, 54th Lunar and Planetary Science Conference 2023 (LPI Contrib. No. 2806). Disponible en: https://www.hou.usra.edu/meetings/lpsc2023/pdf/2380.pdf

Wagner, R. V. and Robinson, M. S. (2021). Occurrence and Or-igin of Lunar Pits: Observations from a New Catalog. 52nd Lunar and Planetary Science Conference, Abstract #2530.

https://www.hou.usra.edu/meetings/lpsc2021/pdf/2530.pdf



Aristoteles, Eudoxus and Cassini*, Larry Todd, Dunedin, New Zealand. 2021 November 12. OMC200 Maksutov-Cassegrain telescope.*



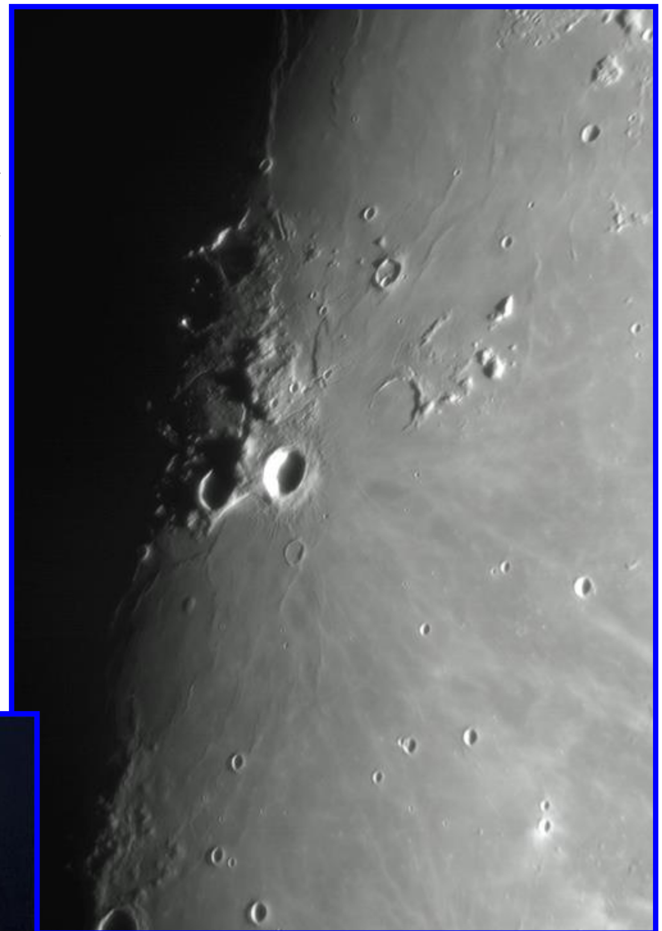
Borda, *István Zoltán Földvári, Budapest, Hungary. 2020 September 05 23:48-00:19 UT, colongitude 132.08º. 70 mm refractor telescope, 500 mm focal length, 4 mm Vixen LV Lanthanum eyepiece, 125x. Seeing 7/10, transparency 4/6.*

Recent Topographic Studies

Gassendi, *Maurice Collins, Palmerston North, New Zealand. 2024 July 18 06:55 UT. Williams Optics FLT 110 mm refractor telescope, 3x barlow, QHY5III462C camera.*

Mare Marginis, Hubble, Goddard and Neper, *Attila Ete Molnar, Budapest, Hungary. 2024 March 19 18:13-20:00 UT, colongitude 24.3^o. 150/1800 Maksutov-Cassegrain telescope, ZEO ASI178 MC camera. Seeing 8/10, transparency 5/6. North is to the upper left, west is to the lower left.*

Recent Topographic Studies

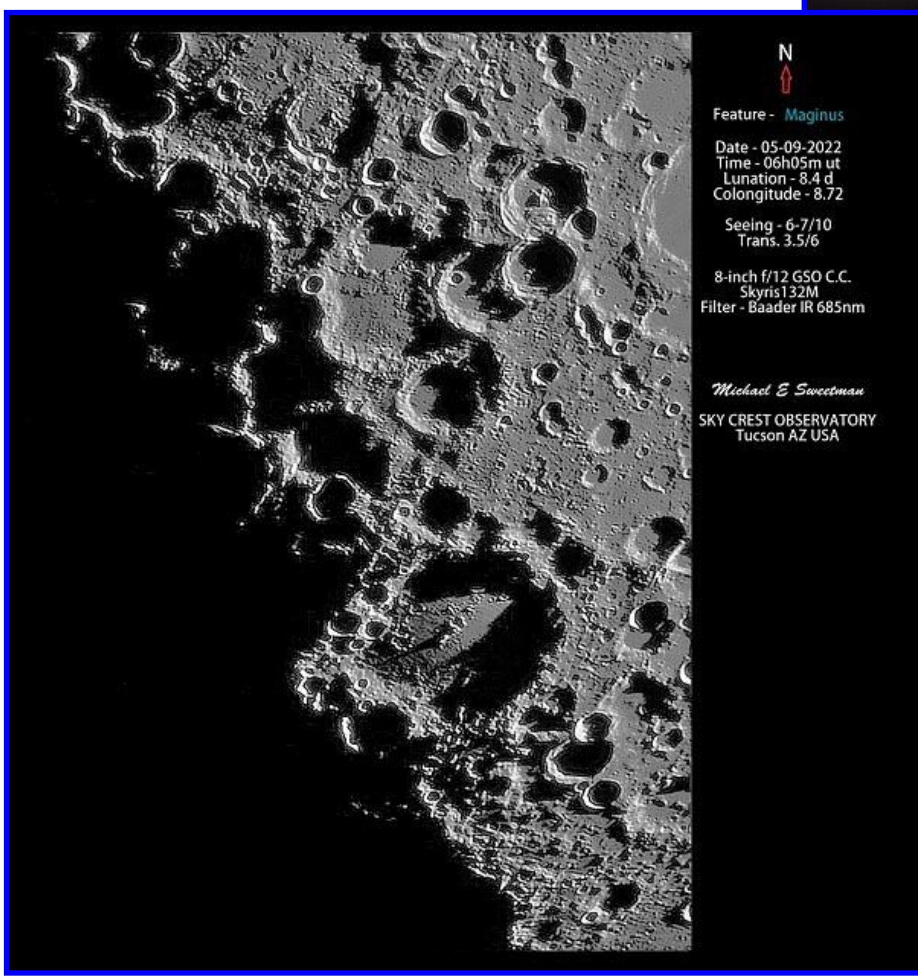


Aristarchus, *Francisco Alsina Cardinalli, Oro Verde, Argentina. 2024 July 17 22:52 UT. 203 mm Newtonian reflector telescope, IR Pass SVBony SV183 685nm filter, QHY5L-II-M camera.*

Waxing Gibbous Moon, *Jairo Chavez, Popayán, Colombia. 2024 May 18 01:02 UT. 311 mm truss tube Dobsonian telescope, MOTO E5 PLAY camera. North is down and west is right.*

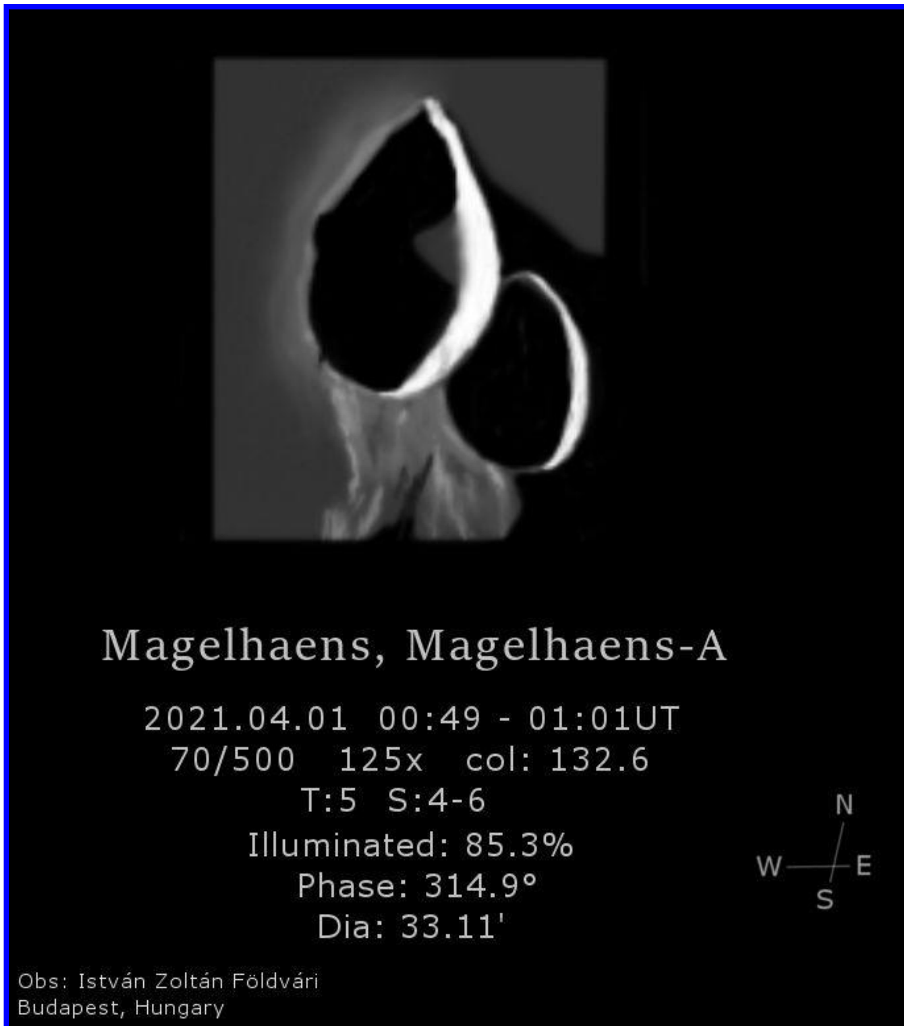
Recent Topographic Studies

Earthshine on the Moon, *Maurice Collins, Palmerston North, New Zealand. 2024 July 09 06:04 UT. 80 mm SkyWatcher Espirit ED refractor telescope, QHY5III462C camera. North is down, west is right.*



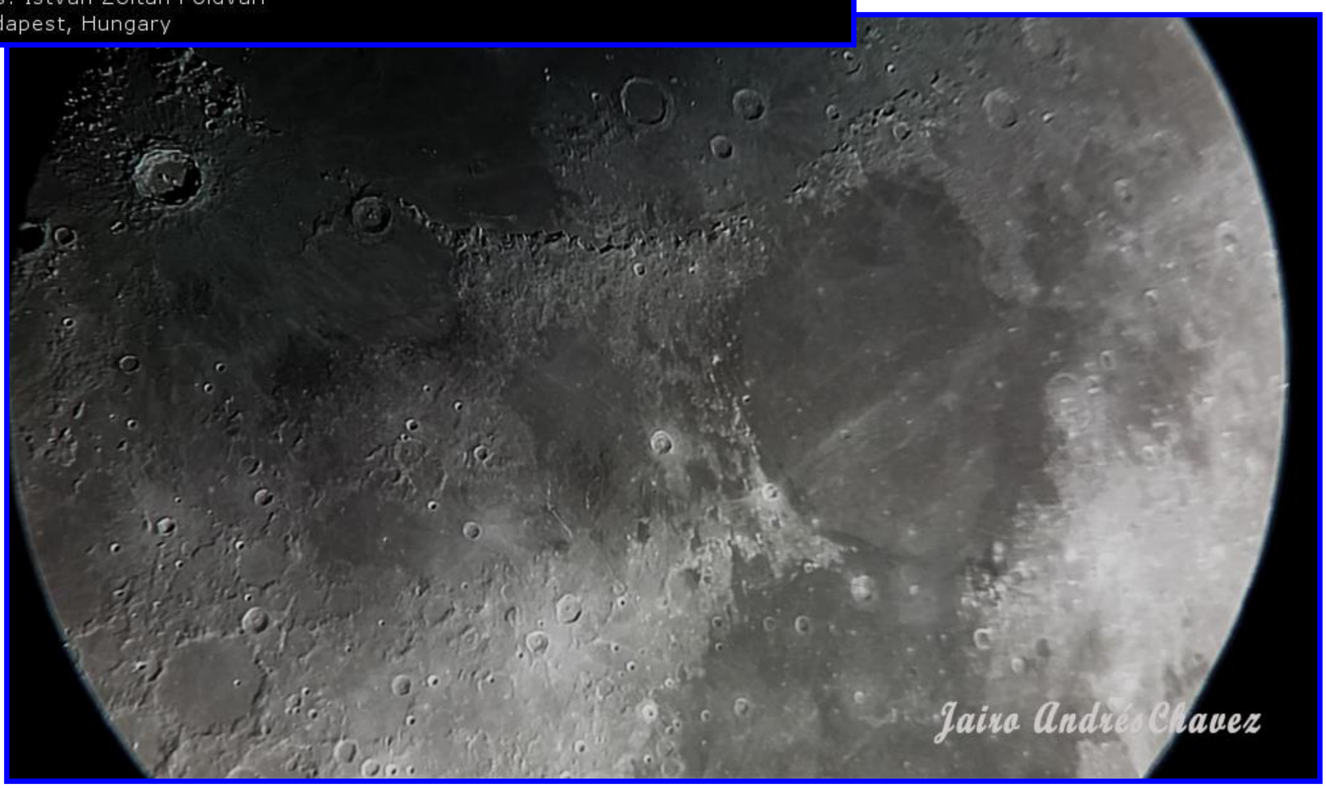
Maginus, *Michael Sweetman, Sky Crest Observatory, Tucson, Arizonia, USA. 2022 May 09 06:05 UT, colongitude 8.72 degrees. 8 inch GSO Classical Cassegrain telescope, f/12, Baader IR 685 nm filter, Skyris 132M camera. Seeing 7-8/10, transparency 3.5/6.*

