The Lunar Observer

A Publication of the Lunar Section of ALPO

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

September 2022

In This Issue

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Online readers, click on images for hyperlinks

Lunar Reflections

Tycho to Clavius, *Rik Hill, Loudon Observatory, Tucson, Arizona, USA. 2012 May 03 04:18 UT. TEC 8 inch f/20 Maksutov-Cassegrain telescope, Wratten 23 filter, DMK41AU04 camera. Seeing 7/10.*

Many thanks to the **30** contributors from across the globe who sent in **191** observations, images, drawings and articles about the Moon. This is awesome that so many contribute so much! With that in mind, please remember that as the coordinator of the ALPO Lunar Topographic Section and editor of this fine newsletter is a volunteer position. I am sure that you knew that. But with that said, please send me all the articles that you wish; they go in pretty easily. Images take much time to get in *The Lunar Observer*. I can put about 8 images per hour, from downloading to editing to placing in *The Lunar Observer* and getting an appropriate hyperlink. So… **Please** send your **BEST** images, **NOT ALL** of your images!

In this issue, you will find an extensive Focus-On article by Alberto Anunziato about bright rayed craters in the lunar southern hemisphere. Of coarse, Tycho steals the show, but there is so much more! There is great participation in this! Rik Hill takes on some great tours of the lunar topography. Alberto Anunziato again explores the lunar terrain with small telescopes and spacecraft. Rafael Benavides explores the region around Archimedes. Guillermo Scheidereiter explores the lunar terminator with some wonderful poetry of Edgar Allen Poe. These are all such wonderful articles. Darryl Wilson continues to tutor us on lunar imaging. He leaves us with a great question. What color is the Moon? Let us know what you think! Tony Cook leads us on more explorations of Lunar Geologic Change and Buried Basins and Craters with great information and observing projects.

Many thanks also to those behind the scenes, Larry Owens and Jim Tomney, who help keep the ALPO website up and running! We just couldn't do it without your ever present help!

Please remember to look through your files to find lunar observations of the crater Eratosthenes. Please send them to Alberto and myself by October 20th. Until then...

Clear skies,
-David Teske

Lunar Topographic Studies

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Observations Received

Name	Location and Organization	Image/Article
Esteban Andrada	Mar del Plata, Argentina	Images of Tycho (2).
Alberto Anunziato	Oro Verde, Argentina	Images of Brygius and Rabbi Levi H, articles and images Wrinkle Ridges from Mons Rümker to Dechen D, Dorsa Harker from Mons Usov to Promontorium Agarum (and a Few Words About Visual Observations) and Wonders of the Full Moon: Southern Bright Rayed Craters.
Sergio Babino	SAO, Montevideo, Uruguay	Images of Tycho (2) and Gassendi.
Rafael Benavides Palencia	Posadas Observatory MPC J53, Córdoba, Spain	Article and four images of Archimedes Region, Mersenius and Gassendi.
Ariel Cappelletti	SLA, Córdoba, Argentina	Image of Tycho.
Francisco Alsina Cardinalli	SLA-LIADA, Oro Verde, Argentina	Images of Campanus, Mons Piton, Blancanus, Tycho, Messier (3), Censorinus and Alpetragius.
Jairo Chavez	Popayán, Colombia	Images of the First Quarter Moon, Werner, Menelaus, Waxing Gibbous Moon (2), 99% Moon, 95% Moon and the 92% Moon.
Maurice Collins	Palmerston North, New Zealand	Images of a 4.5-day old Moon, Fracastorius, 5.5-day old Moon, 6.5-day old Moon and 12.6-day old Moon.
Leonardo Alberto Colombo	Córdoba, Argentina	Images of the Full Moon and Tycho (2).
Jef De Wit	Hove, Belgium	Drawings of Messier, Langrenus and Tycho.
Massimo Dionisi	Sassari, Italy	Images of Milichius, Copernicus, Hortensius, Kies and T. Mayer.
Walter Ricardo Elias	AEA, Oro Verde, Argentina	Images of Aristarchus, Gassendi, Tycho, Maskelyne, Plato, Alpetragius and Alphonsus.
István Zoltán Földvári	Budapest, Hungary	Drawings of Markov, Babbage and Sirsalis.
César Fornari	Oro Verde, Argentina	Image of Fracastorius.
Desiré Godoy	Oro Verde, Argentina	Images of Tycho's rays, Messier and Abulfeda (2).
Victoria Gomez	AEA, Oro Verde, Argentina	Image of Hercules.
Marcelo Mojica Gundlach	Cochabamba, Bolivia	Images of Pascal, Plato, Kepler, Schiller, Aristarchus, Gassendi and Tycho.

Lunar Topographic Studies

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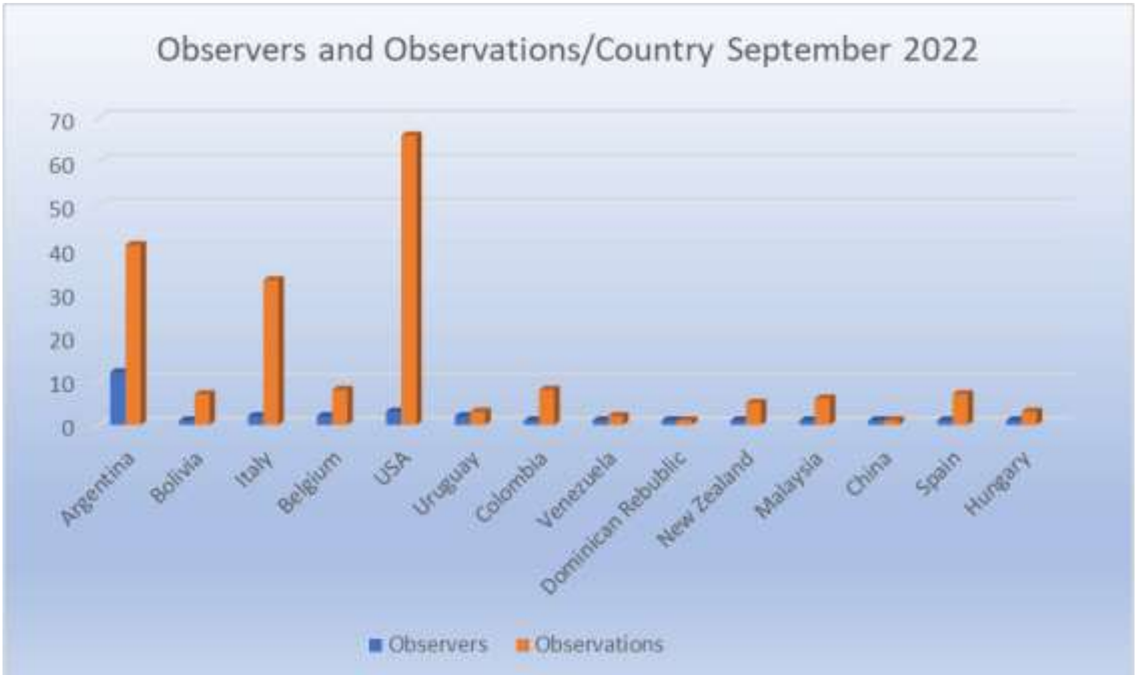
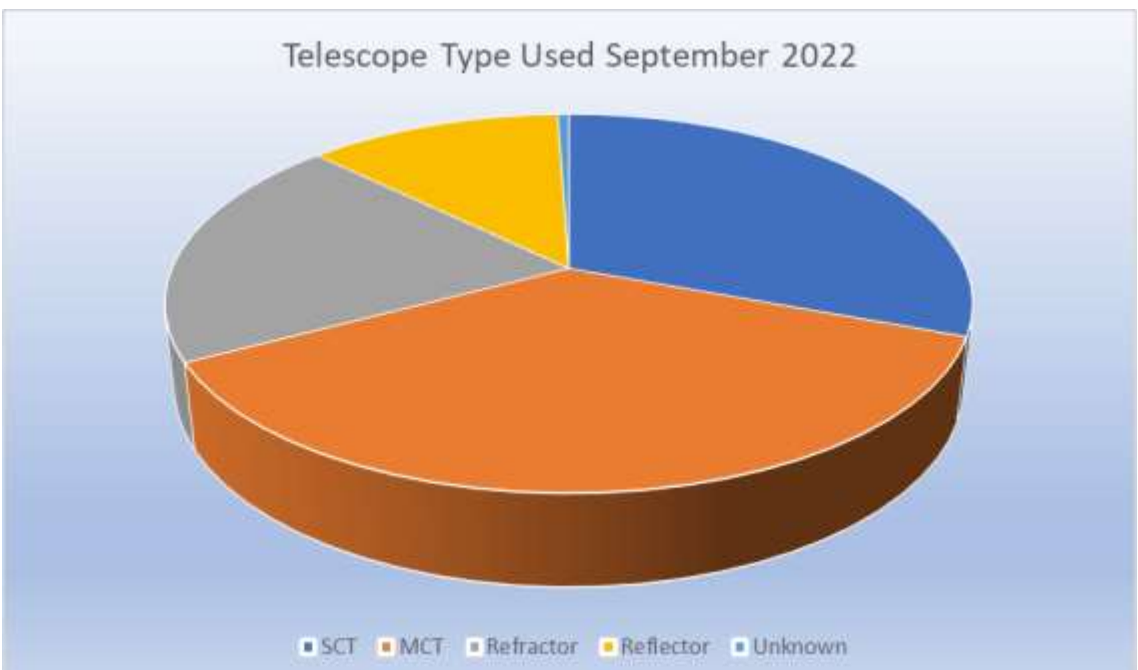
Observations Received

Name	Location and Organization	Image/Article
Rik Hill	Loudon Observatory, Tucson, Arizona, USA	Article and image Petavius and Langrenus, From Torricelli to Apollo 11, The Moon is not no-Fault!, Lansberg Domes and images of Clavius (8), Albategnius, Agatharchides, Barocius, Bohnenberger (2), Abulfeda, Petavius (6), Mare Humorum, Langrenus, Maurolycus, Messier (4), Reiner Gamma (4), Moretus, Rupes Recta (4), Schiller, Theophilus (2) and Tycho (9).
Dominique Host	Kortrijk, West-Vlaanderen, Belgium	Images of Byrgius, Taruntius, Mädler, Stevinus and the Waxing Gibbous Moon.
Eva Leguiza	AEA, Oro Verde, Argentina	Images of Montes Apenninus and Tycho.
Felix León	Santo Domingo, República Dominicana	Images of the Waxing Gibbous Moon.
Richard Martin	Canelones, Uruguay	Image of Mare Crisium.
KC Pau	Hong Kong, China	Image of Lambert.
Jesús Piñeiro	San Antonio de los Altos, Venezuela	Image of Tycho.
Guillermo Scheidereiter	LIADA, Rural Area, Concordia, Entre Ríos, Argentina	Article Agathos, Oinos and the Moon in the Window, and images of the Lunar North, Vallis Alpes, Plato, Ancient Thebit (2), Bond and Eratosthenes.
Michael Teoh	Penang, Malaysia	Images of Mare Serenitatis, Theophilus, Montes Caucasus, Rothmann, Lunar South Pole and Aristoteles.
David Teske	Louisville, Mississippi, USA	Images of Tycho (5), Messier (5), Mare Nectaris, Langrenus and Mare Orientale (2).
Román García Verdier	Paraná, Argentina	Images of Tycho.
Fabio Verza	SNdR, Milan, Italy	Images of Langrenus (2), Gutenberg, Janssen, Mare Nectaris, Piccolomini (2), Endymion (2), Posidonius (2), Mare Crisium, Taruntius, Petavius, Aristoteles, Cassini, Eudoxus, Hyginus, Julius Caesar, Lacus Mortis, Maurolycus, Descartes, Montes Caucasus, Rheita, Theophilus, Longomontanus, Stevinus and Messier.
Darryl Wilson	Marshall, Virginia, USA	Article and images Insertion of Principal Component Bands into the HSV Color Enhancement Process Flow.

September 2022 *The Lunar Observer*
By the Numbers

This month there were 191 observations by 30 contributors in 14 countries.





The Moon is not No-Fault!

Rik Hill

***Triesnecker**, Rik Hill, Loudon Observatory, Tucson, Arizona, USA. 2022 June 08 03:37 UT, colongitude 13.5^o. TEC 8 inch f/20 Maksutov-Cassegrain telescope, 665 nm filter, SKYRIS 132M camera. Seeing 8-9/10.*

This region, virtually dead center of the visible disk of the Moon, features many rilles or rimae. But the interesting thing is that they are all of different origin. Below left of center is the crater Triesnecker (27 km dia.) a young crater of Copernican age (up to 1.1 billion years old - b.y.o.). Immediately to the left of Triesnecker are the fascinating ruins of the ancient crater Murchison (60 km) of Pre-Nectarian age (4.5 to 3.9 b.y.o.) and farther left is the equally interesting Pallas (51 km) of Nectarian age (3.92 to 3.85 b.y.o.). Notice the rimae to the right of Triesnecker. These are thin faults in the smooth mare material of Sinus Medii, generally ranging from 1-3 km in width. North of this rimae complex is the bent line rima with a crater in the middle. The crater is Hyginus (10 km) of Imbrian age (3.85-3.2 b.y.o.) and the rima, Rima Hyginus, that extends east and west from it, upon high magnification, resolves into small pits that are volcanic vents, in a fault. You can see this here if you right click on the image and open it at full resolution in a separate tab on your browser.

To the right (east) of Triesnecker are two north-south oriented craters. The northern one is Agrippa (48 km) and the southern one is Godin (36 km). North of this pair is another rima, Rima Ariadaeus. Right away you can see that this one is different from either of the other two previous rilles. It's a graben, a feature where a block of land between two parallel normal faults, drops down when the faults spread, forming a trough. Just below middle of this rimae is the crater Silberschlag (14 km). Notice how the mountainous ridge that passes north out of this crater is crossed by the rima. The graben passes right over this ridge as if it were flat mare! It's an amazing thing to see this in some of the Apollo 10 images. There is another such crossing farther to the right (east) just past the discontinuity in the rima. A truly fascinating and geologically educational region on the Moon.

Lunar Topographic Studies

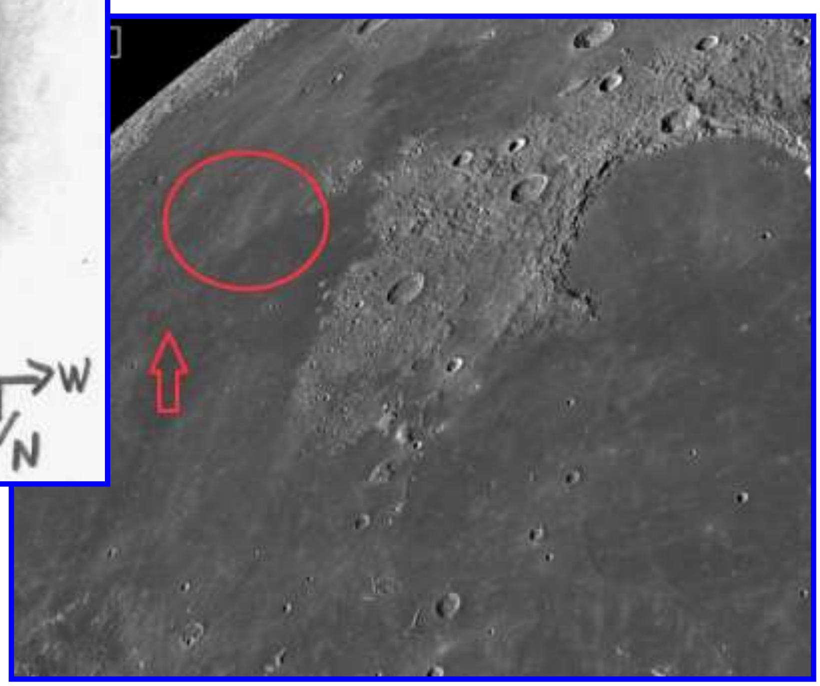
Wrinkle Ridges from Mons Rümker to Dechen D

Alberto Anunziato

IMAGE 1 records an observation of part of the western zone of Oceanus Procellarum, an anodyne zone, which does not present very recognizable features, as can be seen in IMAGE 2, obtained from the LROC Quickmap. The red arrow indicates Mons Rümker, a true volcanic oddity not so easy to see, and the red circle the area drawn in IMAGE 1. What are those curved lines that seem to link? At the time of the observation (61.4º colongitude, grazing illumination) I thought I was observing craters buried by Procellarum lava, and the reader will see that there appear to be two craters that would show only part of their profile. I was excited to collaborate with Tony Cook's new project, the Basin and Buried Crater Project. But, analyzing the area with the LROC Quickmap wrinkle ridges catalog, I concluded that they are wrinkle ridges. We should interpret the area as follows: Mons Rümker to the south (exactly where the image ends, beautiful to look at but difficult to draw) and in the extreme north a small crater (5 km in diameter), Dechen D, shaped like a bowl. The shadows are quite pronounced, even at certain points denoting a greater height, but the wrinkle ridges do not seem steep, I could not observe any variation in brightness or anything that indicated a higher area.

***Image 1, Dechen D to Mons Rümker**, Alberto Anunziato, Paraná, Argentina. 2022 June 12 00:05-00:30 UT. Meade EX105 Maksutov-Cassegrain telescope, 154x.*

Image 2, Dechen D to Mons Rümker, LROC.



Lunar Topographic Studies

In IMAGE 3 (also from the LROC Quickmap) you can see what the area really is like, a network of wrinkle ridges, identified in IMAGE 4. What seemed like a clever observation was not so, I did not observe all the ridges, only the most prominent, as we can see in IMAGE 5, which is the combination of the wrinkle ridges catalog layer with the SLDEM2015 AZIMUTH layer from the Lunar Orbiter Laser Altimeter (LOLA). I also drew Dechen D further east than where it is actually located. Despite this inaccuracy and not having observed the less prominent wrinkle ridges, I liked taking advantage of the low illumination, near the terminator, to record this little-known area.

Image 3, Right, Dechen D to Mons Rümker, LROC.

Image 4, Above, Dechen D to Mons Rümker, LROC.

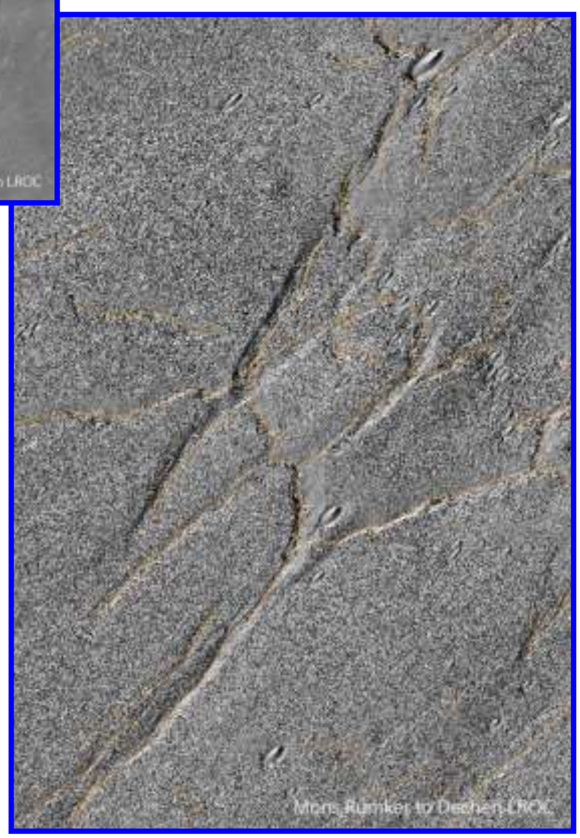


Image 5, Dechen D to Mons Rümker, LROC.

Lunar Topographic Studies

From Torricelli to Apollo 11

Rik Hill

North of Theophilus is Sinus Asperitatis a flat region at the bottom of this image that contains the interesting pear-shaped crater Torricelli (23x31 km) below and right of center. This crater has been a favorite of mine for many years sitting as it does on the north side of a much larger ghost crater some 75 km diameter. It is the merging of at least 2 craters of Imbrium age (3.2-3.8 billion years old) filled with ejecta from surrounding impacts. On the opposite side (left) of the Sinus is another odd shaped crater that points more or less south. This is Hypatia (28x41 km) also of Imbrian age, also overlain by ejecta materials. Notice the sideways "V" shaped shaft of light from sunlight streaming in through the break in the western wall. It's fun to watch these kind of light shows as they change rapidly with time.

North of this region is Mare Tranquillitatis and the site of the Apollo 11 Base. Two large craters on the left side of this are Sabine (31 km) south and Ritter (32 km) north. They make it easy to find the "Tranquility Base". Between these two craters and Torricelli is the small crater Moltke (7 km) and between Moltke and Sabine is a large system of rilles named Rimae Hypatia. These are not the thin cracks like the Triesnecker rimae, but rather are grabens where a block of land drops down between two roughly parallel faults. In this case we have two such grabens parallel to each other. Then in the upper right corner, near the label, is the crater Maskelyne (26 km) another odd shaped crater but younger than most of the other craters we have pointed out, being of Eratosthenian age (1.1-3.2 b.y.o.) and so this one is not filled in by ejecta like the much older craters.

This is a wonderful region with a lot more going on. Enjoy it for yourself when the moon is about 6.3 days old!

***Hypatia**, Rik Hill, Loudon Observatory, Tucson, Arizona, USA. 2022 May 07 02:55 UT, colongitude 342.7º. TEC 8 inch f/20 Maksutov-Cassegrain telescope, 665 nm filter, SKYRIS 445M camera. Seeing 8/10.*

Lunar Topographic Studies

Dorsa Harker from Mons Usov to Promontorium Agarum (and a Few Words About Visual Observation)

Alberto Anunziato

After many cloudy nights in our southern winter, or clear nights when we had to get up early the next day, the night of Sunday, August 14th, was clear, but I was only able to return home at 3 in the morning. So much cold and sleepiness, but it had been so many days since I took out the telescope! My first target is always the lunar features listed for observation by the Lunar Geological Change Detection Program. That night there were few and the observations to replicate implied using filters that I don't have. I went to observe the vicinity of the terminator, the view was beautiful (as it always is in those areas of long shadows like those of an expressionist film), but there did not seem to be anything that could be useful visual record. Or was it that I was too tired and this affected my perception?

Here I interrupt for a brief digression. I have been reflecting on visual observation for a long time, with the purpose of "knowing myself as an observer", both in terms of the biases that condition me and in terms of the possible advantages of visual observation. At the recent ALPO annual conference I shared these reflections, which were reinforced by my recent reading of “A Treatise on Moon Maps” by Francis J. Manasek, which was reminiscent of reading “Epic Moon” by William P. Sheehan and Thomas A. Dobbins. As visual observers, we are proud to be part of a tradition that, with incredible effort over centuries, and at the cost of the health and even the lives of some observers, made the visible side of the Moon understandable. Knowing the observations prior to the primacy of amateur cameras allows us to learn more about our observation experiences, especially the limitations of visual observation. One can become discouraged before the subjectivity that reigns in each of the phases of visual observation (in the interpretation of what we see, in how we draw it, etc.) and legitimately ask: Does it make sense to observe visually if we have the photographic observation that is it objective? Probably not. But we can complement visual observation beforehand with theoretical knowledge about what is going to be observed (now we know much more than the great selenographers of the 19th century) and later with the search for photographic confirmation (a possibility that, obviously, they didn’t have either), and that way we focus on the most important features of what we observed to record them.

Let's go back to the night of the 14th. As I dedicate myself to observing wrinkle ridges, trying to focus my observation on its topographical components, I always look for wrinkle ridges near the terminator that present some peculiarity that deserves a detailed record. The most prominent wrinkle ridges that night were those of Mare Crisium, but my preconception is that they are not very high (I remembered it from having collected images for the Focus On Section report in January 2022). Well, let's search Crisium's east wrinkle ridges before we go to sleep. I began to draw the outlines of the arch and as the minutes passed, I was amazed at how clearly I could see the details of Dorsa Harker's structure, especially the crests. Let us remember that the structure of a ridge consists of a wide arch with rounded tops and, on top, a very steep crest and sometimes smaller secondary crests. Until that night I could infer the presence of crests from the more or less intense light they reflected, but Dorsa Harker's crests looked as they do in the photographs, with relief, I was fascinated. I recorded its strike as carefully as possible with the intention of checking the next day if it coincided with any photograph (remember the scheme: previous knowledge that allows a profitable observation, concentrated on the details that may be useful or anomalous, that can be corroborated by a subsequent photographic confirmation). Already in bed I couldn't stop thinking and asking myself: Did I see the ridges in detail because I already know what they look like? Was it because of the relief of Dorsa Hacker in particular? Did I observe what I wanted to observe, influenced by the photos? The next day my wife asked me if I had observed and I told her about this existential problem. Would she have understood me or did she only pretend to understand me? We astrophiles are strange.

I have already maintained in previous texts my preference for the "Photographic Lunar Atlas for Moon Observers" by KC Pau as it is the Atlas that best illustrates the topography of the wrinkle ridges. And to the Atlas I went to confirm the existence of the crests in the places where I had indicated them. And I found IMAGE 2 on page 85 of Volume 1, which pretty much matches the general shape of the Dorsa and the direction of the crests.

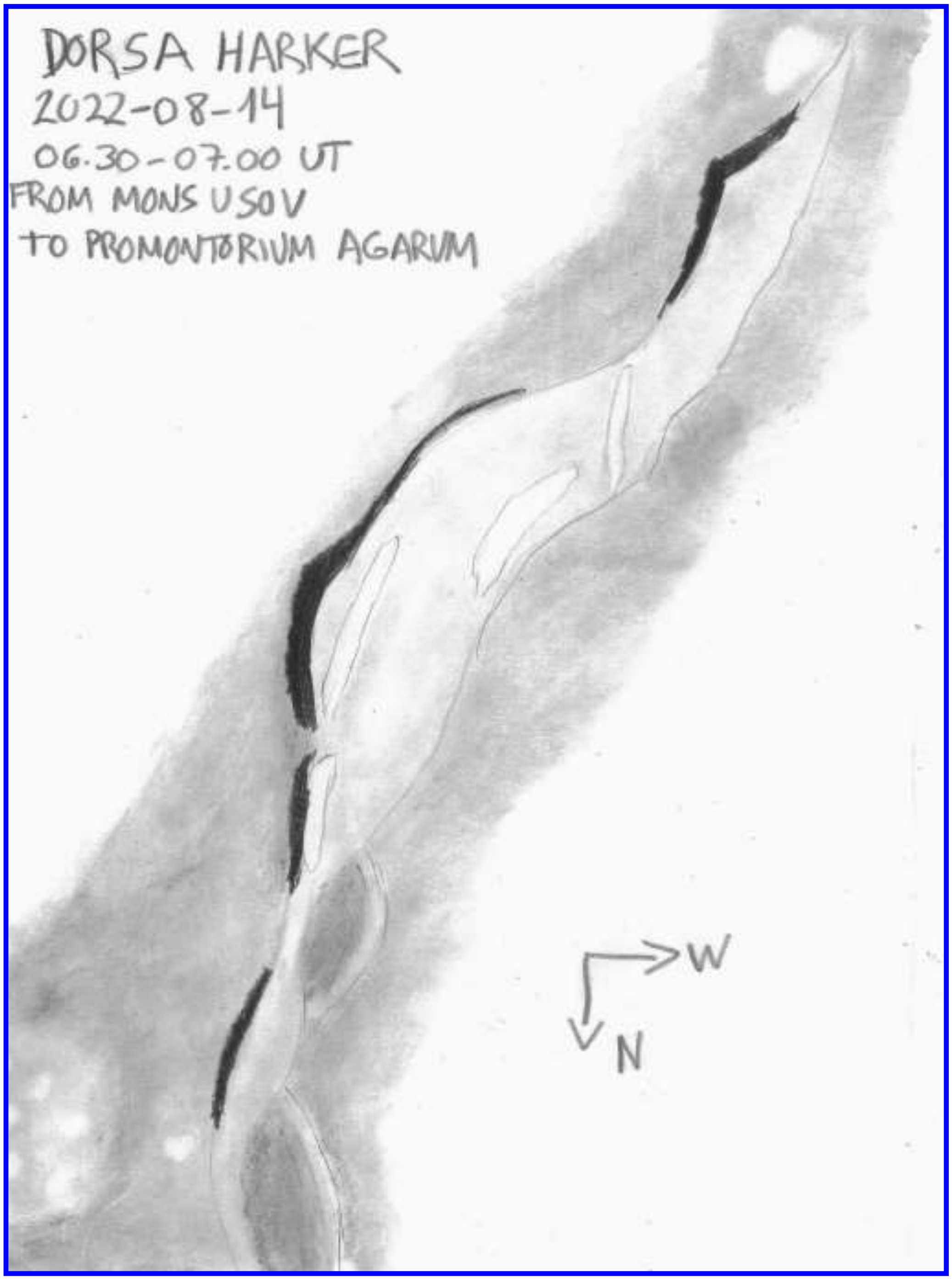


Image 1, Dorsa Harker from Mons Usov to Promontorium Agarum, *Alberto Anunziato, Paraná, Argentina. 2022 August 14 06:30-07:00 UT. Meade EX105 Maksutov-Cassegrain telescope, 154x.*

Image 2, Dorsa Hacker *from Photographic Lunar Atlas for Moon Observers" (KC Pau)*

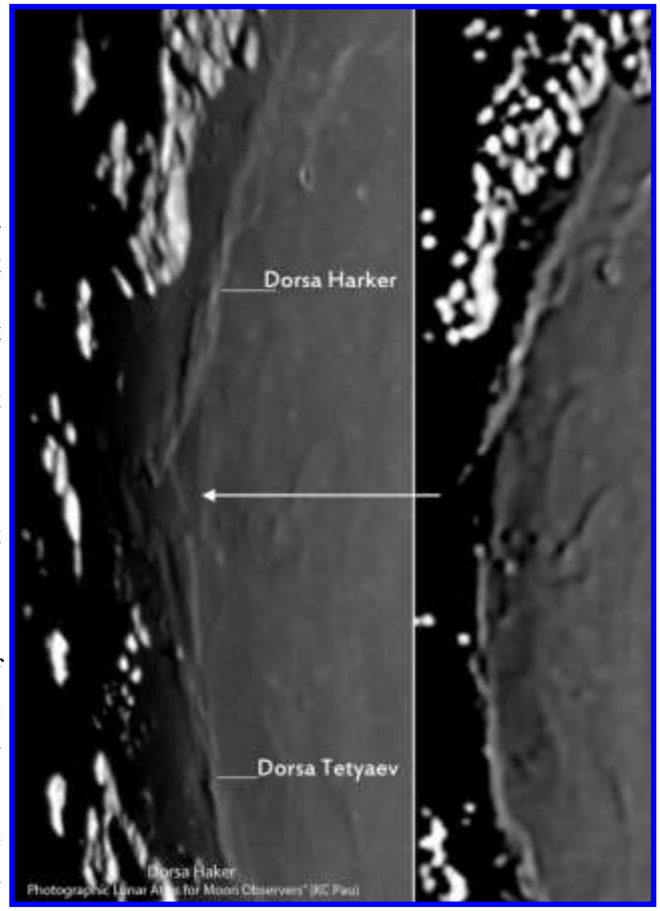


IMAGE 1 does not cover the whole of Dorsa Harker (which stretches about 200 kilometers), but rather about two-thirds of its length, as we see in IMAGE 2, from its beginning in the extreme south, west of Mons Usov (that we see in IMAGE 1 as a bright oval-shaped spot), to a little further north of Promontorium Agarum (the highest point of Mare Crisium), which was seen as a lighter mass with bright spots (higher peaks) and which in the image is in the lower left area (schematically marked, without topographical intention). The shadows clearly mark the highest areas of the dorsum, and are obviously more marked in the area where the crests meet. If we see the lower area, we see that there are two zones of dark shadows, they are lower areas of the wrinkle ridge or areas between two arms of it. The crests are distributed at right angles to the arch in a staggered formation pattern, which is known as "en echelon".

Among the images that the lunar observers sent for the Focus On Section of the month of January 2022, dedicated to Mare Crisium, we selected IMAGE 3, in which Dorsa Harker is observed in the panorama of Crisium, forming with Dorsa Tetyaev one of the rings of the Crisium Basin (we retouched the original image a bit to highlight the dorsa, although the rest of the image has been saturated). Undoubtedly, a fascinating area, close to the place where the Soviet Luna 24 probe landed on August 18, 1976, which four days later returned to Earth with a 170-gram sample obtained at a depth of 2.25 meters. On the internet we can find bibliography related to that mission, we found it interesting "Luna 24: Geological setting of landing site and characteristics of sample core (preliminary data)" by C. P. Florensky et al. (https://adsabs.harvard.edu/full/1977LPSC....8.3257F). On page 3257-3260 we find an interesting description of the area we observed, related to the analysis of the samples that were brought to Earth and employing images from the Lunar Orbiter 4 and Apollo 15 missions (since Luna 24 had no cameras): "Using the interpretoscope of Karl Zeiss Jena. This device uses stereoscopic images to give qualitative and semi-quantitative estimates of surface relief". The paper contains interesting data such as dimensions "Dorsa Harker rises several hundred meters above the adjacent mare areas, and is 10-15 km wide in the investigated area" and topographic components. In this last aspect we must interpret it with the current state of our knowledge about the dorsa, especially in terms of nomenclature. When the authors refer to the arch, they distinguish between two types of formations: "Two types of elevated terrain are distinguished within Dorsa Harker. The first type is more common and is represented by three flat.topped, table like elevations, with sharply sloping borders and dimensions near 30x15 km (…) The second type of elevated terrain is represented by hills with gentle convex slopes. Their size in plan are approximately 10x15 km. Their surfaces are complicated by many small intersecting ridges 2-3 km in length and 100-200 m in width. Their topography resembles small wrinkle ridges". And when the authors refer to what we call crests (the steep part above the arch) they also use the term "wrinkle ridges", but they clearly describe the upper component of them in Dorsa Harker: "these wrinkle ridges appear to be composed of a series of short, assymetric elevations oriented at 45º to the general strike of the wrinkle ridge. Sometimes these elevations in turn are composed of smaller elevations displaced "en echelon"".

Lunar Topographic Studies

Image 3, ***Mare Crisium,*** *Richard Martin, Canelones, Uruguay. 2021 December 06 23:37 UT. 130 mm reflector telescope, ZWO ASI120mm camera.*

The terminological difficulties in understanding Florensky's text show what has been a constant difficulty in cartographic knowledge of the lunar surface: interpreting what we see within the framework of a taxonomy that facilitates understanding. "A teatrise on lunar maps" illustrates the difficulty of observing while generating the theoretical knowledge that should have guided the observation. Think, for example, that the term crater was only imposed a decades ago to name what were previously known as, for example, "ring plains", and the consequences that derive for observation between thinking that we are observing a plain or a depression formed by an impact. For the wrinkle ridges, the terminological normalization has not yet been completed, we only find the division between "arch" and "crest" in the very recent bibliography, in older texts the ridges are described as a unit.

And since the signs are important to standardize the observation, I decided to mark the crests inside the wrinkle ridges with contiguous lines in the drawing instead of the white lines that I had been using, to distinguish the fact that they are observed with relief precision and not as bright areas. More accurate representation of crests details will come with time.

Lunar Topographic Studies

Agathos, Oinos and the Moon in the Window

Guillermo Danielle Scheidereiter

On August 5, the Moon showed its resplendent crescent phase and its magnificent landscape invited you to take some photographs, set yourself observation challenges and enjoy all its charm. I took the classic photographs of some parts of the lunar terminator until the Argentine winter cold was incisive enough to force me to abandon the session. After putting away my telescope, I leaned back in an armchair to enjoy a story by Edgar Allan Poe, The Power of Words, while I could see the Moon through the window and its white reflection reminded me that it was a good time to listen to Moonlight by Ludwig van Beethoven. So it was that in the hearing shelter of that sonata and with the Moon in the window, I started reading.

Lunar North, *Guillermo Daniel Scheidereiter, LIADA, Rural Area, Concordia, Entre Ríos, Argentina. 2022 August 5 22:25 UT. Explore Scientific 127 mm Maksutov-Cassegrain telescope, IR685 nm filter, Player One Ceres C camera. North is to the upper left, west is to the lower left.*

Lunar Topographic Studies

The Power of Words - Edgar Allan Poe

Oinos. -Pardon, Agathos, the weakness of a spirit new-fledged with immortality!

Agathos. -You have spoken nothing, my Oinos, for which pardon is to be demanded. Not even here is knowledge thing of intuition. For wisdom, ask of the angels freely, that it may be given!

Oinos. -But in this existence, I dreamed that I should be at once cognizant of all things, and thus at once be happy in being cognizant of all.

Agathos. -Ah, not in knowledge is happiness, but in the acquisition of knowledge! In for ever knowing, we are for ever blessed; but to know all were the curse of a fiend.

Oinos. - But does not The Most High know all?

Agathos. -That (since he is The Most Happy) must be still the one thing unknown even to Him.

Oinos. -But, since we grow hourly in knowledge, must not at last all things be known?

Agathos. -Look down into the abysmal distances! - attempt to force the gaze down the multitudinous vistas of the stars, as we sweep slowly through them thus—and thus—and thus! Even the spiritual vision, is it not at all points arrested by the continuous golden walls of the universe? the walls of the myriads of the shining bodies that mere number has appeared to blend into unity?

____

I stopped reading to look up. The Moon was still in the window and the sonata advanced in the cadence of the funeral steps and what happened next, dear reader, was as real and amazing as our natural satellite.

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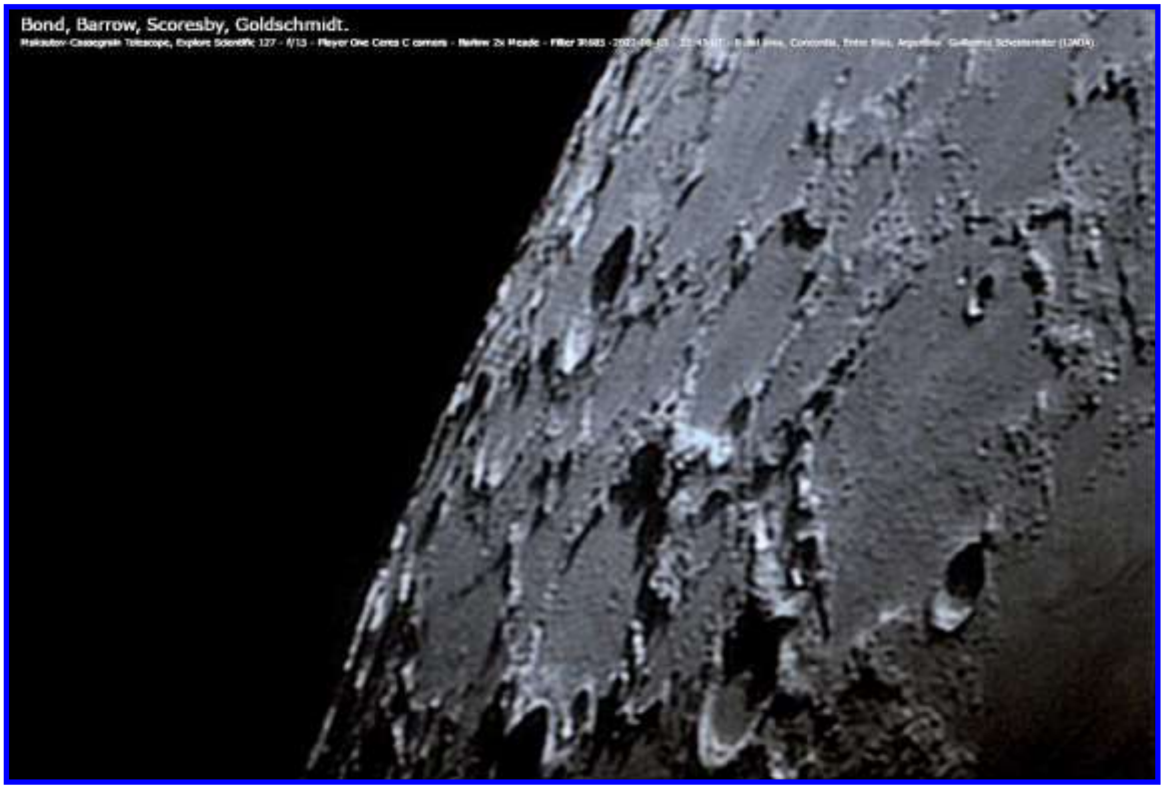
Oinos. -Clearly, I perceive the abysmal distances and the myriads of stars. What can you teach me, Agathos, about that silver rock that shines in the night?

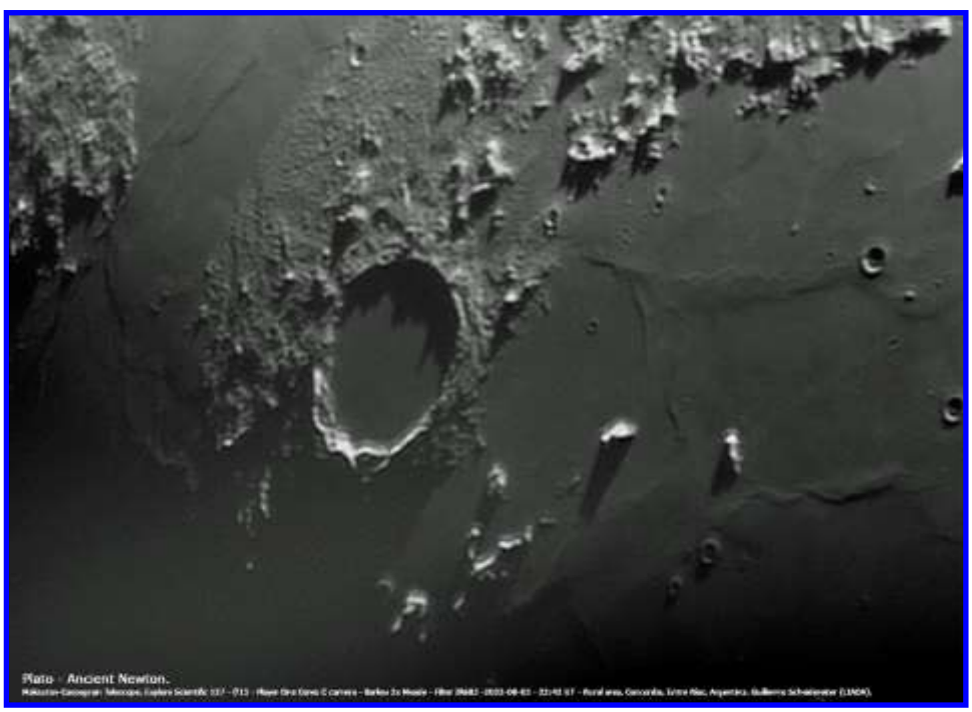
Agathos. -My Oinos! It's called Moon. It is the natural satellite of the Earth and the inspirational source of innumerable songs and poems of the celestial kingdom. His face is dotted with multiple scars and from his entrails lava volcanoes have roared for millions of centuries. She has been given to the angels and to men to observe her and pay homage to her, since this is her most transcendental purpose.

Oinos. -Can we get closer, Agathos? I see a wasteland of rough surface, and then the arenas of a coliseum of munus gladiatorum.



Bond, *Guillermo Daniel Scheidereiter, LIADA, Rural Area, Concordia, Entre Ríos, Argentina. 2022 August 5 22:45 UT. Explore Scientific 127 mm Maksutov-Cassegrain telescope, 2x Meade Barlow, IR685 nm filter, Player One Ceres C camera. North is left, west is down.*

Agathos. -The naivety of your spirit! What you see is the lunar north, full of geological depressions produced by the impact of smaller bodies; They are called craters. In the wild wasteland reign Bond, Barrow, Scoresby, Meton, Goldschmidt, among others. They give shape to the shores of the Mare Frigoris. The gigantic arenas of violent immemorial struggles, it is Plato. An impact crater 100 km in diameter where the towering cliffs of the parapet cast ghastly shadows on its dark floor. Later, the hidden shape of a phantom crater, on its southern side, shows the vestiges of a past shaken by relentless volcanoes that poured out their fire, covering the ancient lunar wounds with lava.



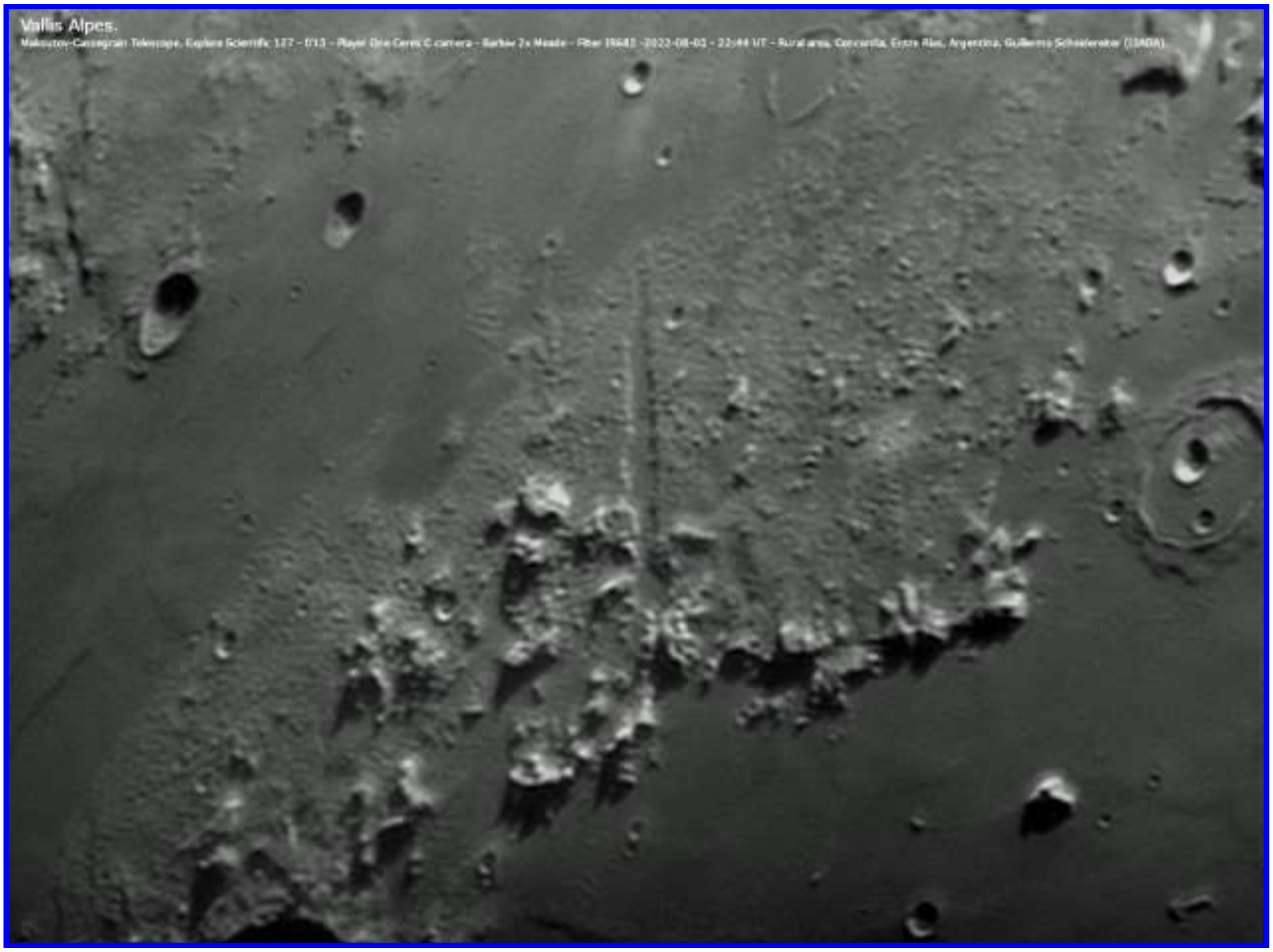
Oinos. -Your wisdom, Agathos, enriches my spirit eager for knowledge. Enlighten me, friend, do I see beautiful golden peaks opened by a painful sore? Or is it just the illusion of a soul to which the secrets of the universe begin to open like a flower in spring?

Plato, *Guillermo Daniel Scheidereiter, LIADA, Rural Area, Concordia, Entre Ríos, Argentina. 2022 August 5 22:42 UT. Explore Scientific 127 mm Maksutov-Cassegrain telescope, 2x Meade Barlow, IR685 nm filter, Player One Ceres C camera. North is left, west is down.*

Lunar Topographic Studies

Agathos. -Dear Oinos, it is a beautiful mountain valley known as Vallis Alpes, which makes its way through the Montes Alpes dividing their high peaks for more than 160 km, from the Mare Imbrium basin to the Mare Frigoris. Beyond, you will see the Caucasus that lead to the imposing mountain range that forms the Montes Apenninus.

Oinos. -Speak to me, Agathos! Describe to me mountains and coasts. Tell me about fishermen and daring sailors in intrepid frigates that sail the lunar seas behind the breakers.



Vallis Alpes, *Guillermo Daniel Scheidereiter, LIADA, Rural Area, Concordia, Entre Ríos, Argentina. 2022 August 5 22:44 UT. Explore Scientific 127 mm Maksutov-Cassegrain telescope, 2x Meade Barlow, IR685 nm filter, Player One Ceres C camera.*

Agathos. -Your adventurous mind remembers my younger days. But reality differs from our dreams and illusions. The seas of the Moon are vast regions of lava that were named by men in those dim ages when they still spoke with their gods. Oh! Mysteries lose their kingdom when they are known. But look, Oinos, as you spread your wings you can see a beautiful crater called Archimedes off to the side! Flanked by its smaller brothers, Aristillus and Autolycus, this giant of the Mare Imbrium is more than two kilometers deep and 83 km in diameter. Showing off their grandeur, to the south lie the Archimedes Mountains, to the southeast, a lava-flooded plain called Palus Putredinis, and then to the northwest, the beautiful Spitzbergen Mountains.

