The Lunar Observer

A Publication of the Lunar Section of ALPO

David Teske, editor

Coordinator, Lunar Topographic Studies Section Program

MARCH 2025

In This Issue

PLEASE TRY TO OBSERVE/IMAGE THE TOTAL LUNAR ECLIPSE 2025 MARCH 14

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Lunar Reflections

Greetings to all. Many thanks to all who have contributed to this issue of *The Lunar Observer*. I hope that you find this issue interesting. In this issue, there are short articles in Lunar Topographic Studies by:

- Rik Hill gave us a tour of Archimedes to Linné.
- Alberto Anunziato looks at a wrinkle ridge near Timocharis and possibly endocraters in northern Mare Imbrium.
- David Teske took a look at the rough highlands north of Mare Crisium with a small telescope.
- Darryl Wilson continues his lunar explorations with a thermal imager, this time with a new model on a large reflector telescope.
- Alberto Anunziato reviews the possibility of endocraters, and explores possible endocraters in northern Mare Imbrium.
- Robert Reeves, Greg Shanos and Robert H. Hays, Jr. have interesting observations and articles about the month's Focus-On article, Clavius.
- Alberto Anunziato led the Focus On: Lunar Base Clavius with outstanding text and images from around the globe.

Several people contributed to the images and drawings to the Recent Topographic Studies. Many thanks to all who contributed.

As always, Tony Cook has provided in depth studies in Lunar Geologic Change and the Buried Basin and Crater Project.

Many thanks to all who contributed, and to all interested in *The Lunar Observer*!

Please try to zoom the ALPO anual meeting on July 25-26, 2025. See page 8 for details.

If it is posible, PLEASE observe and image the total lunar eclipse on the early hours of 14 March. Both images and cráter timings would be apprecited. Please see page 6 for more information.

Our next Focus-On article features Volcanic Lunar Features. Please get images, drawings and articles to Alberto Anunziato and David Teske by April 20, 2025.

Clear skies,

-David Teske

Online readers, click on images for hyperlinks

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Lunar Topographic Studies

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Observations Received

Name	Location and Organization	Image/Article
Alberto Anunziato	Paraná, Argentina	Images of Clavius (2), drawing of Clavius, Article *Focus-On: Lunar Base Clavius, Endocrater Clusters in Northern Mare Imbrium* and *A Wrinkle Ridge With a Central Depression Between Timocharis and Landsteiner*.
Sergio Babino	Montevideo, Uruguay, SAO-LIADA	Images of Clavius (4).
James Brunkella	Thousand Oaks, California, USA	Images of Clavius (4).
Ariel Cappelletti	Córdoba, Argentina, SLA	Images of Clavius (4).
Francisco Alsina Cardinalli	Oro Verde, Argentina, SLA-LIADA	Images of Clavius (2).
Jairo Chavez	Popayán, Colombia	Images of Clavius (4).
Maurice Collins	Palmerston North, New Zealand	Images of the 4.4 day-old Moon, Theophilus, the 5.3 day-old Moon (2), 10.4 day-old Moon, 11.4 day-old Moon
Leonardo Alberto Colombo	Córdoba, Argentina	Image of Clavius (1).
Michel Deconinck	Rocbaron, France	Drawing of Clavius.
Jef de Wit	Hove, Belgium	Drawing of Clavius.
Juan Carlos Dovis	Sunchales, Argentina	Images of the Waxing Gibbous Moon (2).
Howard Fink	New York, New York, USA	Model of Clavius.
Desireé Godoy	Oro Verde, Argentina, SLA-LIADA	Images of Clavius (2).
Marcelo Mojica Gundlach	Cochabamba, Bolivia, LIADA	Images of Clavius (9).
Robert H. Hays, Jr.	Worth, Illinois, USA	Article and drawing *Craters Inside Clavius.*
Philippe Heully	Bouére, France	Drawing of Clavius.
Rik Hill	Loudon Observatory, Tucson, Arizona, USA	Images of Clavius (21), article and image *Archimedes to Linné.*
Mike Karakas	Winnipeg, Manitoba, Canada	Images of Clavius (2).

Lunar Topographic Studies

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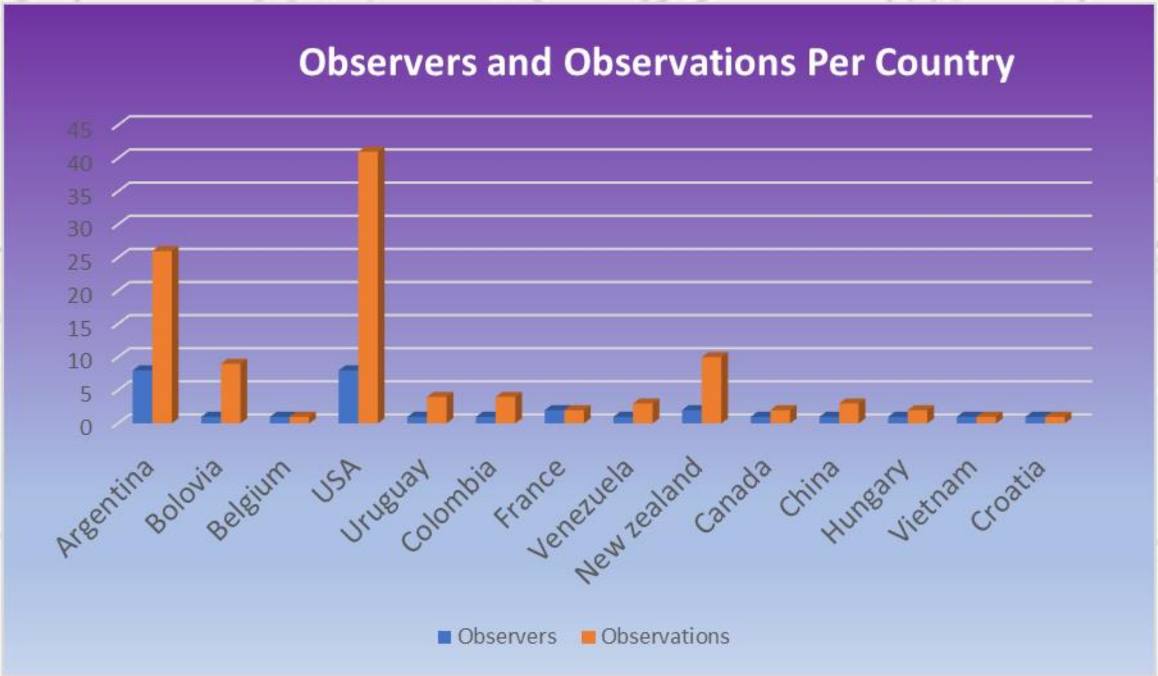
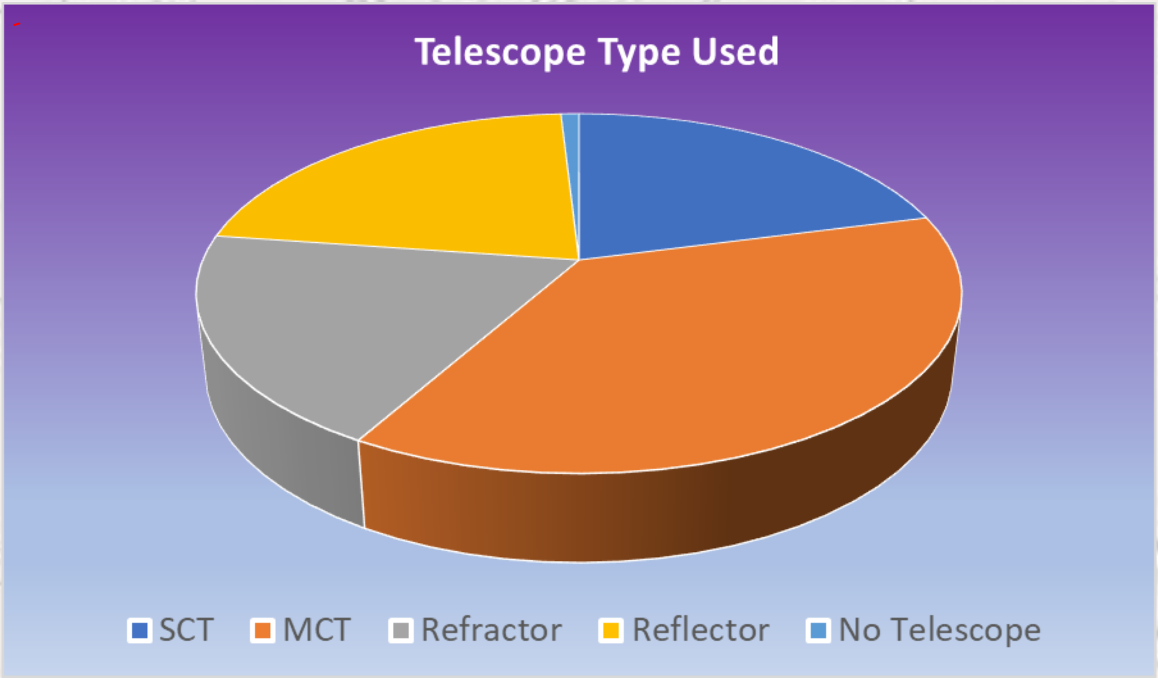
Observations Received

Name	Location and Organization	Image/Article
Sanjin Kovacic	Zagreb, Croatia	Image of Clavius.
Attila Ete Molnar	Budapest, Hungary	Images of Plato and Clavius.
KC Pau	Hong Kong, China	Images of Stöfler, Eudoxus, Eastern Mare Im-brium.
Jesús Piñeiro	San Antonio de los Altos, Venezuela	Images of Clavius (3).
Raúl Roberto Podestá	Formosa, Argentina	Images of Clavius (1).
Robert Reeves	San Antonia, Texas, USA	Article and 7 images *Some Thoughts About Cla-*
Gregory T. Shanos	Sarasota, Florida, USA	Article and three images *Clavius Crater*.
Fernando Surá	San Nicolás de los Arroyos, Argenti-na, SLA-LIADA	Images of Clavius (3), Gassendi and Coperni-cus.
David Teske	Louisville, Mississippi, USA	Images of Clavius (4), article and image *Small Telescope Lunar Musings,: North of Crisium* and *Notes on Observing the Total Lunar Eclipse of 2025 March 14.*
Larry Todd	Dunedin, New Zealand	Images of Clavius (5).
Tien Ngo Tran	Ho Chi Minh City, Vietnam	Image of the Southern Highlands and Clavius.
Darryl Wilson	Marshall, Virginia, USA	Article and images *First Results Win an i3Sys-*

March 2025 *The Lunar Observer*
By the Numbers

This month there were 109 observations by 30 contributors in 14 countries.





Notes on Observing the Total Lunar Eclipse of 2025 March 14

David Teske

I really encourage you to do crater timings if at all possible. It is very enjoyable and can really be *fast* paced. Plus, it really tests your knowledge of crater locations (is that Goclenius?). Use whatever telescope that you have, use a medium magnification (50-90x), and get a telescope ready Moon map. I have an old laminated one from Sky and Telescope. I basically watch carefully and see when, to me best estimate, the Earth's shadow crosses the center of a crater like say Copernicus. Personally, I have my phone set to time.gov. I tap the phone and it gives me the time to the second. I write that time in for say Copernicus, then move to the next crater. I find it much more challenging on the emersion of craters from the shadow, because they seem to sneak up on you!

According to the RASC Handbook USA Edition page 139, they say of crater timings during an eclipse "In 1702 Philippe de La Hire made a curious observation about Earth's umbra. To accurately predict the duration of a lunar eclipse, he found it necessary to increase the radius of the shadow about 1% more than is warranted by geometric considerations. Although the effect is clearly related to Earth's atmosphere, it is not completely understood since the shadow enlargement seems to vary from one eclipse to the next. The enlargement can be measured through careful timings of lunar craters as they enter and exit the umbra."

Get what crater timings that you can. Clouds may well interrupt some of your timings. Doing this carefully can be enjoyable, fast paced and may produce data about our atmosphere. I will try to get these observations sent into Sky and Telescope magazine.

I find it most amazing doing this that as I time the craters immersion it slowly gets darker and darker outside. Then at totality, the Milky Way can be seen from a dark-sky location. Enjoy the eclipse and the Milky Way!

A recap of what I do:

Bring out a copy of the table of crater timings.

Bring out a dim flashlight (red)

Find time at time.gov

Estimate when the shadow covers the center of said crater

Hope for clear skies!

Call to Image the Next Lunar Eclipse

In the May 2024 issue of our newsletter, we referred to study that Giovanni Di Giovanni of the Osservatorio Astronomico CEA "A. Bellini" of the cooperative society COGECSTRE (cogecstre.com) in the city of Penne (Abruzzi, central Italy) about the correlation of the lunar eclipse brightness and the terrestrial atmosphere. For this study, which carries out a diachronic analysis of almost four centuries of detailed observation of lunar eclipses, the photographic record is essential, since the data reduction (the photometries of images of eclipses in the 21st century with visual brightness estimates from the 16th century) allows us to recreate the history of our skies in the last times of humanity.

With the same spirit that animates amateur astronomical observation in general, and the moon in our particular case, it is possible to contribute our grain of sand to this italian study imaging the Moon in the next lunar eclipse of March 14th, even with small optics (e.g. f300mm telephoto lenses) and digital cameras, good fit-for-purpose images of the Moon can be obtained

The images must be taken always with the same instrument (diameter and focal length), always with the same ISO, without filters, in the following sequence: at least two images before the eclipse, at least 3 images near the maximum phase and at least 2 images after the eclipse. Images should not be processed.

The images can be emailed to albertoanunziato @yahoo.com.ar

Total Lunar Eclipse of 2025 March 14 Crater Immersion and emersion times

UTC of Immersion	Crater Name	Observed UTC Immersion	UTC of Emersion	Crater Name	Observed UTC Emersion
05:15	Riccioli		07:41	Riccioli	
05:15	Grimaldi		07:42	Aristarchus	
05:17	Billy		07:43	Grimaldi	
05:22	Campanus		07:50	Kepler	
05:28	Tycho		07:51	Billy	
05:29	Kepler		07:52	Plato	
05:35	Aristarchus		07:55	Pytheas	
05:37	Copernicus		07:57	Timocharis	
05:43	Pytheas		07:58	Copernicus	
05:49	Timocharis		08:03	Aristoteles	
05:53	Dionysius		08:04	Campanus	
05:53	Manilius		08:04	Autolycus	
05:57	Autolycus		08:05	Eudoxus	
05:57	Menelaus		08:13	Endymion	
05:59	Censorinus		08:14	Tycho	
06:01	Plinius		08:14	Manilius	
06:01	Goclenius		08:17	Menelaus	
06:05	Messier		08:22	Plinius	
06:05	Plato		08:22	Dionysius	
06:07	Langrenus		08:31	Censorinus	
06:07	Taruntius		08:33	Proclus	
06:09	Eudoxus		08:36	Taruntius	
06:11	Proclus		08:38	Messier	
06:12	Aristoteles		08:38	Goclenius	
06:22	Endymion		08:44	Langrenus	

From RASC Observer's Handbook 2025-USA edition page 128

ALPO 2025 Conference: Call for Papers

Tim Robertson & Ken Poshedly,
ALPO Conference coordinators

Overview

Due to the success of attracting more and more viewers and participants to our online conferences, the 2025 Conference of the ALPO will once more be held online, this time on Friday and Saturday, July 25 and 26.
The ALPO conference times will be:

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

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

Conference Agenda

The conference will consist of initial welcoming remarks and general announcements at the beginning each day, followed by papers and research findings on astronomy-related topics presented by ALPO members.
Following a break after the last astronomy talk on Saturday will be presentation of the Walter Haas Observing Award. A Peggy Haas Service Award may also be awarded.
A keynote speaker will then follow the awards presentations on Saturday. The selection of a keynote speaker is in progress and the final decision will be announced in the summer issue of this Journal (JALPO66-3).

Presentation Guidelines

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

Suggested Topics

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

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

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

Lunar X Predictions for 2024-2028

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

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

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

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

Submitted by Greg Shanos.

First Results with an i3System Thermal Imager and a 12” Newtonian

Darryl Wilson

This author recently acquired a new thermal imager from i3System, a South Korean company that supplies high technology imaging devices. According to online technical specs, the i3System TE-EV1 has the potential to outperform the imagers used in previous thermal imaging articles. A future article will review the capabilities of the TE-EV1 in detail. For now, we will have a quick look at the lunar images we can obtain with this system.

All previous thermal imaging articles used images obtained with an 18” Newtonian. This author’s 18” mirror is currently being refigured, so a 12” Newtonian was used to acquire the images presented here. Since even the sharpest of these thermal images are diffraction limited, the reduction of aperture from 18” to 12” causes a visible loss of resolution. With 12” of aperture, the resolution is limited to about 10 miles on the lunar surface. Even so, the TE-EV1 images look almost as good as those taken through the larger telescope, partly due to the improved signal to noise (SNR) ratio of the new sensor. For comparison, the interested reader may refer to the November 2019 issue of “The Lunar Observer” (TLO201911). It has two thermal images taken on September 20, 2019. On that date, the lunar phase was nearly the same as it was for the two images in this article.

Figure 1 is a visible light reference image taken February 18, 2025 at 11:49 UT, about the same time as the thermal images. 3 inch refractor telescope, Celestron SKYRIS 274 C camera, red band.

Figure 2 is a thermal image of the moon taken February 18, 2025 at 11:39 UT. It shows sunset on Mare Serenitatis and extends beyond Copernicus, to Kepler in the west. For historical reference, white crosshairs have been placed at the approximate locations of the Apollo 12 – 16 landing sites.

The SNR in Figure 2 is good enough to resolve wrinkle ridges in Mare Imbrium far from the terminator. It correctly shows that Copernicus' rays are almost completely invisible due to the late-afternoon thermal crossover effect noted in previous articles. Kepler is experiencing a higher solar elevation angle than Copernicus, so heating effects are stronger. Due to the stronger insolation, Kepler's ray system is still slightly darker at this time of the lunar day than the background maria, due to albedo-effect cooling. Further to the south, we see the central peak of Alphonsus is just barely resolved.

Examination of the area to the right of the terminator, the dark side, shows several lunar hotspots to the southeast of Mare Serenitatis. These are always interesting to observe, especially if they can be imaged multiple times over several days. Their rate of cooling depends on the thermal inertia of the lunar surface material at their location, and the local topography. Hotspots that persist for several earth days are usually either small craters or larger areas of exposed silicates, free of regolith.

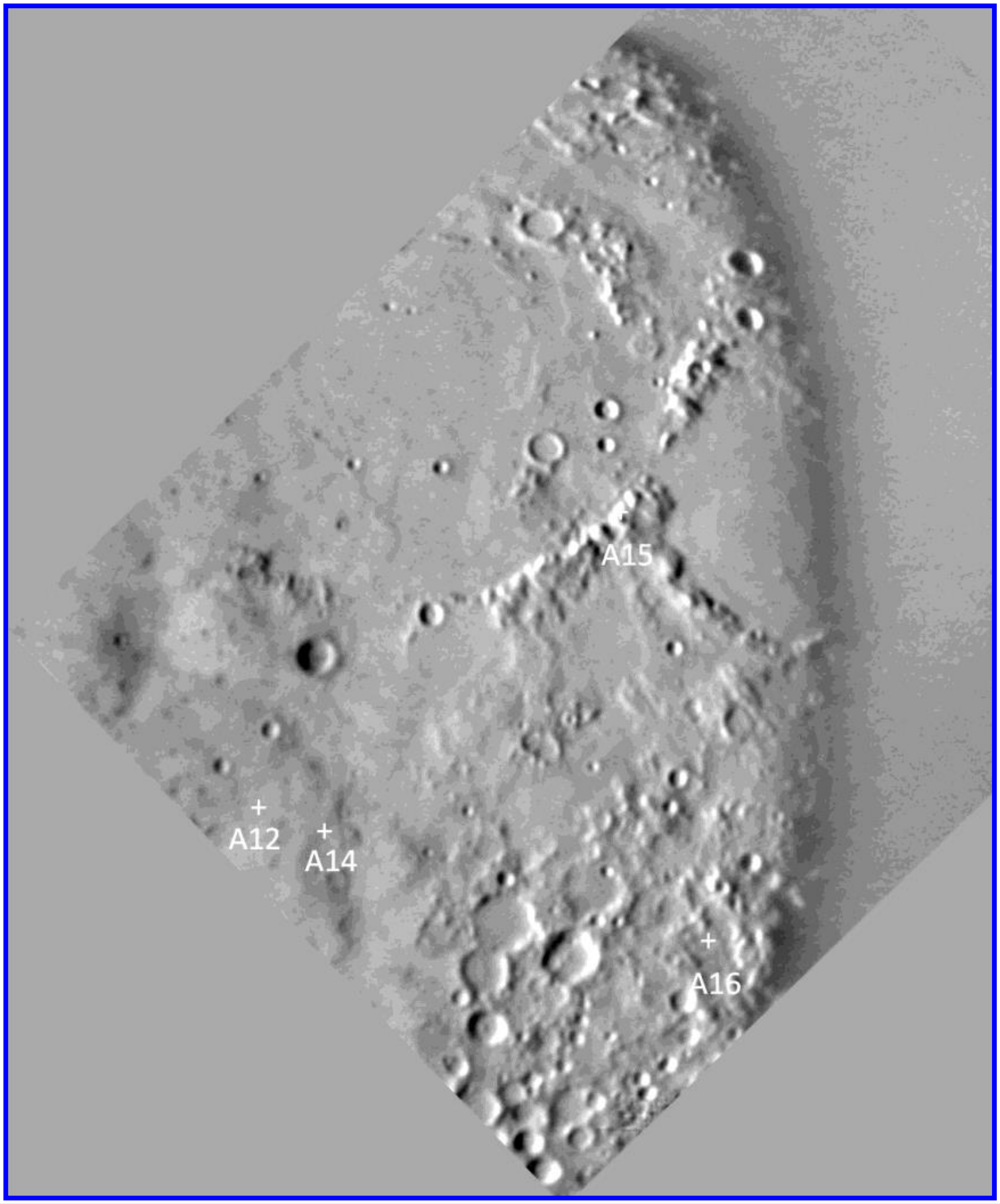


***Image 2, Thermal Image of Mare Imbrium and Mare Serenitatis Region**, Darry Wilson, Marshall, Virginia, USA. 2025 February 18 11:39 UT. Celestron 12 inch Newtonian reflector, i3System TE-EV1 thermal imager, stack of 135 raw images.*

Figure 3 is a thermal image of the moon taken February 18, 2025 at 12:27 UT. As with Figure 2, white cross-hairs have been placed at the approximate locations of the Apollo 12 – 15 landing sites. This image covers most of the western hemisphere. Rupes Recta (The Straight Wall) is resolved as a light vertical line, slightly curved to the left. Note that the wall is completely invisible in visible light images at this lunar phase. It can be found in thermal images because of the strong dependence of temperature on the solar elevation angle at the surface. The slope of the wall is sufficient to cause a large temperature change relative to the surrounding area. Grimaldi is brighter than the surrounding maria, as usual when it experiences a high sun angle. Note the two dark spots at the nearer side of Grimaldi. A comparison with Figure 1 reveals that they are bright craters that have experienced albedo related cooling. Aristarchus, the brightest crater on the moon, is an even darker spot for the same reason.

One interesting note is that, upon cursory inspection, all lunar red spots that were discussed in a previous article (TLO 202411, p. 18) seem to be cooler than their surroundings in this thermal image. Lassell Massif, Helmet, Montes Riphaeus, Darney-a, Hansteen-a, and Mons Gruithuisen are all somewhat darker than the nearby landscape.

In summary, the signal to noise ratio for this imager is amazingly good. If you have ever watched one of those nature shows that have high contrast camera footage of wildlife in the middle of a moonless night, you have an idea of what this imager can do. The results presented here should encourage anyone with a 12" Newtonian to give lunar thermal imaging a try.

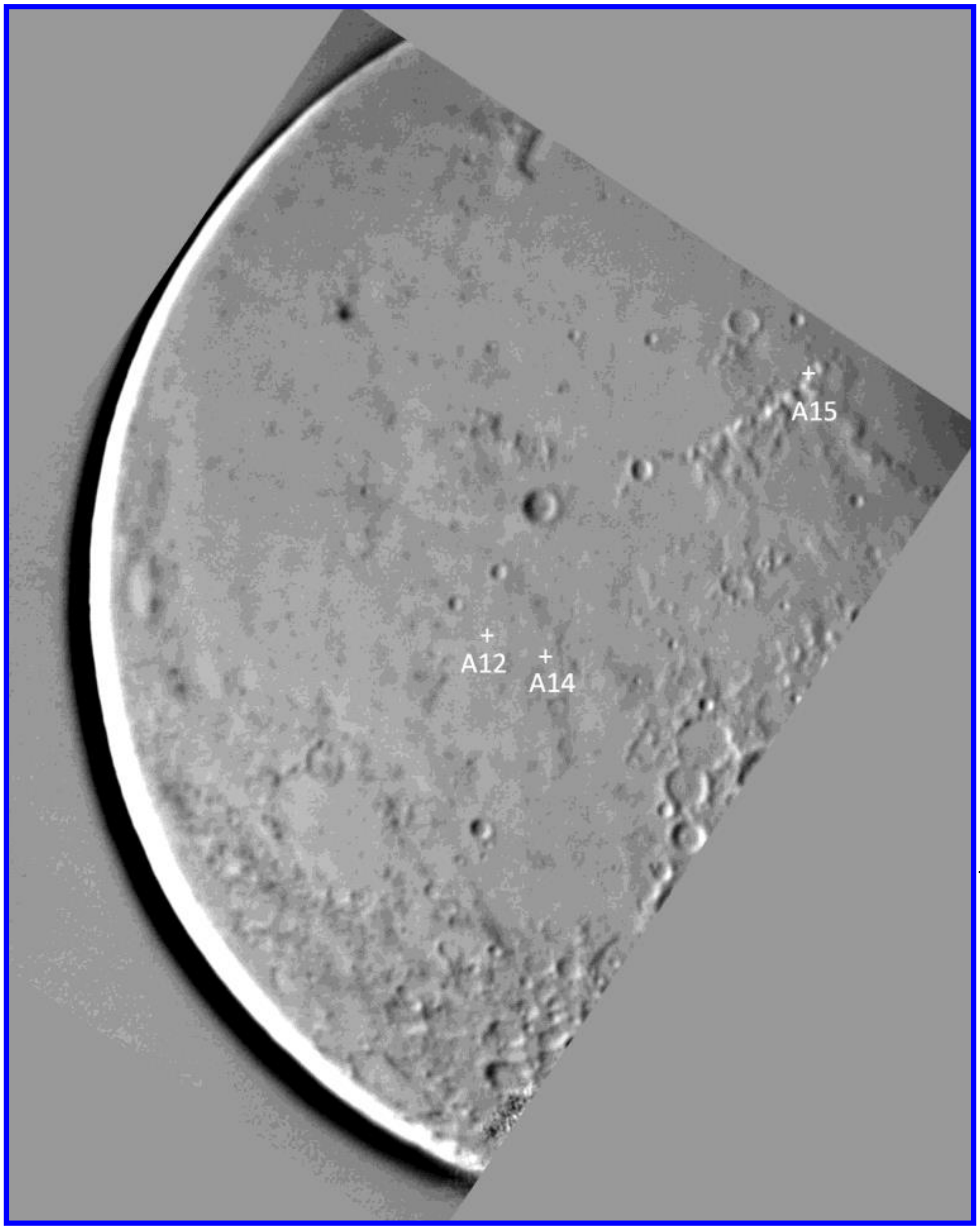
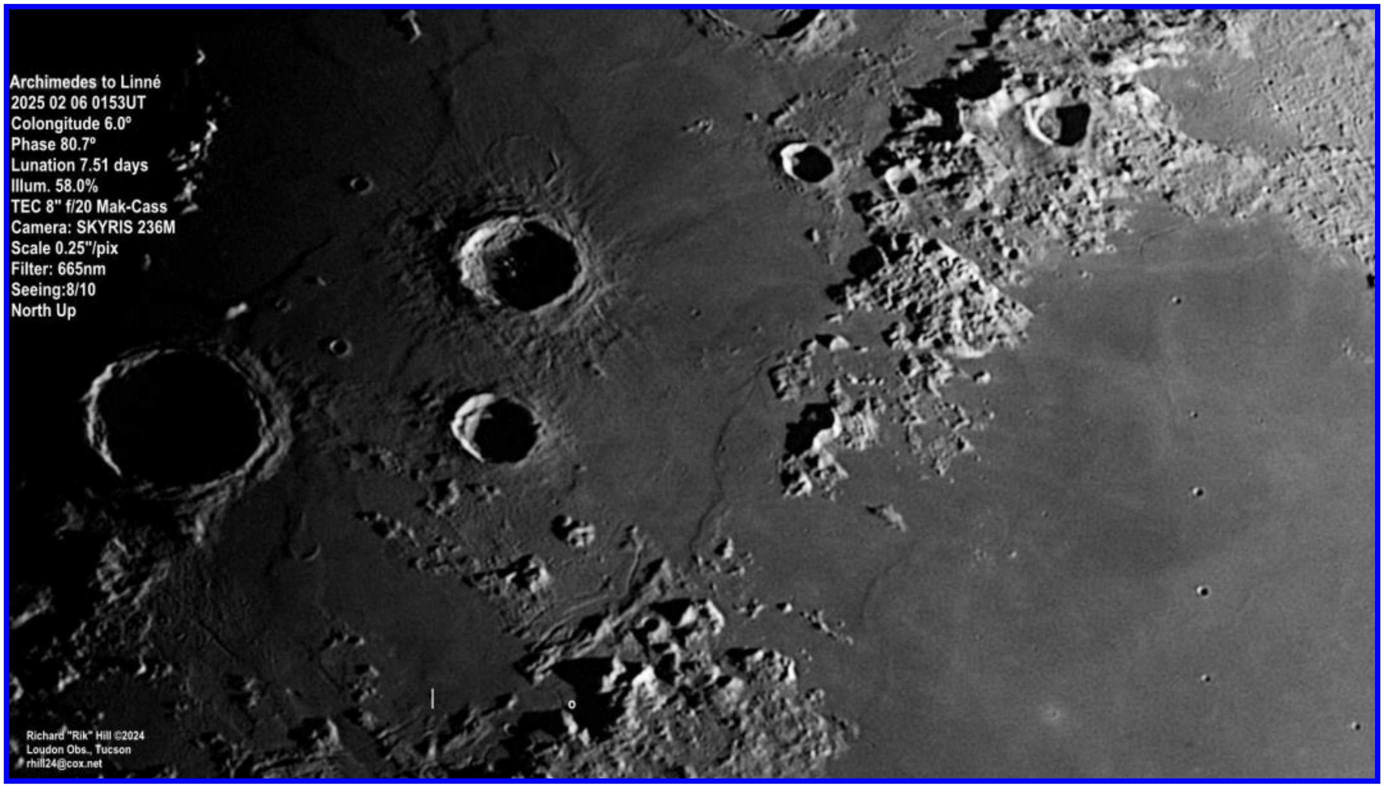


Image 3, Thermal Image of the western limb of the Moon*, Darry Wilson, Marshall, Virginia, USA. 2025 February 18 12:27 UT. Celestron 12 inch Newtonian reflector, i3System TE-EV1 thermal imager, stack of 90 raw images.*

Lunar Topographic Studies

First Results With a i3System Thermal Imager and a 12" Newtonian



Archimedes to Linné

Rik Hill

What a spectacular terminator on this night, in this place! Dramatic features from the great crater Archimedes (83 km dia.) on the left edge to the middle of Mare Serenitatis on the right. Due east (right) of Archimedes is the crater Autolycus (40 km) and above it is the crater Aristillus (55 km) with it's wonderful hatch-work ejecta blanket that according to some extends as far as 600 km from the center of the crater. Below Autolycus and east of Archimedes is a small flat region that is Paulus Putredinis, the "Marsh of Decay", where you can glimpse the lunar dome Putredinis 1 (above my marker) some 7km in diameter and 90 m high. There are several other domes in this area but a lower sun angle is needed to bring them out. A little east the "o" marks the landing site of Apollo 15, much easier to see with slightly higher Sun. Note the great rimae all along this northern portion of the Montes Apenninus.

North of this is a long triangular set of mountains with two medium sized craters on the north end. The mountains are my favorite on the Moon, the Montes Caucasus and the craters are Theaetetus (25 km) on the left and Calippus (33 km) on the right. These mountain peaks are just the tops of what were once lofty ramparts until they were flooded by the lavas of Serenitatis. This flooding left some wonderful passes between the peaks.

Due south of these mountains is a little dusky white spot in the Mare near the bottom of the image. This is the crater Linné the focus of a controversy in the 19th century when the astronomer Johann Friedrich Julius Schmidt claimed that it had changed its appearance from what was described by Beer & Madler in *Der Mond* earlier in the century. After decades of the controversy further observations showed that there was no change and we have since gotten reliable spacecraft observations that show it to be a sharp rimmed relatively young crater around 2km in diameter.

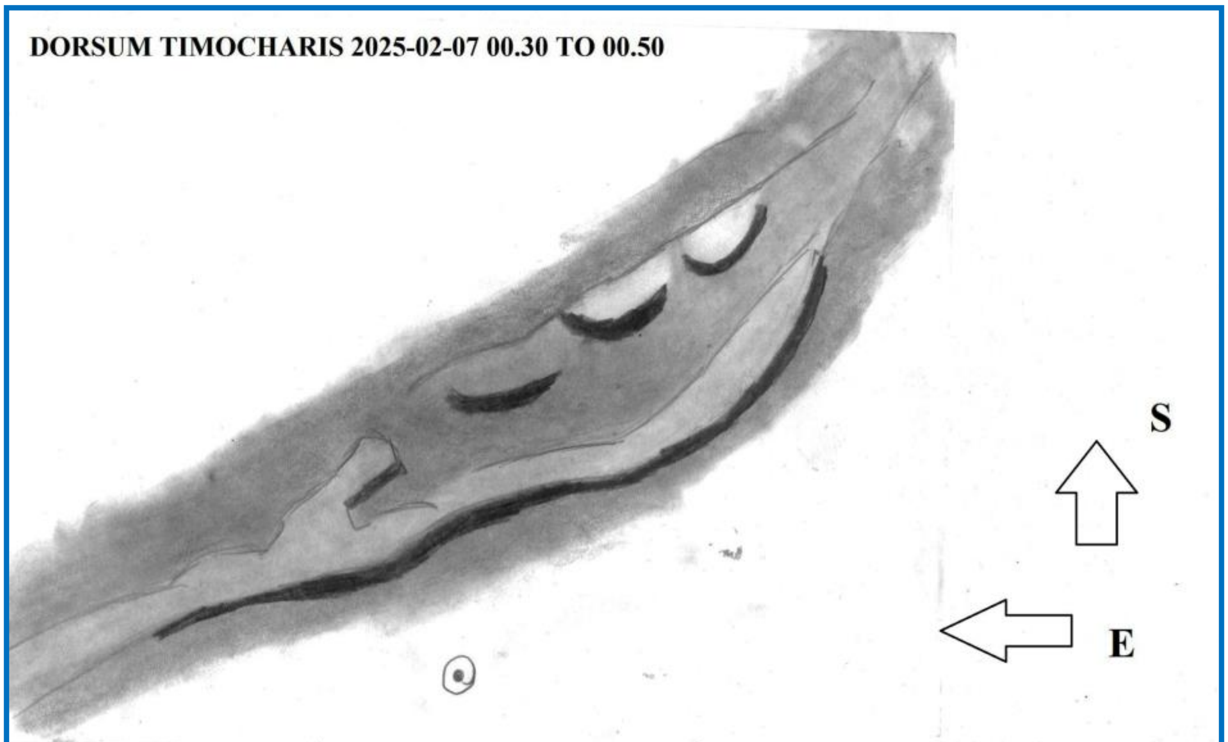
There is much more to explore in this area and I encourage you to do so at any phase of the Moon.

Lunar Topographic Studies
Archimedes to Linné

A Wrinkle Ridge with a Central Depression Between Timocharis and Landsteiner

Alberto Anunziato

The dorsum shown in IMAGE 1 is a segment of a wider chain that is concentric to Mare Imbrium. What we see is the segment that runs between Timocharis to the south and Landsteiner (7 km in diameter) to the north and curves north and passes through Montes Spitzbergen and reaches Mons Pico, defining the outline of an inner ring of the Imbrium Basin. The topography of this segment is very interesting. It is another example of how the topography of the vast majority of wrinkle ridges is much more complex than the typical topography that appears in theoretical studies (a wide and gently sloped element called arch and a narrow and steep upper element called crest). In IMAGE 1 we see what would be an arch with two crests running, one on each margin. The southern crest (facing Timocharis) looked very steep and clearly showed three crest segments casting shadows to the north, within the arc (the two westernmost ridge segments appeared much brighter than the third easternmost). The northern crest is more continuous and less bright. What is peculiar is that the topographic pattern of a wrinkle ridge is that the crest runs on one of the margins of the arch, sometimes migrating from shore to shore, or else runs transversely over the arch (in a step pattern of a spiral staircase). Whereas in our arch the crest… runs on both margins. This indicates that each wrinkle ridge is different, which makes its topographic classification a promising task (except that it may be titanic, since we are dealing with thousands of dorsa). What we have described corresponds to the western half, the eastern half is much simpler. This dorsum, in addition to the double crest, presents another heterodox topographic characteristic: a central depression. The northern crest runs continuously, casting a shadow that widens in certain segments, while the southern crest seems to break in the center and then continue northward, or that short segment that casts a shadow northward would be a fork-shaped branch of the northern crest. It is not the first wrinkle ridge I know that has a central depression, although it is the first one I could observe with my telescope.



Dorsum Timocharis, *Alberto Anunziato, Paraná, Argentina. 2025 February 07 00:30-00:50 UT. Meade EX105 Maksutov-Cassegrain telescope, 154x.*

IMAGE 2 is from Kwok Pau's Photographic Lunar Atlas for Moon Observers (a work that we constantly use to check our visual observations and analyze the topography of the wrinkle ridges); it is a detail of a much larger image on page 7 of Volume 2. Of course, with more detail, IMAGE 2 shows that the central area of our dorsum is extremely complex. Looking at this IMAGE 2 we could think that it is not a central depression but two segments that converge. That is why I thought it would be interesting to look at the relief of the area in the Lunar Reconnaissance Orbiter Quickmap (IMAGE 3), where a relief with two higher areas at the ends of the arch is quite evident. The central depression is lower than the margins, obviously, but higher than the Mare Imbrium terrain to the north and south. In other words, it is an internal depression in the arch, it is part of it. A really interesting wrinkle ridge to observe and, above all, to analyze.

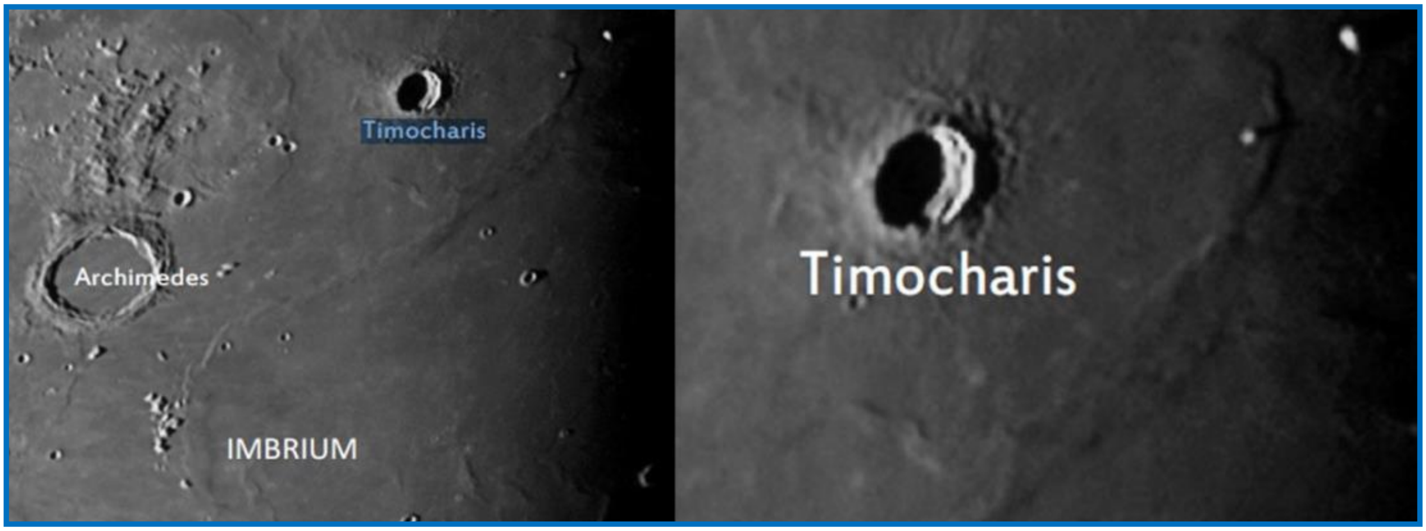
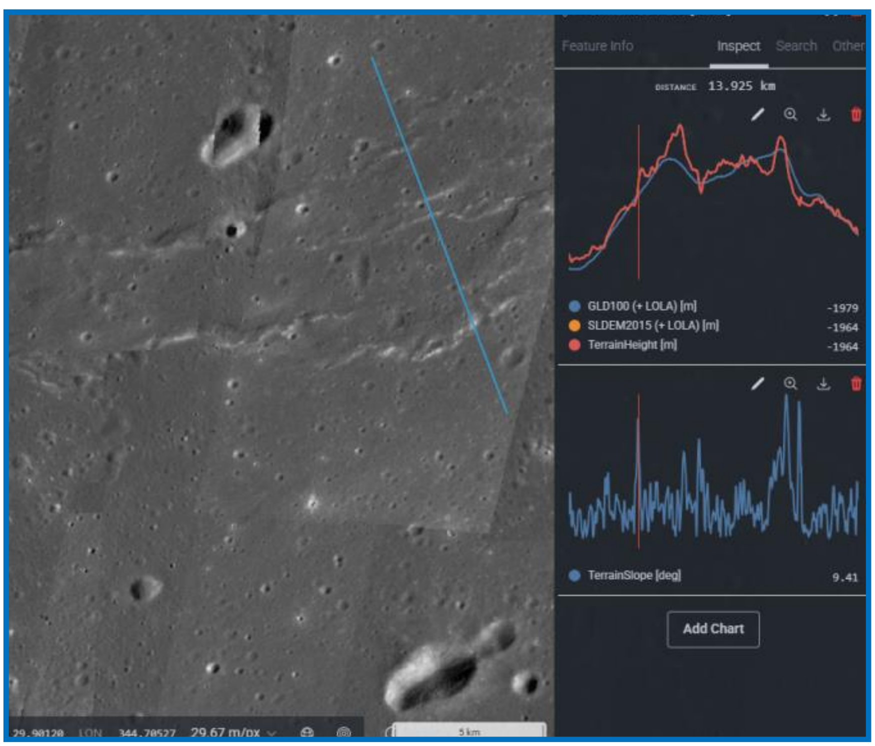


Image 2 Dorsum Timocharis, *Kwok Pau Photographic Lunar Atlas for Moon Observers, Volume 2, page 7.*

Image 3, *Dorsum Timocharis, LROC.*

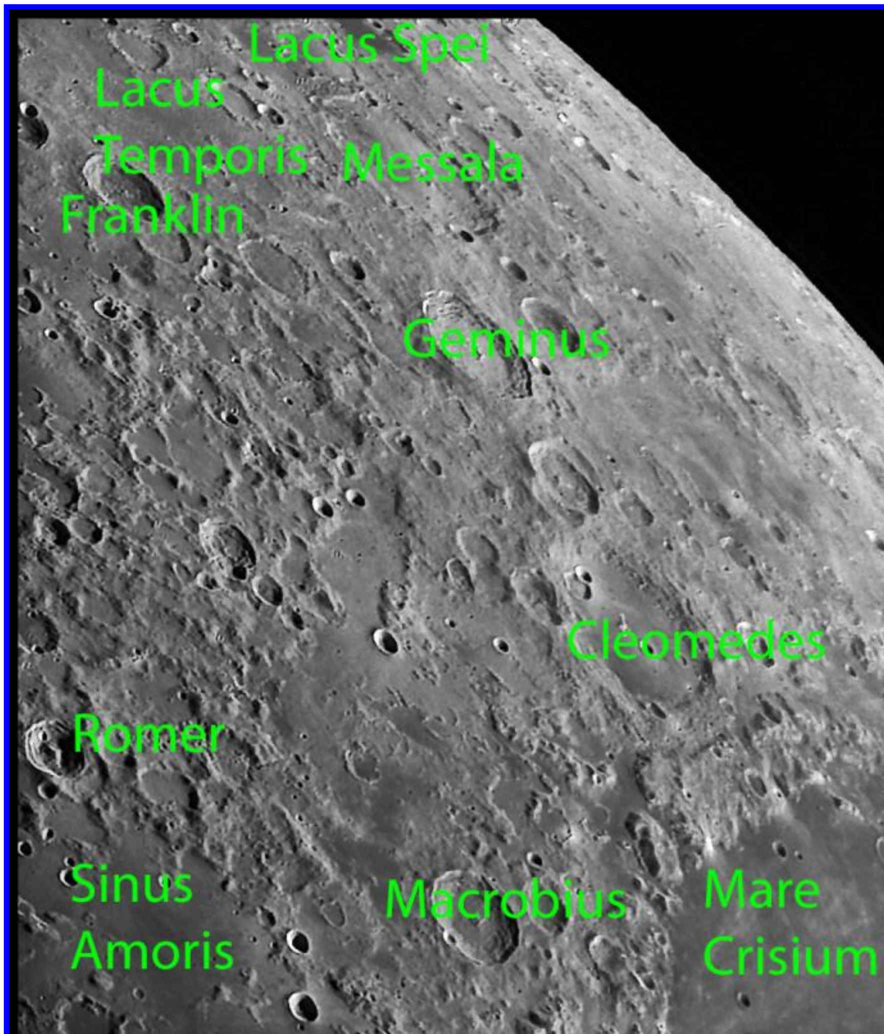


Small Telescope Lunar Musings
North of Crisium
David Teske

This is a somewhat overlooked part of the Moon as there are no "showpiece" features here, but closer inspection finds a wide variety of lunar topography. We will start at the bottom right at Mare Crisium and work our way north then back around. Before we leave Mare Crisium, I call your attention to two features on the Mare's edge. Just above the "M" on Mare is a small bright spot. This is informally known as "Rik's Falls" after Rik Hill. It is likely a slope that is fairly smooth that sunlight reflects off of better than average. Just to the left (west) of this is a large unnamed "island" surrounded by Mare Crisium lavas. This lava spreads northward towards the prominent crater Cleomedes at 126 km in diameter. Careful inspection will see the craters Cleomedes E and very young A on the northwest rim of Cleomedes. Stretching southwest from Cleomedes E is Rima Cleomedes, a rille about 30 km long. It looks like the rille starts in a ray of Cleomedes A and terminates near Cleomedes J. Can you find it? Just north of Cleomedes is Geminus, a prominent crater with a diameter of 86 km. Note the very terraced walls here. North of this is Messala, a battered large crater 124 km in diameter.