Recent Topographic Studies



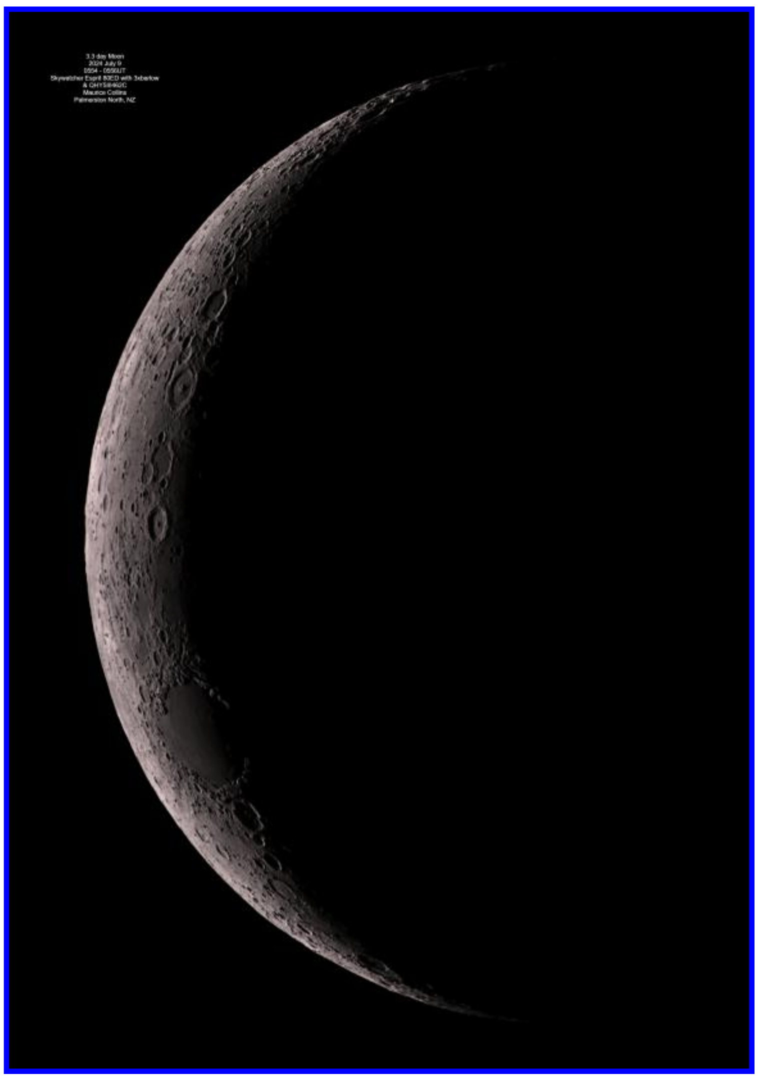
Magelhaens and Magelhaens A, *István Zoltán Földvári, Budapest, Hungary. 2021 April 01 00:49-01:01 UT, colongitude 132.6º. 70 mm refractor telescope, 500 mm focal length, 4 mm Vixen LV Lanthanum eyepiece, 125x. Seeing 7/10, transparency 4/6.*

Manilius, *Jairo Chavez, Popayán, Colombia. 2024 May 17 23:43 UT. 311 mm truss tube Dobsonian telescope, MOTO E5 PLAY camera.*



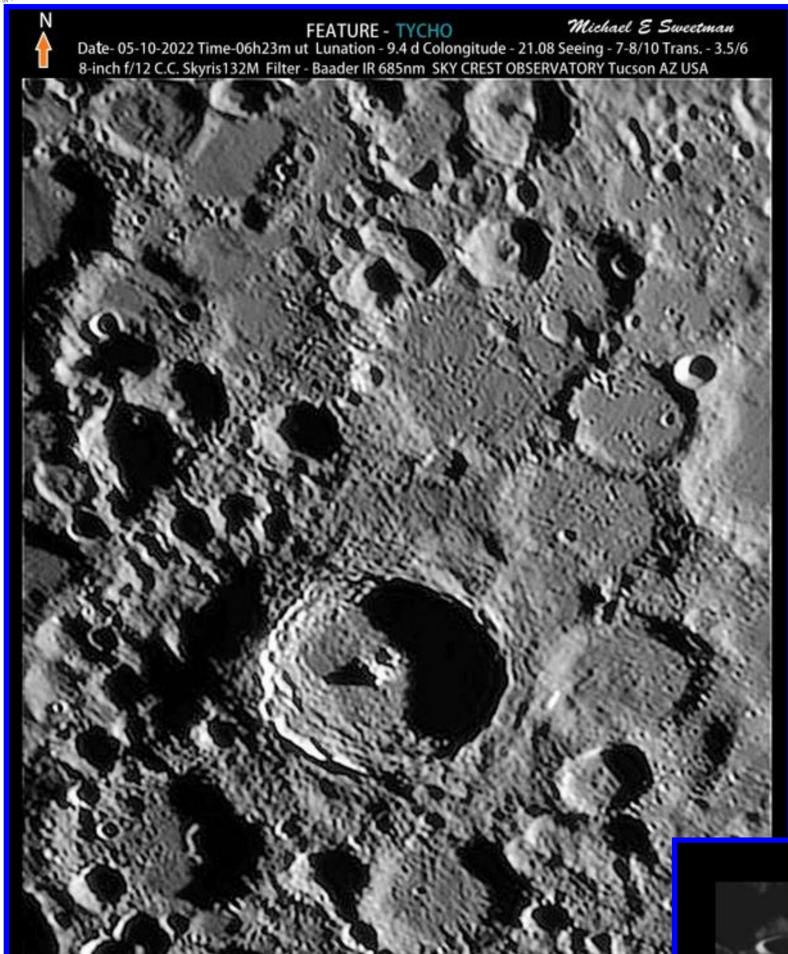
Recent Topographic Studies

__3.3 day-old Moon,__ Maurice Collins, Palmerston North, New Zealand. 2024 July 09 05:34 UT. 80 mm SkyWatcher Espirit ED refractor telescope, QHY5III462C camera. North is down, west is right.

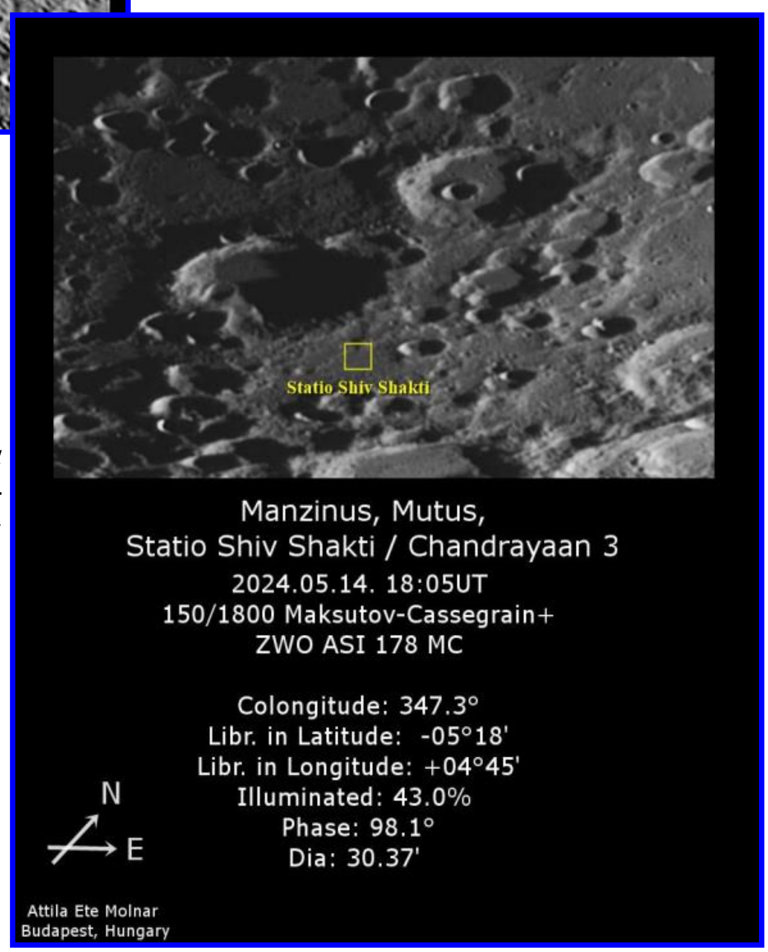


__3.3 day-old Moon,__ Maurice Collins, Palmerston North, New Zealand. 2024 July 09 05:54-05:56 UT. 80 mm SkyWatcher Espirit ED refractor telescope, 3x barlow, QHY5III462C camera. North is down, west is right.

Recent Topographic Studies

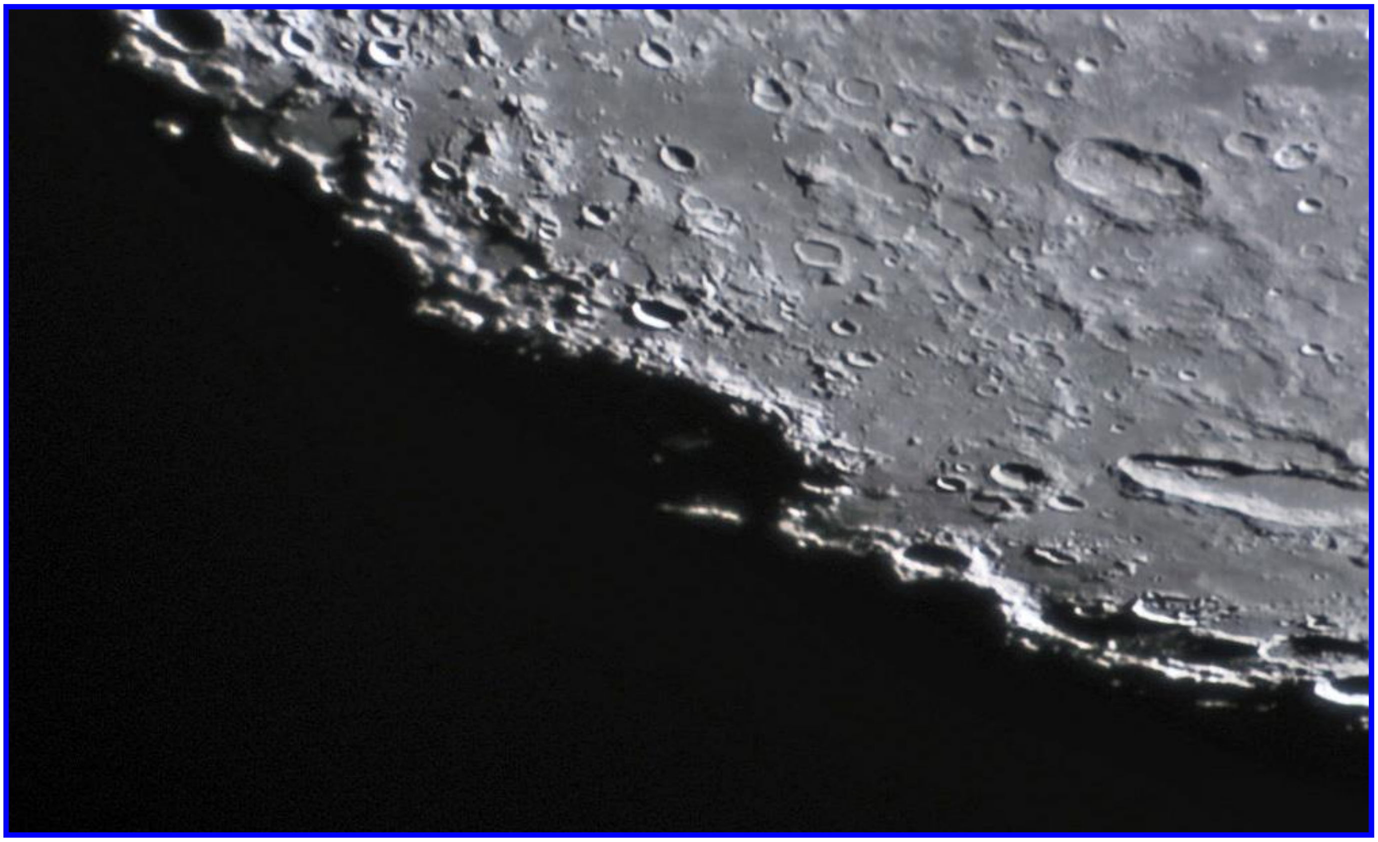


***Tycho,** Michael Sweetman, Sky Crest Observatory, Tucson, Arizonia, USA. 2022 May 10 06:23 UT, colongitude 21.08 degrees. 8 inch GSO Classical Cassegrain telescope, f/12, Baader IR 685 nm filter, Skyris 132M camera. Seeing 7-8/10, transparency 3.5/6.*