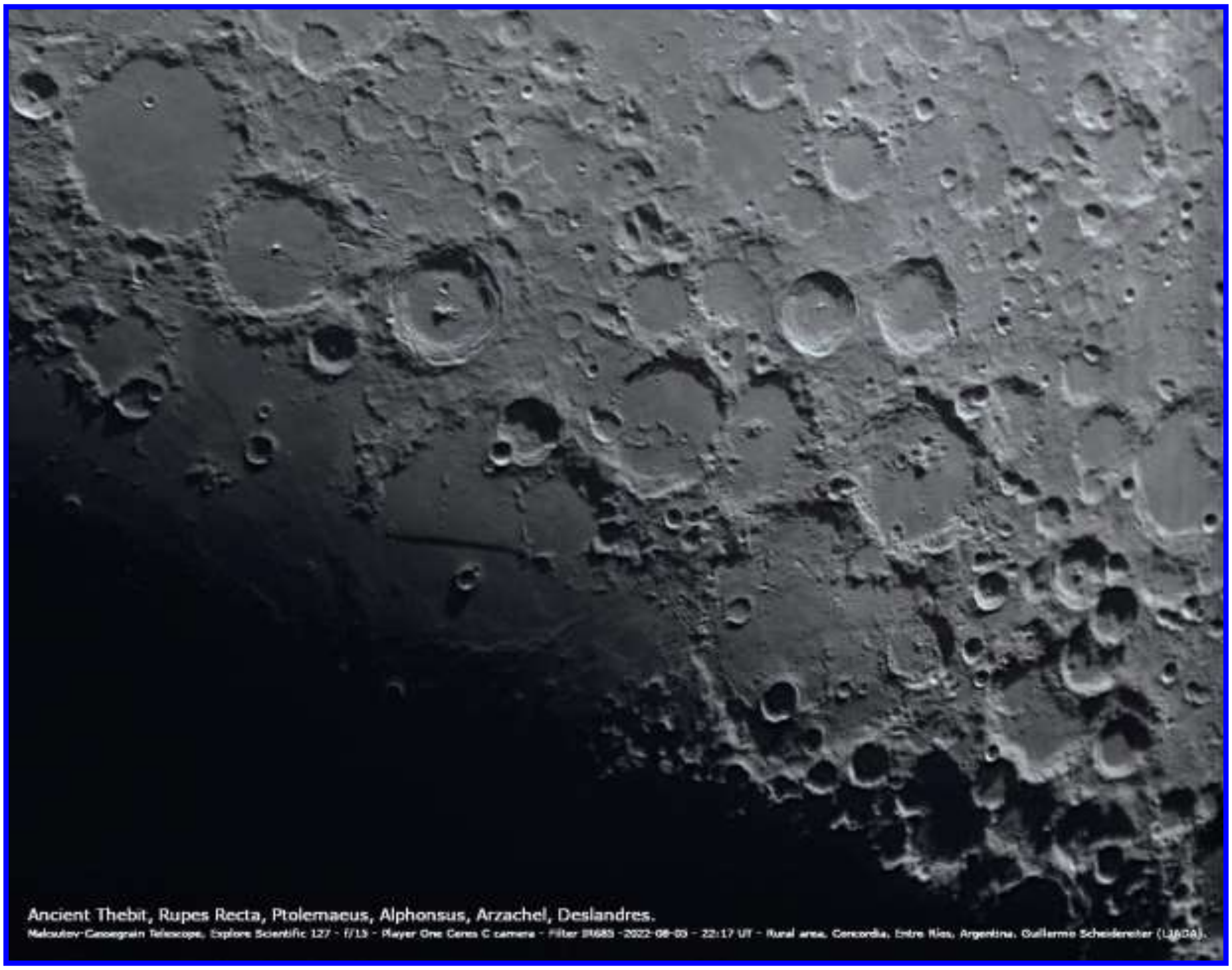
Oinos. -What resplendent landscapes, Agathos! Take me further! I want to know the Moon and its secrets.

Agathos. -The absolute knowledge of the Moon will be an enigma forever and ever! The Moon is one of the mysteries created by the Most High for the pleasure of divine and mortal, and ornament of the universe! The Moon combines the power and beauty of nymphs and deities, the passions and dreams of men and the perpetuity of the gods. Feel, Oinos, under the silks of your wings the high peaks of the Montes Apenninus and towards the extreme, the great Eratosthenes, who stretches out his arm towards Copernicus, as if Miguel Angel left The Creation of Adam unfinished; a broken symmetry that is lost in the shadows of the lunar terminator.

Eratosthenes, *Guillermo Daniel Scheidereiter, LIADA, Rural Area, Concordia, Entre Ríos, Argentina. 2022 August 6 00:17 UT. Explore Scientific 127 mm Maksutov-Cassegrain telescope, 2x Meade Barlow, IR685 nm filter, Player One Ceres C camera. North is to the upper left, west is to the lower left.*

Oinos. -Let's go on, Agathos, please! If I am not deceived by a spell, I see a silver-edged sword and a wounded heart.

Agathos. -Ah! My Oinos! The most beautiful lunar wasteland, but the most terrible. Dark stains stain Alphonsus like sins to the soul, while the Rupes Recta falls like a sword on Ancient Thebit after having hurt the heart of Deslandres in the crater of Hell. Oinos, in that mirror I see reflected my wounds, pains and miseries. Once, after sunset, I looked at this same Moon, still feeling the warmth of the recently hidden Sun, the evening breeze, the sounds of night silence and the dew wetting green meadows under my feet. Once upon a time, I turned my telescope to its still hidden mysteries and filled my nights on earth thinking of calm seas and galleons of daring sailors sailing the waves.



Ancient Thebit, *Guillermo Daniel Scheidereiter, LIADA, Rural Area, Concordia, Entre Ríos, Argentina. 2022 August 5 22:17 UT. Explore Scientific 127 mm Maksutov-Cassegrain telescope, IR685 nm filter, Player One Ceres C camera. North is to the upper left, west is to the lower left.*

Lunar Topographic Studies

I spoke with God and dreamed of dragons melting mountains, I imagined towers erected on the edge of great cliffs and knights guarding ancient holy relics behind their walls, I studied the changing illuminations, I thought about its nooks and crannies and the mathematical calculations of a lost basin revealed to me. Once I saw her rise imposing on the horizon, eclipsed by blood and mother-of-pearl at the zenith and not surrender her banners even with the sun in broad daylight. And once, Oinos, I thought I would be remembered in one of its wounds, in one of its basins, in a sea, in a fault or in a valley. Once, I thought I would not be forgotten...

Ancient Thebit, *Guillermo Daniel Scheidereiter, LIADA, Rural Area, Concordia, Entre Ríos, Argentina. 2022 August 5 22:47 UT. Explore Scientific 127 mm Maksutov-Cassegrain telescope, 2x Meade Barlow, IR685 nm filter, Player One Ceres C camera.*

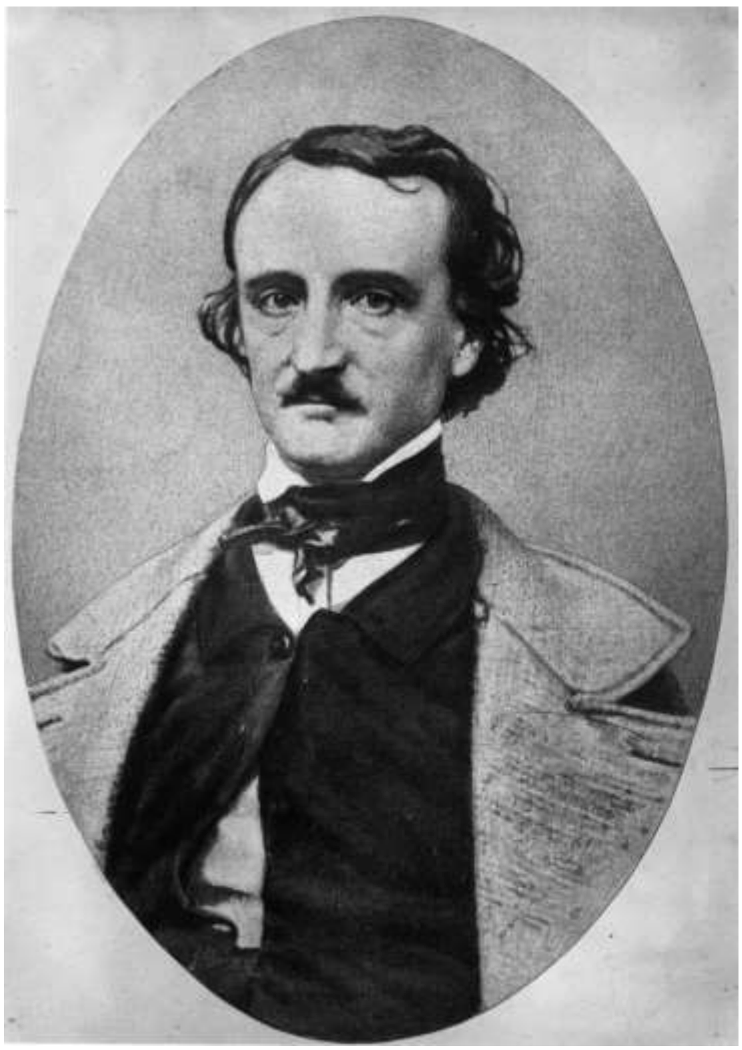
At that moment I opened my eyes. A clarity spilled over my face. The Moon was still in the window and the speakers where moments ago, I think, the beautiful and sad chords sounded, now left only a harsh sound that mixed in the silence of the night. The book lay to one side, on the floor. I leaned over to pick it up, and perhaps it was instinct, chance, or that mysterious Moon in the window, that brought my attention to the last line of The Power of Words:

Oinos. -But why, Agathos, do you weep—and why, oh why do your wings droop as we hover above this fair star—which is the greenest and yet most terrible of all we have encountered in our flight? Its brilliant flowers look like a fairy dream—but its fierce volcanoes like the passions of a turbulent heart.

Agathos. -They are!—they are! This wild star—it is now three centuries since, with clasped hands, and with streaming eyes, at the feet of my beloved—I spoke it—with a few passionate sentences—into birth. Its brilliant flowers are the dearest of all unfulfilled dreams, and its raging volcanoes are the passions of the most turbulent and unhallowed of hearts.

End

Note: The italics correspond to the quote taken from Edgar Allan Poe, The Power of Words.



Edgar Allen Poe

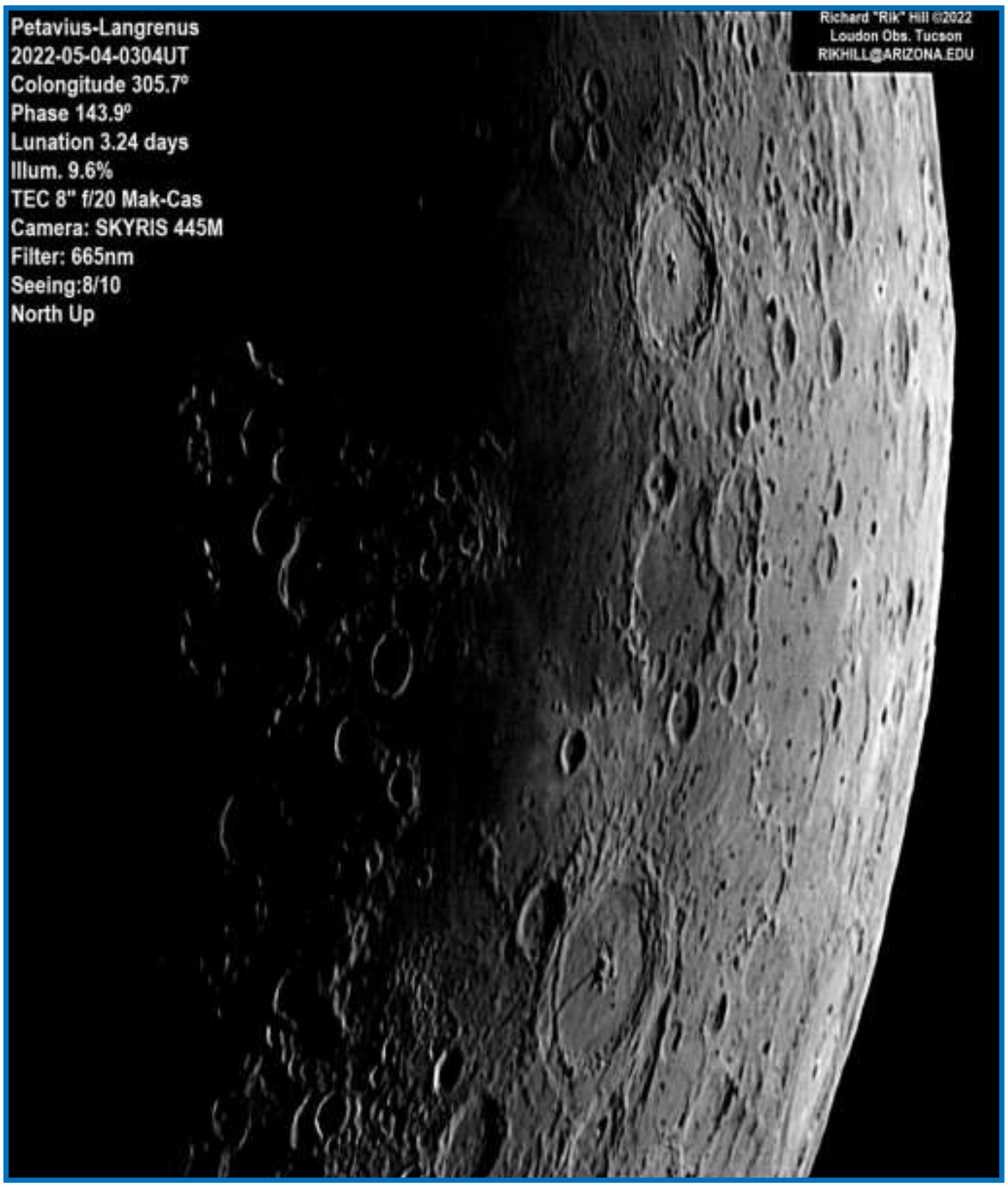
Lunar Topographic Studies

Petavius and Langrenus

Rik Hill

Three days after new moon, at the beginning of a lunation two craters dominate the view because of their size and ejecta splash patterns. They are Langrenus (136km dia.) near the top of this image and Petavius (182km) near the bottom. The latter is the most identifiable with the great rima on the floor that goes from the central peaks to the rim with a width of 2-5 km. Perpendicular to this rima on the other side of the peaks is another thinner rima that is a little more of a test for the smaller aperture telescopes. Don't hesitate to use higher magnifications on this crater to study these details and other even smaller rimae on the floor. This is a very ancient crater being Lower Imbrian with an age of 3.8 billion years. On the northwest rim you can see the crater Wrottesley (60km) which in another part of the Moon would be outstanding on its own!

Langrenus is similar without the rimae on the floor. Notice the north side of the crater floor is rougher than the south side due to ejecta deposits from other nearby impacts. It is younger than Petavius, a mere 1.1-3.2 billion years old or Eratosthenian age. Being younger, it has a more easily seen ejecta blanket surrounding. Then between these two great craters is a completely ruined crater Vendelinus (151km) even older at Pre-Nectarian age 3.9-4.55 billion years old. Overlapping this crater to the north is the crater Lamb (87km) of similar age.



All these features are going to be well placed for viewing tonight with any telescope!

***Petavius and Langrenus**, Rik Hill, Loudon Observatory, Tucson, Arizona, USA. 2022 May 04 03:04 UT, colongitude 305.7º. TEC 8 inch f/20 Maksutov-Cassegrain telescope, 665 nm filter, SKYRIS 445M camera. Seeing 8/10.*

Lunar Topographic Studies

Archimedes Region

Rafael Benavides Palencia

There is something magical about the Imbrium Basin that always impresses us and invites us to visit it again and again. On this occasion we will travel in the surroundings of the great Archimedes crater, a unique place.

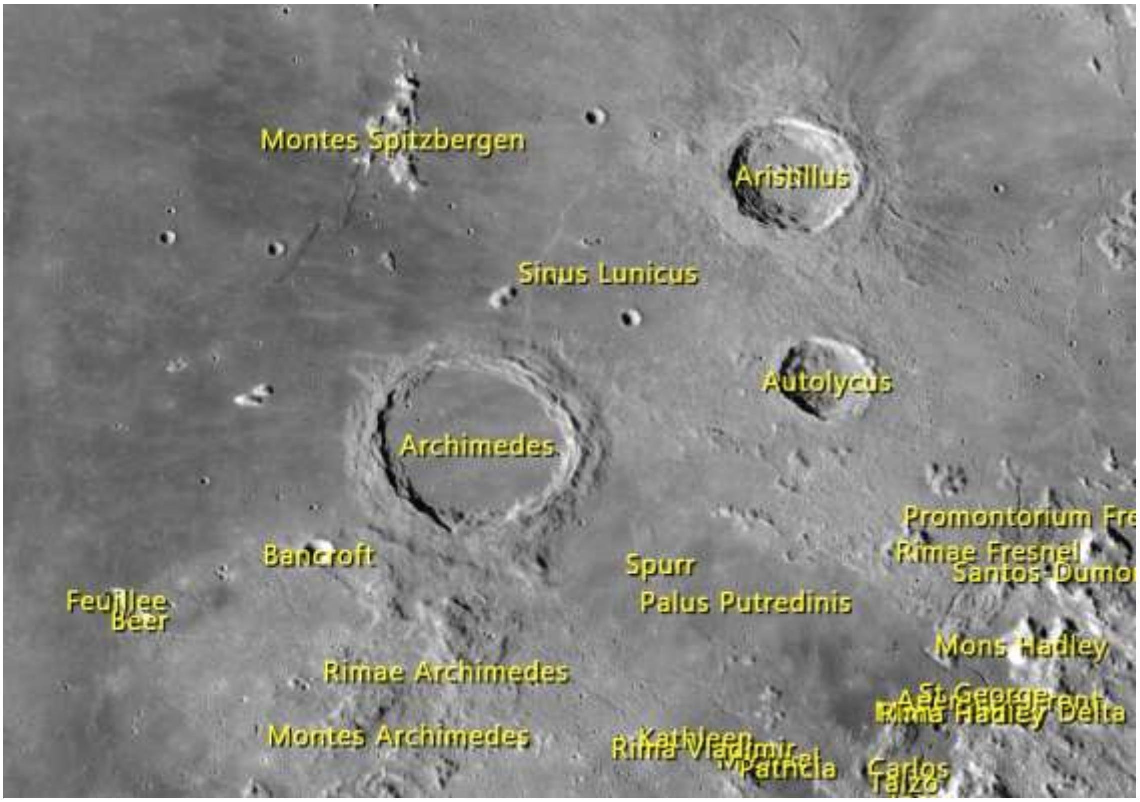


Figure 1*: Cropped image obtained with the Virtual Moon Atlas v 7.0 over the area object of the article*

The Imbrium Basin is one of the largest impact craters in the Solar System, occurring nearly 3.85 billion years ago, with a diameter of 1,145 km. The outer ring is formed by the Montes Alpes, Caucasus, Apenninus and Carpatus. We can also see the highest part of an internal ring, almost buried in lava, formed by the Montes Recti, Montes Tenerife (south of Plato), Mons Pico and Montes Spitzbergen (figure 2).

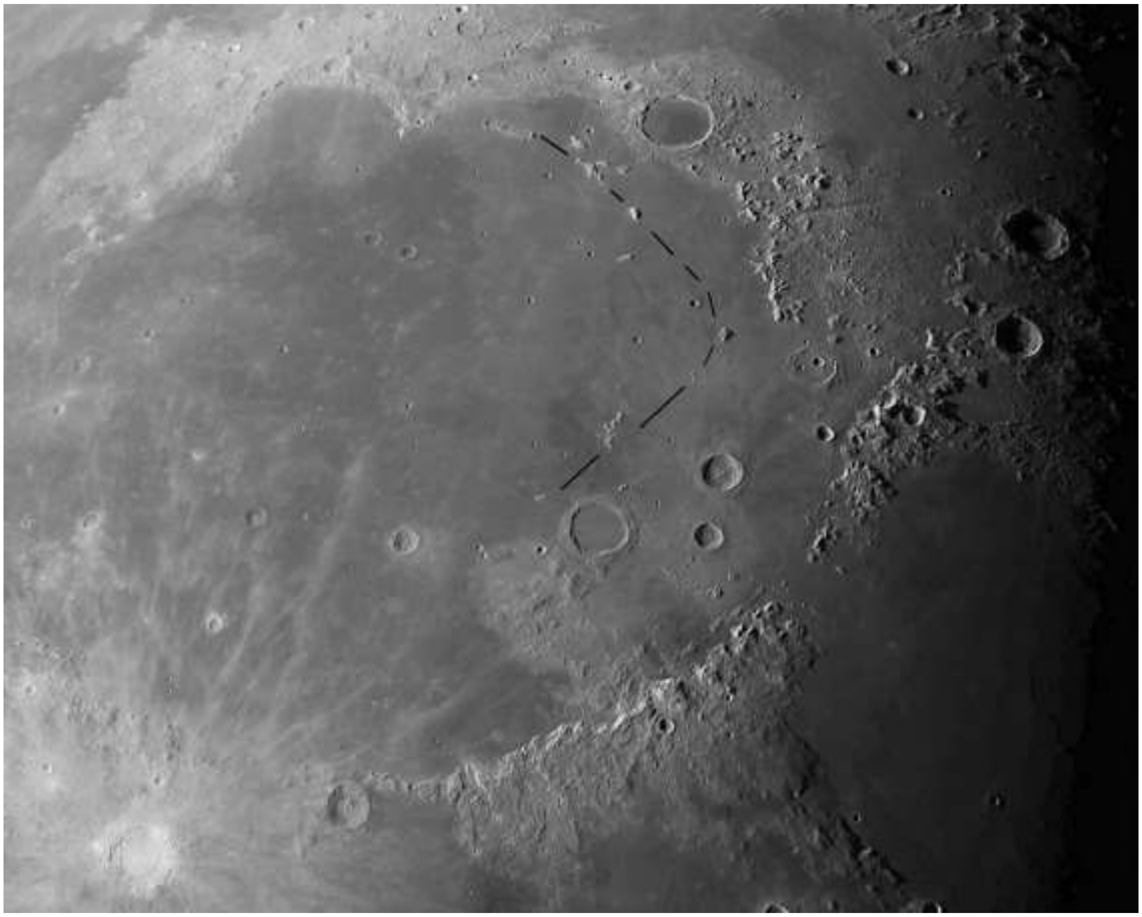


Figure 2: *Cropped image centered on Imbrium basin on a global imagen of the moon taken on September 22th, 2016, 01 h 15 m UT with QHY 5 P II Mono Camera, IR Pass Baader Planetarium filter and a TS Photoline 130 mm f7 refractor.* *https://www.flickr.com/photos/7473900@N02/29865497131/sizes/o/. We have marked in black the inner ring of the basin that includes the Montes Spitzbergen. https://www.flickr.com/photos/7473900@N02/52267612731/sizes/o/*

In this way the Montes Spitzbergen have the same antiquity as Imbrium. It has a length of 60 km, a width of 15 km and peaks that reach 1,300 meters in altitude. Actually, it is only the upper part of that internal ring of Imbrium that is covered by lava and that originally must have been impressive. The shadows we see on the lava when the solar angle is low give us a better idea of its shape and distribution of peaks.

The great Archimedes crater is younger, though not really very young. It is evident that it is after the formation of Imbrium, but it was already on the lunar surface before the subsequent filling of lava that flooded the entire area and that happened 3.3 billion years ago, so the crater is prior to that date. It is 83 km in diameter and only 2,100 meters deep. At first it was much more impressive, but through the cracks in the ground it gradually filled with lava that completely hid the system of central peaks and the internal terraces of its walls, leaving a completely flat bottom. The whole set of craterlets smaller than 2 km from much later impacts stands out, and as in Plato, it is always an incentive to test the resolution of our telescope. Another aspect that has always impressed me, especially when the Sun is low, is to see all the peaks of the wall that are projected on the ground like a sharp system of needles. It is one of those images that always remains in the memory (figure 3).

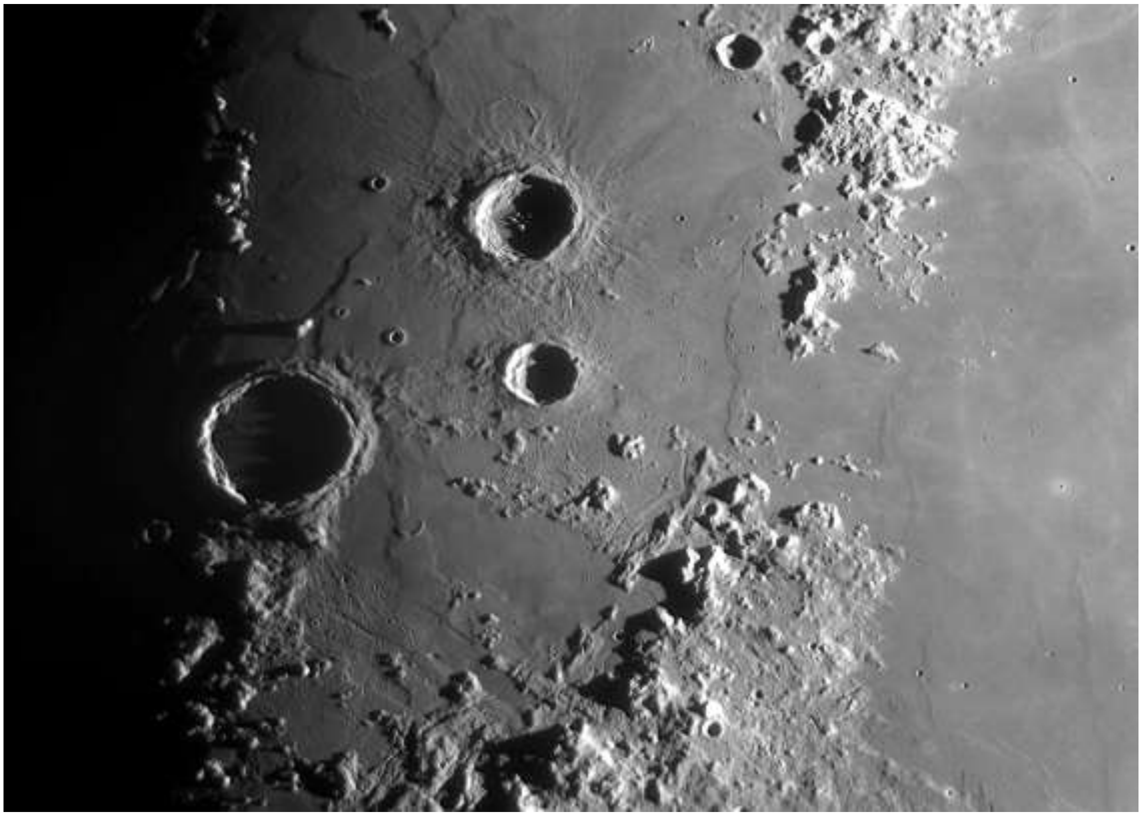


Figure 3: *Image obtained on January 10, 2022, 20 h 30 m UT. The solar angle is low and the ejecta of Aristillus and the shadows of the sharp peaks of the walls of Archimedes are well appreciated. ZWO ASI 290 MM camera, IR Pass Baader Planetarum filter and Celestron 11.* https://www.flickr.com/photos/7473900@N02/51817581249/sizes/o/

To the south are the Montes Archimedes, another example of the Imbrium ring. It has a maximum width of 146 km and peaks that reach 2000 m. If we look closely at the low-resolution image, we see that this entire area, like the one occupied by Palus Putredinis, is much lighter in color than everything around it. This is due to a different origin and composition. It is known as Apennines Bench Formation and the idea was proposed by Hackman in 1966.

Let us think for a moment about the origin of the Moon itself. It is thought that a body the approximate size of Mars hit the proto-Earth, generating a multitude of debris that would later end up agglutinating and forming the Moon. Little by little and as it cooled, the elements were separated according to their density. The heavier ones, such as pyroxene and olivine, went into the mantle, and the lighter anorthosites remained on the surface, forming the lunar crust. Between the crust and the mantle there was another layer of materials of different composition called KREEP, enriched in potassium (K), rare earth elements (REE) and phosphorus (P). On the contrary, they have a low content of iron and titanium. As a consequence of the impact that originated Imbrium, there was a volcanic phase that brought this KREEP material, which was found in the magmatic pockets of the upper mantle, to the surface. These samples were analyzed by Apollo XV and are really very interesting. And this is what we see in the image with that much lighter color than the darker lavas that fill the entire basin. Isn't that exciting? (Figure 4)

Figure 4*: In an image of the full moon, with a high solar angle, we better see the difference in brightness and color of the Apennine Bench Formation. The surrounding lavas are darker. Cropped image centered on Imbrium basin on a global imagen of the moon taken on November 15, 2016, 20 h 15 m UT with QHY 5 P II Mono Camera, IR Pass Baader Planetarium filter and a TS Photoline 130 mm f7 refractor.* https://www.flickr.com/photos/7473900@N02/31219877885/sizes/o/

Autolycus is the smallest of the three main craters at only 39 km in diameter with an estimated age of 2.1 billion years. All craters with a diameter between 20 and 45 km resemble Autolycus. With this size there are small landslides of the walls that end up forming rubble mounds on the ground, but they do not clearly form terraces.

Aristillus is much more modern, notice how his ejecta overlaps any other accident in the entire area. It is estimated to be only 1.29 billion years old within the Copernican period. This ejected material is very easy to see to the northwest and also to the southeast, although to a lesser extent. Instead, it seems almost nonexistent in the direction of Archimedes and on the opposite side. In the image with the low solar angle, this asymmetric distribution of the ejected material can be appreciated very well. Could its formation have been due to an oblique impact? It is a very suggestive theory. It is 55 km in diameter and from 50 km onwards all the craters more or less resemble each other, with a system of central peaks and walls that collapse in landslides with the formation of terraces. The central spike system, in this case, is slightly peculiar. They appear to be triangular in shape pointing towards the center with an almost circular formation reminiscent of Stonehenge and a slab right in the middle. The formation is very strange (figure 5).

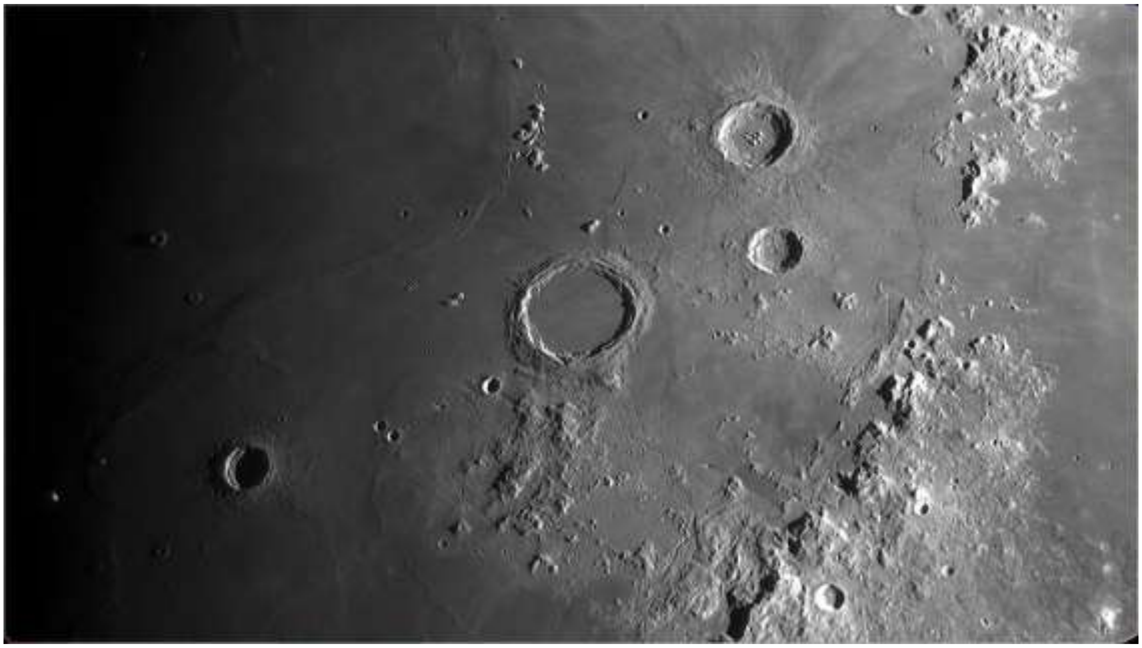


Figure 5: *Image obtained on January 11, 2022, 20 h 36 m UT. ZWO ASI 290 MM camera, IR Pass Baader Planetarium filter and Celestron 11.* *https://www.flickr.com/photos/7473900@N02/52071724051/sizes/o/*

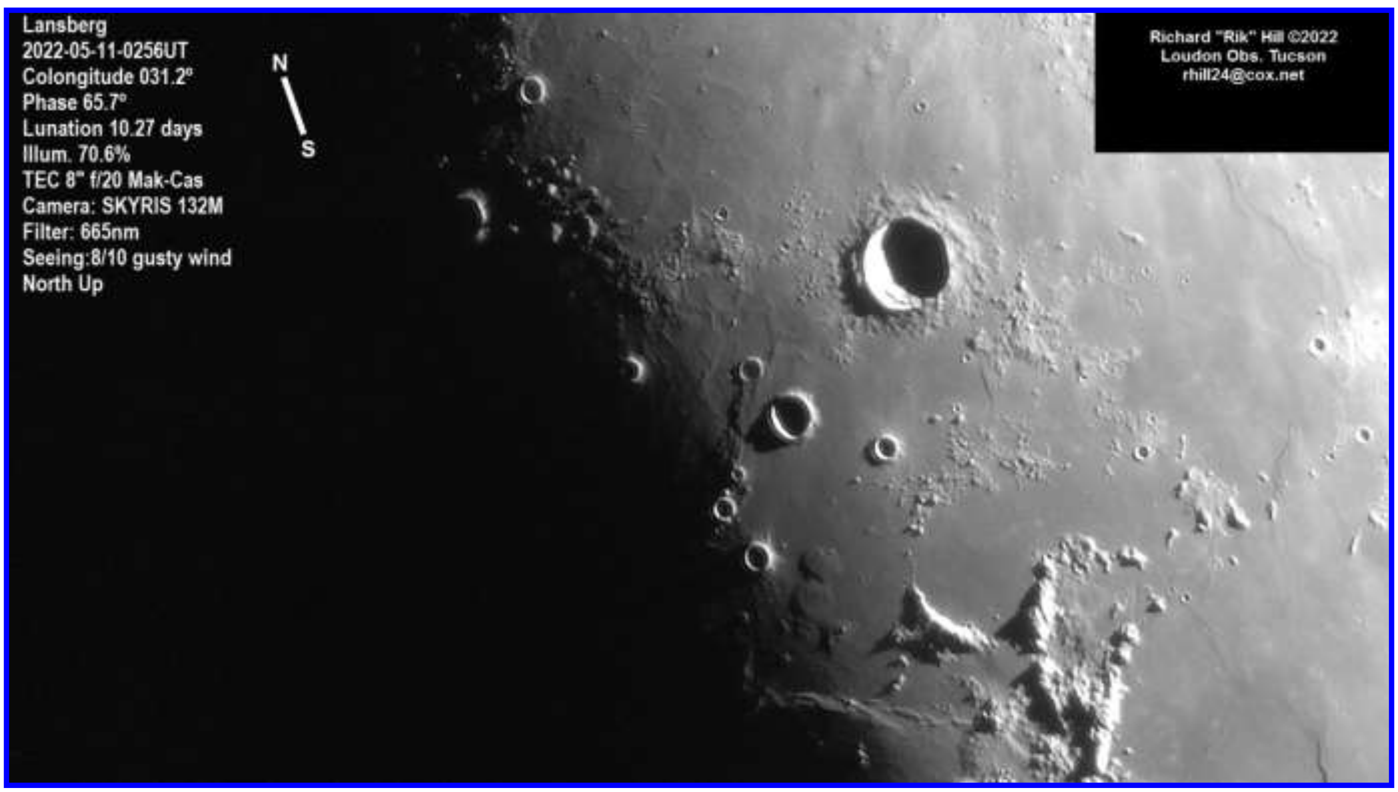
In the Hadley Mountains we see Rima Hadley, visited by the Apollo XV astronauts and from where they collected the KREEP samples that we discussed earlier. We are always amazed to see that serpentine 120 km long course and we imagine Scott, Worden and Irwin visiting this impressive area in that summer of 1971, a time when all dreams were still possible.

Lansberg Domes

Rik Hill

The large crater above and right of center is Lansberg (41 km dia.) in a line with Copernicus and Reinhold. This area of the Moon, in the middle of Oceanus Procellarum is full of domes. This image was processed to show the Lansberg domes the best. There's a system of about six satellite craters to Lansberg just below and to the left. Farther below Lansberg is a bright arc of a crater wall that has its northern half buried in the so the arc opens to the north. Just to the left (west) of the western arc you can see the mild swellings that are Domes Lansberg. There are three of them, the larger two being easily seen but there's a third one further to the south with what appears to be a tiny central peak rather than the usual pit. There is a pit behind (west) of the peak as can be seen in the LROC Quick Map but it is in shadow in the image. This same lighting can be seen in the image on the Lunar Domes Atlas page for this dome system. The domes look like pancakes on the lunar surface. The northernmost dome is 16-20 km in diameter but only 120 m high, while the middle one is 19-25 km in area and only 80 m in height. The third one is 15-19 km in size and 120 m high. With those aspect ratios it's easy to understand why this low sun angle is needed to see them. As soon as the sun get higher, they disappear.

At the top of this image, directly above Lansberg, we can see two more smaller domes. I do not find them on the Lunar Dome Atlas or the Virtual Moon Atlas so I have no information. For orientation, there's a large crater just above right and off the edge of the image that is Reinhold (49 km). (The image is not aligned strictly North-South.) This kind of feature, like wrinkle ridges, are best seen, often only seen, at the terminator to the sharp eyed!



***Lansberg**, Rik Hill, Loudon Observatory, Tucson, Arizona, USA. 2022 May 11 02:56 UT, colongitude 31.2°. TEC 8 inch f/20 Maksutov-Cassegrain telescope, 665 nm filter, SKYRIS 132M camera. Seeing 8/10 with gusty winds.*

Insertion of Principal Component Bands into the HSV Color Enhancement Process Flow

Darryl Wilson

Examples of the use of the HSV transformation to add natural color to grayscale principal component transformation (PCT) images are presented in this tenth article in the multiband image processing series. Conceptually, it is a review of the technique presented in the January 2022 "The Lunar Observer" (TLO) article titled "A Sharpening Technique in HSV Colorspace for Lunar Surface Material Discrimination RGB->HSV; enhance S; replace V; HSV->RGB". Here, we will see examples of "other useful substitutions". Principle component (PC) bands 3 and 4 will be inserted into the HSV based color enhancement process flow to generate colorized versions of those images.

The process flow is diagrammed in Figure 1. A comparison with Figure 1 of the earlier TLO article shows that instead of a Registax sharpened band, a PC band is now substituted for the value (V) band. Although not shown in Figure 1, the PC band was also gently sharpened using Registax.

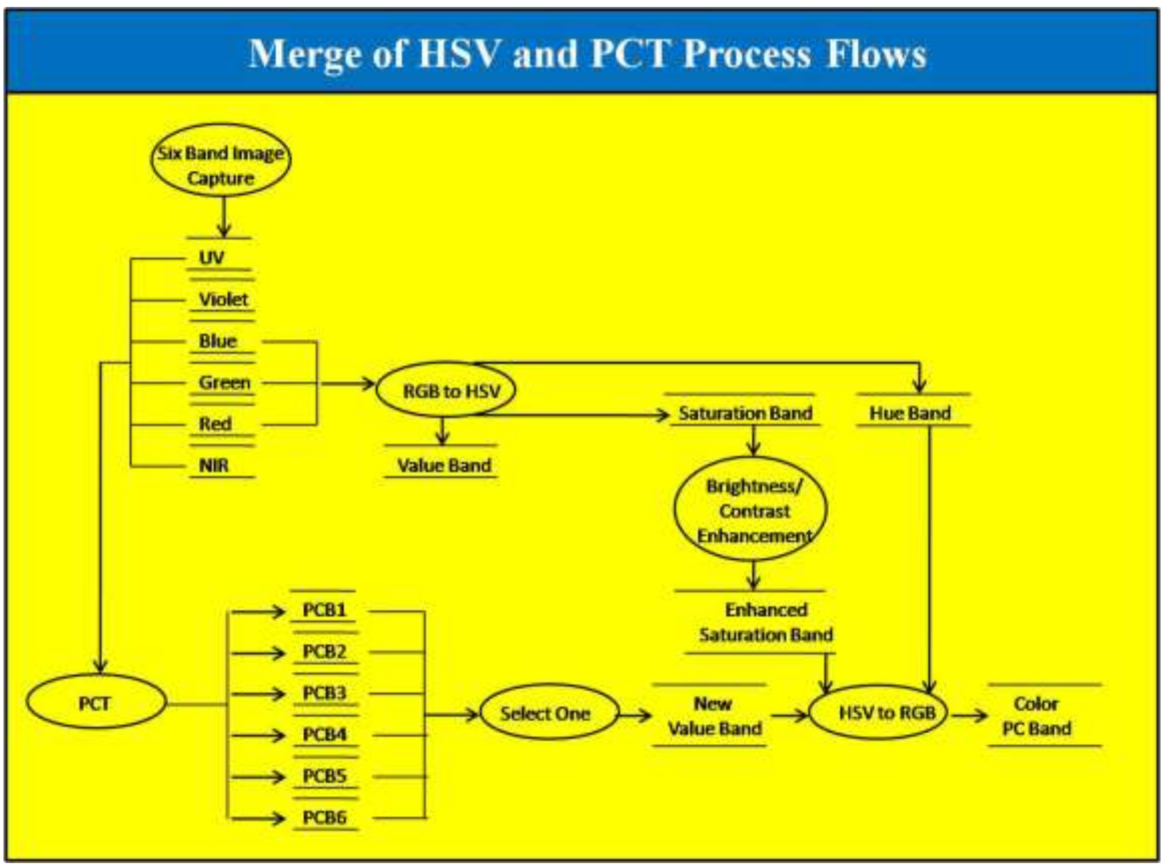


Figure 1, PCT Merge With HSV Transformation, Process Flow Diagram

You might wonder why we would want to colorize the grayscale PC images. Brightness and contrast reversals that are a natural part of the image formation process in a variety of contexts can make side-by-side comparisons confusing. Color is a useful visual cue. This method of colorizing PC bands preserves hue (i.e., color) information that was calculated from the red, green, and blue bands. While not perfect, this technique avoids most of the color confusion we experience when comparing two views of the moon that have independently been rendered in false color. This method prevents the same surface area from appearing blue in image one and red in image two. Hopefully, this facilitates visual cross comparison among the images.

You can immediately see that large brightness differences between features in the RGB image and corresponding features in the PC bands cause qualitative color differences as perceived by the human eye. Saturation has changed, so reddish brown can change to tan, or coppery red - but hue is preserved, so interpretation should be intuitive.

On a related note, the concepts of true-color, natural-color, false-color, and colorization will be the topic of a future article. The question "what is the real, true, natural color of the moon?" is valid, and deserves explanation in the context of these articles. Many color images of the moon are available online, and they often portray the same feature with significantly different colors. Unless the color of the lunar surface changes from time to time, they can't all be correct. Which are and which aren't? How can we know? These and other related issues will be discussed and (hopefully) clarified. Interested readers may also submit questions to David Teske. This author will try to address relevant issues in the article.

Figure 2 is an HSV based color enhanced image of the moon, reproduced from the May 2022 TLO article "Examination of HSV Colorspace Enhanced Imagery of Mare Cognitum, Mare Nubium, the South Polar Highlands and a Wrap-up of the HSV Color Enhancement Process". In the May TLO article, a Registax-sharpened band replaced the V band in the Figure 1 process flow. The May image provides a familiar visual reference as we examine newly revealed sub-visual surface features in the two colorized PC images.

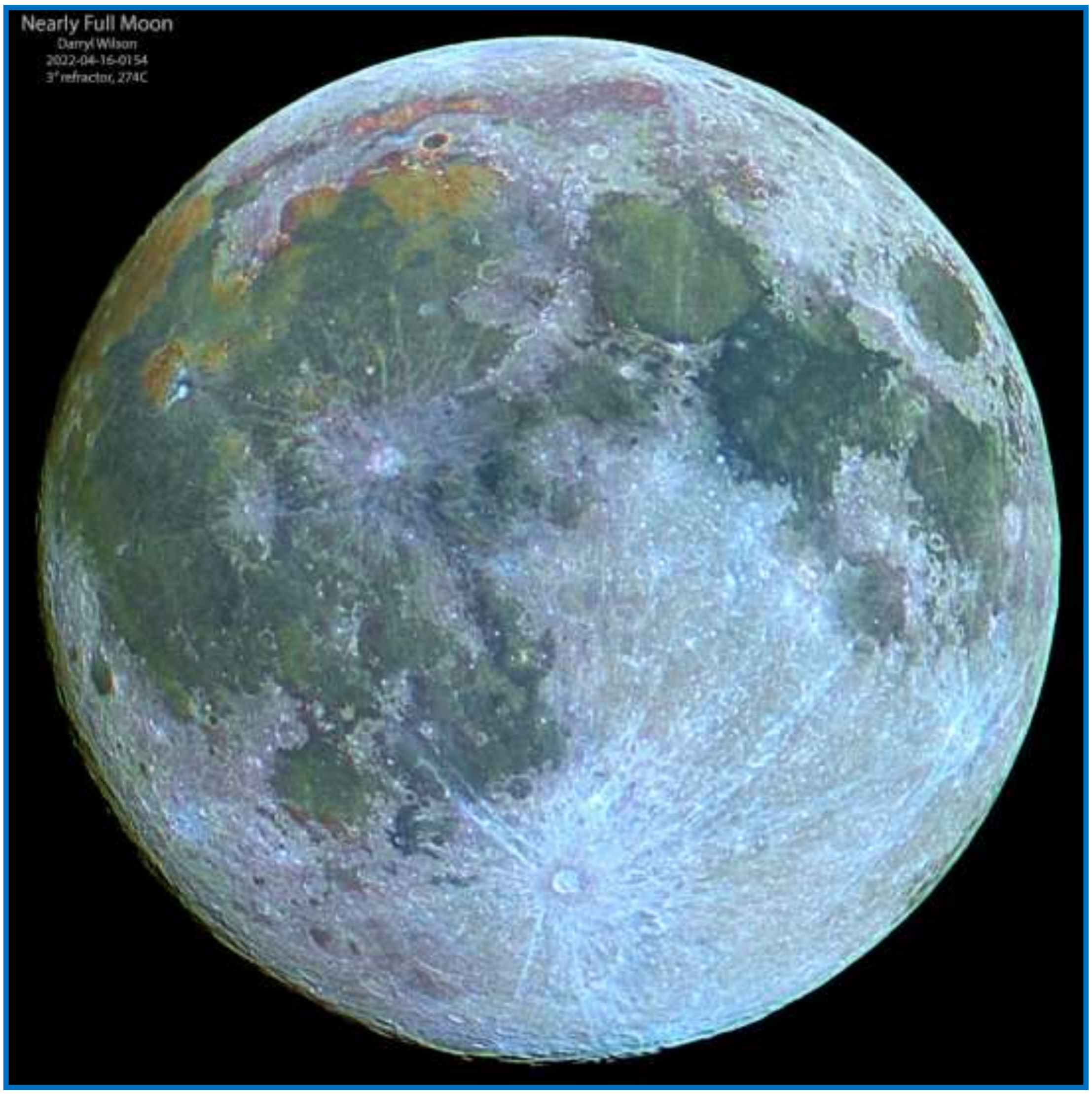


Figure 2, Nearly Full Moon, *Darryl Wilson, Marshall, Virginia, USA. 2022 April 16 01:54 UT. 3 inch refractor telescope, SKYRIS 274C camera. 2.25"/pixel. Exposure 1/6061 sec, gain 9.98 dB. Registax Sharpened HSV Color Enhancement.*

Figure 3 is PC band 3 combined with the hue (H) and saturation (S) information calculated from bands 3, 4, and 5 (B, G, and R) in the six-band input image set. Figure 4 is PC band 4, similarly processed. Technical details related to the generation of PC bands 3 and 4 were presented in the July 2022 TLO article "The Principal Component Transformation Extracts Hidden Information from Multiband Imagery", and the August 2022 TLO article "Use of the Principal Component Transformation to Process Six Bands of Imagery".