North of Crisum
2025 February 07 01:17 UT
Lunation 5.28 days, colongitude 339.3 degrees, illumination 32.9%, seeing 8/10
Stellarvue SVX 127D refractor telescope, 2.5x Power Mate, IR block filter, ZWO ASI120MM/S
David Teske, Louisville, Mississippi, USA
Sunspot Observatory

At the top edge of this image is a small patch of lava that is named Lacus Spei, the Lake of Hope. With a diameter of only 80 km, Lacus Spei is one of a few small lava plains in the neighborhood. Southwest of Lacus Spei we cross Lacus Temporis with a diameter of about 250 km to reach the prominent crater Franklin. Named after the American statesman, this crater is 56 km in diameter, has terraced walls and a small central peak. South of this is the crater Römer. Römer has a sharp rim, terraced walls and a central peak. Its diameter is 40 km. South of Römer is the 250-mile diameter Sinus Amoris, the Bay of Love. Sinus Amoris is a northeastern bay of Mare Tranquillitatis. Coming back full circle, we see the prominent crater Macrobius. This looks like it was gouged out of highland material in the area surrounding Mare Crisium. It is 64 km across and again has nice terraced walls. Please note that this area will be impacted by libration, sometimes closer and sometimes farther from the Moon's northeastern limb. But these features are never liberated off the limb. So, get that telescope, regardless of the size and start with a Sea of Crisis, go to a Lake of Hope and be sure to take a dip in the Bay of Love. And check out all the interesting lunar topography along the way!



North of Crisium
2025 February 04 01:17 UT
Lunation 5.28 days, colongitude 339.3 degrees, illumination 32.9%, seeing 8/10
Stellarvue SVX127D refractor telescope, 2.5x barlow, IR cut filter, ZWO ASI120MM/S, 100/500 frames
David Teske, Louisville, Mississippi, USA
Sunspot Observatory

Endocrater Clusters in Northern Mare Imbrium

Alberto Anunziato

I recently finished reading a work that I was very attracted to, written by Gilbert Fielder, entitled "Secrets of the Moon. Understanding and Analyzing the Lunar Surface", (2022, CRC Press, New York). The work is extremely entertaining and explains with great elegance a series of topics related to geology that can be quite abstruse. I am not an expert on lunar geology, but it seems that Fielder departs from the dominant thesis at least as regards the orientation of the large lineaments on the Moon, which would be explained by a general orientation (Lunar Grid System) instead of the currently accepted explanation of impact basins.

Reading chapter 18 I had a moment of astonishment, since it referred to a subject that I had wondered about on several occasions: the topography of the small formations that seem so different from the large formations to which we pay more attention. The author describes a mechanism for the formation of small craters that is not exogenous. (meteorite impact) nor the endogenous one related to the volcanic craters that we know as pits. Fielder says: "“Dykes are created when liquid magmas ascend through a planetary crust by prying open and filling fractures before solidifying. The magmas rise under hydrostatic pressure. In the special case of the Moon, where there is essentially no atmospheric pressure and uncommonly small overburdens provided by the regolith, the final stage of the ascent of a liquid dyke would be interrupted by the explosive release of any contained gases into the vacuum. In the process, small craters would be formed by the sudden dispersal of near-surface materials accompanied by the collapse of some of the regolith” Fielder calls the craters formed by this endogenous mechanism “endocraters.”

What is striking is that we can distinguish small endocraters from small impact craters in that while the distribution of the latter is obviously random, the distribution on the surface of the endocraters is not, since their formation depends on three main factors: 1) the composition of the lava flows, since the composition of the type of lava determines the degree of possible outgassing; 2) the existence of fractures in the ground and 3) the composition of the regolith, since the possible drainage of the regolith could significantly alter the original shape of the endocrater. In Chapter 21, Fielder explains how counting small craters in certain areas can give results that are not explainable if the craters were all impact craters (in stratigraphically more recent areas there may be a smaller number of craters than in older areas, since the result would depend on the properties of the lava rather than on random impacts).

I find this endogenous mechanism of small crater creation interesting; it could explain a series of crater formations that have always seemed unusual to me and that seem difficult to explain by random impacts. One of these is crater clusters, areas with a high density of craters that would not be explained by the fragmentation of a meteorite by the gravitational attraction of the moon, which would be the case of the “catenae” or chains of craters. We dedicated the Focus On section of our magazine for May 2024 to crater chains, and if you look at that gallery of images you will see that they are radically different from the crater clusters that we will see below.

Traveling around the area south of Plato, in Mare Imbrium, you can see quite clearly a series of crater clusters that could perfectly have been produced by the explosive outgassing of the lavas of northern Mate Imbrium. The area was chosen simply because of what appears to be a greater number of these clusters of possible endocraters (a purely observational criterion). All images are from the Lunar Reconnaissance Orbiter Quickmap.

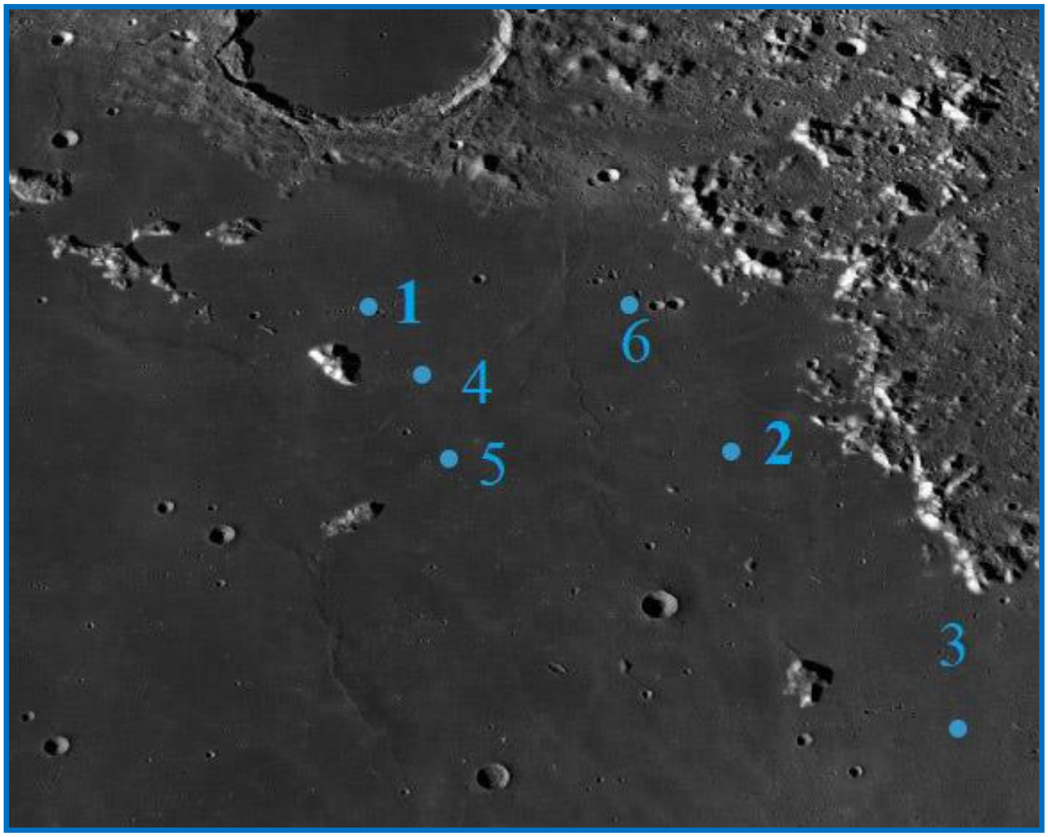
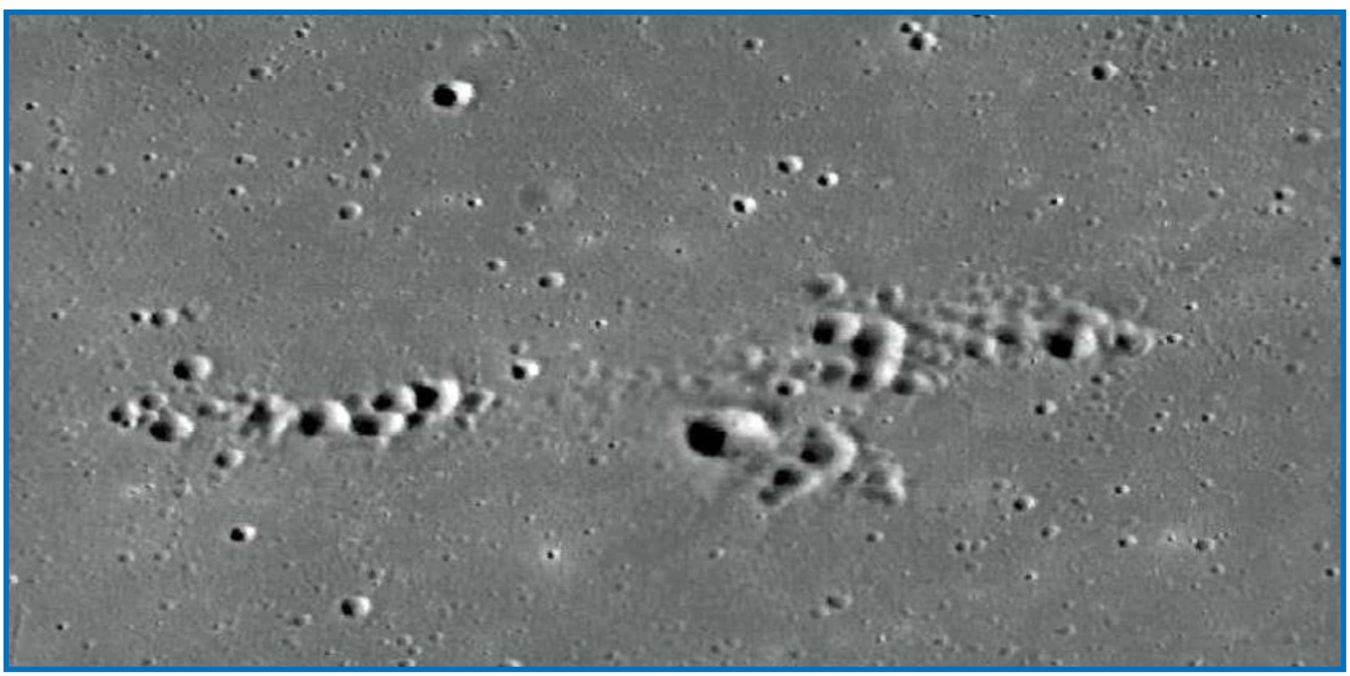


IMAGE 0 shows the area in panoramic view, with Plato to the north and Mons Pico and Mons Piton to the east. There are numerous crater clusters in the area, we invite the reader to examine the area. The points and numbers correspond to the location of the images that follow. Our gallery is not exhaustive, but merely indicative. Of course, there are densely cratered areas that could be included in our gallery, but they could also be random accumulations of impact craters. The examples we propose seem to escape this mechanism. We do not know if they are really clusters of endocraters, but there seems to be a non-random accumulation in them.

IMAGE 1: At point 1 Latitude 46.73 Longitude 351.50 there are two nearby clusters. The one on the left could be an unusual chain of craters, since some overlap each other, but the general shape is not that of a catena, even less so the cluster on the right, especially the craters on the right margin, which seem “seeded”.



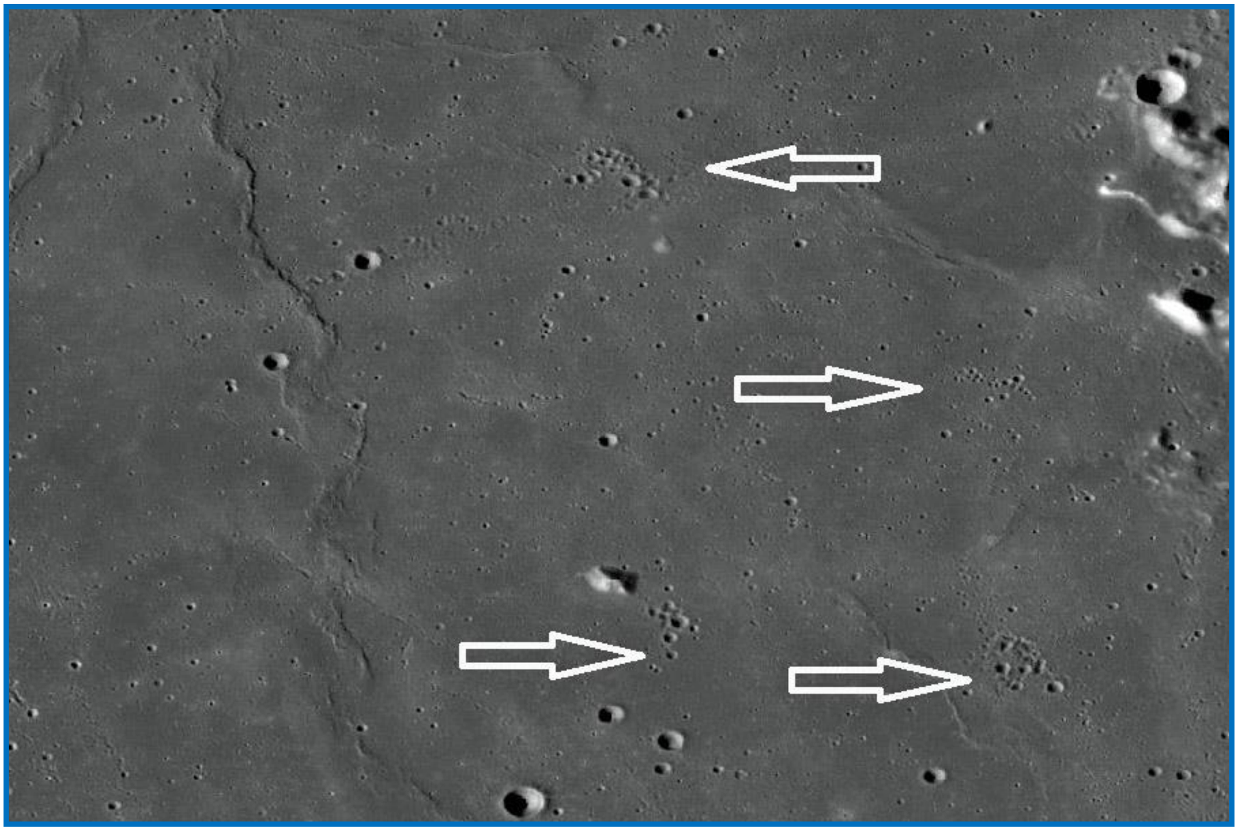
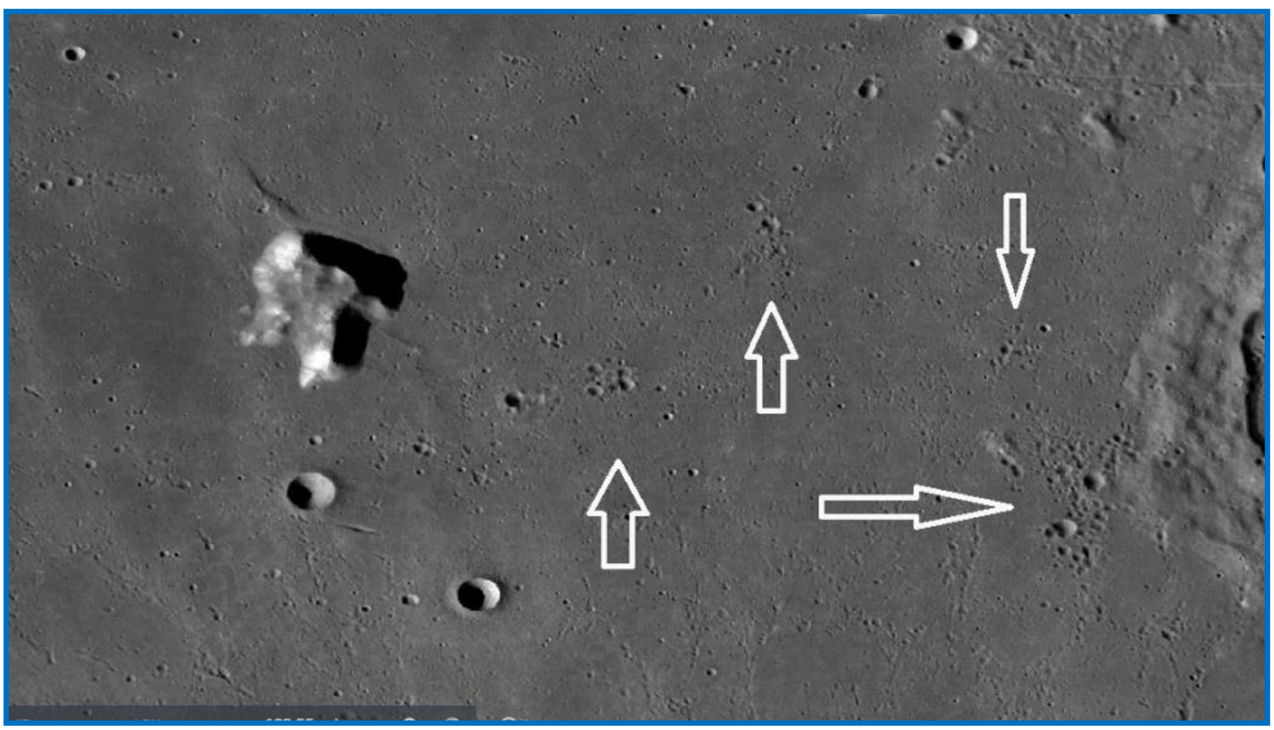
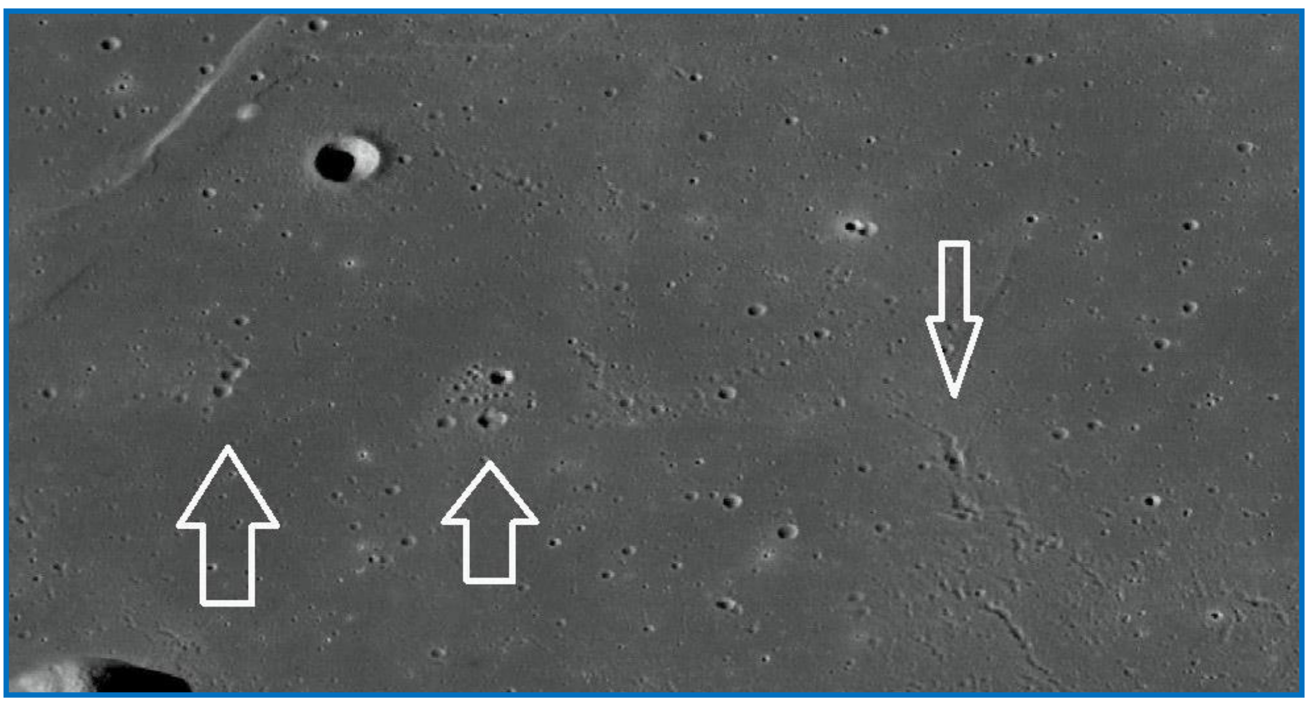


IMAGE 2: Latitude 44.36 Longitude 357.79. This wider field image allows us to appreciate the differences between the groups of craters that appear. Those marked by the arrows would be our cluster candidates. The same can be said for the 4 clusters marked in IMAGE 3, whose center is Latitude 40.01 Longitude 01.39.



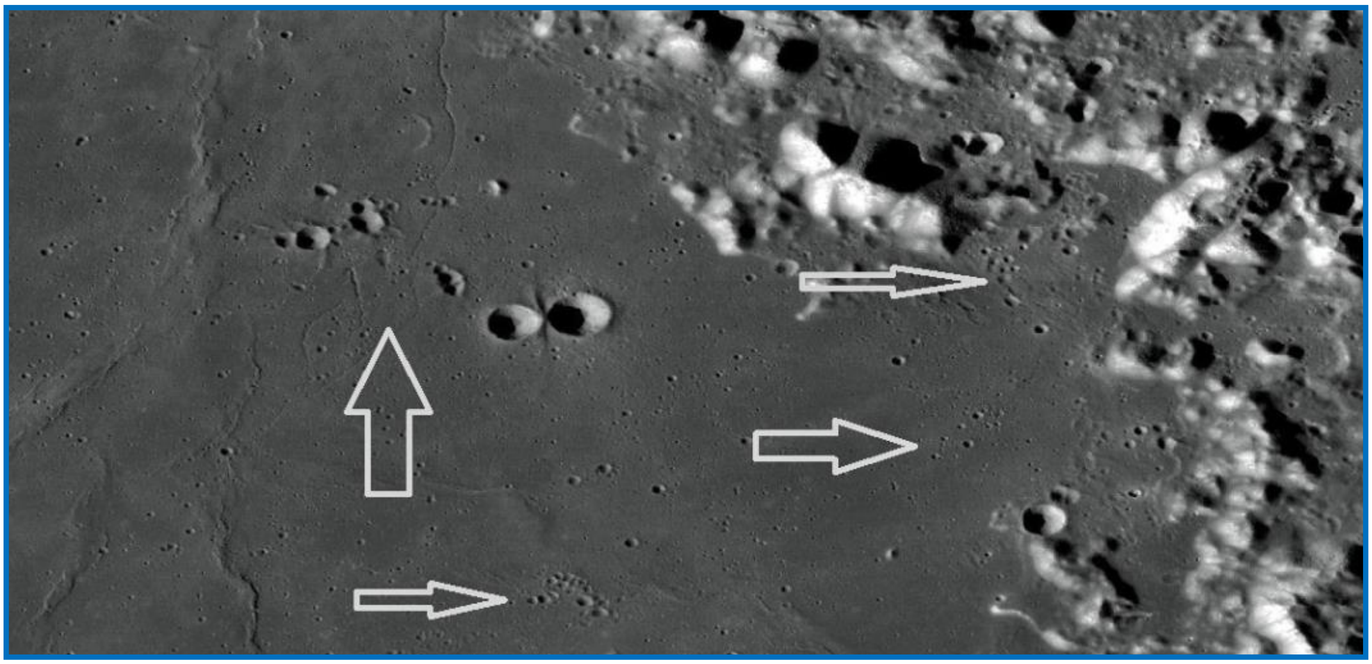
In all of these crater clusters there appear to be one or more larger craters (between 1 and 2 kilometers in diameter) and a majority of smaller craters (500 meters in diameter or less), as can be seen in IMAGE 4 (Latitude 44.25 Longitude 353.19)

IMAGE 5 (Latitude 44.11 Longitude 352.90) is particularly interesting because we see a variety of crater groupings. The arrow in the center would indicate a cluster with some resemblance to those already seen (except that the small craters seem to be grouped less randomly, as if forming a "V"); the arrow on the left appears to be a classic catena or chain of craters (although the 3 craters have a more raised east wall, as if three parallel fragments had hit at the same time and not successively); the arrow on the right could be a fracture with collapsed craters or a grouping of endocraters that emerged along a fissure.



Finally, IMAGE 6 (Latitude 46.78 Longitude 355.95) also shows an interesting contrast between the 3 clusters marked with horizontal arrows (and there could be more) and the one marked with a vertical arrow, which is different from those we have marked as “clusters of endocraters” and also from a traditional chain of craters.

Are these random crater clusters or are they endocraters produced by explosive outgassing of the lava in this area of Mare Imbrium? It is a question that exceeds our knowledge; our approximation is purely observational, originating from Fielder's enthusiastic reading.



Some Thoughts About Clavius

Robert Reeves

When I was in grade school the Moon was becoming a target for the emerging space program. Just seven months after Explorer 1, America's first satellite, the Air Force launched Pioneer, America's first lunar probe in August of 1958. Although Pioneer ended in the all too familiar fireball that punctuated many early space launches, it sparked my imagination and a lifelong fascination with the Moon was born. That Christmas, I received the 1958 edition of James Pickering's book 1001 Questions Answered About Astronomy. I virtually memorized the section about the Moon. One part still sticks with me, question 117: "What is the largest crater on the Moon?" Pickering's answer was Clavius, and that fact stuck with me for decades, until it wasn't true anymore.

The giant crater Clavius is nested near the Moon's southern limb. Whew viewing Clavius through a telescope, we are almost inspired to duck our heads as we imagine we are on a spacecraft looping under the lunar south pole. Clavius, being one of the largest craters on the Moon, is unmistakable simply by its sheer size.

For a time, Clavius lost its largest size claim to Bailly, also near the southern limb, and exceeding Clavius by 69 kilometers. However, one could call foul for demoting Clavius to second largest as Bailly itself is no longer considered to be a crater. Bailly's size exceeds the minimum 300-kilometer size limit for a basin by one kilometer and while traditionally still called a crater, Bailly is now considered to be a basin.

As more was learned about the Moon during the Space Age, Clavius found itself demoted to the third largest crater on the near side behind Bailly and Deslandres. However, the definition of a basin has become fluid in the past several decades and the 300-kilometer minimum size limit is no longer the determining factor as to whether a huge crater is a basin. We now realize there is a fundamental change in crater morphology between 180- and 300-kilometers diameter. If an impact feature possesses two or more impact rings, or if orbital gravity surveys reveal an increase in gravity at the center and a decrease gravity in at the outer ring, then the feature is also a basin, even if smaller than 300 kilometers in diameter.

The amended space age definition of a basin presents some interesting issues. Bailly is a basin because it exceeds 300 kilometers in width. Deslandres is less than 300 kilometers wide, but slightly wider than Clavius, but Deslandres now also qualifies as a basin. So, does this, by default, shift Clavius back to the status of largest near side crater? Not completely, because Clavius also now qualifies as a basin, and like Bailly and Deslandres, is called a crater out of 380 years of tradition.

Depending on where you drive your surveyor's marker, the imperfect shape of most craters makes it difficult to measure their width with precision. My own measurements with Clavius reveal a slight difference from the published figures in the USGS Gazetteer of Lunar Nomenclature. However, my figures are within 97% of the USGS figures, and accounting for the varied eccentricity of most craters, I am going to accept that we both may be right, depending on the luck of the draw as to how crisscross measurements lay on the crater's decidedly irregular rim. An example of the minor size disparities is the popular lunar charting program Virtual Moon Atlas displays Clavius' width as 225-kilometers, the USGS lists it as 230 kilometers, and my own measurements show 222 kilometers. Regardless of the technically correct width, Clavius easily outsizes all other caters in its vicinity.

Clavius is a massive landform and is so broad and shallow that it almost disappears under the high noon sun, but at lower sun elevations it looks dramatically deeper. Clavius covers 41,500 square kilometers, or 25 percent larger than the American state of Connecticut. The Moon's face is crowded with 30,000 craters that are telescopically visible from Earth. The larger of them are not trivial land masses, and if placed on the face of Earth they would be stunningly large features. In 1651, the Italian Jesuit astronomer Giovanni Riccioli named Clavius after the 16th Century German mathematician and astronomer Christoph Klau. Undoubtedly, Riccioli held Klau in very high esteem to have named the apparently largest crater after him.

A common trait between Clavius and its companions Bailly and Deslandres are their age, they are all very old. Clavius dates from the Nectarian Epoch between 3.85 and 3.95 billion years ago while Bailly and Deslandres are Pre-Nectarian. All three formed at a time when the solar system had a lot more high-caliber ammunition to throw and the planets, and their large size testifies to the size and ferocity of their impacting projectiles.

After its formation, Clavius must have had one of the largest ray systems ever to span the face of the Moon. Likely the Clavius rays splashed across the entire hemisphere. By the end of Imbrian Epoch about three billion years ago, Clavius' rays were erased by volcanism and the churning of the surface by ongoing meteor impacts. But while they existed, the huge splash of rays extending from Clavius would have been the crown jewel of the solar system.

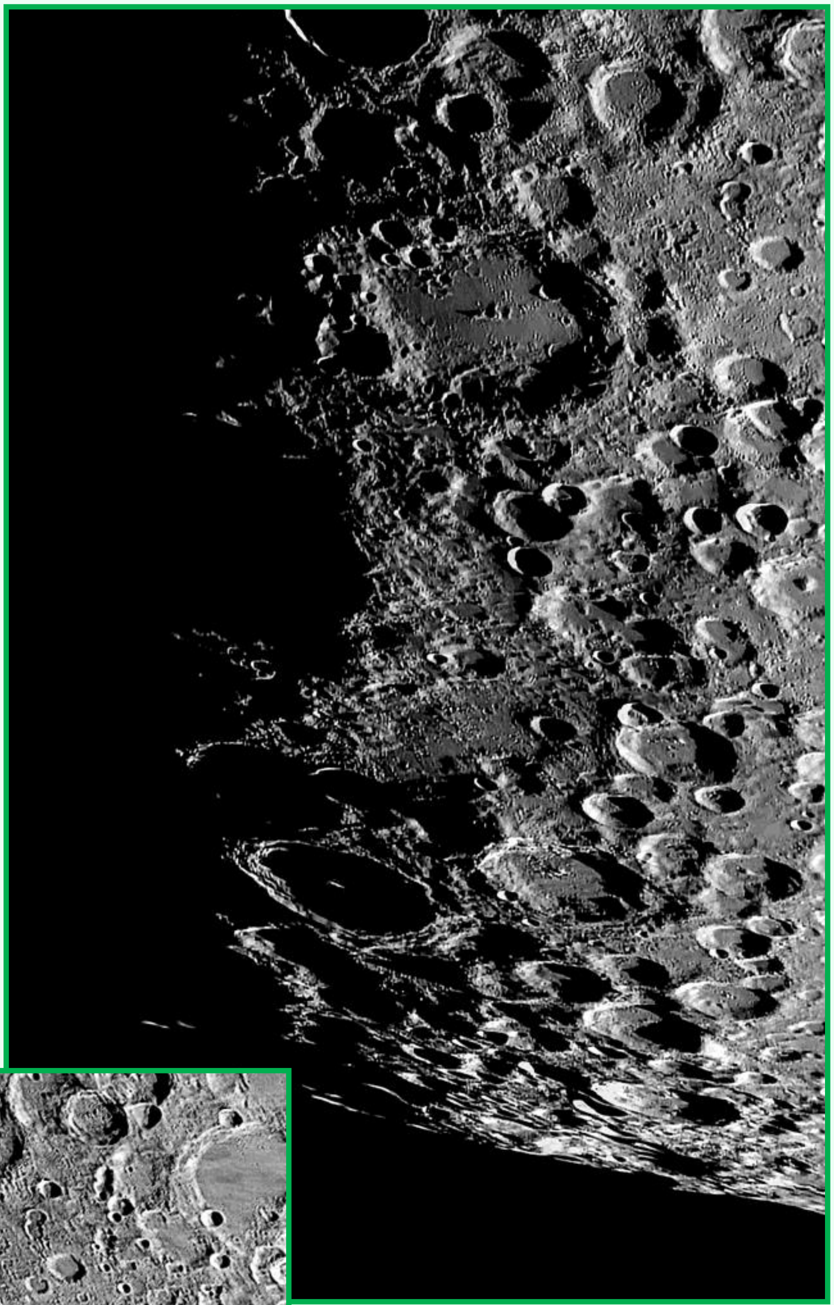
The stunning region around Clavius demonstrates a concept that many people find hard to grasp, how extraordinarily old the face of the Moon is. In terms of Earthly geology, we rarely speak of landforms that are multiple billions of years old, but on the Moon that is the age of much of its surface. With no weather, oceans, or tectonic activity altering it, there are some regions on the Moon that look essentially like they did shortly after Luna formed over four billion years ago. There is something awe-inspiring about peering into Clavius and realizing it is a time capsule that preserves something almost as old as our solar system.

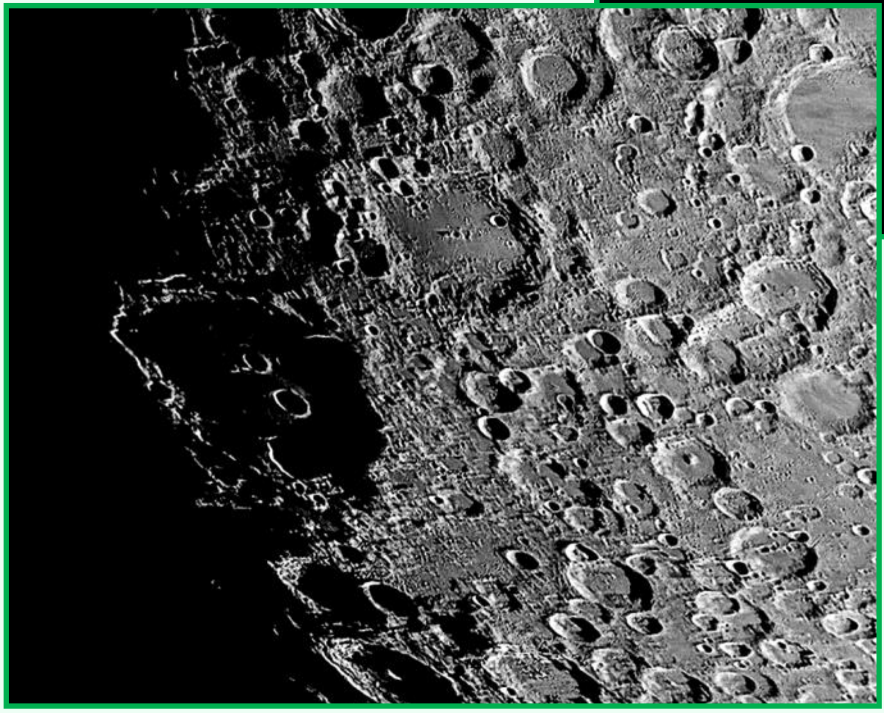
Under exaggerated sunrise shadows, Clavius' three-kilometer depth gives the false impression of even greater depth. But Clavius is so shallow compared to its width that at full Moon, this huge feature almost disappears! A measure of a crater's relative depth is its d/D ratio which compares a crater's depth to its diameter. Clavius has a d/D ratio of 77, meaning its cross section is more dish-shaped than bowl-shaped. Clavius' initially deeper excavation was filled in by several forces: isostatic equilibrium, or the Moon's internal pressure, pushed up the bottom of the crater, naturally flattening Clavius' floor, and the crater interior was filled with material thrown from other basin impacts hundreds of kilometers away.

Regardless of its position on the list of largest craters, Clavius is spectacular in a telescope and looks like it was sculpted by an artist. Low sunrise illumination provides relief to display its interior detail and show off the artistically spectacular arc of progressively larger satellite craters within its walls. Clavius' western rim is punctuated by the small crater Clavius L, which along with 53-kilometer Porter on the northeastern rim and 55-kilometer Rutherford on the southeastern rim, creates the illusion of a westward-pointing arrowhead. The illusion is strengthened by the arc of Clavius J, N, C, and D sweeping eastward across the floor of Clavius. Porter and Rutherford are independent craters and are not classified as Clavius satellite craters, but nonetheless, contribute to the stark and wild beauty of the region.

Robert Reeves is the author of *Exploring the Moon with Robert Reeves* and *Photographic Atlas of the Moon*, both available on Amazon.

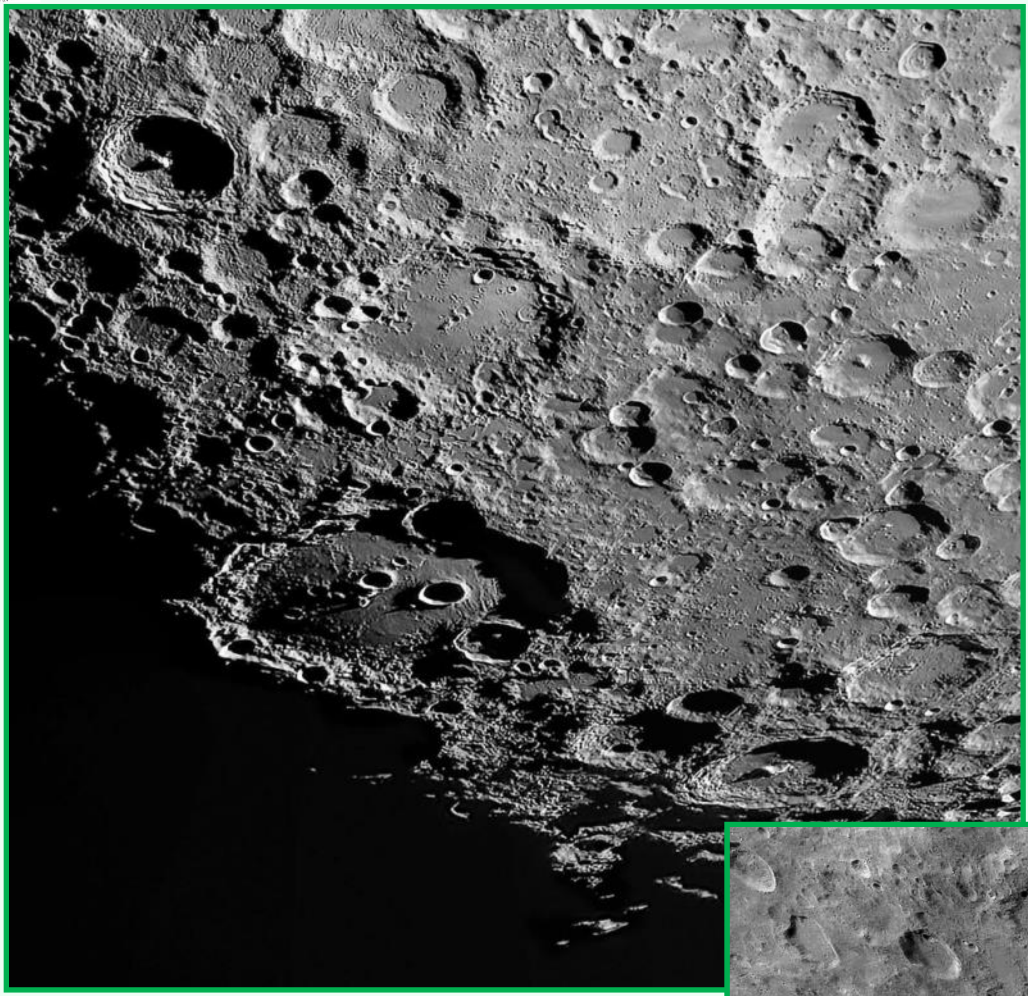
Clavius sunrise 1.jpg
The massive depression of Clavius crater creates an imposing dark pit along the approaching sunrise terminator. Photos by Robert Reeves



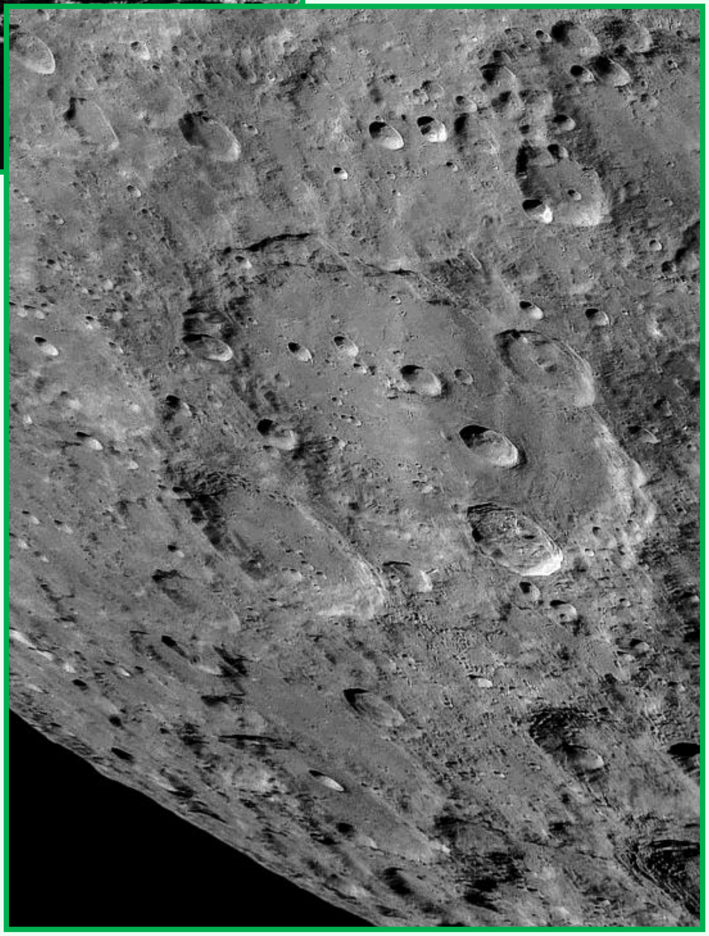


Clavius sunrise 2.jpg
The rims of the satellite craters Clavius C and D within Clavius catch the first rays of sunrise while the floor of Clavius remains dark, creating the effect known as the "Eyes of Clavius".