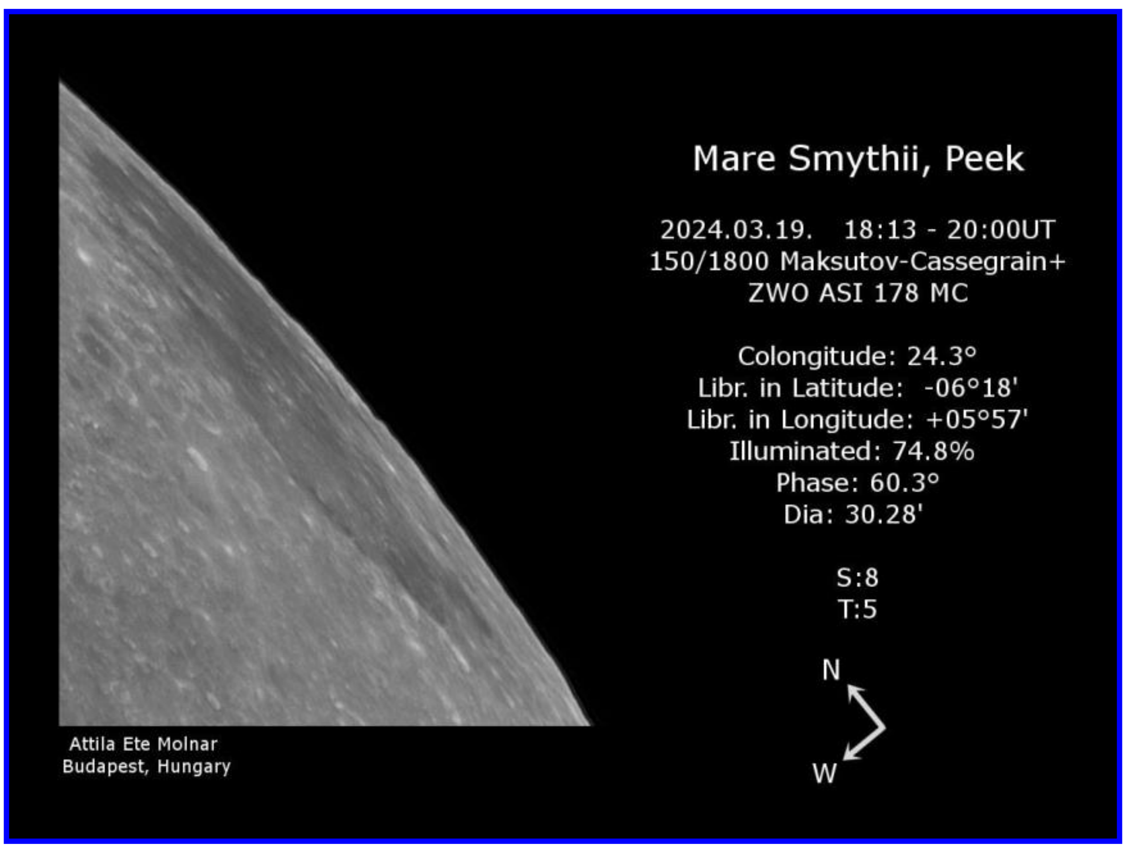


***Manzinus, Mutus, Statio Shiv Shakti/Chandrayaan 3,** Attila Ete Molnar, Budapest, Hungary. 2024 May 14 18:05, colongitude 347.3°. 150/1800 Maksutov-Cassegrain telescope, ZEO ASI178 MC camera. Seeing 8/10, transparency 5/6.*

Recent Topographic Studies

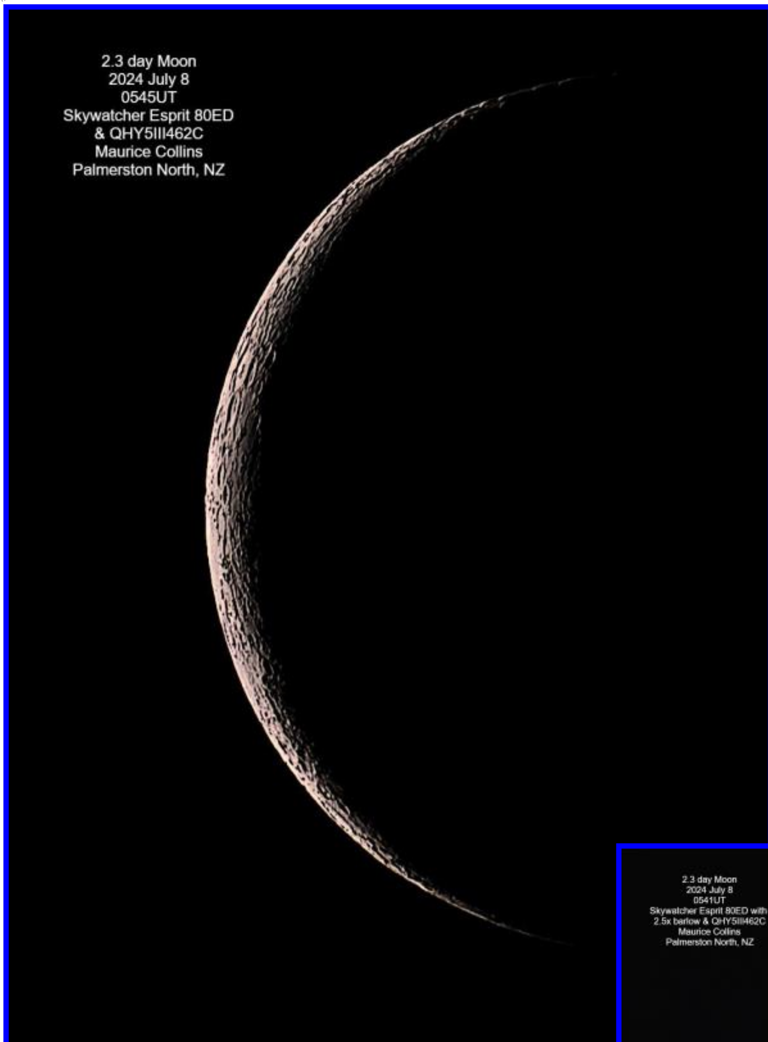


Schickard, *Maurice Collins, Palmerston North, New Zealand. 2024 July 18 06:56 UT. Williams Optics FLT 110 mm refractor telescope, 3x barlow, QHY5III462C camera.*



Mare Smythii and Peek, *Attila Ete Molnar, Budapest, Hungary. 2024 March 19 18:13-20:00 UT, colongitude 24.3°. 150/1800 Maksutov-Cassegrain telescope, ZEO ASI178 MC camera. Seeing 8/10, transparency 5/6. North is to the upper left, west is to the lower left.*

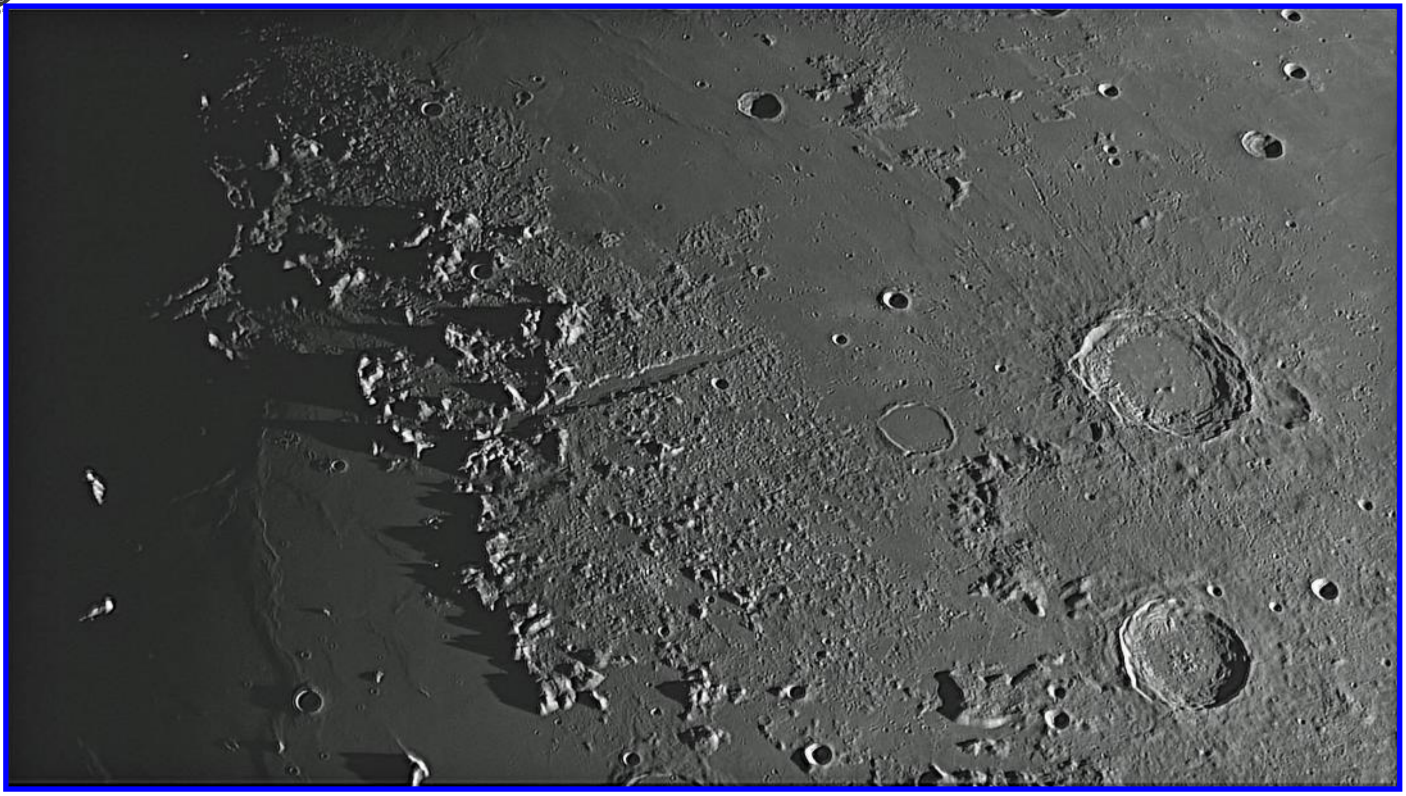
Recent Topographic Studies



2.3 day-old Moon, *Maurice Collins, Palmerston North, New Zealand. 2024 July 08 05:45 UT. 80 mm SkyWatcher Espirit ED refractor telescope, QHY5III462C camera. North is down, west is right.*

2.3 day-old Moon, *Maurice Collins, Palmerston North, New Zealand. 2024 July 08 05:41 UT. 80 mm SkyWatcher Espirit ED refractor telescope, 2.5x barlow, QHY5III462C camera. North is down, west is right*

Recent Topographic Studies



Aristoteles, Eudoxus and Cassini, *Larry Todd, Dunedin, New Zealand. 2022 October 03 09:18 UT. OMC200 Maksutov-Cassegrain telescope.*

Alphonsus, *Raúl Roberto Podestá, Formosa, Argentina. 2024 July 16 03:10 UT. 70 mm refractor telescope, UV/IR cut filter, ZWO ASI178 MC camera. North is right, west is down.*

Recent Topographic Studies

Aristarchus, *Maurice Collins, Palmerston North, New Zealand. 2024 July 18 06:54 UT. Williams Optics FLT 110 mm refractor telescope, 3x barlow, QHY5III462C camera.*

Copernicus, *Raúl Roberto Podestá, Formosa, Argentina. 2024 July 16 03:11 UT. 70 mm refractor telescope, UV/IR cut filter, ZWO ASI178 MC camera. North is right, west is down.*

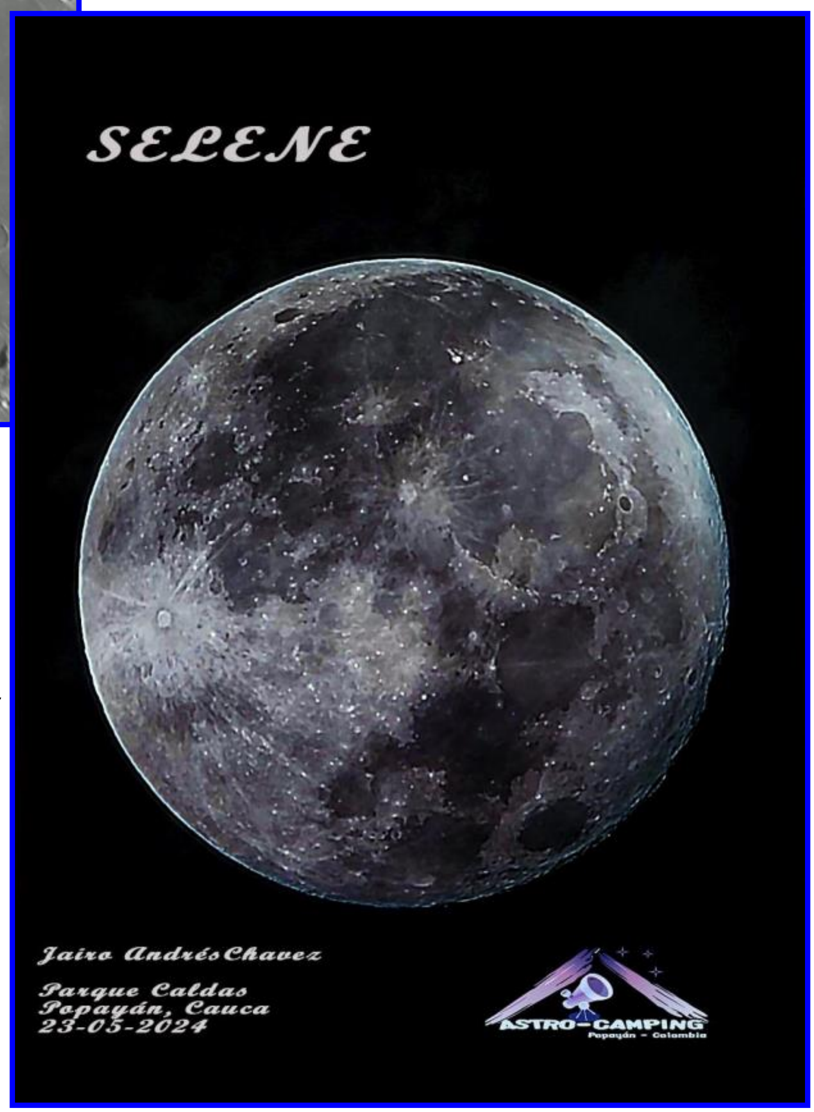
Recent Topographic Studies

Bullialdus, *Francisco Alsina Cardinalli, Oro Verde, Argentina. 2024 July 17 22:40 UT. 203 mm Newtonian reflector telescope, IR Pass SVBony SV183 685nm filter, QHY5L-II-M camera.*

***Waxing Gibbous Moon,** Jairo Chavez, Popayán, Colombia. 2024 May 21 23:32 UT. 311 mm truss tube Dobsonian telescope, MOTO E5 PLAY camera.*