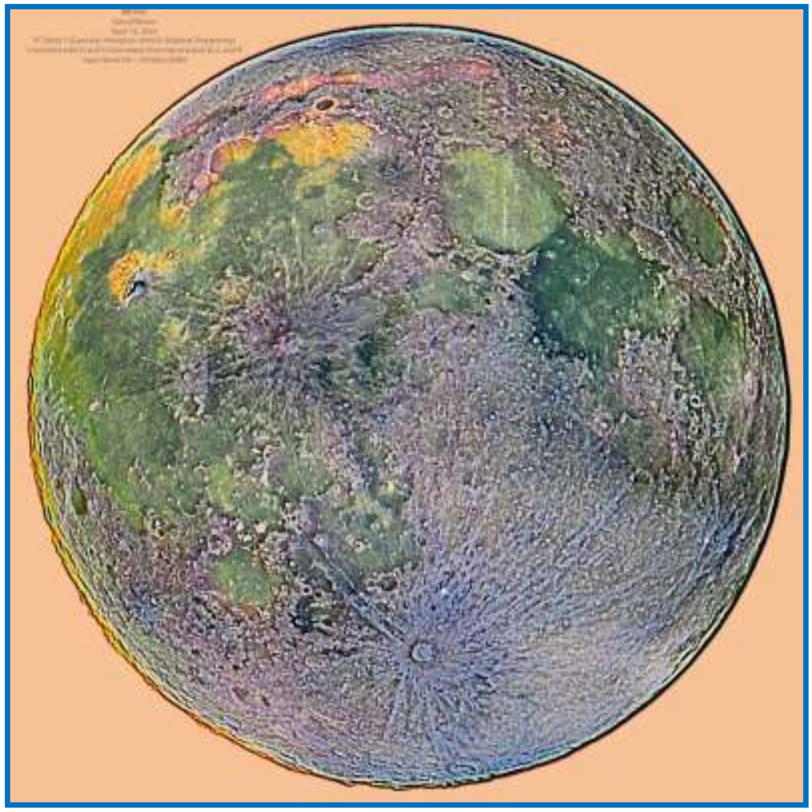


Figure 3, Nearly Full Moon, *Darryl Wilson, Marshall, Virginia, USA. 2022 April 16. 3 inch refractor telescope, PC Band 3 (Gaussian histogram stretch, Registax Sharpening), Combined with H and S Information from Input bands B, G, and R Input Band Set = UV, V, B, G, R, NIR.*

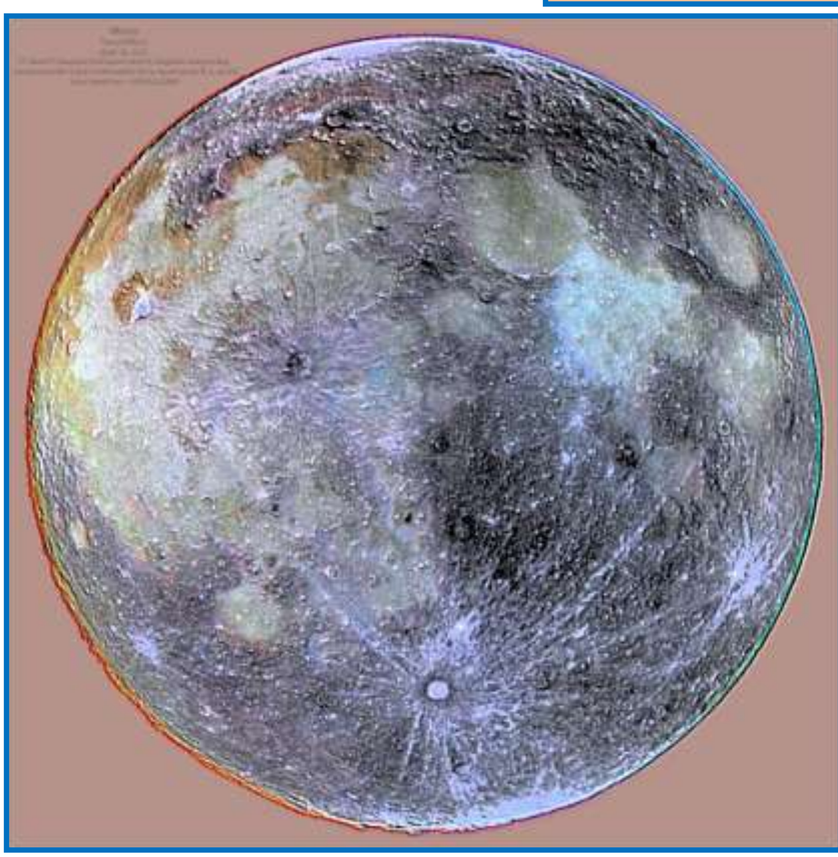


Figure 4, Nearly Full Moon, *Darryl Wilson, Marshall, Virginia, USA. 2022 April 16. 3 inch refractor telescope, PC Band 4 (Gaussian histogram stretch, Registax Sharpening), Combined with H and S Information from Input bands B, G, and R Input Band Set = UV, V, B, G, R, NIR.*

At first glance, Figure 3 looks like a contrast-enhanced version of Figure 2. Colors are more vibrant, but all of the main features correspond well with Figure 2. The PCT is a mathematical rotation of the image data that increases spectral (color) contrast. Since PC band 3 is primarily composed of information from the three visible light bands (see Aug 2022 TLO), it is expected that visual spectrum features would be present. Note that although almost all of the same features can already be seen in Figure 2, they are more prominent in Figure 3. Figure 2 may be more aesthetically pleasing, but Figure 3 more effectively communicates surface material contrast to the viewer.

As noted last month, Figure 4 is an unfamiliar view of the moon. This is exactly the kind of situation that can benefit from consistent colorization. This image is mainly composed of information outside the visible spectrum, which can result in unexpected contrast and brightness changes. Furthermore, the PC transform has caused some significant brightness reversals (e.g., southern highlands and Mare Tranquillitatis). Consistent color references can be helpful in this situation. The casual viewer may notice subdued ray systems from Copernicus and Kepler, and nearly complete disappearance of contrast in some surface features in NE Mare Imbrium. A careful examination reveals features that this author has not previously noticed in lunar images. One example is a slightly darkened area about 60 miles NE of Flamsteed. Extending about 60 miles N-S and about 40 miles E-W, it appears to possibly be the interior of the eastern wall of a mostly buried 240-mile diameter basin centered about 240 miles SSW of Kepler. This author is not a selenologist, and will defer to the experts for a determination of the establishment of a basin at that location. This imagery simply suggests it's worth a look.

In this article, we applied the HSV transformation to add color to grayscale PC images. We saw that while basic color was preserved, minor color distortions were evident. We hope that this structured method of colorization results in easier comparisons than one experiences with random colorization methods. The concepts of true color and natural color of the lunar surface were mentioned as topics for future discussion. PC bands 3 and 4 from the August 2022 TLO article "Use of the Principal Component Transformation to Process Six Bands of Imagery" were colorized and visible features in each were discussed. Novel details were noted in PC band 4.

The multiband lunar image processing series will be paused next month so that thermal imagery of the November 2021 total lunar eclipse can be presented. Subsequently, we will explore one more (hyperspectral) algorithm that can be used with multiband imagery to determine lunar surface material composition, before wrapping up loose ends and finishing the multiband image processing articles.

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Wonders of the Full Moon: Southern Bright Ray Craters

Alberto Anunziato

After having strolled through the wonders of the full moon in the northern hemisphere, we will do it in the southern hemisphere. At first glance they are not so much the bright ray craters we find, nor as important as the Copernicus-Kepler-Aristarchus trio, but the real reasons are twofold. The most important, and obvious: the imposing presence of the most important bright ray crater on the lunar surface: Tycho. How many bright rays from older craters are not buried in Tycho's ejecta, which cover virtually most of the near side?

Image 1 (left) and Image 2 (below) Waxing Gibbous Moon, Normal and Inverted, *Dominique Hoste, Kortrijk, West-Vlaanderen, Belgium. 2021 January 25 17:51 UT. TS Photoline 102 mm f/7 refractor telescope, Altair GP camera.*

What at first seemed to us to be an arbitrary division between northern and southern bright ray craters, a way of separating the large number of specimens in this category to which we dedicate this section, finally ended up being a thematic division between bright ray craters in the maria and in the highlands. The two great guides of our Section this month will again be Robert Garfinkle and Charles Wood. In "Luna Cognita" we read: "A general comparison of bright rays can be made between mare and highland rayed craters. The ejecta blankets around mare craters tend to be broader near the crater than for highland craters and their rays tend to be shorter with fuzzy feathery edges. A few of the larger mare rayed craters have long twisted tapering rays that extend for hundreds of kilometers beyond the ejecta blanket. The bright rays of highland craters tend to be longer, narrower, and straighter than mare crater rays. This difference in the two main types of bright rays is probably due to the difference of the mechanical properties of the mare basaltic rocks compared to the more compacted rocky highland materials".

IMAGE 3 shows, being a little saturated, a fact that allows an inference: Tycho is not the brightest crater, but it is if we include its ray system, and the explanation is that it is very young in geological terms, barely 109 million years.

Image 3, 99% Moon, *Jairo Chavez, Popayán, Colombia . 2022 April 16 01:30 UT. 311 mm truss tube reflector telescope, MOTO E5 PLAY camera. North is right, west is up.*

As Charles Wood says: "The Tycho impactor, probable 8 to 10 km wide, came in low over the Moon's western horizon. On Earth, 109 million years ago, dinosaurs and other reptiles must have witnessed this devastating collision and perhaps suffered a few days later when fist-size pieces of Tycho ejecta hit the Earth" (page 125).

What is Tycho really like, without its bright rays? It is also an impressive crater, a kind of model of the characteristics of the Copernican impact craters. Its dimensions are considerable (85 kms diameter, 4.8 km deep), but it still has some difficulty finding it near the terminator, because it is located in the densely cratered highlands. IMAGE 4 and its detail IMAGE 5 show its rim with terraced walls, its splendid central peak 2.5 km high and its "floor relatively smooth in the east side, but there is a sector of roughness radiating from the central peak to the west wall. Early examination of very high-resolution Lunar Orbiter spacecraft images of Tycho's floor showed rough textures and domelike features, which were thought to be of volcanic origin. But growing recognition of the widespread existence of material totally melted by the great energy of impact in and around fresh lunar crater led to impact melt as the accepted interpretation. It appears that both the smooth and the rough portions of Tycho's floor consist of impact-melted debris that veneer the original surface" (Woods page 124).

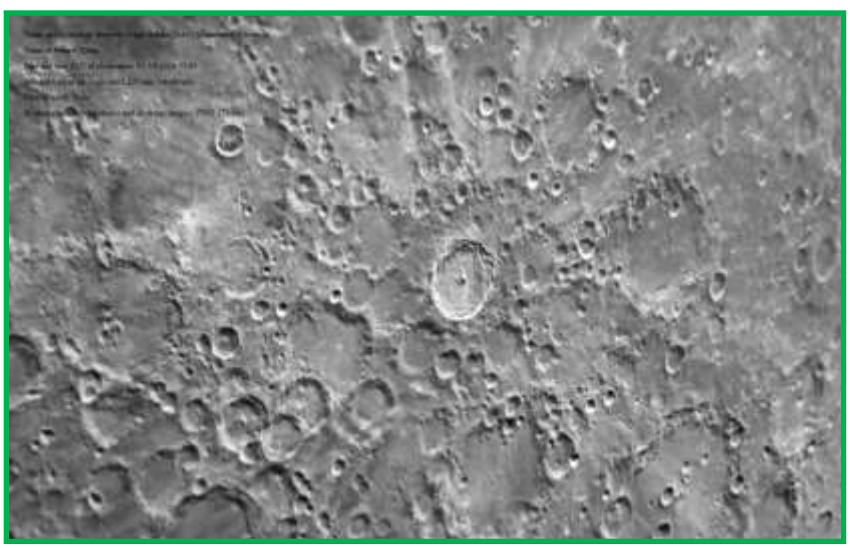

Image 4 (left) and Image 5 (right) (close-up), Tycho, *Sergio Babino, SAO, Montevideo, Uruguay. 2020 March 14 05:04 UT. 203 mm catadrioptic telescope, ZWO ASI174mm camera. Both images, north to the upper left, west down.*

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Image 6, Tycho, *Rik Hill, Loudon Observatory, Tucson, Arizona, USA. 2015 July 26 02:28 UT. TEC 8 inch f/20 Maksutov-Cassegrain telescope, 656.3 nm filter, SKYRIS 445M camera. Seeing 9/10.*

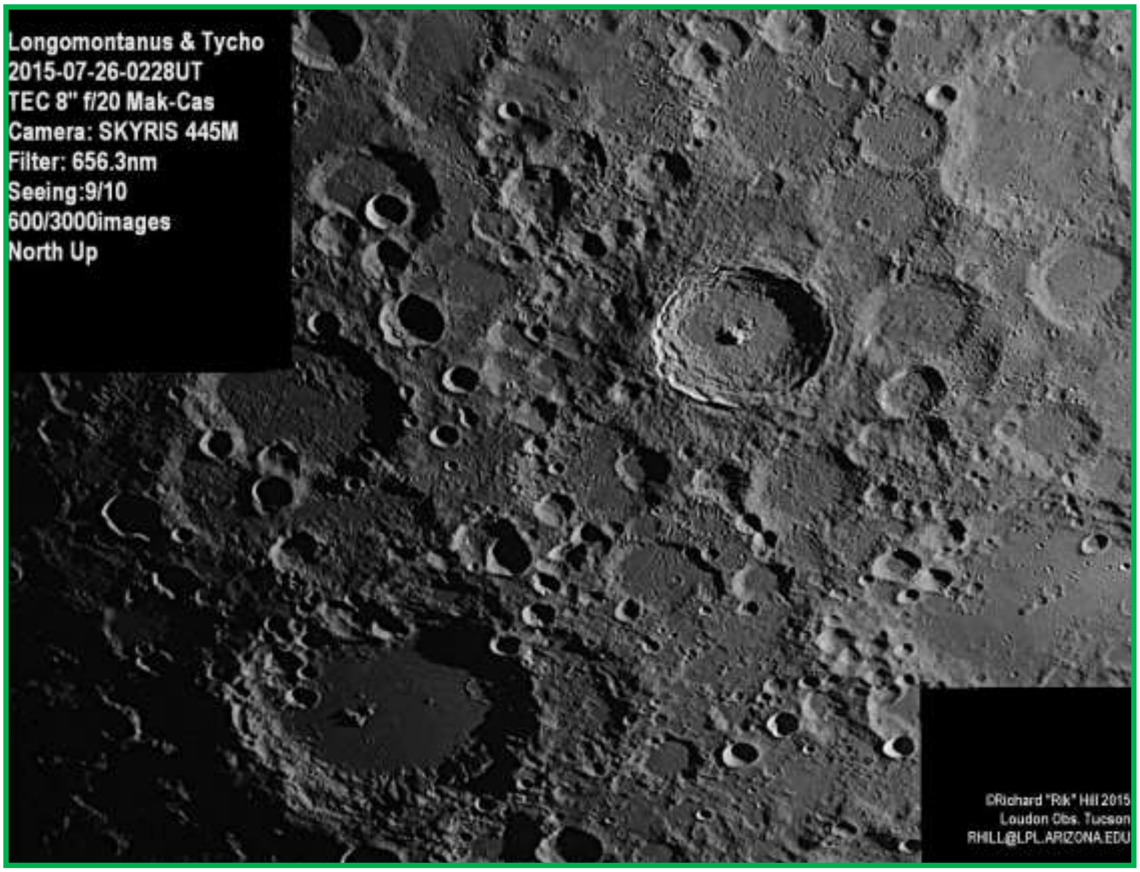
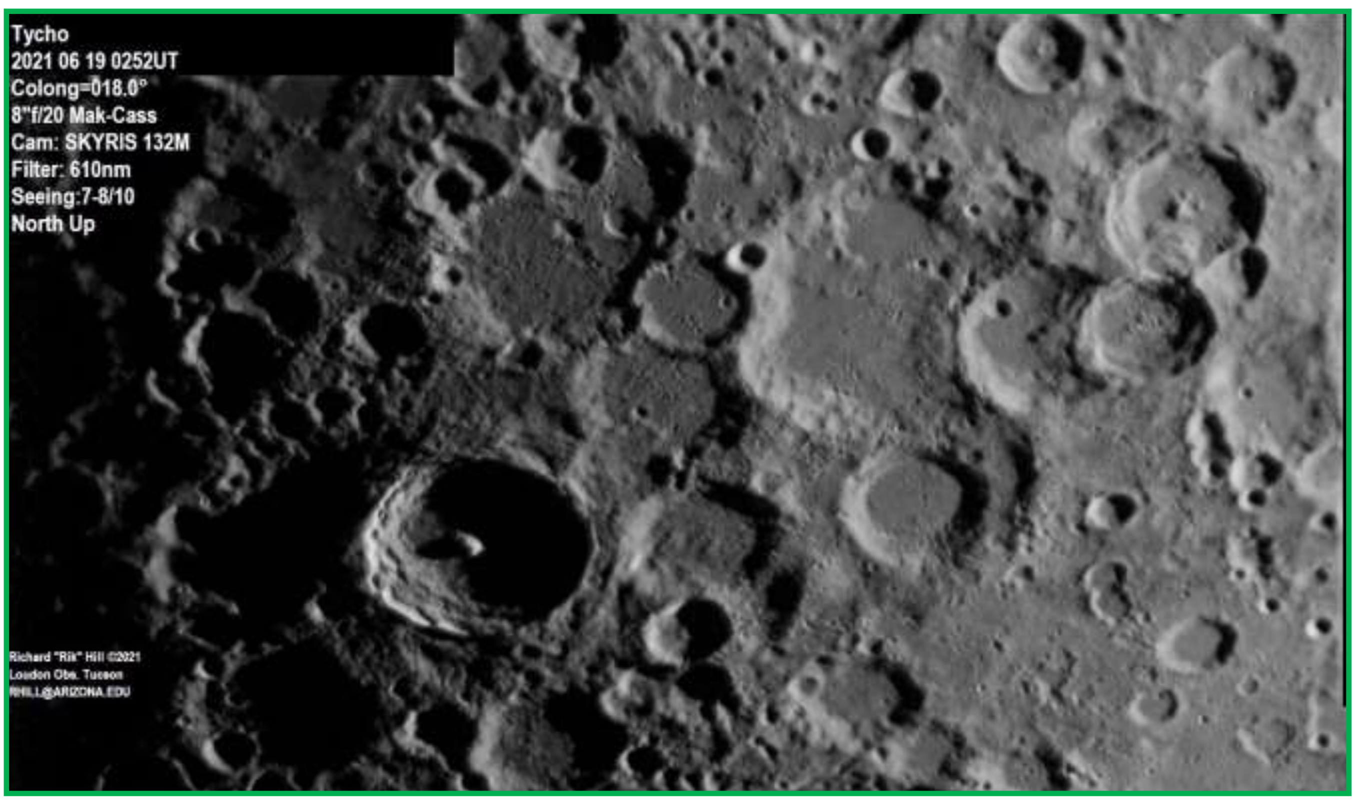


Image 7, Tycho, *Rik Hill, Loudon Observatory, Tucson, Arizona, USA. 2021 June 19 02:52 UT, colongitude 18.0^o. TEC 8 inch f/20 Maksutov-Cassegrain telescope, 610 nm filter, SKYRIS 132M camera. Seeing 7-8/10.*



Focus-On: Wonders of the Full Moon

It is interesting to note how even with oblique illumination the very bright rays of Tycho are seen when less bright rays would not be visible, which can be seen in IMAGE 8 to 12 by looking at the larger craters with smoother floors where can perceive how they are pierced by bright rays.

Image 8, Tycho, *David Teske, Louisville, Mississippi, USA. 2022 February 12, 02:12 UT, colongitude 36.0°. 4 inch f/15 refractor telescope, IR cut filter, ZWO ASI120mm/s camera.*

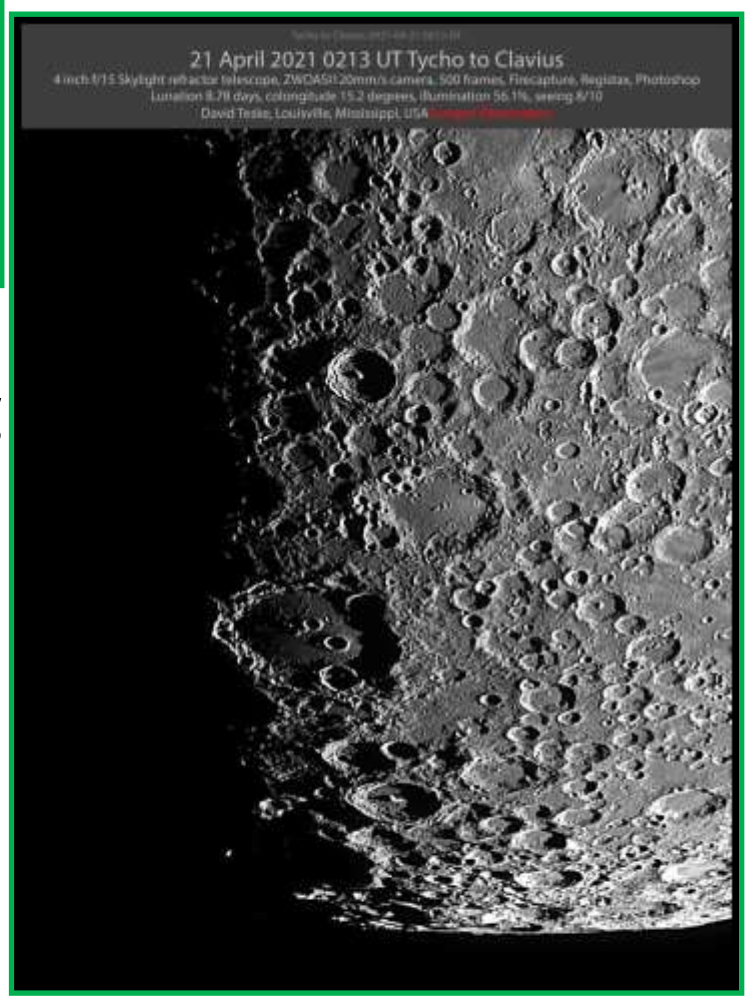


Image 9, Tycho, *David Teske, Louisville, Mississippi, USA. 2021 April 21, 02:13 UT, colongitude 15.2°. 4 inch f/15 refractor telescope, IR cut filter, ZWO ASI120mm/s camera.*

Image 10, ***Tycho,*** *David Teske, Louisville, Mississippi, USA. 2022 February 12, 02:12 UT, colongitude 36.2º. 4 inch f/15 refractor telescope, IR cut filter, ZWO ASI120mm/s camera.*

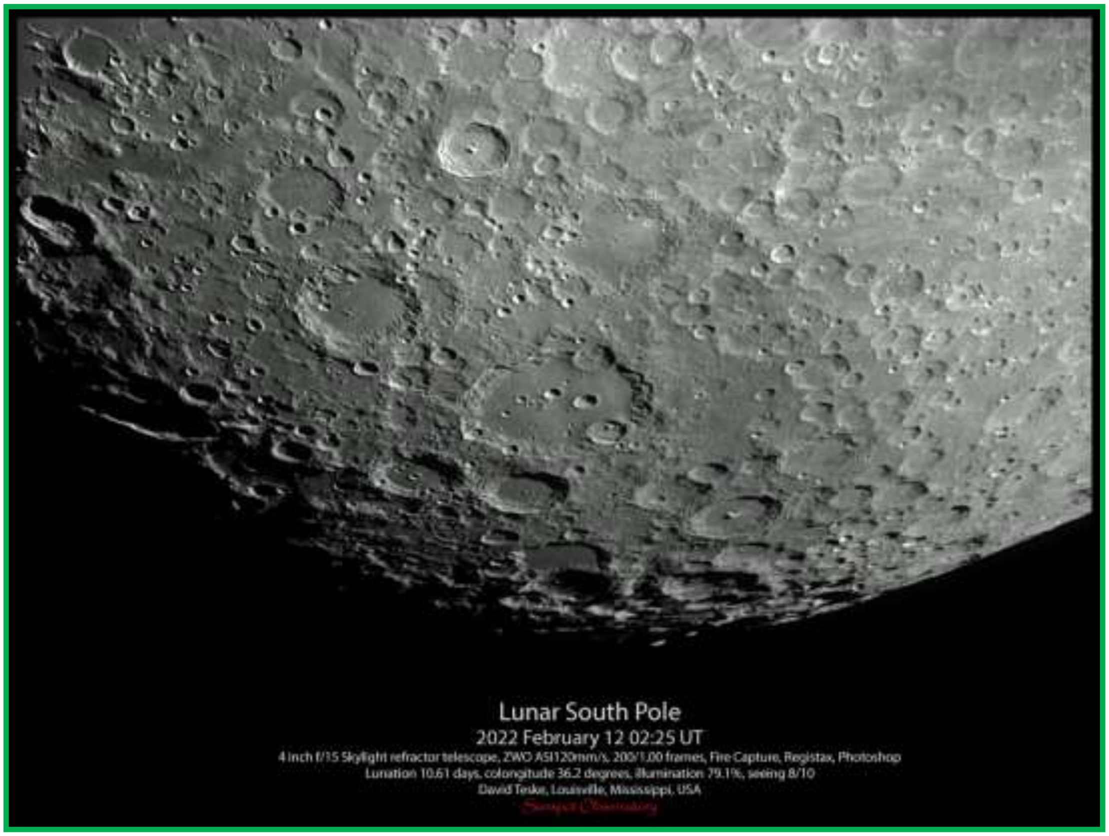


Image 11, Tycho, *Román García Verdier, Paraná, Argentina. 2021 July 18 22:50 UT. 180 mm reflector telescope, QHY5-II camera.*

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Image 12, Tycho, *Marcelo Mojica Gundlach, Cochabamba, Bolivia. 2018 July 22 22:42 UT. 150 mm refractor, Orion V-minus block, telescope, SWO CMOS camera. North is right, west is down.*

IMAGE 13 and 14 show us only the Tycho rays, the crater does not appear in the images. In IMAGES 15 to 21 we can see a unique feature of Tycho, and also related to its "geological youth": the dark halo that completely encircles the main crater. "When the Moon is full, Tycho is circled by a dusky halo, which extends out from the rim about one Tycho radius. No other rayed crater has such a conspicuous dark collar. This halo, or nimbus, coincides with the area immediately surrounding Tycho, which under low lightning is seen to be pockmarked with kilometer sized secondary pits but under a somewhat higher Sun appears softened. The Surveyor 7 spacecraft landed in this area (about 25 km north of Tycho's rim), and Orbiter photographs reveal a region of striated hills interspersed with smooth ponds. The ponds are interpreted as impact-melt material that splashed all around Tycho, flowed off hills and collected in low spots. The dark annulus maps out the distribution of a nearly continuous veneer of dark, glassy impact melt. Tycho has such a conspicuous nimbus because the crater is so young that its melt deposits have not been pulverized and mixed in with surrounding rocks by a myriad of small impacts" (Wood, pages 124/125).

Image 13, Blancanus, *Francisco Alsina Cardinalli, SLA-LIADA, Oro Verde, Argentina. 2016 June 19 02:31 UT. 10 inch Meade LX200 Schmidt-Cassegrain telescope, Astronomik ProPlanet 742 nm IR pass filter, QHY5-II camera. North is left, west*

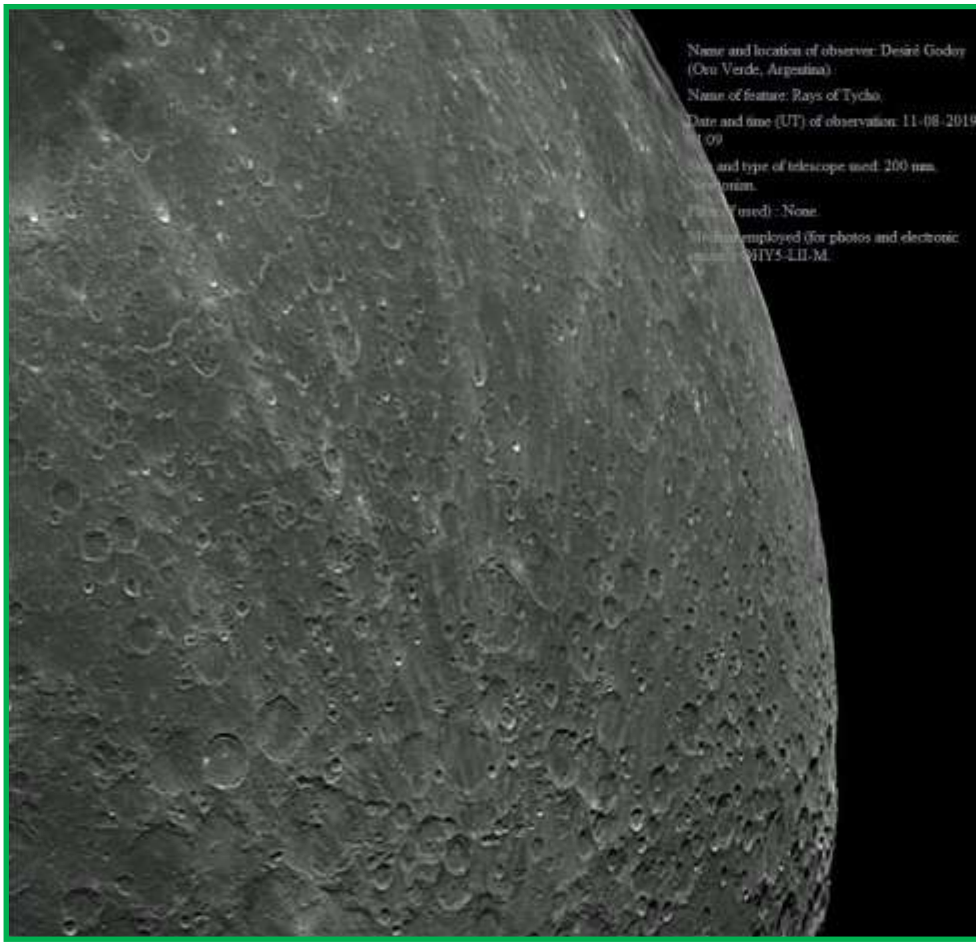

Image 14, Tycho Rays, *Desiré Godoy, Oro Verde, Argentina. 2019 November 08 01:09 UT 8 inch Newtonian reflector telescope, QHY5-LII-M camera. North is left, west is down.*

Image 15, Tycho, *Leonardo Alberto Colombo, Córdoba, Argentina. 2020 March 08 02:16 UT. 67 mm Teleobjective, Samsung SCB 2000 camera. North is down, west is right.*

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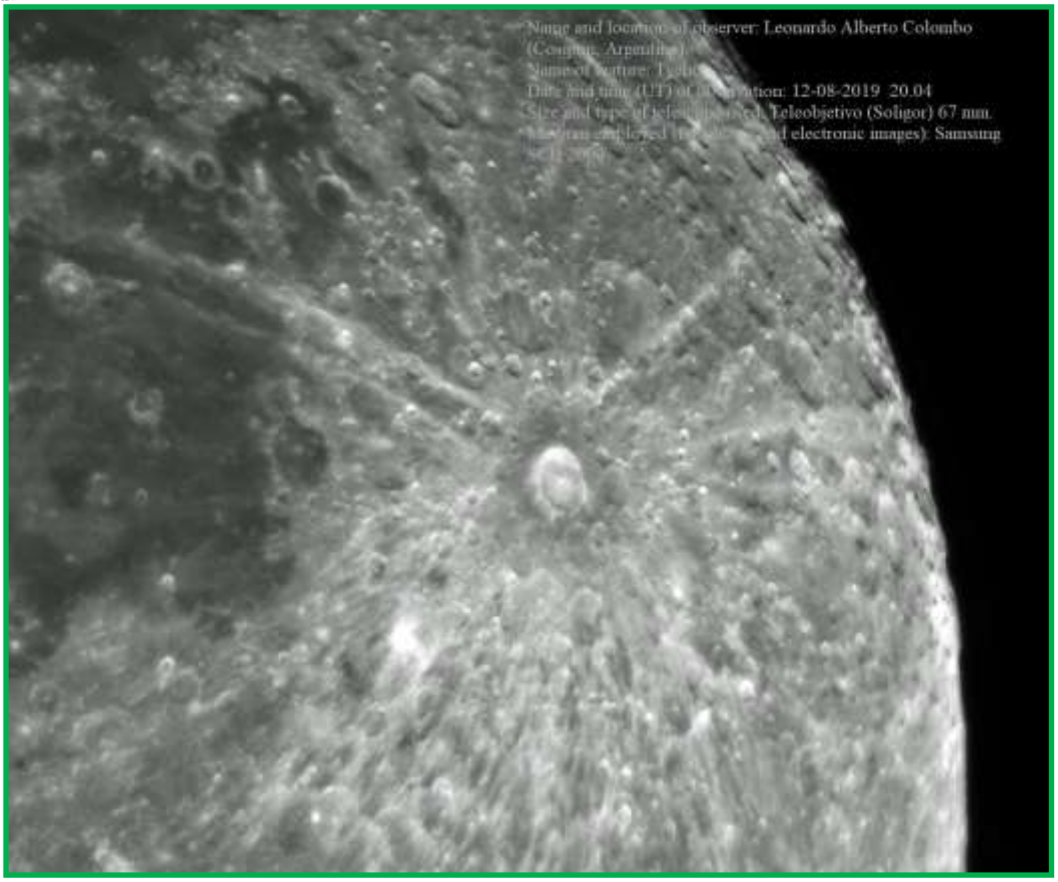

Image 16, Tycho, *Leonardo Alberto Colombo, Córdoba, Argentina. 2019 December 08 20:04 UT. 67 mm Tele-objective, Samsung SCB 2000 camera. North is left, west is up.*

Image 17 Tycho, *Ariel Cappelletti , Córdoba, Argentina, SLA . 2019 April 16 23:15 UT. 8 inch Newtonian reflector telescope, IR filter, ZWO ASI178mc camera. North is left, west is up.*

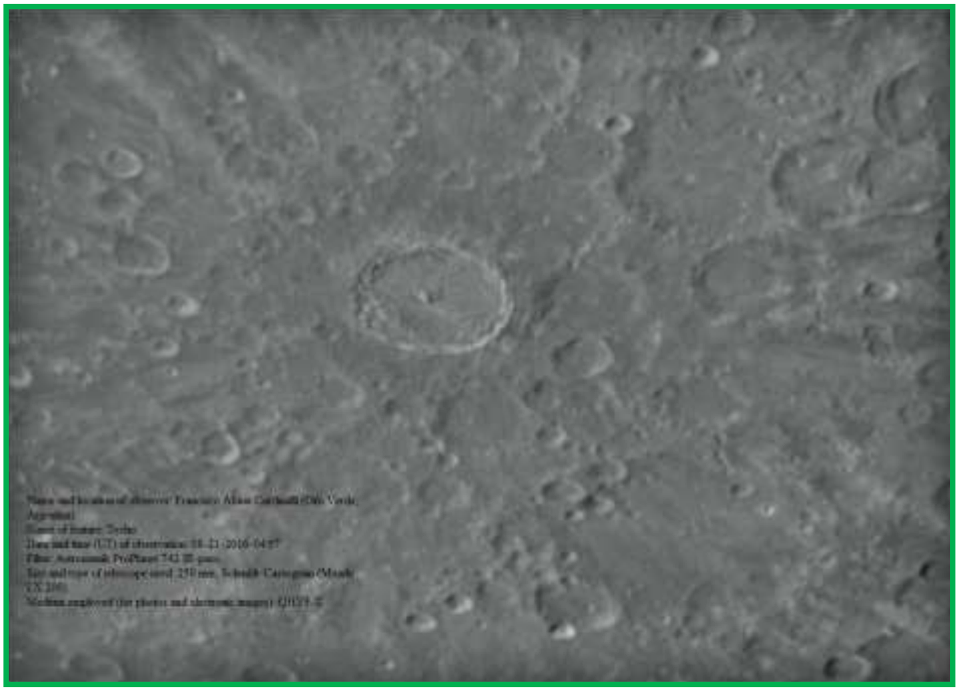

Image 18, Tycho, *Francisco Alsina Cardinalli, SLA-LIADA, Oro Verde, Argentina. 2016 August 21 04:57 UT. 10 inch Meade LX200 Schmidt-Cassegrain telescope, Astronomik ProPlanet 742 nm IR pass filter, QHY5-II camera.*

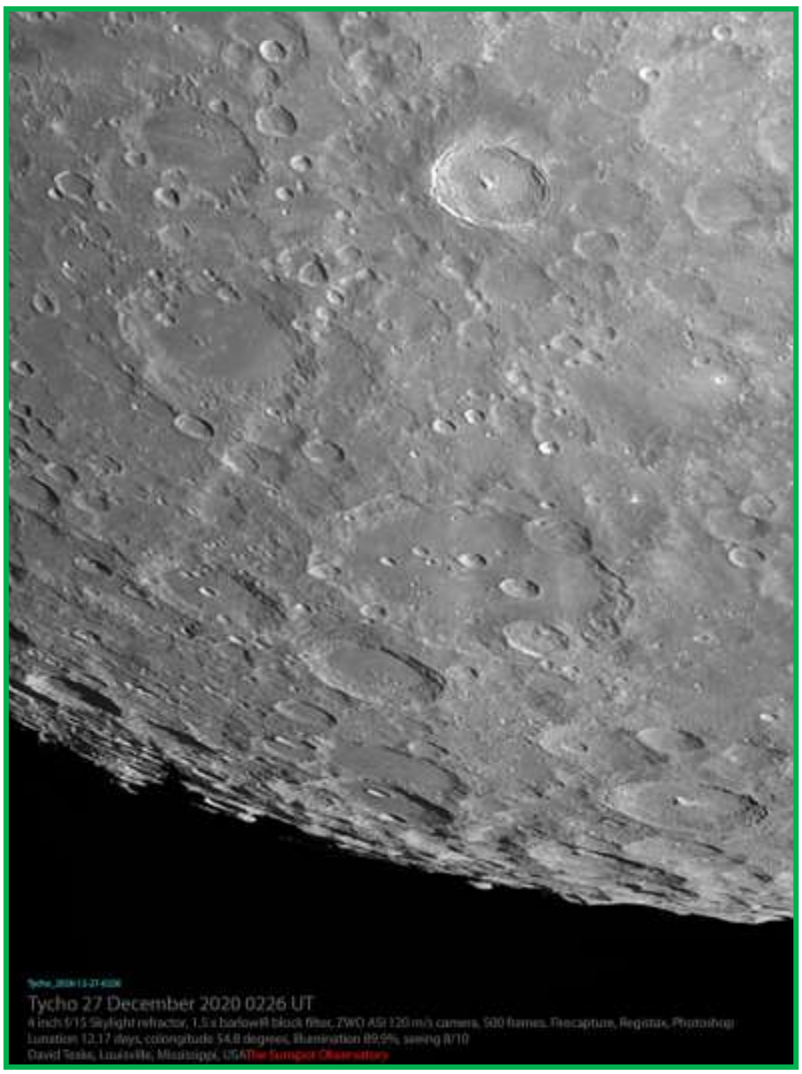

Image 19, Tycho, *David Teske, Louisville, Mississippi, USA. 2020 December 27, 02:26 UT, colongitude 54.8º. 4 inch f/15 refractor telescope, 1.5x barlow, IR cut filter, ZWO ASI120mm/s camera.*

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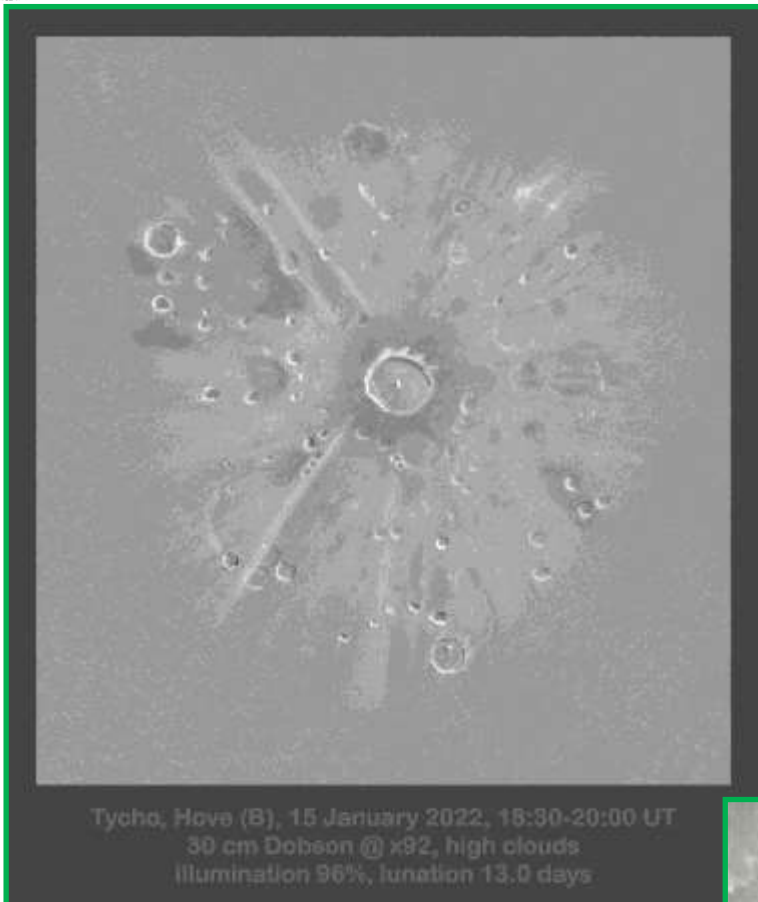

Image 20, Tycho, *Jef De Wit, Hove, Belgium. 2022 January 15 18:30-20:00 UT. 30 cm Dobsonian reflector telescope, 92 x.*

Image 21, Tycho, *Esteban Andrada, Mar del Plata, Argentina. 2022 April 16 00:30 UT. 4 inch Maksutov-Cassegrain telescope, Nikon D5100 camera. North is left, west is down.*

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In the area that we indicate the last Surveyor landed on the moon: "Surveyor 7, the last of its program, would be devoted to science (…) But an even bolder suggestion, apparently arrived at almost unanimously among the experimenters, finally won: the north rim of the crater Tycho in the southern highlands. Here at last was pure terra and Pure Science. There was little chance an Apollo could ever land at Tycho, and none ever did" (Wilhelms, To a Rocky Moon, page 144). Although "In all scientists' minds, Tycho was still in the running for Apollo 17, if not 16. It had drilled into a thick section of the all-important southern highlands in a place seemingly out of Imbrium's reach (…) NASA was leery of Tycho, however, because it looks rough and lies beyond the envelope considered accessible to Apollo landings, though they admitted it was marginally accessible in some months. I remember Jim McDivitt, the former Apollo 9 commander who had become manager of the Apollo Spacecraft Program Office at MSC in late 1969 when George Low moved back to NASA Headquarters, telling a GLEP meeting in early 1970, "no way, over my dead body." The dead body was Tycho. Critics of the manned program as an effective exploration tool pointed at Surveyor 7 sitting unscathed on the forbidden rocky field and felt vindicated" (Wilhelms, To a rocky moon, page 287).

The rugged aspect of Tycho's ejecta field, what was known in the 19th century as the "glacis" is seen in IMAGE 15 and 18, while in IMAGE 16, 17, 19, 20 and 21 we can see its conspicuous darkness of the same.

These interesting features of Tycho are not, however, what make Tycho famous but rather his majestic system of bright rays: "As the centre from which the principal bright ray system of the moon radiates, and the most conspicuous object in the southern hemisphere, this noble ring-plain may justly claim the pre-eminent title of "the Metropolitan crater" (Elger, page 102). "The extensive star-like ray system of the crater Tycho plays a leading role in the lunar ray show; its ray pattern spreads for hundreds of kilometers from its center and crosses over all kinds of lunar terrain" (Garfinkle).

Image 22, 95% Full Moon, *Jairo Chavez, Popayán, Colombia . 2022 April 15 01:22 UT. 311 mm reflector telescope, MOTO E5 PLAY camera. North is down, west is right.*

Another interesting aspect of the Tycho bright ray system is that it is asymmetric: most rays are located on the eastern side of the crater. We can see in IMAGE 23 to 27 that there are practically no rays passing through Mare Nubium, except for two very noticeable parallel rays, which we can see in IMAGE 28. It seems obvious that the impact that Tycho generated was oblique (like so many on the Moon). This asymmetry was an argument to deny that Tycho was produced by an impact, at the time of the debate with the theory of volcanic origin, as Don Wilhelms (The Geological History of the Moon, page 29): "An explosive origin by the sudden release of accumulated volcanic gases could theoretically explain the patterns except for the enormous energy required, estimated for Copernicus by Shoemaker (…) Such energies could not accumulate in a planetary crust because the weak rocks could not contain them without premature release (…) Endogenic mechanisms fail abjectly to explain the ray pattern of Tycho, part of which extends to the limbs of the Moon (…) One advocate of such structural systems (Alter, 1963) realized that an impact must have formed Tycho but postulated that the secondaries formed endogenically along impact-opened cracks, because the rays are not exactly radial. This offcenter relation of the rays was among the first arguments for internal origin to be finally refuted by Lunar Orbiter photography in 1967".

Image 23, Tycho, *David Teske, Louisville, Mississippi, USA. 2021 September 26, 08:06 UT, colongitude 147.8°. 4 inch f/15 refractor telescope, IR cut filter, ZWO ASI120mm/s camera.*

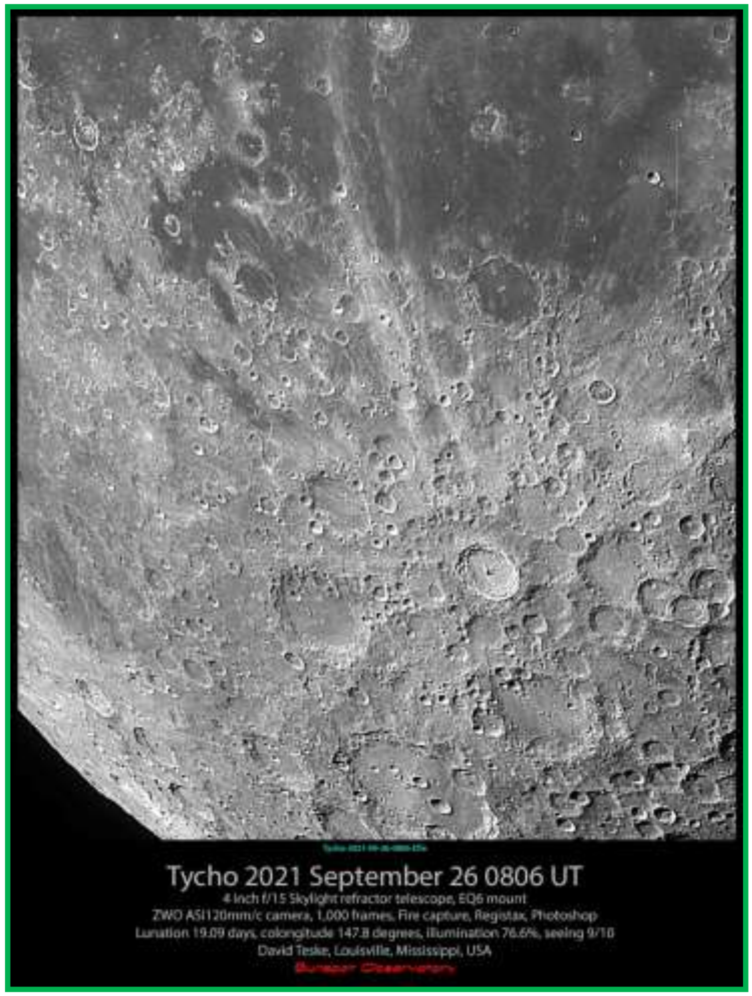

Image 24, Tycho, *Jesús Piñeiro, San Antonio de los Altos, Venezuela. 2021 May 30 04:34 UT. 90 mm Maksutov-Cassegrain telescope, IR cut UV-IR ASTRONOMIK L2 UV-IR 2" filter, ZWO ASI462 camera. North is left, west is up.*

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Image 25, 92% Full Moon, *Jairo Chavez, Popayán, Colombia . 2018 August 24 02:23 UT. 10 inch reflector telescope, Sony DSC-WX50 camera. North is down, west is right.*

Image 26, Tycho, *Esteban Andrada, Mar del Plata, Argentina. 2021 October 16 22:55 UT. 4 inch Maksutov-Cassegrain telescope, Nikon D5100 camera. North is left, west is down.*

Focus-On: Wonders of the Full Moon

Image 27, Tycho, *Walter Ricardo Elias, AEA, Oro Verde, Argentina. 2022 August 17 06:07 UT. 114 mm Helios reflector telescope, QHY5-IIC camera.*

Image 28 Gassendi, *Sergio Babino, SAO, Montevideo, Uruguay. 2020 March 08 01:34 UT. 203 mm catadrioptic telescope, ZWO ASI174mm camera. North to the lower right, west to the upper right.*

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It is interesting what Garfinkle says (like everything he says) about Tycho's cometary origin inferred by the distribution of his rays: "Tycho rays and ejecta blanket appears to be centered near the eastern rim of the crater. The ejecta blanket and mantling of dark material deposits are generally wider in a semicircle ranging from the northeastern rim around to the southern rim of the crater. The heaviest concentration of Tycho rays is also to the east of the crater. Ewen Whitaker suggested that the impact of a comet could be the source of the bright ray material; only the central crater is bright like the rays under high solar illumination; while the ejecta-caused secondary craters are rayless. The distribution of secondary craters around the rayless primary craters is about the same as the major post-mare-formation rayed craters".

Don't you think that the western edge of Tycho is higher than the eastern edge in PICTURES 29 to 33?