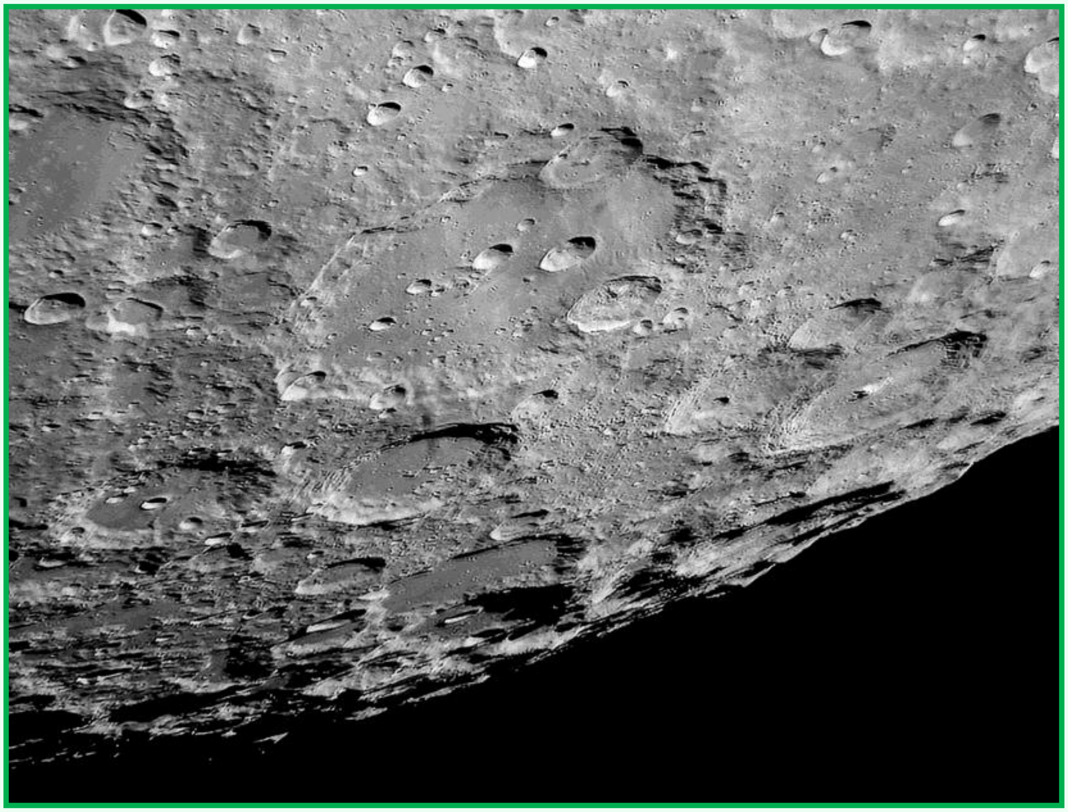
Focus On: Lunar Topographic Studies
Some Thoughts About Clavius



Clavius sunrise 3.jpg
The floor of Clavius lies three kilometers below the surrounding highlands, but enhanced shadows from low sunrise illumination give the impression of greater depth.

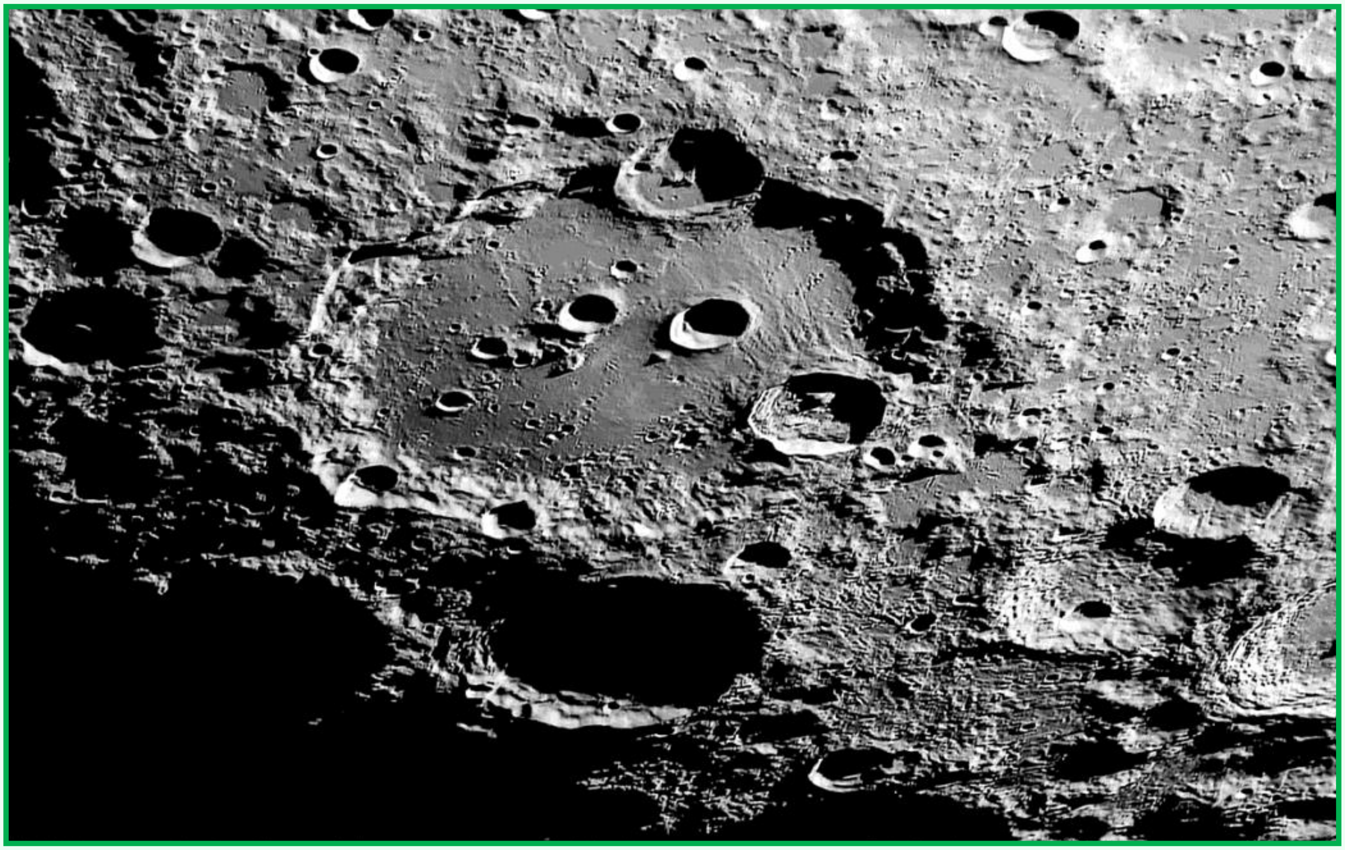


Clavius Blancanus.jpg
The 100-kilometer plus craters Blancanus, Klaproth, and Casatus descend south like steppingstones from Clavius' western rim. Although they are large craters, their stature is greatly diminished next to massive Clavius.



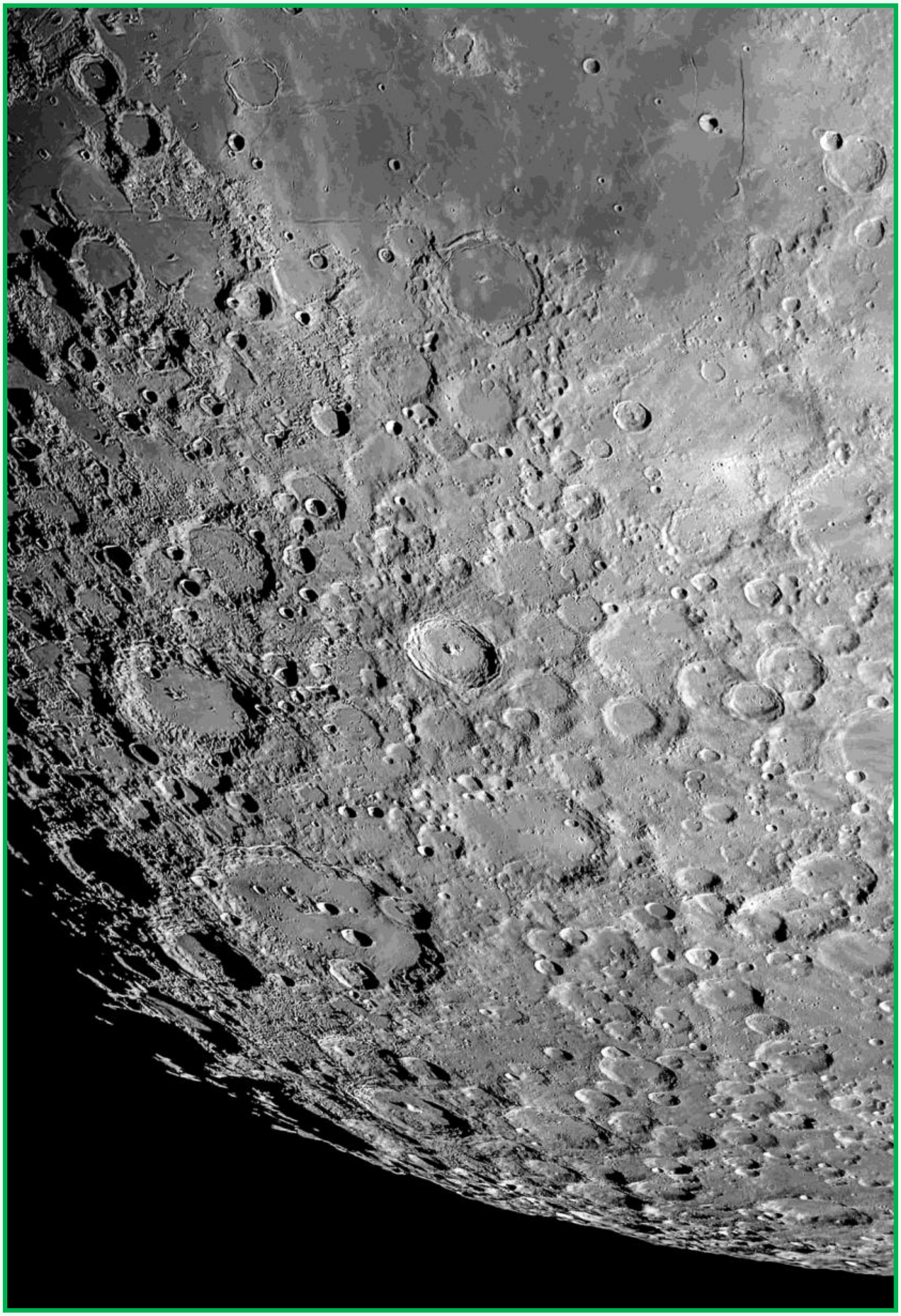
Clavius Moretus.jpg
A telescopic view of Clavius not only shows one of the largest and oldest craters on the near side of the Moon, but it also treats us to a fascinating view of the limb along the lunar south pole. The southern territory is a rough and tumble place with large craters upon large craters, so foreshortened we do not see the individual craters themselves. Instead, we see their rims protruding against the black of space.

Clavius.jpg
Clavius is so big that the substantial craters Porter and Rutherford, each over 50 kilometers wide, on Clavius' northeast and southeast rim, look small. Their placement does add an endearing quality by adorning ancient Clavius, which is nearly four billion years old. Equally enchanting is the artistic arc of four progressively larger satellite craters Clavius J, N, C, and D spread across the interior of Clavius.



Focus On: Lunar Topographic Studies
Some Thoughts About Clavius

Southern highlands.jpg
The fresh, crisp appearance of Tycho crater contrasts with the worn and degraded appearance of Clavius and its neighbors Longomontanus and Maginus, all of which are almost 40 times older than Tycho.



Crater Clavius

Gregory T. Shanos

Clavius Crater is the third largest crater at 231 kilometers (143.5 miles) and is in located the southern highlands of the Moon just south of the prominent rayed crater Tycho. The crater is named for the Jesuit priest Christopher Clavius, a 16th-century German mathematician and astronomer. Clavius is one of the older and well-preserved formations and likely formed during the Nectarian period about 4 billion years ago. Unlike other large craters, Clavius has no major mountain reaching up from its center, instead it has a low outer wall and is heavily worn and pock-marked by craterlets. The rim does not significantly overlook the surrounding terrain, making this a "walled depression". The inner surface of the rim is hilly, notched, and varies in width, with the steepest portion in the southern end. The walls of Clavius are low and worn down, slumped and terraced in places, and are punctured by several substantial craters. The most notable of these is a curving chain of craters that begin with Rutherfurd in the south, then arc across the floor in a counterclockwise direction forming a sequence of ever diminishing diameters. From largest to smallest, these craters are designated Clavius D, C, N, J, and JA. The smaller crater Clavius L lies across the western rim, and Clavius K breaks through the west-southwest rim. On the northern side, the 51 kilometer-wide (32 mile) crater Porter has an impressive central peak, as does the 50-kilometer wide (31 mile) Rutherford on the opposite southern side. Below Rutherford's northern flank, the crater floor is streaked and etched with a number of fine lines. The relative smoothness of the floor and the low size of the central peaks may indicate that the crater surface was formed sometime after the original impact. See references 1-4.

Clavius is the site of a somewhat surprising discovery of water on the Moon. This finding was published on October 26, 2020 in the journal Nature Astronomy. See reference 5 & 6. The researchers used the airborne infrared telescope SOFIA to detect the characteristic signature of water molecules in the floor of Clavius. Molecules containing hydrogen and oxygen have been found in many previous observations, and these strongly implied the presence of water. However, the SOFIA observations found emissions at a wavelength specific to H_2O (water) and not just hydroxyl (OH) compounds. At 100 to 400 parts per million of water, Clavius is still much drier than the driest deserts on Earth. The crater is far from the permanently shadowed regions of the lunar poles, where water ice can be protected from evaporating, therefore, the presence of any amount of water there is a mystery that awaits further explanation.

Clavius was also featured as the site of the fictional Moon base in Stanley Kubrick's movie 2001: A Space Odyssey. Perhaps fact will follow fiction, and NASA may one day establish a moon base on Clavius after all.

Clavius Moon Base from 2001 A Space Odyssey.

Focus On: Lunar Topographic Studies

Crater Clavius

Image 1: The moon on February 7, 2025 at 7:55 pm or February 8, 2025 00h 55m UT. The waxing gibbous moon was at 79% phase and 77 degrees above the horizon. The sky was perfectly clear with good steady seeing. Image was acquired using an Orion 80mm 400mm fl f/5 short tube refractor piggybacked on an equatorially mounted Meade LX6 8-inch SCT, a ZWO ASI 178MM monochrome camera, Optolong UV-IR cut filter and an MSI GF65 gaming computer. Firecapture v2.7.14 acquired the SER video which was processed using Autostakkert 3.1.4 and Registax 6.1. Further sharpening and processing in Photoshop CS4. Image by Gregory T. Shanos, Longboat Key, Sarasota, Florida, USA.

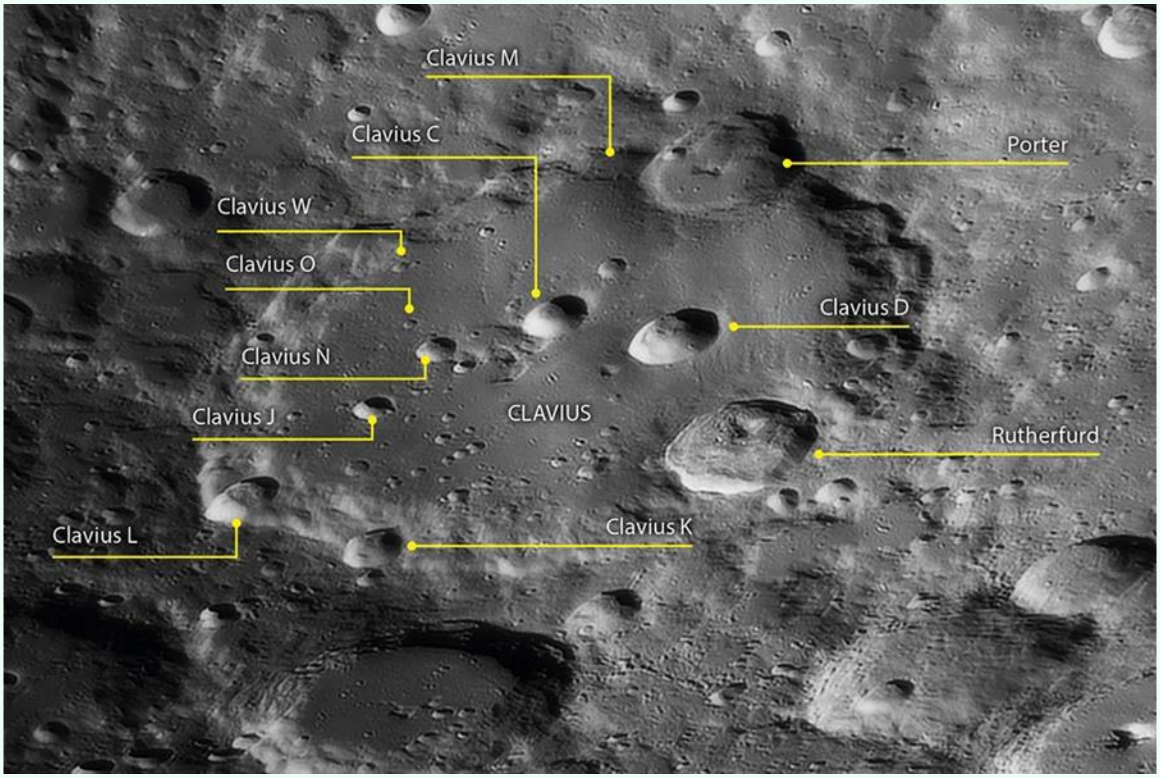
Image 2: Crater Clavius is at the southern limb of the moon just below Tycho. The image was taken on February 7, 2025 at 8:10 pm or February 8, 2025 01h 10m UT. The waxing gibbous moon was at 79% phase and had risen to 81 degrees above the horizon. The sky was perfectly clear with good steady seeing. Image was acquired using an Orion 80mm 400mm fl f/5 short tube refractor piggybacked on an equatorially mounted Meade LX6 8-inch SCT, a ZWO ASI 178MM monochrome camera, Coronado Cemax 2X Barlow, Baader CMOS optimized UV-IR cut filter and an MSI GF65 gaming computer. Firecapture v2.7.14 acquired the SER video which was processed using Autostakkert 3.1.4 and Registax 6.1. Further sharpening and processing in Photoshop CS4. Image by Gregory T. Shanos, Longboat Key, Sarasota, Florida, USA.

Focus On: Lunar Topographic Studies
Crater Clavius

Image 3: Close-up of Crater Clavius. The moon on February 7, 2025 at 8:35 pm or February 8, 2025 01h 35m UT. The moon was a waxing gibbous at 79% phase and was almost at the zenith at 86 degrees above the horizon. The sky was perfectly clear with good steady seeing. Image was acquired using a Meade LX200GPS 10-inch 2500mm fl f/10 alt-azimuth mounted with a ZWO ASI 178MM monochrome camera, Optolong UV-IR cut filter and an Optec 0.62X focal reducer. Firecapture v2.7.14 acquired the SER video which was processed using Autostakkert 3.1.4 and Registax 6.1. Further sharpening and processing in Photoshop CS4. Image was cropped from a larger field of view. Image by Gregory T. Shanos, Longboat Key, Sarasota, Florida, USA.

Focus On: Lunar Topographic Studies

Crater Clavius



Craterlets identified from reference 2.

References:

1) The Moon's Clavius Crater NASA SVS website at https://svs.gsfc.nasa.gov/4868

2) How to see crater Clavius on the Moon by Pete Lawrence Sept 24, 2020. BAA Sky at Night Magazine https://www.skyatnightmagazine.com/astrophotography/moon/crater-clavius-moon-how-see

3) Every Full Moon: you can see the craters made famous in 2001: A Space Odyssey by Stuart Atkinson Astronomy Magazine https://www.astronomy.com/observing/explore-clavius-and-tycho-craters/

4) Infogalactic: The Planetary Knowledge Core website at https://infogalactic.com/info/Clavius_(crater)

5) Molecular water detected on the sunlit Moon by SOFIA by C. I. Honniball, P. G. Lucey, S. Li, et al *Nature Astronomy* volume 5, pages121–127 (2021)

6) NASA's SOFIA Discovers Water on Sunlit Surface of Moon https://www.nasa.gov/news-release/nasas-sofia-discovers-water-on-sunlit-surface-of-moon/

Focus On: Lunar Base Clavius

Alberto Anunziato

Clavius is a fairly obvious choice when observing or photographing the southern area of the nearside of the Moon. It is an admirable feature, no doubt about it: "a giant crater that is absolutely stunning to behold through any-sized telescope, is the chief topographic attraction of the Moon's southern uplands" (Grego), "There are few lunar observers who have not devoted more or less attention to this beautiful formation, one of the most striking of telescopic objects. However familiar we may consider ourselves to be with its features, there is always something fresh to note and to admire as often as we examine its apparently inexhaustible details" (Elger). We will devote a good part of the text and images that follow to these details. Despite being located in a very densely cratered area, its enormous size (231 km in diameter) makes it stand out clearly from the rest (**IMAGES 1 to 4**). It is the second largest crater on the nearside, only surpassed by Bailly (303 km in diameter).

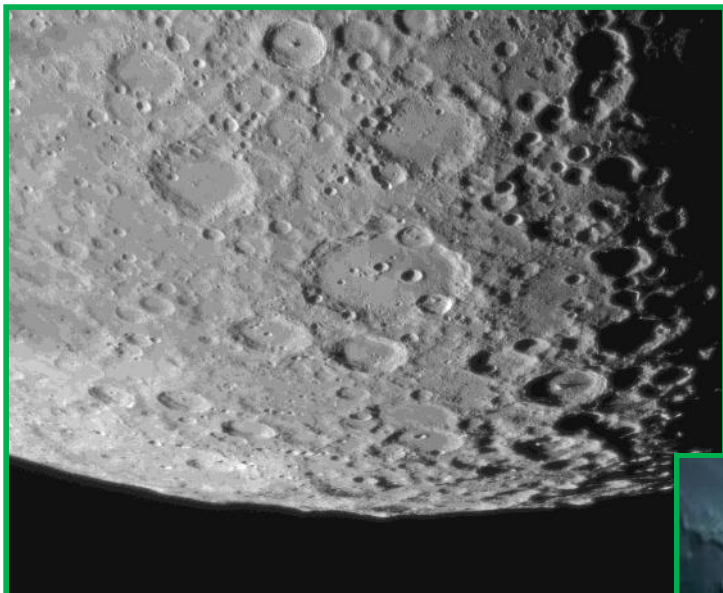


Image 1, Clavius crater and its surroundings *as imaged by Tien Ngo Tran of Ho Chi Minh City, Vietnam (10° 46'06" N, 106°40'33" E), on 2024 August 25th at 11:48 UT (Daylight condition). Equipment: 6.3-inch f/8 Newtonian reflector telescope on manual dobsonian mount, effective focal length = 1280mm, IMC-3616UC as camera, SVBONY 685nm Ir Pass filter. Seeing condition: 7/10 (Pickering Scale). Software details: NeptuneViewer 5.1.0.7 acquisition (mono), AutoStakkert! 4.0.6 stacking, Astrosurface V2 wavelet.*

Image 2, Clavius*, Fernando Surá, San Nicolás de los Arroyos, Argentina, SLA-LIADA. 2020 April 03 00:53 UT. 127 mm Maksutov-Cassegrain telescope, CPL Svbony, Blu cell phone camera.*

Image 3, Clavius, *Marcelo Mojica Gundlach, Cochabamba, Bolivia-LIADA. 2018 July 22 21:53 UT. 150 mm refractor telescope, Orion V block filter, SWO CMOS camera.*

Image 4, Clavius to Mare Nubium, *Richard Hill, Loudon Observatory, Tucson, Arizona, USA. 2013 January 21 01:23 UT. Questar 3.5 inch Maksutov-Cassegrain telescope, 656.3 nm filter, DMK21AU04 camera. Seeing 7/10.*

Due to its size, it could well be a basin, but it lacks topographical and geological features that suggest that it is an ancient basin: "But why isn't Clavius a basin itself? It is one of the largest craters on the Moon that doesn't have a basin's inner ring-a feature that even a few smaller craters possess. Are there submerged rings beneath Clavius's smooth floor?" (Wood, 2003).

We will describe this giant crater, using primarily Elger's description (the descriptions in "The Moon" are very useful for the observer, since they were made to guide the observation). We begin, with Elger, with the drawing of the walls, it has been noted that the walls of Clavius are not as spherical as those of the other impact craters: "its irregular circumvallation (**IMAGES 5 to 7**), which is only comparatively slightly elevated above the bright plateau on the E., though it stands at least 12,000 feet above the depressed floor". It has also been frequently mentioned how low the walls of this ancient pre-Nectarian crater are (**IMAGE 8**), although in other images (such as **IMAGE 9**) the walls do not appear to be so low.

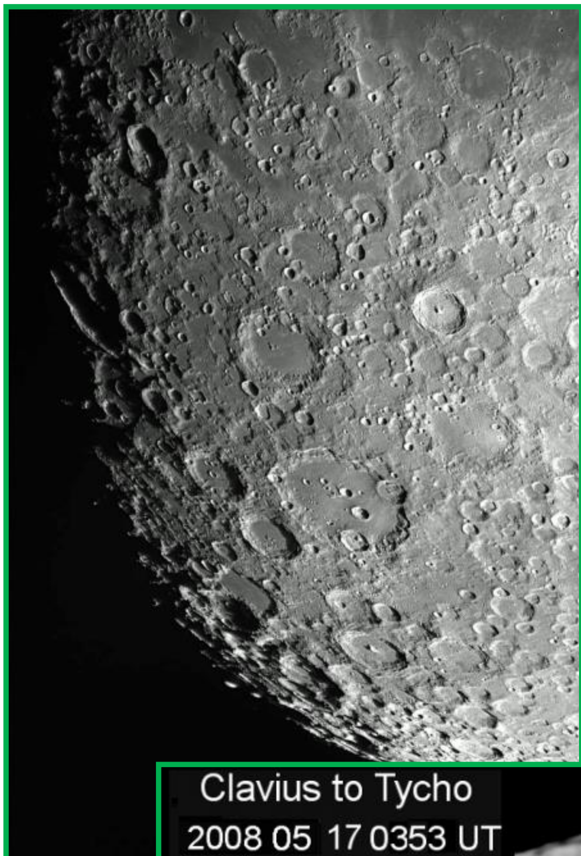


Image 5, Clavius, *Marcelo Mojica Gundlach, Cochabamba, Bolivia-LIADA. 2020 April 03 23:30 UT. 6 inch Sky Watcher Maksutov-Cassegrain telescope. SWO ASI178B/W camera.*

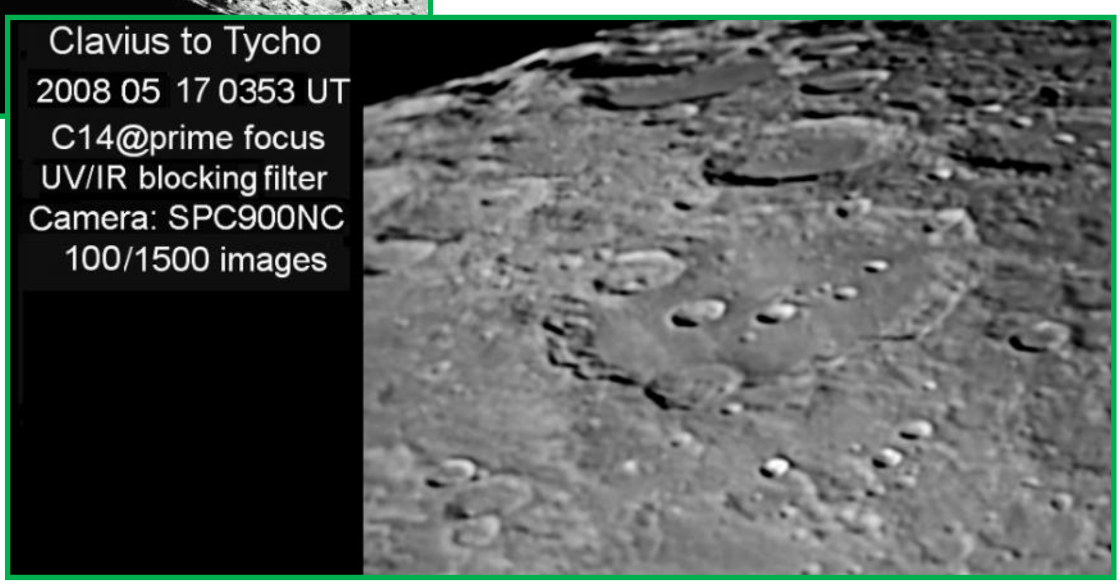


Image 6, Schiller to Clavius, *Richard Hill, Loudon Observatory, Tucson, Arizona, USA. 2009 January 08 02:17 UT. 14 inch Celestron Schmidt-Cassegrain telescope, UV/IR blocking filter, SPC900NC camera. Seeing 5/10. North is down, west is right.*

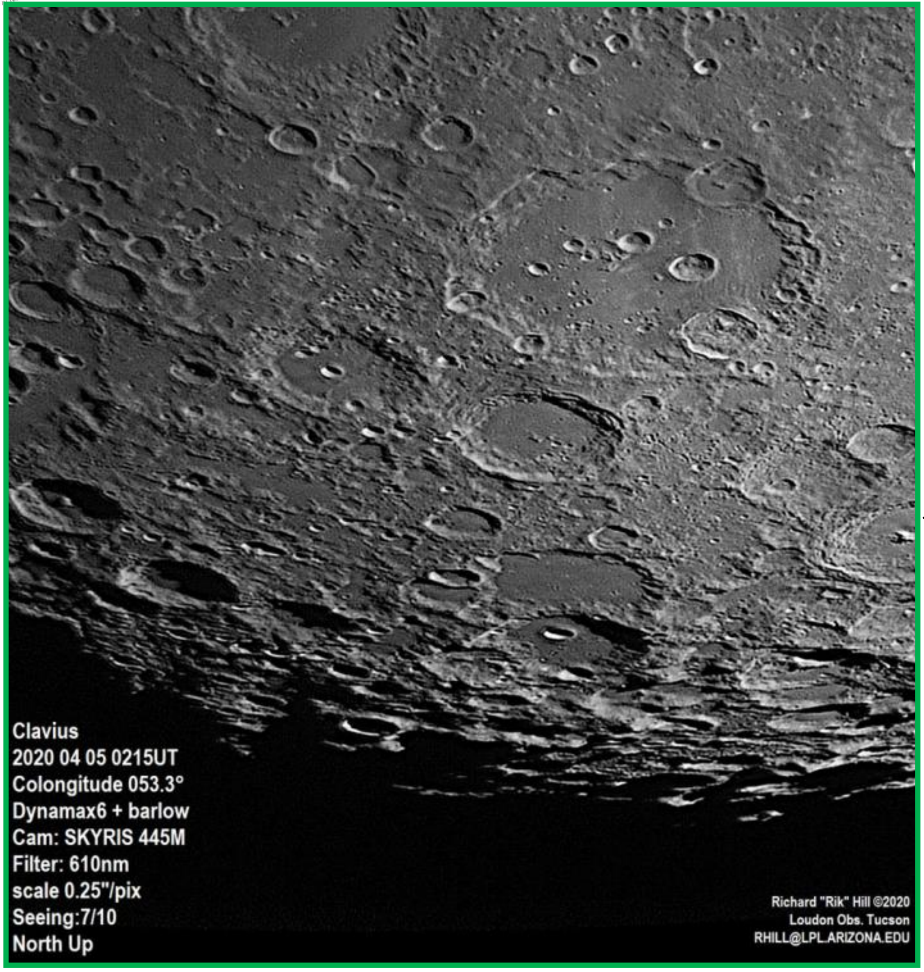


Image 7, Clavius morning, *Richard Hill, Loudon Observatory, Tucson, Arizona, USA. 2020 April 05 02:15 UT, colongitude 53.3˚. Dynamax 6 inch Schmidt-Cassegrain telescope, barlow, 610 nm filter, SKYRIS 445M camera. Seeing 4/10.*

Image 8, Tycho and Clavius*, Jairo Chavez, Popayán, Colombia. 2021 August 19 02:21 UT. 311 mm truss Dobsonian reflector telescope, MOTO E5 PLAY camera. North is down, west is right.*

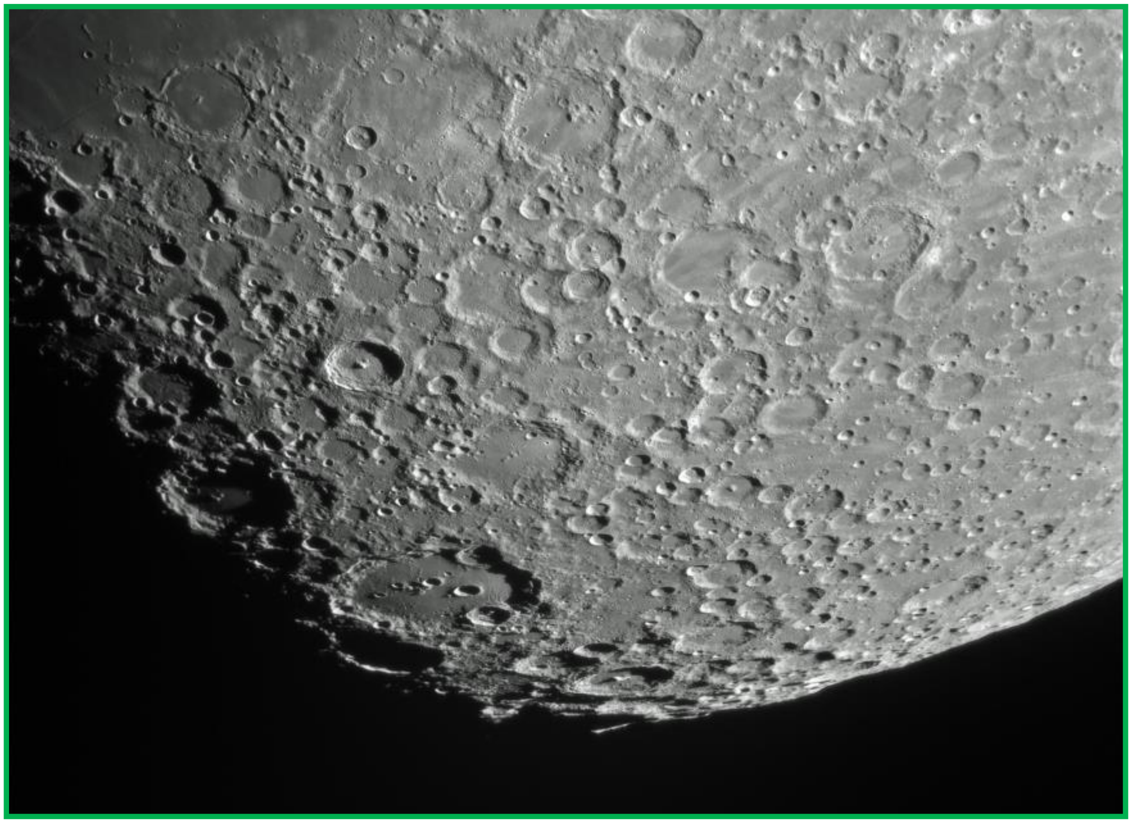


Image 9, Clavius, *Ariel Cappelletti, Córdoba, Argentina, SLA. 2019 November 07 23:44 UT. 200 mm Newtonian reflector telescope, IR block filter, ZWO ASI1600 camera.*

The walls have a complicated structure, Elger points out that "At a point on the S.E. a peak rises nearly 17,000 feet above the interior". It was quite difficult to find this peak that Elger refers to, it seems to me that, if we look at **IMAGE 10**, the rise is in the lower right corner, it is a miniature mountain (with a crater on its summit), "while on the W. the cliffs are almost as lofty" (the west wall is the left wall in IMAGE 10). In this IMAGE 10 we see that the west wall (left) presents a series of "channels" (using a significant word), like those we marked with arrows in **IMAGE 11** (detail of IMAGE 10), which in **IMAGE 12** are seen more clearly because they are completely in shadow. I believe that these are the formations that Elger refers to when he says: "On the broad massive N.W. border, the bright summit ridge and the many transverse valleys running down from it to the floor, are especially interesting features".

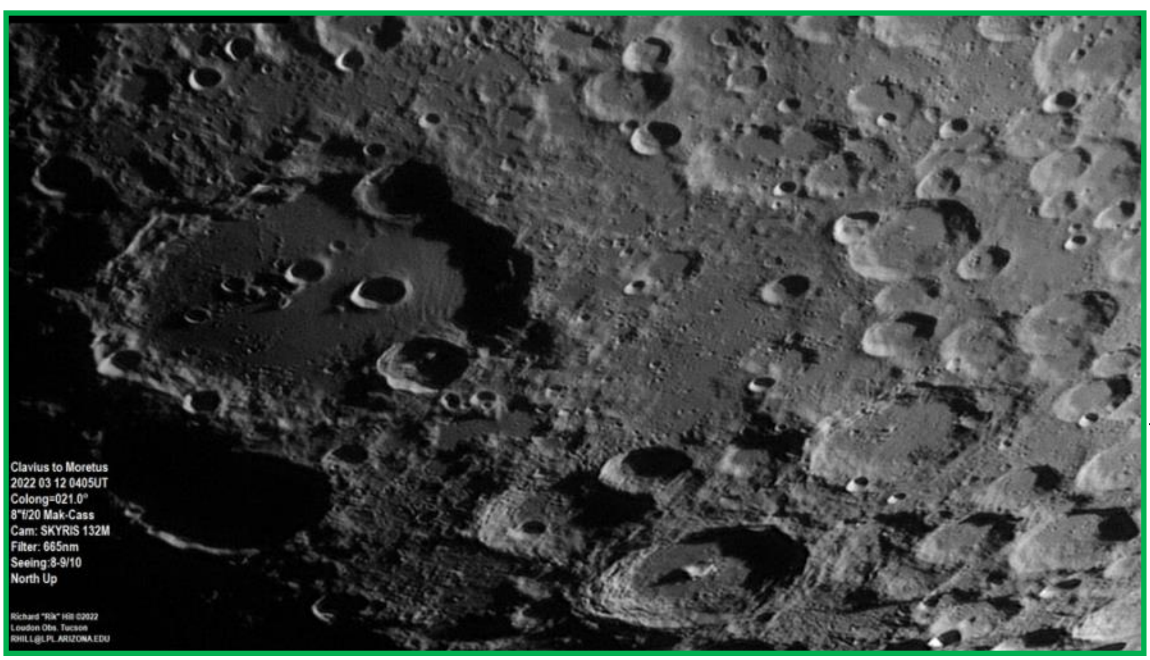


Image 10, Clavius to Moretus, *Richard Hill, Loudon Observatory, Tucson, Arizona, USA. 2022 March 12 04:05 UT, colongitude 21.0˚. TEC 8 inch Maksutov-Cassegrain telescope, 665 nm filter, SKYRIS 132M camera. Seeing 8-9/10.*

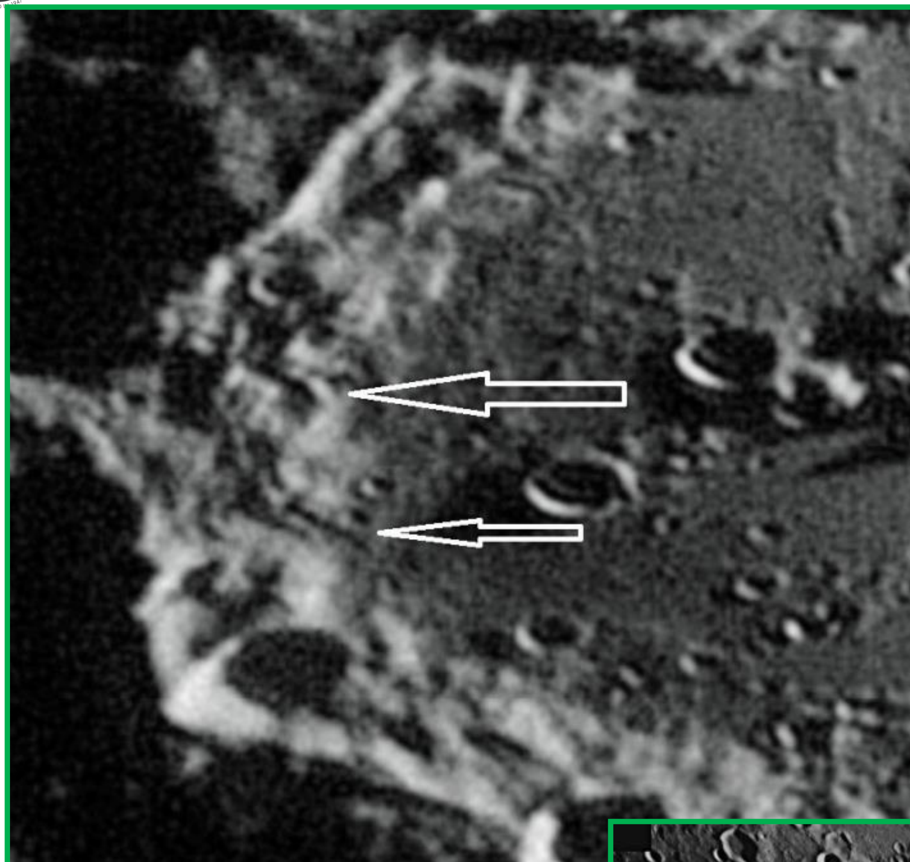


Image 11, Clavius to Moretus, *Richard Hill, Loudon Observatory, Tucson, Arizona, USA. 2022 March 12 04:05 UT, colongitude 21.0˚. TEC 8 inch Maksutov-Cassegrain telescope, 665 nm filter, SKYRIS 132M camera. Seeing 8-9/10. This is a close-up of image 10.*

Image 12, Clavius, *Richard Hill, Loudon Observatory, Tucson, Arizona, USA. 2013 October 15 02:18 UT. TEC 8 inch Maksutov-Cassegrain telescope, 665nm filter, SKYRIS445M camera. Seeing 8/10.*

IMAGE 13 is very interesting, because it is a 3D model of the relief of our crater, and it shows, first of all, one of the numerous optical illusions that deceive us observers (and that we often unconsciously forget): Clavius has a circular shape that in the other images appears as oval, due to its proximity to the southern limb; and secondly, that the southern and northern walls are much lower than the eastern and western walls, and much less complex as well, with almost no remains of the primitive terracing. Surely what influences the partial destruction of the northern and southern walls is that each one suffered an enormous impact: the pre-Imbrian Porter (53 km in diameter) on the northern wall and the Copernican Rutherfurd (55 km in diameter) on the southern wall. According to Elger “there are two remarkable ring-plains, each about 25 miles in diameter, associated, one with the N., and the other with the S. wall, the floors of both abounding in detail”. These details are very interesting.

Image 13, Model of Clavius, *Howard Fink, New York, New York, USA.*

If we look at **IMAGE 14**, we notice that the topography of both craters (almost twins due to their size and their symmetrical location on the edges of Clavius) is quite different. Rutherfurd appears to have an elongated central elevation with gentle slopes, as well as “totally slumped walls and possible patches of impact melt on its floor” (Wood, 2006), while Porter appears to have two central peaks joined together, slightly offset from the center, as seen in many medium-sized impact craters. You will surely have noticed an interesting detail near Rutherfurd: “the curious corrugations visible soon after sunrise on the outer N. slope of its wall, resembling the ribbed flanks of some of the Java volcanoes”, according to Elger, who uses a curious comparison that could be accurate for those who (like Fielder) consider that Clavius has been volcanically modified at some point in its geological history, to Wood (2003) “Although they have been compared to the radial erosion ridges and dykes on terrestrial volcanoes, that origin seems very unlike”, they would be (Wood, 2006): “Ejecta from Rutherfurd radiates away in a few lines of just resolved secondary crater pits”. In **IMAGES 15** and **16** we can see the interior of these craters on the walls of Clavius in quite a bit of detail.