Recent Topographic Studies

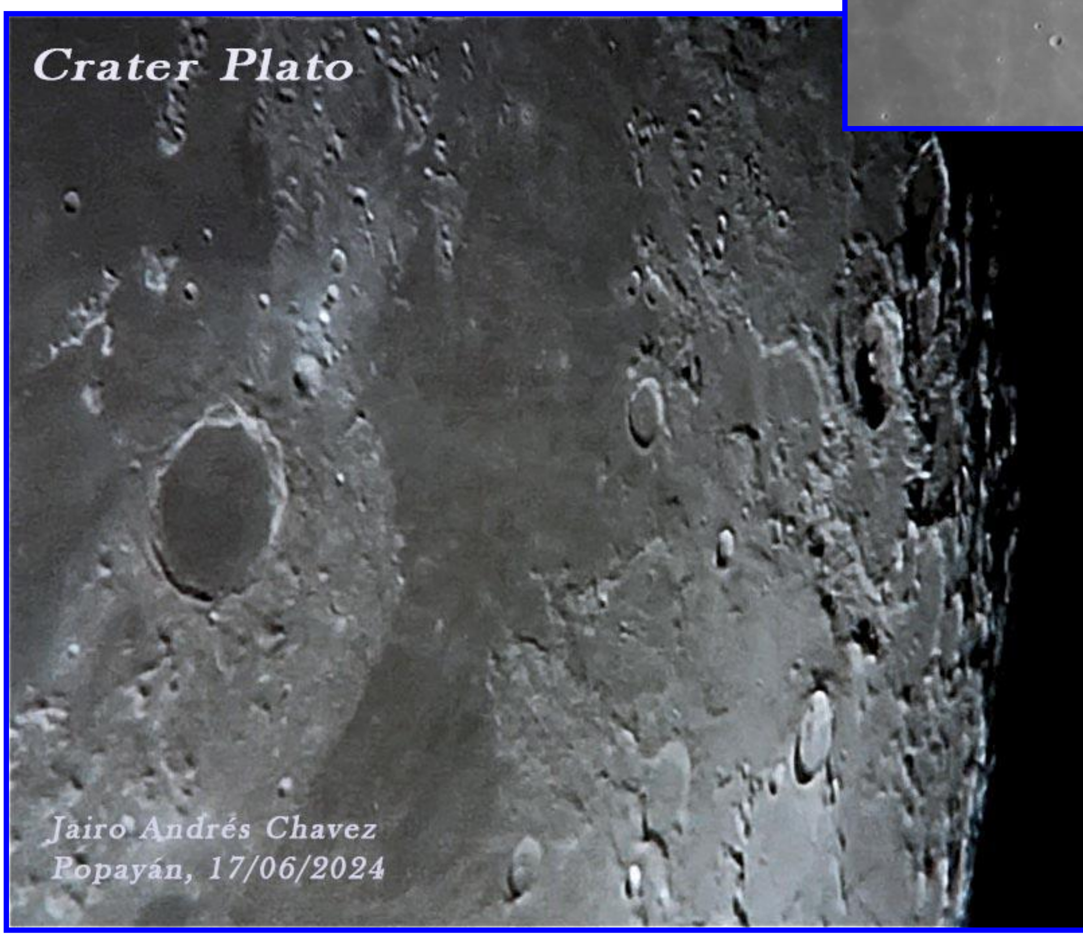
Gassendi, *Francisco Alsina Cardinalli, Oro Verde, Argentina. 2024 July 17 22:46 UT. 203 mm Newtonian reflector telescope, IR Pass SVBony SV183 685nm filter, QHY5L-II-M camera.*



Full Moon, *Jairo Chavez, Popayán, Colombia. 2024 May 24 00:44 UT. 311 mm truss tube Dobsonian telescope, MOTO E5 PLAY camera.*

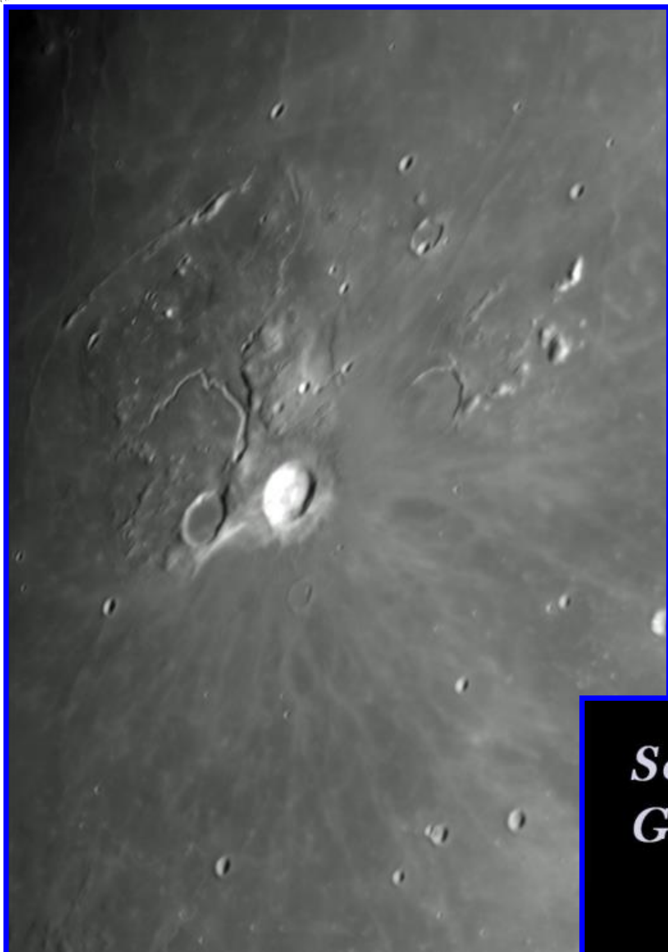
Recent Topographic Studies

Mons Pico, *Francisco Alsina Cardinalli, Oro Verde, Argentina. 2024 July 17 23:09 UT. 203 mm Newtonian reflector telescope, IR Pass SVBony SV183 685nm filter, QHY5L-II-M camera.*

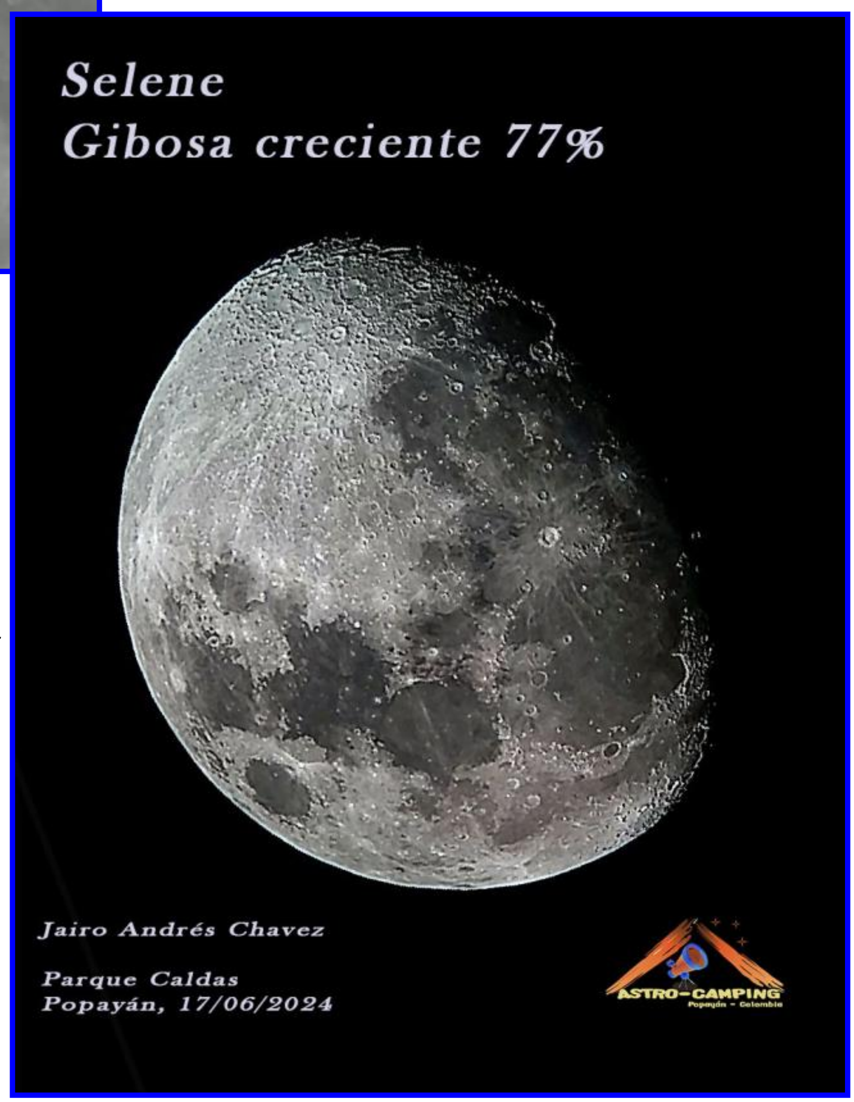


Plato, *Jairo Chavez, Popayán, Colombia. 2024 June 18 01:02 UT. 311 mm truss tube Dobsonian telescope, MOTO E5 PLAY camera. North is to the right and west is up.*

Recent Topographic Studies



Aristarchus, *Francisco Alsina Cardinalli, Oro Verde, Argentina. 2024 May 21 02:21 UT. 405 mm Ritchey Chretien telescope, QHY5L-II-M camera.*



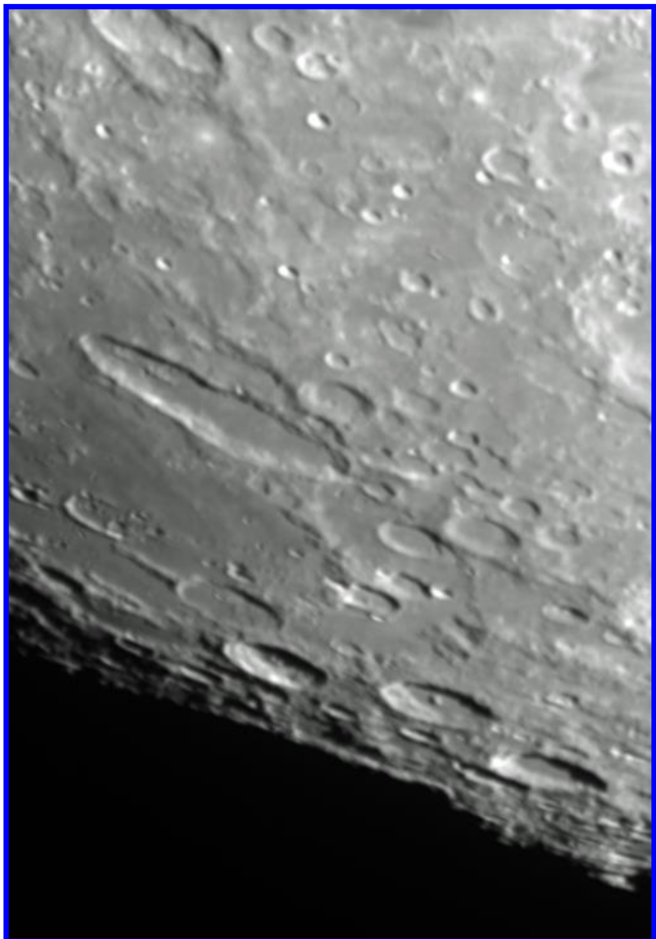
Waxing Gibbous Moon, *77%,* *Jairo Chavez, Popayán, Colombia. 2024 June 18 00:51 UT. 311 mm truss tube Dobsonian telescope, MOTO E5 PLAY camera.*

Recent Topographic Studies

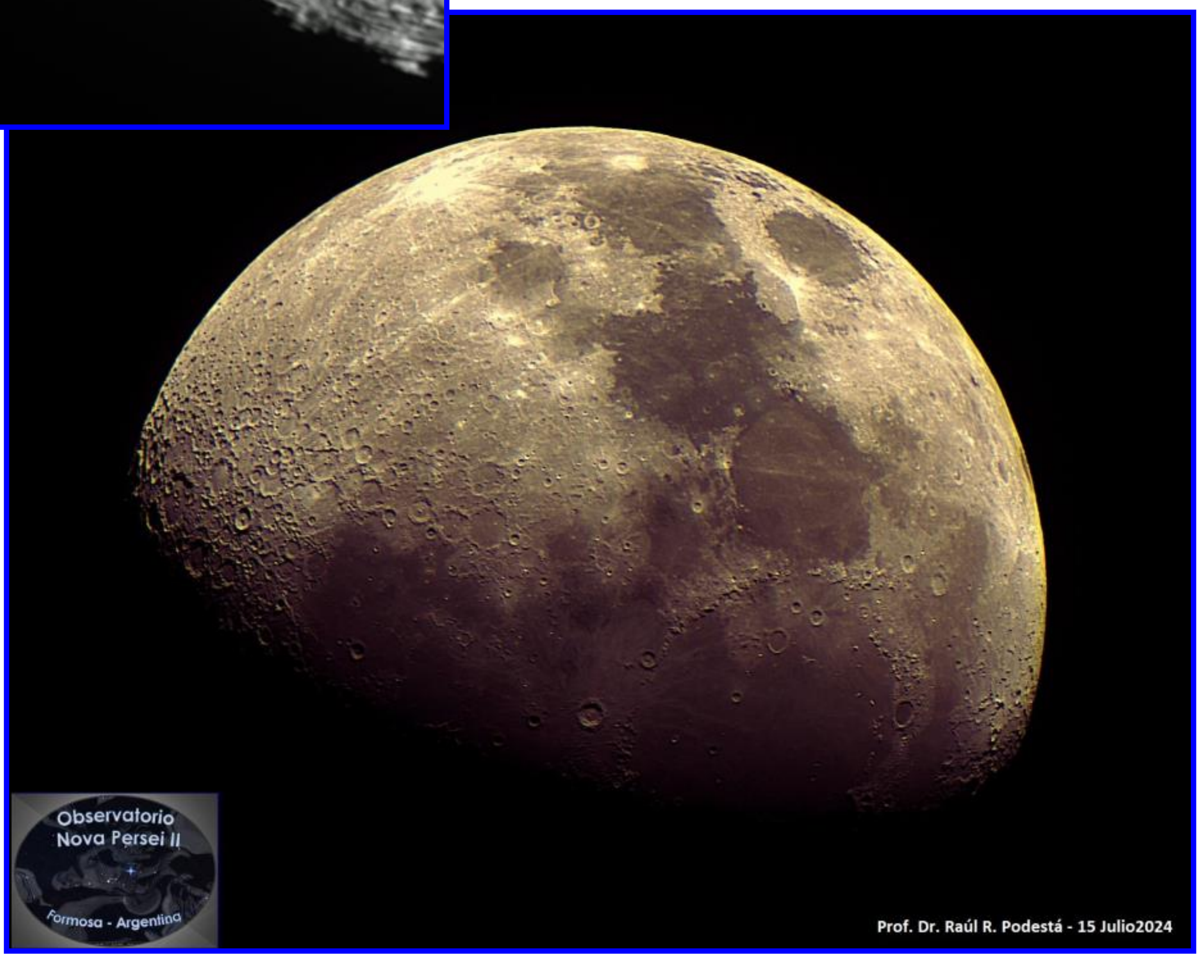
Schickard, *Francisco Alsina Cardinalli, Oro Verde, Argentina. 2024 May 21 02:35 UT. 405 mm Ritchey Chretien telescope, QHY5L-II-M camera.*