Image 29, Tycho, *Rik Hill, Loudon Observatory, Tucson, Arizona, USA. 2012 May 03 04:15 UT. TEC 8 inch f/20 Maksutov-Cassegrain telescope, Wratten 23 filter, DMK21AU04 camera. Seeing 7/10.*

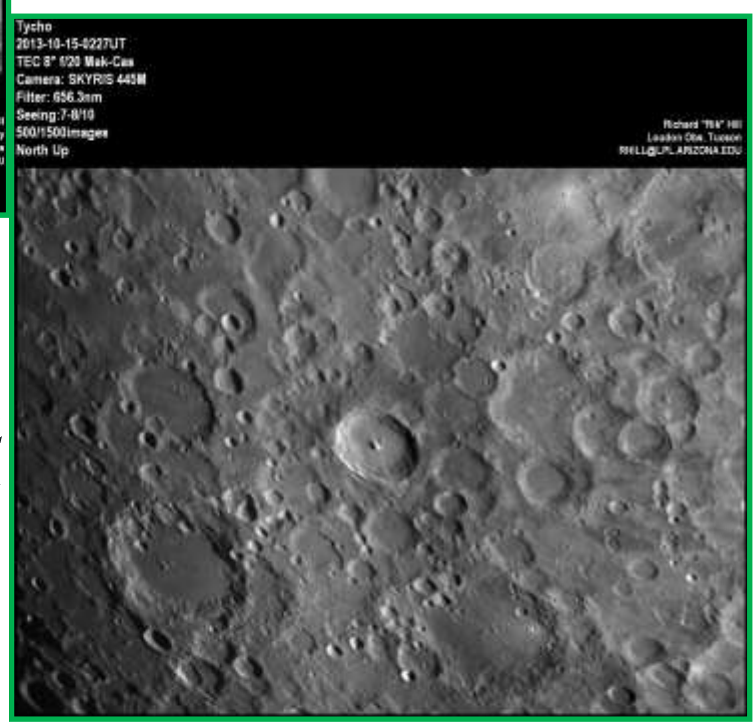

Image 30, Tycho, *Rik Hill, Loudon Observatory, Tucson, Arizona, USA. 2013 October 15 02:27 UT. TEC 8 inch f/20 Maksutov-Cassegrain telescope, 656.3 nm filter, SKYRIS 445M camera. Seeing 7-8/10.*

Focus-On: Wonders of the Full Moon

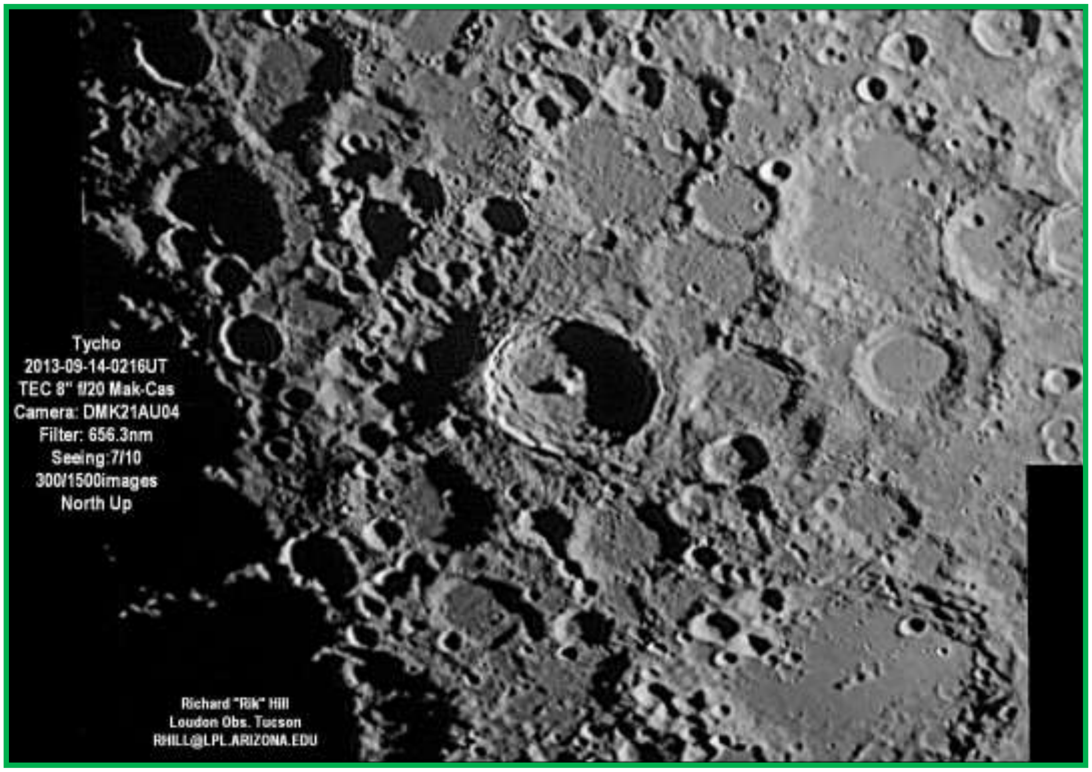

Image 31, Tycho, *Rik Hill, Loudon Observatory, Tucson, Arizona, USA. 2013 September 14 02:16 UT. TEC 8 inch f/20 Maksutov-Cassegrain telescope, 656.3 nm filter, DMK21AU04 camera. Seeing 7/10.*

Image 32, Tycho, *Rik Hill, Loudon Observatory, Tucson, Arizona, USA. 2012 May 03 04:15 UT. TEC 8 inch f/20 Maksutov-Cassegrain telescope, Wratten 23 filter, DMK21AU04 camera. Seeing 7/10.*

Focus-On: Wonders of the Full Moon

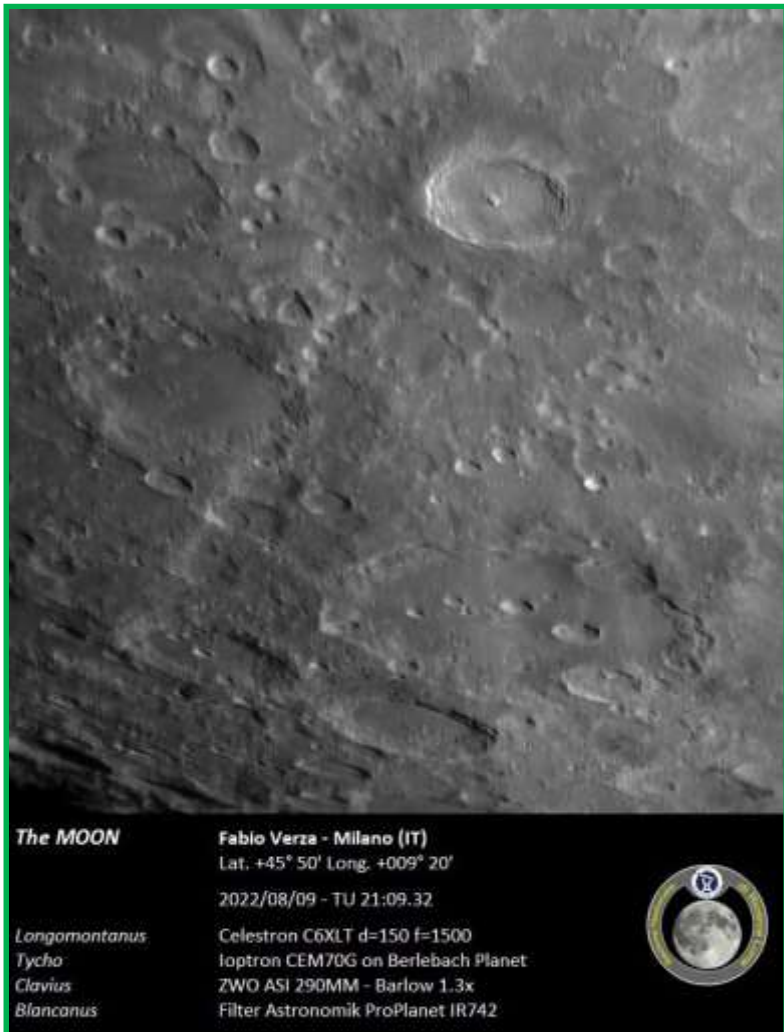

Image 33, Longomontanus, *Fabio Verza, SNdR, Milan, Italy. 2022 August 09 21:09 UT. Celestron 6 inch XLT Schmidt-Cassegrain telescope, 1.3x barlow, iOptron CEM70G, Astronomik ProPlanet IR742 filter, ZWO ASI290M camera.*

According to Garfinkle: “The Tycho ray system consists of 10 major rays that appear like powdery white, sometimes wispy, streaks. (...) Some of the rays are long, thin streaks, and others are wide broken swaths”. Can the reader identify the 10 majors rays that Garfinkle mentions in IMAGE 34?

Image 34, Waxing Gibbous Moon, *Felix León, Santo Domingo, República Dominicana. 2021 March 27 00:25 UT. 127 mm Maksutov-Cassegrain telescope, DMK 21 618 AU camera. North is right, west is up.*

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Enough of Tycho (if we can get enough of Tycho), let's move on to some other very famous bright rays: those of Messier A, Messier's twin. According to Peter Grego: “Messier (7 × 13 km) and Messier A (14 × 9 km), two neighboring craters in northwestern Mare Fecunditatis, are fascinating to observe. Messier is a deep, oval crater whose long axis lies east–west, while Messier A is a deep, circular bowl with a raised semi-circular lip beyond its western rim. The pair are separated by just 6 km, Messier lies along a broad ray that extends from Taruntius in northern Mare Fecunditatis, tapering to a point 100 km south of Messier. Close examination will reveal a fine butterfly pattern of rays spreading in a narrow fan to Messier’s north and south, superimposed upon the larger ray from Taruntius. Extending from the west of Messier A is one of the Moon’s most remarkable ray systems, a close pair of linear rays that reach the western border of the mare 150 km away, diverging very slightly over their course. It is likely that Messier and Messier A were produced when a small asteroid hit the lunar surface from the east at a very shallow angle, probably less than 5°. Messier was formed from the primary impact, and Messier A was carved out by the impact of a large fragment of this asteroid that rebounded and careered into the Moon a little further downrange. This scenario would explain the elongated shapes of the pair and their unique pattern of ejecta (page 217). The Messier and Messier A pair is very attractive to lunar observers, as evidenced by the many images we share: IMAGES 35 to 48, in IMAGE 49 we see the brightness of the rim of both craters that shows how oblique the impact was. Messier and Messier A were a great mystery that were solved when the conditions of an oblique impact were reproduced in the laboratory. This is how Wood tells it: “Previous explanations for this crater pair have ranged from imaginative to fantastical. All were wrong. In the 18th century, German physician and astronomer Franz von Gruithuisen proposed that the parallel rays were artificial (…) In the 1960’s, British planetary observer Valdemar Axel Firsoff believed the crater Messier A (once called Pickering) to be migrating eastward, leaving behind a trail of faint ruins that are the remnants of previous positions. But the most bizarre idea came from the great meteorite collector Harvey Nininger, who proposed that a meteorite crashed through a ridge, leaving a hole on either side. Presumably a tunnel links them” (page 94). In IMAGE 50 we observe the asymmetric pattern not only of the rays but of the entire mantle of ejecta in the area.

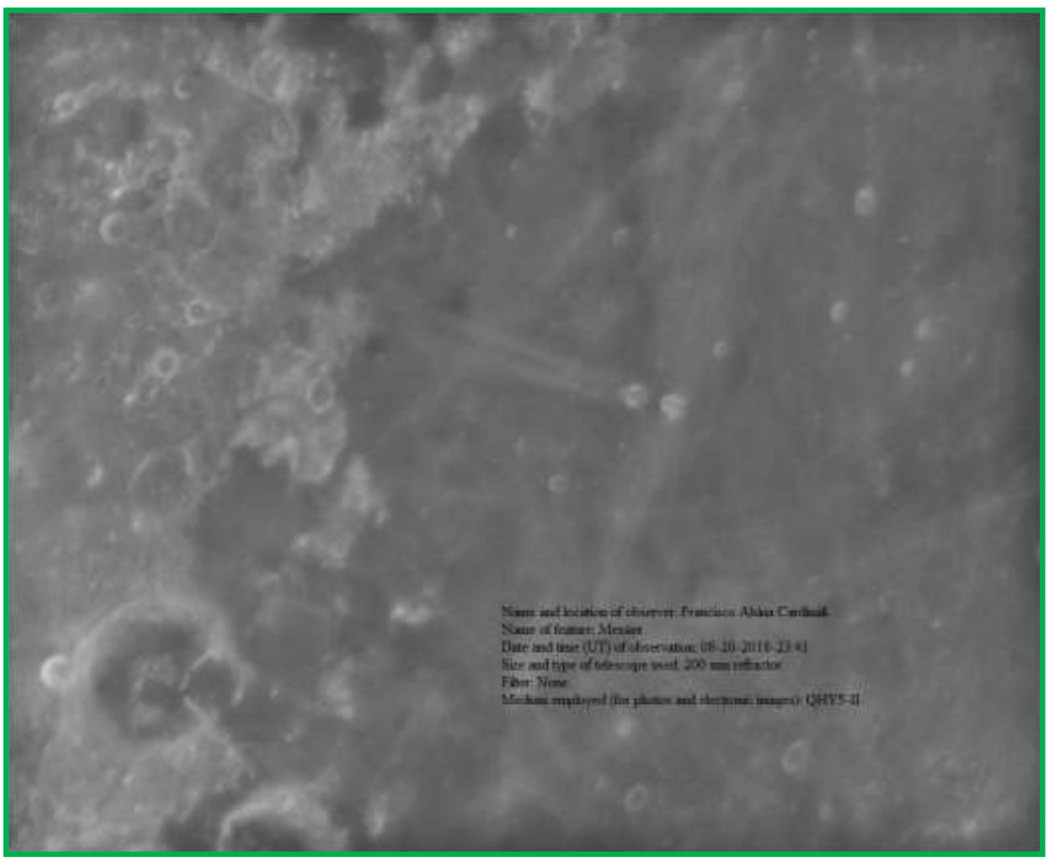

Image 35, Messier, *Francisco Alsina Cardinalli, SLALIADA, Oro Verde, Argentina. 2018 August 20 23:41 UT. 200 mm refractor telescope, QHY5-II camera.*

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Image 36, ***Messier,*** *Desiré Godoy, Oro Verde, Argentina. 2020 August 28 23:53 UT 200 mm refractor telescope, 742 nm filter, QHY5-II camera.*

Image 37, ***Tycho,*** *Francisco Alsina Cardinalli, SLA-LIADA, Oro Verde, Argentina. 2016 January 21 00:59 UT. 10 inch Meade LX200 Schmidt-Cassegrain telescope, Canon EOS Digital Rebel XS camera.*

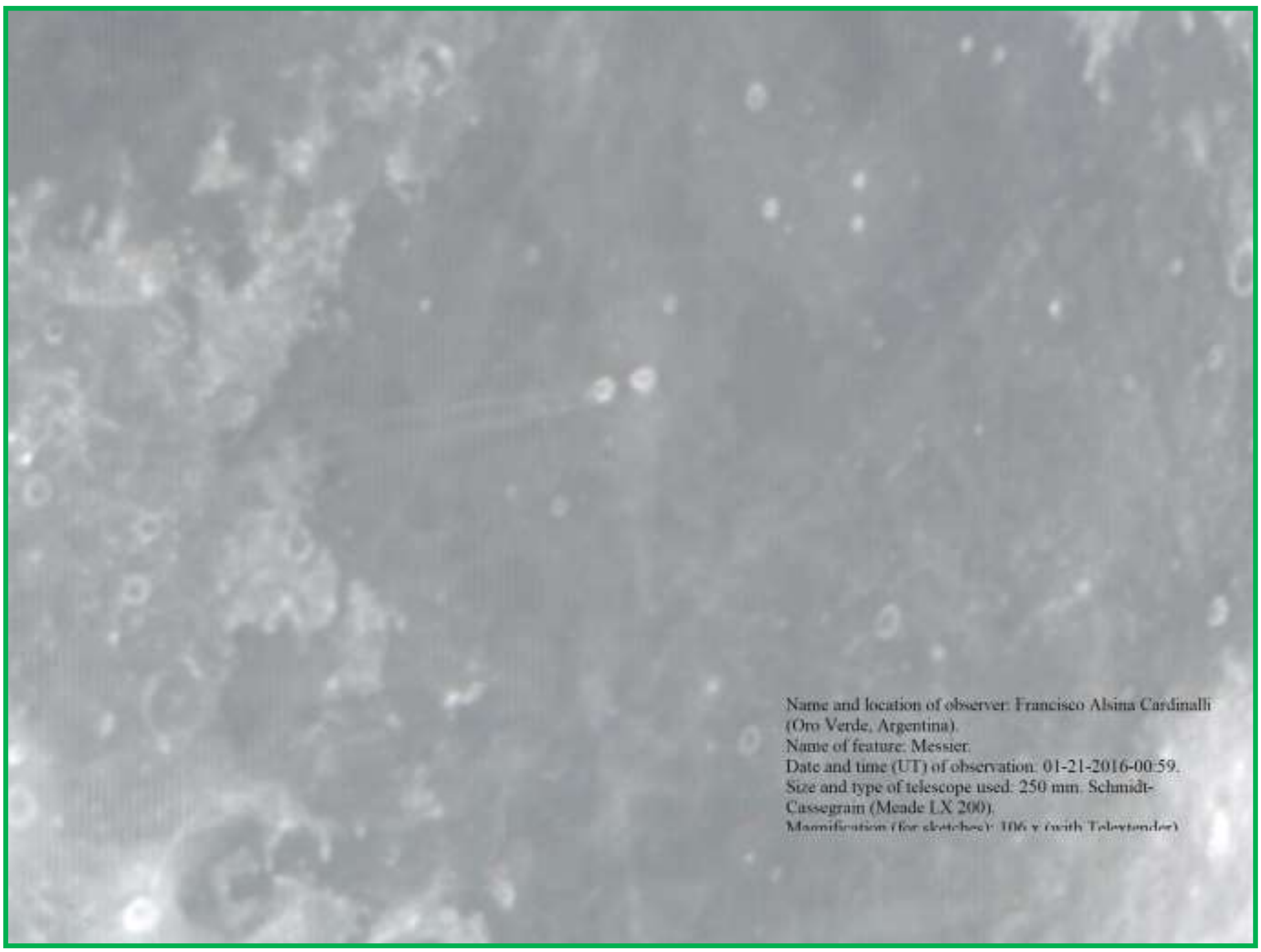

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Image 38, Messier, *David Teske, Louisville, Mississippi, USA. 2021 June 17, 02:31 UT, colongitude 351.3°. 4 inch f/15 refractor telescope,1.5x barlow, IR cut filter, ZWO ASI120mm/s camera.*

Image 39, Messier, *David Teske, Louisville, Mississippi, USA. 2022 January 12, 01:05 UT, colongitude 18.3°. 4 inch f/15 refractor telescope,1.5x barlow, IR cut filter, ZWO ASI120mm/s camera.*

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Image 40, Messier, *David Teske, Louisville, Mississippi, USA. 2022 February 09, 02:20 UT, colongitude 359.5º. 3.5 inch Questar Maksutov-Cassegrain telescope, 2 x barlow, IR cut filter, ZWO ASI120mm/s camera.*

Image 41, Messier, *David Teske, Louisville, Mississippi, USA. 2022 June 06, 02:28 UT, colongitude 346.5º. 6 inch Celestron Schmidt-Cassegrain telescope, IR cut filter, ZWO ASI120mm/s camera.*

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Image 42, Messier, *Francisco Alsina Cardinalli, SLA-LIADA, Oro Verde, Argentina. 2015 December 20 01:35 UT. 10 inch Meade LX200 Schmidt-Cassegrain telescope, Canon EOS Digital Rebel XS camera.*

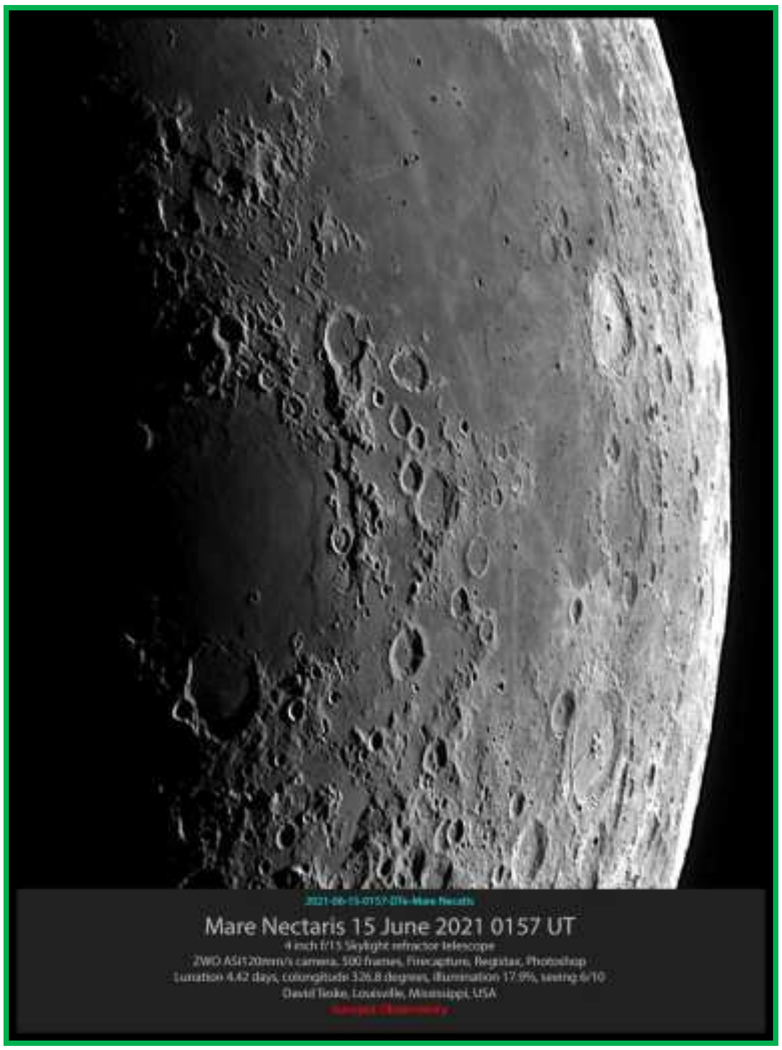

Image 43, Messier, *David Teske, Louisville, Mississippi, USA. 2021 June 15, 01:57 UT, colongitude 326.8°. 4 inch f/15 refractor telescope, IR cut filter, ZWO ASI120mm/s camera.*

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Image 44, Messier, *Rik Hill, Loudon Observatory, Tucson, Arizona, USA. 2016 July 10 02:51 UT. TEC 8 inch f/20 Maksutov-Cassegrain telescope, 656.3 nm filter, SKYRIS 445M camera. Seeing 7/10.*

Image 45, Messier, *Rik Hill, Loudon Observatory, Tucson, Arizona, USA. 2012 October 03 06:55 UT. TEC 8 inch f/20 Maksutov-Cassegrain telescope, 656.3 nm filter, DMK21AU04 camera. Seeing 7/10.*

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Image 46, Messier, *Rik Hill, Loudon Observatory, Tucson, Arizona, USA. 2016 March 14 02:18 UT. TEC 8 inch f/20 Maksutov-Cassegrain telescope, 656.3 nm filter, SKYRIS 445M camera. Seeing 8/10.*

Image 47, Messier to Langrenus, *Rik Hill, Loudon Observatory, Tucson, Arizona, USA. 2009 June 01 03:48 UT. Questar 3.5 inch Maksutov-Cassegrain telescope, 2x barlow, UV/IR blocking filter, SPC900NC camera. Seeing 7/10*

Image 48, Messier, *Fabio Verza, SNdR, Milan, Italy. 2022 August 09 21:14 UT. Celestron 6 inch XLT Schmidt-Cassegrain telescope, 1.3x barlow, iOptron CEM70G, Astronomik ProPlanet IR742 filter, ZWO ASI290M camera.*

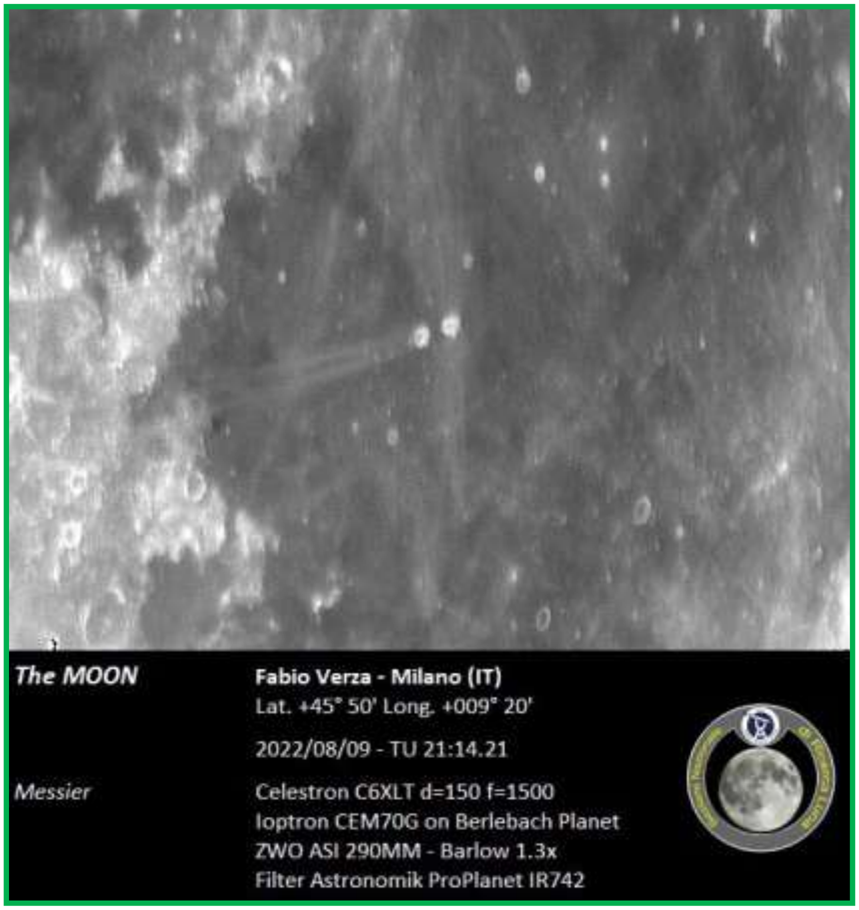

Image 49, Messier, *Jesús Piñeiro, San Antonio de los Altos, Venezuela. 2021 December 10 22:48 UT. 10 inch Schmidt-Cassegrain telescope, ASTRONOMIK L2 UV-IR 2" filter, ZWO ASI462 camera. North is right, west is up.*

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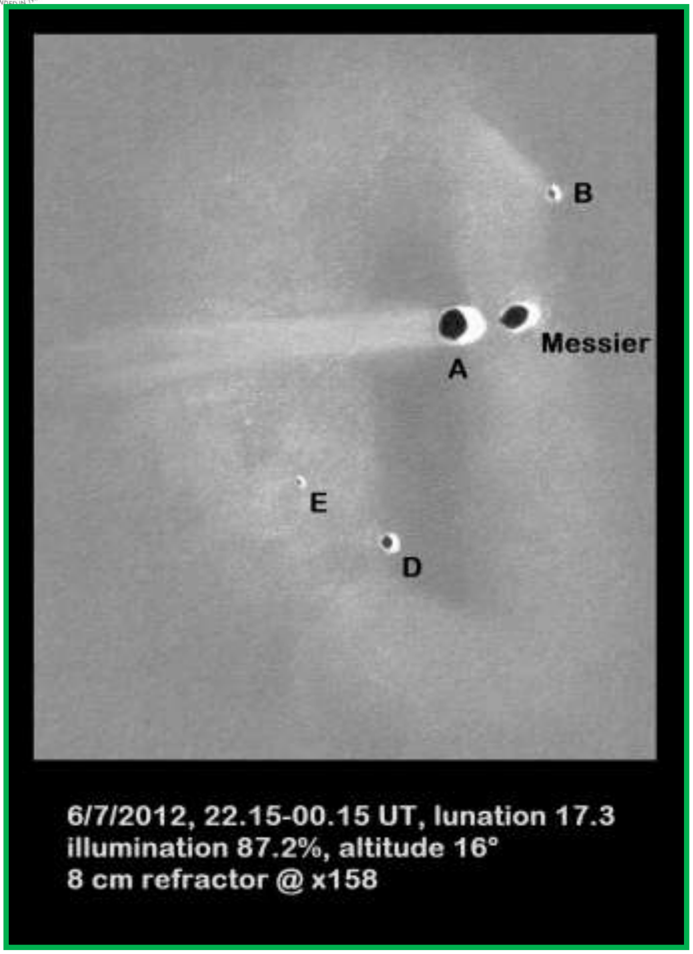

Image 50, Messier, *Jef De Wit, Hove, Belgium. 2012 July 06 22:15-00:15 UT. 8 cm refractor telescope, 158 x.*

Messier A is located near two other craters with completely different bright rays. In IMAGE 51 the Messier pair is on the left, if we go to the right and go down a bit we find a very small crater (less than 4 km in diameter) that shines very brightly: Censorinus, one of the spots with highest albedo on the near side of the Moon. Its rays present the typical pattern of small craters: not very long and uniformly distributed around the crater of origin, to appreciate them better we have to resort to images in orbit.

Image 51, Censorinus, *Francisco Alsina Cardinalli, SLA-LIADA, Oro Verde, Argentina. 2017 July 01 23:20 UT. 200 mm refractor telescope, QHY5-II camera. North is down, west is right.*

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In IMAGE 52 and 53 Messier and Messier A appear next to Langrenus, a crater that we already visited in a previous Focus On, since its rays occupy number 85 on the Lunar 100 list. If Censorinus is young and bright, Langrenus is a splendid Eratosthenian crater but has almost lost its rays, best seen in IMAGE 54 to 56.

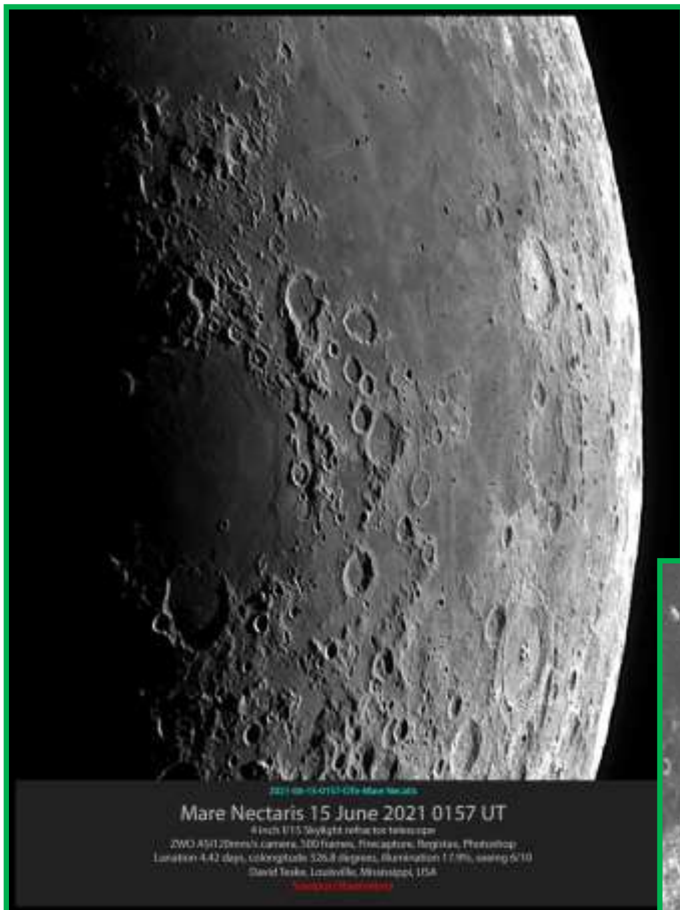


Image 52, Mare Nectaris, *David Teske, Louisville, Mississippi, USA. 2021 June 15, 01:57 UT, colongitude 326.8^o. 4 inch f/15 refractor telescope, IR cut filter, ZWO ASI120mm/s camera.*

Image 53, Langrenus, *David Teske, Louisville, Mississippi, USA. 2020 September 03, 07:43 UT, colongitude 97.4^o. 4 inch f/15 refractor telescope, IR cut filter, ZWO ASI120mm/s camera.*

Focus-On: Wonders of the Full Moon

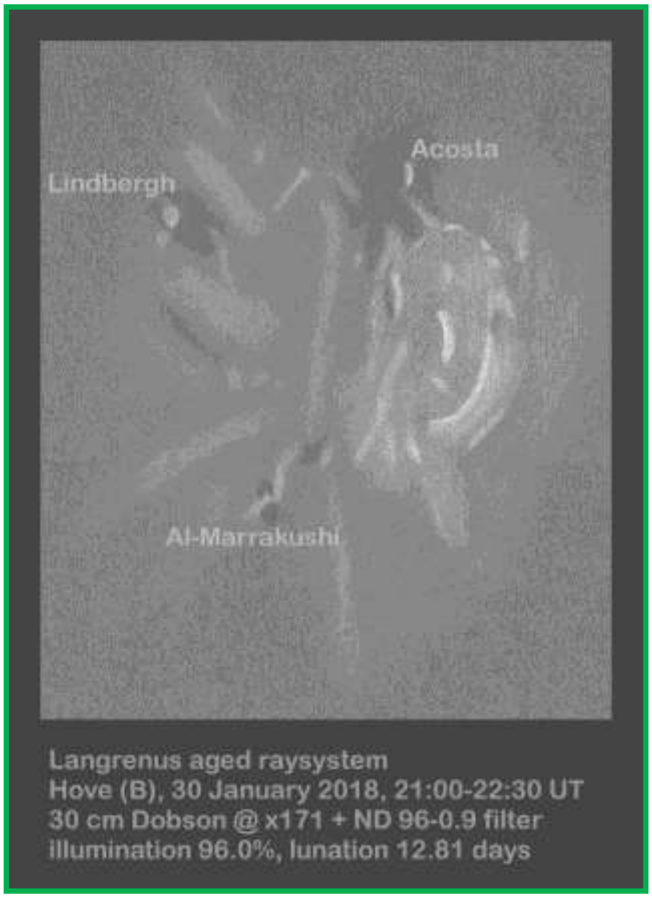


Image 54, Langrenus, *Jef De Wit, Hove, Belgium. 2018 January 30 21:00-22:30 UT. 30 cm Dobsonian reflector telescope, 171 x.*

Image 55, Langrenus, *Fabio Verza, SNdR, Milan, Italy. 2022 August 02 18:57 UT. Celestron 6 inch XLT Schmidt-Cassegrain telescope, 1.3x barlow, iOptron CEM70G, ZWO ASI290M camera.*

Focus-On: Wonders of the Full Moon

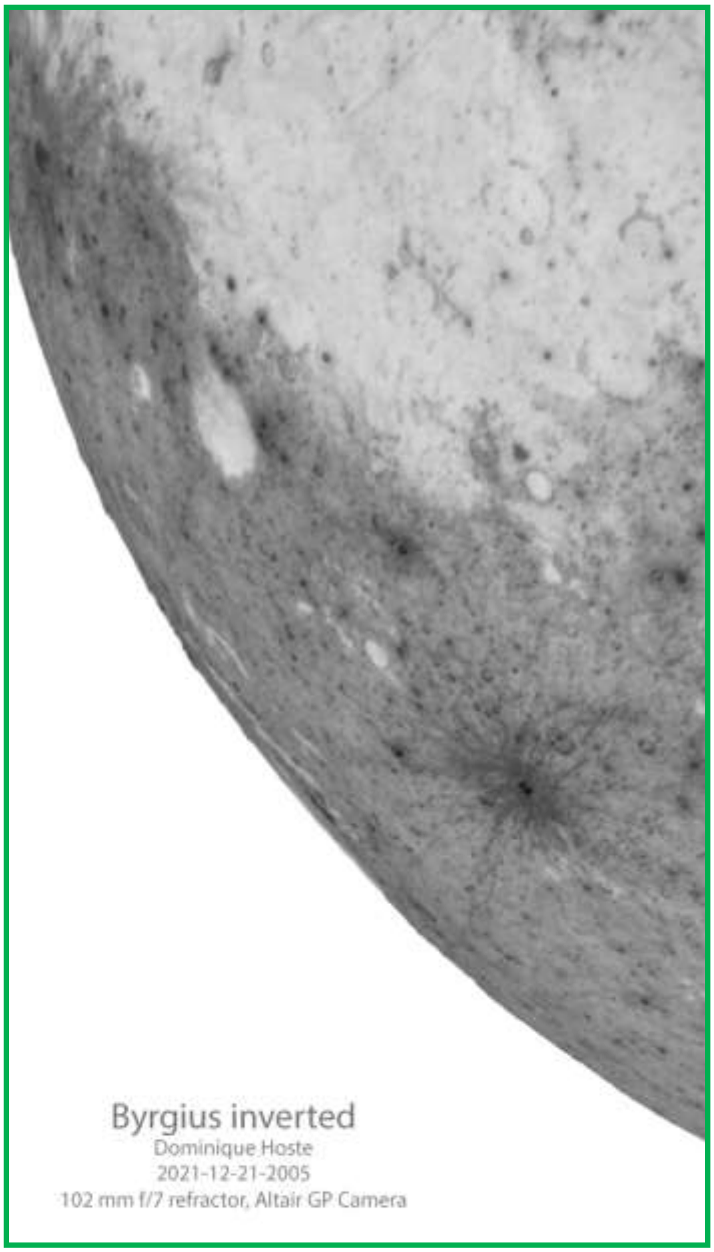
Image 56, Langrenus, *Fabio Verza, SNdR, Milan, Italy. 2022 August 09 21:15 UT. Celestron 6 inch XLT Schmidt-Cassegrain telescope, 1.3x barlow, iOptron CEM70G, Astronomik ProPlanet IR742 filter, ZWO ASI290M camera.*

After Tycho and Messier, in third place for brightness, comes my favorite bright ray crater: Byrgius A (19 kms diameter). It is not such a well-known crater, says Peter Grego: “a small, bright crater at the center of a prominent splash of rays, easily visible through binoculars, which reach distances of more than 300 km” (page 191). The bright ray system of Byrgius A looks delicately beautiful in IMAGE 57. Don't you think that despite being a highland crater the rays have a similar ray pattern to that of Kepler or Copernicus, which are craters located in maria? In other images like IMAGE 58 to 64, we see what Garfinkle points out: “Long streamers spread to the northwest and southwest. Four almost parallel streamers head toward the northeast of the crater”, and more closely resembles a highland crater.

Image 57, Brygius, *Alberto Anunziato, Oro Verde, Argentina. 2016 April 30 09:02 UT. Meade LX200 10 inch Schmidt-Cassegrain telescope, QHY5-II camera.*

Focus-On: Wonders of the Full Moon

Images 58 and 59, Byrgius, Normal and Inverted, *Dominique Hoste, Kortrijk, West-Vlaanderen, Belgium. 2021 December 21 20:05 UT. TS Photoline 102 mm f/7 refractor telescope, Altair GP camera.*



Focus-On: Wonders of the Full Moon

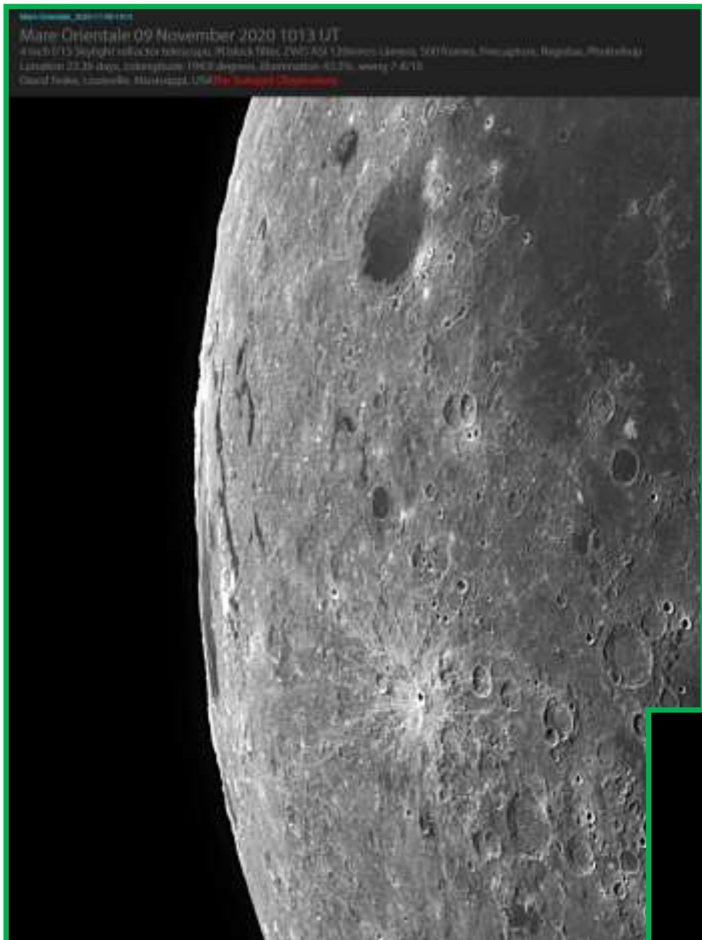
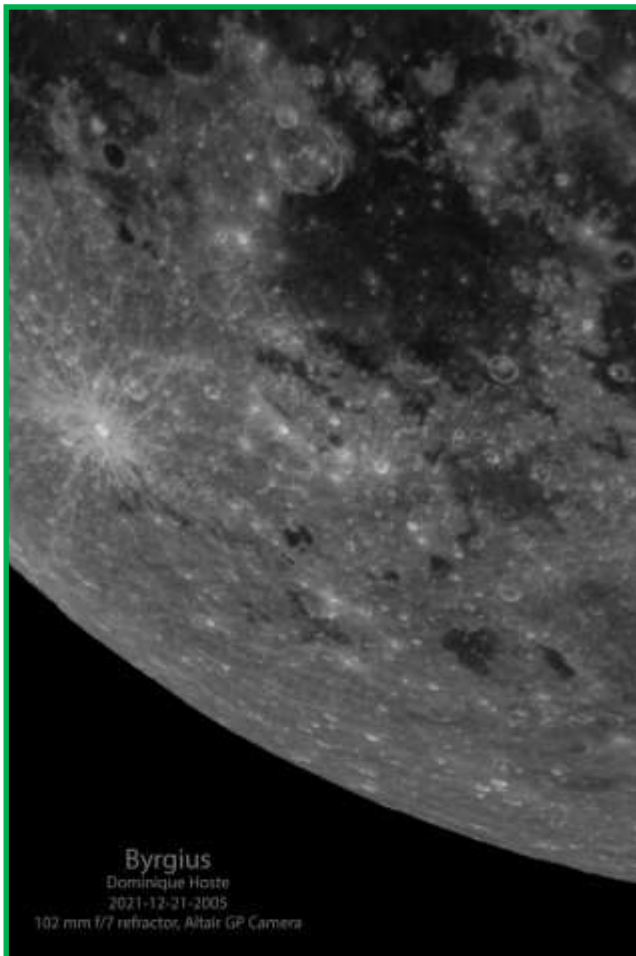
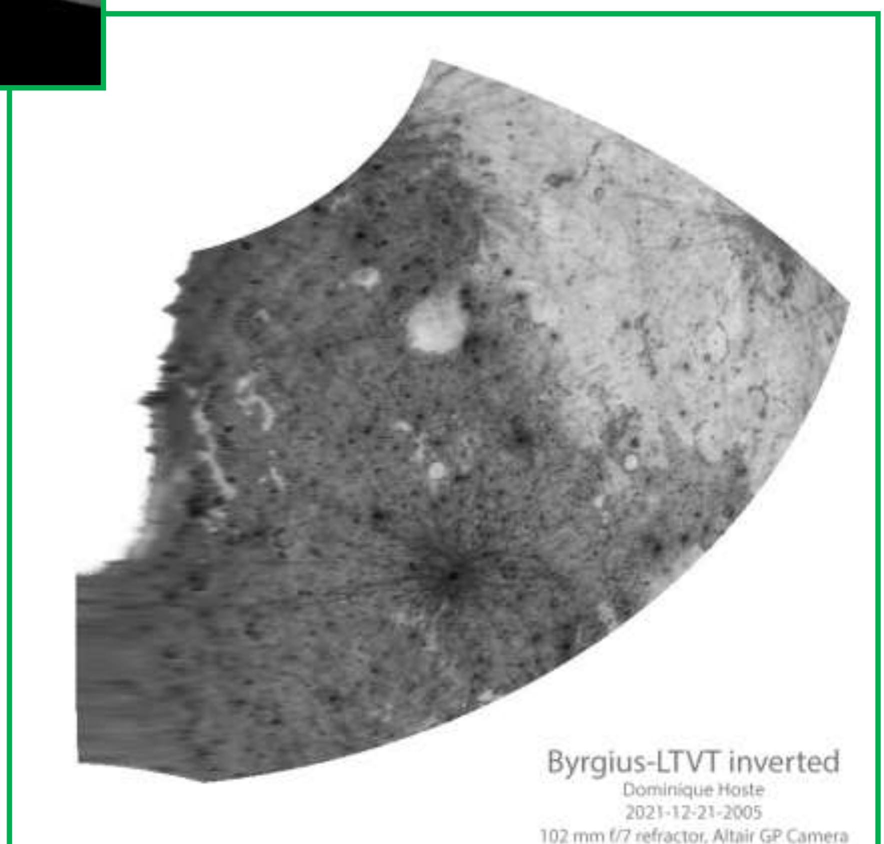


Image 60, Mare Orientale, *David Teske, Louisville, Mississippi, USA. 2020 November 09, 10:13 UT, colongitude 194.9°. 4 inch f/15 refractor telescope, IR cut filter, ZWO ASI120mm/s camera.*

Image 61, Mare Orientale, *David Teske, Louisville, Mississippi, USA. 2020 December 08, 11:05 UT, colongitude 188.1°. 4 inch f/15 refractor telescope, IR cut filter, ZWO ASI120mm/s camera.*

Focus-On: Wonders of the Full Moon





Images 62, 63 and 64, Byrgius, LTVT Normal and Inverted, *Dominique Hoste, Kortrijk, West-Vlaanderen, Belgium. 2021 December 21 20:05 UT. TS Photoline 102 mm f/7 refractor telescope, Altair GP camera.*

A little known but very interesting bright ray crater is Petavius B (perhaps Petavius gets all the attention). In IMAGE 65 and 66 you can see its characteristics, as stated by Garfinkle: "This bright-walled crater is nestled into the southern shore of Mare Fecunditatis with its brightest rays splayed westward across the darker mare surface. The bright ejecta blanket overlies a rumpled medium-albedo highland area to the east, and there is a startling lack of bright material on the low-albedo mare to the north of the crater. Might the mare lava have been emplaced after the formation of Petavius B, or did the impacting object(s) come in from the north and create the non-circular crater?"

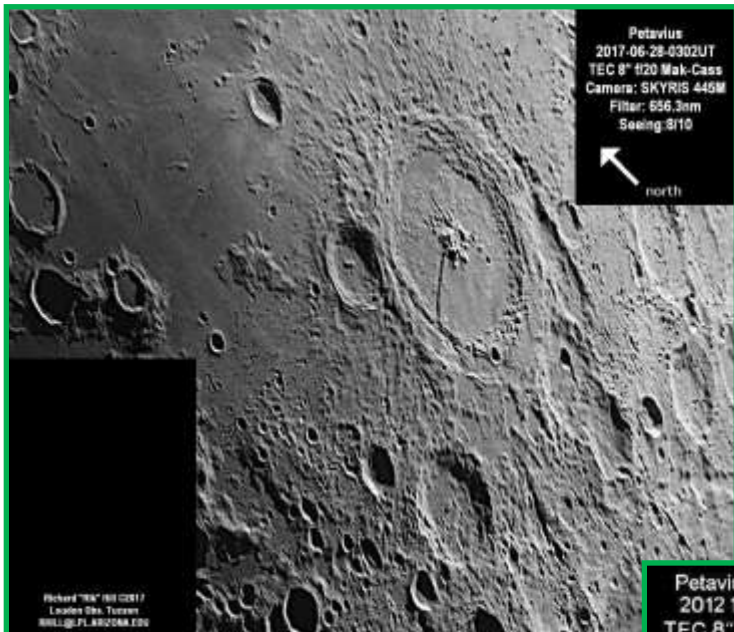


Image 65, Petavius, *Rik Hill, Loudon Observatory, Tucson, Arizona, USA. 2017 June 28 03:02 UT. TEC 8 inch f/20 Maksutov-Cassegrain telescope, 656.3 nm filter, SKYRIS 445M camera. Seeing 8/10.*

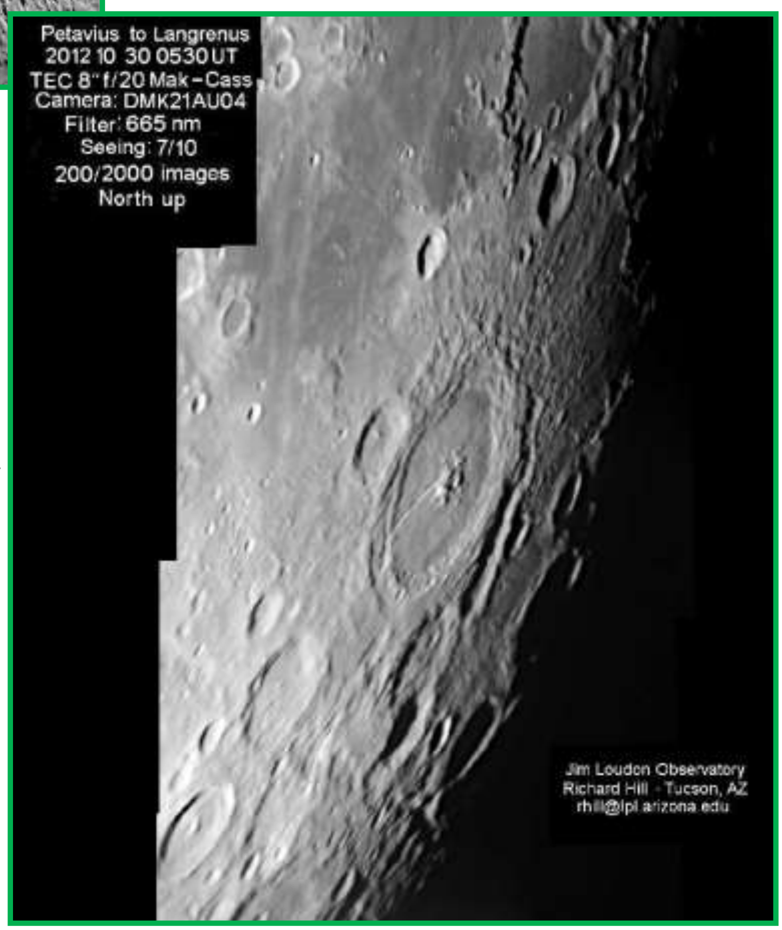


Image 66, Petavius, *Rik Hill, Loudon Observatory, Tucson, Arizona, USA. 2012 November 30 05:30 UT. TEC 8 inch f/20 Maksutov-Cassegrain telescope, 665 nm filter, DMK21AU04 camera. Seeing 7/10.*

Focus-On: Wonders of the Full Moon

Quite similar to Petavius B is Agatharchides A (16 km diameter), located at the western end of Mare Nubium (IMAGE 67). A little smaller (12 km diameter) and less bright is Bohnenberger G (IMAGE 68).