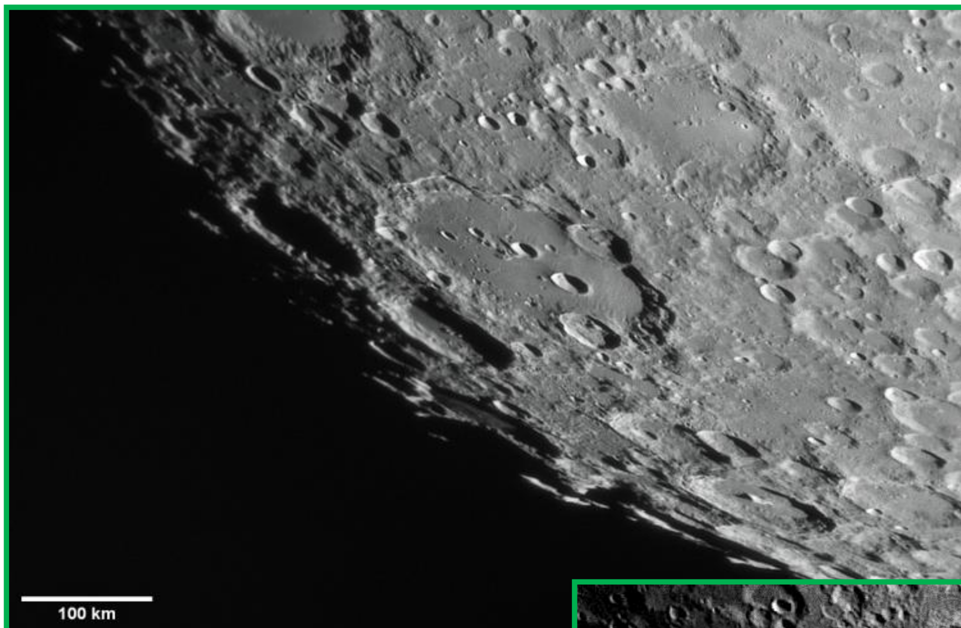


Image 14, Clavius, *Ariel Cappelletti, Córdoba, Argentina, SLA. 2019 November 07 23:44 UT. 200 mm Newtonian reflector telescope, IR block filter, ZWO ASI1600 camera.*

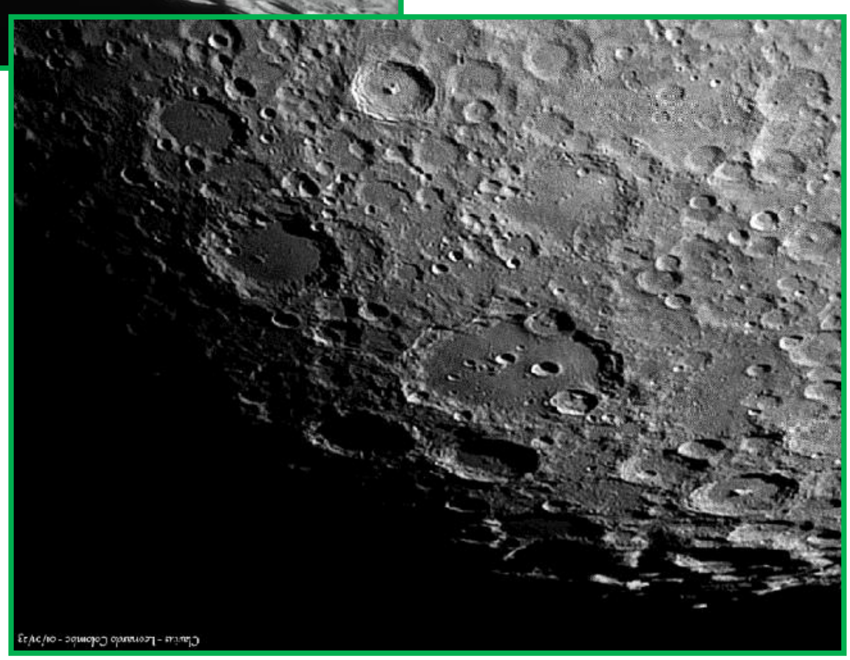


Image 15, Clavius, *Leonardo Alberto Colombo, Córdoba, Argentina. 2023 January 02 02:00 UT. 102 mm Maksutov-Cassegrain telescope, 685 nm IR pass filter, QHY5LII-M camera.*

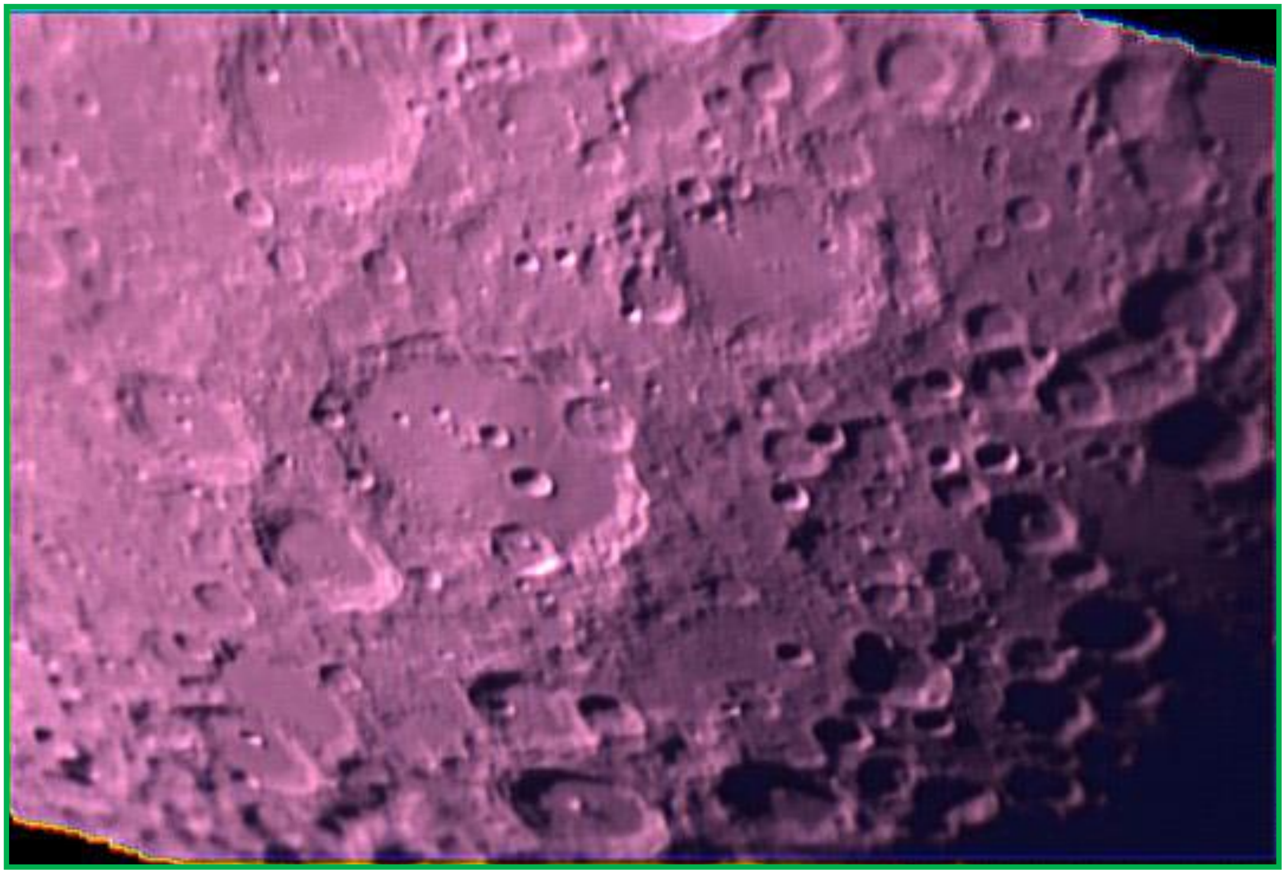
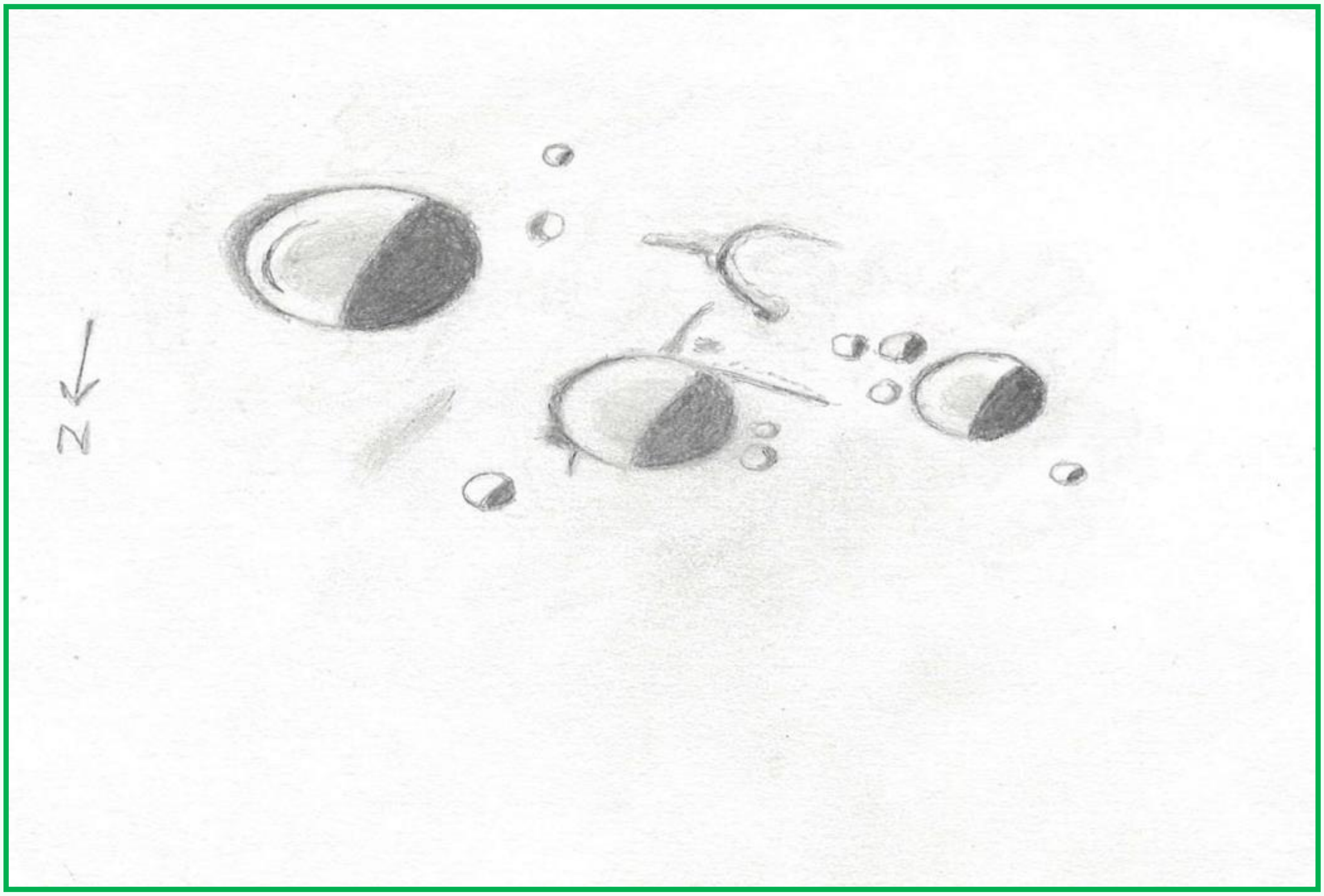


***Image 16, Clavius**, Fernando Surá, San Nicolás de los Arroyos, Argentina, SLA-LIADA. 2020 December 03 06:05 UT. 127 mm Maksutov-Cassegrain telescope, CPL Svbony, Neximage 5 camera.*

Now let's go into the floor of Clavius, which has always captured the attention of observers. Wood (2003) says that "like Plato far to the north, Clavius has been the site of crater-counting competitions." The subject of Clavius' interior craters is excellently presented in Robert Hays Jr.'s text "Craters Inside Clavius," in this same issue of TLO.

Craters Inside Clavius

Robert H. Hays, Jr.



Craters inside Clavius, Robert H. Hays, Jr., Worth, Illinois, UDSA. 2009 August 12, 05:45 UT-06:17 UT. 15 cm reflector telescope, 170x. Seeing 8/10, transparency 6/6.

I drew some of the detail inside Clavius on the morning of August 12, 2009. This huge feature has interior detail worthy of attention in its own right. The three main craters in this sketch are, from east to west, Clavius D, C and N: their sizes also decrease in that order. These three craters appear similar with proportional inner shadows and moderate outer shadowing. Clavius D shows evidence of terracing, and Clavius C has at least one high point on its northeast rim. Clavius CB is northeast of Clavius C, and Clavius Y is just southeast of N; CB and Y look similar. Clavius O is northwest of Clavius N, and two more craters are east of N and Y. The one north of Y is relatively shallow, and the one east of Y appears to have a squarish shape. Clavius CA is a shallow crater just west of C, and a similar but smaller crater is just to its south. Clavius DB is southwest of D, and the conspicuous peak Clavius theta is near D and DB. A partial ring is south of Clavius C and east of N; it has a noticeable peak at its north end. There are several other ridges and strips of shadow in this area which I drew as I saw them.

Focus On: Lunar Topographic Studies

Lunar Base Clavius

We continue following Elger: "There are five large craters on the floor of Clavius, following a curve convex to the N., and diminishing in size from E. to W. The most easterly stands nearly midway between the two large ring-plains on the walls". By chance, the main interior craters of Clavius follow a topographic order from largest to smallest (east to west). The first is Clavius D (28 km in diameter): "This satellite rises steeply from Clavius' floor, has sharp rim crests, and mounds of slump materials partly filling the bottom of the 27.85-km (17.30-miles)-in-diameter crater" (Garfinkle). Zooming in a bit, the mounds of slump materials can be distinguished in **IMAGES 17 to 20**. These images also show the second crater in the series, Clavius C (21 km in diameter). According to Elger, both Clavius D and Clavius C "have central mountains", which are actually, as Garfinkle said, mounds (typical of Copernican craters of this size, think of Proclus, for example). We continue with Elger: "the second (about two- thirds its area) is associated with a complex group of hills and smaller craters". It is "the central peak complex and a clustering of craters. A low broken string of mountains appears to connect the central peak to the base of the northern wall of the crater at the small cone crater Clavius MA" (Garfinkle).

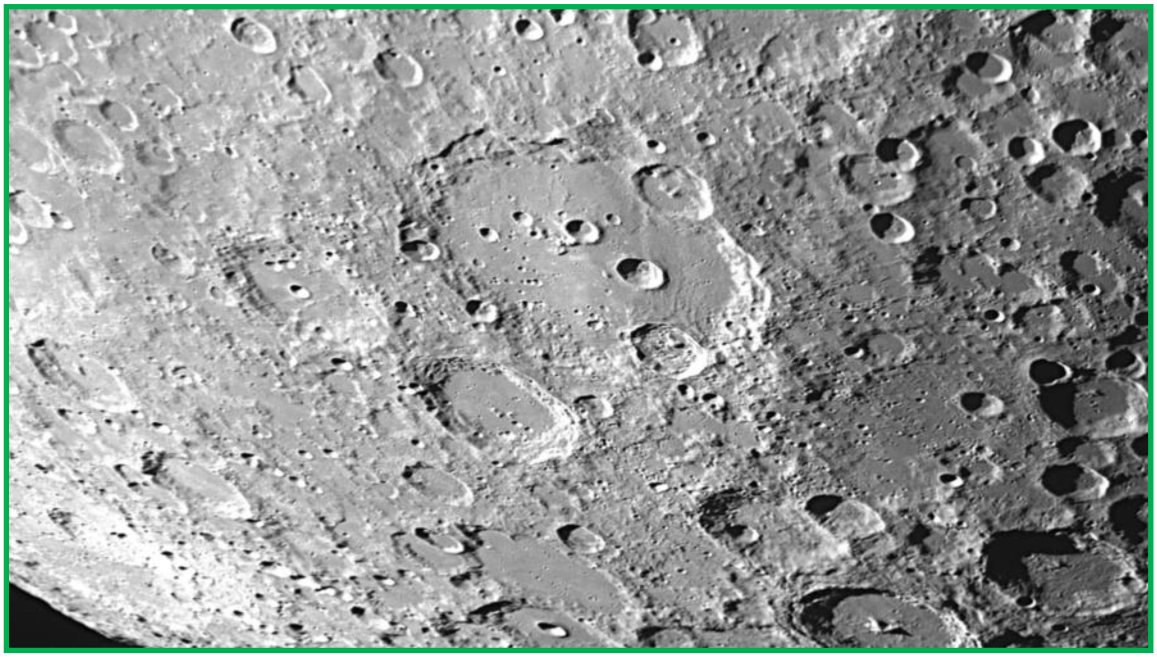


Image 17, Clavius, *James Brunkella, Thousand Oaks, California, USA. 2024 September 23 12:40 UT. Intes 9 inch f/15 Maksutov-Cassegrain telescope, ZWO ASI678MM camera. Seeing 6/10, transparency 5/6.*

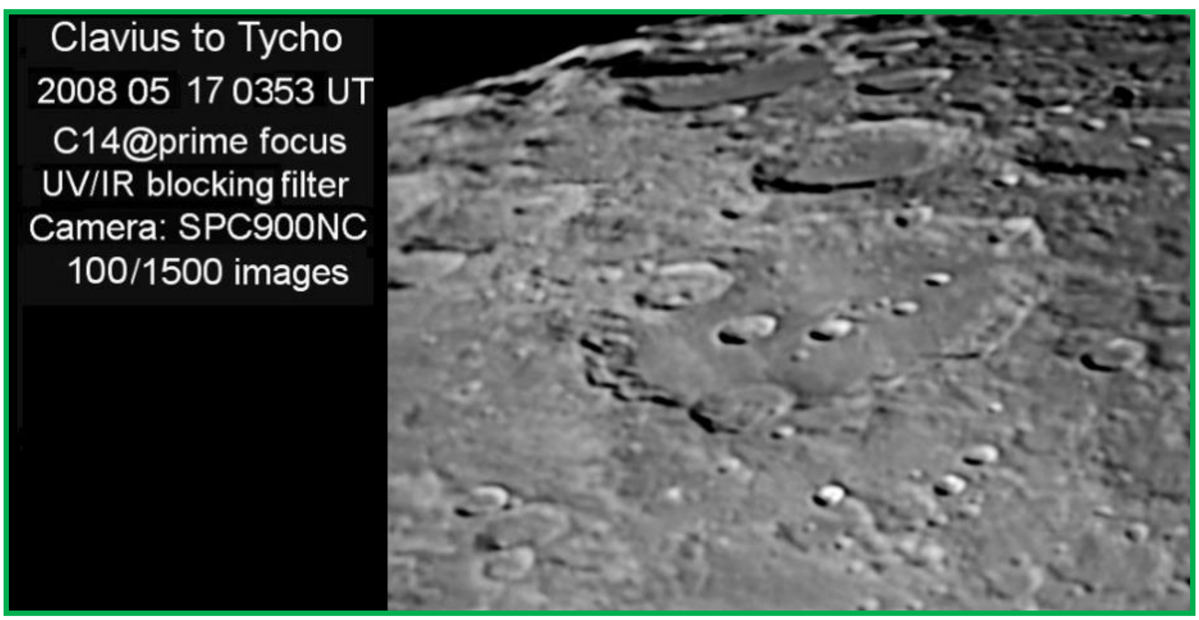


Image 18, Clavius, *Richard Hill, Loudon Observatory, Tucson, Arizona, USA. 2008 May 17 03:53 UT. 14 inch Celestron Schmidt-Cassegrain telescope, UV/IR blocking filter, SPC900NC camera. North is own, west is right.*

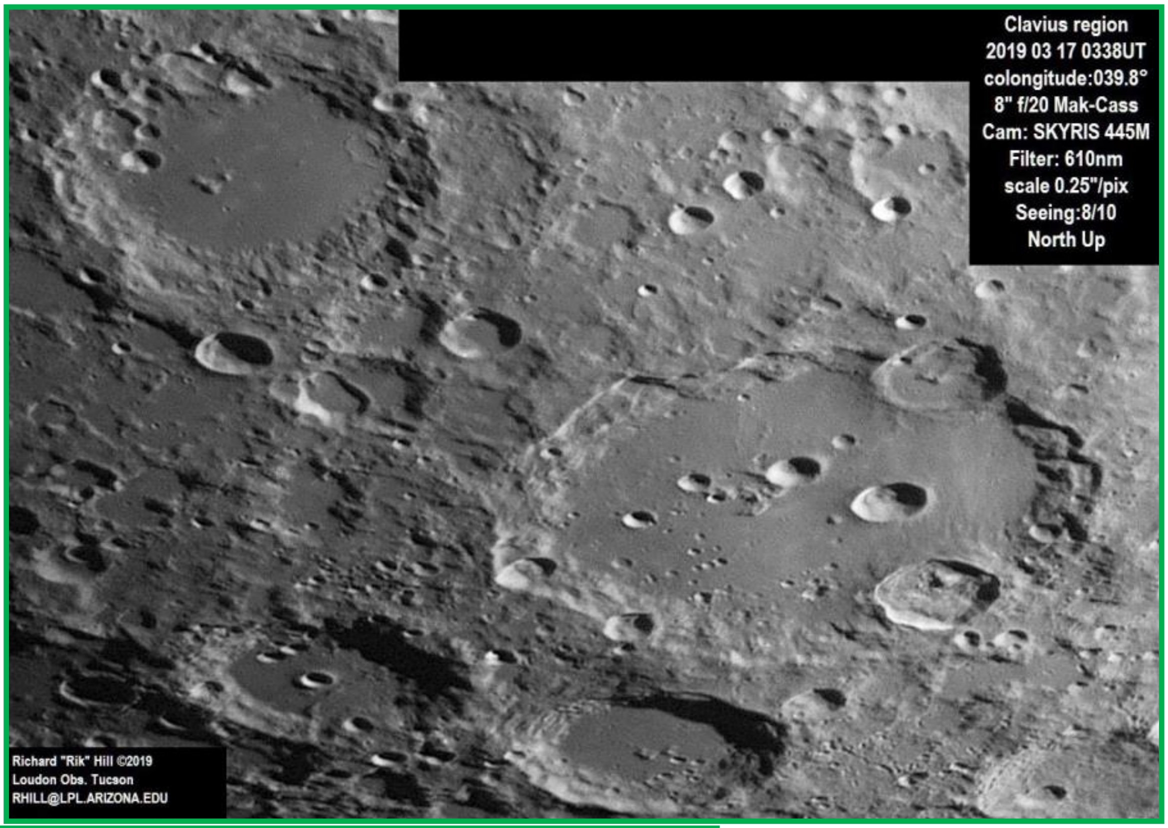


Image 19, Clavius morning, *Richard Hill, Loudon Observatory, Tucson, Arizona, USA. 2019 March 17 03:38 UT, colongitude 39.8˚. TEC 8 inch Maksutov-Cassegrain telescope, 610 nm filter, SKYRIS445M camera. Seeing 8/10.*

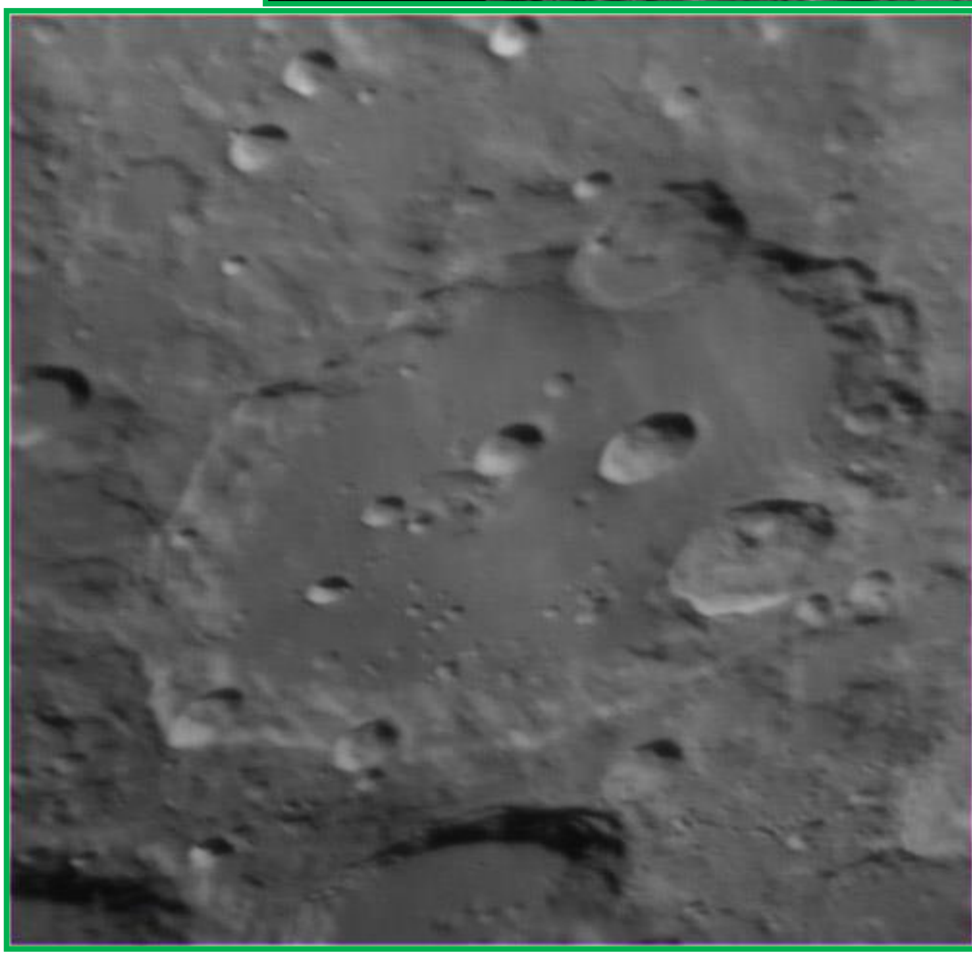


Image 20, Clavius, *Larry Todd, Dunedin, New Zealand. 2022 June 11 06:00 UT. OMC200 Maksutov-Cassegrain telescope.*

In **IMAGES 21 to 23**, the remnant of what must have been a majestic central mountain (or group of mountains) can be seen before the floor of Clavius almost completely disappeared. In **IMAGES 24 to 26**, the shadow of the remnant of the central peak projects shadows, shadows that, combined with that of Clavius C, make visual observation difficult with a small telescope (as seen in **IMAGE 27**). Precisely, the fact that the central mass has almost disappeared and the floor of Clavius is quite smooth clearly indicate that its interior has been modified at some point in the geological history of the Moon. According to Wood (2006): "The floor is generally thought to be fluidized ejecta from Orientale or Imbrium; it could be lava flows, but certainly not dark ones like mare basalts" (which can be seen in **IMAGES 28 to 32**).

Image 21, Clavius, *Marcelo Mojica Gundlach, Cochabamba, Bolivia-LIADA. 2019 July 07 23:30 UT. 150 mm refractor telescope, ZWO ASI120 camera.*

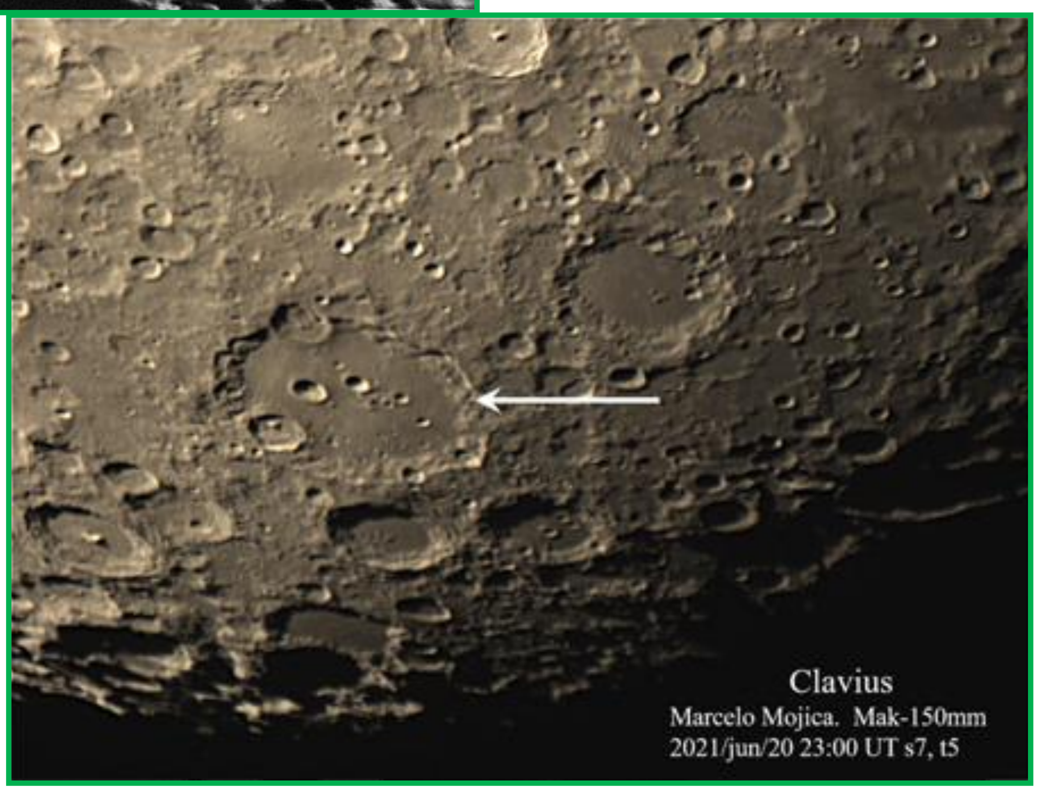
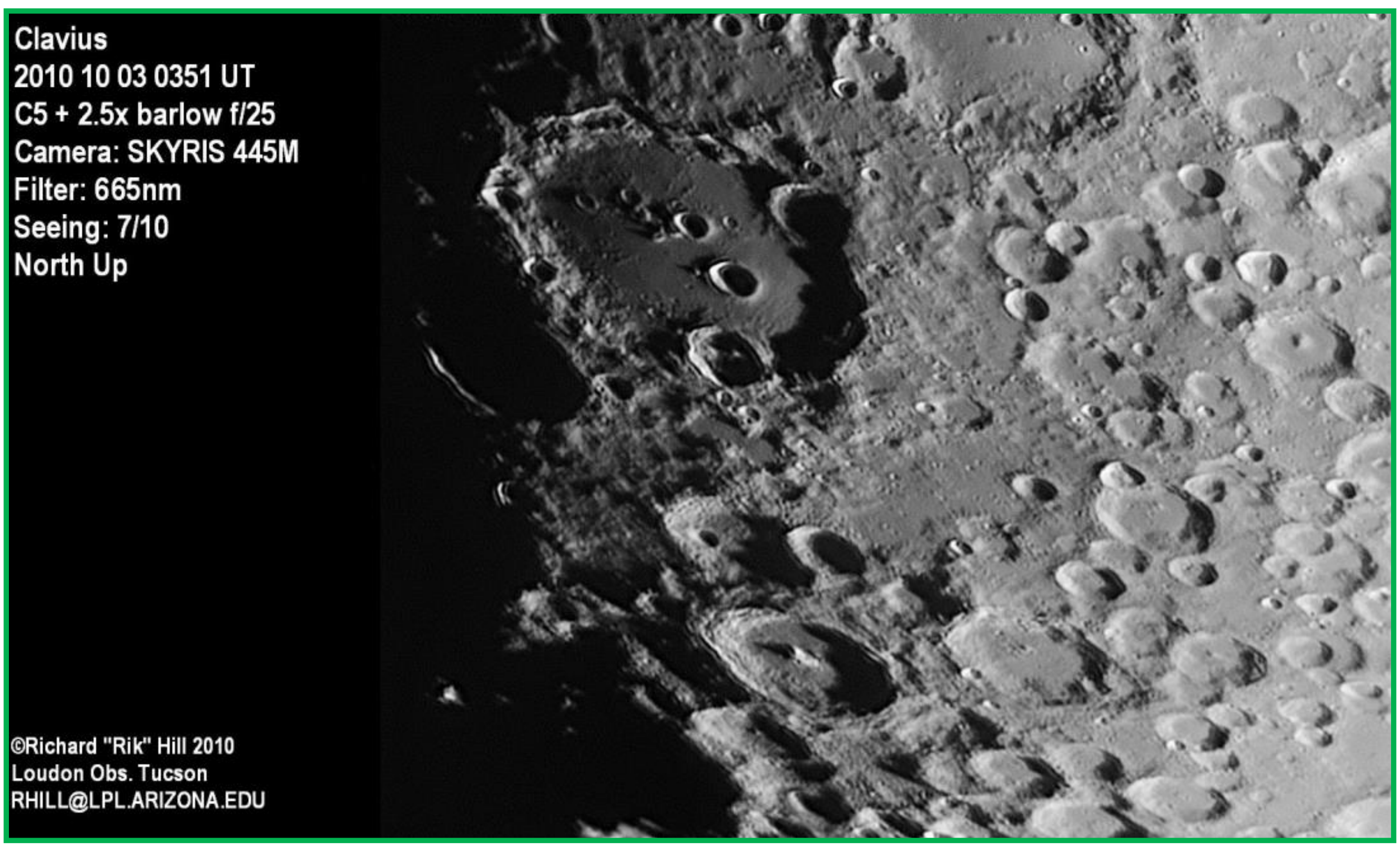


Image 22, Clavius, *Marcelo Mojica Gundlach, Cochabamba, Bolivia-LIADA. 2021 June 20 23:00 UT. 150 mm refractor telescope, Orion V block filter, SWO CMOS camera. North is up, west is to the right.*

***Image 23, Clavius**, Fernando Surá, San Nicolás de los Arroyos, Argentina, SLA-LIADA. 2024 September 13 01:00 UT. 127 mm Maksutov-Cassegrain telescope, Celestron NEX-IMAGE 5 camera*

***Image 24, Clavius,** Richard Hill, Loudon Observatory, Tucson, Arizona, USA. 2010 October 03 03:51 UT. 5 inch Celestron Schmidt-Cassegrain telescope, 2.5x barlow, 665 nm filter, SKYRIS 445M camera. Seeing 7/10.*



Focus On: Lunar Topographic Studies
Lunar Base Clavius

Image 25, Clavius to Maginus, *Richard Hill, Loudon Observatory, Tucson, Arizona, USA. 2013 February 20 01:12 UT. TEC 8 inch Maksutov-Cassegrain telescope, 665nm filter, DMK21AU04 camera. Seeing 8/10.*

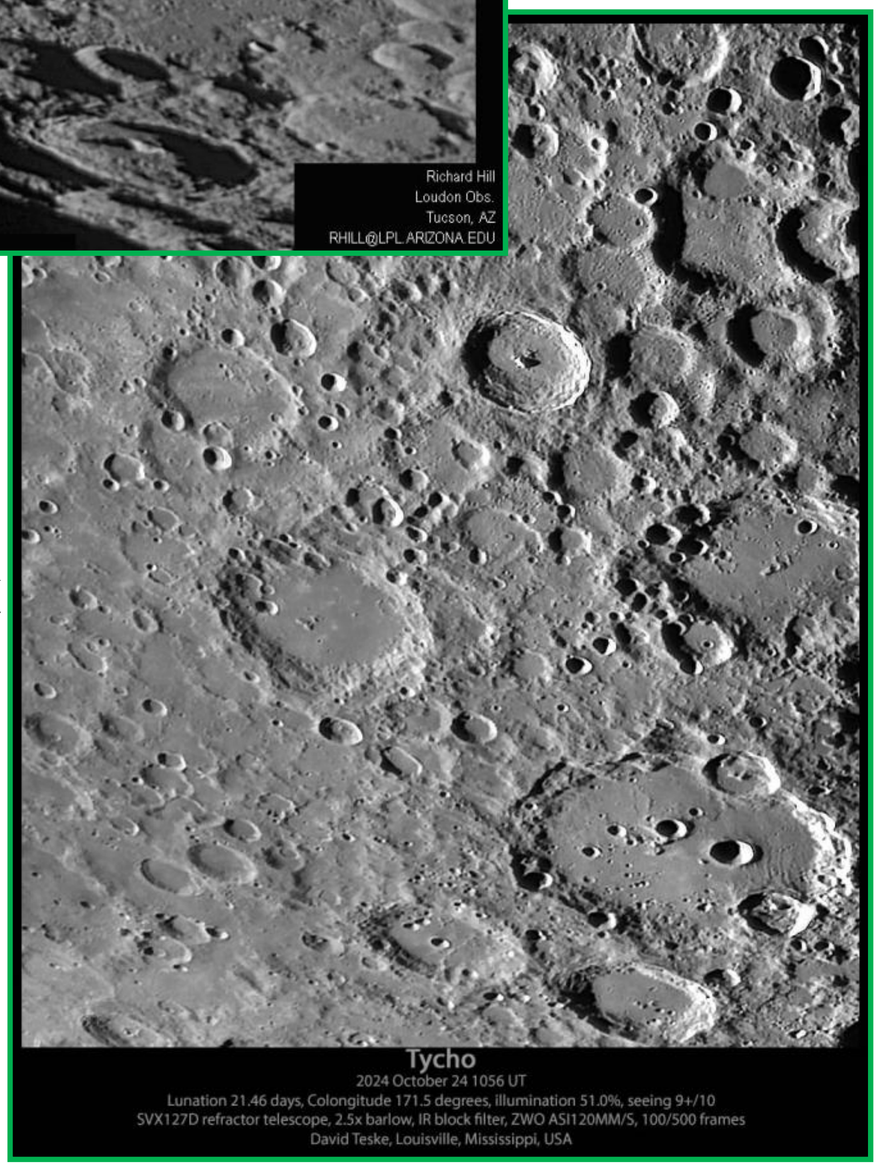


Image 26, Clavius, *David Teske, Louisville, Mississippi, USA. 2024 October 24 10:56 UT, colongitude 171.5˚. Stellarvue SVX 127 mm refractor telescope, 2.5 x barlow, IR block filter, ZWO ASI120MM/S camera. Seeing 9+/10.*

Focus On: Lunar Topographic Studies
Lunar Base Clavius

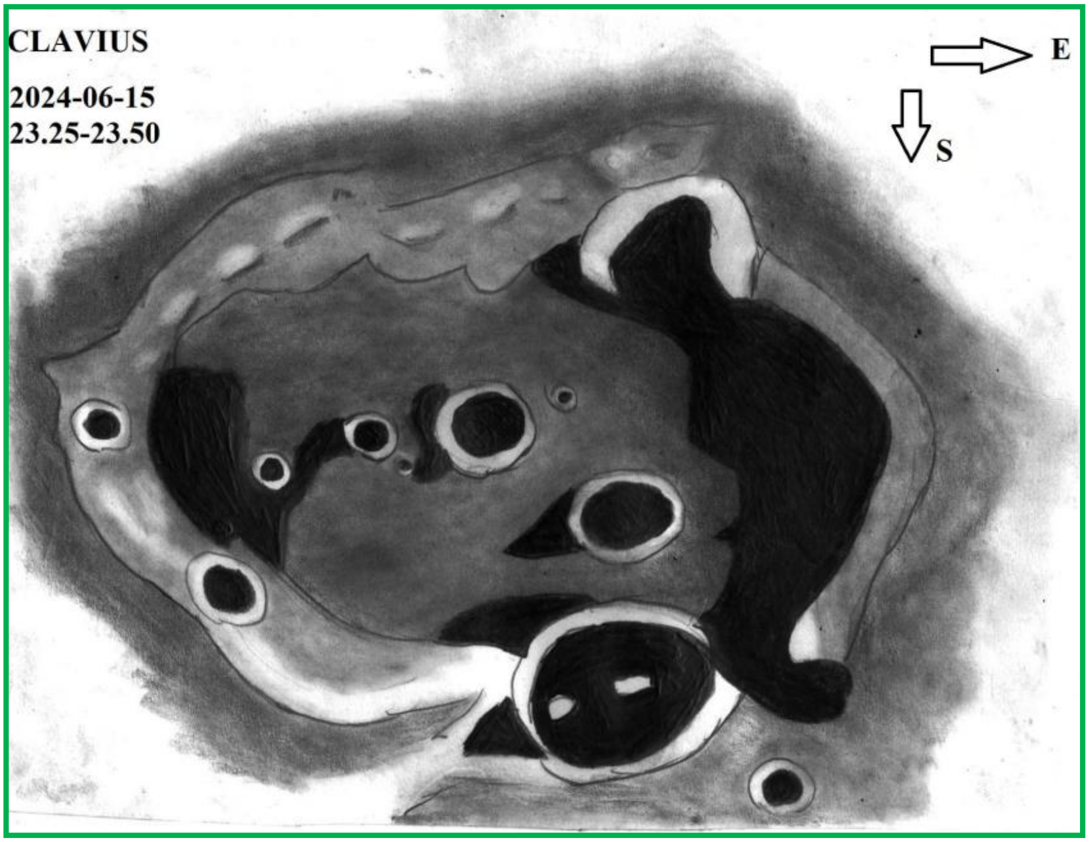
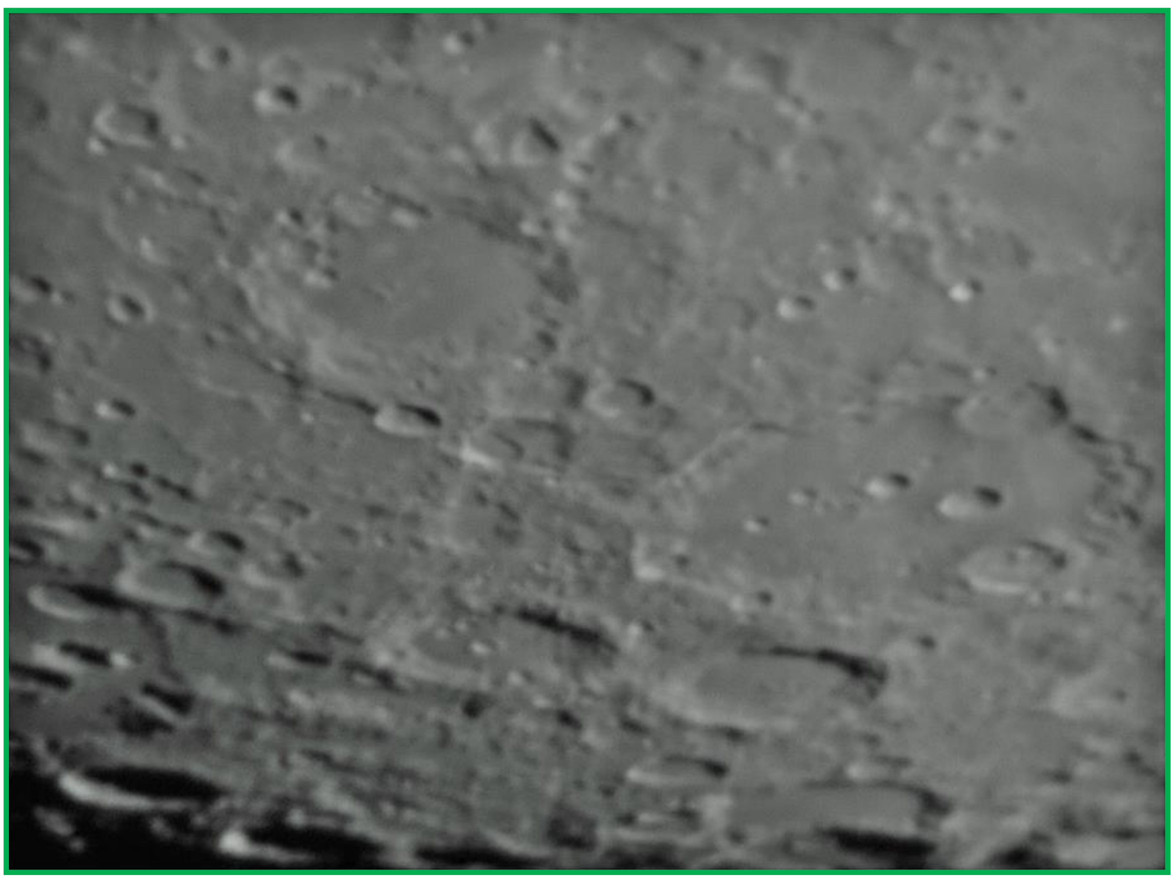


Image 27, Clavius, *Alberto Anunziato, Paraná, Argentina. 2024 June 15 23:25-23:50 UT. Meade EX105 Maksutov-Cassegrain telescope, 154x.*



28, Clavius, *Francisco Alsina Cardinalli, Oro Verde, Argentina, SLA-LIADA. 2016 December 11 03:37 UT. Meade 10 inch LX200 Schmidt-Cassegrain telescope, Astronomik ProPlanet 642 nm IR-pass filter.*

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Lunar Base Clavius

Image 29, Clavius, *Alberto Anunziato, Paraná, Argentina. 2021 July 18 22:41 UT. 180 mm Newtonian reflector telescope, ZWO ASI120MC camera.*

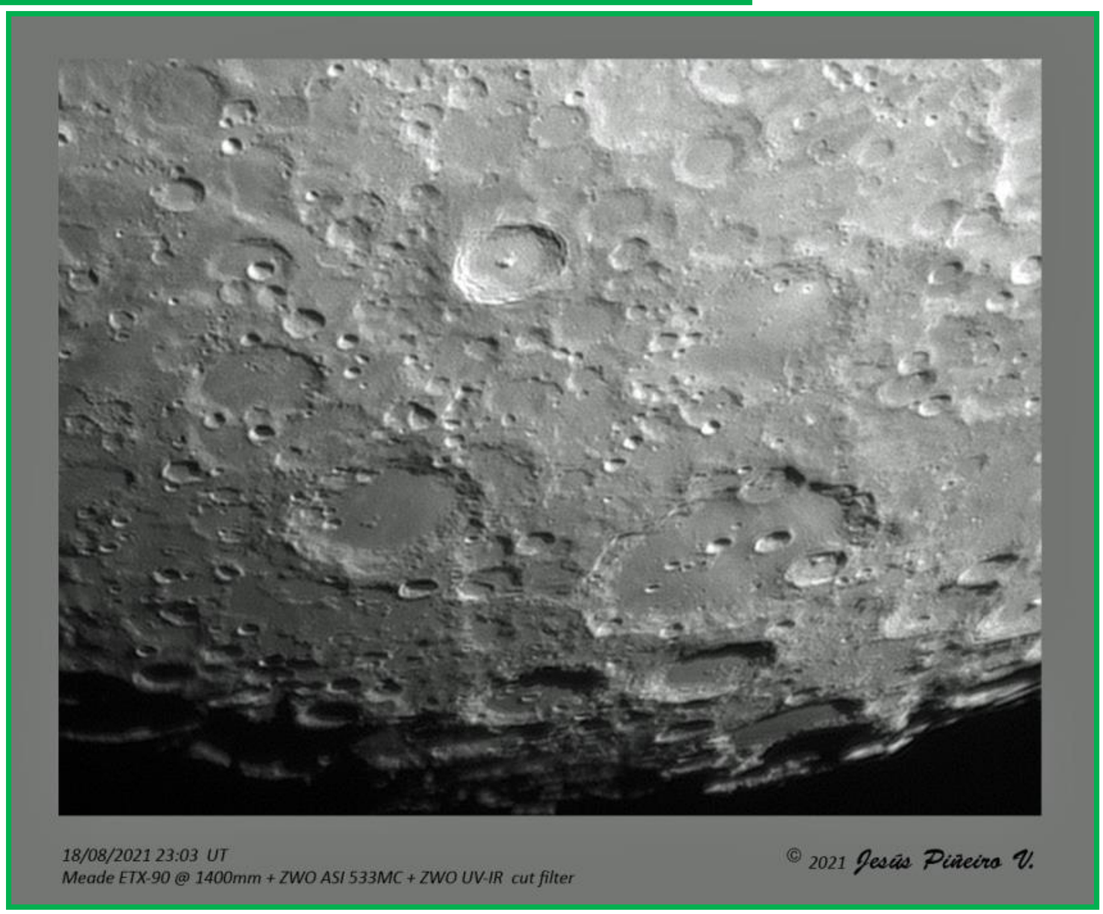

Image 30, Tycho, *Jesús Piñeiro, San Antonio de los Altos, Venezuela. 2021 August 17 23:03 UT. 90 mm Maksutov-Cassegrain telescope, ProPlanet Astronomik L2 UV-IR filter, ZWO ASI533MC camera.*