Tycho, *Walter Ricardo Elias, Oro Verde, Entre Rios Argentina, AEA. 2024 July 27 10:58 UT. Skywatcher 150/750 mm reflector telescope, QHY 5II C camera.*

Recent Topographic Studies



Schiller, *Francisco Alsina Cardinalli, Oro Verde, Argentina. 2024 May 21 02:37 UT. 405 mm Ritchey Chretien telescope, QHY5L-II-M camera.*



Mare Serenitatis, *Raúl Roberto Podestá, Formosa, Argentina. 2024 July 16 03:10 UT. 70 mm refractor telescope, UV/IR cut filter, ZWO ASI178 MC camera. North is right, west is down.*

Recent Topographic Studies

Atlas, *Francisco Alsina Cardinalli, Oro Verde, Argentina. 2024 July 17 23:14 UT. 203 mm Newtonian reflector telescope, IR Pass SVBony SV183 685nm filter, QHY5L-II-M camera.*

Eratosthenes, *Raúl Roberto Podestá, Formosa, Argentina. 2024 July 16 03:12 UT. 70 mm refractor telescope, UV/IR cut filter, ZWO ASI178 MC camera. North is right, west is down.*

Recent Topographic Studies

12.3 day-old Moon, *Maurice Collins, Palmerston North, New Zealand. 2024 July 18 06:39-06:42 UT. Williams Optics FLT 110 mm refractor telescope, QHY5III462C camera.*

Cassini, *Gonzalo Vega, Oro Verde, Entres Rio, Argentina, AEA. 2024 July 14 00:18 UT. 200 mm Newtonian reflector telescope, 1000 mm fl, Barlow APO 2.5x + 2x barlow, EQ5 Goto mount, Player One CC camera. North is down, west is right.*

Recent Topographic Studies

*Waning Gibbous Moon***,** *Gonzalo Vega, Oro Verde, Entres Rio, Argentina, AEA. 2024 July 25 05:56 UT. 200 mm Newtonian reflector telescope, 1000 mm fl, EQ5 Goto mount, Nikon D5100 camera.*

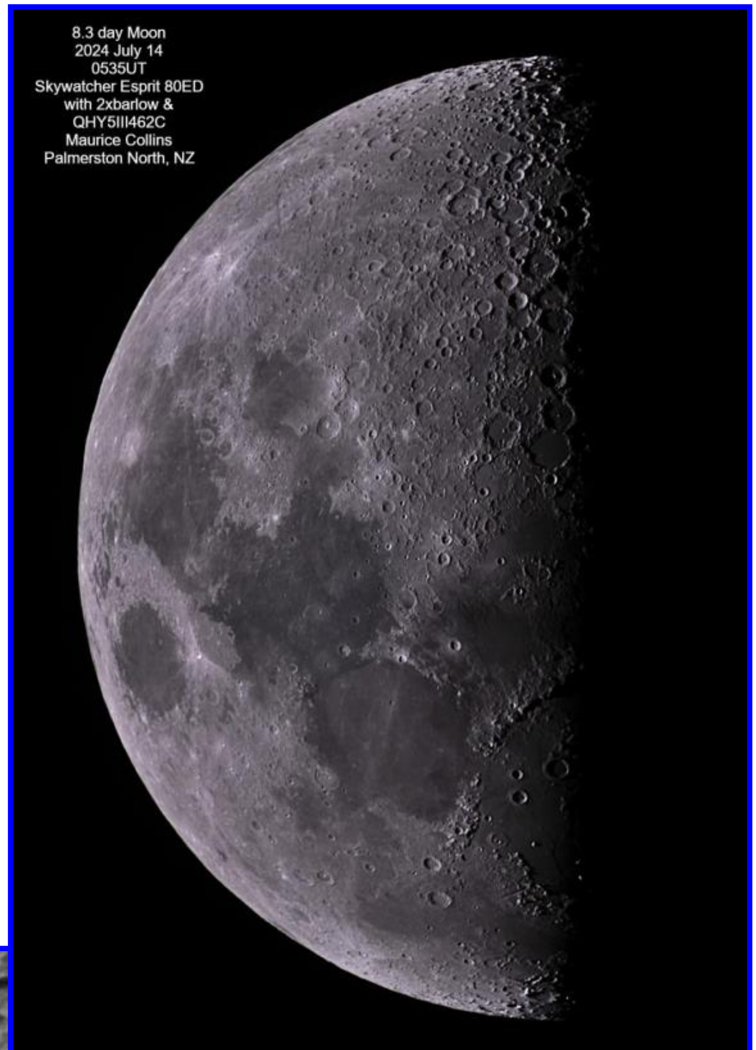
Cauchy, *Massimo Dionisi, Sassari, Italy. 2024 July 24 22:40 UT. Skywatcher 10 inch f/4.8 reflector telescope, 3x barlow, efl 3600 mm, Skywatcher EQ6 Pro mount, IR Pass filter 685 nm, Neptune M camera. Seeing 7/10 Pickering scale, transparency good.*

Recent Topographic Studies

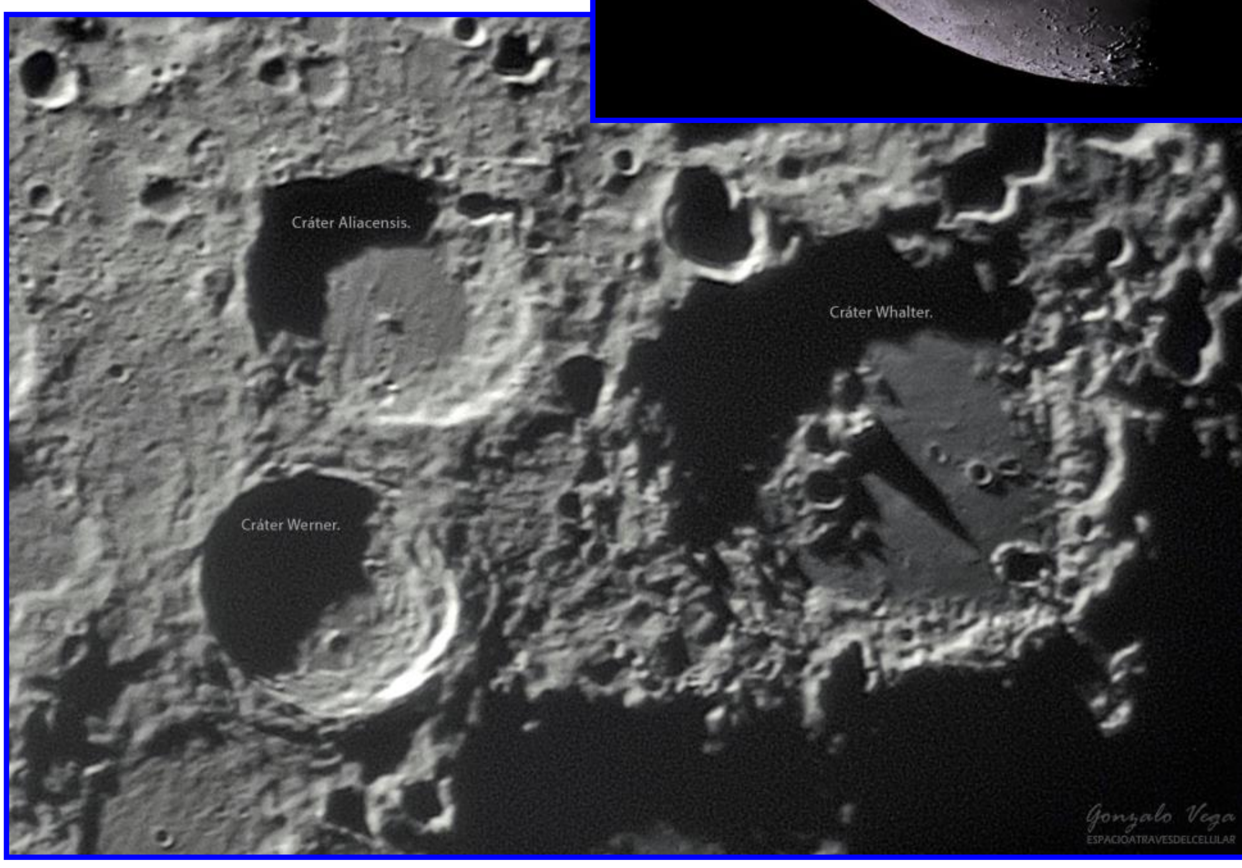
Alphonsus, *Walter Ricardo Elias, Oro Verde, Entre Rios Argentina, AEA. 2024 July 27 10:48 UT. Sky-watcher 150/750 mm reflector telescope, QHY 5II C camera.*

Waxing Crescent Moon, *Gonzalo Vega, Oro Verde, Entres Rio, Argentina, AEA. 2024 July 18 00:18 UT. 200 mm Newtonian reflector telescope, 1000 mm fl, EQ5 Goto mount, Nikon D5100 camera.*

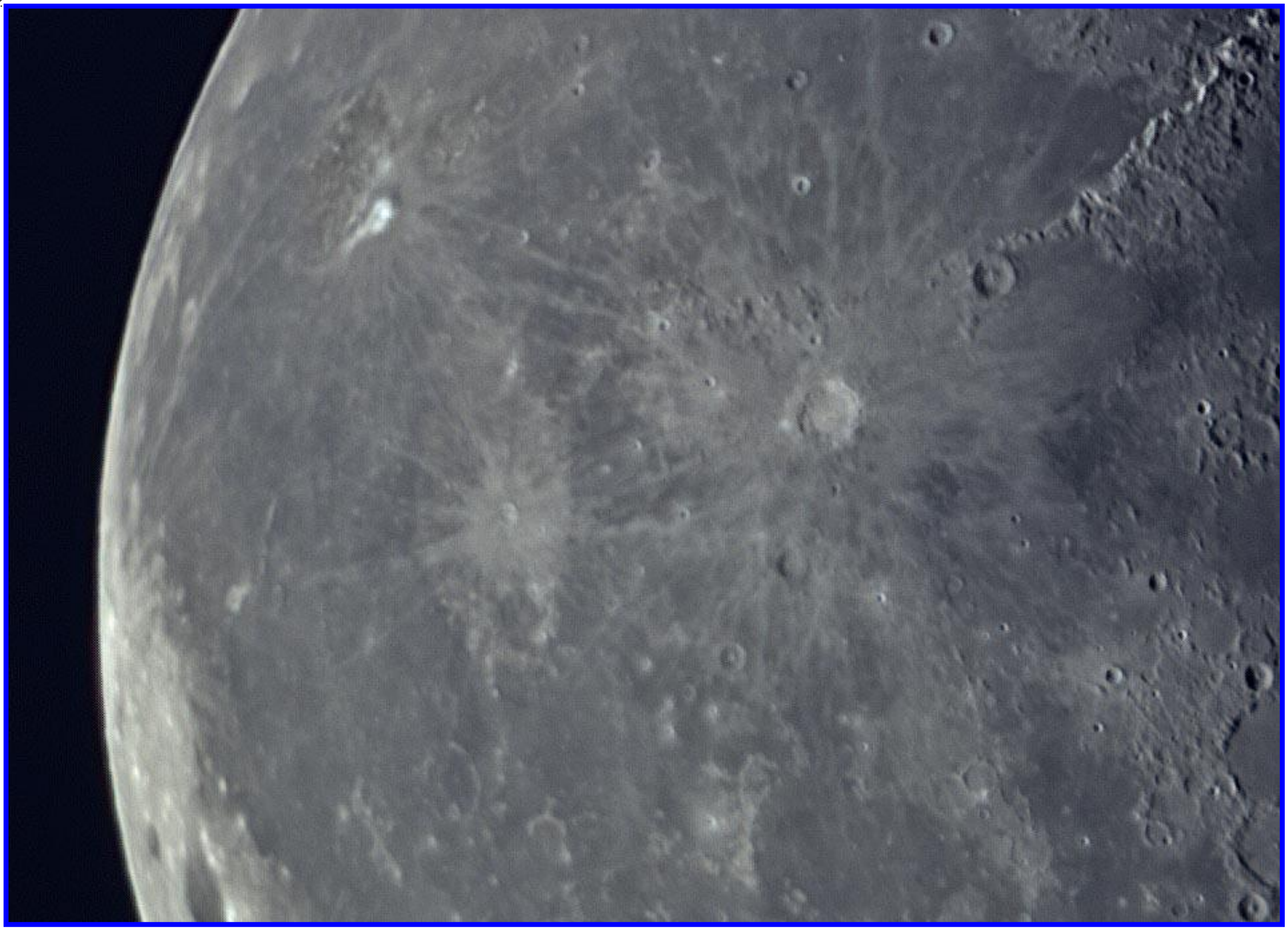
8.3 day-old Moon, *Maurice Collins, Palmerston North, New Zealand. 2024 July 14 05:35 UT. 80 mm Sky-Watcher Espirit ED refractor telescope, 2x barlow, QHY5III462C camera. North is down, west is right.*