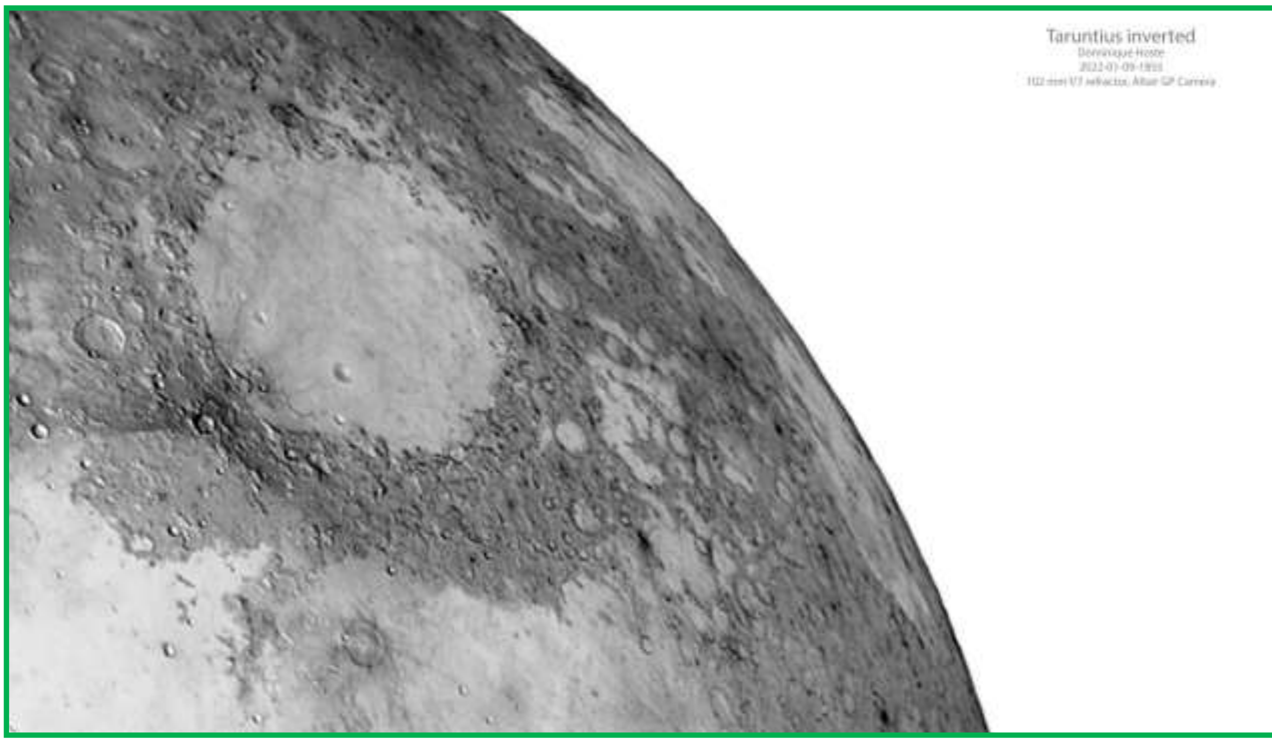
Image 67, Agatharchides A, *Rik Hill, Loudon Observatory, Tucson, Arizona, USA. 2013 October 16 04:10 UT. TEC 8 inch f/20 Maksutov-Cassegrain telescope, 656.3 nm filter, SKYRIS 445M camera. Seeing 8/10. North is up, west is right.*

Image 68, Bohnenberger G, *Rik Hill, Loudon Observatory, Tucson, Arizona, USA. 2020 May 28 02:11 UT, colongitude 339.8°. Dynamax 6 inch Schmidt-Cassegrain telescope, 2x barlow, 850 nm filter, SKYRIS 445M camera. Seeing 8/10.*

Focus-On: Wonders of the Full Moon

Very similar to the bright ray pattern of Langrenus is the Taruntius ray pattern (IMAGE 69/70), located on the border of our arbitrary north-south division, and images of which we also included in our previous Focus On. IMAGE 71 illustrates a famous, and very prominent, pair of southern hemisphere bright ray craters Stevinus A and Furnerius C, which was the target of the March 2022 Focus-On Section.

Images 69 and 70, Taruntius, Normal and Inverted, *Dominique Hoste, Kortrijk, West-Vlaanderen, Belgium. 2022 January 09 18:55 UT. TS Photoline 102 mm f/7 refractor telescope, Altair GP camera.*



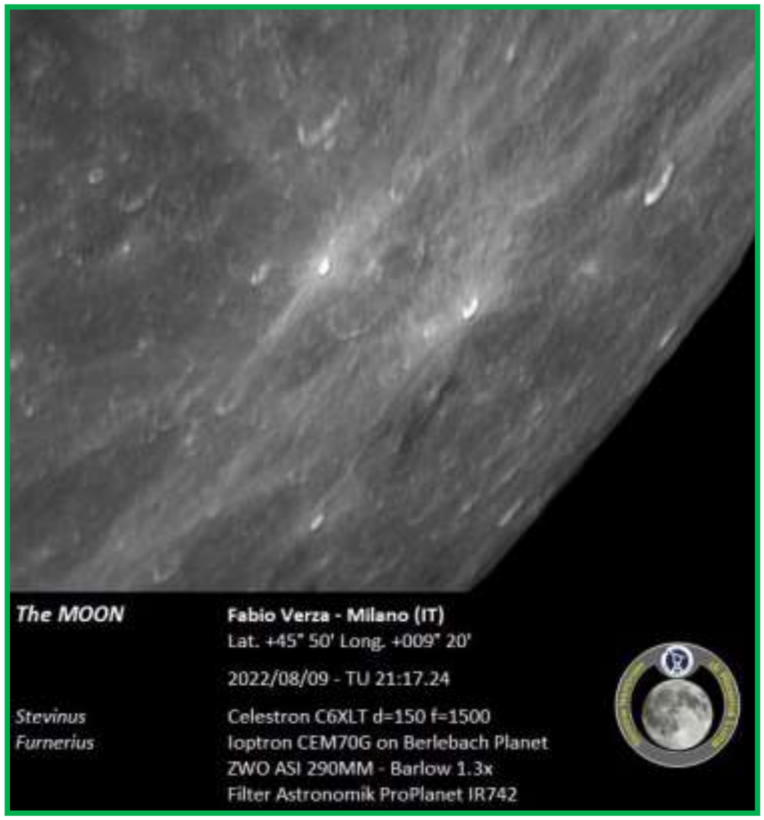


Image 71, Stevinus, *Fabio Verza, SNdR, Milan, Italy. 2022 August 09 21:17 UT. Celestron 6 inch XLT Schmidt-Cassegrain telescope, 1.3x barlow, iOptron CEM70G, Astronomik ProPlanet IR742 filter, ZWO ASI290M camera.*

One of the goals of ALPO's Lunar Bright Ray Project is to identify geological structures that have the appearance of bright rays. Is the so-called "Mädler's ray" a bright ray a "residual ray" or is it rather an area of high relief and especially bright? IMAGE 72 and 73 illustrate this conundrum. IMAGE 74 shows Mädler and the famous Catharina-Cyrillus-Theophilus trio. Before seeing this image I was unaware that the area was so rich in bright rays: Theophilus B (8 km diameter) is on the western edge of Theophilus, in Cyrillus we find Cyrillus A, a 17 km diameter crater that almost covers it with its rays in its entirety, in Cyrillus F (an ancient crater 44 kilometers diameter) we find on its eastern rim Cyrillus G, 8 kilometers in diameter, and whose rays almost make disappear the crater where it is located, and Catharina F (7 kilometers diameter, on the southern rim of Catharina) appears to have bright rays, although it is not on the ALPO list.

Image 72, Theophilus, *Rik Hill, Loudon Observatory, Tucson, Arizona, USA. 2014 November 29 23:34 UT. TEC 8 inch f/20 Maksutov-Cassegrain telescope, 665 nm filter, SKYRIS 445M camera. Seeing 8/10.*

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Image 73, Mädler, *Dominique Hoste, Kortrijk, West-Vlaanderen, Belgium. 2022 January 09 17:14 UT. TS Photoline 102 mm f/7 refractor telescope, Altair GP camera.*

Image 74, Theophilus, *Rik Hill, Loudon Observatory, Tucson, Arizona, USA. 2015 July 26 02:52 UT. TEC 8 inch f/20 Maksutov-Cassegrain telescope, 656.3 nm filter, SKYRIS 445M camera. Seeing 9/10.*

Bright ray craters do not have to be massive to be very interesting, there are many small ones and really recent in geological terms. Let's go back to IMAGE 4. Can you find on the left, inside Deslandres, the famous Cassini's Bright Spot? (IMAGE 75), named after an observation by the brilliant astronomer (and expert selenographer) Giovanni Cassini of a passing "white cloud" in the area that would actually be the ray system of the small Hell Q crater, barely 4 kilometers in diameter and a few million years old, since the density of microcraters in this bright area has been compared with the rays of Tycho, which is older (100 million years).

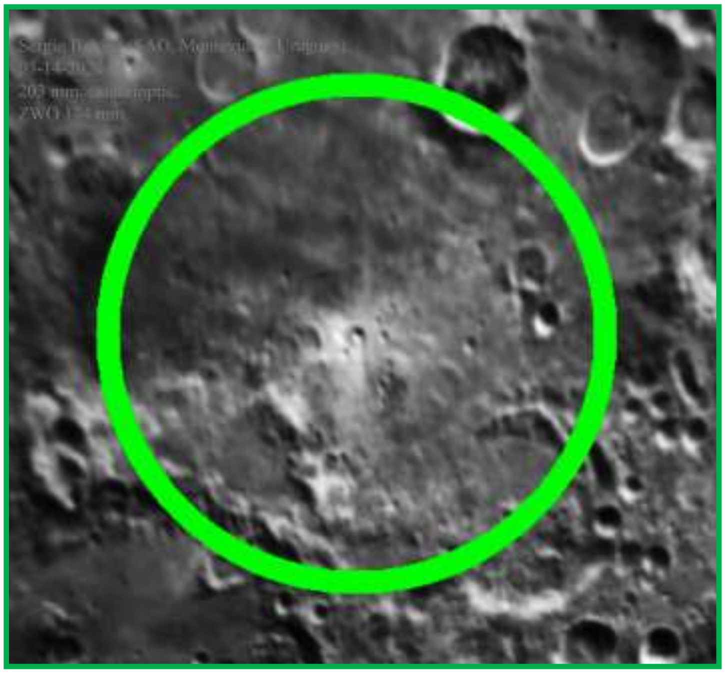

Image 75, Tycho, *Sergio Babino, SAO, Montevideo, Uruguay. 2020 March 14 05:04 UT. 203 mm catadrioptic telescope, ZWO ASI174mm camera. North to the upper left, west down.*

In an area dominated by the magnificent Ptolemaeus-Alphonsus-Arzachel trio, small Abulfeda E (6 km in diameter, upper right corner) is the brightest crater, with the typical bright ray pattern of small craters (IMAGE 76). Garfinkle attributes to Abulfeda E "a fine star pattern". Abulfeda E (3) does not look so spectacular in IMAGE 77, where we mark a series of bright craters from the ALPO list: (1) Kant P, 5 kms diameter, Kant Z, 3 kms diameter; (2) Descartes C (4 kms diameter); (4) Dollond E, 6 kms diameter. A much more spectacular image of little Descartes C is IMAGE 78.

Image 76, Abulfeda, *Desiré Godoy, Oro Verde, Argentina. 2016 December 10 01:59 UT Meade LX200 10 inch Schmidt-Cassegrain telescope, Astronomik ProPlanet 742 nm filter. North is to the upper left and west is to the lower left.*

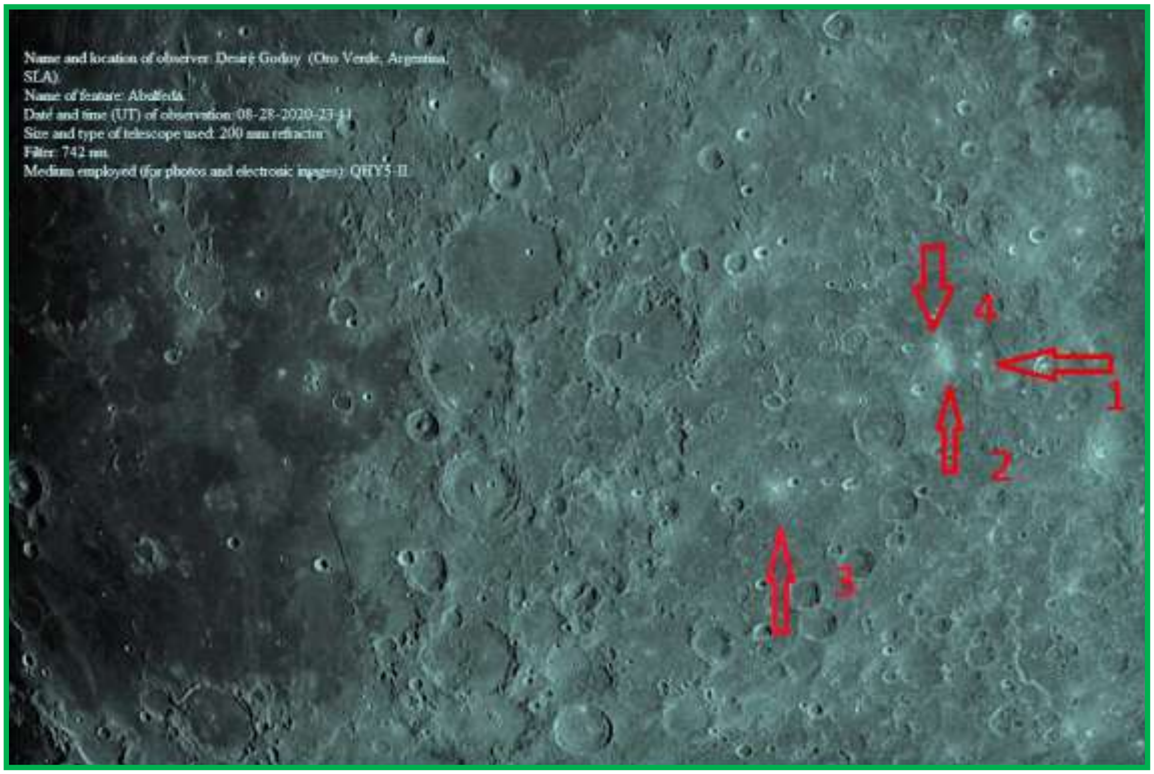

Image 77, Abulfeda, *Desiré Godoy, Oro Verde, Argentina. 2020 August 28 23:41 UT Meade 200 mm refractor telescope, Astronomik ProPlanet 742 nm filter, QHY5-II camera.*

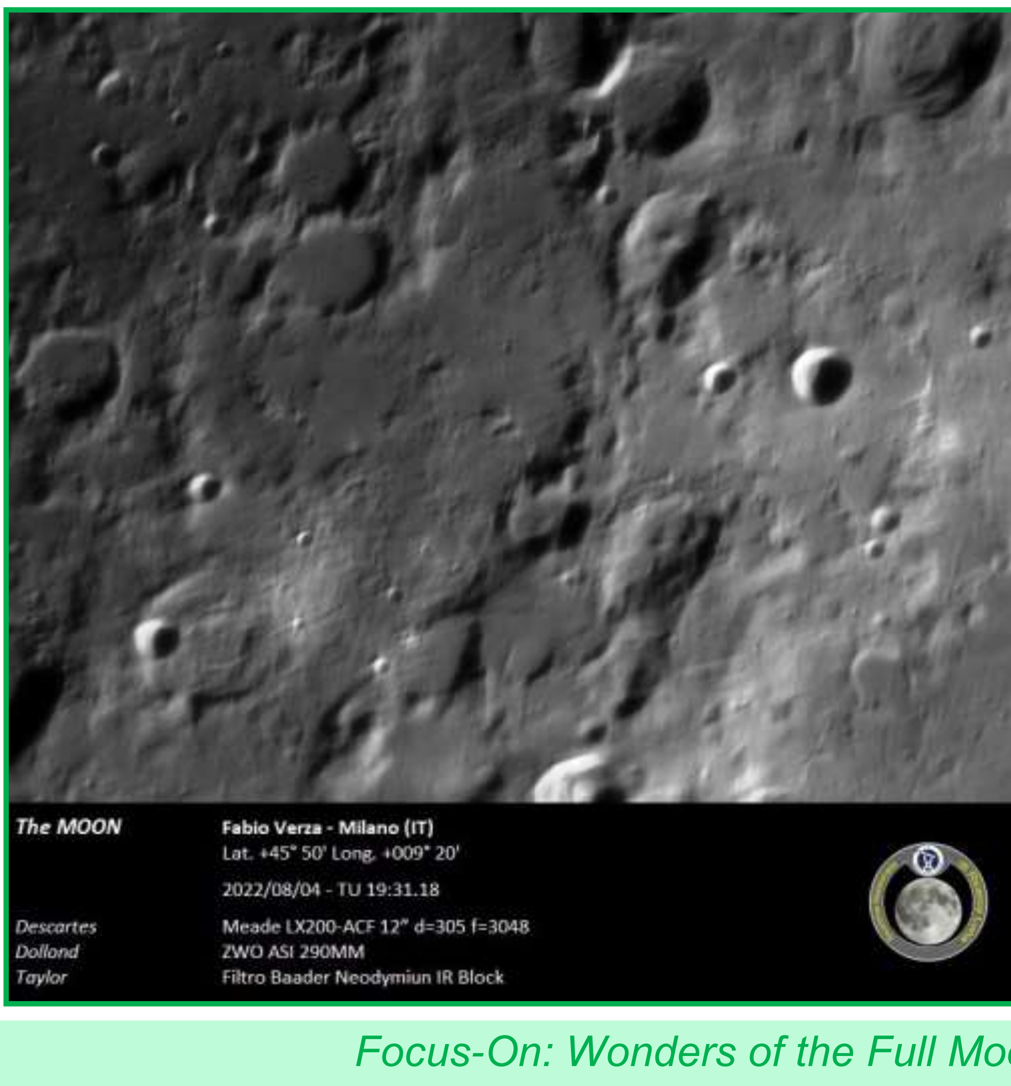

Image 78, Descartes, *Fabio Verza, SNdR, Milan, Italy. 2022 August 04 19:31 UT. Meade 12 inch LX200 Schmidt-Cassegrain telescope, Baader Neodymium IR block filter, ZWO ASI290M camera.*

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Much smaller and much brighter is Lassell D, barely 2 km across, to the west of Alphonsus (IMAGE 79, upper left), an example of what Garfinkle calls “smaller systems”: “The nearside is peppered with thousands of small light-colored ray systems emanating from intensely white craterlets. Most of these unnamed craterlets are less than 1.5 km (1 mile) in diameter. Observing these smaller systems closely, you will notice that the rays generally fan out and cover an area proportional to the diameter of the crater. As a rule, they do not have long tenuous streaks stretching radially away from the craterlet”.

Image 79, Alpetragius, *Francisco Alsina Cardinalli, SLA-LIADA, Oro Verde, Argentina. 2015 December 20 00:31 UT. 10 inch Meade LX200 Schmidt-Cassegrain telescope, Canon EOS Digital Rebel XS camera.*

In IMAGE 80 we see the bright ray craters of Mare Humorum: Doppelmayer K (5 km in diameter) and Puiseux D (7 km in diameter).

Image 80, Mare Humorum, *Rik Hill, Loudon Observatory, Tucson, Arizona, USA. 2014 January 13 06:47 UT. TEC 8 inch f/20 Maksutov-Cassegrain telescope, 656.3 nm filter, SKYRIS 445M camera. Seeing 7/10.*

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IMAGE 81 illustrates 2 craters not as small as the previous ones, but with rays not as bright: Rosse (1) and Polybius A (2)

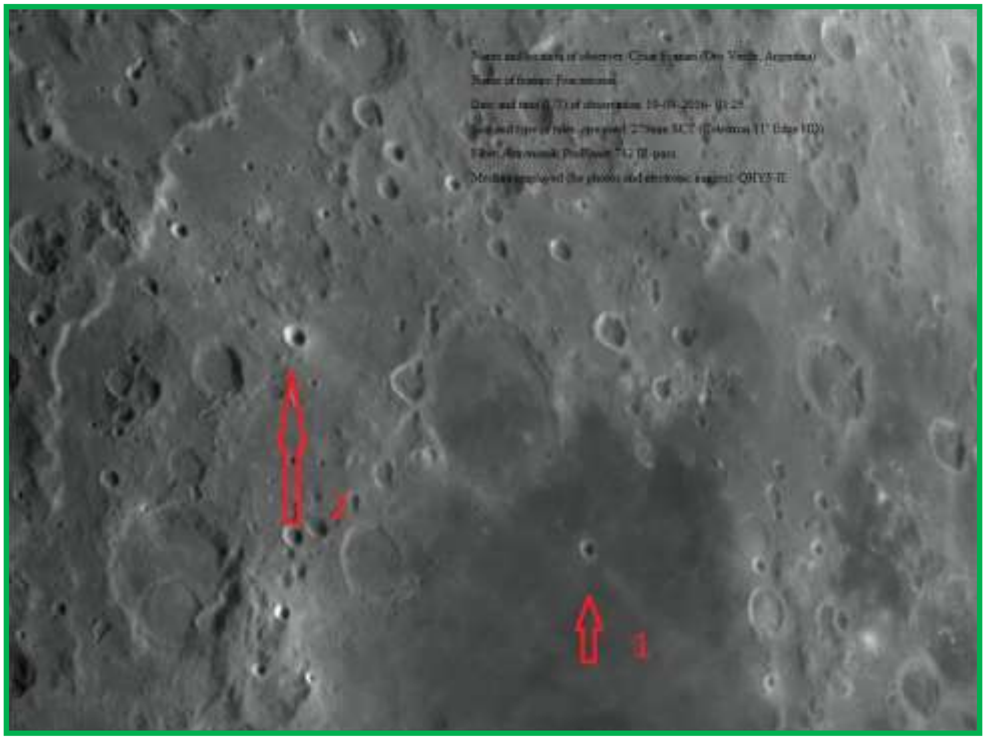

Image 81, Fracastorius, *César Fornari, Oro Verde, Argentina. 2016 October 09 01:25 UT. Celestron 11 inch Edge HD Schmidt-Cassegrain telescope, Astronomik ProPlanet 742 nm filter, QHY5-II camera. North is down, west is left.*

We began with the characterization of the vast majority of bright ray craters in the highlands, with the quote from Garfinkle, in which we read "The bright rays of highland craters tend to be longer, narrower, and straighter than mare crater rays" and we close with one of these craters with few long thin rays, which manage to shine brightly, although there is almost no contrast with the bright surface of the highlands and with the very bright rim, Rabbi Levi H (8 kms in diameter) (IMAGE 82).

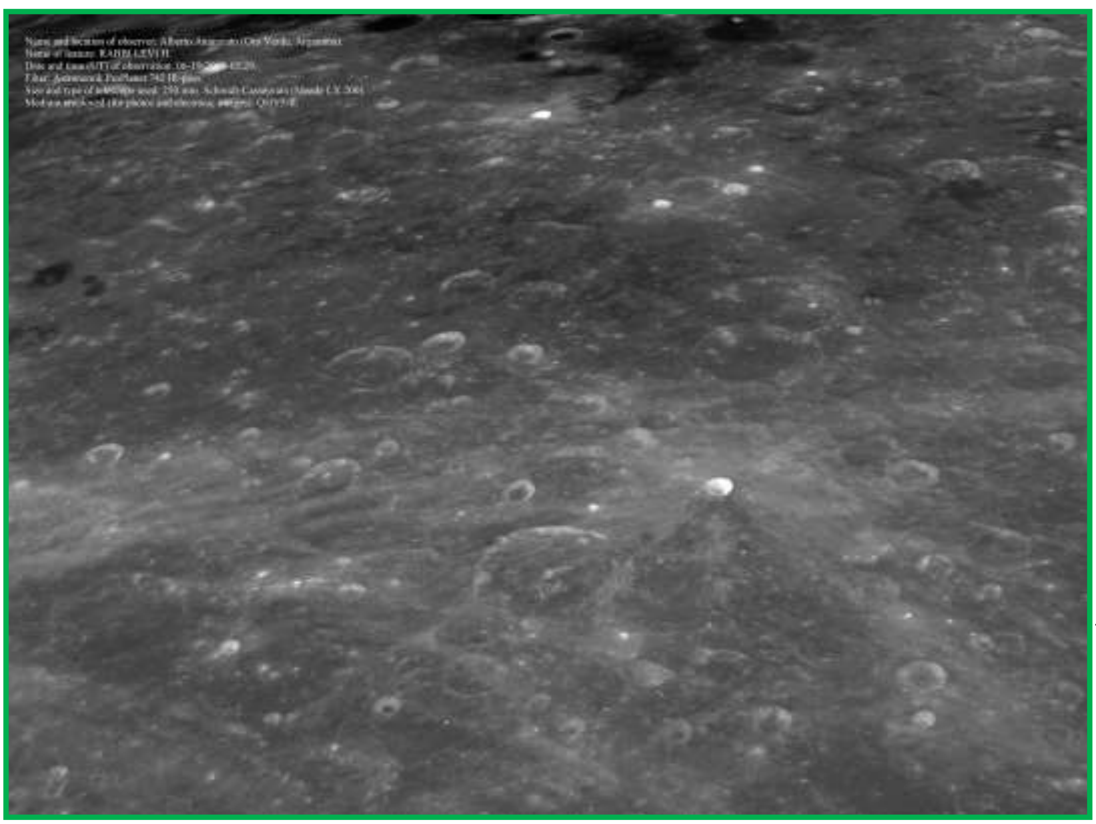

Image 82, Rabbi Levi H, *Alberto Anunziato, Oro Verde, Argentina. 2016 June 19 05:29 UT. Meade LX200 10 inch Schmidt-Cassegrain telescope, Astronomik ProPlanet 742 nm IR-pass filter, QHY5-II camera.*

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We thank all ALPO lunar observers who have collaborated in these 4 months of collections of images of bright ray craters, a field in which ALPO contributes fundamentally, through its Bright Rays Project, the main source of information on the subject, especially its list, which is a very valuable and essential reference.

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Wilhelms, Don (1993), “To a Rocky Moon”, University of Arizona Press.

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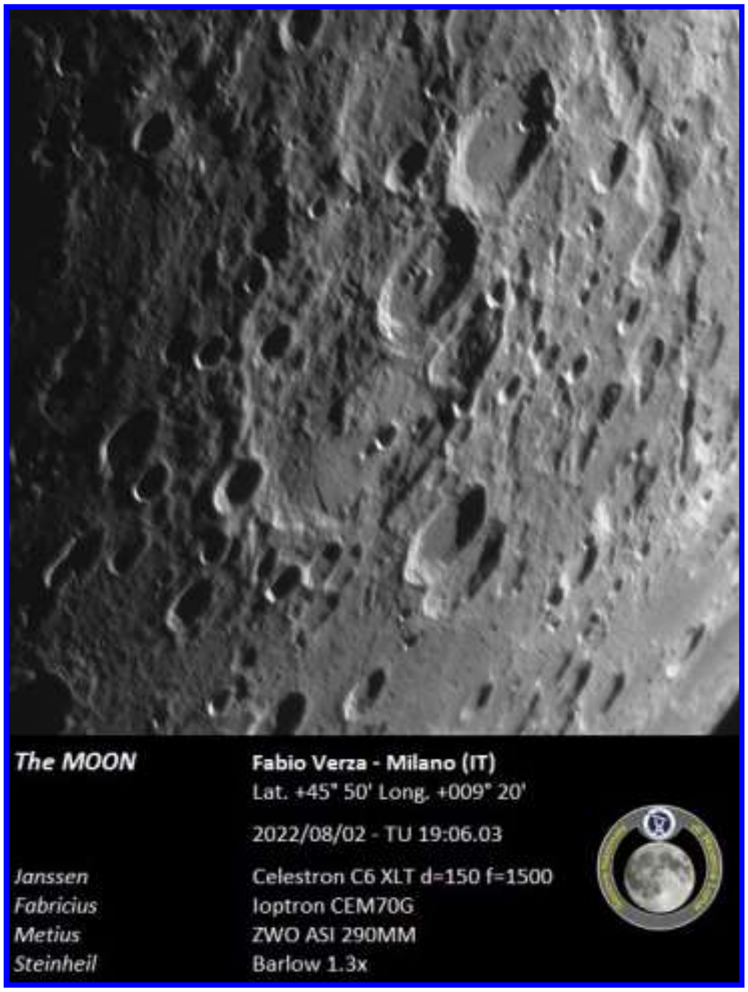
Tycho, *Rik Hill, Loudon Observatory, Tucson, Arizona, USA. 2012 May 03 04:15 UT. TEC 8 inch f/20 Maksutov-Cassegrain telescope, Wratten 23 filter, DMK21AU04 camera. Seeing 7/10.*

Focus-On: Wonders of the Full Moon

Gutenberg, *Fabio Verza, SNdR, Milan, Italy. 2022 August 02 19:13 UT. Celestron 6 inch XLT Schmidt-Cassegrain telescope, 1.3x barlow, iOptron CEM70G, ZWO ASI290M camera.*

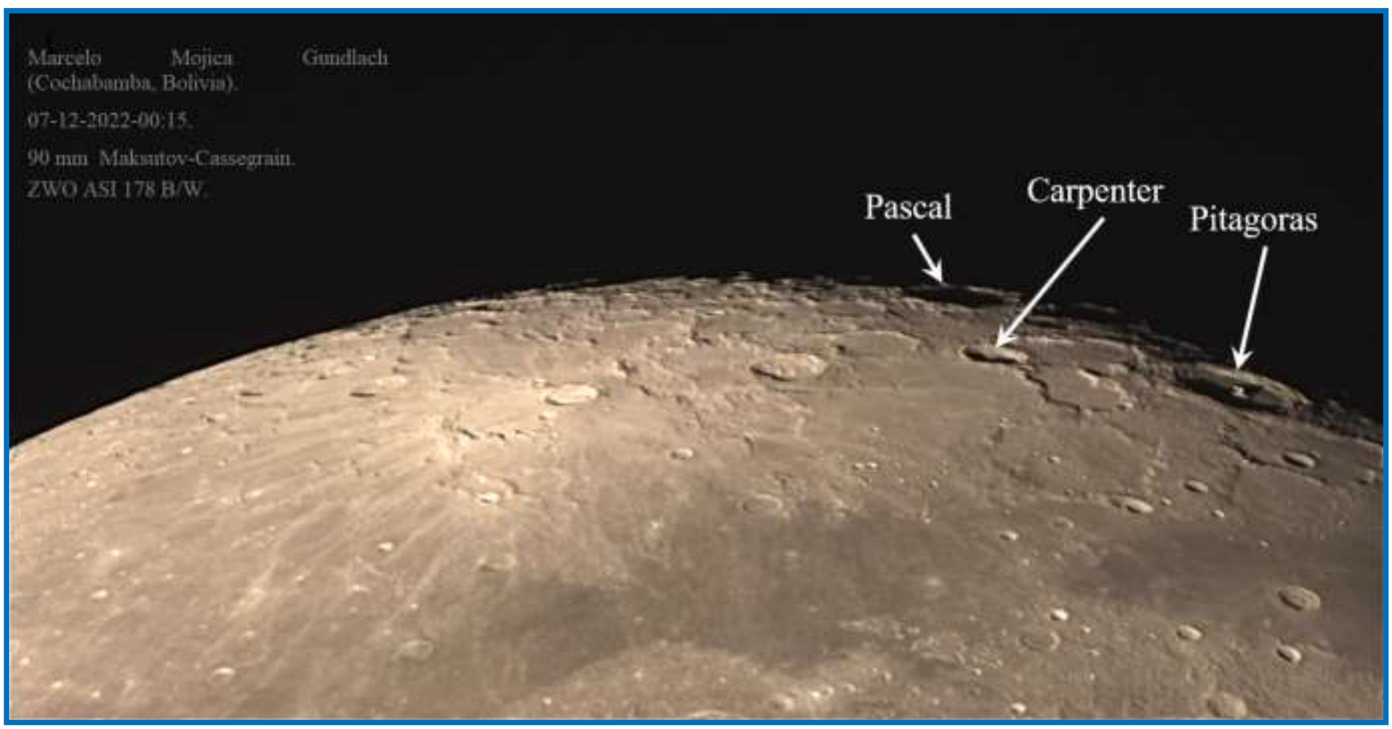
Sinus Roris, Markov, Markov U and Markov E, *István Zoltán Földvári, Budapest, Hungary. 2016 January 21, 19:17-19:36 UT, colongitude 57.5º to 57.7º. 80 mm refractor telescope, 900 mm focal length, 150 x. Seeing 6/10, transparency 4/6.*

Recent Topographic Studies



Janssen, *Fabio Verza, SNdR, Milan, Italy. 2022 August 02 19:06 UT. Celestron 6 inch XLT Schmidt-Cassegrain telescope, 1.3x barlow, iOptron CEM70G, ZWO ASI290M camera.*

Pascal, *Marcelo Mojica Gundlach, Cochabamba, Bolivia. 2022 July 12 00:15 UT. 90 mm Maksutov-Cassegrain telescope, ZWO-ASI178B/W camera.*

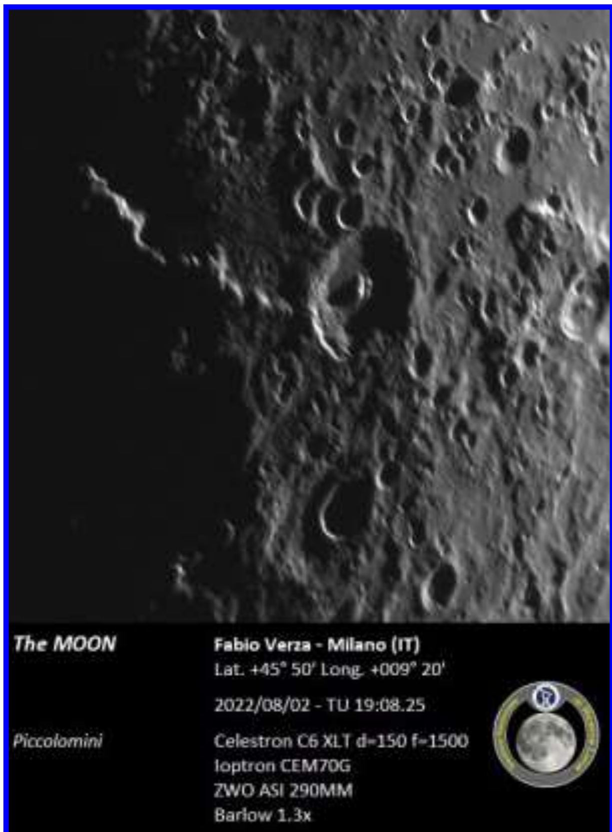


Recent Topographic Studies

Mare Nectaris, *Fabio Verza, SNdR, Milan, Italy. 2022 August 02 18:54 UT. Celestron 6 inch XLT Schmidt-Cassegrain telescope, 1.3x barlow, iOptron CEM70G, ZWO ASI290M camera.*

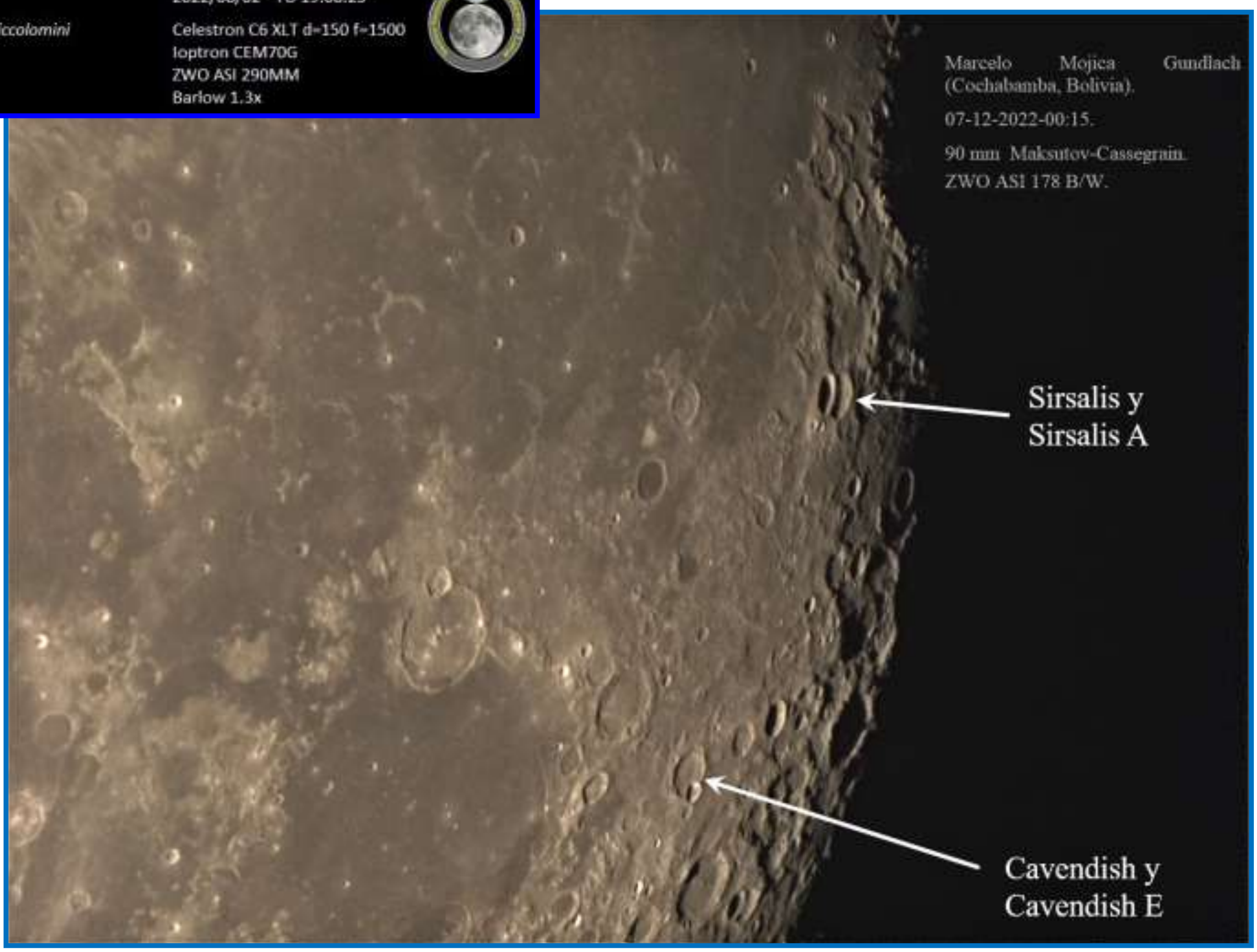
Full Moon, *Leonardo Alberto Colombo, Córdoba, Argentina. 2022 July 13 23:40 UT. 350 mm Teleobjective, 685 nm filter, QHY5LII-M camera. North is left, west is down.*

Recent Topographic Studies



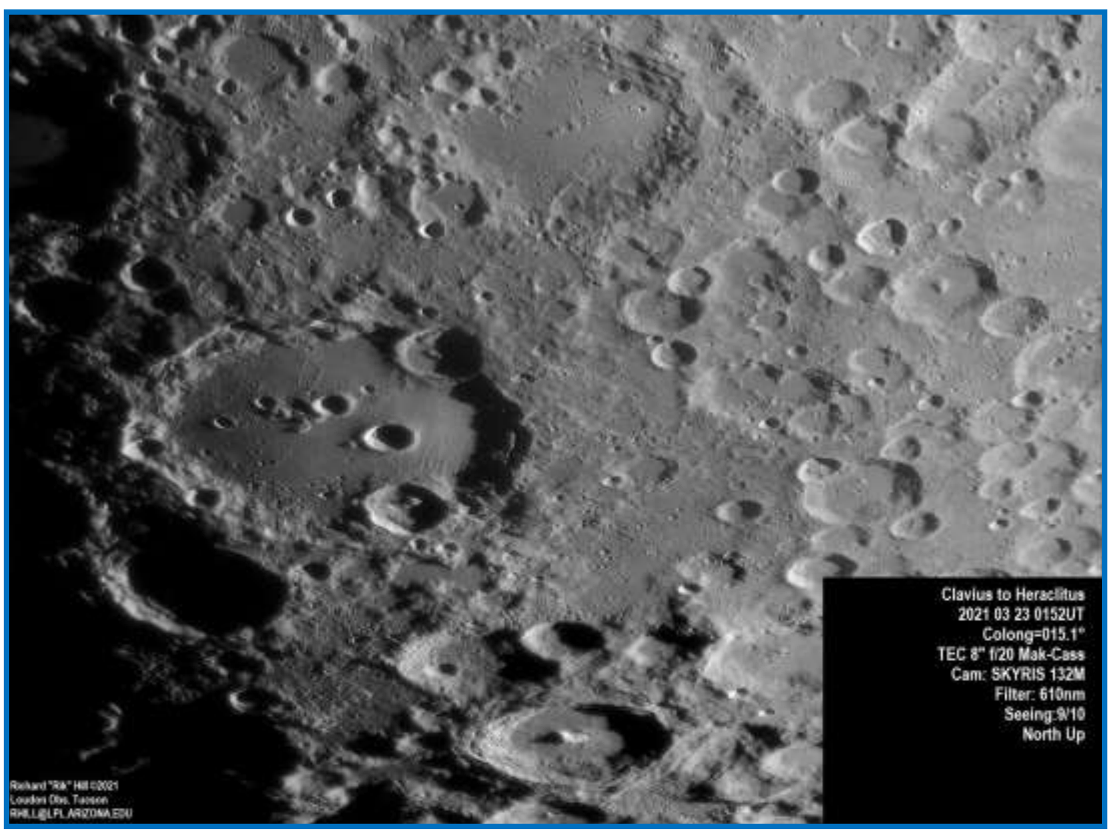
Piccolomini, *Fabio Verza, SNdR, Milan, Italy. 2022 August 02 19:08 UT. Celestron 6 inch XLT Schmidt-Cassegrain telescope, 1.3x barlow, iOptron CEM70G, ZWO ASI290M camera.*

Gassendi, *Marcelo Mojica Gundlach, Cochabamba, Bolivia. 2022 July 12 00:15 UT. 90 mm Maksutov-Cassegrain telescope, ZWO-ASI178B/W camera. North is up, west is right.*



Recent Topographic Studies

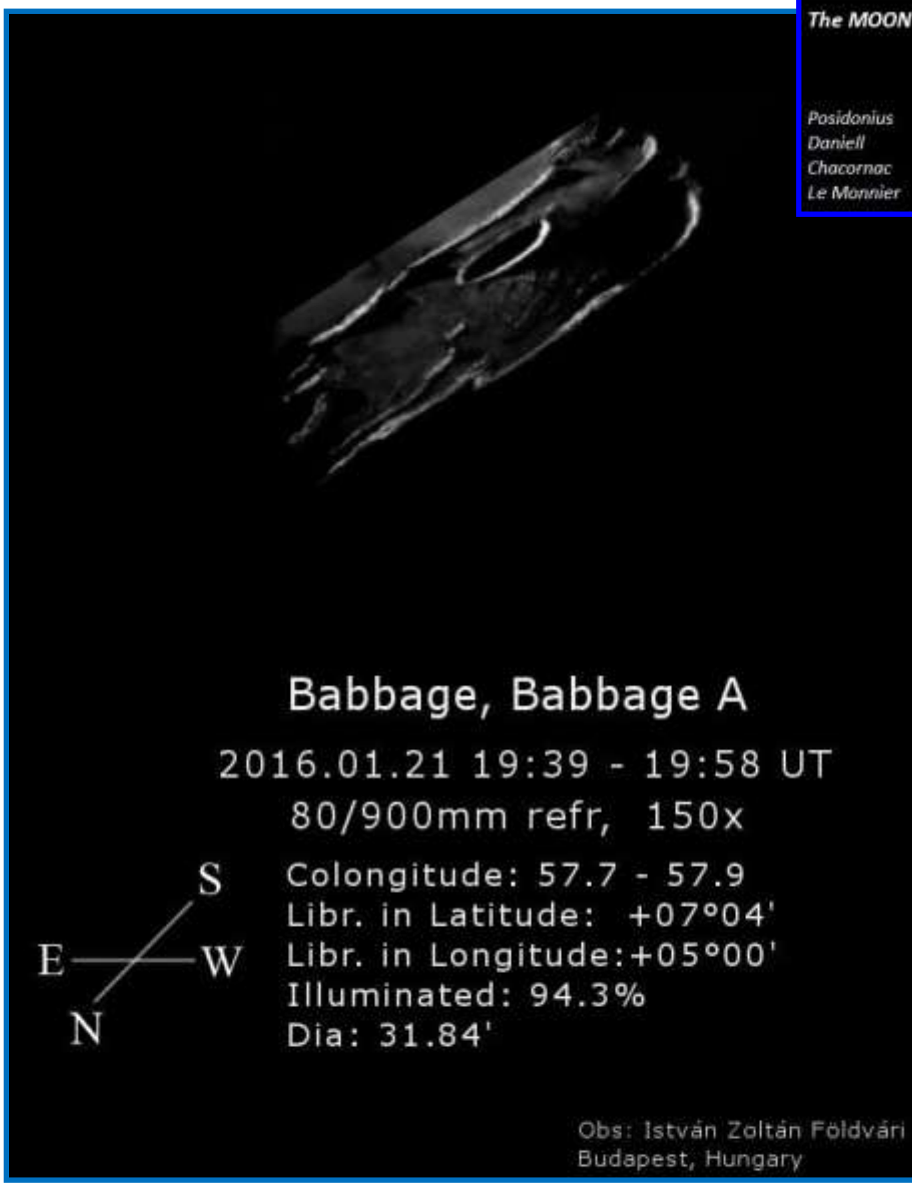
Endymion, *Fabio Verza, SNdR, Milan, Italy. 2022 August 02 19:02 UT. Celestron 6 inch XLT Schmidt-Cassegrain telescope, 1.3x barlow, iOptron CEM70G, ZWO ASI290M camera.*



Clavius to Heraclitus, *Rik Hill, Loudon Observatory, Tucson, Arizona, USA. 2021 March 23 01:52 UT, colongitude 15.1°. TEC 8 inch f/20 Maksutov-Cassegrain telescope, 610 nm filter, SKYRIS 132M camera. Seeing 9/10.*

Recent Topographic Studies

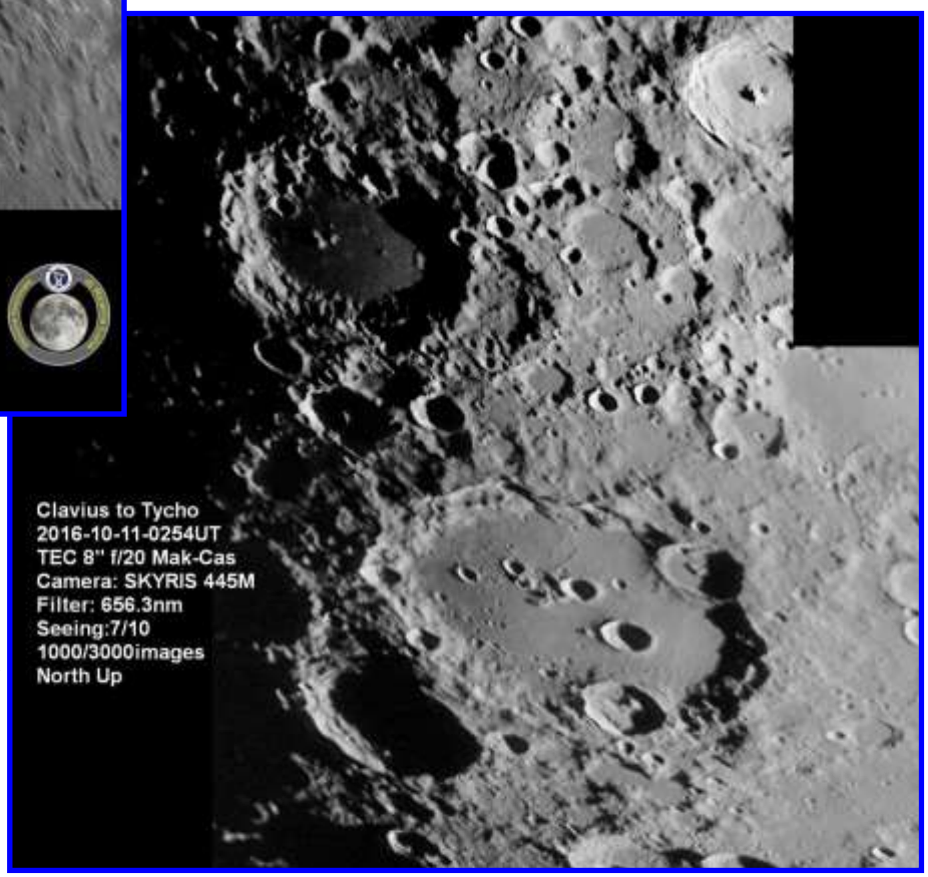
Posidonius, *Fabio Verza, SNdR, Milan, Italy. 2022 August 02 19:03 UT. Celestron 6 inch XLT Schmidt-Cassegrain telescope, 1.3x barlow, iOptron CEM70G, ZWO ASI290M camera.*