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Lunar Base Clavius

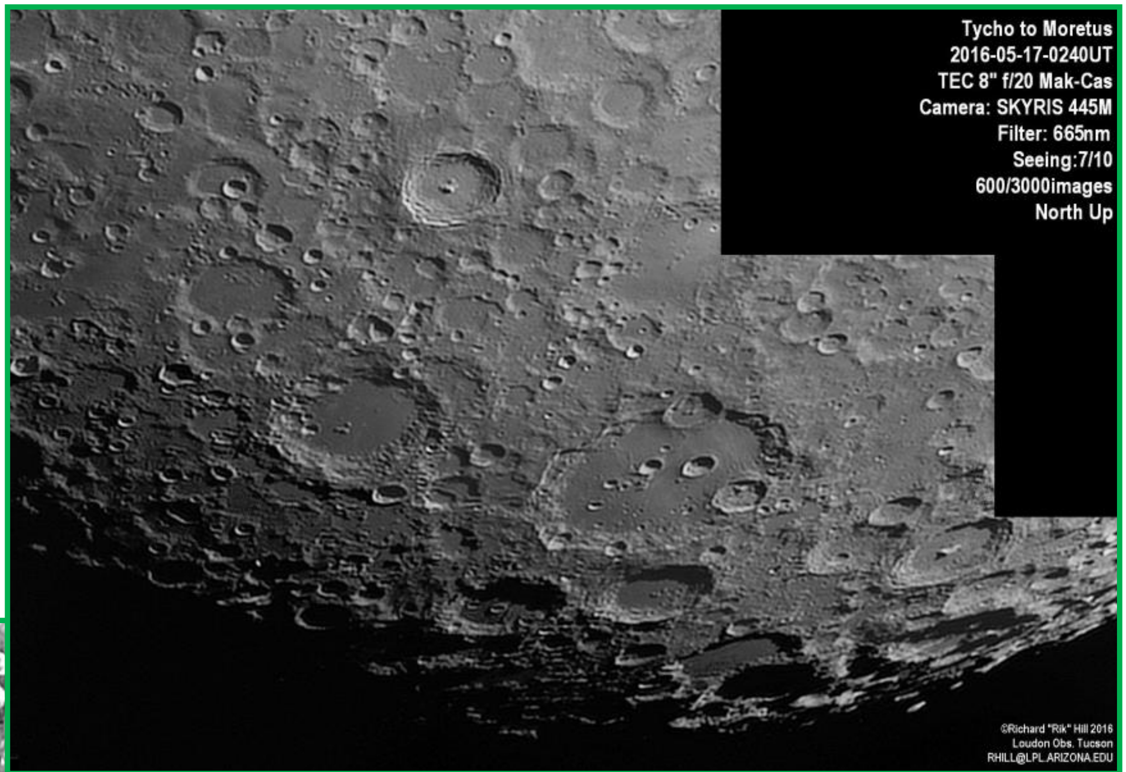

Image 31, Clavius to Moretus, *Richard Hill, Loudon Observatory, Tucson, Arizona, USA. 2016 May 17 02:40 UT. TEC 8 inch Maksutov-Cassegrain telescope, 665nm filter, SKYRIS445M camera. Seeing 7/10.*

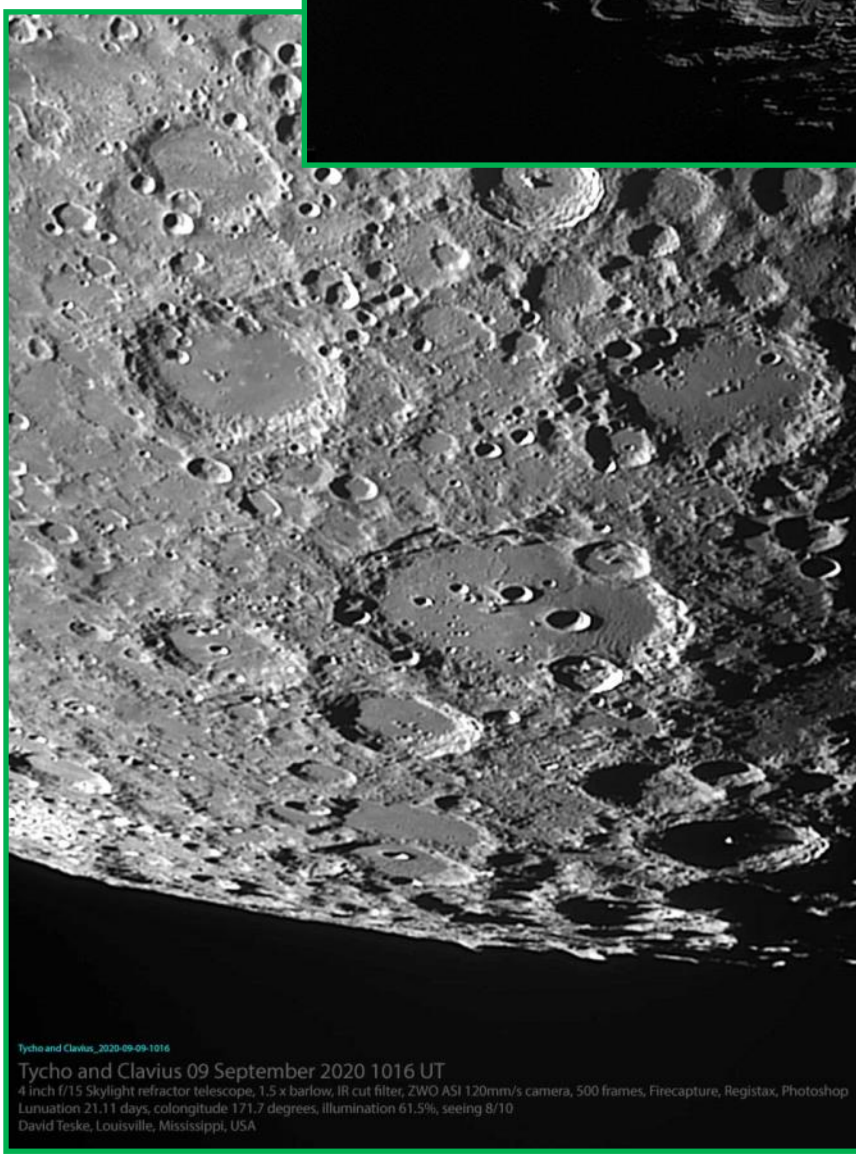

Image 32, Clavius, *David Teske, Louisville, Mississippi, USA. 2020 September 09 10:16 UT, colongitude 171.7˚. 4 inch f/15 refractor telescope, 1.5 x barlow, IR block filter, ZWO ASI120MM/S camera. Seeing 8/10.*

There are not only small craters in the central part of Clavius: "In addition to this prominent chain, there are innumerable craters of a smaller type on the floor, but they are more plentiful on the S. half than elsewhere" (Elger). This obvious asymmetry, which can be seen in **IMAGES 33 to 35**, does not have a clear cause, it would be what Wood points out: "One of the lines of small craters on the south side of its floor points directly towards the Orientale basin, and many of the craters in and around Clavius are probably basin secondaries". In **IMAGE 36**, and its **detail 37**, we can see what I estimate to be the radial chains of secondary craters of the Orientale basin (marked by arrow 1), much more difficult is to determine the origin of the cluster of craters marked by arrow 2.

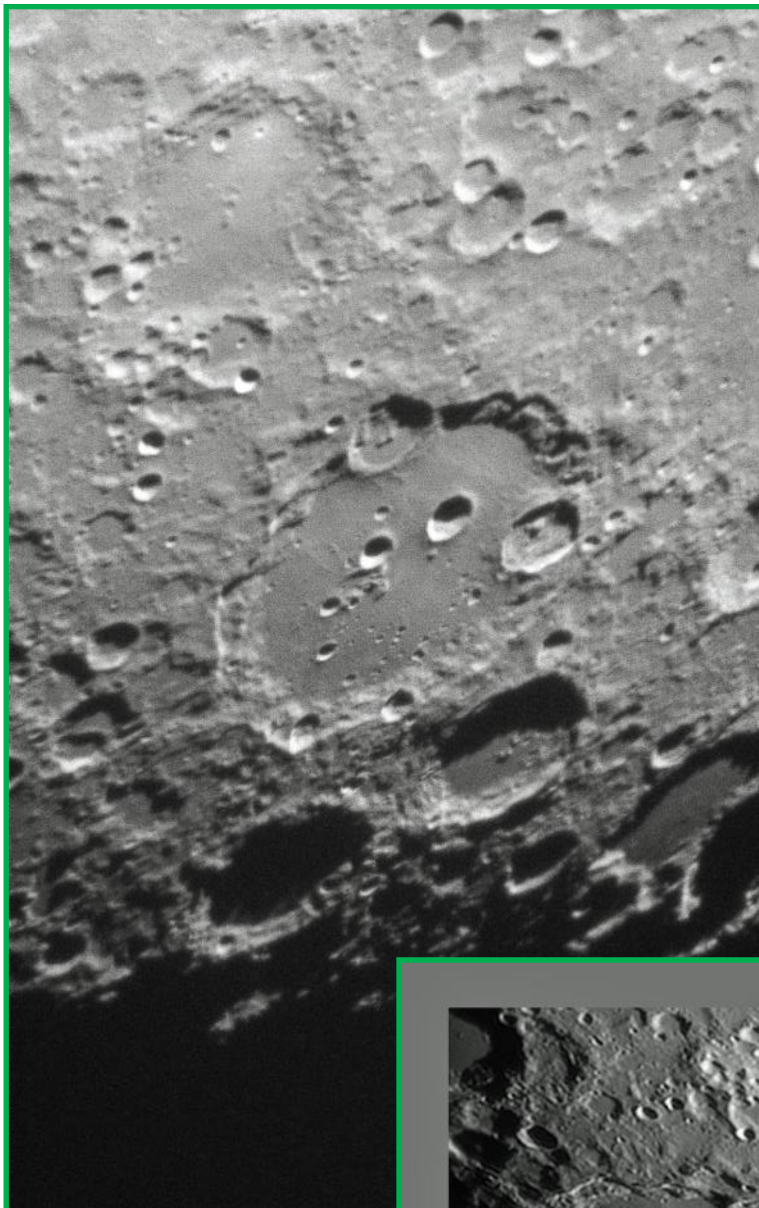

Image 33, Clavius, *James Brunkella, Thousand Oaks, California, USA. 2025 February 08 03:18 UT. Intes 9 inch f/15 Maksutov-Cassegrain telescope, ZWO ASI715MC camera. Seeing 6/10, transparency 5/6.*

Image 34, Clavius, *Jesús Piñeiro, San Antonio de los Altos, Venezuela. 2021 August 17 23:31 UT. Meade ETX 90 Maksutov-Cassegrain telescope, ZWO UV-IR cut filter, ZWO ASI533MC camera.*

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Lunar Base Clavius

***Image 35, Tycho and Clavius**, Jairo Chavez, Popayán, Colombia. 2019 July 12 03:04 UT. 10 inch truss Dobsonian reflector telescope, Sony DSC-WX50 camera. North is to the lower left, west is to the lower right.*

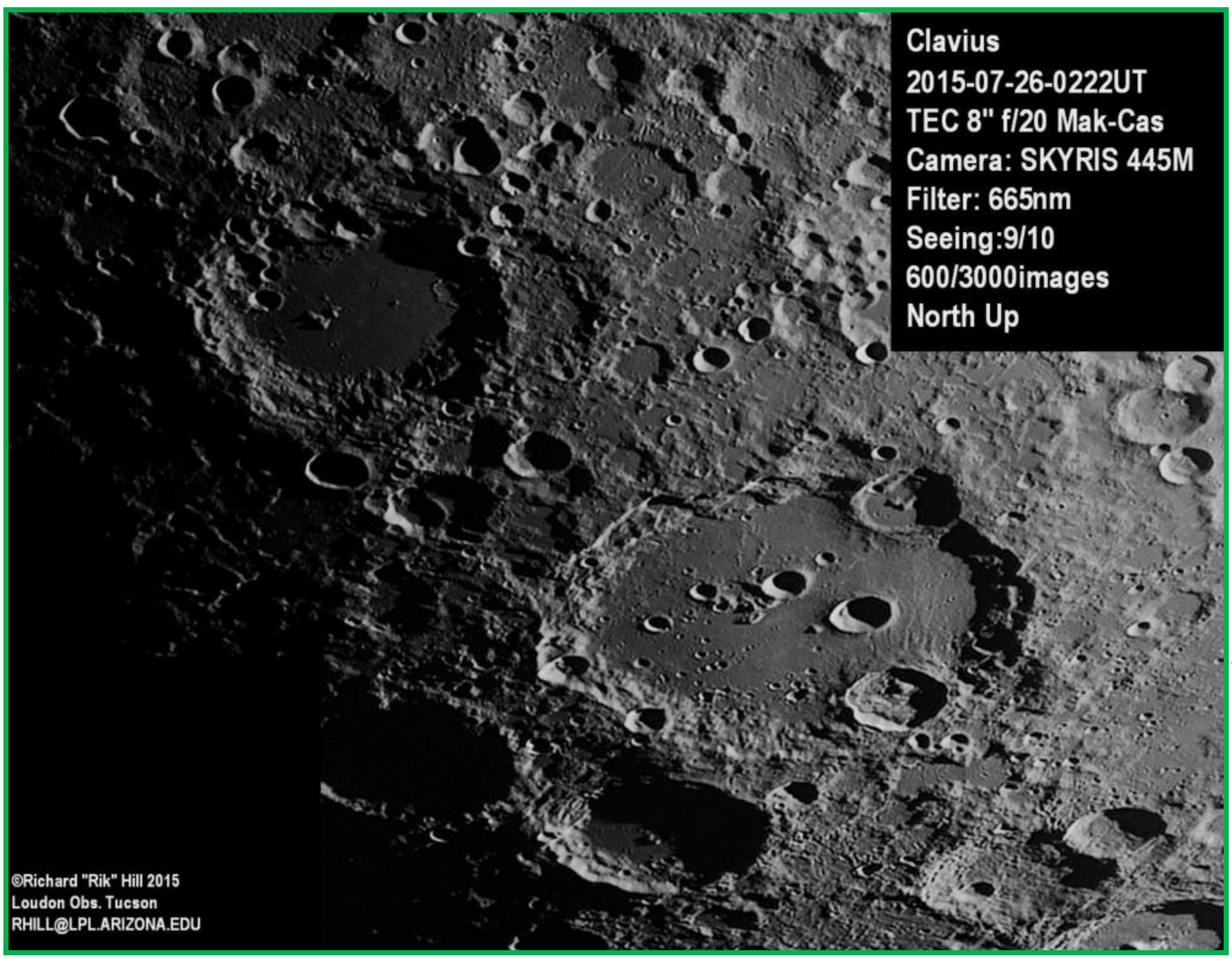

***Image 36, Clavius,** Richard Hill, Loudon Observatory, Tucson, Arizona, USA. 2015 July 26 02:22 UT. TEC 8 inch Maksutov-Cassegrain telescope, 665nm filter, SKYRIS445M camera. Seeing 9/10.*

Focus On: Lunar Topographic Studies
Lunar Base Clavius

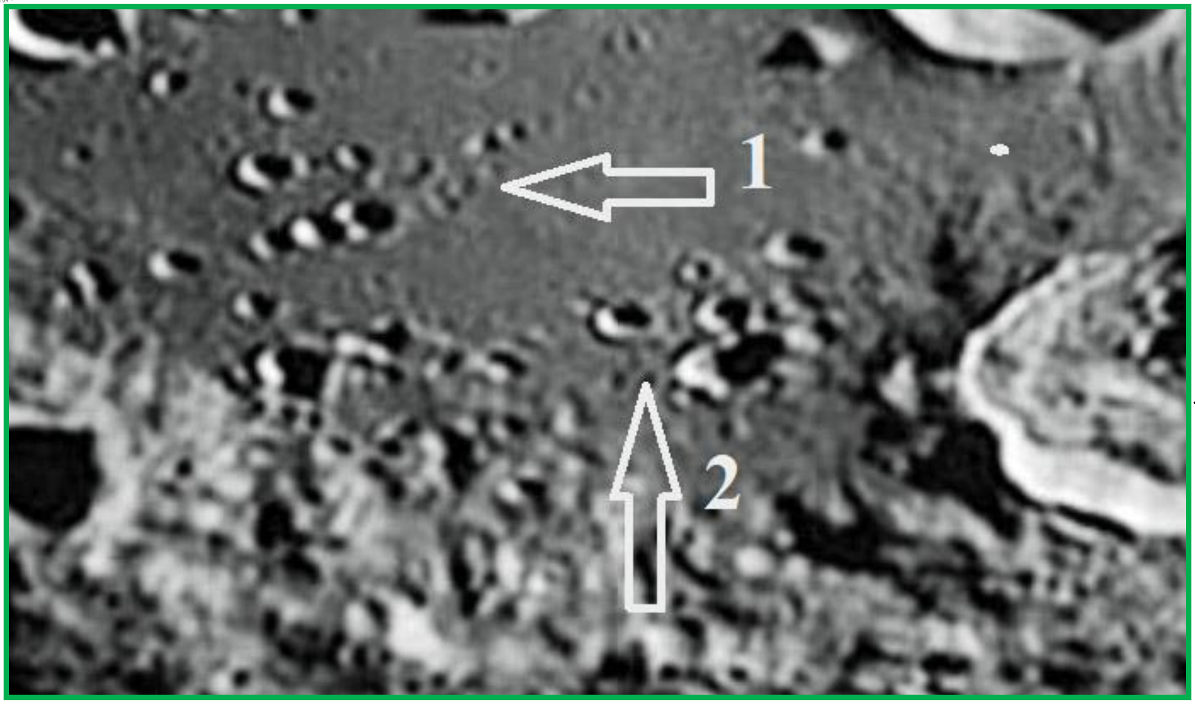

Image 37, Clavius, *Richard Hill, Loudon Observatory, Tucson, Arizona, USA. 2015 July 26 02:22 UT. TEC 8 inch Maksutov-Cassegrain telescope, 665nm filter, SKYRIS445M camera. Seeing 9/10. This is a close-up of image 36.*

In addition to the interior craters of the deceptively smooth floor of Clavius there are numerous hills and mounds (presumably of volcanic origin), as can be seen in **IMAGES 38** and **39**. Elger notes that on the north wall "There are very clear indications of "faulting" on a vast scale where this broad section of the wall abuts on the N. side of the formation", which can be seen in **IMAGE 40**. Looking at the north wall, we can see a pair of parallel wrinkle ridges running between the north wall and Clavius C crater, which are particularly clear in **IMAGES 41, 42 (and its detail 43), 44 to 46**.

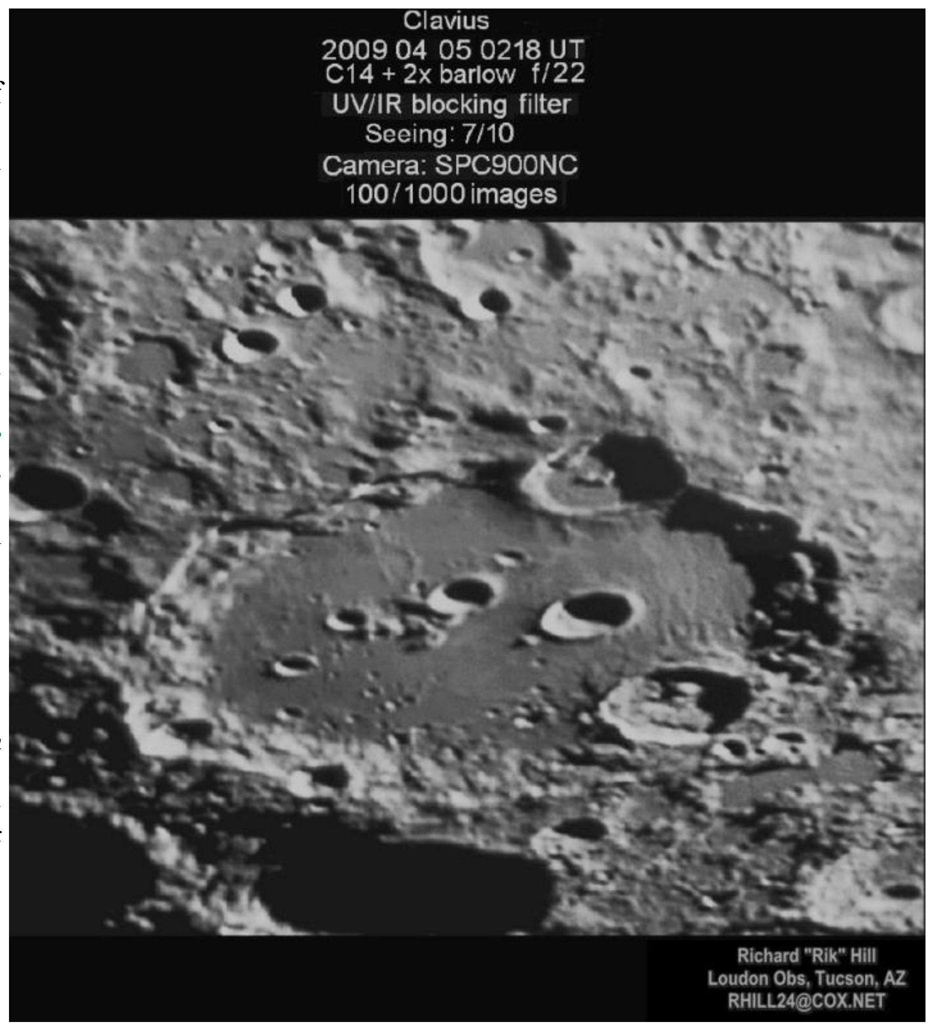

Image 38, Clavius, *Richard Hill, Loudon Observatory, Tucson, Arizona, USA. 2009 April 04 02:18 UT. 14 inch Celestron Schmidt-Cassegrain telescope, 2x barlow, UV/IR blocking filter, SPC900NC camera. Seeing 7/10.*

Image 39, Clavius to Maginus, *Richard Hill, Loudon Observatory, Tucson, Arizona, USA. 2013 February 20 01:12 UT. TEC 8 inch Maksutov-Cassegrain telescope, 665nm filter, DMK21AU04 camera. Seeing 8/10.*

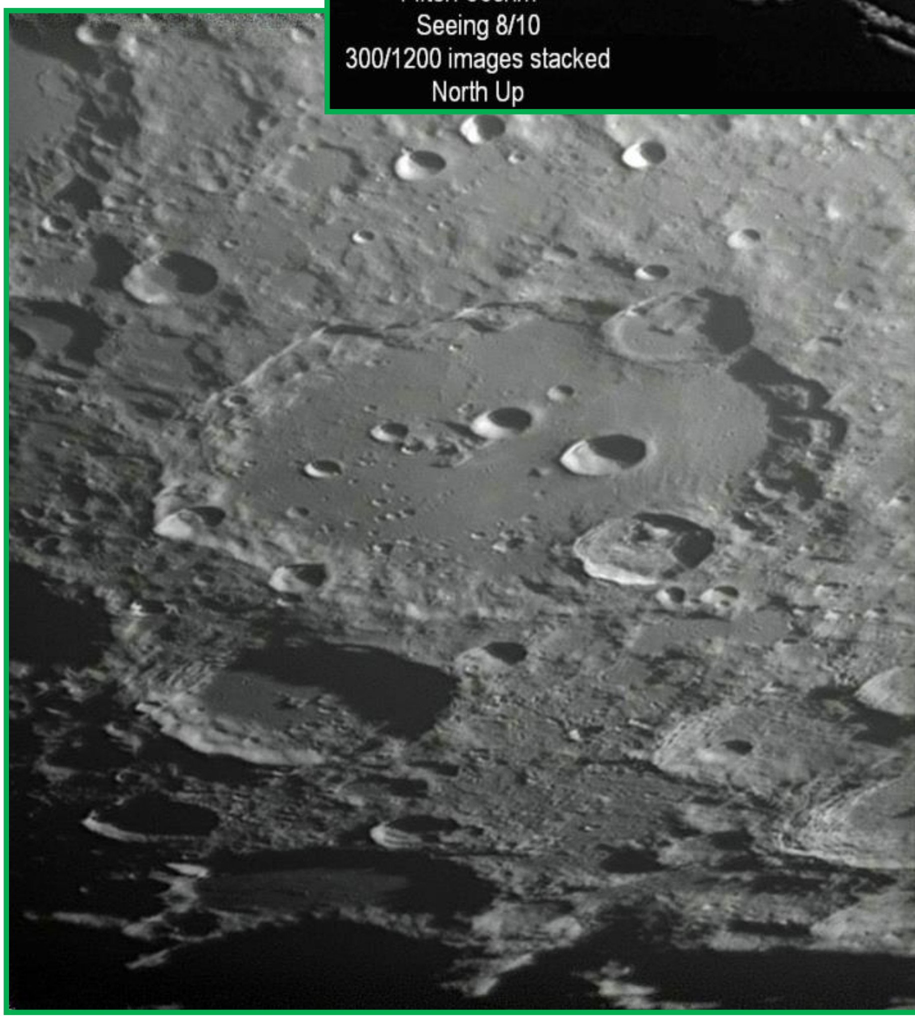

Image 40, Clavius, *Larry Todd, Dunedin, New Zealand. 2023 July 28 07:30 UT. OMC200 Maksutov-Cassegrain telescope, Neptune C camera.*

Image 41, Clavius, *Larry Todd, Dunedin, New Zealand. 2021 May 22 07:18 UT. OMC200 Maksutov-Cassegrain telescope*

Image 42, Moretus, *Richard Hill, Loudon Observatory, Tucson, Arizona, USA. 2024 June 16 03:46 UT, colongitude 22.9˚. TEC 8 inch Maksutov-Cassegrain telescope, 665 nm filter, SKYRIS 236M camera. Seeing 8/10.*

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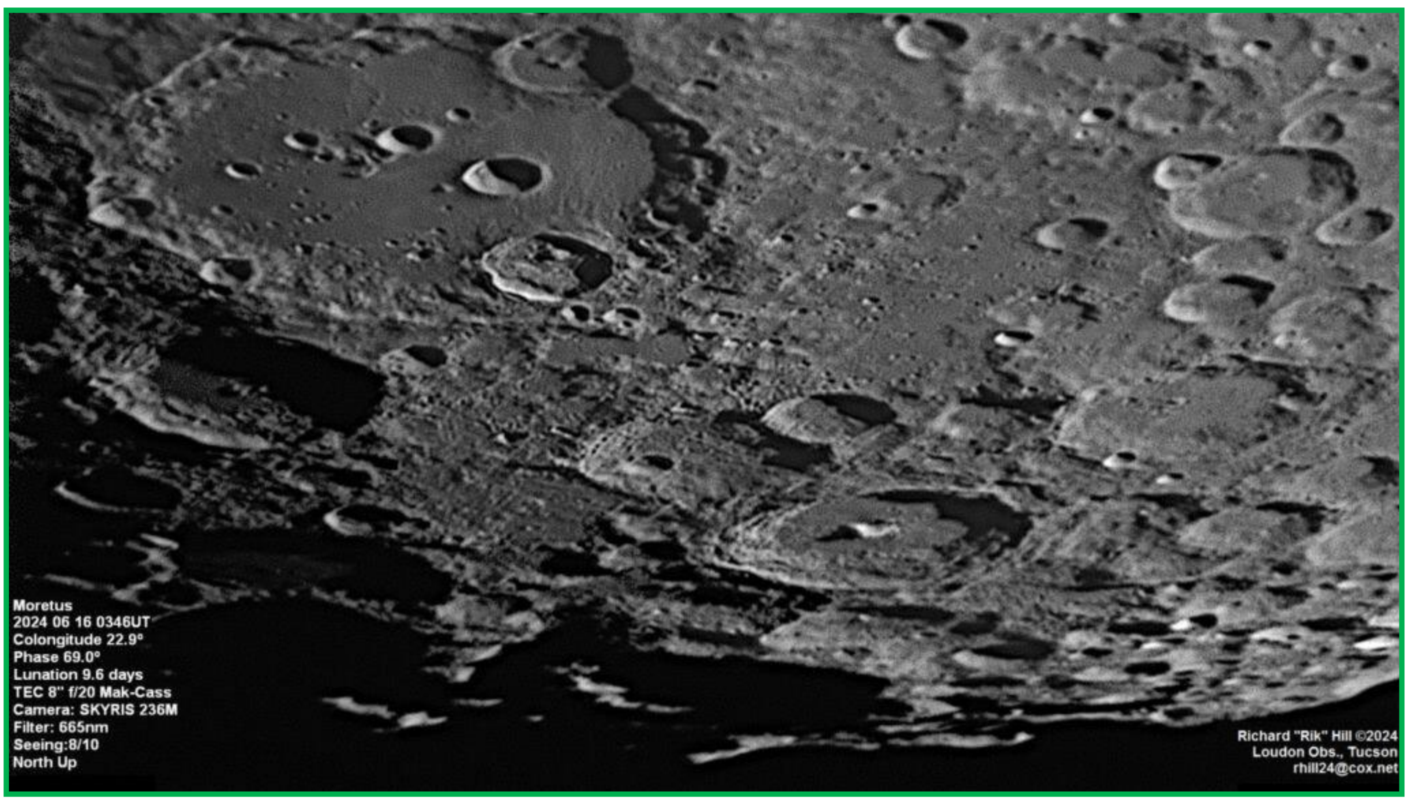


Focus On: Lunar Topographic Studies

Lunar Base Clavius

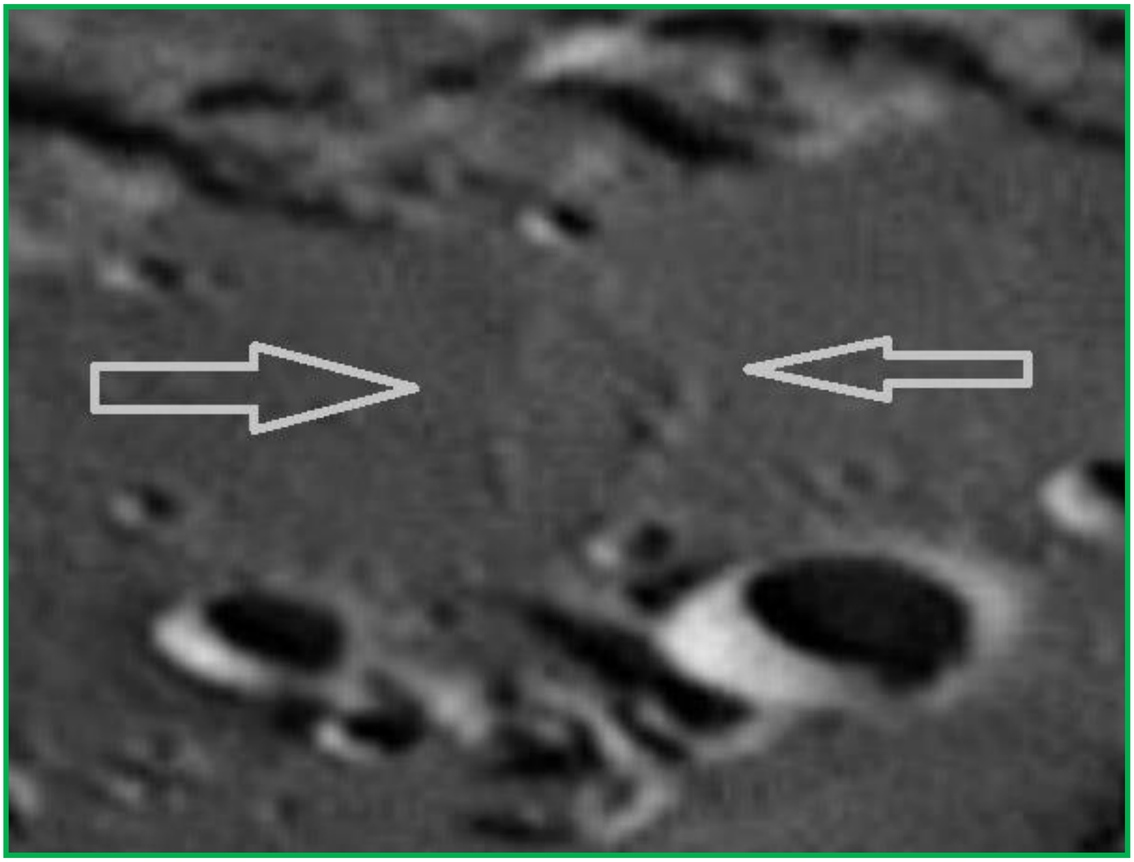


Image 43, Moretus, *Richard Hill, Loudon Observatory, Tucson, Arizona, USA. 2024 June 16 03:46 UT, colongitude 22.9˚. TEC 8 inch Maksutov-Cassegrain telescope, 665 nm filter, SKYRIS 236M camera. Seeing 8/10. This is a close-up of image 42.*

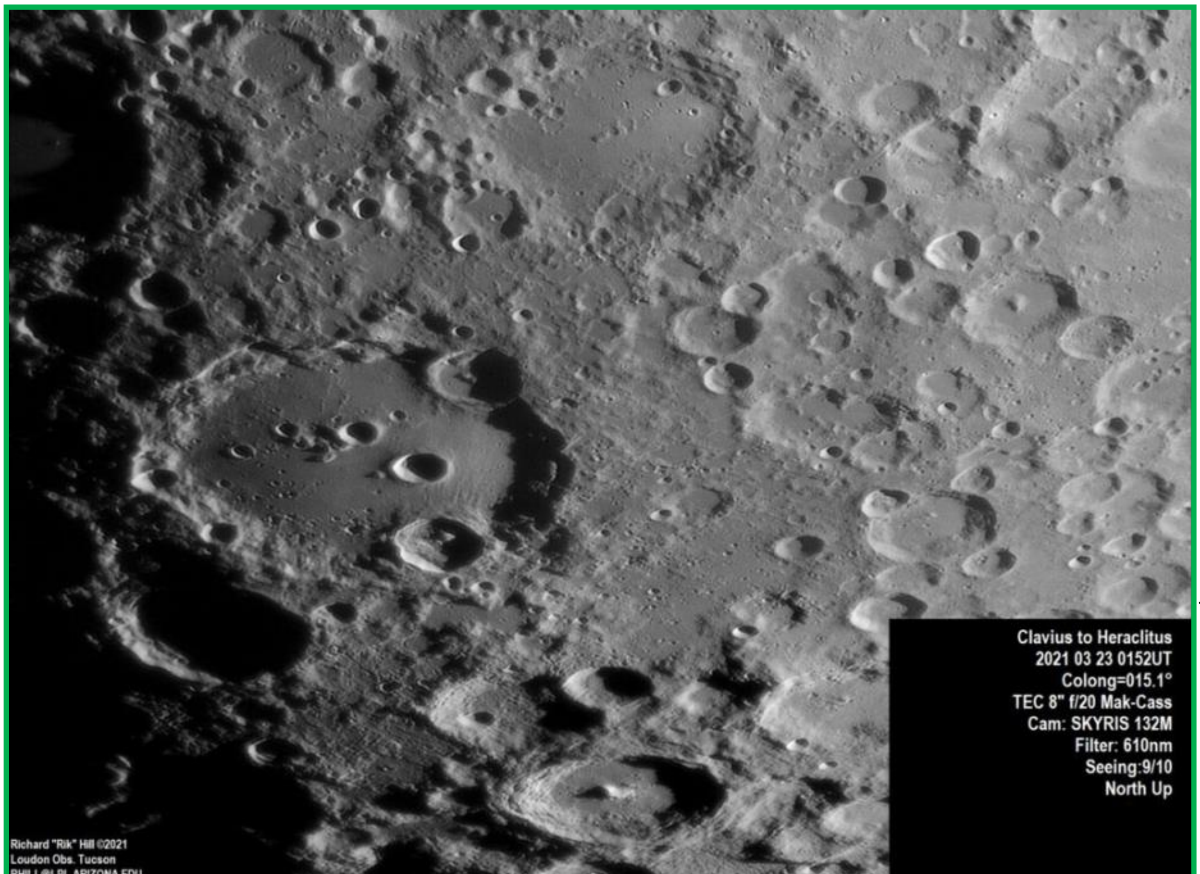


Image 44, Clavius to Heraclitus, *Richard Hill, Loudon Observatory, Tucson, Arizona, USA. 2021 March 23 01:52 UT, colongitude 15.1˚. TEC 8 inch Maksutov-Cassegrain telescope, 610 nm filter, SKYRIS 132M camera. Seeing 9/10.*

Focus On: Lunar Topographic Studies
Lunar Base Clavius

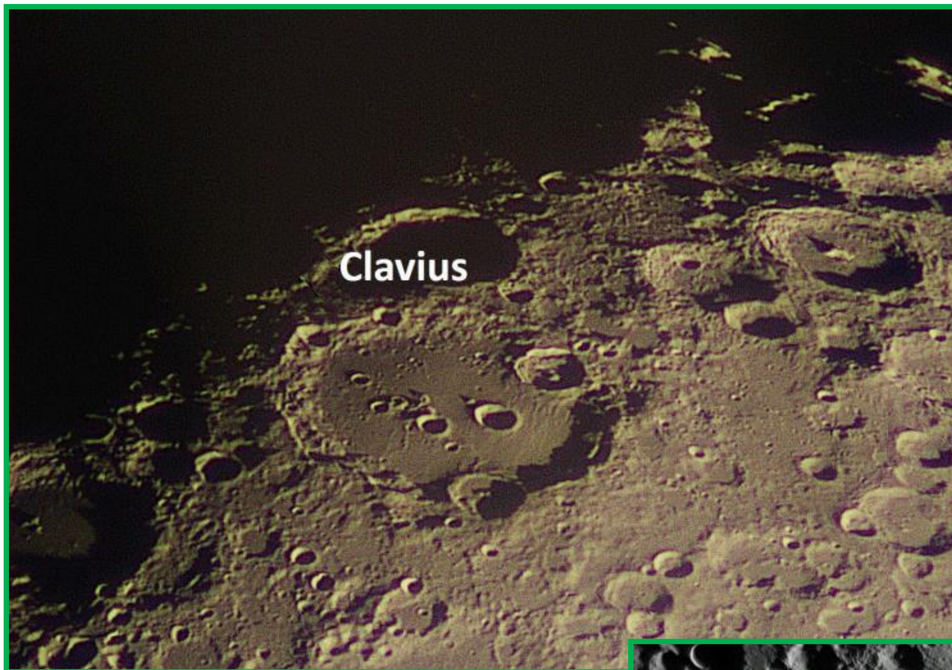


Image 45, Clavius, *Marcelo Mojica Gundlach, Cochabamba, Bolivia-LIADA. 2019 May 14 05:02 UT. 150 mm refractor telescope, ZWO ASI120 camera. North is down, west is left.*

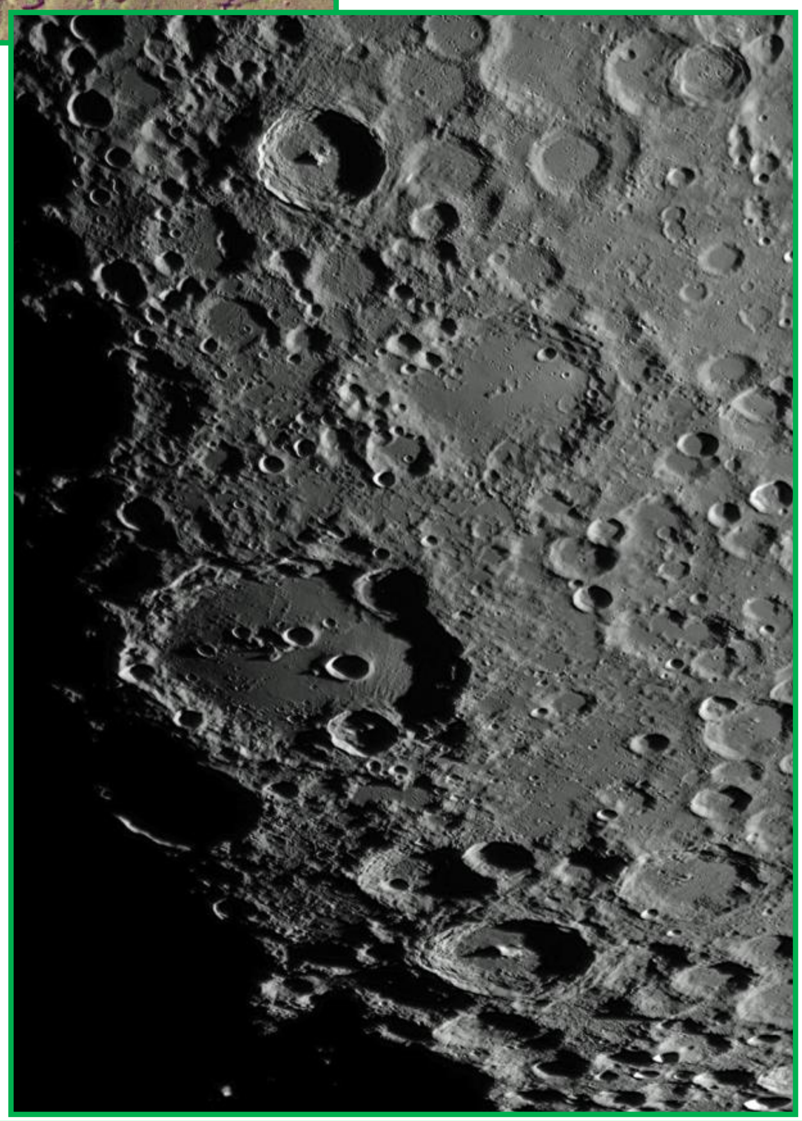


Image 46, Clavius, *Desireé Godoy, Oro Verde, Argentina, SLA_LIDA. 2016 September 10 23:15 UT. Celestron Edge HD 11 inch Schmidt-Cassegrain telescope, QHY5-II camera.*

In the previous images we have not always been able to see the polygonal outline that so many observers have attributed to Clavius, it can be seen quite clearly in **IMAGES 47** to **49**. It is interesting that these polygonal walls have served as an argument to support the volcanic origin of Clavius, as we read in Fielder: "Spurr… grouped the craters into types. One of these types was his "graben-crater", examples being Ptolemaeus and Clavius. Noting that graben craters have polygonal shapes, Spurr reasoned that they grew from deep-seated fissures or fractures".