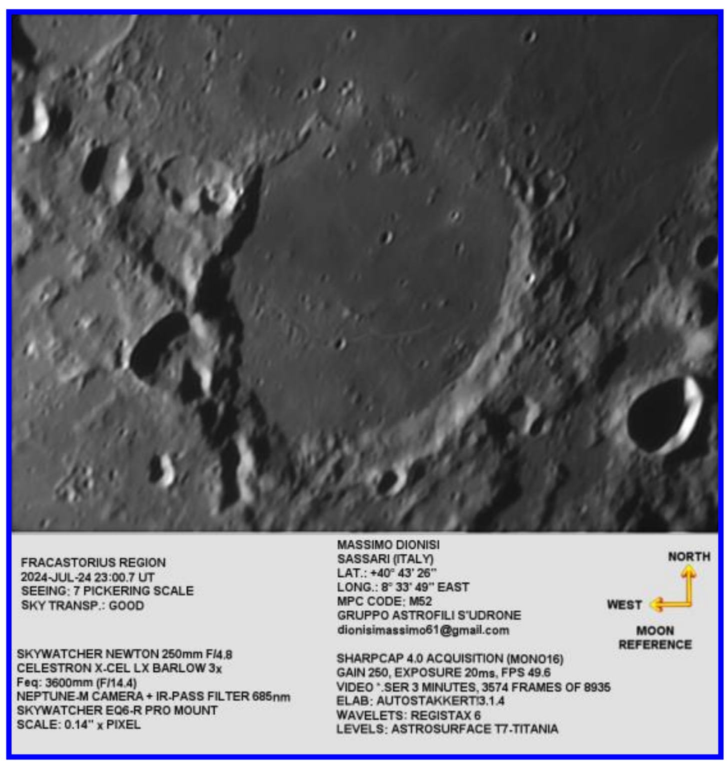
Walter, *Gonzalo Vega, Oro Verde, Entres Rio, Argentina, AEA. 2024 July 18 00:51 UT. 200 mm Newtonian reflector telescope, 1000 mm fl, Barlow APO 2.5x + 2x barlow, EQ5 Goto mount, Player One CC camera. North is down, west is right.*



Recent Topographic Studies



Copernicus, *Walter Ricardo Elias, Oro Verde, Entre Rios Argentina, AEA. 2024 July 27 10:54 UT. Skywatcher 150/750 mm reflector telescope, QHY 5II C camera.*



Fracastorius, *Massimo Dionisi, Sassari, Italy. 2024 July 24 22:00 UT. Skywatcher 10 inch f/4.8 reflector telescope, 3x barlow, efl 3600 mm, Skywatcher EQ6 Pro mount, IR Pass filter 685 nm, Neptune M camera. Seeing 7/10 Pickering scale, transparency good.*

Recent Topographic Studies

Lunar Geologic Change Detection Program

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

2024 August

LTP Reports Received
No new LTP or impact flash reports have been reported.

News: Please have a go at videoing the earthshine during the Perseids on the nights on Aug 11-13. For further details of when to look see: https://users.aber.ac.uk/atc/lunar_schedule.htm and click on the Future option if the prediction are still showing July. Because of the Moon's low altitude from high latitudes in the northern hemisphere, this will favour southern hemisphere observers and those in the southern states on mainland USA. Please send all reports to Brian Cudnik, ALPO's lunar impact flash coordinator – contact details and observing instructions on: https://www.pvamu.edu/pvso/cosmic-corner/lunar-meteor-watch/

Addendum: Correction to last month's newsletter - the Image of Herodotus taken on 2023 Apr 20 UT 21:41 was actually taken by Aldo Tonon and not by Franco Taccogna - my apologies over this.
.
Routine reports received for June included: Alberto Anunziato (Argentina – SLA) observed: Bullialdus, Censorinus, Clavius, Jansen, Plato, Posidonius and Tycho. Bob Bowen (Newtown, UK – NAS) imaged: several features. Maurice Collins (New Zealand - ALPO/BAA/RASNZ) imaged: Archimedes, Eratosthenes, Plato, Rupes Recta, and several features. Anthony Cook (Mundesley, UK – ALPO/BAA) imaged: several features. Walter Elias (Argentina – AEA) imaged: Capella, Cyrillus, Eudoxus, Menelaus, Posidonius and Proclus. David Finnigan (Halesowen, UK – BAA) imaged: Clavius. Bill Leatherbarrow, Sheffield, UK – BAA) imaged: Janssen, Piccolomini, Polybius, Posidonius, Sabine and Steinheil. Franco Taccogna (Italy – UAI) imaged: earthshine. Aldo Tonon (Italy – UAI) imaged: Posidonius. Luigi Zanatta (Italy – UAI) imaged: Posidonius.

Note that we I have included some BAA pooled observations in with this report.

Analysis of Routine Reports Received (June)

Earthshine: On 2024 Jun 7 UT 19:13 and 19:17 Franco Taccogna (UAI) imaged earthshine 27 and 23 minutes respectively before the following lunar schedule similar colongitude request:

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

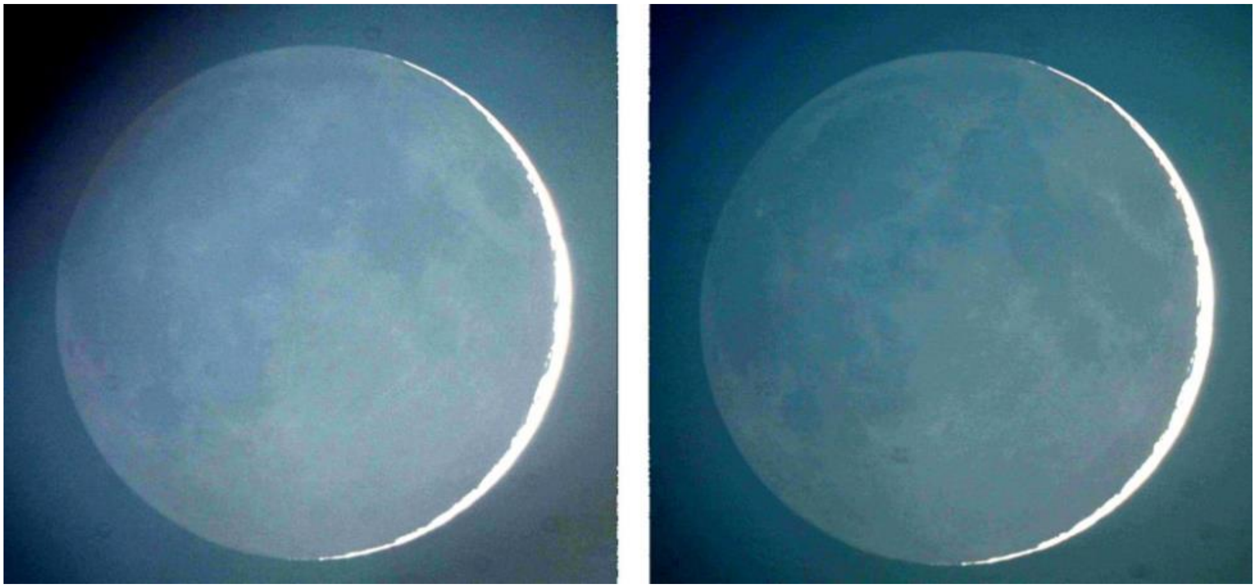


Figure 1. *Earthshine as imaged by Franco Taccogna (UAI) on 2024 Jun 11 and orientated with north towards the top.* ***(Left)*** *Taken at 19:13 UT.* ***(Right)*** *Taken at 19:17 UT.*

Figure 1 shows no sign of a bright rim around the earth lit western limb. I am gradually coming to the conclusion that the effect is libration dependent and is due to far side highland coming into view when the Moon's tilt is favorable. But we shall keep on trying for a little longer – just in case its impact dust related on the lunar far side and you can get a limb arc from forward scattering off high altitude dust particles of sunlight from the Sun on the far side.

Cyrillus G: On 2024 Jun 11 UT 22:52 Walter Elias (AEA) imaged thus region under similar illumination to the following report:

Cyrillus G 1983 Aug 13 UT 20:17-20:59 L. Paynter (Radcliffe, UK, 22cm reflector, seeing III or better, transparency good). Cyrillus G was relatively bright and surrounded by a shaded area. On increasing the magnification from x65 to x130 he became aware of a diffused "cerise" coloration, in and around the crater. The coloration was similar though to other spurious color on the Moon, but unlike other areas affected by spurious color, was more diffuse and spread out and not so concentrated. In view of some uncertainty by the observer, ALPO/BAA weight=1.

Figure 2. *Cyrillus G at the centre of this image, taken by Walter Elias (AEA) on 2024 Jun 11 UT 22:52 and orientated with north towards the top.*

As we can see from a section of Walter's image in Fig 2, Cyrillus G, which is 7.5km in diameter, is a relatively bright craterlet, and it does have some chromatic aberration in the image, but slightly different to what Lawrence Paynter described back in 1983. It is however incorrect to say that it is completely surrounded by a shaded area – there is certainly terminator off to the west, but some highland off to the east and perhaps another crater or depression to the NE? I think we shall leave the weight at 1 for now, but at least we have a view of what the area ought to look like now!

Alpetragius: On 2024 Jun 15 UT 07:38 Maurice Collins imaged this crater under similar illumination to the following Lick Observatory report:

Alpetragius 1889 Aug 03 UT 03:00-03:45 observed by E.E. Barnard (Lick Observatory, CA, USA, 36" refractor, x150, x700) "Shadow of CP diffused & pale. Entire inside of crater seemed filled with haze or smoke. Shad. of E. wall was black & sharp. CP & floor seen thru haze. No other craters showed this appear. (date & time rep't Sep 3, 1830L T)" NASA catalog weight=4. NASA catalog ID #264.ALPO/BAA weight=3.

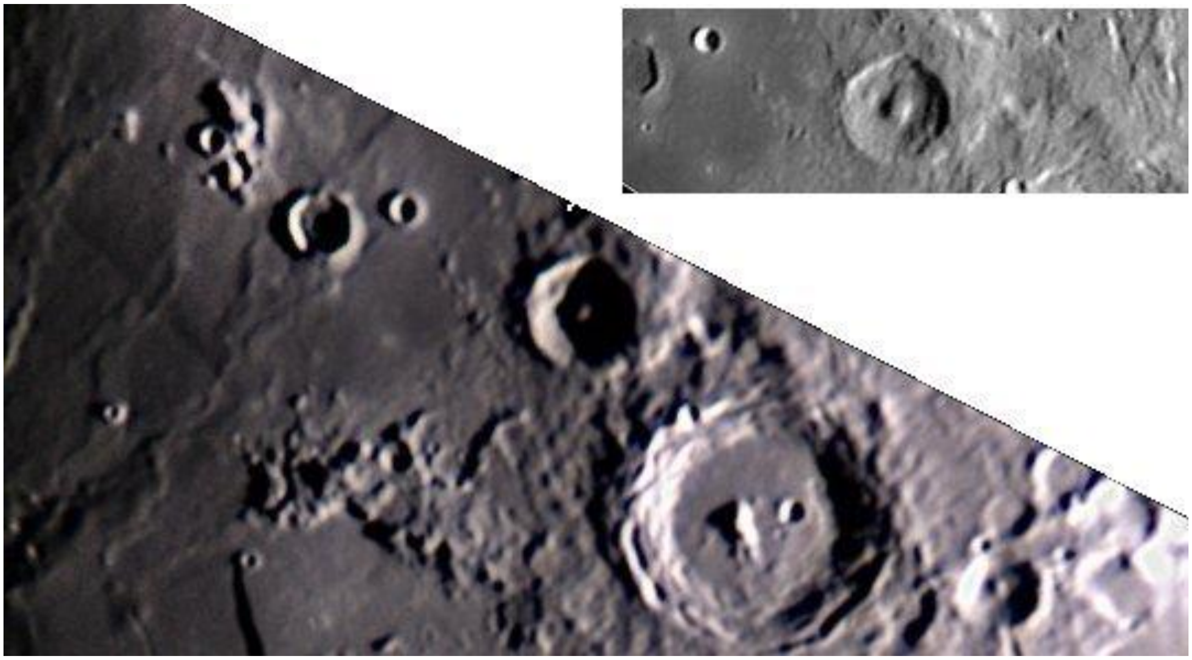


Figure 3. *Alpetragius orientated with north towards the top.* ***(Bottom Left)*** *from a larger area image of Rupes Recta, taken by Maurice Collins on 2024 Jun 15 UT 07:38.* ***(Top Right)*** *from a larger image of the Alphonsus region, taken by Ed Crandall (ALPO) on 2010 Mar 25 UT 00:38 – from ALPO's The Lunar Observer 2010 Jul, p6.*

Although Maurice was using a 4" refractor, compared to E.E. Barnard's 36" refractor, imaging quality has moved on from the Victorian visual observation era, nevertheless Barnard probably had better resolution! In Maurice's image (Fig 3 – Top Left), there is no sign of a haze or smoke inside the crater and the central peak shadow on the western illuminated rim is not diffuse and pale. Anyway, it's worth checking the Cameron Card catalog, and in doing so I see the description of the event being on 1889 Aug 03 is incorrect – this must be a typo error that I made when transcribing the text. It's actually Oct 04. I will make a correction in the database. In the mean-time, the ALPO/BAA archives, came up with an image by Ed Crandall (Fig 3 – Top Right) of what Alpetragius would normally have looked like on 1889 Oct 04 UT 03:00-03:45. It maybe could be said that the shadow of the central peak does look a bit pale and diffuse compared to the darkness of the shadow on the east, and maybe the floor does look slightly hazy? I think I will lower the ALPO/BAA weight from 3 to 2.

Censorinus: On 2024 Jun 15 UT 22:40-22:45 Alberto Anunziato observed visually this crater under similar illumination to the following report:

On 1972 Apr 22 at UT 18:58-00:28 Hopp (75mm refractor, 1200mm focal length, transparency 4 out of 5 and seeing 4 out of 5, located at 52deg 30' N and 13deg 15'E) Censorinus brighter than normal relative to Proclus. Published in Hilbrecht and Kuveler, Moon and Planets, 30 (1984) p53-61. ALPO/BAA weight=1.

Alberto was using a 105mm Maksutov-Cassegrain (Meade EX 105) at x154 and found that Censorinus appeared less bright than Proclus – the northern wall of Proclus being the brightest of the crater. Looking at the UT given for the 1972 event, it seems to last 5.5h, which is quite lengthy for a LTP, if that is what it was?