Babbage and Babbae A, *István Zoltán Földvári, Budapest, Hungary. 2016 January 21, 19:39-19:58 UT, colongitude 57.7^o to 57.9^o. 80 mm refractor telescope, 900 mm focal length, 150 x. Seeing 6/10, transparency 4/6.*

Recent Topographic Studies

Mare Crisium, *Fabio Verza, SNdR, Milan, Italy. 2022 August 02 19:00 UT. Celestron 6 inch XLT Schmidt-Cassegrain telescope, 1.3x barlow, iOptron CEM70G, ZWO ASI290M camera.*



Clavius, *Rik Hill, Loudon Observatory, Tucson, Arizona, USA. 2016 October 11 02:54 UT. TEC 8 inch f/20 Maksutov-Cassegrain telescope, 656.3 nm filter, SKYRIS 445M camera. Seeing 7/10.*

Recent Topographic Studies

Taruntius, *Fabio Verza, SNdR, Milan, Italy. 2022 August 02 19:10 UT. Celestron 6 inch XLT Schmidt-Cassegrain telescope, 1.3x barlow, iOptron CEM70G, ZWO ASI290M camera.*

Mersenius to Cavalerius, *Rafael Benavides, Posadas Observatory MPC J53, Córdoba, Spain. 2022 January 15 22:05 UT. Celestron 11 inch Schmidt-Cassegrain telescope, Baader Planetarium IR Pass filter, ZWO ASI290mm/s camera. Seeing 6/10, transparency 5/6. https://www.flickr.com/photos/7473900@N02/52184138569/sizes/o/*

Recent Topographic Studies

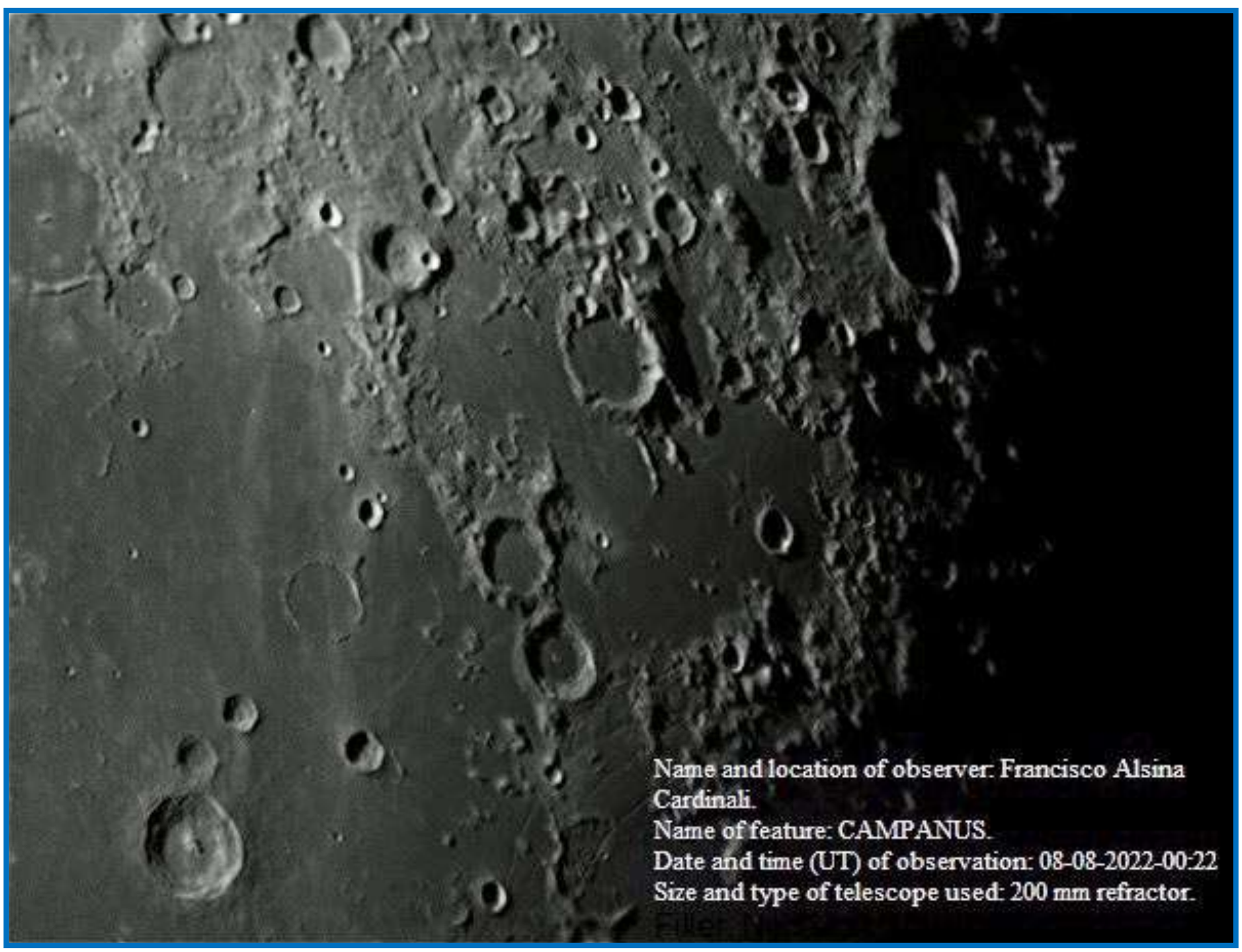
Petavius, *Fabio Verza, SNdR, Milan, Italy. 2022 August 02 18:56 UT. Celestron 6 inch XLT Schmidt-Cassegrain telescope, 1.3x barlow, iOptron CEM70G, ZWO ASI290M camera.*

Plato, *Marcelo Mojica Gundlach, Cochabamba, Bolivia. 2022 July 12 00:15 UT. 90 mm Maksutov-Cassegrain telescope, ZWO-ASI178B/W camera. North is up, west is right.*

Recent Topographic Studies

Aristoteles, *Fabio Verza, SNdR, Milan, Italy. 2022 August 04 19:20 UT. Meade 12 inch LX200 Schmidt-Cassegrain telescope, Baader Neodymium IR block filter, ZWO ASI290M camera.*

Campanus, *Francisco Alsina Cardinalli, SLA-LIADA, Oro Verde, Argentina. 2022 August 08 00:22 UT. 200 mm refractor telescope, QHY5-II camera. North is down, west is right.*



Recent Topographic Studies

Endymion, *Fabio Verza, SNdR, Milan, Italy. 2022 August 04 19:51 UT. Meade 12 inch LX200 Schmidt-Cassegrain telescope, Baader Neodymium IR block filter, ZWO ASI290M camera.*

Aristarchus, *Walter Ricardo Elias, AEA, Oro Verde, Argentina. 2022 August 17 05:59 UT. 114 mm Helios reflector telescope, QHY5-IIC camera.*

Recent Topographic Studies

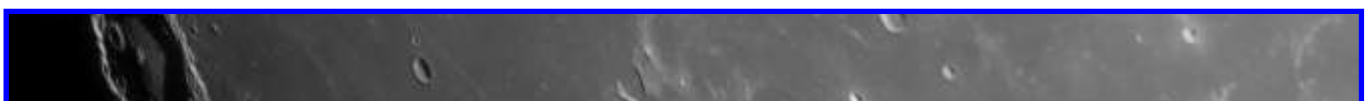
Cassini, *Fabio Verza, SNdR, Milan, Italy. 2022 August 04 19:48 UT. Meade 12 inch LX200 Schmidt-Cassegrain telescope, Baader Neodymium IR block filter, ZWO ASI290M camera.*

Werner, *Jairo Chavez, Popayán, Colombia . 2022 August 04 23:47 UT. 311 mm reflector telescope, MOTO E5 PLAY camera. North is down, west is right.*

Recent Topographic Studies

Eudoxus, *Fabio Verza, SNdR, Milan, Italy. 2022 August 04 19:21 UT. Meade 12 inch LX200 Schmidt-Cassegrain telescope, Baader Neodymium IR block filter, ZWO ASI290M camera.*

Hansteen, *Rafael Benavides, Posadas Observatory MPC J53, Córdoba, Spain. 2022 January 15 22:27 UT. Celestron 11 inch Schmidt-Cassegrain telescope, Baader Planetarium IR Pass filter, ZWO ASI290mm/s camera. Seeing 6/10, transparency 5/6.* https://www.flickr.com/photos/7473900@N02/52262512467/sizes/o/



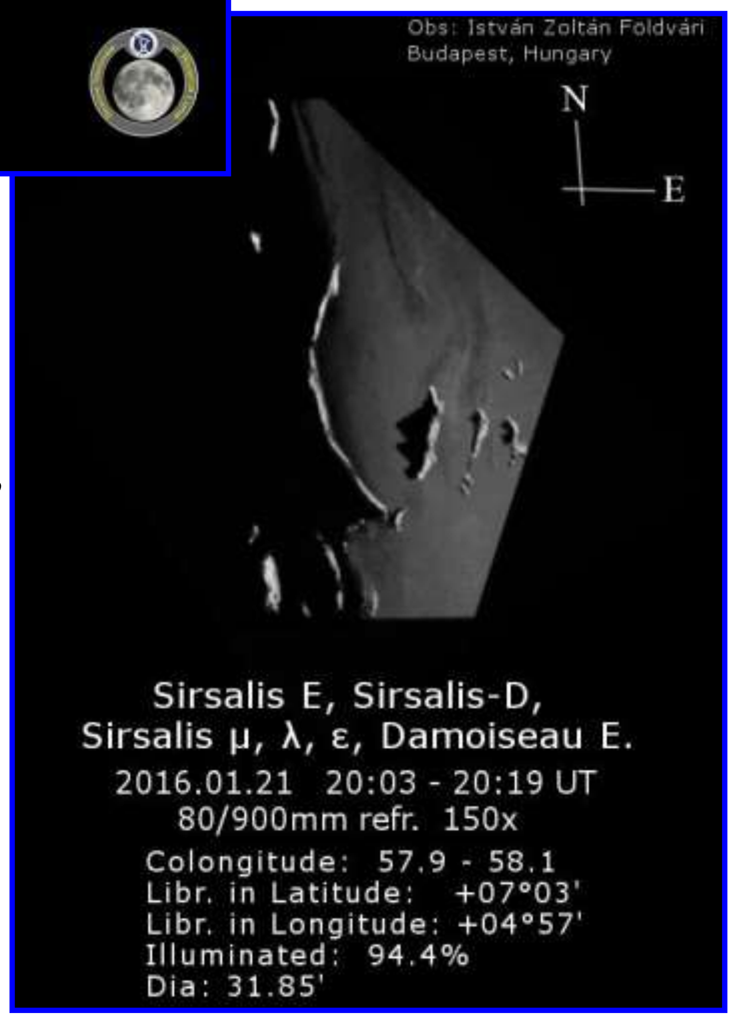
Recent Topographic Studies

Hyginus, Fabio Verza, SNdR, Milan, Italy. 2022 August 04 19:45 UT. Meade 12 inch LX200 Schmidt-Cassegrain telescope, Baader Neodymium IR block filter, ZWO ASI290M camera.

Mons Piton, Francisco Alsina Cardinalli, SLA-LIADA, Oro Verde, Argentina. 2022 August 08 00:32 UT. 200 mm refractor telescope, QHY5-II camera. North is left, west is down.

Recent Topographic Studies

Julius Caesar, *Fabio Verza, SNdR, Milan, Italy. 2022 August 04 19:33 UT. Meade 12 inch LX200 Schmidt-Cassegrain telescope, Baader Neodymium IR block filter, ZWO ASI290M camera.*

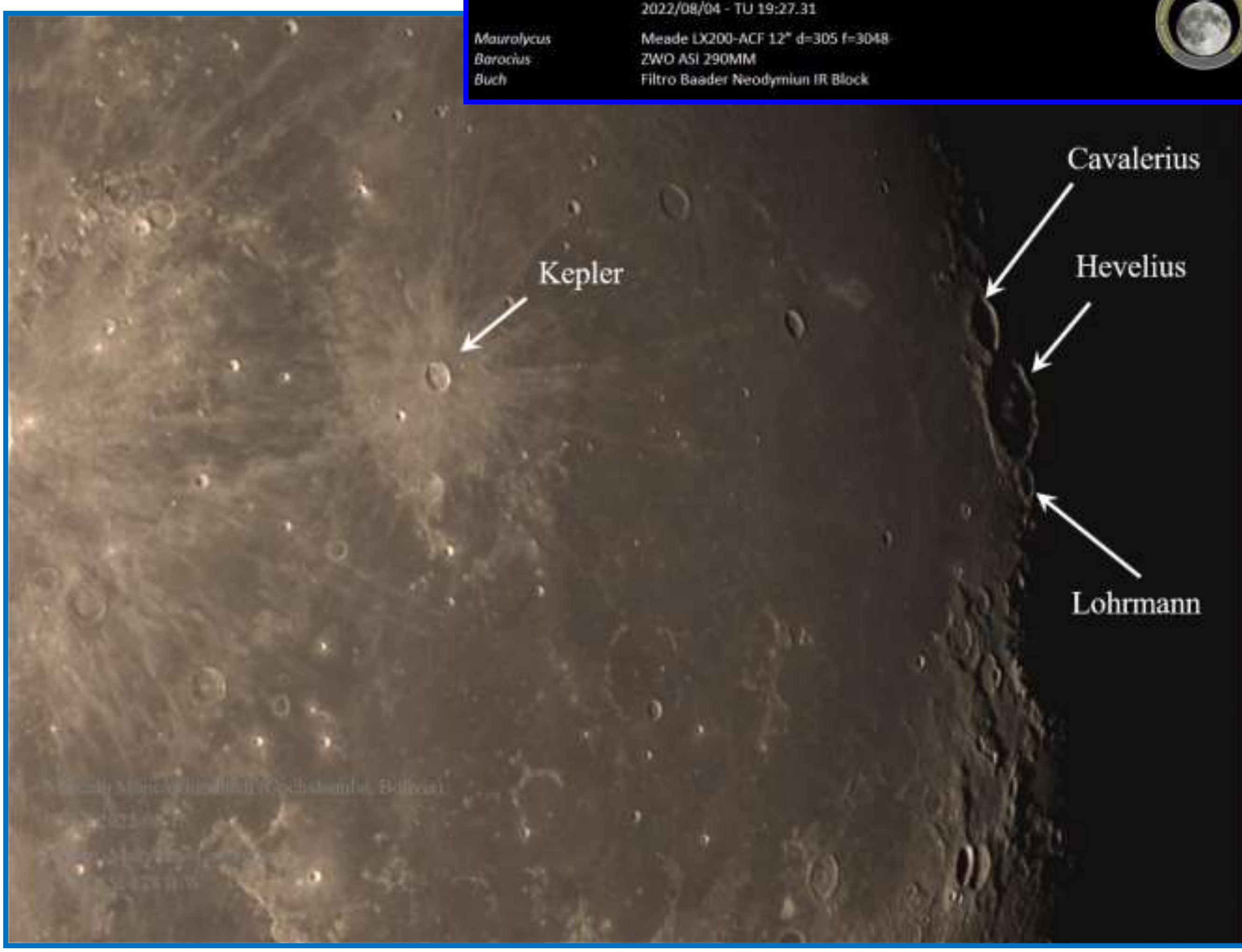


Sirsalis E, *István Zoltán Földvári, Budapest, Hungary. 2016 January 21, 20:03-20:19 UT, colongitude 57.9^o to 58.1^o. 80 mm refractor telescope, 900 mm focal length, 150 x. Seeing 6710, transparency 4/6.*

Recent Topographic Studies

Maurolycus, *Fabio Verza, SNdR, Milan, Italy. 2022 August 04 19:27 UT. Meade 12 inch LX200 Schmidt-Cassegrain telescope, Baader Neodymium IR block filter, ZWO ASI290M camera.*

Kepler, *Marcelo Mojica Gundlach, Cochabamba, Bolivia. 2022 July 12 00:15 UT. 90 mm Maksutov-Cassegrain telescope, ZWO-ASI178B/W camera. North is up, west is right.*



Lacus Mortis, *Fabio Verza, SNdR, Milan, Italy. 2022 August 04 19:38 UT. Meade 12 inch LX200 Schmidt-Cassegrain telescope, Baader Neodymium IR block filter, ZWO ASI290M camera.*

Menelaus, *Jairo Chavez, Popayán, Colombia . 2022 August 04 23:47 UT. 311 mm reflector telescope, MOTO E5 PLAY camera. North is to the lower right, west is upper right.*

Recent Topographic Studies

Montes Caucasus, *Fabio Verza, SNdR, Milan, Italy. 2022 August 04 19:36 UT. Meade 12 inch LX200 Schmidt-Cassegrain telescope, Baader Neodymium IR block filter, ZWO ASI290M camera.*

Waxing Gibbous Moon, *Jairo Chavez, Popayán, Colombia . 2022 August 08 00:43 UT. 311 mm reflector telescope, MOTO E5 PLAY camera. North is down, west is right.*

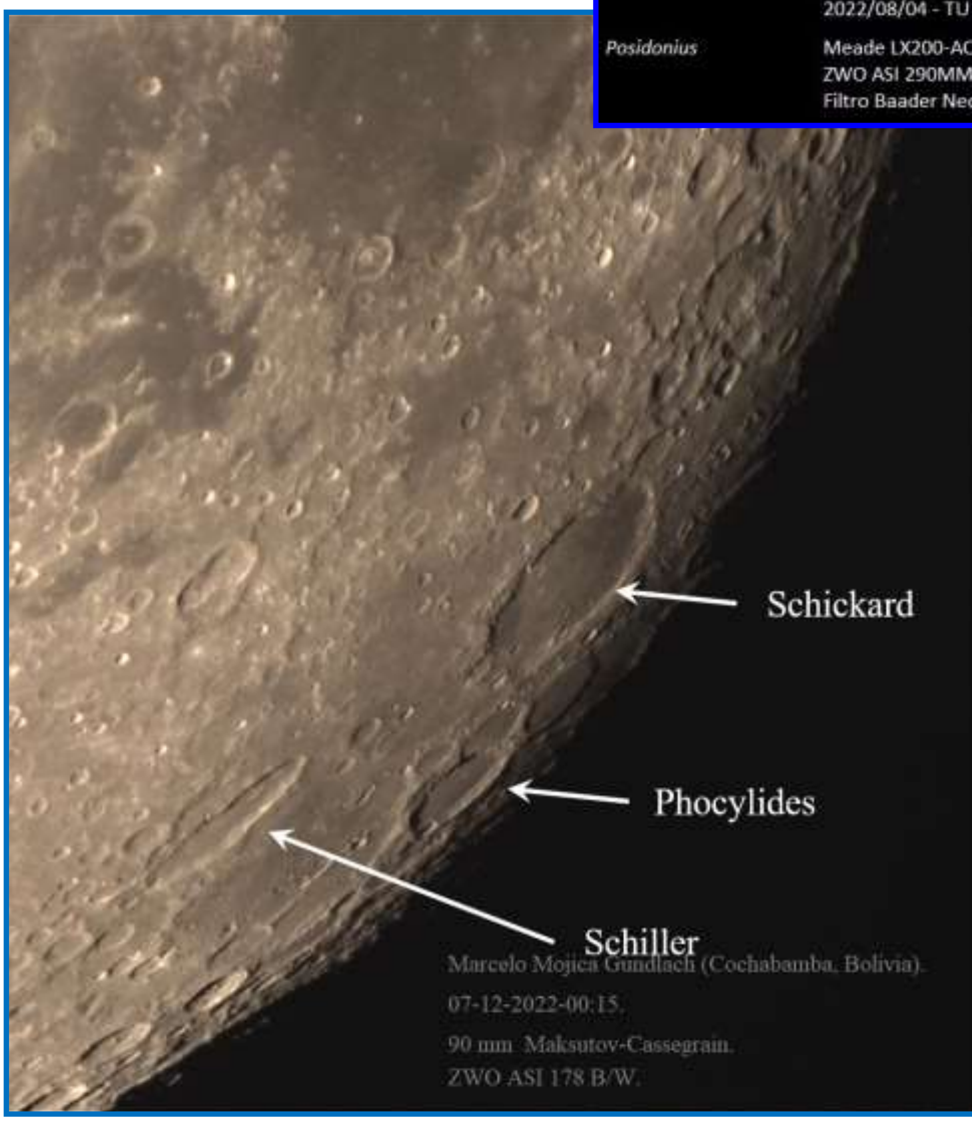
Recent Topographic Studies

Piccolomini, *Fabio Verza, SNdR, Milan, Italy. 2022 August 04 19:27 UT. Meade 12 inch LX200 Schmidt-Cassegrain telescope, Baader Neodymium IR block filter, ZWO ASI290M camera.*

Gassendi, *Rafael Benavides, Posadas Observatory MPC J53, Córdoba, Spain. 2022 January 15 22:13 UT. Celestron 11 inch Schmidt-Cassegrain telescope, Baader Planetarium IR Pass filter, ZWO ASI290mm/s camera. Seeing 6/10, transparency 5/6. https://www.flickr.com/photos/7473900@N02/52215621016/sizes/o/*

Recent Topographic Studies

Posidonius, *Fabio Verza, SNdR, Milan, Italy. 2022 August 04 19:15 UT. Meade 12 inch LX200 Schmidt-Cassegrain telescope, Baader Neodymium IR block filter, ZWO ASI290M camera.*



Schiller, *Marcelo Mojica Gundlach, Cochabamba, Bolivia. 2022 July 12 00:15 UT. 90 mm Maksutov-Cassegrain telescope, ZWO-ASI178B/W camera. North is up, west is right.*

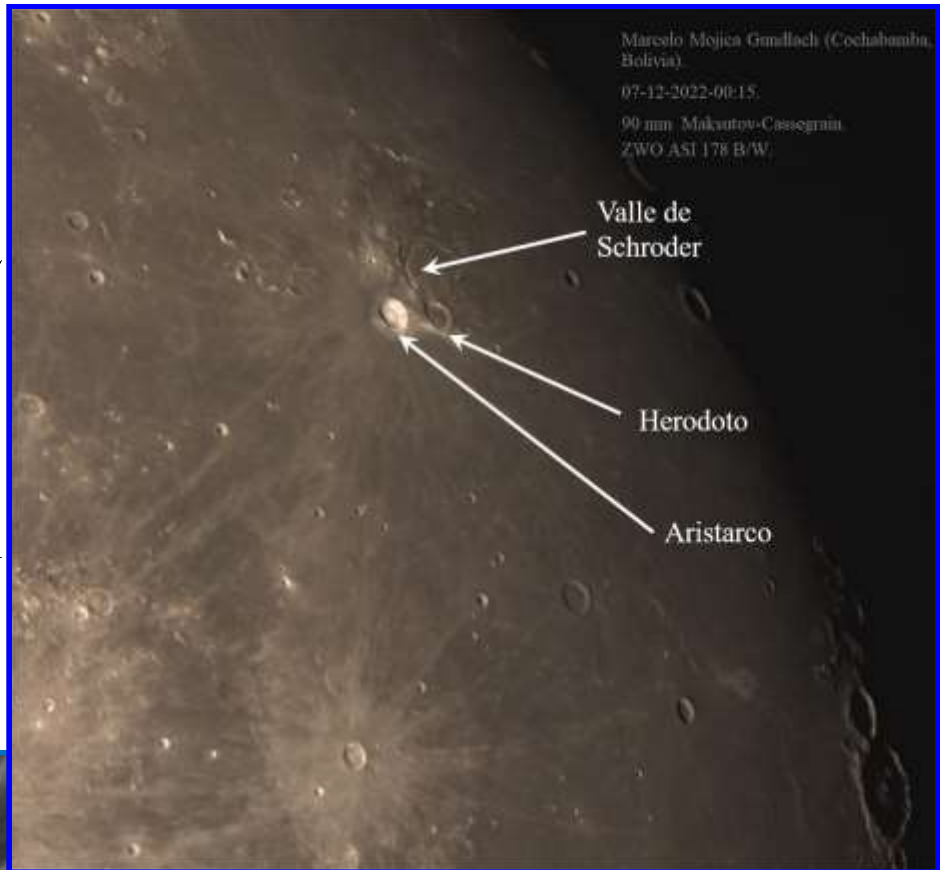
Recent Topographic Studies

Rheita, *Fabio Verza, SNdR, Milan, Italy. 2022 August 04 19:38 UT. Meade 12 inch LX200 Schmidt-Cassegrain telescope, Baader Neodymium IR block filter, ZWO ASI290M camera.*

Gassendi, *Walter Ricardo Elias, AEA, Oro Verde, Argentina. 2022 August 17 06:02 UT. 114 mm Helios reflector telescope, QHY5-IIC camera.*

Recent Topographic Studies

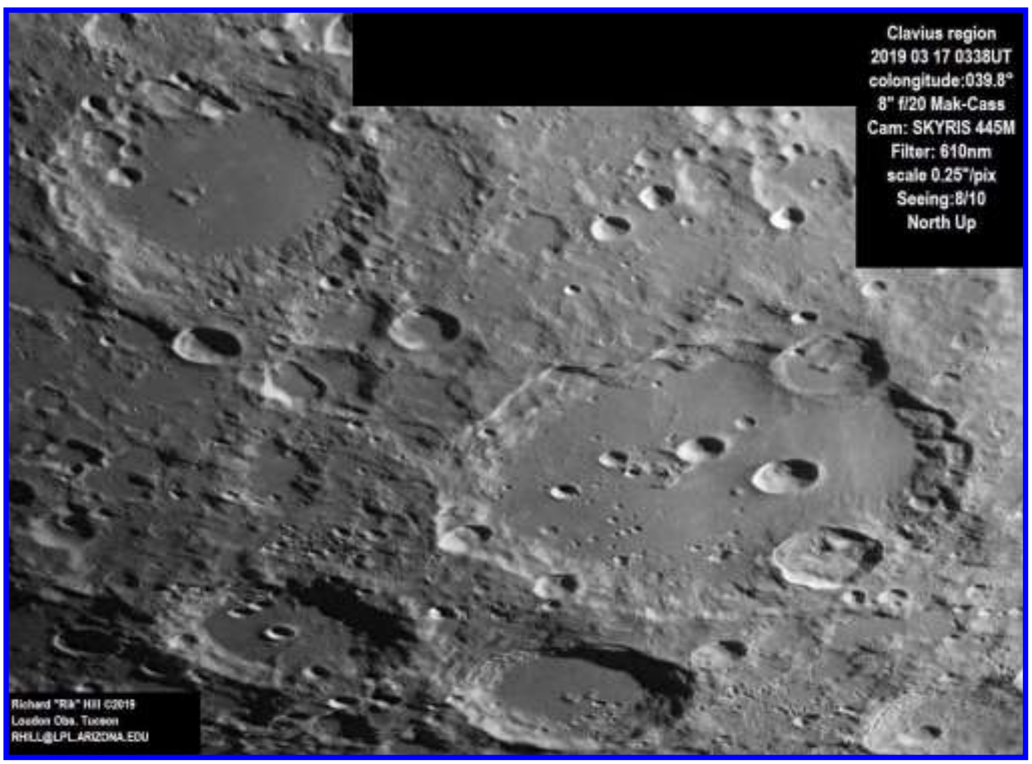
Aristarchus, *Marcelo Mojica Gundlach, Cochabamba, Bolivia. 2022 July 12 00:15 UT. 90 mm Maksutov-Cassegrain telescope, ZWO-ASI178B/W camera. North is up, west is right.*



Theophilus, *Fabio Verza, SNdR, Milan, Italy. 2022 August 04 19:24 UT. Meade 12 inch LX200 Schmidt-Cassegrain telescope, Baader Neodymium IR block filter, ZWO ASI290M camera.*

Recent Topographic Studies

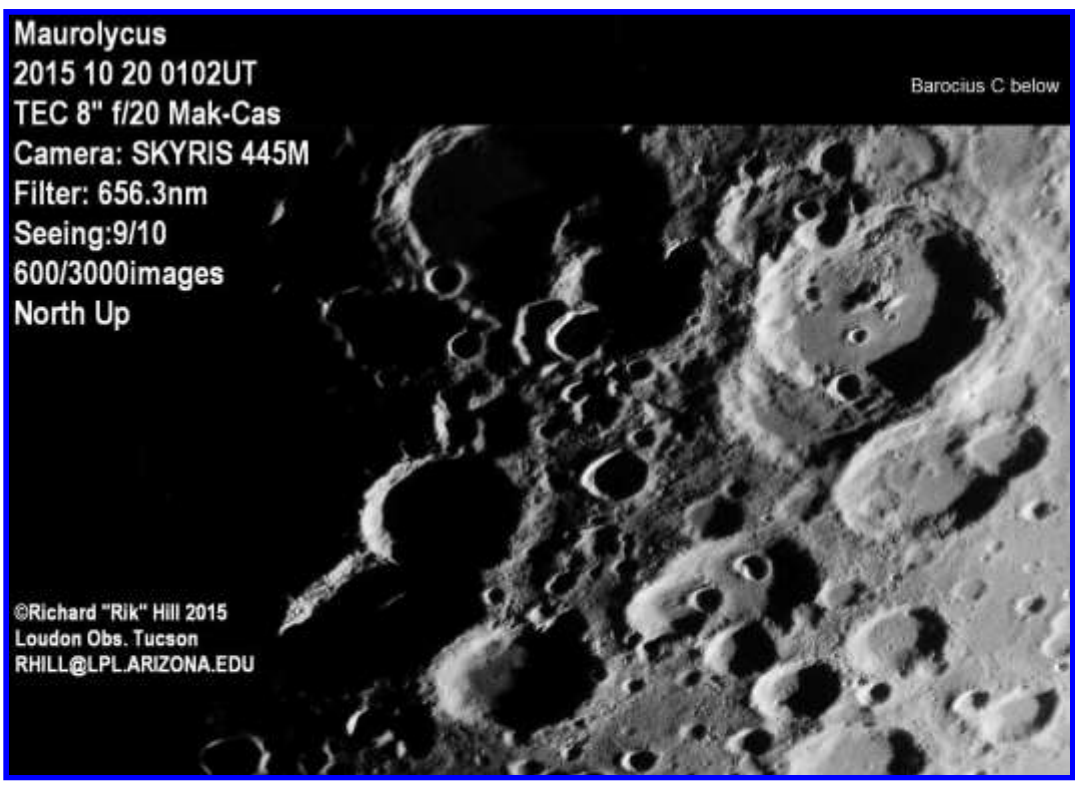
First Quarter Moon, *Jairo Chavez, Popayán, Colombia . 2022 August 04 23:39 UT. 311 mm reflector telescope, MOTO E5 PLAY camera. North is down, west is right.*



Clavius, *Rik Hill, Loudon Observatory, Tucson, Arizona, USA. 2019 March 17 03:38 UT, colongitude 39.8°. TEC 8 inch f/20 Maksutov-Cassegrain telescope, 610 nm filter, SKYRIS 445M camera. Seeing 8/10.*

Recent Topographic Studies

Copernicus, *Massimo Dionisi, Sassari, Italy. 2022 August 21 01:50 UT. Skywatcher Newtonian telescope, 3x Barlow, f/15, Wratten #8 filter (yellow), Skywatcher EQ6Pro mount, ZWO ASI120MC camera.*

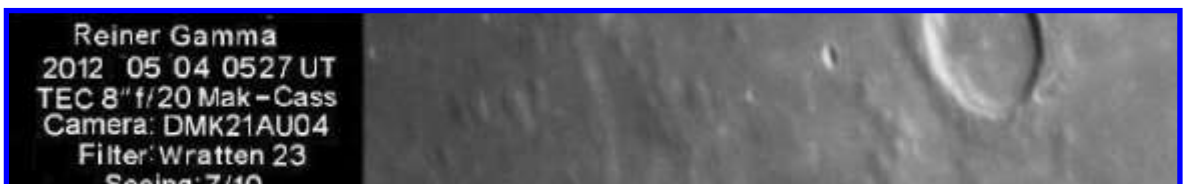


Maurolycus and Barocius C, *Rik Hill, Loudon Observatory, Tucson, Arizona, USA. 2015 October 20 01:01 UT. TEC 8 inch f/20 Maksutov-Cassegrain telescope, 656.3 nm filter, SKYRIS 445M camera. Seeing 9/10.*

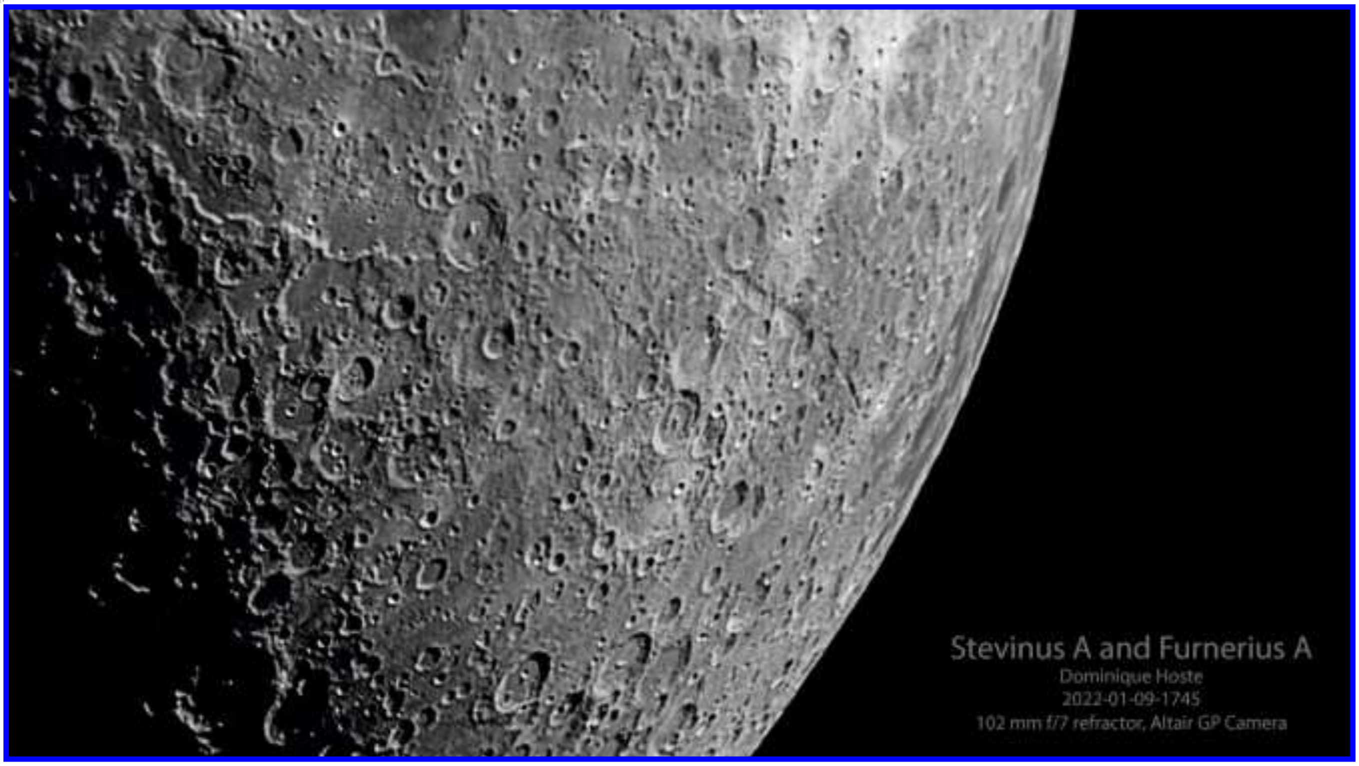
Recent Topographic Studies

Tycho, *Eva Leguiza, AEA, Oro Verde, Argentina. 2022 July 09 20:58 UT. Celestron 11 inch CPC Schmidt-Cassegrain telescope, ZWO ASI120mm camera.*

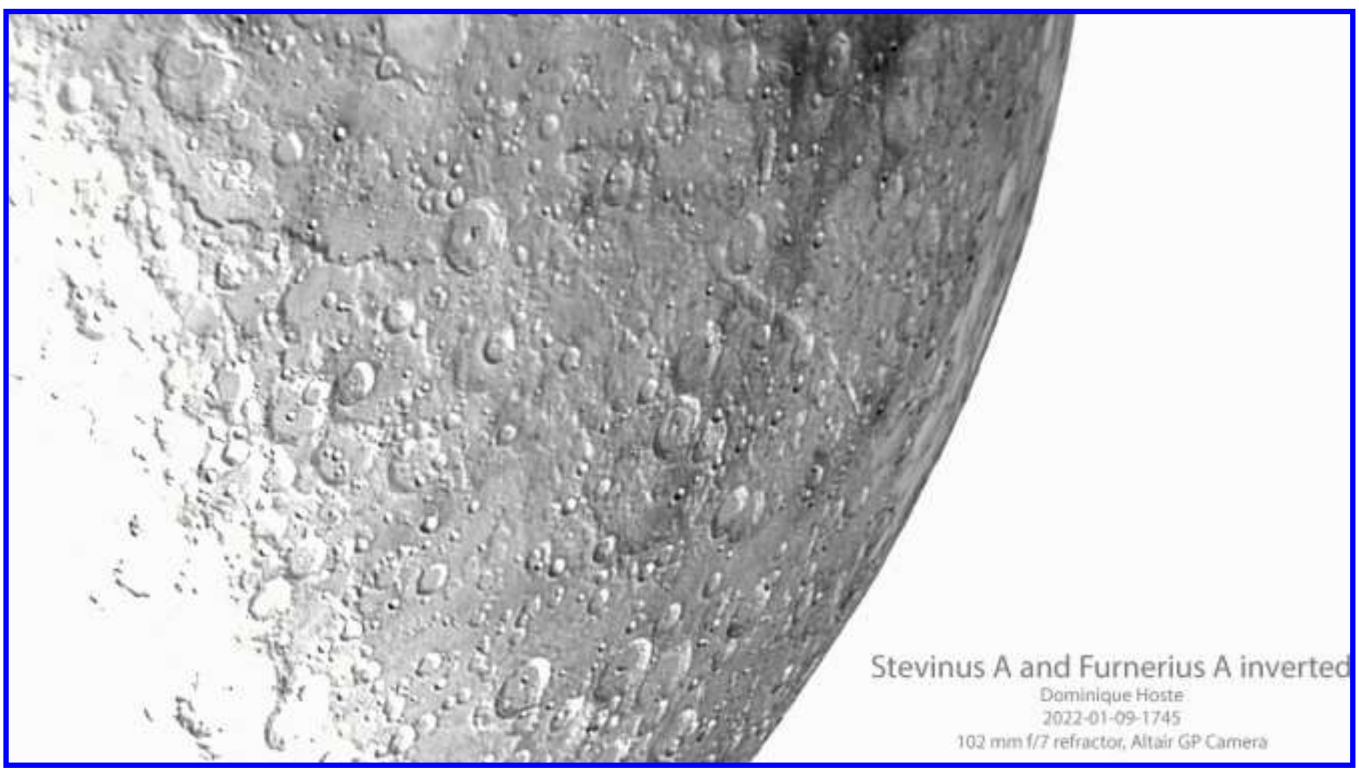
Reiner Gamma, *Rik Hill, Loudon Observatory, Tucson, Arizona, USA. 2012 May 04 05:27 UT. TEC 8 inch f/20 Maksutov-Cassegrain telescope, Wratten 23 filter, DMK21AU04 camera. Seeing 7/10.*



Recent Topographic Studies



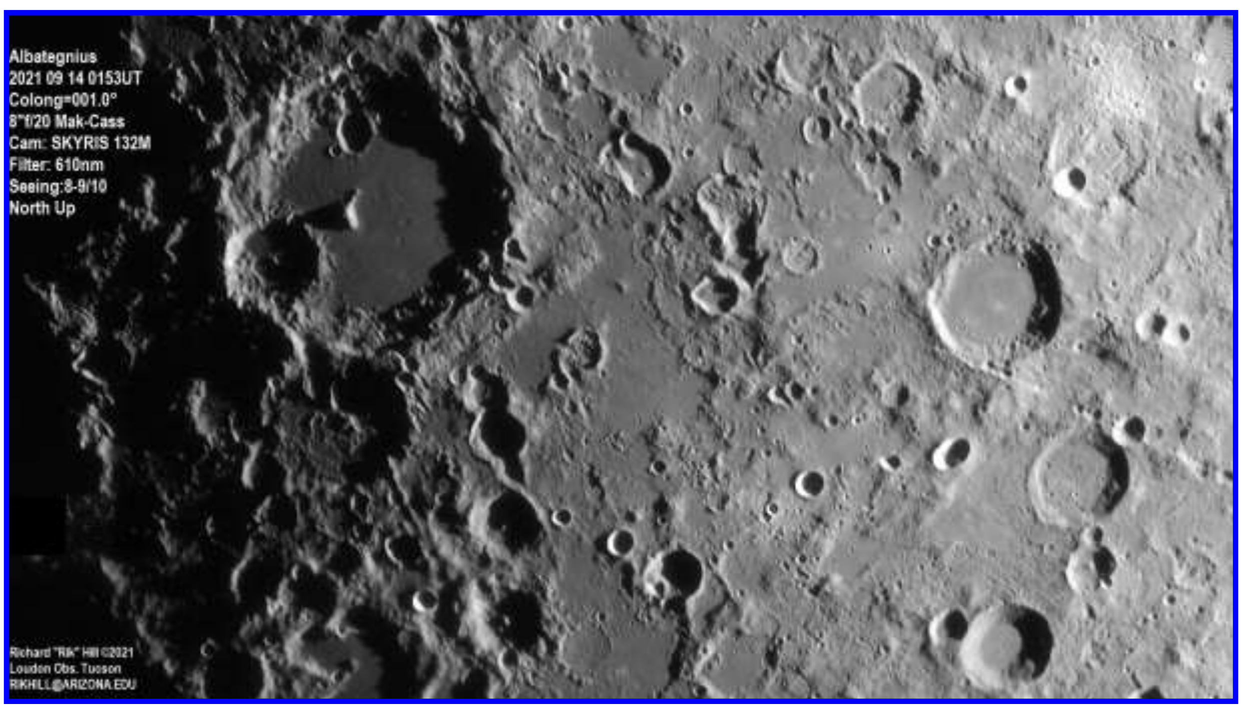
Stevinus A and Furnerius A, Normal and Inverted, *Dominique Hoste, Kortrijk, West-Vlaanderen, Belgium. 2022 January 09 17:45 UT. TS Photoline 102 mm f/7 refractor telescope, Altair GP camera.*



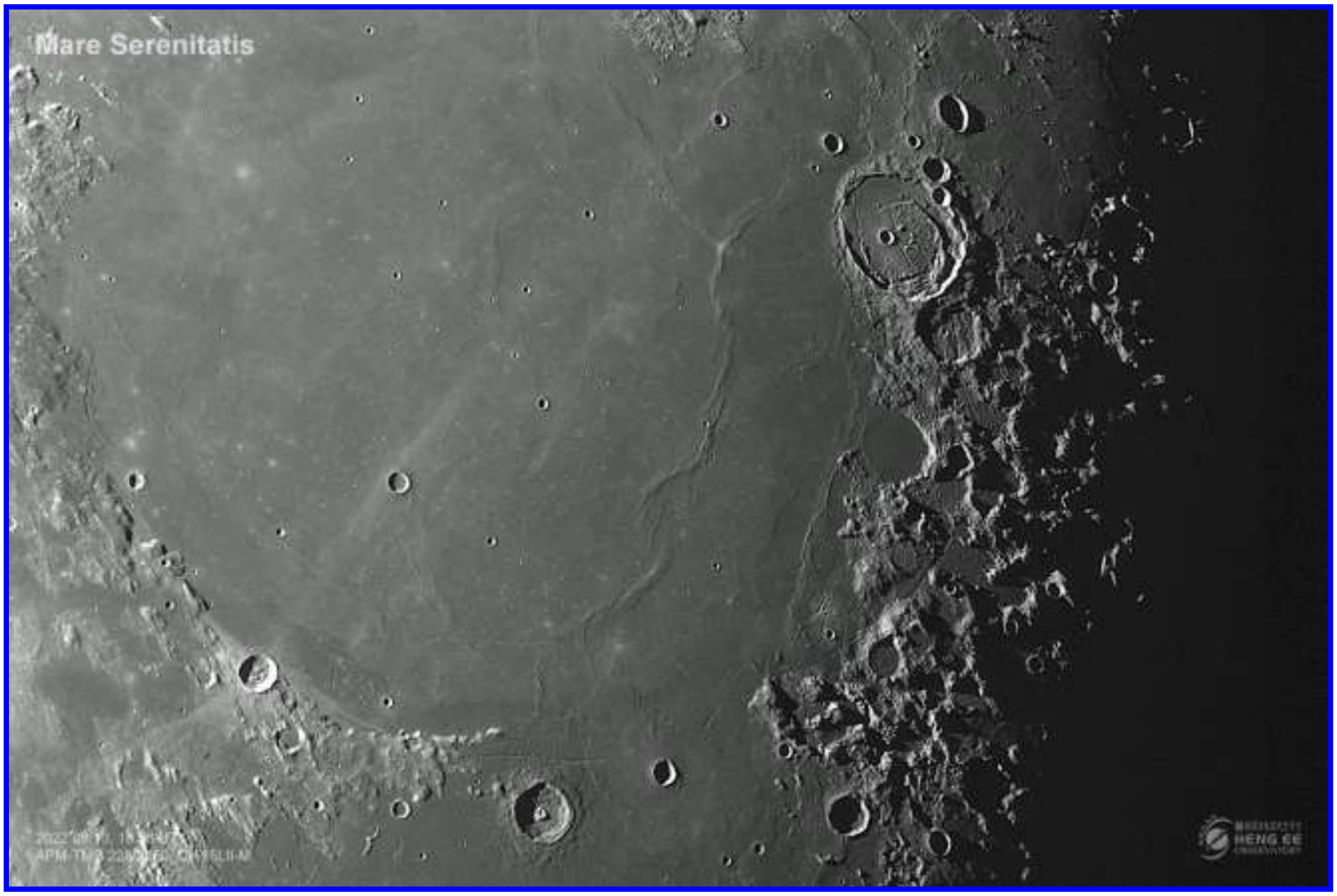
Recent Topographic Studies

Hortensius, *Massimo Dionisi, Sassari, Italy. 2022 August 21 01:48 UT. Skywatcher Newtonian telescope, 3x Barlow, f/15, Wratten #8 filter (yellow), Skywatcher EQ6Pro mount, ZWO ASI120MC camera.*

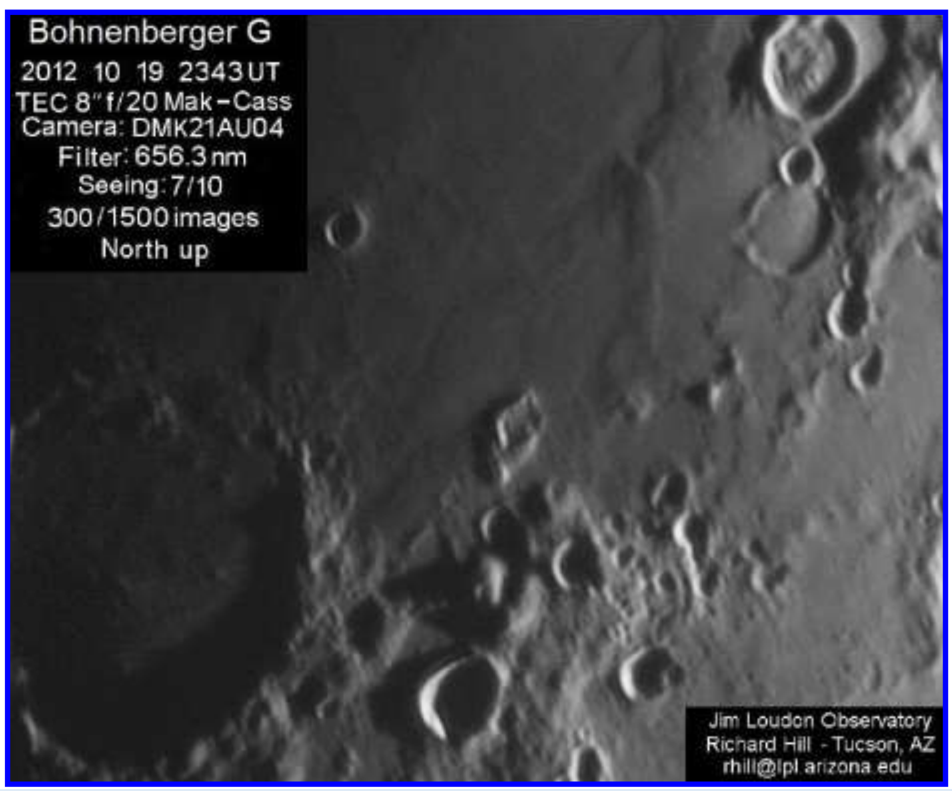
Albategnius, *Rik Hill, Loudon Observatory, Tucson, Arizona, USA. 2021 September 14 01:53 UT, colongitude 1.0°. TEC 8 inch f/20 Maksutov-Cassegrain telescope, 610 nm filter, SKYRIS 132M camera. Seeing 8-9/10.*