Image 47, Clavius, *Larry Todd, Dunedin, New Zealand. 2020 July 02 17:17 UT. OMC200 Maksutov-Cassegrain telescope.*

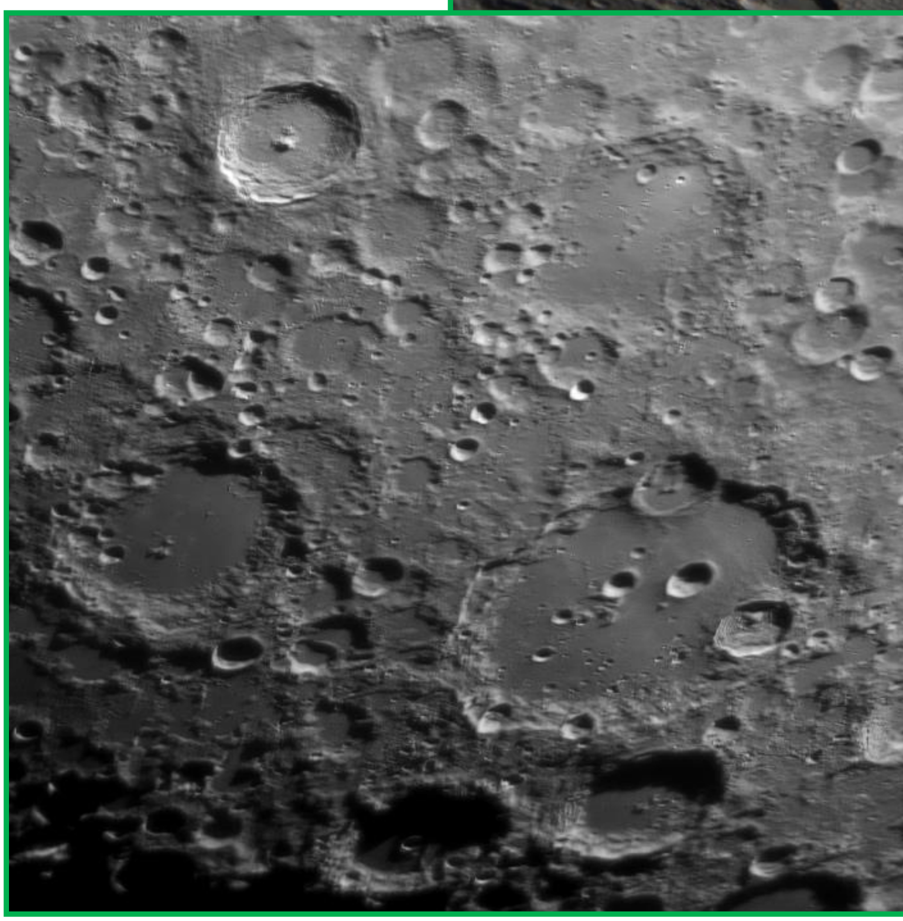


Image 48, Clavius, *Mike Karakas, Winnipeg, Manitoba, Canada. 2023 April 01 03:41 UT. Celestron 11 inch Schmidt-Cassegrain telescope, 2x barlow, 642 nm IR-pass filter, ZWO ASI174MM camera. Seeing 5/10.*

Image 49, Clavius to Tycho, *Richard Hill, Loudon Observatory, Tucson, Arizona, USA. 2016 October 11 02:54 UT. TEC 8 inch Maksutov-Cassegrain telescope, 665nm filter, SKYRIS445M camera. Seeing 7/10.*

It is a bit challenging to see in the **IMAGES 50** to **53** that the center of Clavius is higher than the rim: "Clavius is so large that the curvature of the Moon causes the center of its floor to be noticeably higher than the edges. When the Sun is just rising, the center will be illuminated while parts of the rim are still in shadows" (Wood. 2007). It is interesting to see the highest parts of the ground emerge into the light while the rest is in shadow in **IMAGES 54** and **55**.

Image 50, Clavius, *Marcelo Mojica Gundlach, Cochabamba, Bolivia-LIADA. 2018 July 22 23:51 UT. 150 mm refractor telescope, Orion V block filter, SWO CMOS camera.*

Image 51, Clavius, Richard Hill, Loudon Observatory, Tucson, Arizona, USA. 2013 January 22 00:01 UT. TEC 8 inch Maksutov-Cassegrain telescope, 665nm filter, DMK21AU04 camera. Seeing 8/10.

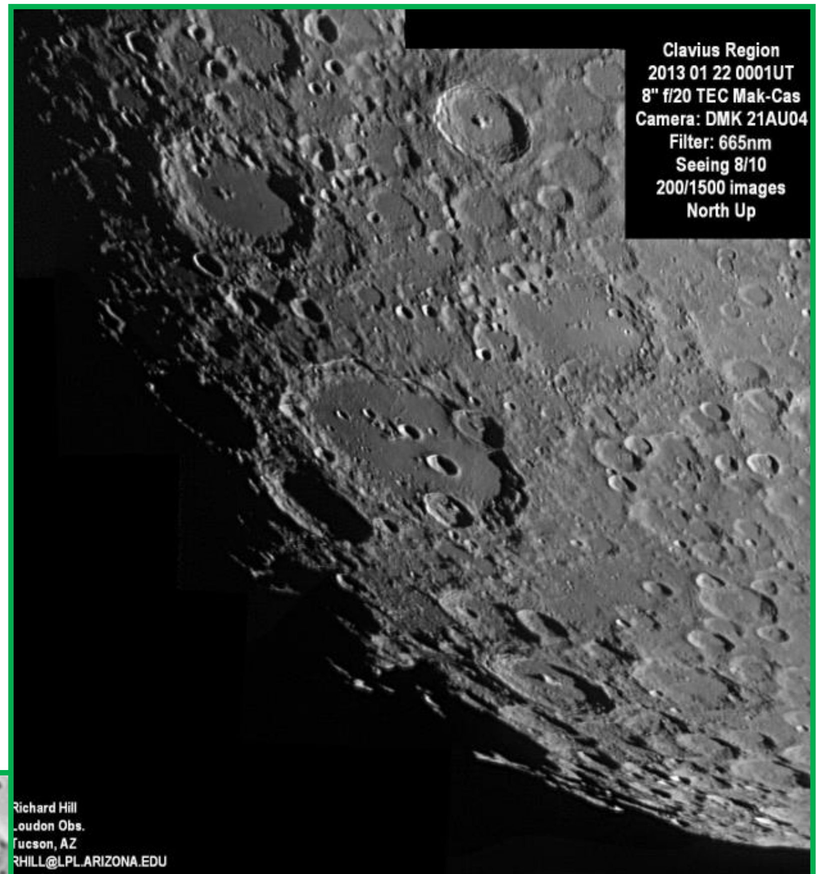


Image 52, Clavius to Tycho, Richard Hill, Loudon Observatory, Tucson, Arizona, USA. 2014 August 05 02:42 UT. Questar 3.5 inch Maksutov-Cassegrain telescope, 1.7x barlow, 665 nm filter, SKYRIS 445M camera. Seeing 8/10.

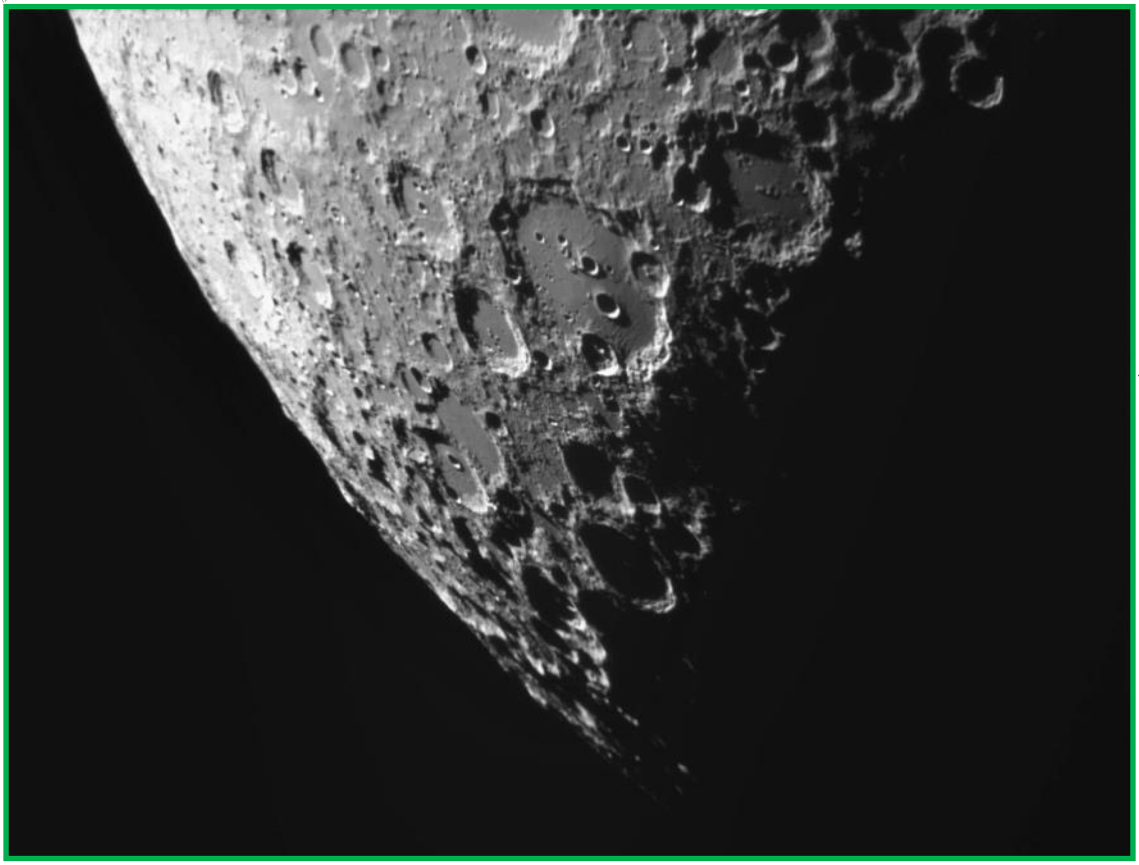


Image 53, Clavius, *James Brunkella, Thousand Oaks, California, USA. 2024 September 23 12:58 UT. Intes 9 inch f/15 Maksutov-Cassegrain telescope, ZWO ASI678MM camera. Seeing 6/10, transparency 5/6.*

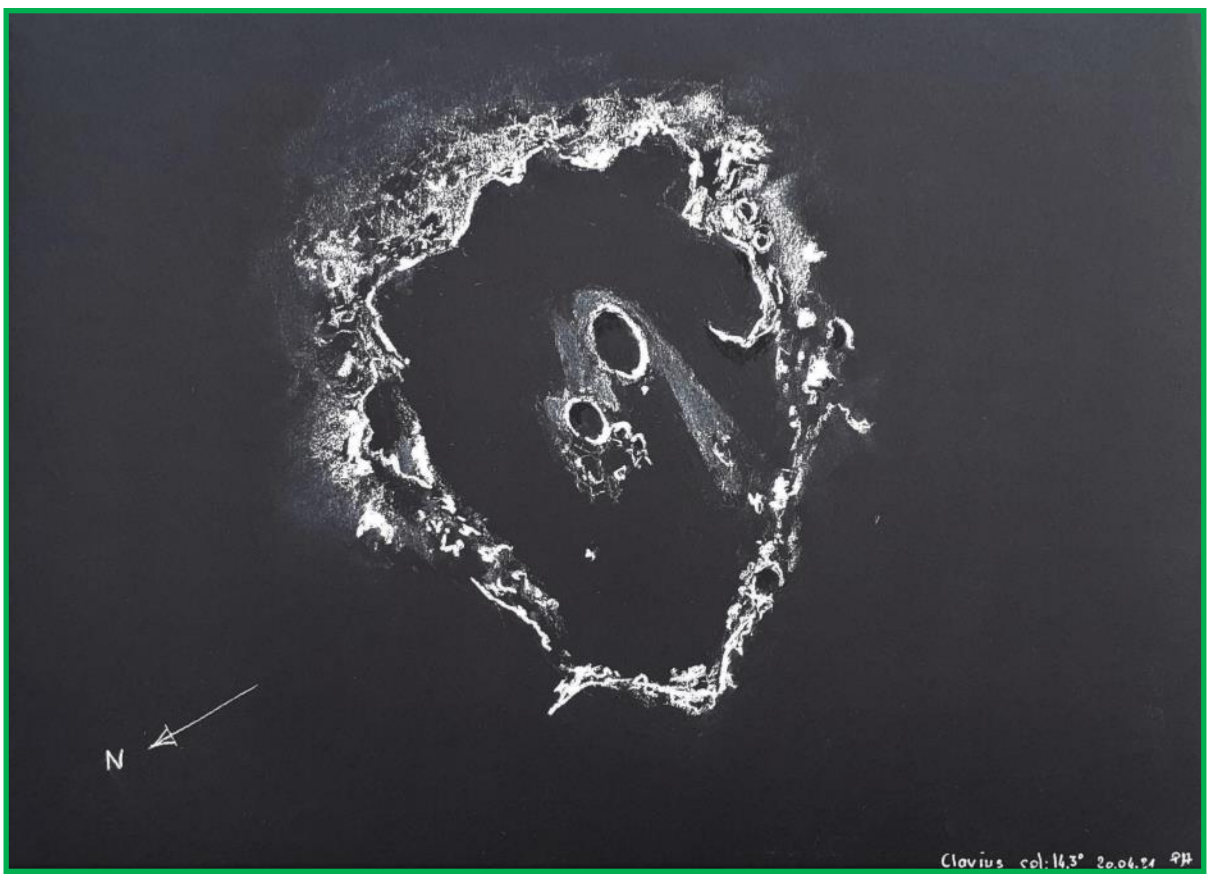
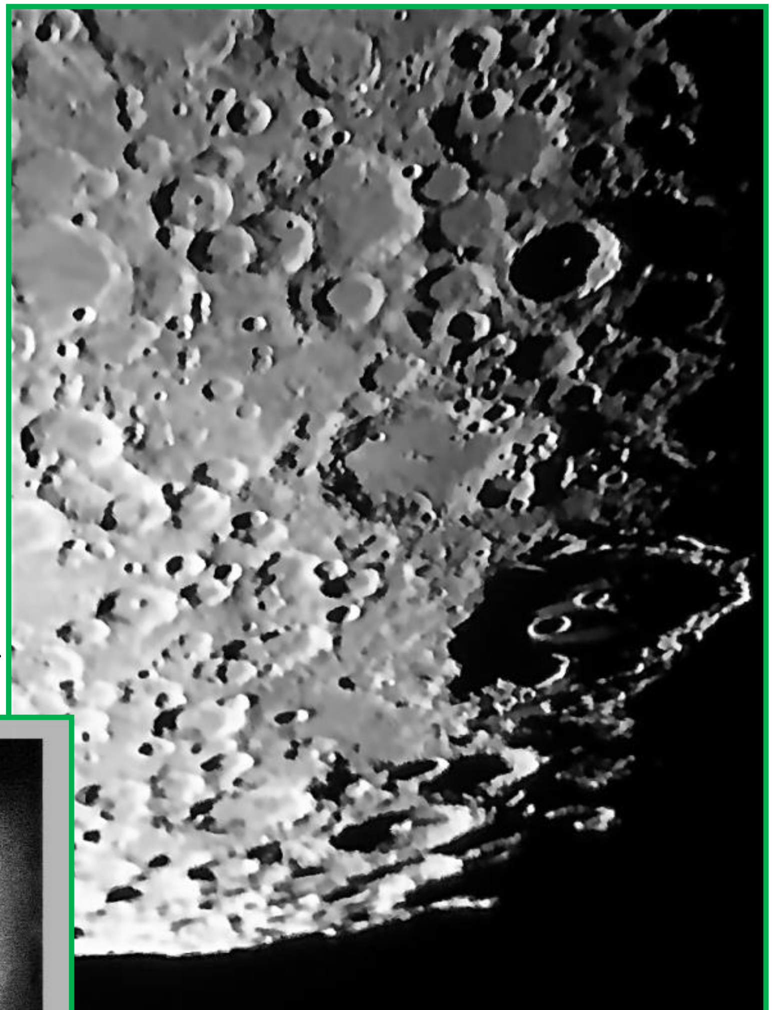


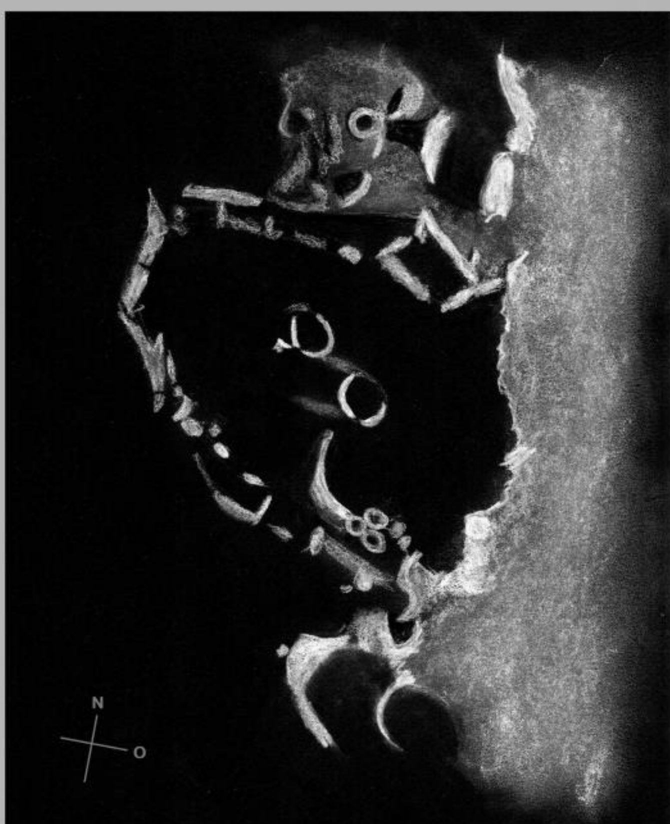
Image 54, Clavius, *Philippe Heully, Bouére, France. 2021 April 20, colongitude 14.3˚. 403 mm Dobsonian reflector telescope, 4.7 mm Ethos eyepiece.*

Focus On: Lunar Topographic Studies
Lunar Base Clavius

Image 55, Clavius, *James Brunkella, Thousand Oaks, California, USA. 2021 February 22 14:19 UT. Intes 9 inch f/15 Maksutov-Cassegrain telescope, iPhone 12 camera. Seeing 6/10, transparency 5/6.*



Regarding the ground of Clavius, which is higher in its central area, we read on the essential website www.the-moon.us, in the entry on Clavius, about a clair-obscur phenomenon in Clavius, in words of Danny Caes: “One of the most impressive lunar Clair-Obscur phenomena is the illuminated ring appearance of the larger craters on the floor of Clavius, always observable during the local sunrise hours. According to a vague memory of something which I heard during one of the moonlit nights at the Public Observatory of my city in Flanders-Belgium, some dedicated moon observers over there called this phenomenon the "Ears of Clavius" (perhaps it should have been the "Eyes of Clavius"?)”. This (in my opinion, somewhat disturbing) pareidolia of eyes (Bela Lugosi's eyes in the dark or something like that) is very clearly visible in **IMAGES 56** and **57**. The eyes are the craters Clavius C and Clavius N. **IMAGES 58** to **65** shows, in an interesting and beautiful way, how the shadows are receding and the ground is becoming brighter. On the other hand, looking at **IMAGES 66** and **67**: do you think that the eastern region of the ground is darker than the western one? In **IMAGE 68**, with more frontal illumination, this difference in coloration, which occurs in other craters like the nearby Schickard, seems more evident.



Clavius, 2/1/2011, 20.30-21.15 UT
8 cm refractor @ x111
65% ill., 9.1 days, 44° alt.

***Image 56, Clavius**, Jef de Wit, Hove, Belgium. 2011 January 02 20:30-21:15 UT. 8 cm refractor telescope, 111x.*

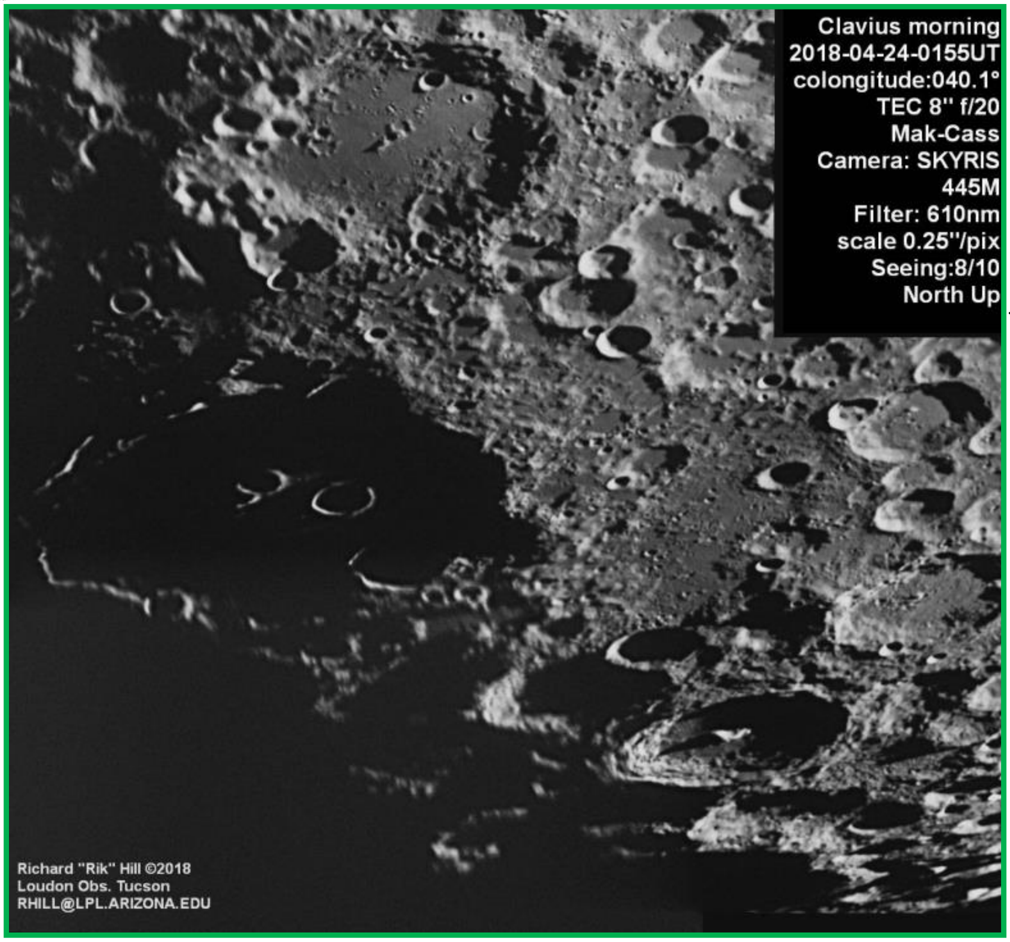


Image 57, Clavius morning, *Richard Hill, Loudon Observatory, Tucson, Arizona, USA. 2018 April 24 01:55 UT, colongitude 40.1˚. TEC 8 inch Maksutov-Cassegrain telescope, 610 nm filter, SKYRIS445M camera. Seeing 8/10.*

Image 58, Clavius, *Francisco Alsina Cardinalli, Oro Verde, Argentina, SLA-LIADA. 2015 December 20 01:56 UT. Meade 10 inch LX200 Schmidt-Cassegrain telescope, 168x with Telextender, Canon EOS Digital Rebel XS camera.*

Focus On: Lunar Topographic Studies

Lunar Base Clavius

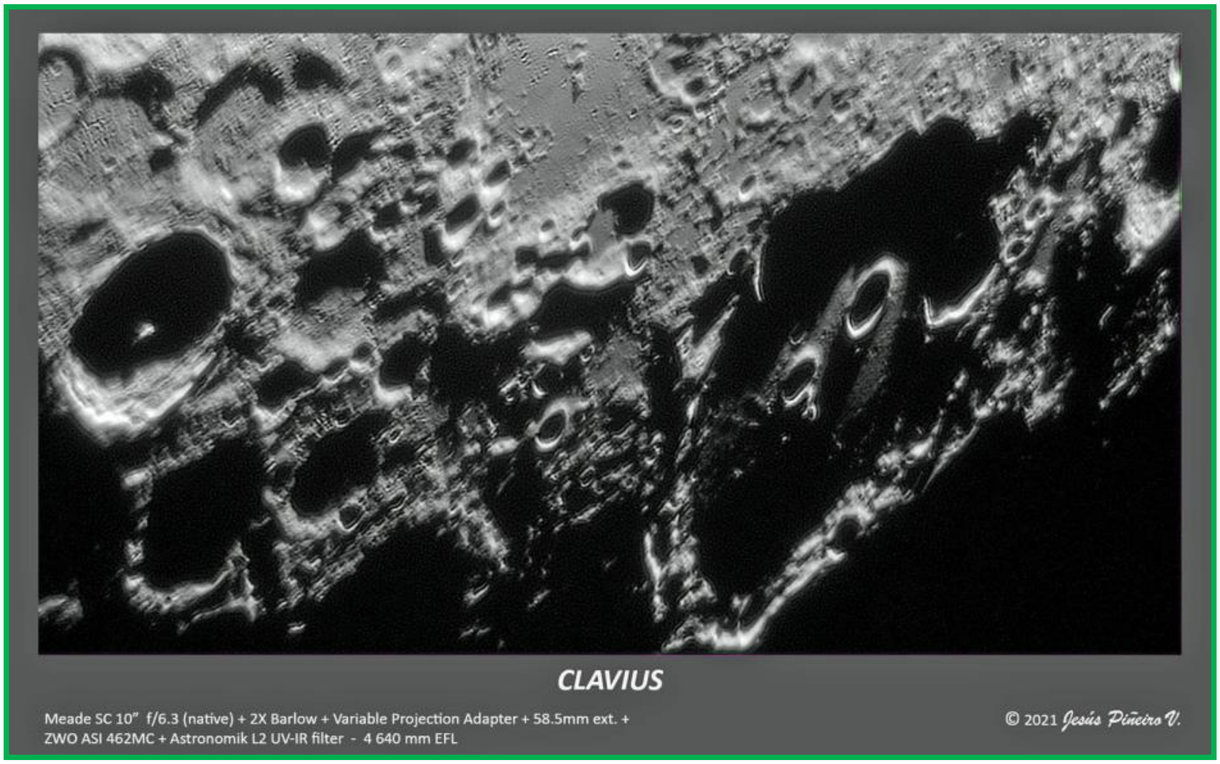
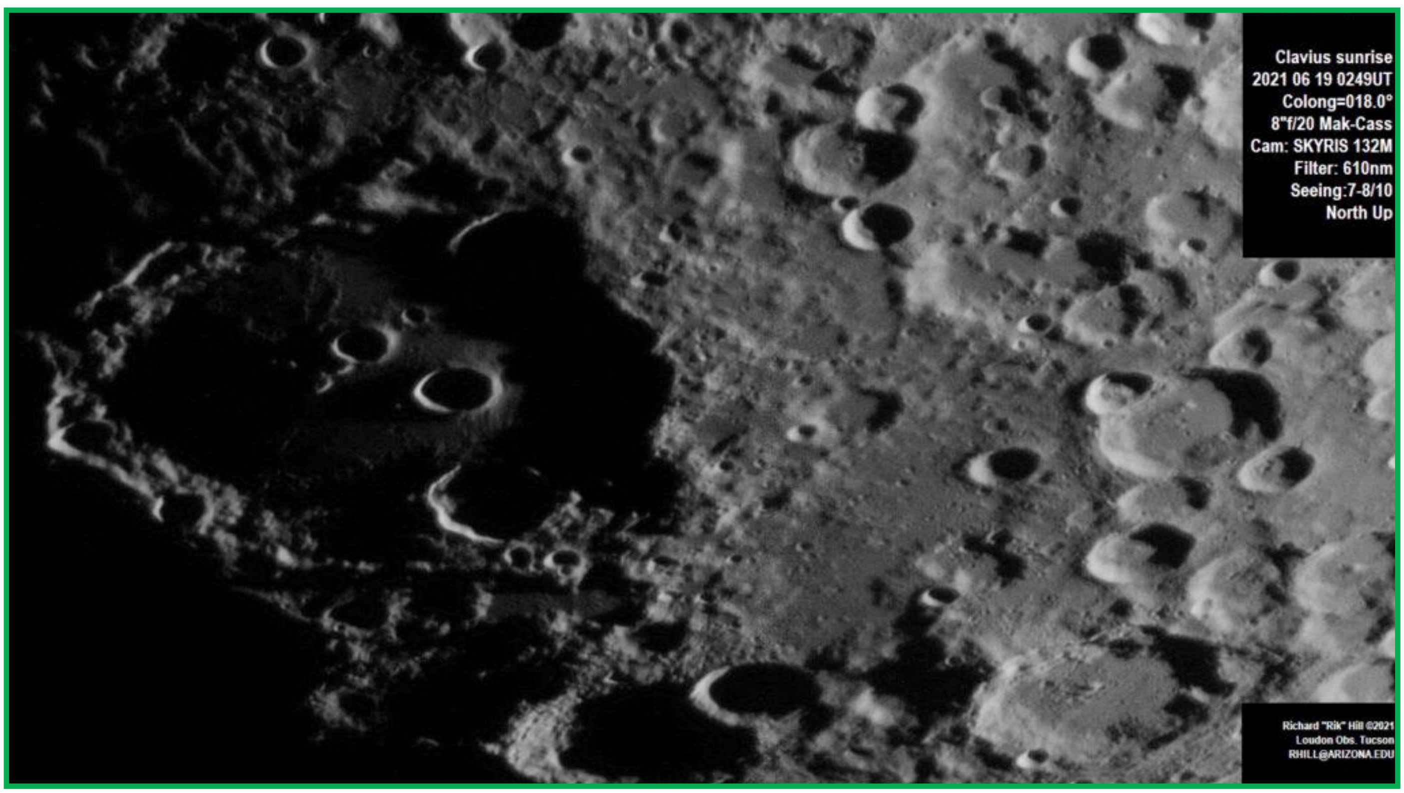


Image 59, Clavius, *Jesús Piñeiro, San Antonio de los Altos, Venezuela. 2021 December 12 23:46 UT. Meade 10 inch f/6.3 Schmidt-Cassegrain telescope, 2x barlow, Variable projection adapter, 58.5 mm extension, ProPlanet Astronomik L2 UV-IR filter, ZWO ASI462MC camera.*

Image 60, Clavius sunrise, *Richard Hill, Loudon Observatory, Tucson, Arizona, USA. 2021 June 19 02:49 UT, colongitude 18.0˚. TEC 8 inch Maksutov-Cassegrain telescope, 610 nm filter, SKYRIS 132M camera. Seeing 7-8/10.*



Focus On: Lunar Topographic Studies
Lunar Base Clavius

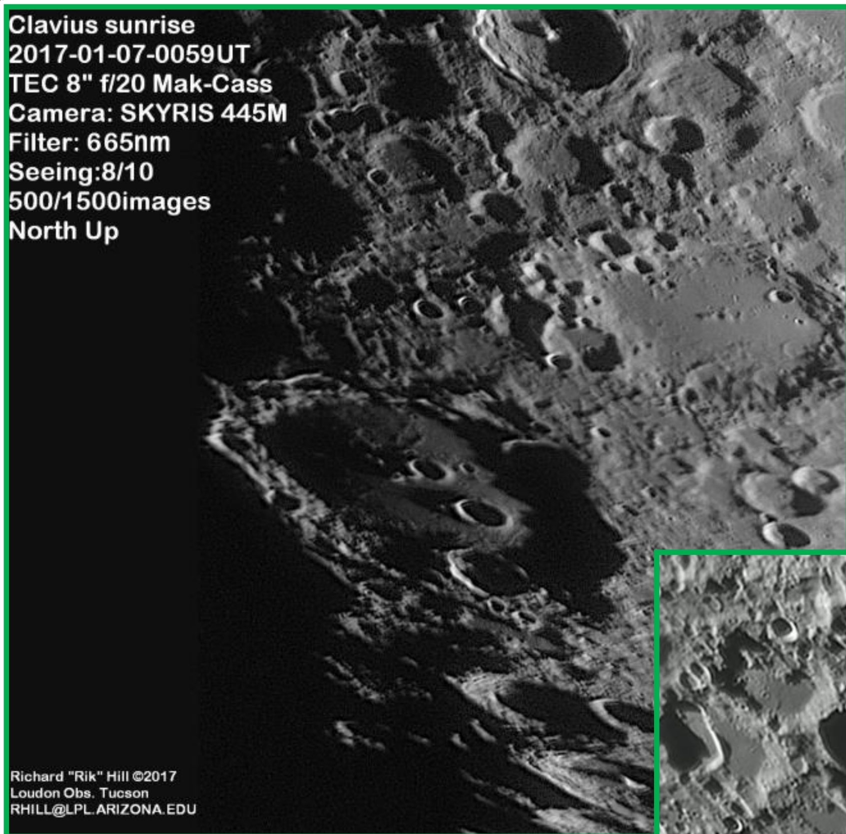


Image 61, Clavius sunrise, *Richard Hill, Loudon Observatory, Tucson, Arizona, USA. 2017 January 07 00:59 UT. TEC 8 inch Maksutov-Cassegrain telescope, 665nm filter, SKYRIS445M camera. Seeing 8/10.*

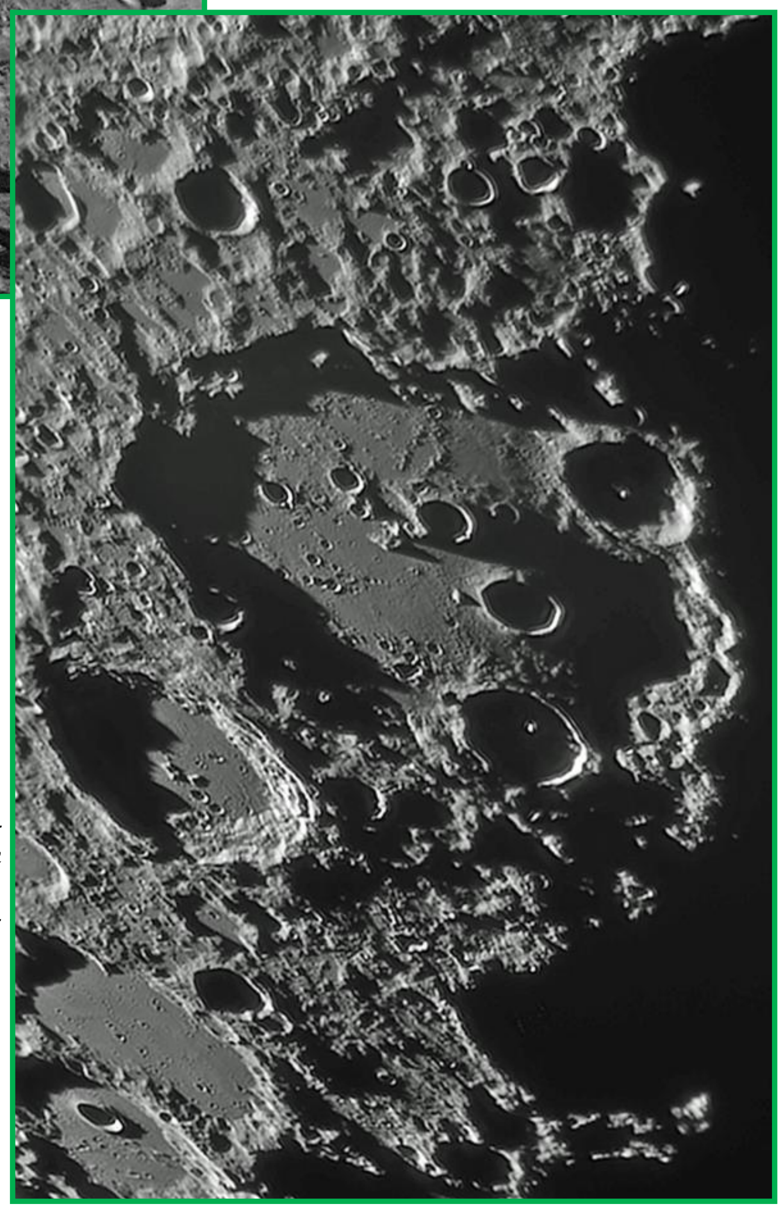
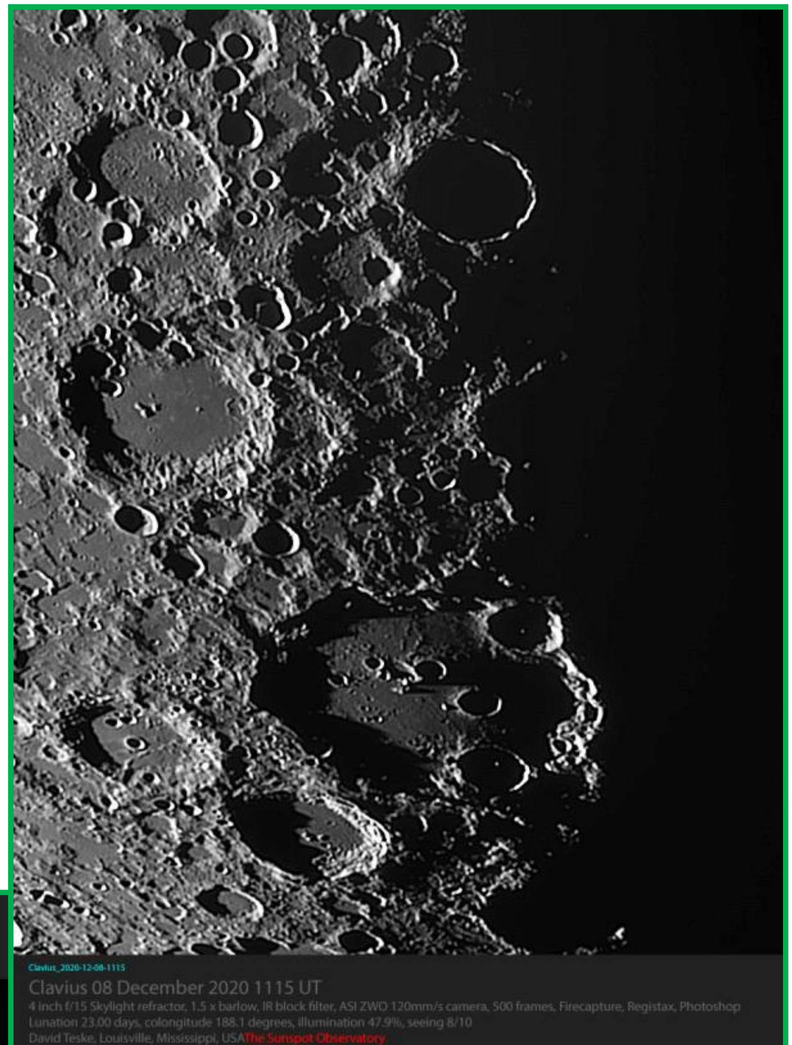


Image 62, Clavius, *Mike Karakas, Winnipeg, Manitoba, Canada. 2022 October 18 11:53 UT. Celestron 11 inch Schmidt-Cassegrain telescope, 2x barlow, 642 nm IR-pass filter, ZWO ASI174MM camera. Seeing 7/10.*

Image 63, ***Clavius,*** *David Teske, Louisville, Mississippi, USA. 2020 December 08 11:15 UT, colongitude 188.1˚. 4 inch f/15 refractor telescope, 1.5 x barlow, IR block filter, ZWO ASI120MM/S camera. Seeing 8/10.*



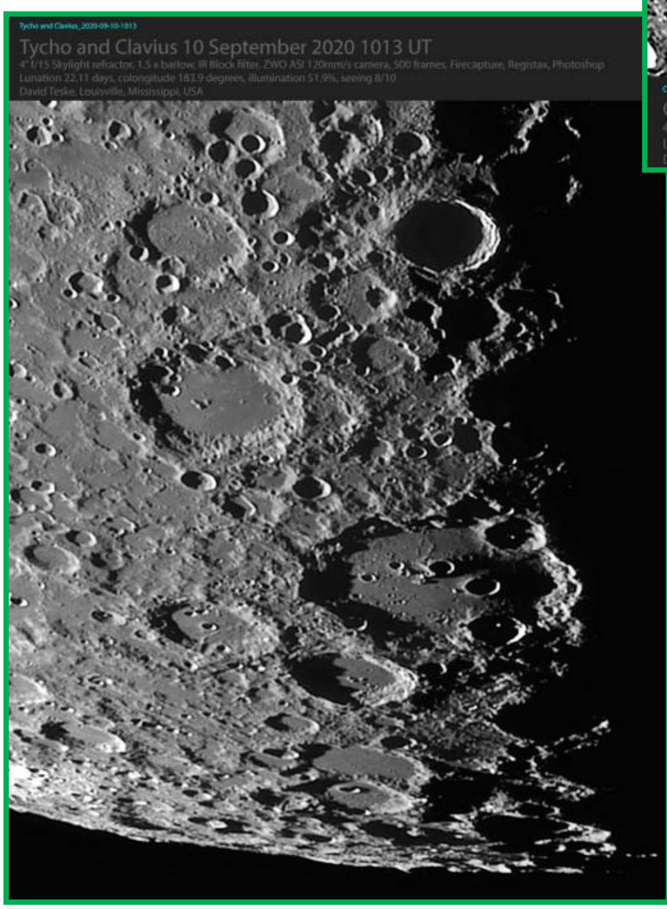


Image 64, Clavius, *David Teske, Louisville, Mississippi, USA. 2020 September 10 10:13 UT, colongitude 183.9˚. 4 inch f/15 refractor telescope, 1.5 x barlow, IR block filter, ZWO ASI120MM/S camera. Seeing 8/10.*

Focus On: Lunar Topographic Studies

Lunar Base Clavius

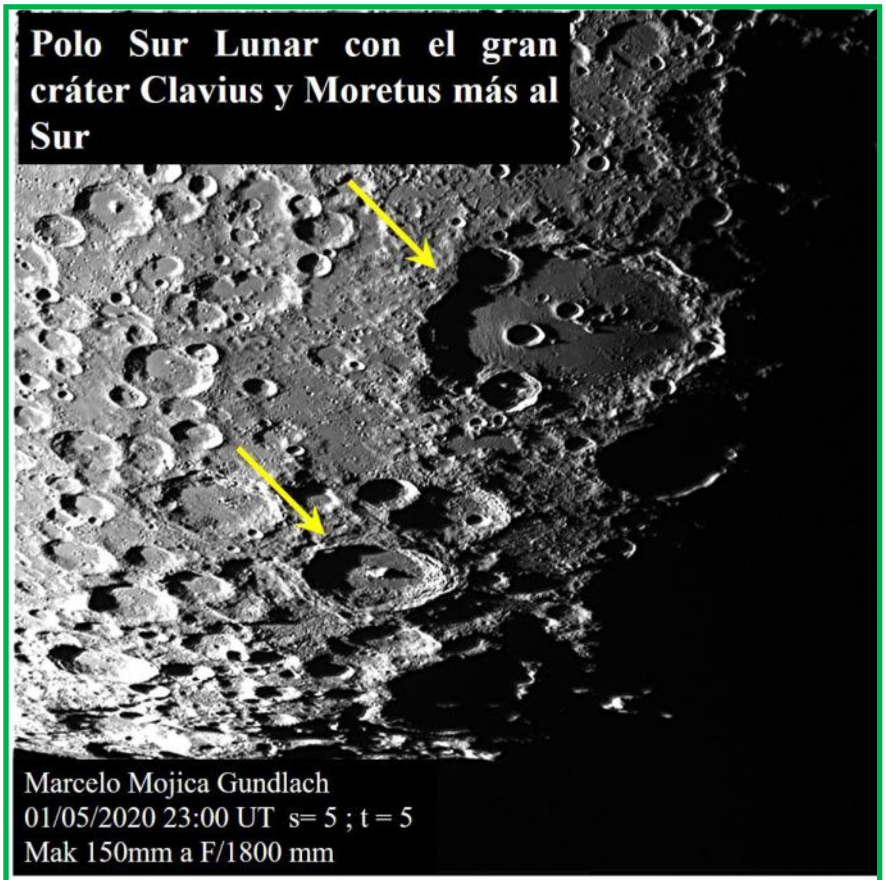


Image 65, Clavius, *Marcelo Mojica Gundlach, Cochabamba, Bolivia-LIADA. 2020 May 01 23:00 UT. 150 mm Maksutov -Cassegrain telescope. Seeing 5/10, transparency 5/6. North is up, west is to the right.*

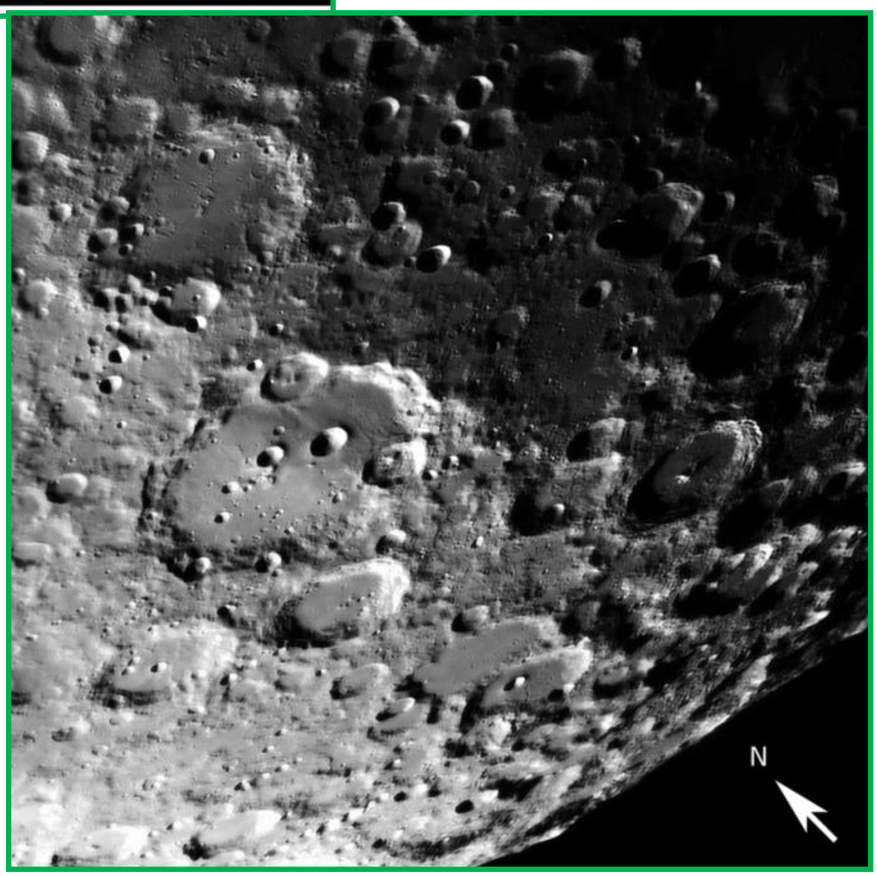


Image 66, Clavius, *Sanjin Kovacic, Zagreb, Croatia. 2024 September 24 00:03 UT, colongitude 162.53˚. 203 mm Cassegrain telescope, fl 2436 mm, 742 nm filter, ASI224MC camera. Seeing 7-8/10, transparency average.*