Posidonius: On 2024 Jun 16 UAI observers: Aldo Tonon and Luigi Zanatta imaged this crater, from 21:54 -22:15UT, and from Argentina, SLA observer Alberto Anunziato observed visually, under similar illumination to the following report:

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

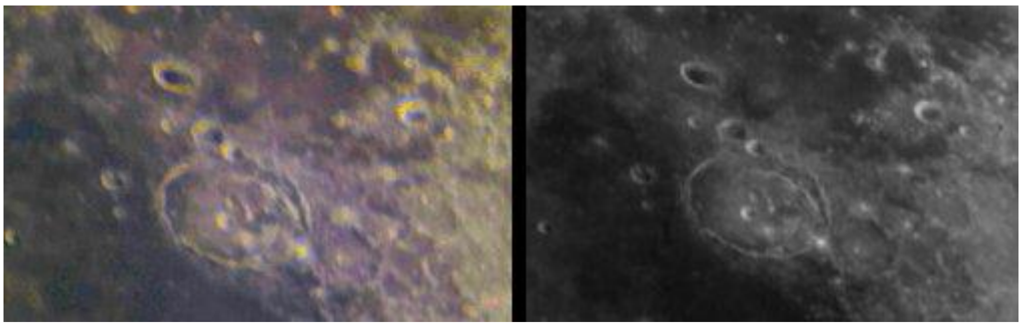
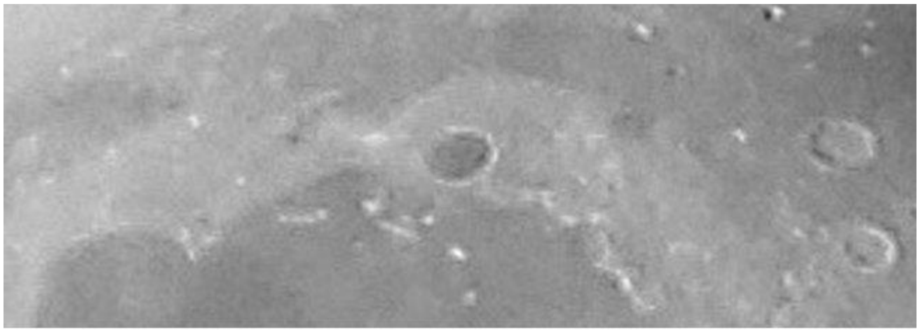


***Figure 4.** Posidonius orientated with north towards the top as imaged by UAI observers: **(Left)** Aldon Tonon took this at 22:01 UT. The image has had its color saturation enhanced using GIMP. **(Right)** A monochrome image taken by Luigi Zanatta, taken at 22:12UT.*

There is no obvious sign of natural color on the northern edge of Posidonius in Fig 4 (Left), and Alberto Anunziato, observing from the other side of the southern Atlantic, reported no sign of color either. We shall therefore leave the ALPO/BAA weight at 3 for now. We have covered this report before in the 2020 Dec newsletter.

Plato: On 2024 Jun 25 UT 01:06 Bob Bowen (NAS) imaged the whole Moon. This was during a repeat illumination and repeat topocentric libration (viewing angle) for the following report:

Plato 1886 Nov 14 UT 21:45 Observed by Lihou (France?) "Brilliant band N-S, area marked G in NE was only slightly visible, poorly defined. Drawing (there were rays on the floor)." NASA catalog weight=3. NASA catalog ID #253. ALPO/BAA weight=ALPO/BAA weight=3.



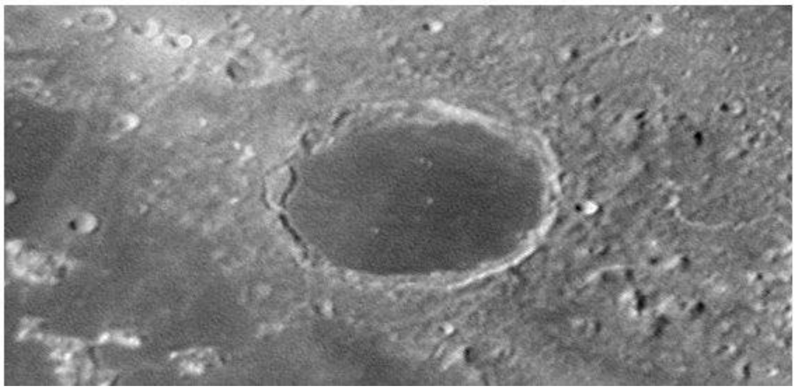


Figure 5. Plato orientated with north towards the top. ***(Top)*** *From an image of the whole Moon taken by Bob Bowen (NAS) on2024 Jun 25 UT 01:06 using a Canon 70-200 2.8 L IS Lens with a 2x Multiplier. The camera ISO was 200 and the exposure 1/100th sec.* ***(Bottom)*** *From an image by Brendan Shaw (BAA) taken on 2004 Sep 02 UT 23:21.*

Bob's image in Fig 5 (Top), although a telephoto camera lens image, would, one has thought, have shown a "brilliant band" running north to south across Plato, if this was the normal appearance. Consulting the Cameron catalog index cards, I see that the telescope used by Lihou was a 108mm, and the magnification was x100. The report was apparently published in L'Astronomie, 6, 69, 1887. Alas the card gives no more information, and I do not have access to L'Astronomie, so we are none the wiser as to what Lihou saw and what their drawing looked like, but at least from Bob's image we can see that Plato was librated south as it is not as elliptical as we normally are used to. Just out of interest, whilst checking through the archives, I came across an image by Brendan Shaw, that although not taken at similar libration, is very similar in illumination (Fig 5 Bottom). Again, there is absolutely no sign of a brilliant N-S band, but there is some evidence of rays across the floor, in agreement with Lihou's description/ We shall leave the weight of the LTP report at 3.

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

Basin & Buried Crater Project – Skylar Rees and Tony Cook

The co-author this month is my PhD student, who is starting research on using AI to identify and catagorize impact basins on the Moon and other planets and their moons, at the start of October. He will be taking over the role of this mini-project.

Sinus Medii – Impact Basin

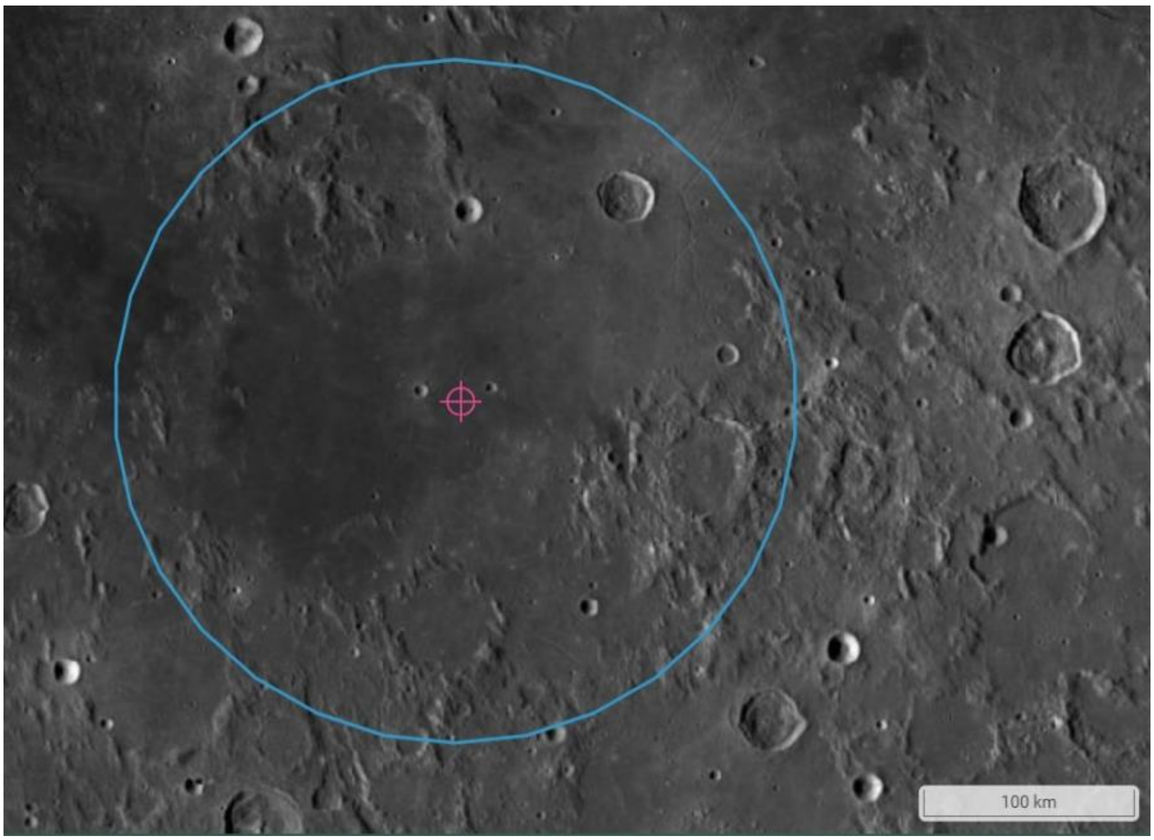


Figure 1. *Outline of the rim of the Sinus Medii impact basin, and centre, using the NASA Quickmap web site image mosaic.*

Evaluating lunar basins, with only the bare surface to work from, can be difficult, if not deceiving, yet many named basins are from an era in which this was the only option. In modern times however, there are many more tools at our disposal thanks to subsequent spacecraft measurements since the 1970s, begging another look at basin classification.

Sinus Medii is very close to the centre of the lunar nearside (1° E, 1°N), and was estimated by Neumann *et al* (2015) to be around 326 km in diameter, had two rings, and a visible gradient of volcanic-origin mare. The exact criteria for an impact basin has been a matter of some debate, three basic requirements are: (1) a diameter of no less than 300 km, (2) sometimes exhibiting multiple rings, and (3) 'geological complexity' (that is, should demonstrate some heterogeneity in composition and structure). Gravity data can also provide support evidence for a basin, unless it is highly degraded. *Medii* therefore should immediately meet these requirements if it is a true impact basin – but are they stringent enough to capture the gamut of nuances? Let us analyse the *LROC* suite of filtered views, meaning remote sensing and other cartographic datasets. Fig 1 using just an image mosaic, shows that there is mare infill but the rim is very poorly defined, if there at all?

Switching to another filer, the topographic height map (Fig 2 Left), we can see that there is a hint of a depression, the centre being about 400m deeper than closer to the edge of the floor, but it departs from a circular depression. At least some topographic highs lie around the main proposed basin ring, but again it is perhaps not so convincing? Normally we would expect to see some a few peaks or arcs along the basin rim, but the topography is very scattered here. Maybe this is starting to hint at a very degraded basin? For a third filter we can use a slope map (Fig 2 Right) – here we can start to see a lot more hummocky hill slopes begin to appear to have a better fit to the proposed rim, especially in the arcs on the NW and from the SW to S to SE and E, though the latter is not so convincing and some may be chance alignments? Another useful filter, at least for finding buried craters, is slope azimuth, but on this occasion it is not very helpful at illsutratinng where the basin lies, and is not shown here.

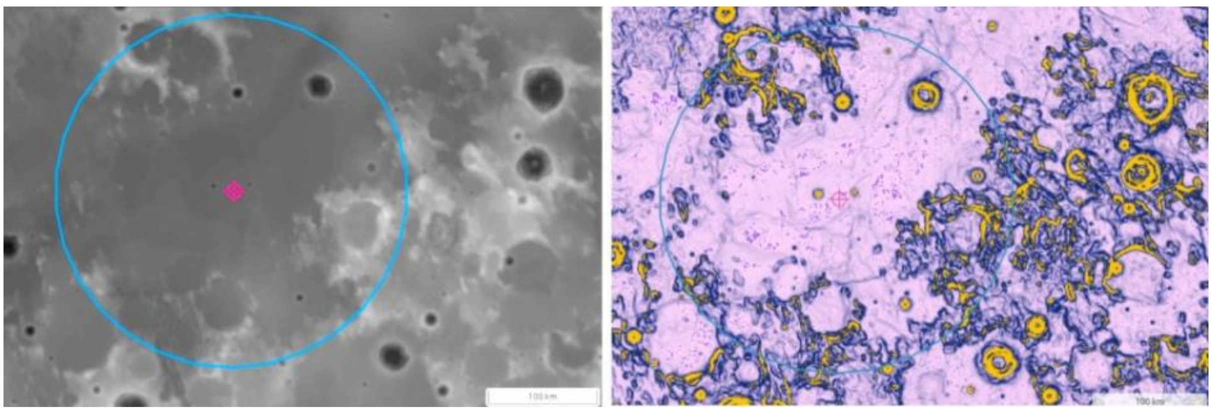


Figure 2. *Outline of the rim of the Sinus Medii impact basin, and centre, using the NASA Quickmap web site* ***(Left)*** *digital elevation model, where (dark is low, and white is high).* ***(Right)*** *terrain* slope map.

Another possible stem of basin detection is to use gravity data. Although no obvious bulls eye effect can be seen in the Free Air + Bouguer data (Fig 3 – Left), which is often associated with impact basins, there are plenty of example basins without this effect. Perhaps the most compelling evidence for a basin ring is the gravity gradient data (Fig 3 - Centre) as several high gradient areas (red) lie on arcs just inside the proposed ring. The floor of the basin has a low cristal thicknes (Fig 3 – Right), for the area, of just 20km, though is unusually extended in a NE direction.