Recent Topographic Studies



Mare Serenitatis, *Michael Teoh, Penang, Malaysia. 2022 August 16 18:56 UT. APM-TMB 228/2050 refractor telescope, QHY5LII-M camera.*



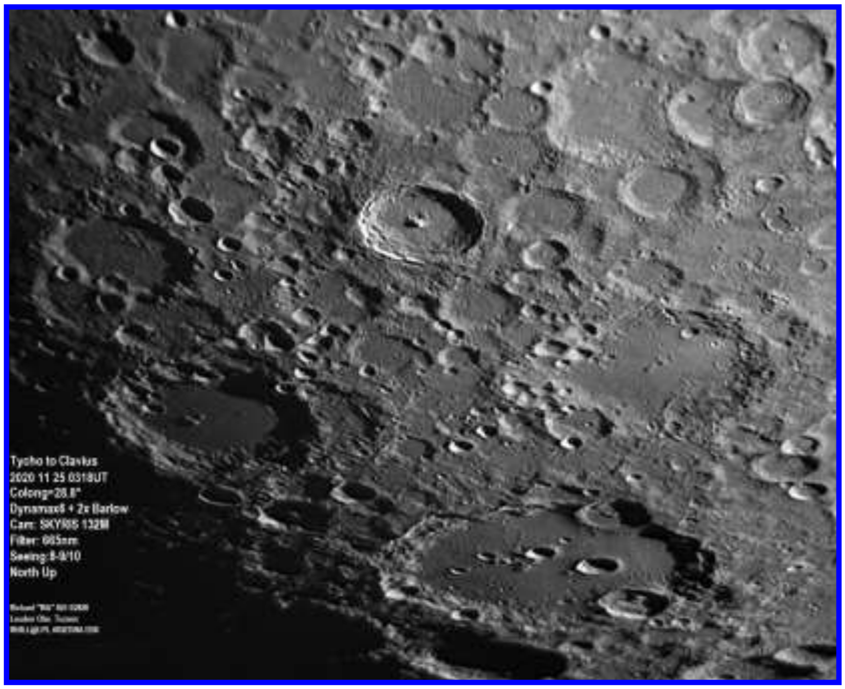
Bohnenberger G, *Rik Hill, Loudon Observatory, Tucson, Arizona, USA. 2012 October 19 23:43 UT. TEC 8 inch f/20 Maksutov-Cassegrain telescope, 656.3 nm filter, DMK21AU04 camera. Seeing 7/10.*

Recent Topographic Studies

Kies, *Massimo Dionisi, Sassari, Italy. 2022 August 21 02:10 UT. Skywatcher Newtonian telescope, 3x Barlow, f/15, Wratten #8 filter (yellow), Skywatcher EQ6Pro mount, ZWO ASI120MC camera.*

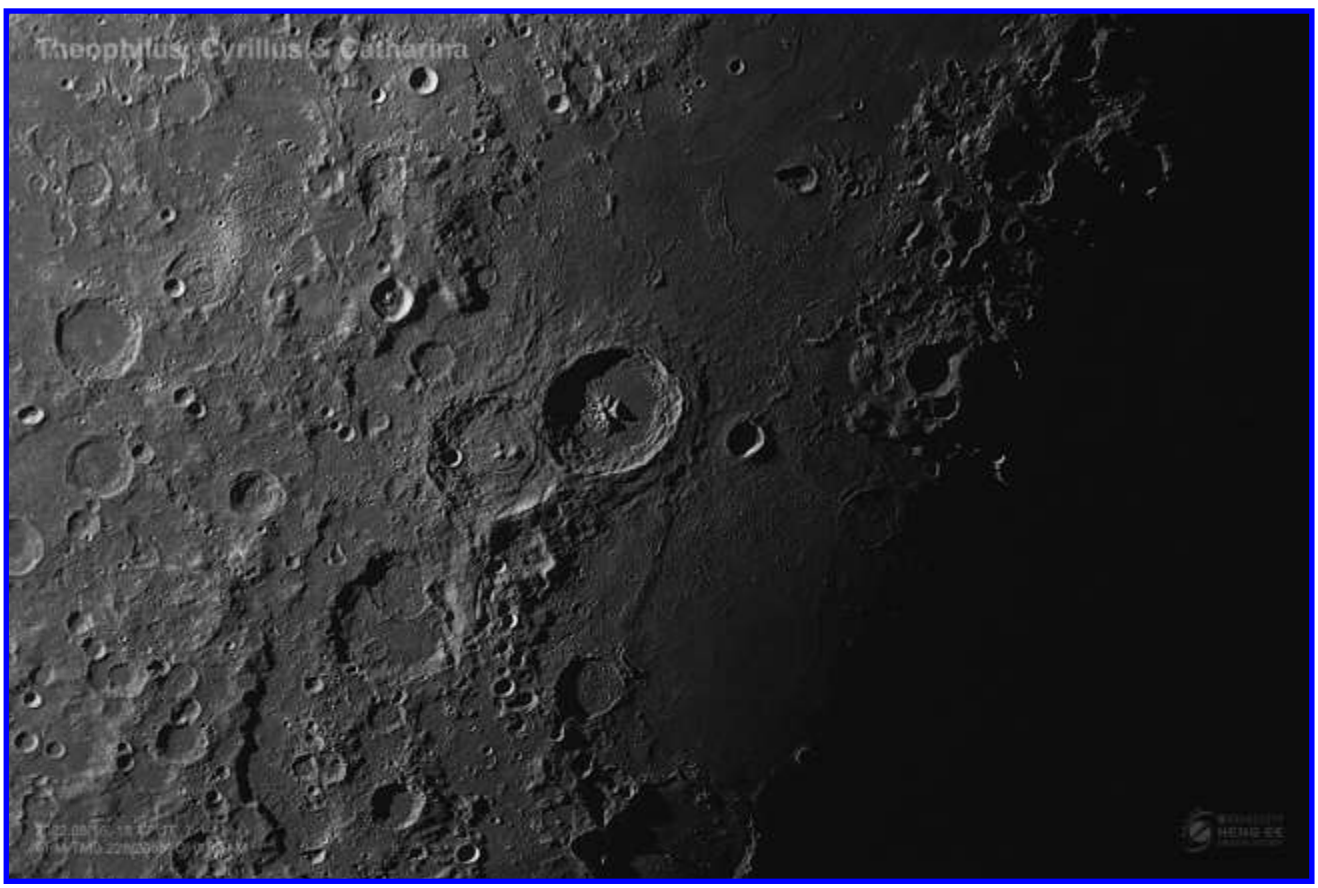
Maurolycus, *Rik Hill, Loudon Observatory, Tucson, Arizona, USA. 2017 July 01 02:33 UT. TEC 8 inch f/20 Maksutov-Cassegrain telescope, 656.3 nm filter, SKYRIS 445M camera. Seeing 8/10.*

Recent Topographic Studies



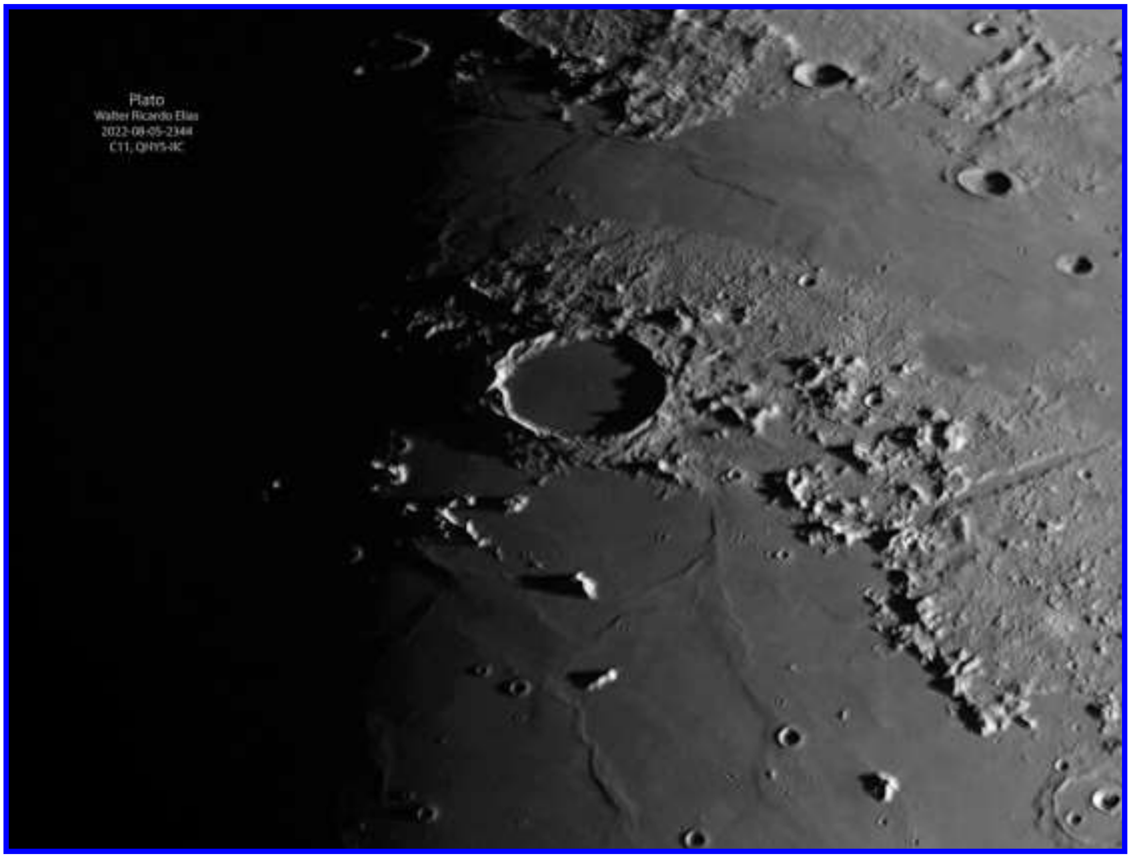
Clavius, *Rik Hill, Loudon Observatory, Tucson, Arizona, USA. 2020 November 25 03:18 UT, colongitude 28.8°. Dynamax 6 inch Schmidt-Cassegrain telescope, 2x barlow, 665 nm filter, SKYRIS 132M camera. Seeing 8-9/10.*

Theophilus, *Michael Teoh, Penang, Malaysia. 2022 August 16 18:47 UT. APM-TMB 228/2050 refractor telescope, QHY5LII-M camera.*



Recent Topographic Studies

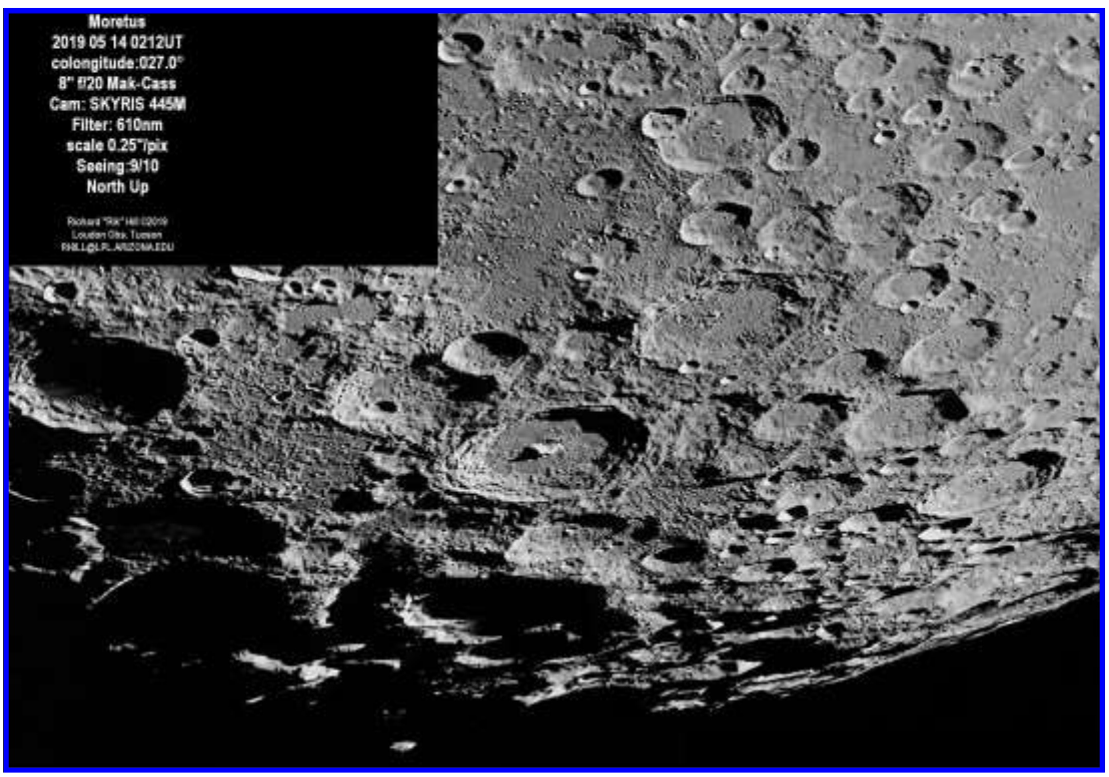
Plato, *Walter Ricardo Elias, AEA, Oro Verde, Argentina. 2022 August 05 23:44 UT. Celestron 11 inch CPC Schmidt-Cassegrain telescope, QHY5-IIC camera.*



Schiller to Clavius, *Rik Hill, Loudon Observatory, Tucson, Arizona, USA. 2009 January 08 02:17 UT. Celestron 14 inch Schmidt-Cassegrain telescope, prime focus, f/11, UV/IR blocking filter, SPC900NC camera. Seeing 5/10.*

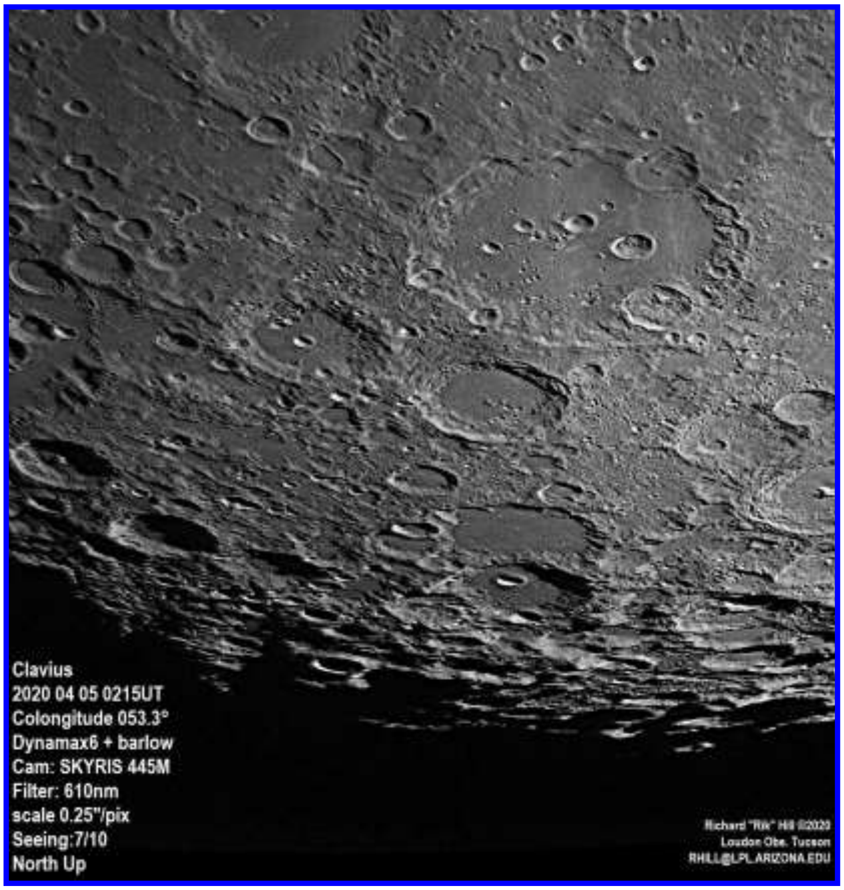
Recent Topographic Studies

Milichius, *Massimo Dionisi, Sassari, Italy. 2022 August 21 01:38 UT. Skywatcher Newtonian telescope, 3x Barlow, f/15, Wratten #8 filter (yellow), Skywatcher EQ6Pro mount, ZWO ASI120MC camera.*



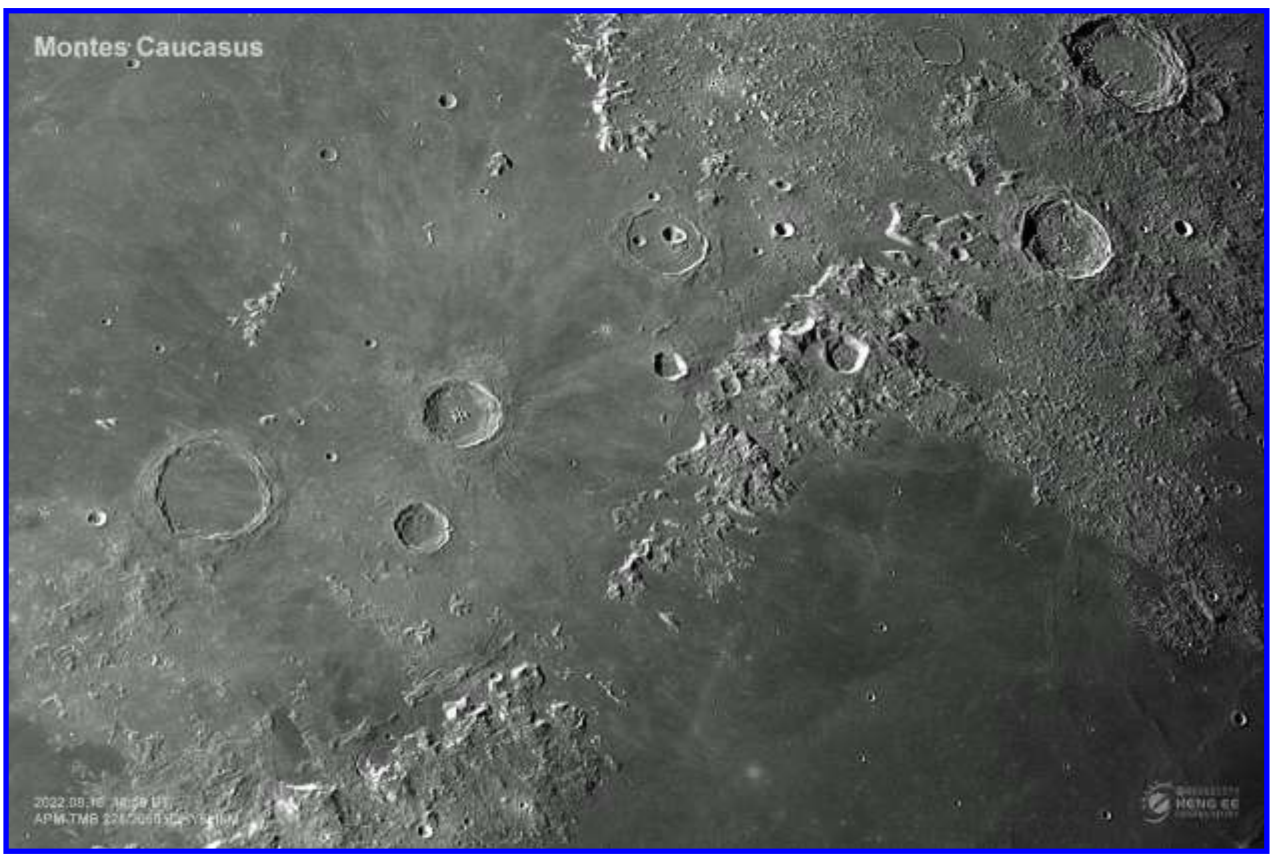
Moretus, *Rik Hill, Loudon Observatory, Tucson, Arizona, USA. 2019 May 14 02:12 UT, colongitude 27.0°. TEC 8 inch f/20 Maksutov-Cassegrain telescope, 610 nm filter, SKYRIS 445M camera. Seeing 9/10.*

Recent Topographic Studies

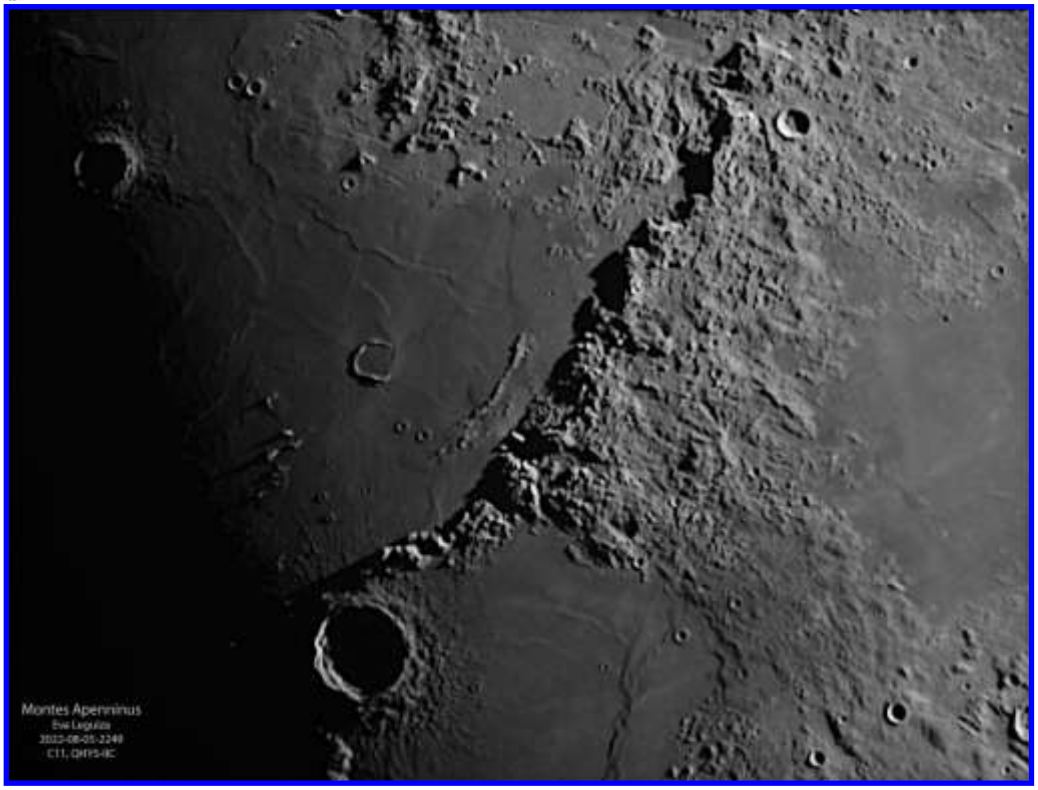


Clavius, *Rik Hill, Loudon Observatory, Tucson, Arizona, USA. 2020 April 05 02:15 UT, colongitude 53.3°. Dynamax 6 inch Schmidt-Cassegrain telescope, barlow, 610 nm filter, SKYRIS 445M camera. Seeing 7/10.*

Montes Caucasus, *Michael Teoh, Penang, Malaysia. 2022 August 16 18:58 UT. APM-TMB 228/2050 refractor telescope, QHY5LII-M camera*



Recent Topographic Studies



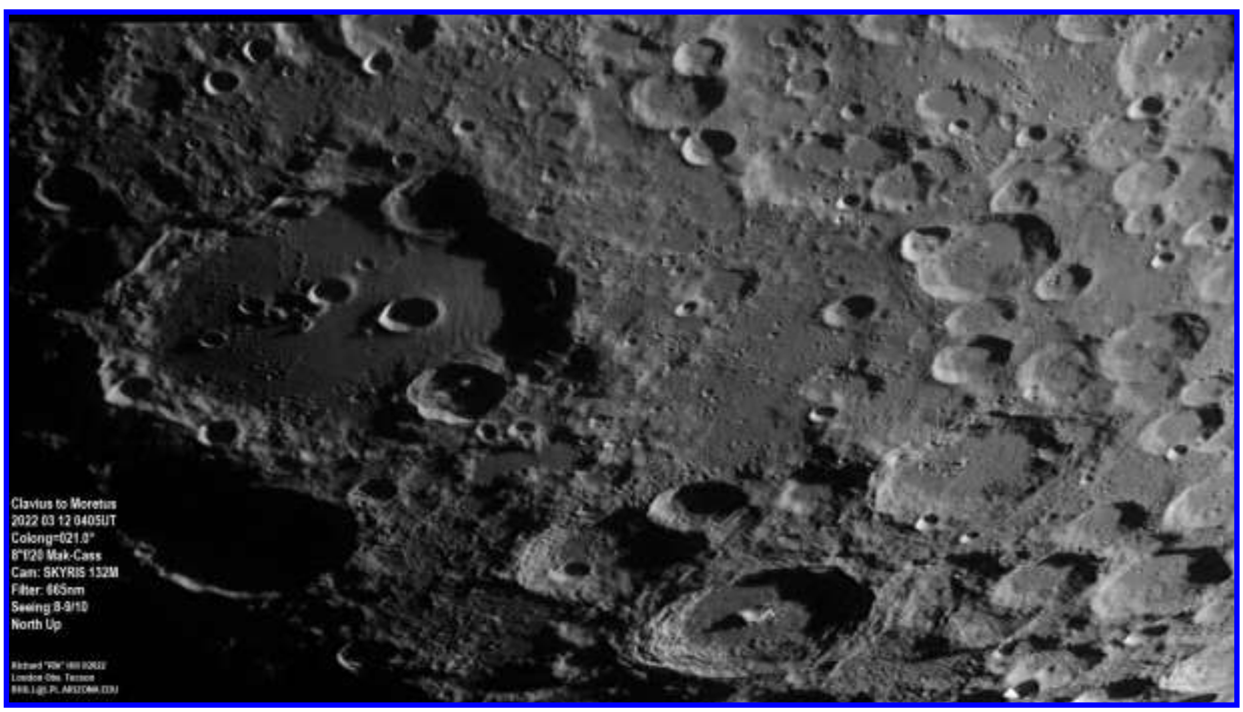
Montes Apenninus, *Eva Leguiza, AEA, Oro Verde, Argentina. 2022 August 05 22:49 UT. Celestron 11 inch CPC Schmidt-Cassegrain telescope, QHY5-IIC camera.*

Alphonsus, *Walter Ricardo Elias, AEA, Oro Verde, Argentina. 2022 August 05 23:53 UT. Celestron 11 inch CPC Schmidt-Cassegrain telescope, ZWO ASI120mm camera.*

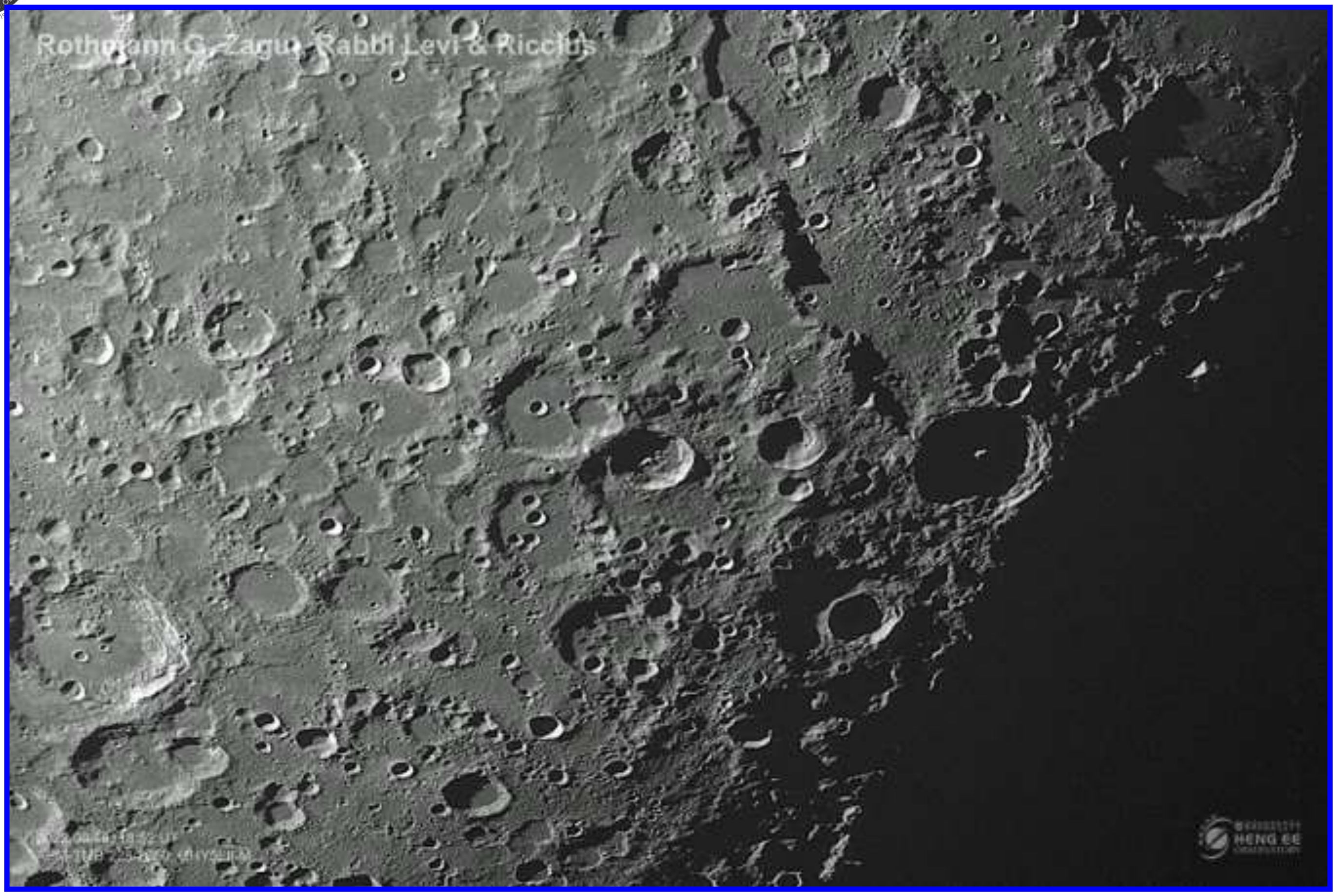
Recent Topographic Studies

T. Mayer, *Massimo Dionisi, Sassari, Italy. 2022 August 21 01:45 UT. Skywatcher Newtonian telescope, 3x Barlow, f/15, Wratten #8 filter (yellow), Skywatcher EQ6Pro mount, ZWO ASI120MC camera.*

Clavius, *Rik Hill, Loudon Observatory, Tucson, Arizona, USA. 2022 March 12 04:05 UT, colongitude 21.0°. TEC 8 inch f/20 Maksutov-Cassegrain telescope, 665 nm filter, SKYRIS 132M camera. Seeing 8-9/10.*

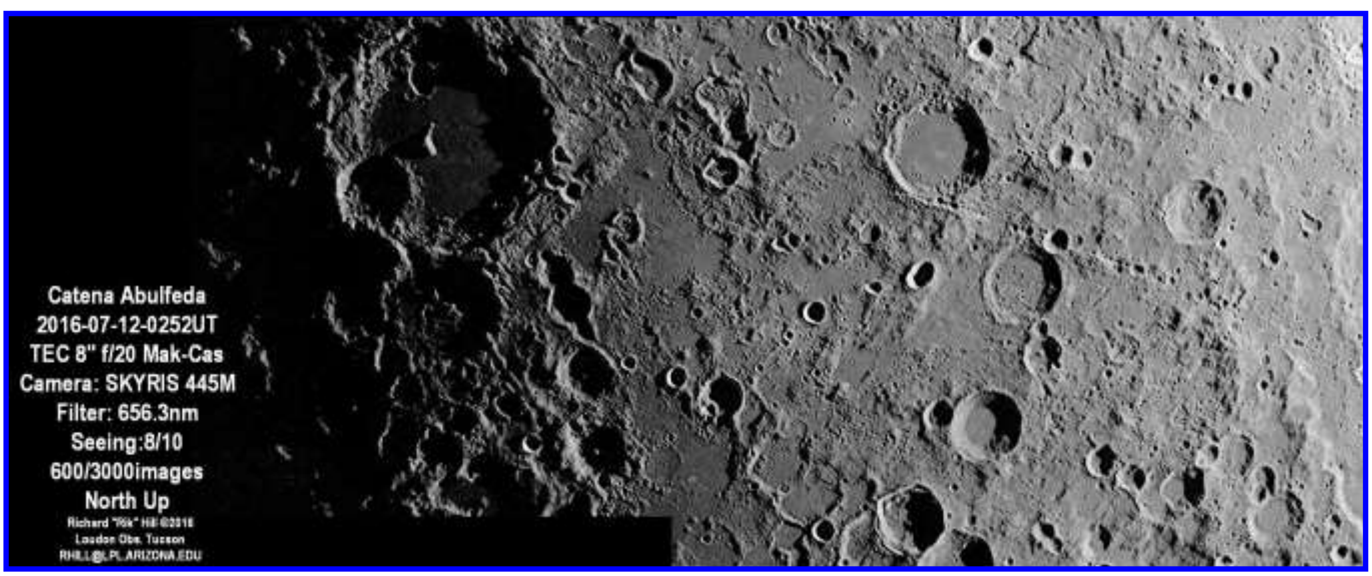


Recent Topographic Studies



Rothmann, *Michael Teoh, Penang, Malaysia. 2022 August 16 18:52 UT. APM-TMB 228/2050 refractor telescope, QHY5LII-M camera*

Catena Abulfeda, *Rik Hill, Loudon Observatory, Tucson, Arizona, USA. 2016 July 12 02:52 UT. TEC 8 inch f/20 Maksutov-Cassegrain telescope, 656.3 nm filter, SKYRIS 445M camera. Seeing 8/10.*



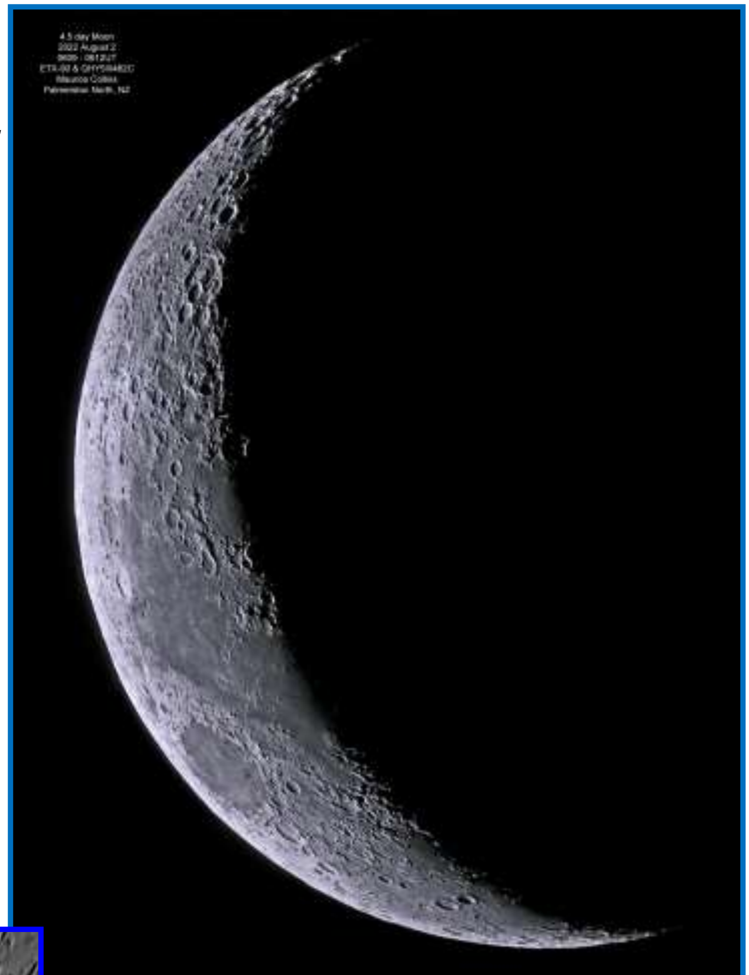
Recent Topographic Studies

Hercules, *Victoria Gomez, AEA, Oro Verde, Argentina. 2022 August 05 23:23 UT. Celestron 11 inch CPC Schmidt-Cassegrain telescope, QHY5-IIC camera.*

Alpetragius, *Walter Ricardo Elias, AEA, Oro Verde, Argentina. 2022 August 05 23:03 UT. Celestron 11 inch CPC Schmidt-Cassegrain telescope, ZWO ASI120mm camera.*

Recent Topographic Studies

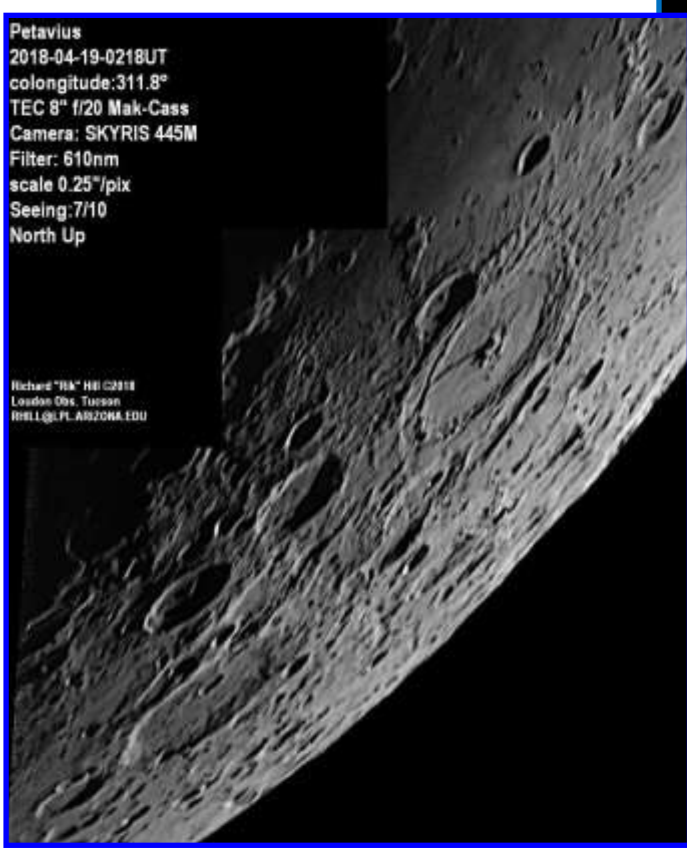
4.5 day old Moon, *Maurice Collins, Palmerston North, New Zealand. 2022 August 2 06:09-06:12 UT. Meade ETX90 Maksutov-Cassegrain telescope, QHY5III462C camera. North down, west right.*



Maurice adds: "While waiting for a Rocket Lab launch attempt, and watching on my phone (the launch was eventually scrubbed due to high winds), I imaged the 4.5-day Moon with the ETX-90. It was windy here also and the telescope was shaking a bit. Luckily the image was not affected. The terminator was running through Mare Nectaris and Fracastorius, and in the image I can see what looks like a lighted central peak in Fracastorius, though that crater only has a very small peak if you can call it that.

The feature that struck me visually when I had a quick look, was the Gardner Megadome. It was really looking like a huge mountain on the terminator.

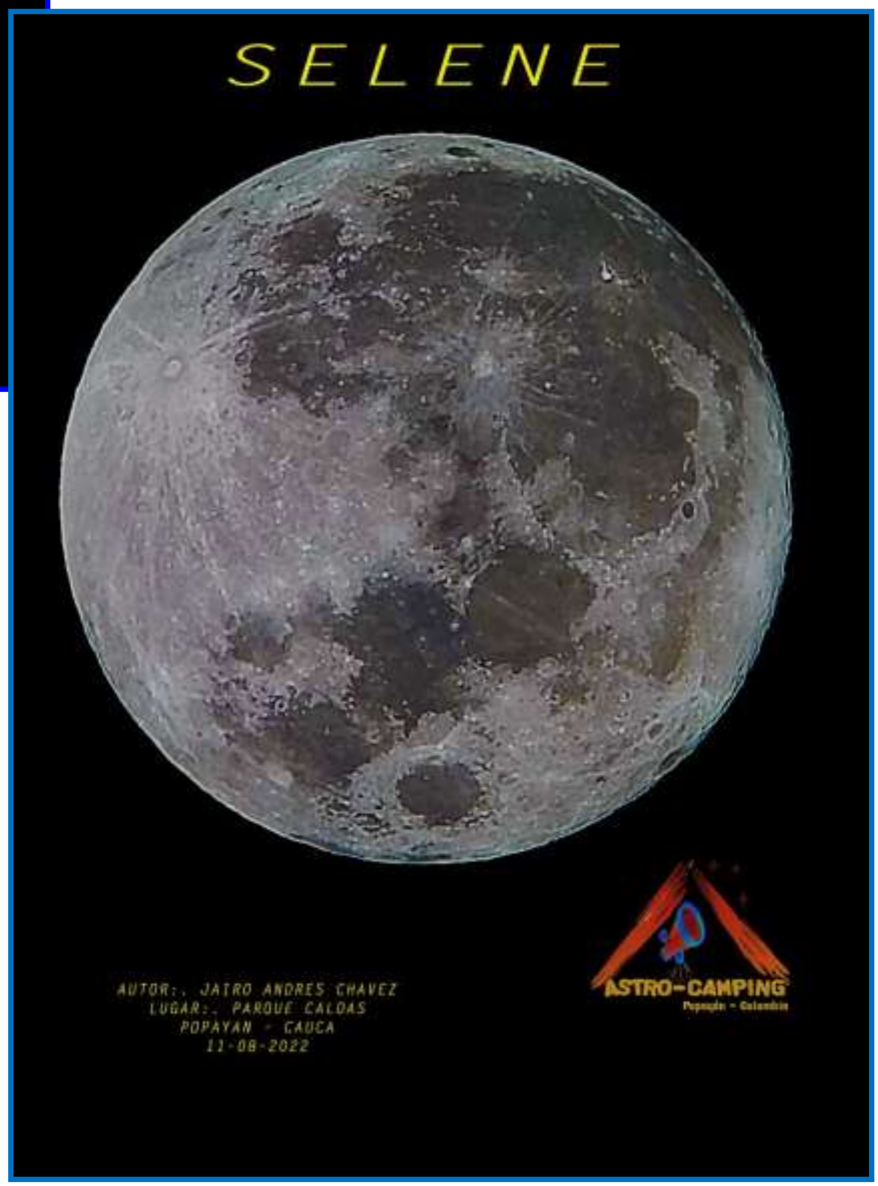
It then clouded over and I came in for dinner and the launch attempt was scrubbed at just before 7pm (0700UT). Rescheduled for Thursday 5pm."



Petavius, *Rik Hill, Loudon Observatory, Tucson, Arizona, USA. 2018 April 19 02:18 UT, colongitude 311.8°. TEC 8 inch f/20 Maksutov-Cassegrain telescope, 610 nm filter, SKYRIS 445M camera. Seeing 7/10.*

Recent Topographic Studies

5.5 day old Moon, *Maurice Collins, Palmerston North, New Zealand. 2022 August 3 06:21-06:25 UT. Meade ETX90 Maksutov-Cassegrain telescope, QHY5III462C camera. North down, west right.*



Full Moon, *Jairo Chavez, Popayán, Colombia . 2022 August 12 00:36 UT. 311 mm reflector telescope, MOTO E5 PLAY camera. North is right, west is up.*

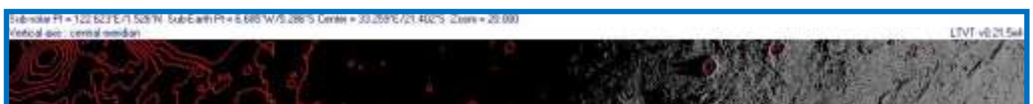
Recent Topographic Studies

Fracastorius, *Maurice Collins, Palmerston North, New Zealand. 2022 August 2 06:11 UT. Meade ETX90 Maksutov-Cassegrain telescope, QHY5III462C camera. Below Fracastorius SLDEM512, LTVT.*

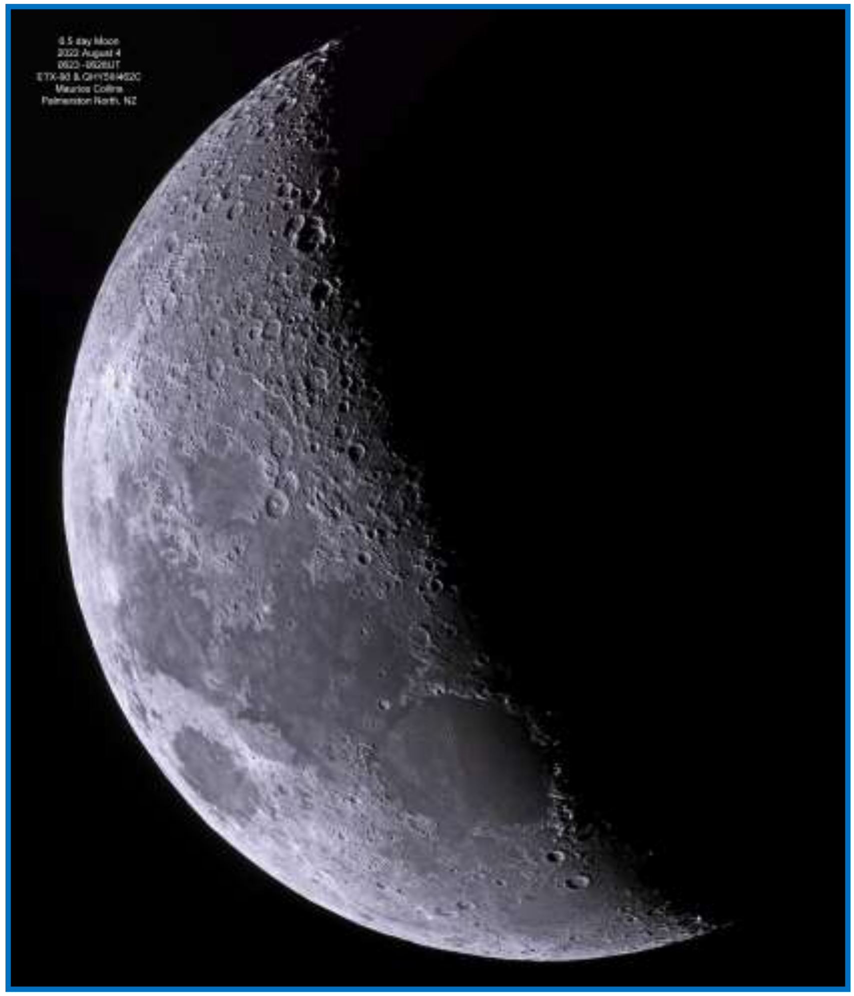
Recent Topographic Studies

Fracastorius_SLDEM512_zoom20_2022-08-02_0611UT_NZ_gamma=2

Fracastorius_SLDEM512_zoom20_2022-08-02_0611UT_NZ_gamma=2_500m_contours



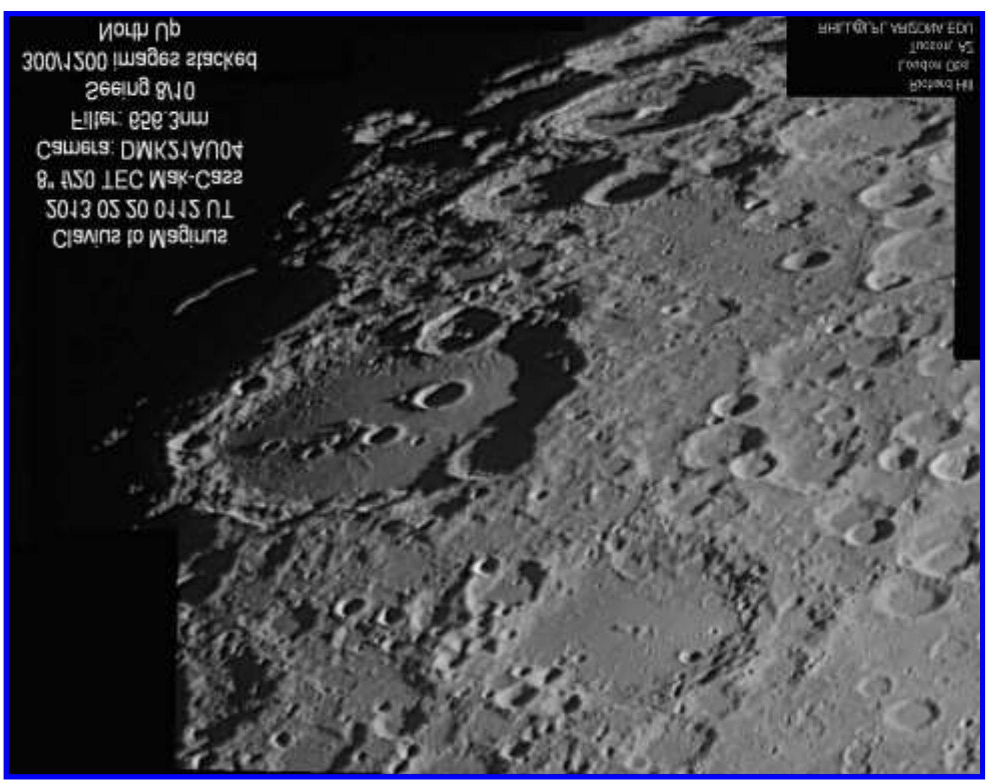
Recent Topographic Studies



6.5 day old Moon, *Maurice Collins, Palmerston North, New Zealand. 2022 August 4 06:23-06:28 UT. Meade ETX90 Maksutov-Cassegrain telescope, QHY5III462C camera. North down, west right.*

*Maurice adds: "*Another Moon image captured, on my second session out last night as the first was clouded over as soon as I got the telescope out and started to image. So packed away and then saw it clear a bit later so got out and got this image. Even though the seeing didn't look too steady, it is the slower wave type which gives very sharp images on camera. So, the little 90mm works better than bigger telescopes under those conditions.