Focus On: Lunar Topographic Studies
Lunar Base Clavius

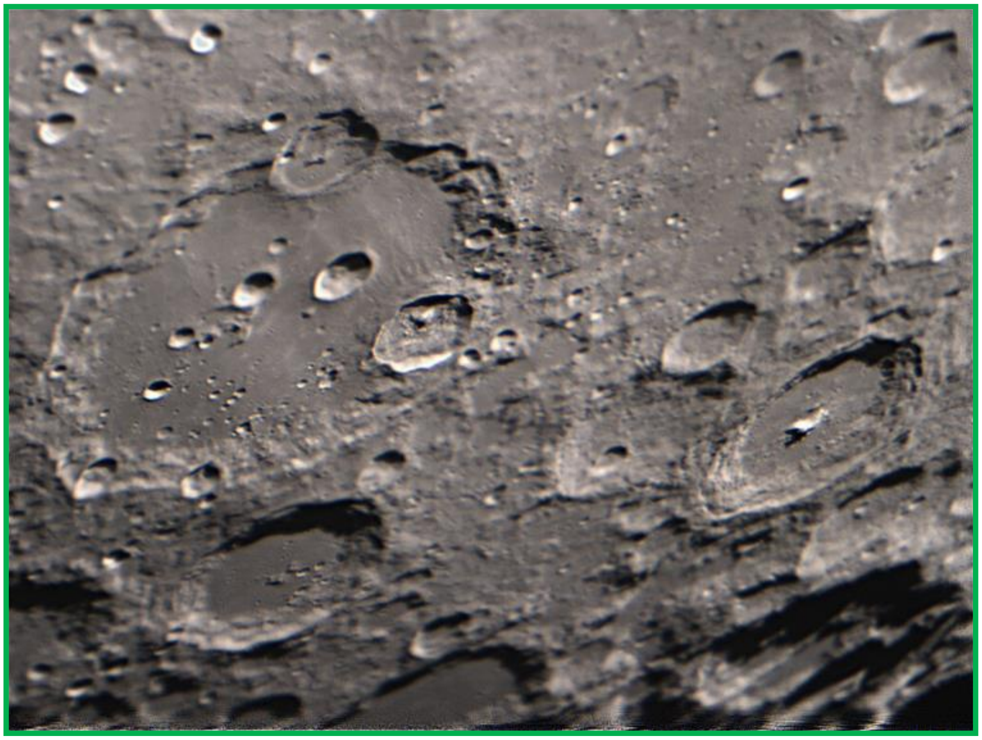


Image 67, Clavius, *Larry Todd, Dunedin, New Zealand. 2021 June 21 07:30 UT. OMC200 Maksutov-Cassegrain telescope.*

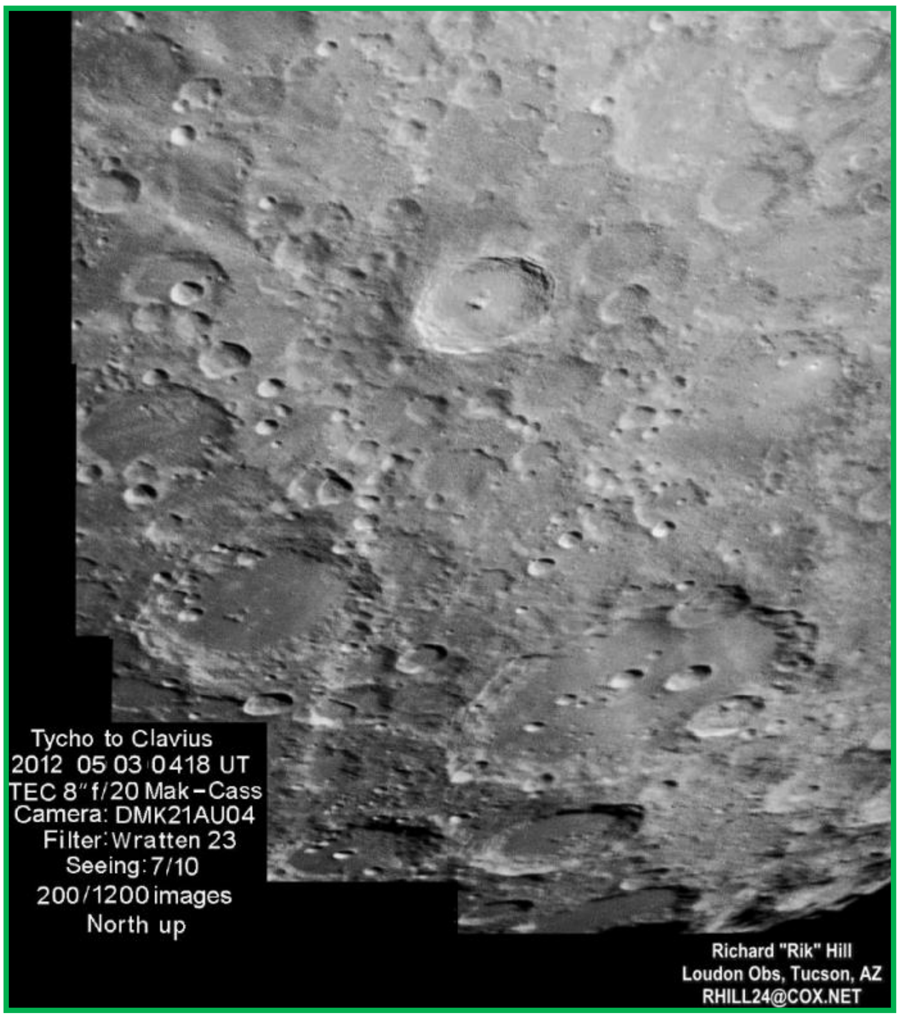


Image 68, Tycho to Clavius, *Richard Hill, Loudon Observatory, Tucson, Arizona, USA. 2012 May 03 04:18 UT. TEC 8 inch Maksutov-Cassegrain telescope, Wratten 23 filter, DMK21AU04 camera. Seeing 7/10.*

Focus On: Lunar Topographic Studies
Lunar Base Clavius

As if by magic, when the solar illumination is frontal, near the full Moon, Clavius almost disappears, buried by the bright rays of the nearby and much more geologically recent crater Tycho (**IMAGES 69 to 73**). In **IMAGE 74**, the bright rays of Tycho are not seen passing through Clavius, as in the previous ones, but the length of the bright rays and the proximity of Clavius are appreciated. In **IMAGES 75** to **78**, two rays of Tycho are clearly seen passing through Clavius in a quite obvious way: to the west of Clavius C a rather thick bright ray, with several filaments and to the east a ray that splits into two and passes through Porter, Clavius D and Rutherfurd from north to south.

Image 69, Tycho and Clavius*, Jairo Chavez, Popayán, Colombia. 2021 July 21 00:02 UT. 311 mm truss Dobsonian reflector telescope, MOTO E5 PLAY camera. North is to the right, west is up.*

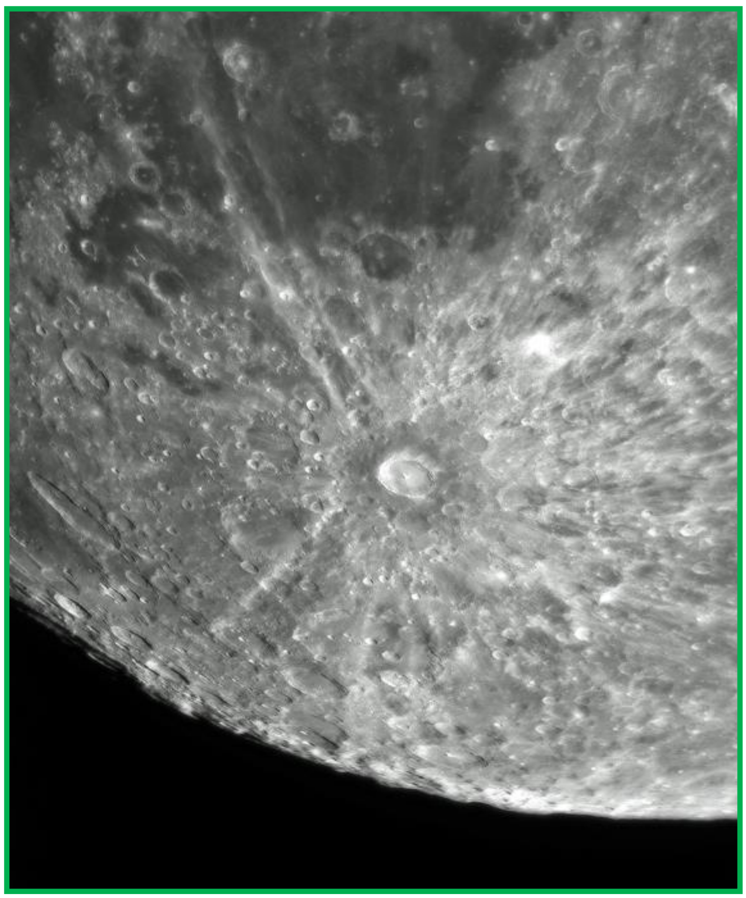
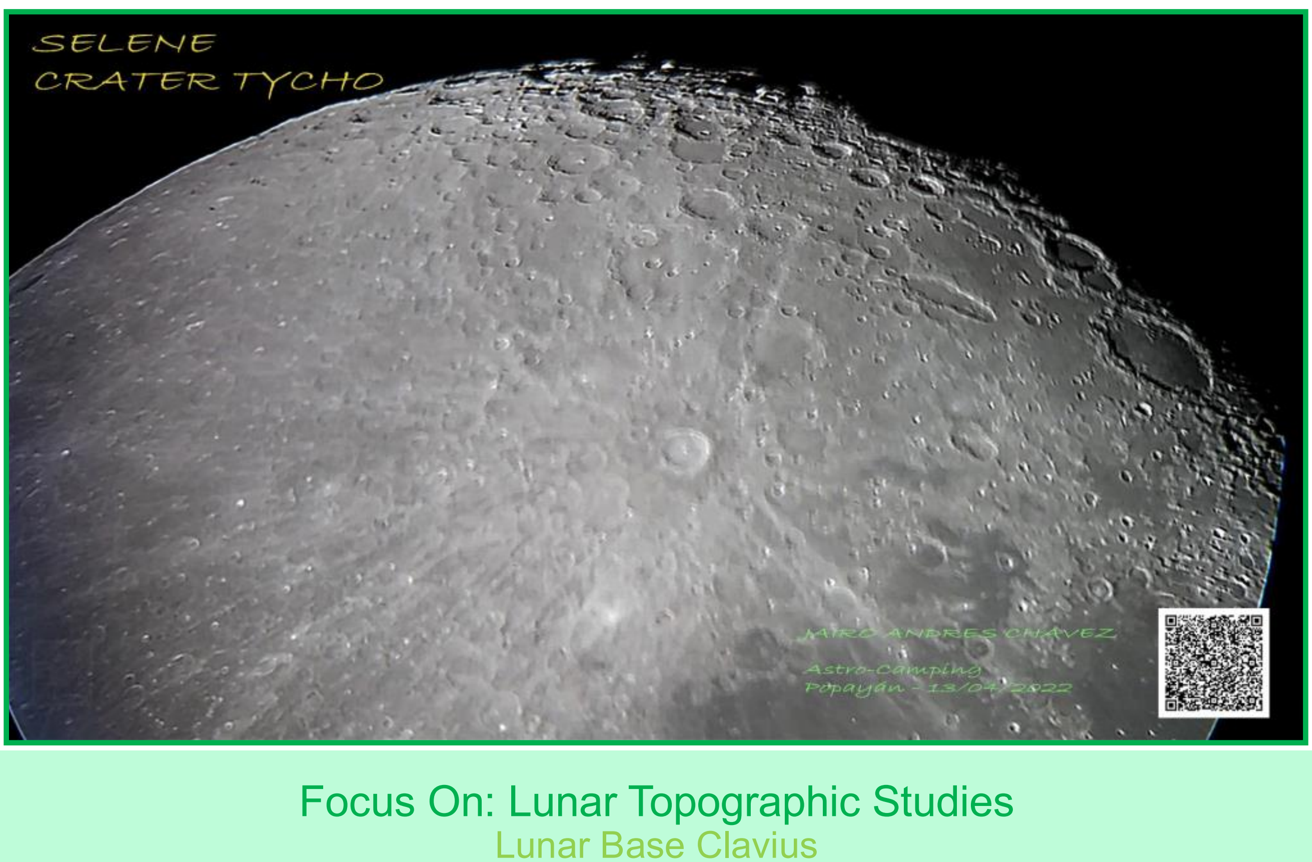


Image 70, Clavius*, Sergio Babino, Montevideo, Uruguay, SAO-LIADA. 2019 December 10 01:10 UT. 250 mm catadrioptic telescope, ZWO ASI174MM camera.*

***Image 71, Clavius**, Sergio Babino, Montevideo, Uruguay, SAO-LIADA. 2018 May 26 22:18 UT. 81 mm refractor telescope, Baader Moon and Skyglow filter, ZWO ASI174MM camera.*

***Image 72, Tycho, Jairo Chavez,** Popayán, Colombia. 2022 April 13 00:27 UT. 311 mm truss Dobsonian reflector telescope, MOTO E5 PLAY. North is down, west is to the right.*



Focus On: Lunar Topographic Studies
Lunar Base Clavius

__Image 73, Clavius,__ Ariel Cappelletti, Córdoba, Argentina, SLA. 2019 April 16 23:15 UT. 200 mm Newtonian reflector telescope, IR filter, ZWO ASI178MC camera.

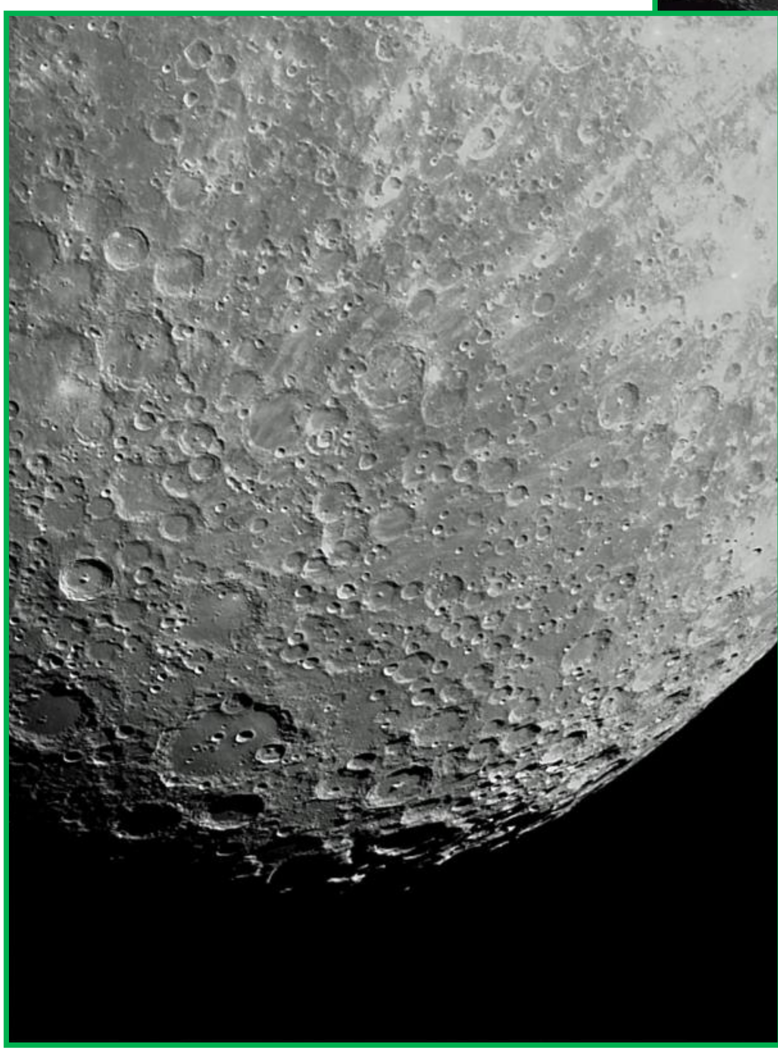


__Image 74, Clavius,__ Marcelo Mojica Gundlach, Cochabamba, Bolivia-LIADA. 2018 July 22 22:42 UT. 150 mm refractor telescope, Orion V block filter, SWO CMOS camera.

Focus On: Lunar Topographic Studies
Lunar Base Clavius

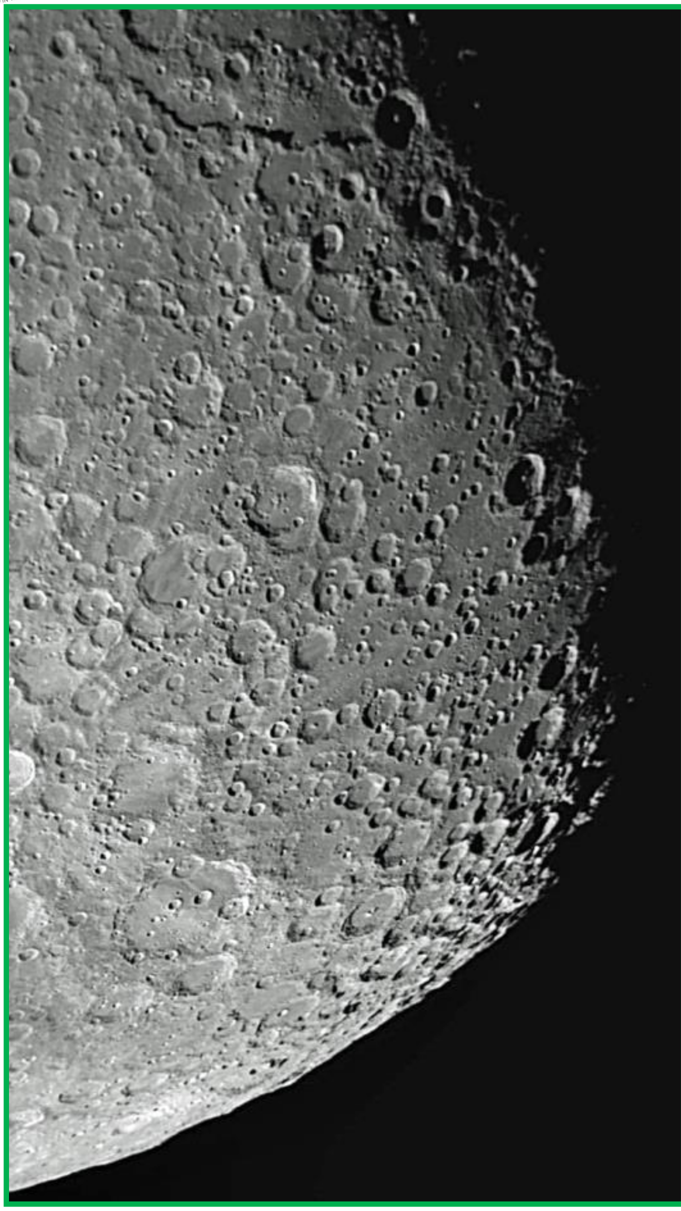


Image 75, Clavius, *Sergio Babino, Montevideo, Uruguay, SAO-LIADA. 2020 March 14 04:37 UT. 203 mm catadrioptic telescope, ZWO ASI174MM camera.*

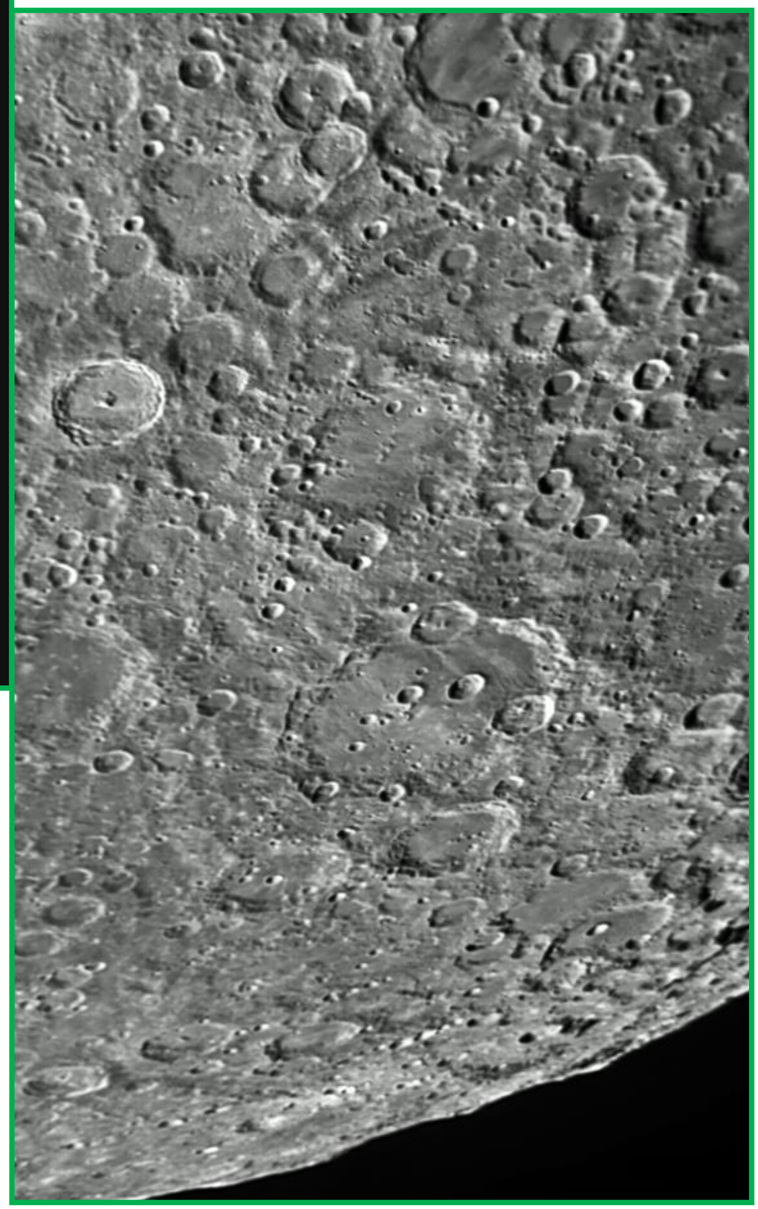
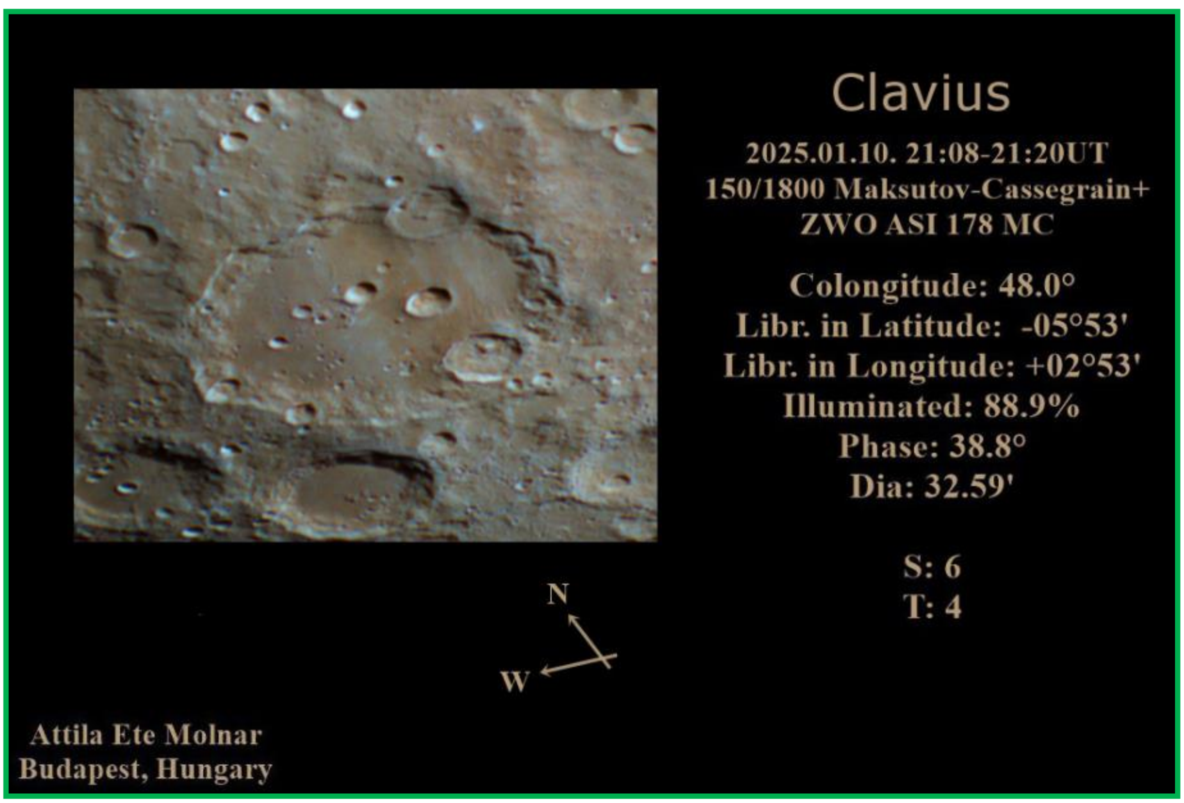


Image 76, Clavius, *Sergio Babino, Montevideo, Uruguay, SAO-LIADA. 2020 March 14 01:34 UT. 203 mm catadrioptic telescope, ZWO ASI174MM camera.*

Image 77, Tycho, *Raúl Roberto Podestá, Formosa, Argentina. 2024 September 15 22:46 UT. 127 mm Maksutov-Cassegrain telescope, UV/IR cut filter, ZWO ASI178MC camera.*

Image 78, Mineral distribution in Clavius, *Attila Ete Molnar, Budapest, Hungary. 2025 January 10 21:08-21:20 UT, colongitude 48.0˚. 150 mm Maksutov-Cassegrain telescope, 1800 mm focal length, ZWO ASI178MC camera. Seeing 6/10, transparency 4/6.*



Focus On: Lunar Topographic Studies

Lunar Base Clavius

In addition to all the incredible features of this crater (or basin), the discovery was recently added, published in the journal Nature Astronomy in October 2020, of the existence of molecular water near Clavius, at concentrations of up to 412 parts per million. The discovery greatly expanded the prospects of having the most important resource of all on our satellite for future in situ activities. There isn't much water in the vicinity of Clavius (it is estimated that there is 100 times more water in the Sahara), but it is not that little either, especially if we consider that 50 or 60 years ago it was thought that there was no water on the Moon and today it turns out that it could even exist in the least propitious places and not only in places in permanent shadows. It is very interesting that this crucial discovery was made not from lunar orbit but from the Earth's atmosphere, in NASA's Stratospheric Observatory for Infrared Astronomy (SOFIA), a modified Boeing 747SP aircraft.

Speaking of water, necessary for future lunar bases, the place where SOFIA made its discovery could not be more evocative. The name of this authentic underground world will evoke memories of "2001: A Space Odyssey" among fans of Stanley Kubrick and Arthur C. Clarke films, as it was the location of "Clavius Base", the place where the protagonist arrives and from which he will begin the lunar journey that will start the plot of the story, searching for the magnetic anomaly that will be a monolith of unknown origin. Where do you think Clavius Base could be located in IMAGE 79?

In Clarke's novel, "Clavius Base" is man's first step on the Moon, it is a self-sufficient system. In Clarke's novel, "Clavius Base" is man's first step on the Moon, it is a self-sufficient system: "The Base was a closed system, like a tiny working model of Earth itself, recycling all the chemicals of life. The atmosphere was purified in a vast "hothouse" - a large, circular room buried just below the lunar surface". Its population was 1700 people "all highly trained scientists or technicians, carefully selected before they had left Earth. Though lunar living was now virtually free from the hardships, disadvantages, and occasional dangers of the early days, it was still psychologically demanding, and not recommended for anyone suffering from claustrophobia", who lived in "a large underground base out of solid rock or compacted lava, the standard one-man "living module" was a room only about six feet wide, ten feet long, and eight feet high". A hard and difficult life, but with a purpose: "With its complex of workshops, offices, storerooms, computer center, generators, garage, kitchen,laboratories, and food-processing plant, Clavius Base was a miniature world in itself (…) Any man who had ever worked in a hardened missile site would have felt at home in Clavius. Here on the Moon were the same arts and hardware of underground living, and of protection against a hostile environment; but here they had been turned to the purposes of peace".

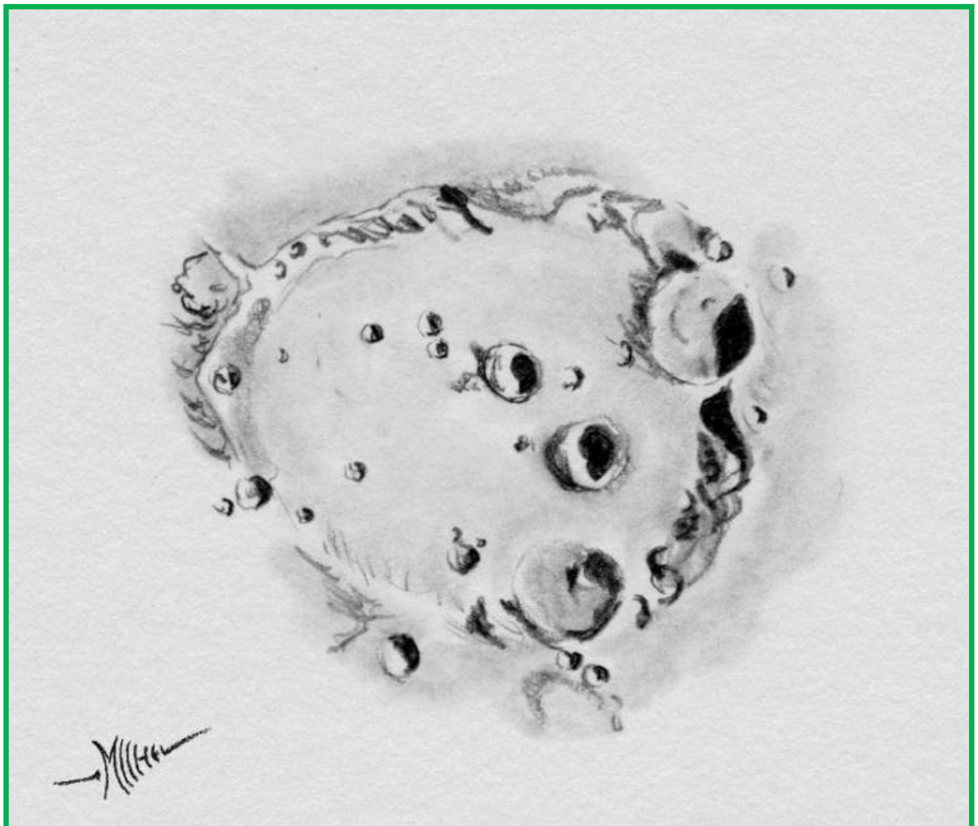


***Image 79, Clavius**, Michel Deconinck, Rocbaron, France. 2013 August 16 19:00 UT. Bresser 100 mm f/9 refractor telescope, 10 mm eyepiece, 90x*

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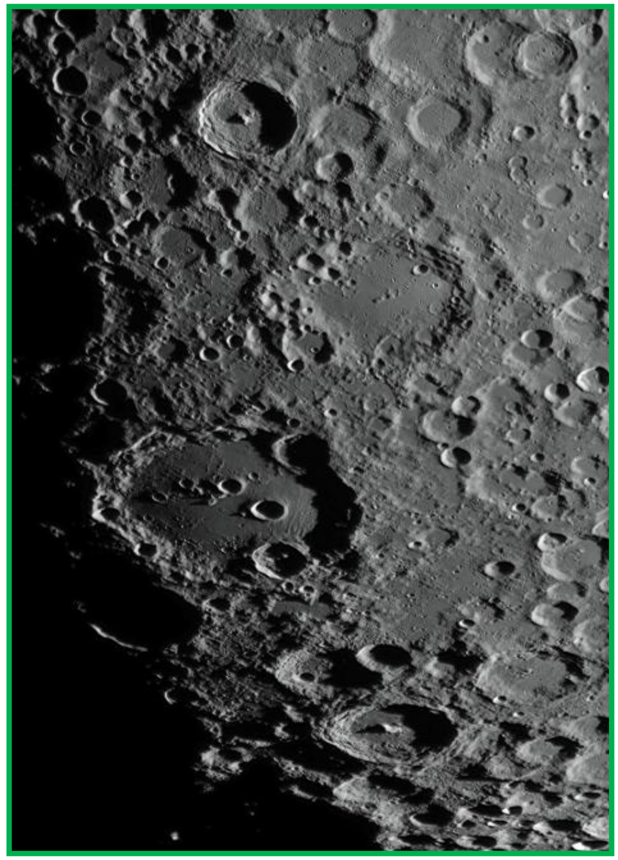
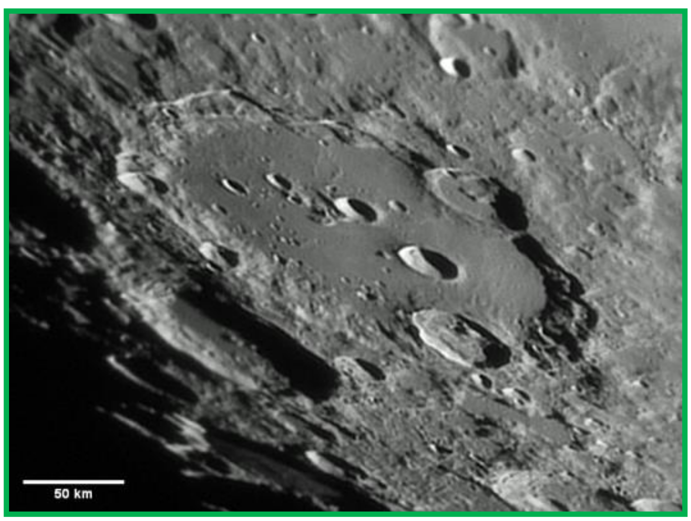
Clavius, *Marcelo Mojica Gundlach, Cochabamba, Bolivia-LIADA. 2019 May 14 05:02 UT. 150 mm refractor telescope, ZWO ASI120 camera.*



Clavius, *Desireé Godoy, Oro Verde, Argentina, SLA_LIDA. 2016 September 10 23:15 UT. Celestron Edge HD 11 inch Schmidt-Cassegrain telescope, QHY5-II camera.*



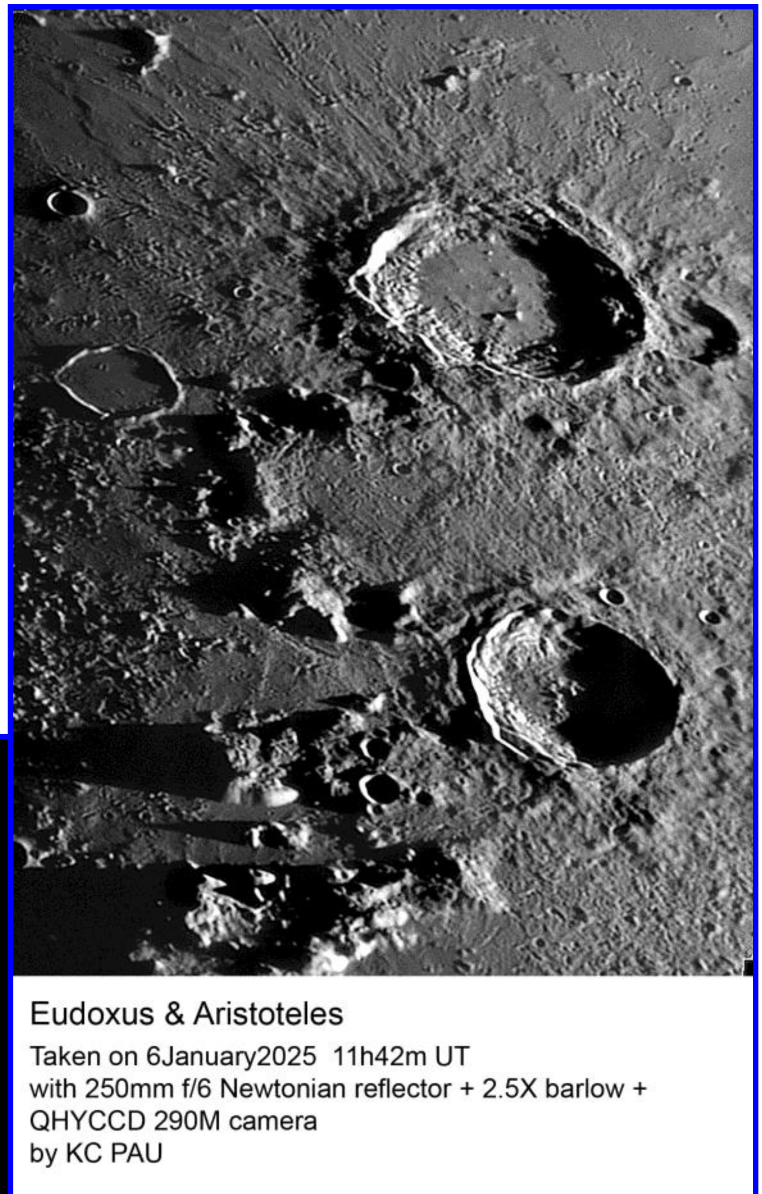
Clavius, *Ariel Cappelletti, Córdoba, Argentina, SLA. 2020 October 26 23:42 UT. 254 mm Newtonian reflector telescope, QHY5III 462C camera.*

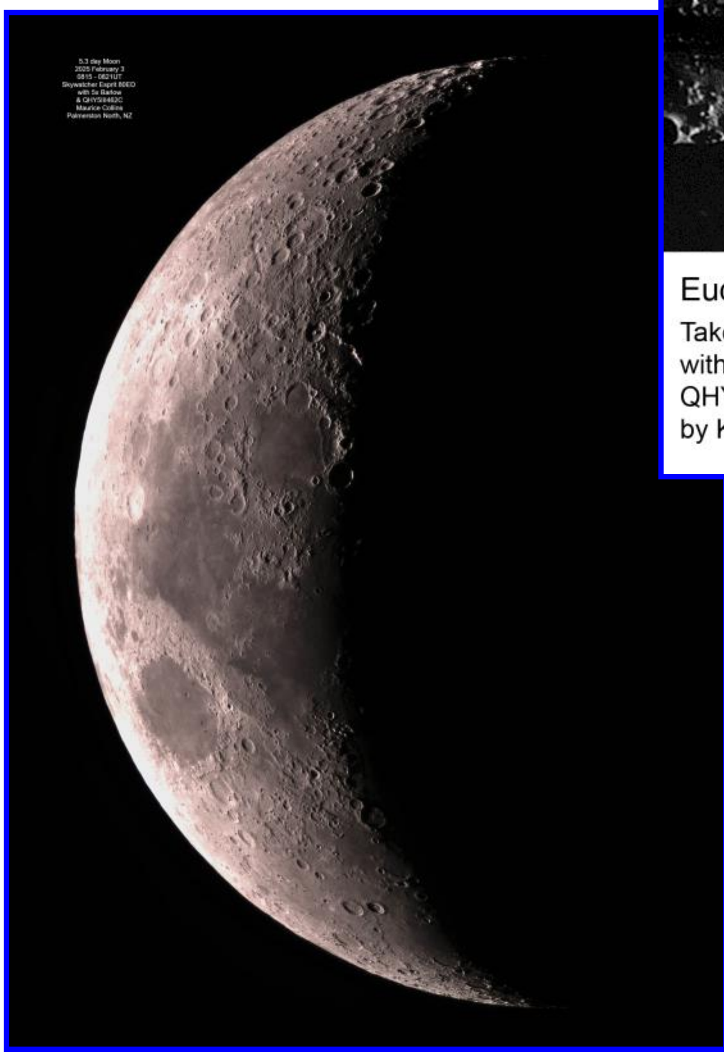
4.4 Day-Old-Moon, *Maurice Collins, Palmerston North, New Zealand. 2025 February 02 08:17. 80 mm Sky-Watcher Espirit ED refractor telescope, QHY5III462C camera. North is down, west is right.*

Stöfler, *KC Pau, Hong Kong, China. 2025 January 06 12:01UT. 250 mm f/6 Newtonian reflector telescope, 2.5x barlow, QHYCCD290M camera.*

Recent Topographic Studies

Eudoxus and Aristoteles, *KC Pau, Hong Kong, China. 2025 January 06 11:42 UT. 250 mm f/6 Newtonian reflector telescope, 2.5x barlow, QHYCCD290M camera.*





5.3 Day-Old-Moon, *Maurice Collins, Palmerston North, New Zealand. 2025 February 03 08:15-08:21 UT. 80 mm SkyWatcher Espirit ED refractor telescope, 5x barlow, QHY5III462C camera. Very good seeing conditions, for a change! North is down, west is right.*

Recent Topographic Studies

Clavius, *Gonzalo Vega, Oro Verde, Argentina, AEA. 2025 February 07 01:26 UT. 200 mm Newtonian reflector telescope, 1000 mm focal length, UV/IR filter, 2.5x barlow, Player One cc camera.*

***Copernicus**, Fernando Surá, San Nicolás de los Arroyos, Argentina, SLA-LIADA. 2025 February 10 00:41 UT. 127 mm Maksutov-Cassegrain telescope, NEXIMAGE 5 camera.*