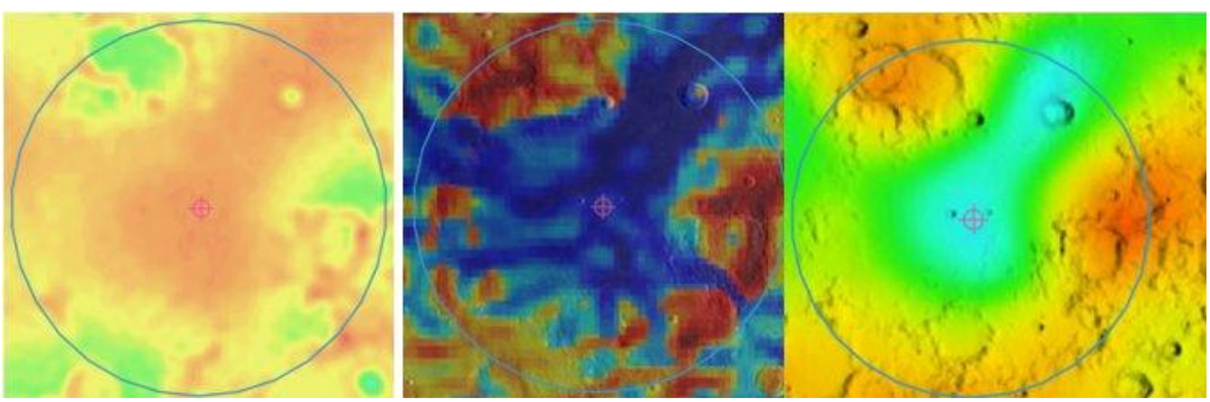


Figure 3. *Grail Gravity data from the NASA LROC Quickmap web site.* ***(Left)*** *Free Air + Bouguer Gravity.* ***(Centre)*** *Gravity Gradient.* ***(Right)*** *Custal Thicknes – light blue is 20km and orange 40 km.*

So to sum up, although Sinus Medii has little to show for in image mosaics, apart from a mare area, and the depression nature of the floor is not very circular, and anyway very low lying, slope map data hints at a fragmented hummocky ring, but the most compelling evidence comes from the arc-like structures in the gravity gradient data, and the thin crust at the centre of the basin. So far we see no evidence of multi-rings stuctures suggested by Neumann[1]. We would welcome any telescopic imagery of this area where you can see evidence of ring arcs.

Reference
[1] Neumann, G. et al. (2015). "Lunar impact basins revealed by Gravity Recovery and Interior Laboratory measurements." *Sci. Adv.* DOI:10.1126/sciadv.1500852.

Mare Frigoris Buried Crater

We are indebted to Alberto Anunziato (SLA) for highlighting a possible buried crater in the Mare Frigoris area, located at 1.9W, 57.3N, with a diameter of 37km (See Fig 4 - Left). Interestingly this is very close to buried crater QCMA 4, which has coordinates 1.7W, 58.9N, with a proposed diameter of 167 km though looking at the azimuth slope plot (Fig 4 – Right) the coordinates and diameter appear to be 1.1W, 58.6N and 65 km across. QCMA means "Quasi-Circular Mass Anomaly" so is largely based upon inferences on gravity data as to what size crater might produce this effect? So, we will add Alberto's crater with a designation of Anunzato-1 and a certainty weight of 6, and as for QCMA 4, the coordinates will be updated and a weight of 4 applied.

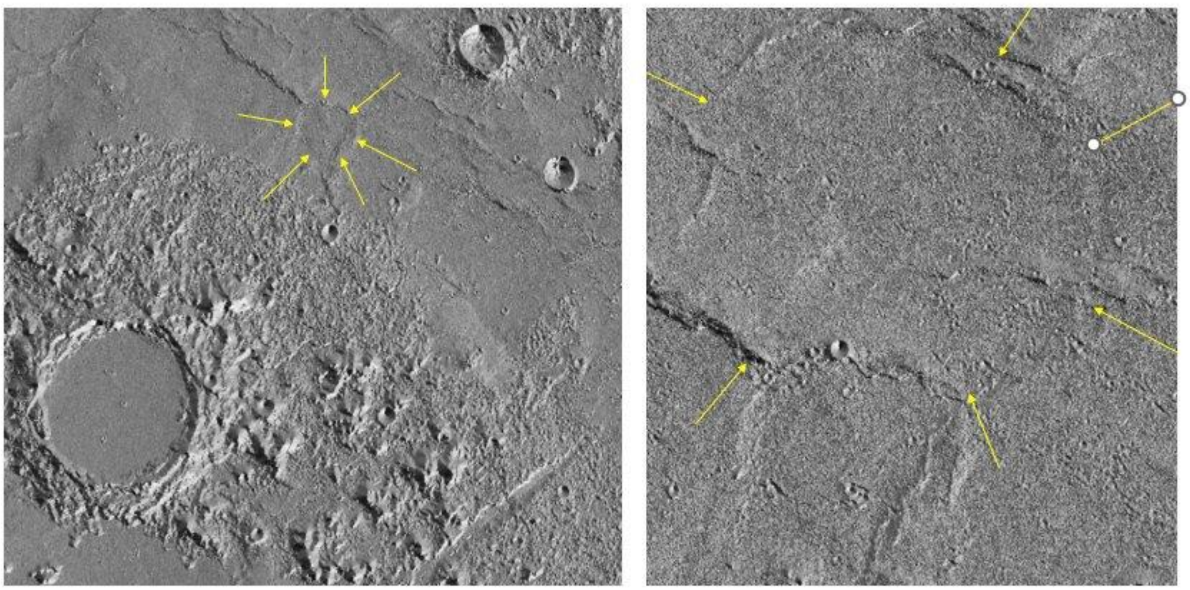


Figure 4. *Slope Azimuth plots from NASA's Quickmap web site* ***(Left)*** *Location of Anunziato-1.* ***(Right)*** *Possible location of QCMA-4, just north of the previous buried crater.*

Future Work

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 August 2024

Date	UT	Event
1		Greatest northern declination +28.4°
1		East limb most exposed +5.6°
2		South limb most exposed -6.6°
3	0000	Pollux 1.8° north of Moon
4	1113	New Moon (lunation 1257)
5	2200	Venus 1.7° south of Moon
9	0106	Moon at descending node
9	0200	Moon at apogee 405,297 km
10	1000	Spica 0.7° south of Moon, occultation Europe, Asia, Micronesia
12	1519	First Quarter Moon
15	0500	Antares 0.004° north of Moon, occultation Pacific Ocean
15		West limb most exposed -6.9°
16		Greatest southern declination -28.5°
16		North limb most exposed +6.7°
19	1826	Full Moon
21	0300	Saturn 0.5° south of Moon, occultation South America to Europe
21	0500	Moon at perigee 360,196 km
21	2200	Neptune 0.7° south of Moon, occultation Africa to Russia
22	1027	Moon at ascending node
26	0000	Uranus 4° south of Moon
26	0000	Moon in Pleiades
26	0926	Last Quarter Moon
27	1300	Jupiter 6° south of Moon
28		Greatest northern declination +28.4°
28	0000	Mars 5° south of Moon
28		East limb most exposed +6.8°
29		South limb most exposed -6.8°
30	0500	Pollux 1.7° north of Moon

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

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

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

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

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.

ATTENTION ALL CONTRIBUTORS

Effective Immediately (March 1, 2024)

While it is a great honor to put together The Lunar Observer, we are now overwhelmed by our success with some issues in excess of 200 pages.

The increased time it requires for me to perform this job (as a volunteer) pulls me away from my own family and other obligations. Thus, the following rules are being implemented to improve content flow on my end and provide you with the criteria needed to make the "TLO" even more professional in appearance and subject matter.

1. **Review your image(s) at your location before submitting it/them, then brighten or darken it/them as needed and if required, using whatever tools you have at hand. Images deemed unsuitable (including blurry, out-of-focus or "clouded-out" images) will either be returned for your attention or simply not used.**
2. **Images in jpeg format are preferred but others are also acceptable.**
3. **Crop your images to avoid jagged edges.**
4. **Orient the image so it makes the most sense. North at the top (with Mare Crisium at the upper right) is preferred but not required. To our many wonderful southern hemisphere contributors, please orient as you wish (probably south at top).**
5. **Be very limited on end-of-the-month submissions.**
6. **CHOOSE ONLY YOUR BEST IMAGES and limit the number to no more than eight (8) per each issue of the TLO. (obviously, if there is an article you are writing or contributing to this does not apply).**
7. **The image filename should be submitted with the object name spelled correctly, then the year-month-day-hour-minutes-Your Name or initials So, my image of Copernicus should have a file name of:**

Copernicus_2023-08-31-2134-DTe
means
Copernicus, 2023 August 31, 21:34 UT by David Teske

If we all do this going forward, it should make putting this all together faster and easier. Many of you already do this. Thank you for your contributions and your help. We have a premier lunar resource for the planet.

Please send images/drawings/text to drteske@yahoo.com

ATTENTION ALL CONTRIBUTORS

Effective Immediately (March 1, 2024)

In his efforts to make our organization as professional as possible, the late Walter Haas, the founder of the ALPO, urged that all image and sketch CAPTIONS be as complete as possible. This could enable others to perform their own observations using as much of the original caption data as possible to obtain the same or at least similar results. And while not everyone can provide every detail, we request the following in your captions:

1. Name of feature or object followed by name of imager and their specific location (including geographical coordinates if readily available).
2. Date and Universal Time when image was captured (or sketch was completed) using either the three-letter abbreviation or full spelling of the month to avoid possible month-and-date or date-and-month confusion.
3. Sky seeing (steadiness) conditions (0 = Worst and 10 = Perfect).
4. Sky transparency (opacity of the atmosphere) conditions (poor to good)
5. Intensity conditions (Standard ALPO Scale of Intensity: 0.0 = Completely black and 10.0 = Very brightest features, Intermediate values are assigned along the scale to account for observed intensity of features).
6. Equipment details (including instrument type, brand is optional) and aperture size (inches or mm/cm); telescope mount data (if applicable), camera brand and type, filter data (if applicable), as much exposure data as available (sketchers should provide other pertinent data).
7. Capturing, exposure and processing software data.
8. Personal comments about specific features including north (or south) in the image (sketch), markings and all other items pertinent to the subject being presented.
9. Any other pertinent comments.
10. Email or other contact information.

Below are two sample captions. Both at least attempt to follow the above-stated guidelines

Meton Region as imaged by Massimo Dionisi of Sassari, Italy (10°43’26” N, 8° 33’9” E), on 2024 January 30, at 00:03 UT. Equipment details: Sky Watcher 250 mm, f/4.8 reflector telescope, Tecnosky ADC, Celestron X-cel LX 3x Barlow lens, effective focal length = 4,750 mm, 685 nm IR pass filter, Neptune-M camera, Skywatcher EQ6-R Pro mount. Seeing conditions = III-to-IV (Antoniadi scale). Software details: SharpCap 4.0 acquisition (mono), AutoStakkert! 3.1.4 ELAB, Registax Wavelets.

Lunar craters Hausen and Bailly D as imaged by István Zoltán Földvári of Budapest, Hungary on 2020 April 07, at 21:03-21:17 UT. Colongitude 86.5°. Equipment details: 70 mm refractor telescope, f/l = 500 mm, Vixen Lanthanum LV 4mm eyepiece, 125x, Baader Contrast Booster Filter. Sky seeing = 7 out of 10, sky transparency = 6 out of 6.

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: Aristoteles and Eudoxus

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 September 2024, will be Aristoteles and Eudoxus. 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 Aristoteles and Eudoxus Focus-On article is August 20, 2024

FUTURE FOCUS ON ARTICLES:

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

Subject	TLO Issue	Deadline
Aristoteles and Eudoxus	**September 2024**	**August 20, 2024**
Archimedes Region	**November 2024**	**October 20, 2024**
Anaxagoras	**January 2025**	**December 20, 2024**
Clavius	**March 2025**	**February 2025**
Volcanic Features	**May 2025**	**April 20, 2025**

Focus-On Announcement
Aristoteles and Eudoxus: Similar and Different

The Moon offers us many areas of contrasts, one of them is very close to two areas that we have recently visited in the Focus Section, near Mare Frigoris and Lacus Mortis, two very close giants: the Aristoteles and Eudoxus craters. These two craters, so magnificent and so close, allow an interesting comparison between two geological eras in the same image: the Eratosthenian Aristoteles and the Copernican Eudoxus.

FOCUS ON JULY 2024: Due June 20, 2024: MARE NECTARIS

FOCUS ON SEPTEMBER 2024: Due August 20, 2024: ARISTOTELES AND EUDOXUS

FOCUS ON NOVEMBER 2024: Due: October 20, 2024: ARCHIMEDES, AUTOLYCUS AND ARISTILLUS

FOCUS ON JANUARY 2025: Due December 20, 2024: ANAXAGORAS

FOCUS ON MARCH 2025: Due February 20, 2025: CLAVIUS

FOCUS ON: MAY 2025: Due April 20, 2025: VOLCANIC FEATURES

Germán Savor

Focus On Announcement:
Archimedes, Autolycus and Aristillus: The Magnificent Three

These beautiful features in the western part of the Mare Imbrium are well known but always deserves another look. Archimedes, Autolycus and Aristillus are very different from each other. Archimedes is a large crater (83 km.) with a floor completely flooded by the lava that formed Mare Imbrium, which also flooded partially it's ejecta blanket. Autolycus (39 km.) is the smaller one, its main characteristic is a rough and disintegrated floor. Aristillus (55 km.) is a typical and splendid impact crater with terraced inner walls, wide and bright ejecta blanket and a constellation of central peaks. Let's enjoy these 3 magnificent craters along with other nearby wonders such as Montes Spitzbergen, Montes Mountains or Palus Putredinis.

SEPTEMBER 2024 ISSUE-Due August 20 2024: ARISTOTELES AND EUDOXUS

NOVEMBER 2024 ISSUE-Due October 20 2024: ARCHIMEDES, AUTOLYCUS AND ARISTILLUS

JANUARY 2025 ISSUE-Due December 20 2024: ANAXAGORAS

MARCH 2025 ISSUE-Due February 20 2025: CLAVIUS

MAY 2025 ISSUE-Due April 20 2024: VOLCANIC FEATURES

IMAGE CREDIT: JESÚS PIÑEIRO

Key to Lunar Images In This Issue

1. Alphonsus
2. Aristarchus
3. Aristoteles
4. Atlas
5. Borda
6. Bullialdus
7. Cassini
8. Cauchy
9. Copernicus
10. Fracastorius
11. Frigoris, Dorsum
12. Gassendi
13. Gruithuisen
14. Langrenus
15. Magelhaens
16. Maginus
17. Manilius
18. Manzinus
19. Marginis, Mare
20. Nielson
21. Pico, Mons
22. Plato
23. Proclus
24. Ptolemaeus
25. Schickard
26. Shiller
27. Smythii, Mare
28. Tranquillitatis, Mare
29. Tycho
30. Walter
31. Yerkes