Terminator now further west from last night, through the Caucasus and Alps mountains."



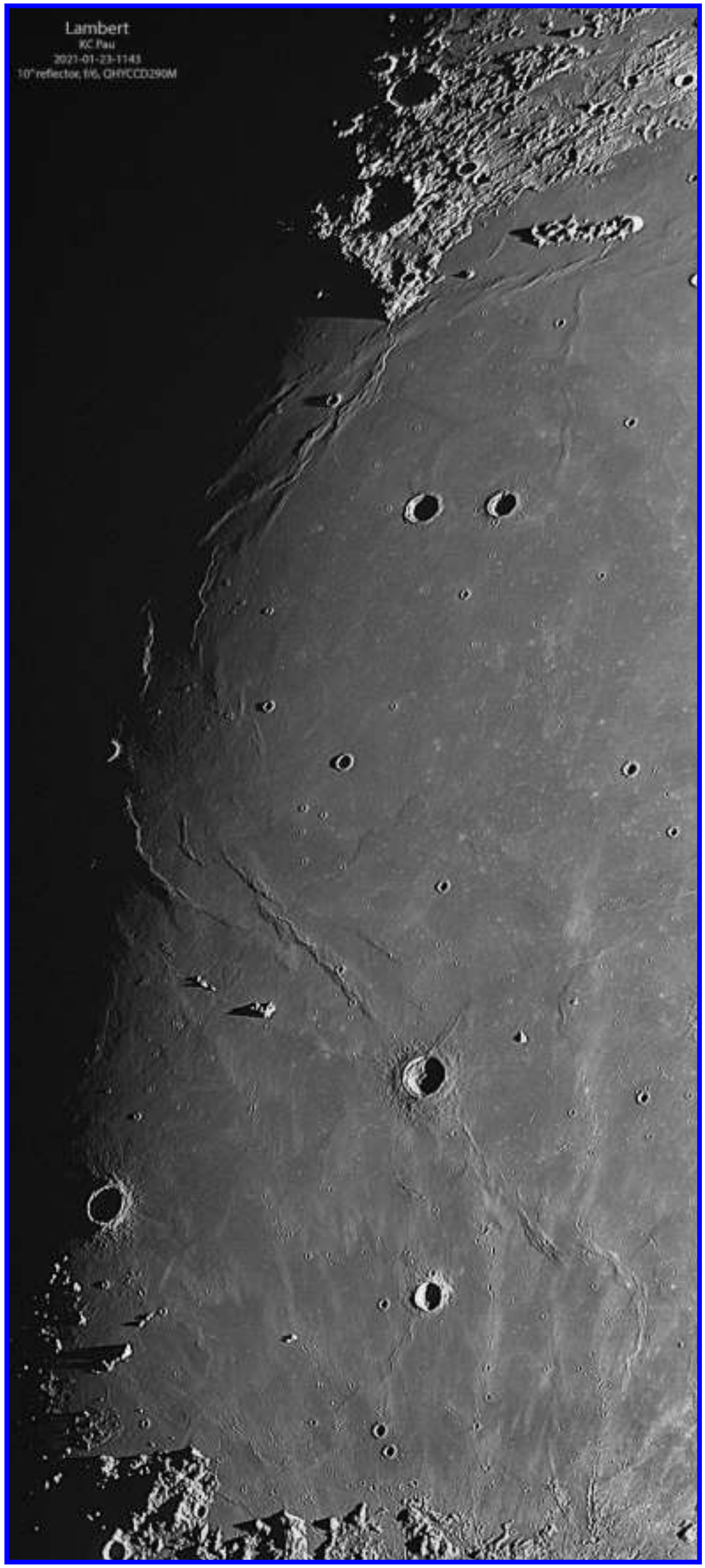
Clavius, *Rik Hill, Loudon Observatory, Tucson, Arizona, USA. 2013 February 20 01:12 UT. TEC 8 inch f/20 Maksutov-Cassegrain telescope, 656.3 nm filter, DMK21AU04 camera. Seeing 8/10. North is to the lower right, west is to the upper right.*

Recent Topographic Studies

12.6 day old Moon, *Maurice Collins, Palmerston North, New Zealand. 2022 August 10 07:28-07:33 UT. Meade ETX90 Maksutov-Cassegrain telescope, QHY5III462C camera. North down, west right.*

Petavius, *Rik Hill, Loudon Observatory, Tucson, Arizona, USA. 2018 September 13 01:53 UT, colongitude 306.1º. TEC 8 inch f/20 Maksutov-Cassegrain telescope, 610 nm filter, SKYRIS 445M camera. Seeing 8/10.*

Recent Topographic Studies

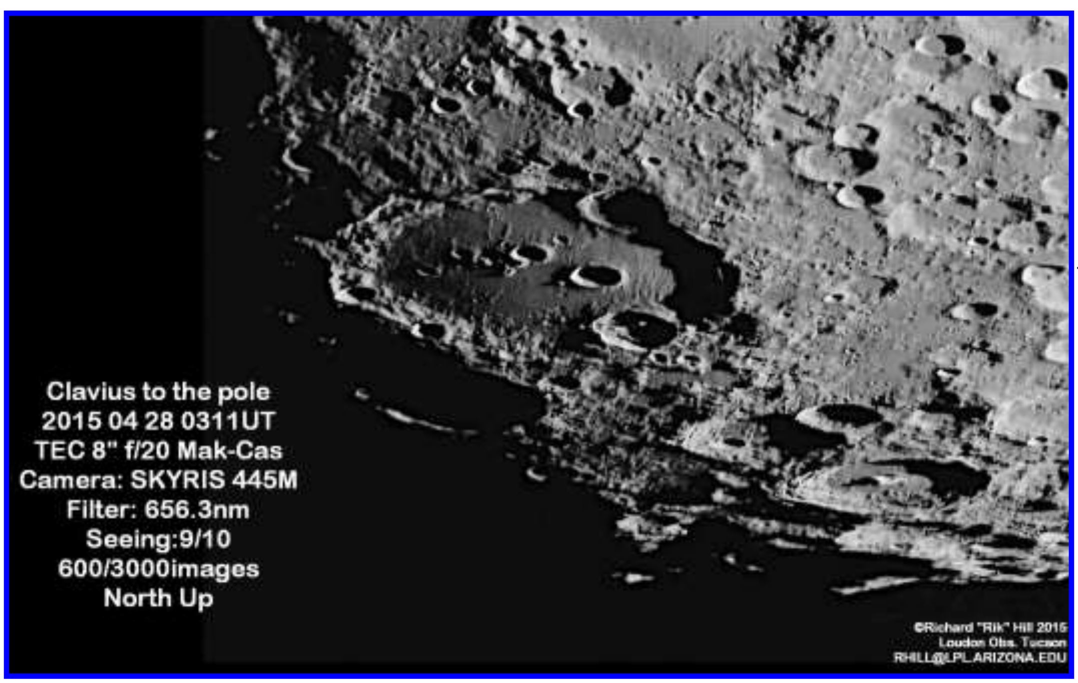


***Lambert,** KC Pau, Hong Kong, China. 2021 January 23 11:43 UT. 10 inch f/6 reflector telescope, prime focus, QHYCCD290M camera.*

*KC adds "*Enclosed is a wide-field photo showing the panoramic view of the western part of Mare Imbrium for TLO. The photo was taken on 23January2021, 11h43m UT with 250mm f/6 Newtonian reflector + prime focus + QHYCCD290M camera. The lava flow front is clearly shown near the center of the photo under the oblique illumination. Mare ridges arising from the tip of Promontorium Laplace of Sinus Iridum run all its way down to the foothills of Montes Carpatus."

Recent Topographic Studies

Lunar South Pole, *Michael Teoh, Penang, Malaysia. 2022 August 16 18:50 UT. APM-TMB 228/2050 refractor telescope, QHY5LII-M camera.*

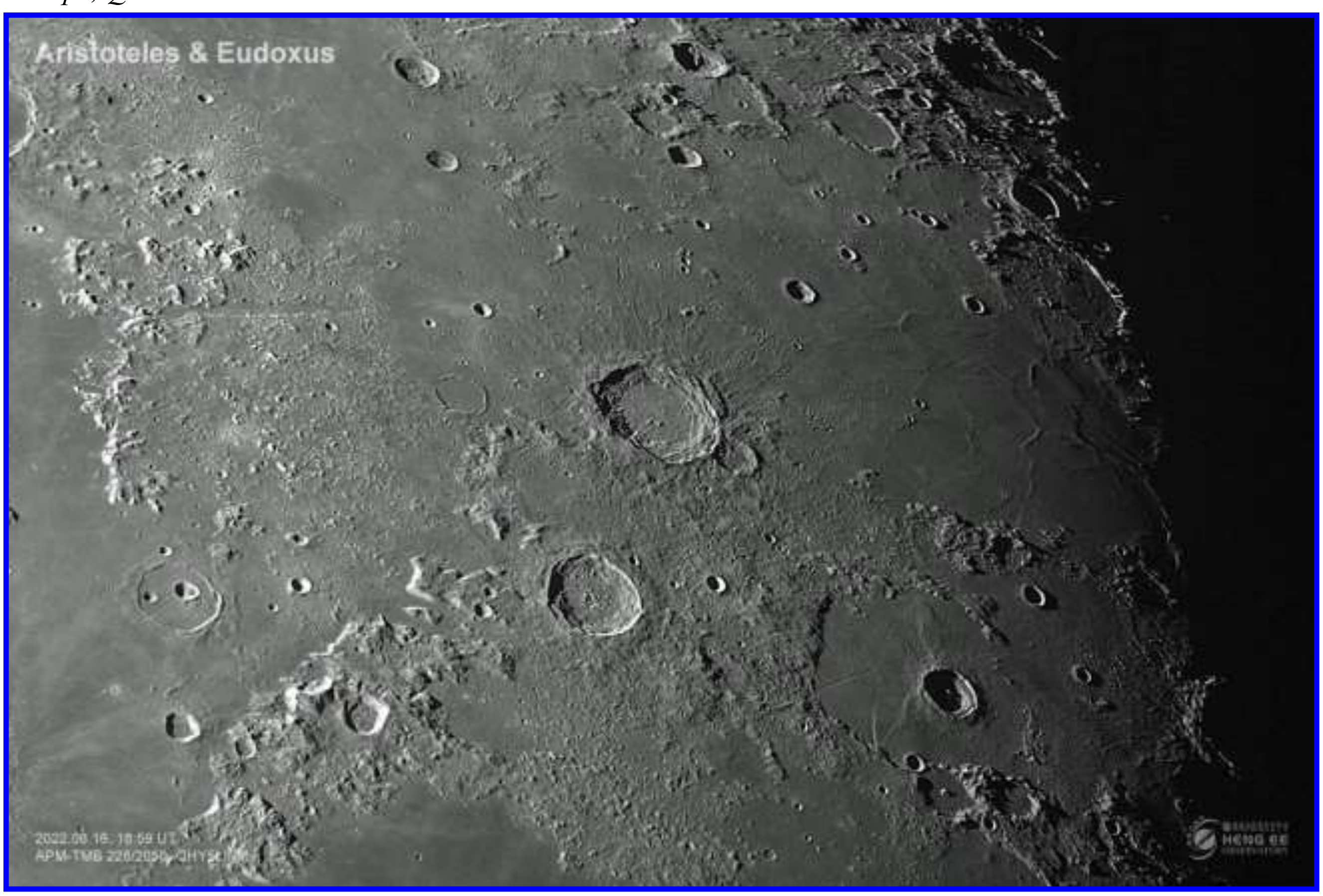


Clavius, *Rik Hill, Loudon Observatory, Tucson, Arizona, USA. 2015 April 28 03:11 UT. TEC 8 inch f/20 Maksutov-Cassegrain telescope, 656.3 nm filter, SKYRIS 445M camera. Seeing 9/10.*

Recent Topographic Studies

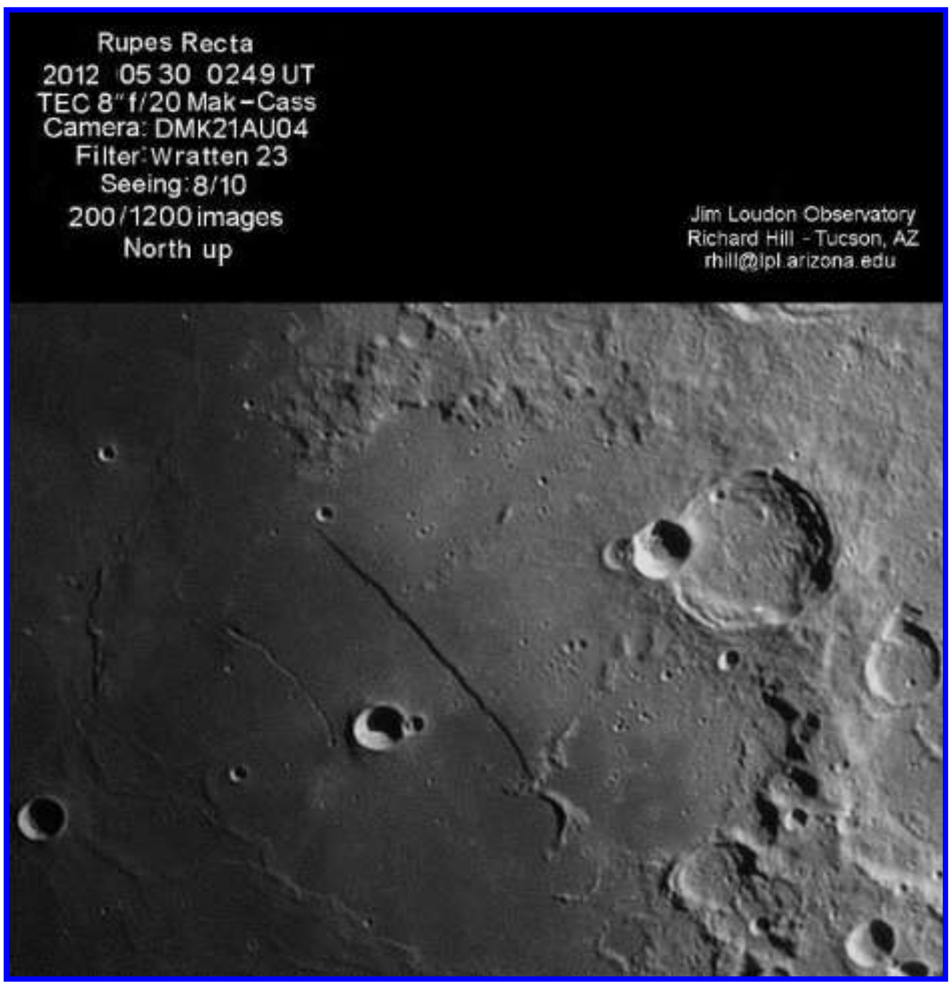
Reiner Gamma, *Rik Hill, Loudon Observatory, Tucson, Arizona, USA. 2011 February 16 04:49 UT. Celestron 14 inch Schmidt-Cassegrain telescope, 2x barlow, f/22, UV/IR blocking filter, DMK21AU04 camera. Seeing 7/10.*

Aristoteles and Eudoxus, *Michael Teoh, Penang, Malaysia. 2022 August 16 18:59 UT. APM-TMB 228/2050 refractor telescope, QHY5LII-M camera.*



Recent Topographic Studies

Maskelyne, *Walter Ricardo Elias, AEA, Oro Verde, Argentina. 2022 August 05 22:15 UT. Celestron 11 inch CPC Schmidt-Cassegrain telescope, QHY5-IIC camera.*



Rupes Recta, *Rik Hill, Loudon Observatory, Tucson, Arizona, USA. 2012 May 30 02:49 UT. TEC 8 inch f/20 Maksutov-Cassegrain telescope, 2x barlow, f/22, Wratten 23 filter, DMK21AU04 camera. Seeing 8/10.*

Recent Topographic Studies

Lunar Geologic Change Detection Program

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

2022 September

Figure 1. *An image of an aircraft in front of the nearly Full Moon, taken by Patricia Wainwright on 2022 Aug 11 UT 20:26, from Littlestone, Kent, UK. Taken with a Canon EOS R6 with RF100-400 lens. Single point autofocus, spot metering, F/8, 1/500s exposure at ISO 3200.*

News: A Fireballs Workshop #3, with a significant No. of contributions on Impact Flashes, was organized by Europlanet and held in Glasgow & on-line on 13/14th August. A couple of presentations were given by well-known members: Brian Cudnik (ALPO): "The Lunar Meteor Observing Program of the A.L.P.O. - Current State and Future Directions" and Antonio Mercatali (UAI): "Impact flash observations coordinated by the Italian Sezione Luna UAI were given. Also, some new impact flash detection software has been made available, (see: https://drive.google.com/drive/folders/1E10bOIElYU12XG5z3xvycQKmlFU9aaG) though the last time I looked there was still no online-documentation.

LTP reports: No reports were received for August, though another image of an aircraft crossing the Moon in silhouette was received. (Fig 1) – perhaps one of the more distant aircraft images I have seen - if you look at its small angular size, compared the lunar disk. Clearly Kent is a popular crossing point for aircraft across the English Channel.

Figure 2. *Rupes Recta as sketched by Paul Abel for the date and UT given in the sketch. Note that north is towards the bottom. The insert on the bottom right is from the NASA Quickmap web site showing an enhanced WAC Color Hapke-Normalized global mosaic.*

Again, not LTP but on 2022 Aug 20 Paul Abel made a sketch of Rupes Recta (Fig 2). He commented that this is the first time he had seen it when the evening terminator was close by. The Rima Birt rille was quite distinctive and where it ended in the north, there may have been some slight orange color though he thought it not a LTP. A quick look on the NASA Quickmap web site, revealed a red "L" shaped feature here, slightly akin to the rectangular red "Wood's Spot" NW in which Aristarchus sits. So this is clearly a rare example of natural surface color that Paul has spotted here. Why has nobody else seen it visually? Firstly observations after Full Moon are relatively rare due to having to observe during non-social hours. Secondly maybe this orange material is emplaced on westward facing slopes and so is more prominent at sunset than during sun rise?

Routine Reports received for July included: Jay Albert (Lake Worth, FL, USA – ALPO) observed: Alpretagius, Erathothenes, Plato, and Tycho. Alberto Anunziato (Argentina – SLA) observed visually: Gassendi, Jansen, Proclus and Ross D. Maurice Collins (New Zealand – ALPO/BAA/RASNZ) imaged: Bullialdus, Copernicus, and several features. Anthony Cook (Newtown – ALPO/BAA) videoed earthshine and the dayside of the Moon in the SWIR (1.1-1.7 microns), and also in the thermal IR (7.5-15 microns). Valerio Fontani (Italy – UAI) imaged: Archimedes. Aldo Tonon (Italy – UAI) imaged: Descartes. Malcolm Porter (Kent, UK – BAA) imaged the Moon.

Analysis of Reports Received:

Posidonius: On 2022 Jul 04 UT05:42-05:43 Maurice Collins (ALPO/BAA/RASNZ) imaged the whole Moon, but at sufficient resolution to examine this crater at similar illumination to the following two reports:

Posidonius 1821 Apr 07 UT 18:00? Observed by Gruithuisen (Munich, Germany) "Small bright crater in it was shadowless. Schroter also saw it shadowless several X" NASA catalog weight=4. NASA catalog ID #87. ALPO/BAA weight=3.

In 1963 Oct 22 at UT 21:00? M. Gabriel Andre (Belgium, 2.25" refractor) noticed that Posidonius A's shadow was not seen when it should have been seen. The Cameron 1978 catalog ID=777 and weight=3. The ALPO/BAA weight=2.

Figure 3. *Posidonius, on 2022 Jul 04 UT 05:42-05:43 as imaged by Maurice Collins (ALPO/BAA/RASNZ). Note this is a small section of a larger mosaic and has been orientated with north towards the top.*

It is interesting that both past LTP reports refer to shadowless craters, possibly both Posidonius A? Now there is some uncertainty in the UTs from 1821 and 1963, as denoted by the "?" in the Cameron catalog descriptions. From Munich the Moon would have been visible from sunset at 17:57 UT-00:40 UT the next day when it set. Cameron's 18:00 UT estimate is a good compromise and the Moon would have been at a high elevation of 59°. We have discussed this LTP before in the 2014 Jun newsletter. For the Belgium observation, assuming Brussels as the observing site, then sunset was at 16:38 and moonset was at 19:23. So Cameron's 21:00 is clearly wrong here, and I will change it to a guestimate of 17:30 although by then the Moon is just 10° above the horizon.

Nevertheless, in either case interior craterlet should not have been shadowless. We shall therefore leave the weights of these LTP reports as they were.

Archimedes: On 2022 Jul 06 UT20:42, 20:46, 20:52, and 20:57 Valerio Fontani (UAI) imaged this region under similar illumination to the following report:

Near Archimedes 2001 Sep 25 UT 08:30 Observed by Try (Whangarei, New Zealand, 4" f/10 reflector) "observed two possible LTPs on the edge of the terminator near the crater Archimedes. They appeared to be two bright points of light about the size of Mount Piton. They seem to form a triangle with Mount Piton. He observed them for two hours and they were still visible when he ended his observing session. He was observing with a 4" f10 reflector. Then Moon age was 7.9 days old and the colongitude was 4.83. submitted a drawing showing the area where the lights were observed." ALPO report. ALPO/BAA weight=1.

Figure 4. *Archimedes as imaged by Valerio Fontani (UAI) on 2022 Jul 06 UT 20:57 and orientated with north towards the top.*

Fig 4 shows a couple of sunlit mountain peaks. The first immediately north of Archimedes and the second to the north west by one crater diameter. Whether these are what Try was referring to is unclear as we do not have a copy of their original observation in our archives. So, for now I think the weight will have to remain at 1.

Eratosthenes: On 2022 Jul 08 UT02:45-02:55 Jay Albert (ALPO) observed this crater under similar illumination to the following report:

Eratosthenes 1954 May 11 UT 20:00 Observer: Cattermole (UK, 3" refractor) "Central peak invis. tho surroundings were sharp". NASA catalog ID #563, NASA weight=4. ALPO/BAA weight=2.

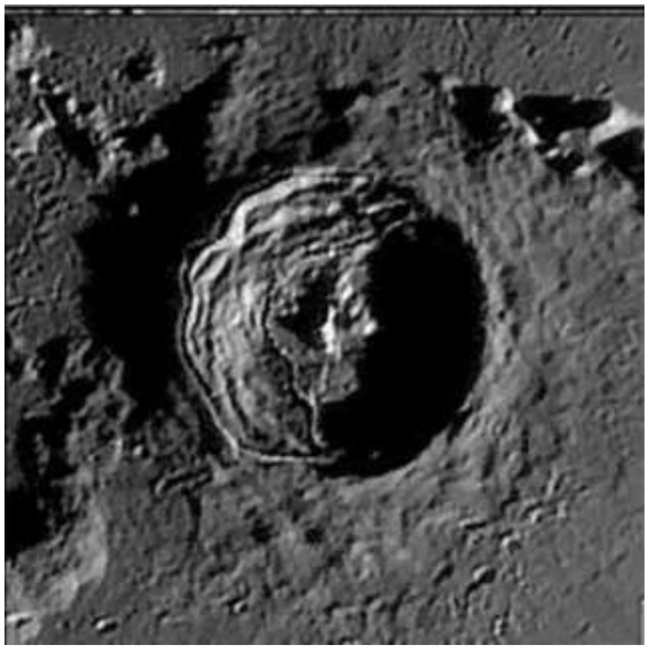


Figure 5. *Eratosthenes as imaged by Mike Brown (BAA) on 2012 Mar 31 UT 19:14 and orientated with north towards the top. From p16 of the 2012 Dec LSC.*

Jay was using a Celestron NexStar Evolution 8" SCT (x290), the transparency was 3rd magnitude and seeing was 7-8/10. He noted that contrary to the original LTP description, that the central peak complex was clearly visible along with its shadows. The terracing on the interior walls was sharp and detailed. The east wall shadow was black and extended to the base of the east peak of the central peak complex. Just as a comparison, Fig 5 is an archive image, taken under similar illumination. We have discussed repeat illumination observations of this LTP before in the Apr 2015 (p17-18), Feb 2016 (p20), Jan 2017 (p19-20), Dec 2017 (p24) and Jan 2019 (p32 & 34) newsletters. We shall leave the weight as 2 for now though as Peter Cattermole was using a small 3" refractor, maybe it was a resolution issue?

Ross D: On 2022 Jul 09 UT 23:25-23:33 Alberto Anunziato (SLA) observed visually this crater under similar illumination to the following report:

Ross D area - 1966 Aug 27 UT 06:06-06:25 observed by Harris, Eastman, Bornhusrt, Cameron, astronet observers (Tucson, AZ, USA - 21" reflector x200) and by Corralitos observatory (Organ Pass, NM, USA, 24" reflector) "Obscuration on E. wall, bright area E. of crater at its brightest. (I (WSC) was present at obs. but did not note anything not attributable to bad seeing, but am not familiar with the area in normal aspect. Others present did not see anything unusual, but Bornhurst & Eastman confirmed). Corralitos Obs. found due to changing light conditions. NASA catalog weight=1. NASA catalog ID=967. ALPO/BAA weight=1.

Figure 6. *Ross D at the center of the image as captured by Maurice Collins from a mosaic made on 2009 Jun 04 UT 04:40-05:36. North is towards the top.*

Alberto was using a 105 mm. Maksutov-Cassegrain (Meade EX 105, at magnification x154, seeing not very good at 4.5/10). He comments that the east wall seems less bright, but at the limit of the resolution of his telescope, there is a bright area further east, to the east Plinius A, that seems completely normal. For comparison a similar illumination image from 2009 is included (Fig 6). Clearly, we need higher resolution images of this crater. We shall leave the weight at 1 for now.

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

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Basin and Buried Crater Project

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

Buried Craters

This month I thought I would start off discussing buried craters as they have not featured much in the articles so far. By "Buried Crater" I mean any crater like object that is partly buried, or heavily degraded, and which does not have an official IAU name. We have a list of candidate buried craters on the website: https://users.aber.ac.uk/atc/basin_and_buried_crater_project.htm and I enclose a close up to illustrate what is in the table in Fig 1.

Version:	2022 Jul 05												
Crater	Far/Near Side	Lon	E/W	Lat	N/S	Diam (km)	Status	Age	Col-SR1	Col-SR2	Col-SS1	Col-SS2	Ref
QCMA 1	N	17.9	W	74.4	N	48	Proposed						3
PFC 39	N	23.6	W	66.6	N	60	Uncertain						3
QCMA 2	N	9.8	W	63.7	N	146	Proposed						3
PFC 38	N	18.9	W	63.4	N	36	Uncertain						3

Figure 1. *Part of the buried crater catalog which as of 5 July 2022 contains 168 entries.*

As the proposed buried craters do not have IAU names, they are given catalog numbers for now e.g., QCMA 1 is from the "Quasi-Circular Mass Anomaly" list published in Evans, A. J., Soderblom, J.M., Andrews-Hanna, J.C., Zuber, M.T. (2016) "Identification of buried lunar impact craters from GRAIL data and implications for the nearside maria", Geophysical Research Letters, 10.1002/2015GL067394. You can use the buried crater catalog to either go out and image an area to see if you can confirm there is a buried crater there, or use LTVT to simulate a low angle of incidence view in order to bring out low relief detail, or you can use some of the datasets on the NASA Quickmap web site, for example the slope map or slope azimuth map, to see if you can enhance further detail that might be remnants of a crater rim.

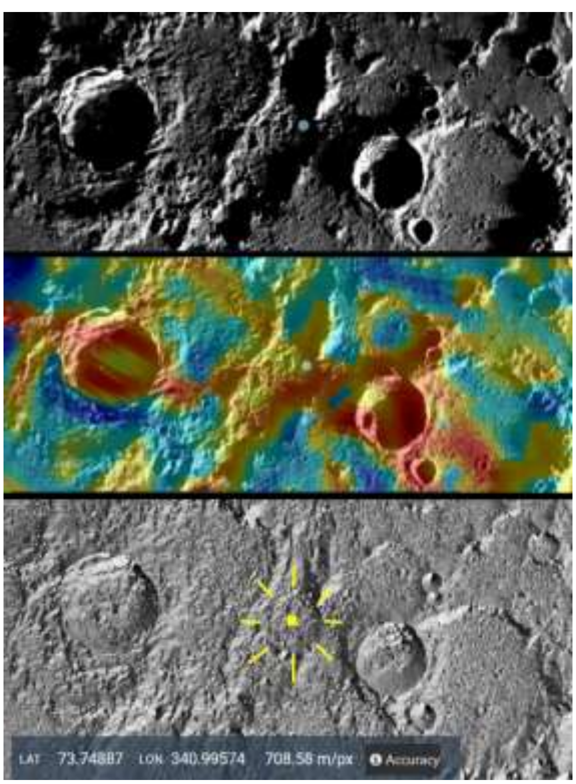


Figure 2. *QCMA1 proposed buried crater evidence from the NASA Quick Map web site.* ***(Top)*** *WAC mosaic of the near side with shadows. The dot is the catalog location for the proposed crater centre.* ***(Centre)*** *A GRAIL Bouguer gravity gradient map. The dot is the catalog location for the proposed crater centre.* ***(Bottom)*** *LOLA slope azimuth map. The yellow square highlights a refined centre for the proposed buried crater, and yellow dashes point to slope azimuth evidence for a possible buried rim.*

Let us take a look at QCMA1 at 17.9W (or 342.1E) and 74.4N and see what Quickmap shows here. Nothing obvious can be seen in the WAC mosaic view (Fig 2 – Top). There is a hint of a part circle of a gravity gradient, but it is offset from the proposed crater centre in the catalog, and is really not very obvious. However, in the slope azimuth plot (Fig 2 – Bottom), we see the clearest indication of a circular ring, which perhaps represents the strongest evidence for a buried crater here. Also, the crater centre is at 19.0W and 73.7N and the diameter is smaller at 39 km.

So please have a go at using the LROC web site, LTVT, or just imaging the Moon to try to prove the existence of these buried/eroded craters.

Lastly some other items to mention: (1) Concerning the Werner-Airy basin, mentioned last month, Guillermo Daniel Scheidereiter has used the Astro Image-J image processing program to refine the three ring diameters. I am in discussion with Guillermo on how to devise a methodology for impact basin ring measurements. (2) Dominique Hoste sent in some Quickmap visualisations of the Mendel-Ryberg basin, and suspects the antipodal point is near the crater Goddard. (3) Following on from his ALPO conference talk, Chuck Wood answered a question of mine about what gets destroyed when an impact basin forms – it is essentially everything inside the inner ring. Topography beyond this will be affected severely by shock waves, and also buried by basin ejecta deposits. (4) Alberto Anunziato has sent in some images e.g., a possible buried crater on the floor of Grimaldi (See Fig 2) and a Mons Rumker-Dechen buried crater.

I would like to mention that although the proposed buried carter on the floor of Grimaldi looks circular, the ellipticity is wrong compared to other craters in that area, and would actually be quite elliptical if viewed from overhead. So, it’s either a glancing blow impact crater, or might be attributed to arc-like wrinkle ridges.

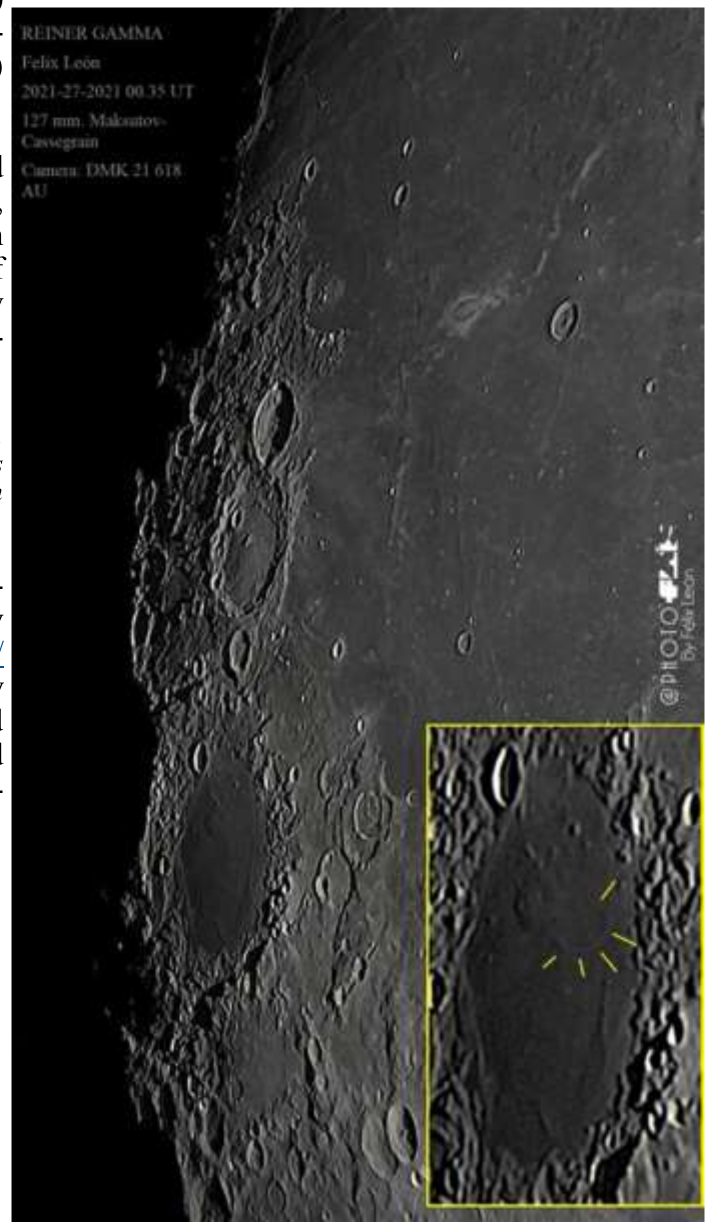


Figure 3, *A candidate buried crater on the floor of Grimaldi. Observer and image details included in the image. Yellow dashes in the inset image show where the proposed buried crater rim might be.*

Please take a look at our website for other lunar impact basins and buried craters that you may want to image: https://users.aber.ac.uk/atc/basin_and_buried_crater_project.htm . I am really keen to gather imagery of the less certain basins, and also for all basins and buried craters in order to find the best selenographic colongitudes to see them at sunrise and sunset.

Tony Cook

Lunar Calendar September 2022

Date	UT	Event
1		West limb most exposed -5.3°
3	1808	First Quarter Moon
6		Greatest southern declination -27.1°
7	1800	Moon at perigee 364,492 km
8		North limb most exposed +6.6°
8	1100	Saturn 4° north of Moon
10	0959	Full Moon
10	1900	Neptune 3° north of Moon
11	1000	Jupiter 1.8° north of Moon
13		East limb most exposed +6.4°
14	1500	Uranus 0.8° south of Moon, occultation North Africa, Europe, Russia, Alaska
17	2152	Last Quarter Moon
17	200	Mars 4° south of Moon
19	1500	Moon at apogee 404,555 km
19		Greatest northern declination +27.3°
20	1900	Pollux 1.9° north of Moon
22		South limb most exposed -6.7°
25	2154	New Moon lunation 1234
27		West limb most exposed -4.5°

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

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

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

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

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

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

SUBMISSION THROUGH THE ALPO IMAGE ARCHIVE

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

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

It is helpful if the filenames follow the naming convention :

FEATURE-NAME_YYYY-MM-DD-HHMM.ext

YYYY {0..9} Year

MM {0..9} Month

DD {0..9} Day

HH {0..9} Hour (UT)

MM {0..9} Minute (UT)

.ext (file type extension)

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

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

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

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

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

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

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

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

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

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

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

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

CALL FOR OBSERVATIONS:
FOCUS ON: Ever Changing Eratosthenes

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 November 2022, will be Eratosthenes. 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 Bright Rays North Focus-On article is June 20, 2022

FUTURE FOCUS ON ARTICLES:

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

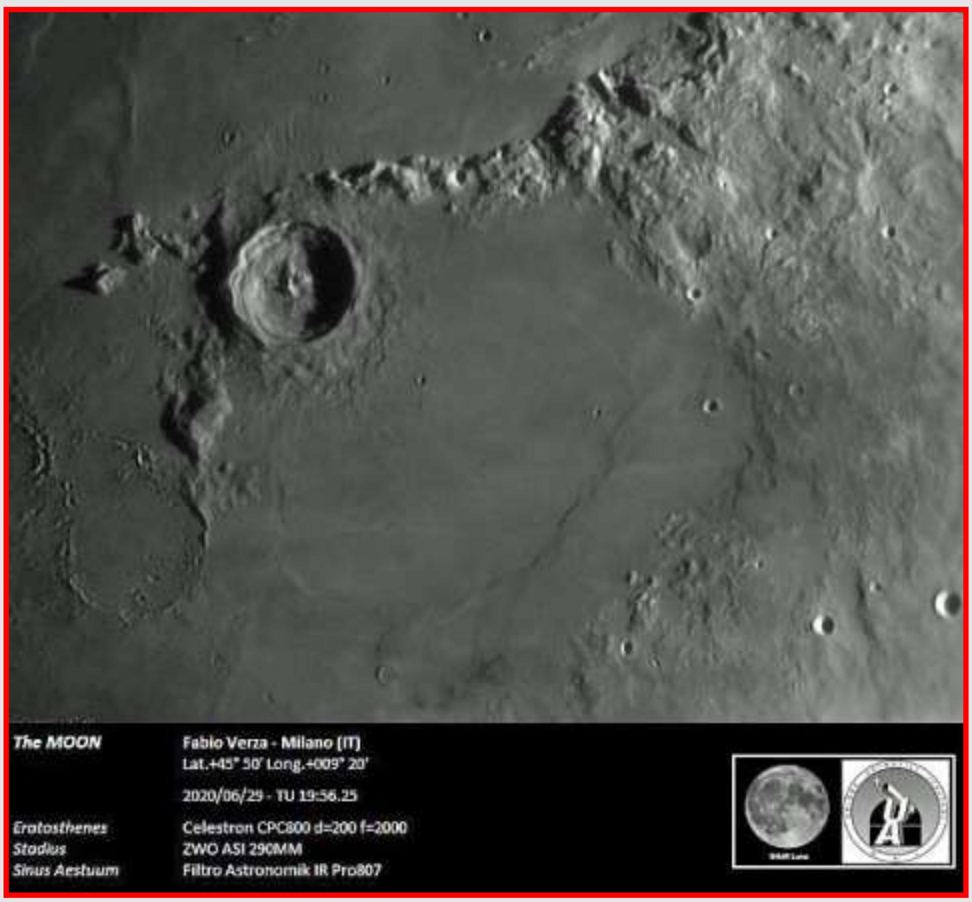
Subject	TLO Issue	Deadline
Ever Changing Eratosthenes	**November 2022**	**October 20, 2022**
Petavius	**January 2023**	**December 20, 2022**
Mare Nubium	**March 2023**	**February 20, 2023**
Reiner Gamma	**May 2023**	**April 20, 2023**
Mons Rümker	**July 2023**	**June 20, 2023**

Focus-On Announcement

EVER CHANGING ERATOSTHENES

Eratosthenes is a model impact crater, albeit "unfairly" overshadowed by the younger Copernican craters. It is interesting to observe its rim, well defined and with linear segments, its spectacular terraced walls, the central peaks, its irregular and fractured floor full of mounds, and its majestic ramp-shaped ejecta field, formerly known as “glacis”. Eratosthenes is very changeable, it is seen as a deep well of darkness near the terminator, passing through its phase of maximum splendor in the first or last quarter and to practically disappear in full moon, buried by the ejecta of its younger relative, Copernicus. And in addition to Copernicus, Eratosthenes has other very interesting sights: the complex topography of Sinus Aestuum and the grandeur of the Montes Apenninus.

NOVEMBER 2022 ISSUE-**Due October 20th, 2022: ERATOSTHENES**



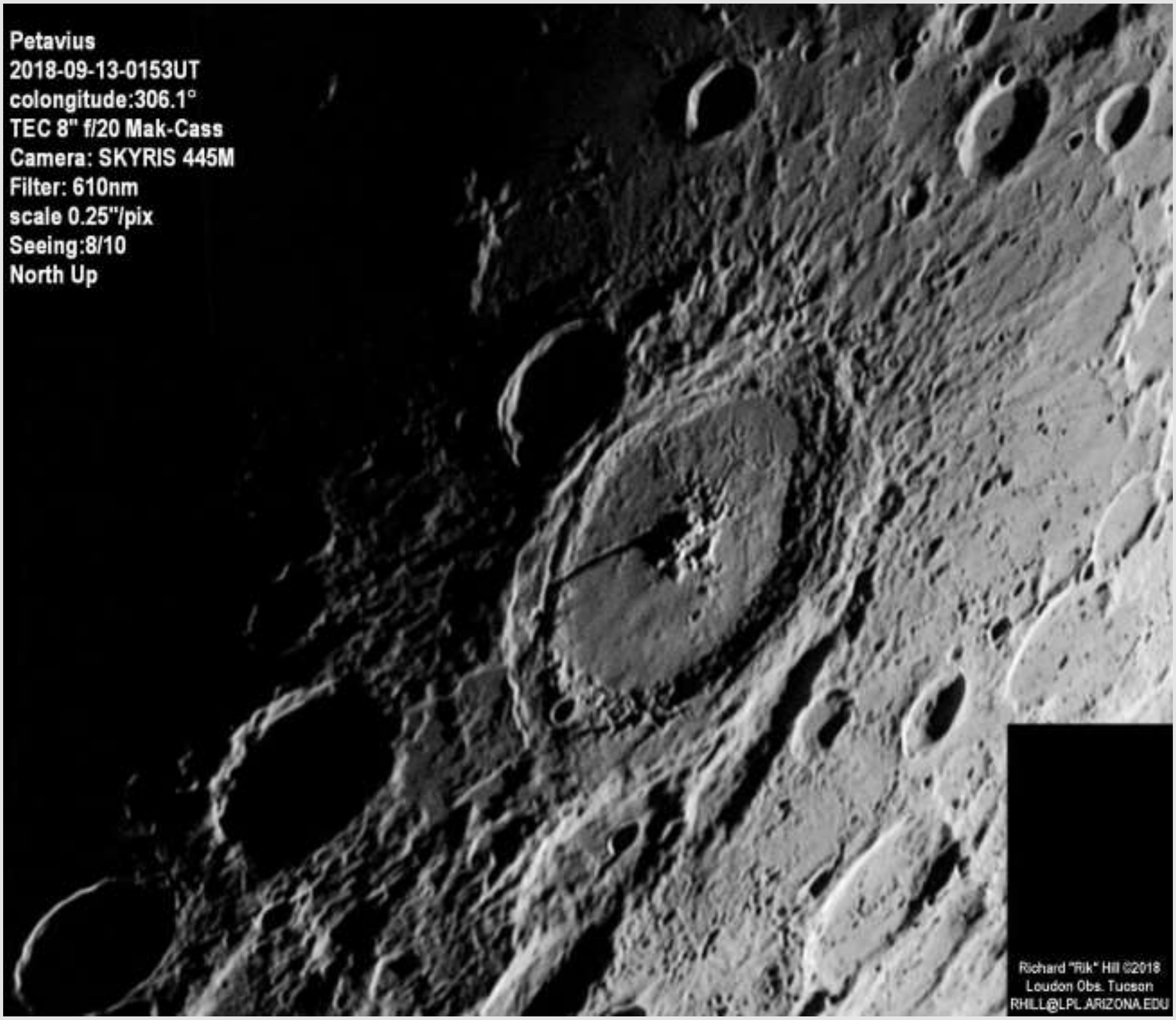
Fabio Verza

Focus-On Announcement

LAND OF CRACKS: PETAVIUS

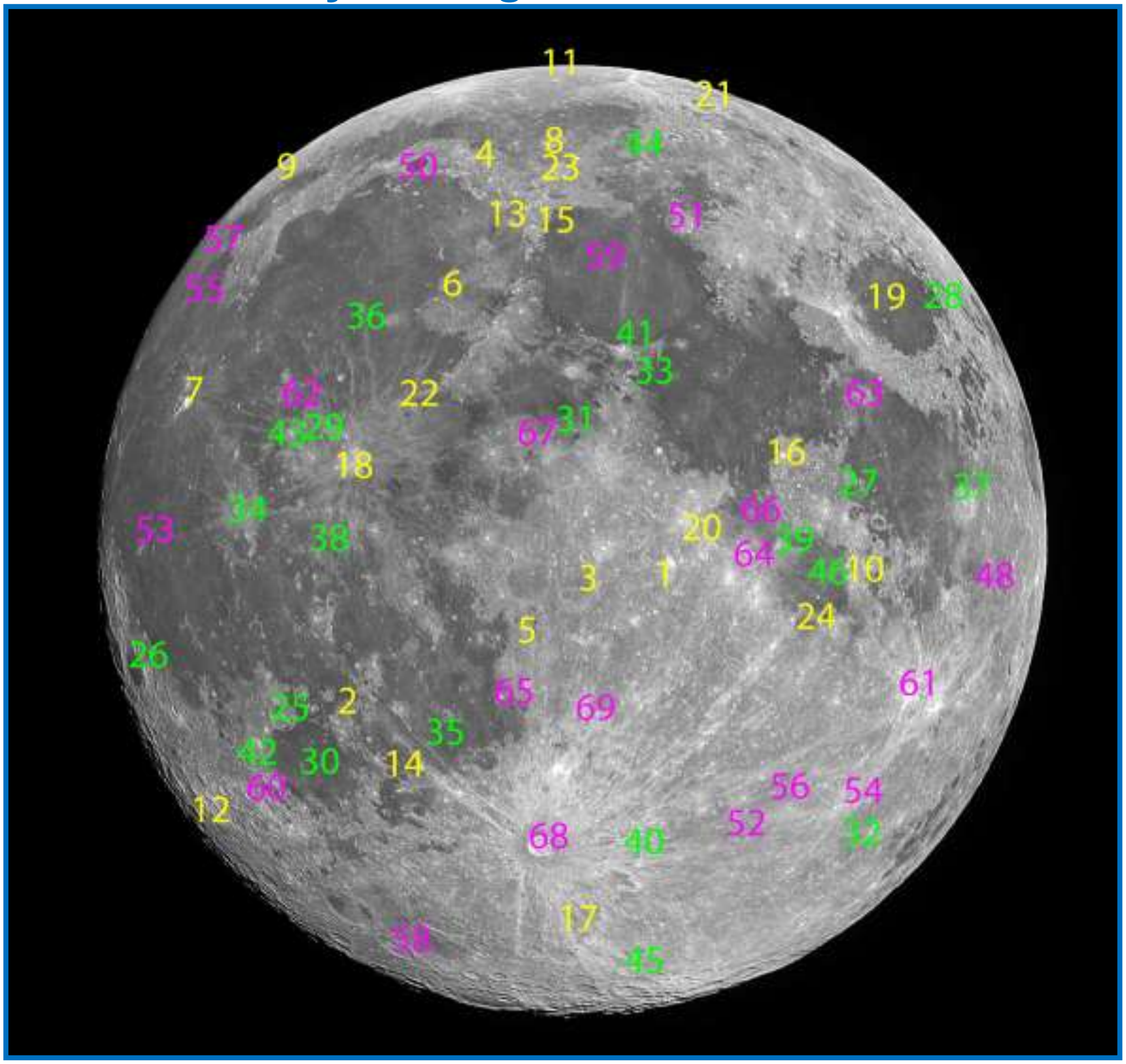
Petavius is a venerable antiquity, think how beautiful it must have been, hundreds of millions of years ago, when he would have looked like a super-grown Copernicus. Then it has lived through a whole geological history that has transformed it. Petavius is an opportunity to learn about the remains of its primitive grandeur, its massive, terraced walls, its mighty central peaks, and its ejecta field; and its more recent geological history: its uplifted ground and the rilles that later fractured it, including its best-known and most beautiful feature: Rimae Petavius, “the great cleft,” as Elger called it.

JANUARY 2023 ISSUE – Due December 20, 2022: PETAVIUS
MARCH 2023 ISSUE-Due February 20, 2023: MARE NUBIUM
MAY 2023 ISSUE-Due April 20th, 2023: REINER GAMMA
JULY 2023 ISSUE-Due June 20th, 2023: MONS RÜMKER



Rik Hill

Key to Images In This Issue



1. Abulfeda
2. Agatharchides
3. Albategnius
4. Alpes, Vallis
5. Alpetragius
6. Archimedes
7. Aristarchus
8. Aristoteles
9. Babbage
10. Bohnenberger
11. Bond
12. Brygius
13. Cassini
14. Campanus
15. Caucasus, Montes
16. Censorinus
17. Clavius
18. Copernicus
19. Crisium, Mare
20. Descartes
21. Endymion
22. Eratosthenes
23. Eudoxus
24. Fracastorius
25. Gassendi
26. Grimaldi
27. Gutenberg
28. Harker, Dorsa
29. Hortensius
30. Humorum, Mare
31. Hyginus
32. Janssen
33. Julius Caesar
34. Kepler
35. Kies
36. Lambert
37. Langrenus
38. Lansberg
39. Mädler
40. Maurolycus
41. Menelaus
42. Mersenius
43. Milichius
44. Mortis, Lacus
45. Moretus
46. Nectaris, Mare
47. Pascal
48. Petavius
49. Piccolomini
50. Plato
51. Posidonius
52. Rabbi Levi
53. Reiner Gamma
54. Rheita
55. Roris, Sinus
56. Rothmann
57. Rümker, Mons
58. Schiller
59. Serenitatis, Mare
60. Sirsalis
61. Stevinus
62. T. Mayer
63. Taruntius
64. Theophilus
65. Thebit
66. Torricelli
67. Triesnecker
68. Tycho
69. Werner