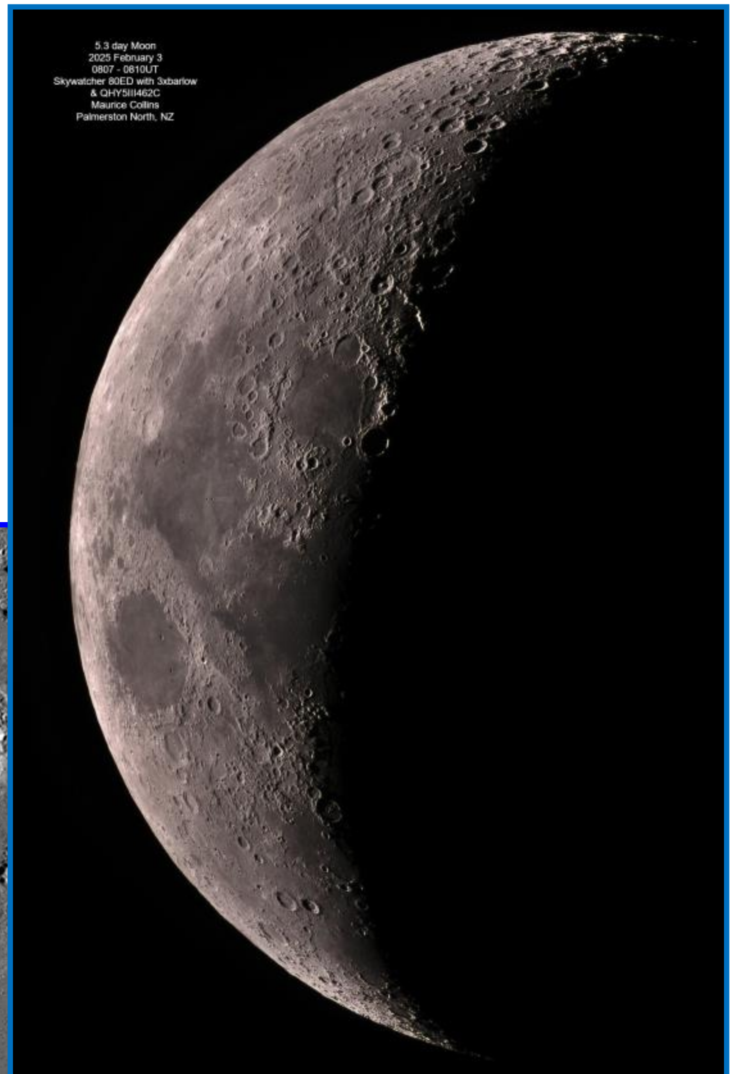
Recent Topographic Studies

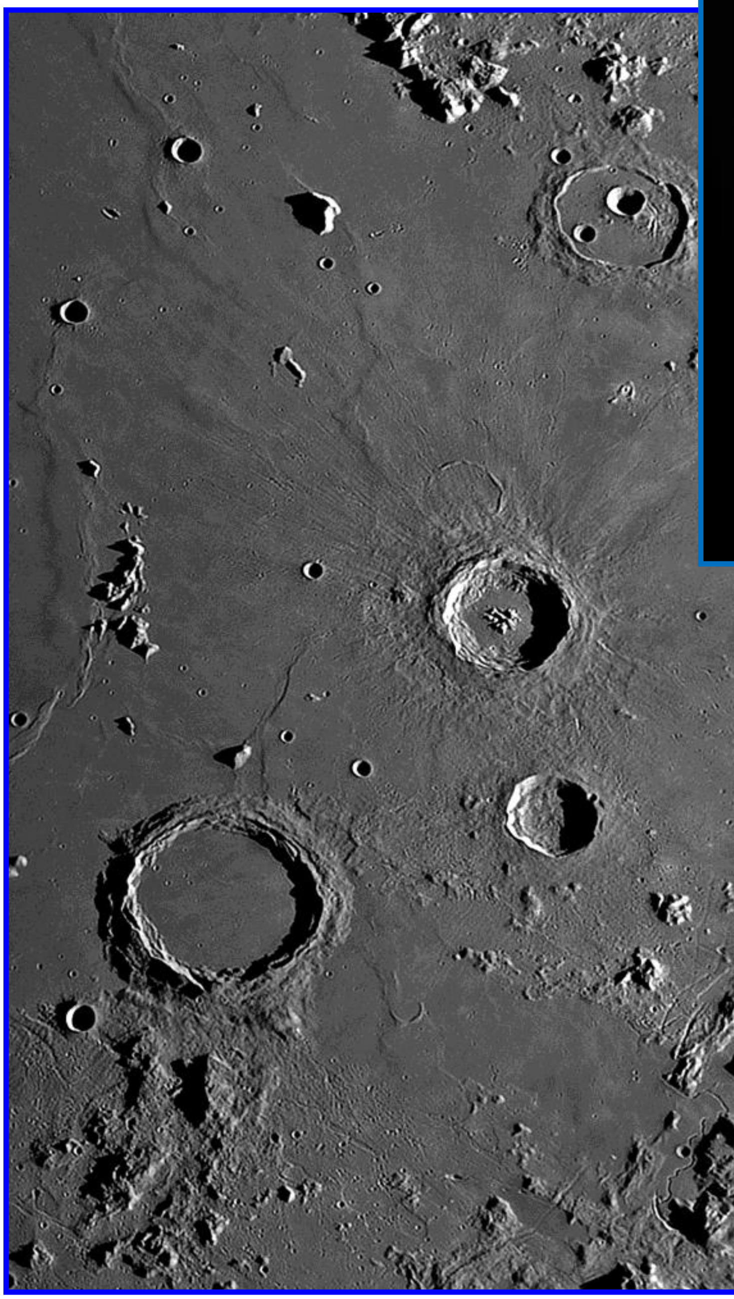
Theophilus, *Maurice Collins, Palmerston North, New Zealand. 2025 February 03 08:22 UT. 80 mm SkyWatcher Espirit ED refractor telescope, 5x barlow, QHY5III462C camera. Very good seeing conditions, for a change!*

Plato, *Gonzalo Vega, Oro Verde, Argentina, AEA. 2025 February 07 01:30 UT. 200 mm Newtonian reflector telescope, 1000 mm focal length, UV/IR filter, 2.5x barlow, Player One cc camera.*

Recent Topographic Studies

5.3 Day-Old-Moon, *Maurice Collins, Palmerston North, New Zealand. 2025 February 03 08:07-08:10 UT. 80 mm SkyWatcher Espirit ED refractor telescope, 3x barlow, QHY5III462C camera. North is down, west is right.*





Aristillus and Eastern Mare Imbrium, *KC Pau, Hong Kong, China. 2019 February 13 12:28 UT. 250 mm f/6 Newtonian reflector telescope, 2.5x barlow, QHY-CCD290M camera.*

Recent Topographic Studies

Plato, *Gonzalo Vega, Oro Verde, Argentina, AEA. 2025 February 07 23:47 UT. 200 mm Newtonian reflector telescope, 1000 mm focal length, UV/IR filter, Player One cc camera.*

Waxing Gibbous Moon, *Jaun Carlos Dovis, Sunchales, Argentina. 2025 February 08 00:44 UT. 4.5 inch Newtonian reflector telescope, Canon EOS Rebel T7 camera. North is down, west is right.*

Recent Topographic Studies

10.4 Day-Old-Moon, *Maurice Collins, Palmerston North, New Zealand. 2025 February 08 08:50-08:54 UT. 80 mm SkyWatcher Espirit ED refractor telescope, 5x barlow, QHY5III462C camera. North is down, west is right.*

Copernicus, *Gonzalo Vega, Oro Verde, Argentina, AEA. 2025 February 08 01:08 UT. 200 mm Newtonian reflector telescope, 1000 mm focal length, UV/IR filter, Player One cc camera.*

Recent Topographic Studies

Tycho, *Gonzalo Vega, Oro Verde, Argentina, AEA. 2025 February 08 01:56 UT. 200 mm Newtonian reflector telescope, 1000 mm focal length, UV/IR filter, Player One cc camera.*

Mineral distribution in Plato, *Attila Ete Molnar, Budapest, Hungary. 2025 January 10 21:08-21:20 UT, colongitude 48.0˚. 150 mm Maksutov-Cassegrain telescope, 1800 mm focal length, ZWO ASI178MC camera. Seeing 6/10, transparency 4/6.*

Recent Topographic Studies

11.4 Day-Old-Moon, *Maurice Collins, Palmerston North, New Zealand. 2025 February 09 08:53-08:55 UT. 80 mm SkyWatcher Espirit ED refractor telescope, 2.5x barlow, QHY5III462C camera. North is down, west is right.*

Recent Topographic Studies

***Gassendi**, Fernando Surá, San Nicolás de los Arroyos, Argentina, SLA-LIADA. 2025 February 10 00:41 UT. 127 mm Maksutov-Cassegrain telescope, NEXIMAGE 5 camera.*

***Waxing Gibbous Moon,** Jaun Carlos Dovis, Sunchales, Argentina. 2025 February 06 03:10 UT. 4.5 inch Newtonian reflector telescope, Canon EOS Rebel T7 camera.*

Recent Topographic Studies

Lunar Geologic Change Detection Program

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

2025 March

News: On 2025 Mar 02 UT 09:34UT Blue Ghost Mission 1 will land in Mare Crisium. Details can be found on: https://fireflyspace.com/news/blue-ghost-mission-1-live-updates/ and lice streaming will be available on the YouTube link on https://fireflyspace.com/missions/blue-ghost-mission-1/ . It is doubtful that we could video anything through Earth-based telescopes, but as it is close to sunrise, there is always a remote chance that one might be able to detect sunlight scattered off dust clouds blasted off the surface during the landing phase, especially if these are seen above dark shadowed areas. So why not have a go at imaging Mare Crisium, in particular near Mons Latreille, just east of the center of the mare.

On 2025 Mar 14 there will be a total lunar eclipse. It will be best seen from the Americas, and from Europe it only the umbral stage before totality will be visible, except for parts of totality close to moonset as seen from western extremities of Europe. The Penumbral contact (P1) starts at 03:57UT and you might notice a very faint, slightly yellow, tint the Moon. Then the dark umbral shadow encroaches (U1) the Moon at 05:09UT and will be plainly visible spreading across the Moon from the SW to NE of the disk. The total eclipse begins (U2) at 06:26UT. The middle of the eclipse is at 06:59UT. Then the Moon begins to leave the umbra (U3) at 07:31UT, with the last remaining umbral shadow (U4) at 08:48UT. Then finally the Moon exits the faint penumbral shadow (P4) at 10:01UT. Please monitor the umbral shadow with video for lunar impact flashes.

TLP Reports: Upon re-examination of an archive video from March and a new Video from Dec 2024 the Italian UAI Lunar Section reports two candidate impact flashes. Unfortunately these have yet to be confirmed so they need your help. If you were videoing the Moon at these times please check: a flash videoed on 2024 May 12 UT 20:14:05, observed by Luigi Zanatta, with the flash located in western Sinus Medii. The second was recorded on 2024 Dec 06 UT 17:13:53 also by Luigi Zanatta, with the flash located not far from Plato.

Additional Routine reports received for December included: Valerio Fontani (Italy – UAI) imaged Herodotus, Eugino Polito (UAI – Italy) imaged: Plato. Aldo Tonon (Italy – UAI) imaged: Herodotus.

Analysis of Reports Received (December): Note that time constraints imposed on the author don't allow us to do any analysis in full this time, so please just take a look at the images and the reports and make your own judgement as to whether what happened in the past and was regarded as a TLP is recurring under these repeat illumination windows or was something unique that was seen.

Herodotus: On 2024 Dec 12 Valerio Fontani and Aldo Tonon respectively imaged this crater under similar illumination to the following two reports:

On 2002 Feb 24 UT 06:05-06:20 W. Haas (Las Cruces, NM, USA) observed that the shadow was, almost, but not completely black. This might have been related to the observing conditions. ALPO/BAA weight=2.

On 2016 Jun 17 UT 05:00 A. Anunziato (AEA, Argentina Meade ETX 105, seeing 7/10, sketch made) observed a very tiny light spot where the shadow from topographic relief to the south of Vallis Schroteri merges into the crater rim shadow on the floor of Herodotus. There should be no light spot here. ALPO/BAA weight=1.

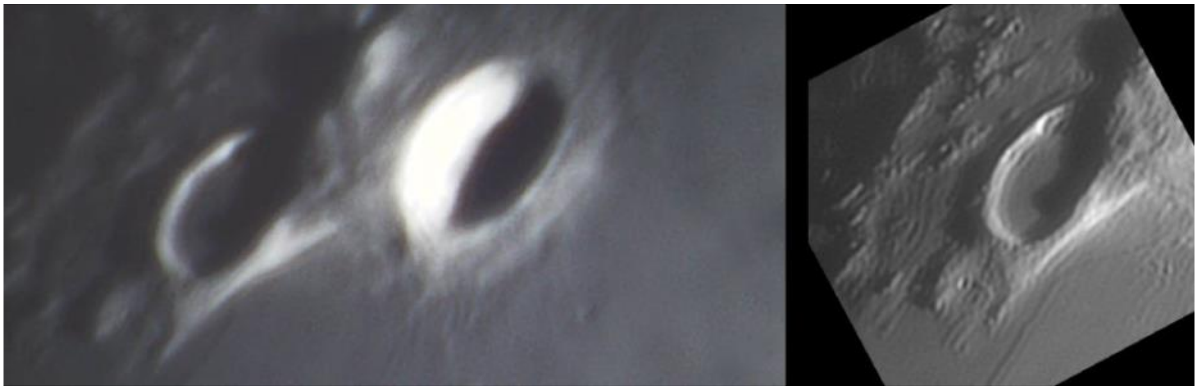


Figure 1. *Herodotus from 2024 Dec 12 with north towards the top.* ***(Left)*** *An image by Valerio Fontani at 16:47 which matches the illumination of the 2002 TLP.* ***(Right)*** *An image by Aldo Tonon taken at 20:43 UT which matches the illumination of the 2016 TLP.*

Plato: On 2024 Dec 14 UT 16:55 Eugino Polito imaged this crater for the following Lunar Schedule request:

BAA Request: Two observers have reported colour on the rim around this colongitude, once in 1938, and again in 2013. Please take a look and report what you see, and where on the rim. Please send any high resolution images, detailed sketches, or visual descriptions to: a t c @ a b e r . a c. u k .

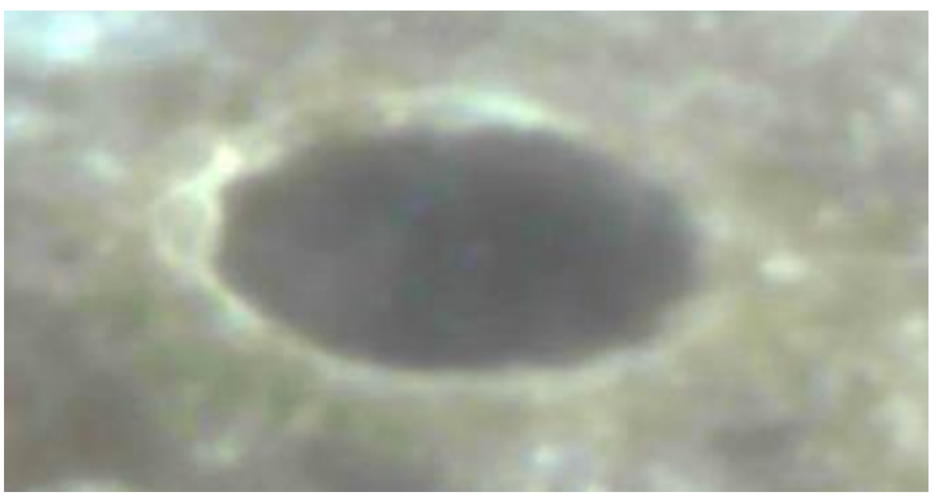


Figure 2. *Plato on 2024 Dec 24 at 16:55UT with north towards the top and colour saturation increased.*

Routine reports received for January included: Alberto Anunziato (SLA – Argentina) observed: Aristarchus, Gassendi, Peirescius and Proclus. Maurice Collins (ALPO/BAA/RASNZ) imaged the whole Moon. Tony Cook (Newtown, Wales – BAA): videoed the Moon in polarized light and in the H band in the SWIR. James Dawson (BAA – Nottingham) imaged: Clausius, Gassendi, Letronne, Plato and Schiller. Walter Elias (AEA – Argentina) imaged: Archimedes, Aristarchus, Censorinus, Gassendi, and Proclus. Chris Longthorn (BAA) imaged: Alphonsus, Cassini, Censorinus, Manilius, Vallis Alpes and several features. Trevor Smith (BAA - Codnor, UK) observed: Aristarchus, Copernicus, Mare Crisium, Mons Piton, Plato and Promontorium Laplace. Bob Stuart (BAA – Wales) imaged: Apollonius, Atlas, Bela, Boussingault, Casatus, Cleomedes, de la Rue, Furnerius, Galle, Langrenus, Manzinus, Mare Crisium, Mercurius, Mutus, Petavius, Rosenberger, Sheepshanks, Vendelinus, Watt, Yoshi, Zach and several features. Aldo Tonon (UAI - Italy) imaged: Cyrillus and Mons Vinograd. A. Vandenbohde (BAA) imaged: Clavius, Moretus, and Schiller.

Analysis of Reports Received (January): Note that time constraints imposed on the author don't allow us to do any analysis in full this time, so please just take a look at the images and the reports and make your own judgement as to whether what happened in the past and was regarded as a TLP is recurring under these repeat illumination windows or was something unique that was seen.

Lyell: On 2025 Jan 04 UT 08:09-08:13 Maurice Collins imaged the Moon under similar illumination to the following report:

Lyell 1972 Nov 10 UTC 23:43 Observed by Bartlett (Baltimore, MD, USA, 3" refractor x54, x100, x200S=3, T=5) "At apparent centre of floor & edge of morning shadow an elongated, N-S irreg. obj. dull whitish-gray, albedo=4 like a c.p. (photo in Kwasan atlas in 1963 taken at col. 339.3 deg has a faint suggestion of a bright spot in that place- (plate 20) LO IV66 h2 & 73 H2, sun elev. @ 20deg show an even, dark floor with a very small crater right in centre -- unresolvable at earth. Kwasan photo's spot could be an artifact" NASA catalog weight=3. NASA catalog ID #1349. ALPO/BAA weight=2.

Figure 3. *Lyell on 2024 Dec 24 UT 08:09-08:13 the Lyell area, from a larger mosaic, as imaged by Maurice Collins (ALPO/BAA/RASNZ) and orientated with north towards the top. Lyell is located just left of the image centre here.*

Birt: On 2025 Jan 07 UT 18:07 Chris Longthorn (BAA), imaged Alphonsus, but the image included part of Birt under similar illumination to the following report:

2004 Dec 20 UT 02:51-03:26 R. Gray (Winumma, USA) noted that the crater had exceptional brightness to nimbus surrounding it. ALPO/BAA weight=1.

Figure 4. *The eastern edge of Birt, with part of the nimbus area (lower left edge of image), on 2024 Jan 07 UT 18:07 as imaged by Chris Longthorn and orientated with north towards the top.*

Mons Piton: On 2025 Jan 09 UT 21:00-21:52 Trevor Smith (BAA) observed visually this mountain under similar illumination to the following report:

Piton 1969 Nov 19 UT 21:15-22:00 Observed by Baum (England, 4.5" refractor) "Traces of cloudiness on E. slope at 2115h. Increased at 2150h in extent & brightness. Spread onto plain. Summit & shadow in W. part sharp & clear. (Apollo 12 watch)."NASA catalog weight=2. NASA catalog ID #1221. ALPO/BAA weight=2.

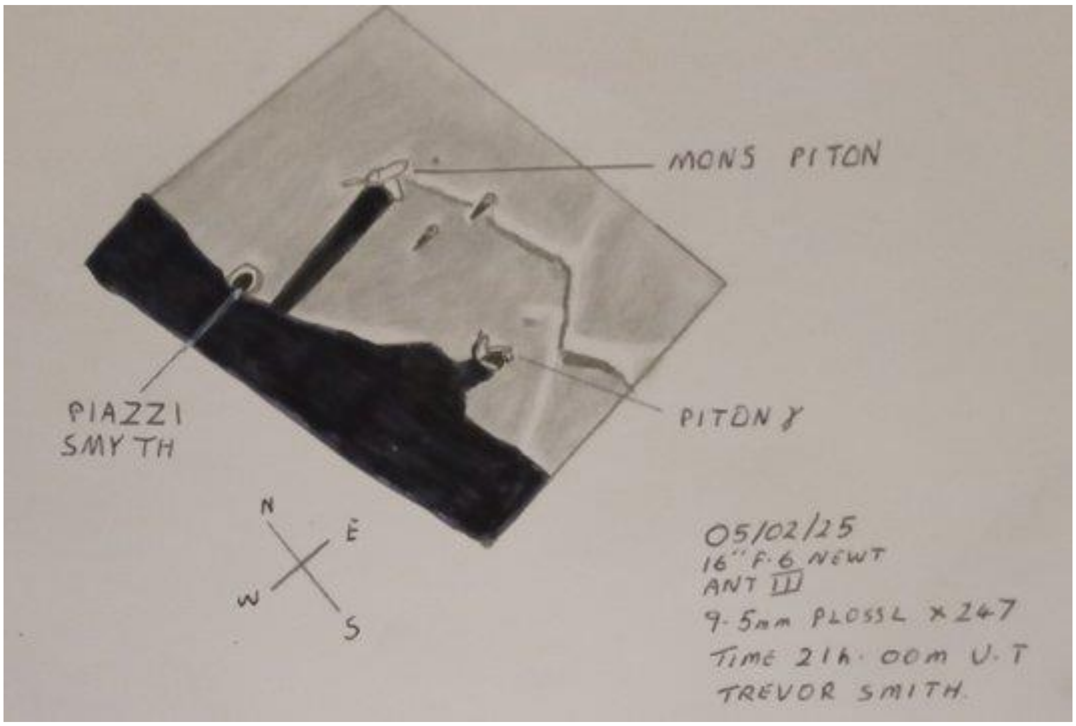


***Figure 5** Mons Piton as sketched by Trevor Smith BAA – see image for details*

Trevor commented "I looked and found Mons Piton in my estimate to be very slightly fainter than Proclus. Piton was bright but no brighter than is usual at this stage of illumination. Piton had a long narrow Black Shadow Spire to its western edge reaching all the way to the terminator. Its north, south and eastern edges were bright and not in shadow as stated in Marshall's report! To me everything looked normal! No false colour or obscuration was seen"

Plato: On 2025 Jan 10 UT 17:39 James Dawson (BAA) imaged Plato under similar illumination to the following report:

Plato 1980 May 25 UT 21:33-22:54 Observed by North (Seaford, UK, seeing III-IV, 460mm Newtonian) Definite strong reddish glow along NNW border, definitely much stronger than spurious colouration and always visible when telescope moved in RA and Dec to eliminate possible chromatic aberration effects in the eyepiece. Effect ended by 21:54 UT. BAA Lunar Section Report. ALPO/BAA weight=2

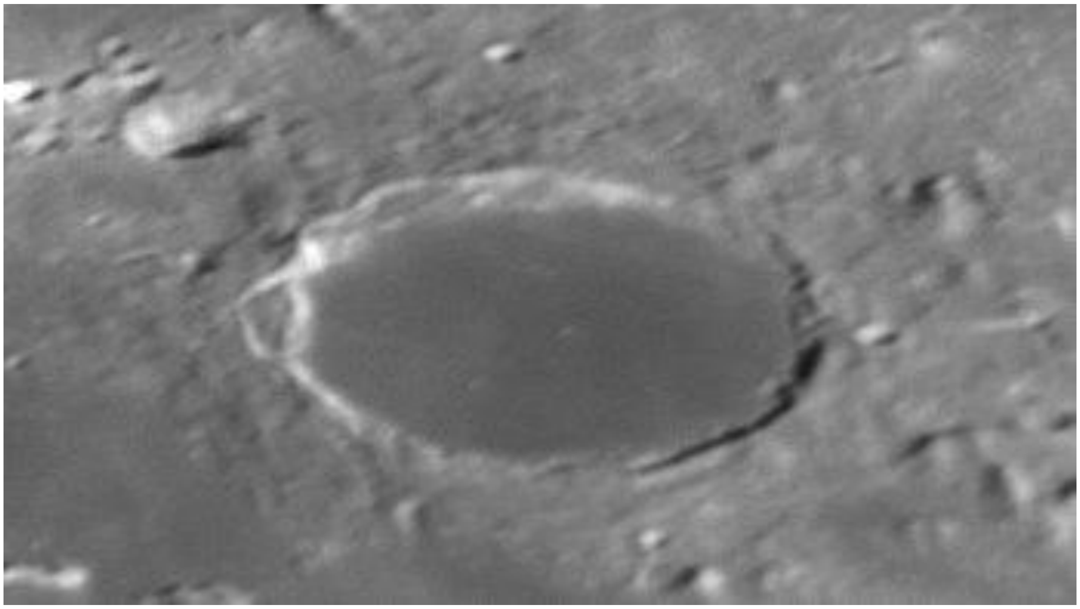


Figure 6 *Plato as imaged by James Dawson (BAA) on 2025 Jan 10 UT 17:39 and orientated with north towards the top.*

Proclus: On 2025 Jan 14 UT 04:24 Walter Elias (AEA) imaged this crater under similar illumination to the following report:

Proclus 1972 Nov 20 UT 20:20 Observed by Farrant (Cambridge, England, 8.5" reflector, x178) "Dark patch in crater. Disappeared by next nite. The normal ring seemed thickened. On Dec. 7. the crater appeared bright. Drawings. (prob. real LTP, nr. FM)" NASA catalog weight=3. NASA catalog ID #1350.

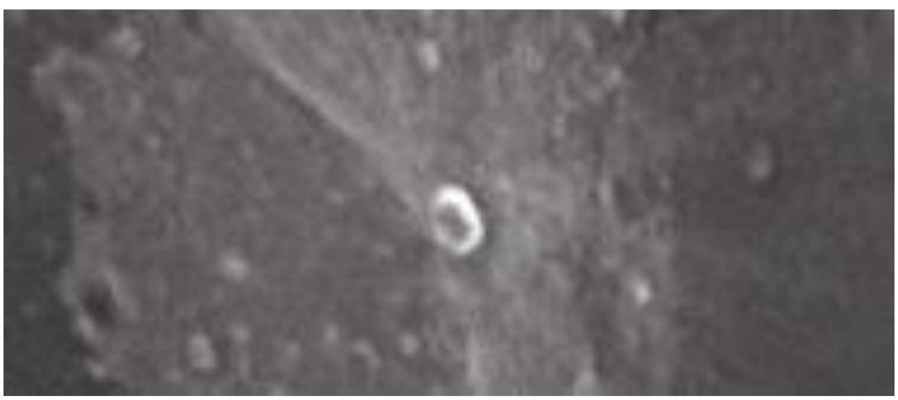


Figure 7 *Proclus as imaged by Walter Elias (AEA) on 2025 Jan 14 UT 04:24 and orientated with north towards the top.*

Cleomedes A: On 2025 Jan 15 UT 00:02 Bub Stuart (BAA) imaged Cleomedes under similar illumination to the following report:

On 1993 Sep 02 UT2250-23:30 C. Brook (Plymouth, UK, 70mm refractor, x100, seeing=III) noted that Cleomedes A was exceptionally bright and compared it with plate 4C in Henry Hatfield's Atlas. He had noticed it was bright earlier in the evening, but his attention was drawn to it at 22:50UT. By 23:07UT it was dimmer, with patches of cloud coming up and a slight deterioration in seeing. By 22:30 UT the crater was no longer exceptionally bright. The Cameron 2006 catalog ID=466 and weight=5. The ALPO/BAA weight=1.

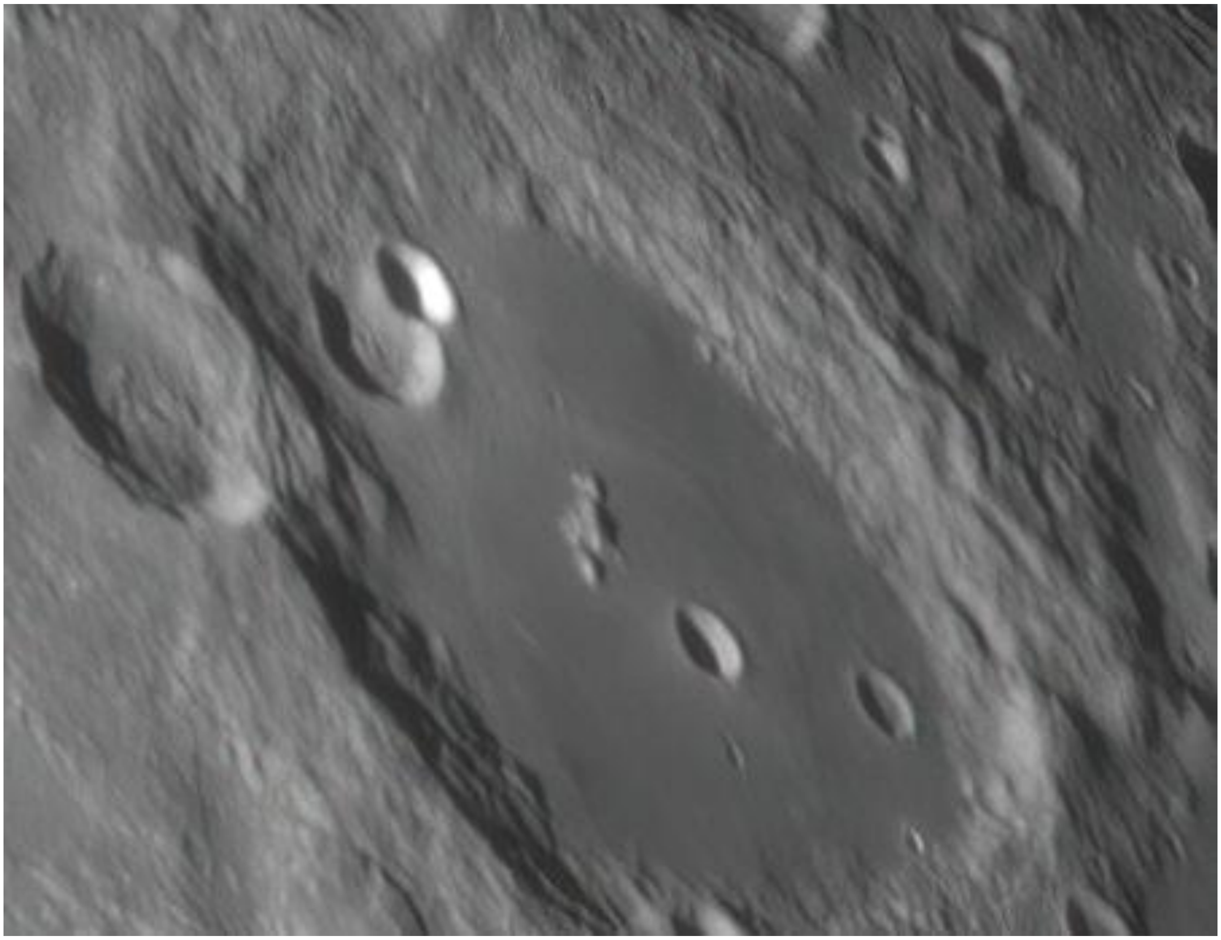


Figure 8 *Cleomedes as imaged by Bob Stuart (BAA) on 2025 Jan 15 UT 00:02 and orientated with north towards the top. Cleomedes A is near the top of the floor of the crater.*

Mons Vinogradov: On 2025 Jan 17 UT 23:33 Aldo Tonon (UAI) imaged this area under similar illumination to the following report:

On 2006 Jan 16 at 05:44UT T. Bakowski (Orchard Park, NY, USA) observed a round dark object in 1 of 21 frames from a camera. The exposure was 1/250th sec. Seeing conditions were bad. The dark spot is east of Mons Vinogradov, at or near crater J. ALPO/BAA weight=1.

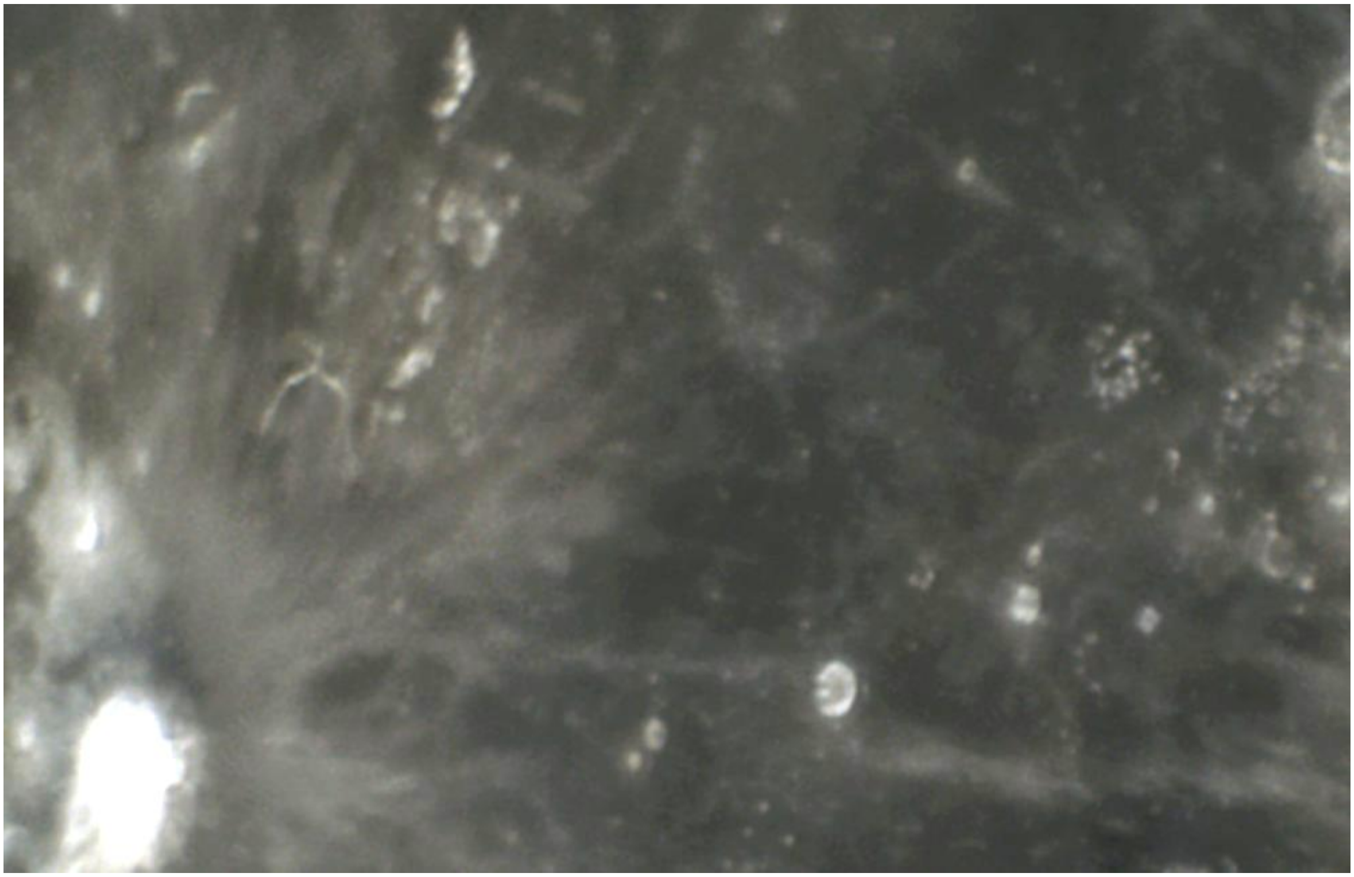


Figure 9 *Mons Vinogradov as imaged on 2025 Jan 17 UT 23:33 and taken by Aldo Tonon (UAI).*

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

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

Buried Basin and Crater Project

Coordinator Dr. Anthony Cook- atc@aber.ac.uk
Assistant Coordinator Skylar Rees

Skylar Rees

Last month, we received a report of a possible ghost crater by Alberto Anunziato (SLA) in Argentina. They propose a structure southeast of *Plato* and next to *Piazzi Smyth*, centred at LAT = 41.5°N, LON = 2.0°W on the nearside, and suggest many other potential ghost crater candidates may be nearby. There are none currently listed in this area on our catalogue, so please send in any additional observations from this region.

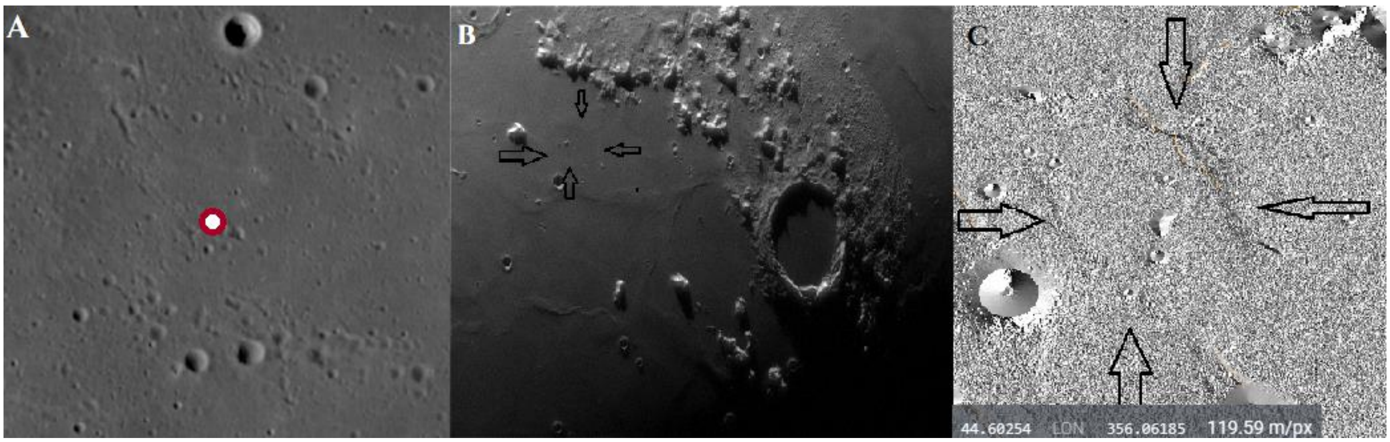


Fig.1*(a) QuickMap view of the suggested area with dot at the suggested centre. (b) Submitted photography of the suggested ghost crater. (c) Submitted QuickMap Azimuth filter view of the crater.*

The three views in Fig.1 above do highlight a faint enclosure, though Fig.1(c) demonstrates it is not circular. In Fig.1(b) and the faint orange line of Fig.1(c) the presence of wrinkle ridges is also highlighted, which infers the overlaying lava (possibly from *Mare Imbrium* due southeast) has bent and fractured upon cooling. It is possible that the ghost crater may have infilled and preferentially formed a ridge upon the northern edge, particularly as asymmetry in impact formations can lead to slumping on one side. However, the difference in elevation according to Quickmap, is very modest – only ~100m separating the 'rim' coincident with the wrinkle ridge and the 'southern rim' – therefore the raised part of Fig.1(c) being a surviving rim is difficult to justify. Possibly due to widespread mare resurfacing, the terrain elevation is remarkably uniform here at around 2700m absolute height everywhere. Unfortunately, this also means it is practically useless in this instance at defining topographically distinct features.

TerrainSlope (Fig.2 below) is typical of a highly degraded and resurfaced structure, with the average change in slope only ~2-3° throughout. Exceptions to this occur at the centre of both latitudinal (2b) and longitudinal (2c) cross-sections, an upturn to nearly 7°; this seems to be the approximate location of the central mound in Fig.1(c). As highlighted by the orange arcs in Fig.2(d), the faint oval outline of the proposed impact structure does appear with some uncertainty. However, the southern arc does also show the highest variations in slope in the area (~8-9°), suggesting a difference from the flatter terrain above it. If these are indeed rims, the approximate diameter of this structure is ~16km. At that diameter it is possible that this was a complex crater prior to resurfacing, this central spike in slope and the mound in Fig.1(c) the central complex. However, the actual size of the possible ghost crater is visibly uncertain therefore so is the 'complex'.

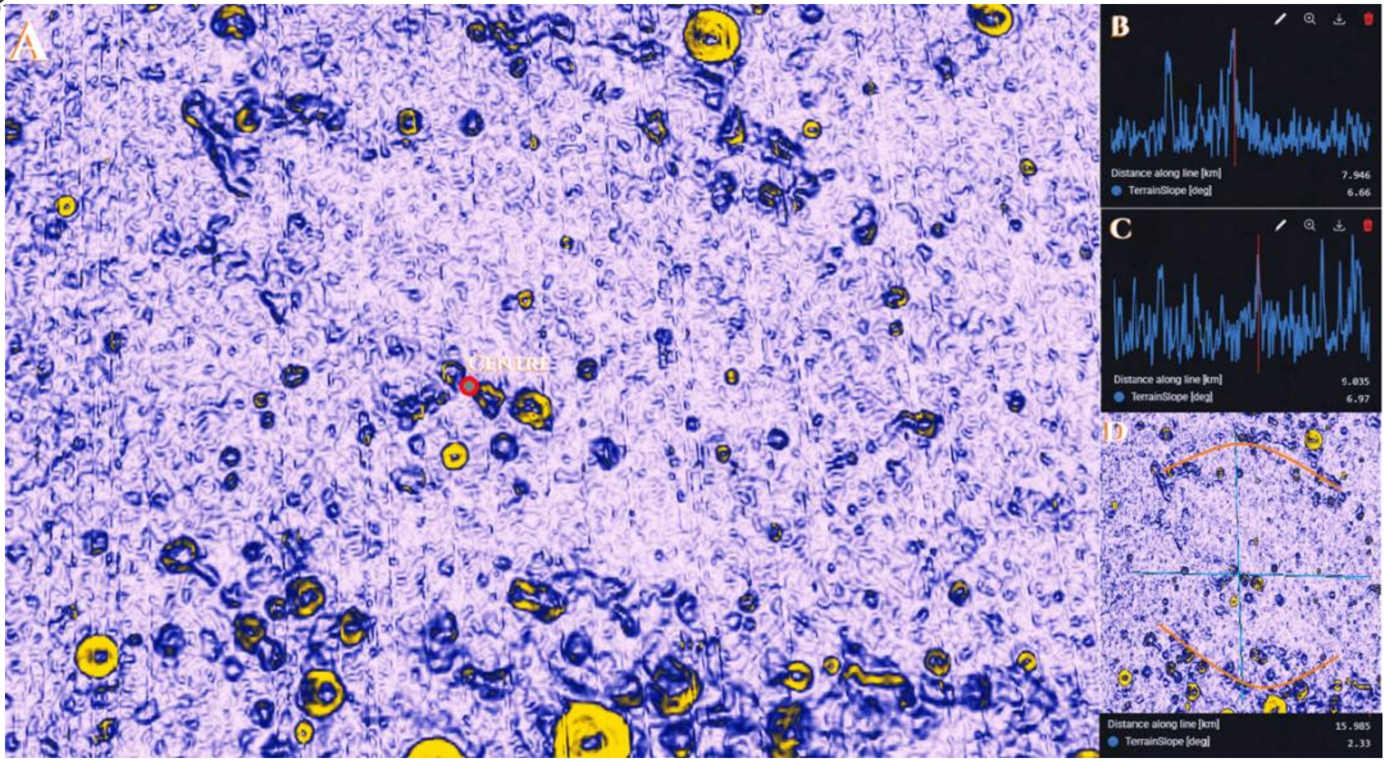


Fig.2*(a) QuickMap's TerrainSlope filter. (b) Latitudinal variation of slope. (c) Longitudinal variation of slope. (d) Asymmetric plotting of axes; orange lines highlight an arcuate slope pattern, possibly a rim. Contrast boosted 40% in all images for clarity. Approximate size of the area based on the arcs is 16km.*

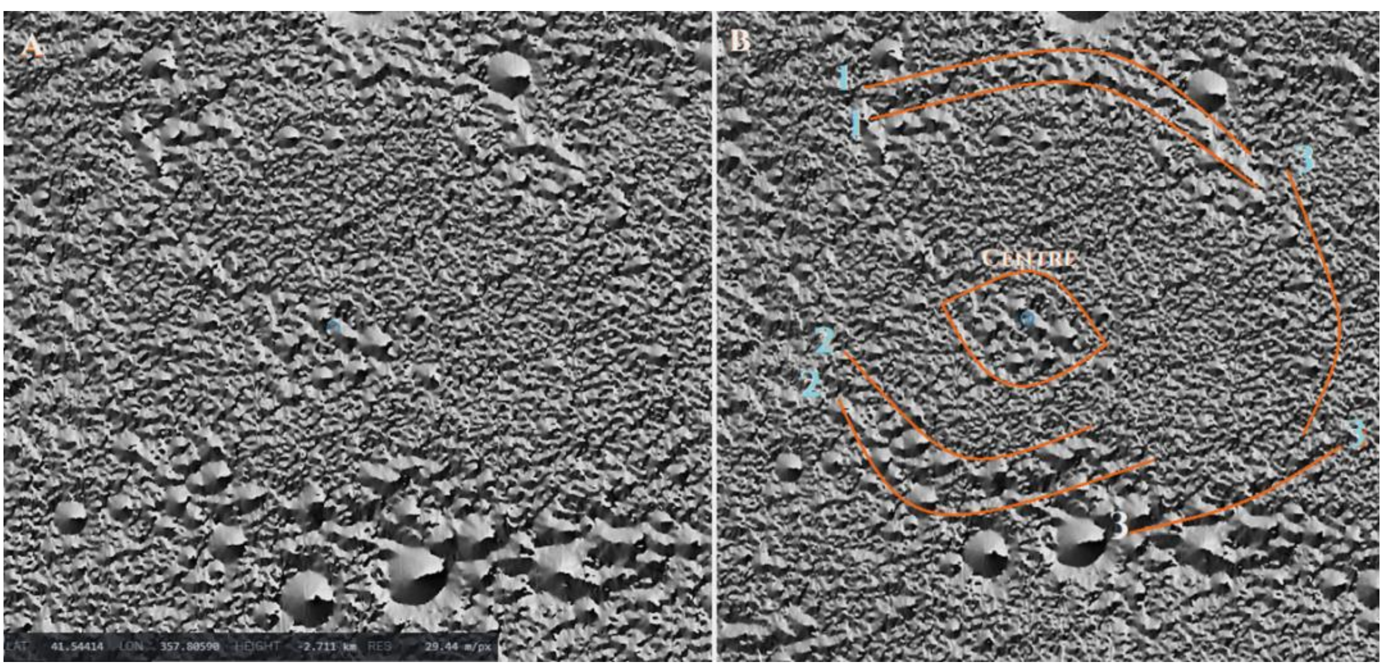


Fig.3*(a) QuickMap's TerrainAzimuth filter. (b) Potential remnants, assessed in confidence intervals (1 = more confident, 3 = less clear). Brightness decreased by 10% and contrast increased by 20% for visibility.*

The possible remnants are also observed, in varying confidences, by the TerrainAzimuth filter in Fig.3(b) above. However, rather than smooth and continuous topography – for example in the more confident arcs to the north (labelled 1) – most of the terrain is quite 'rough' and discontinuous. The southern 'arcs' (labelled 2) appear to retain their shape but are made up of several smaller circular structures, which would suggest degradation by subsequent impactors rather than a product of resurfacing or contraction. The edges (labelled 3) are even more tenuous and do not display this kind of "mackerel sky" texture like the southern arcs. The centre again shows an accumulation of smoother and more connected terrain than its immediate surroundings, suggesting a topographical distinction, but overall, this region is coarser and more disconnected than expected from mare flooding or impact-gardening.

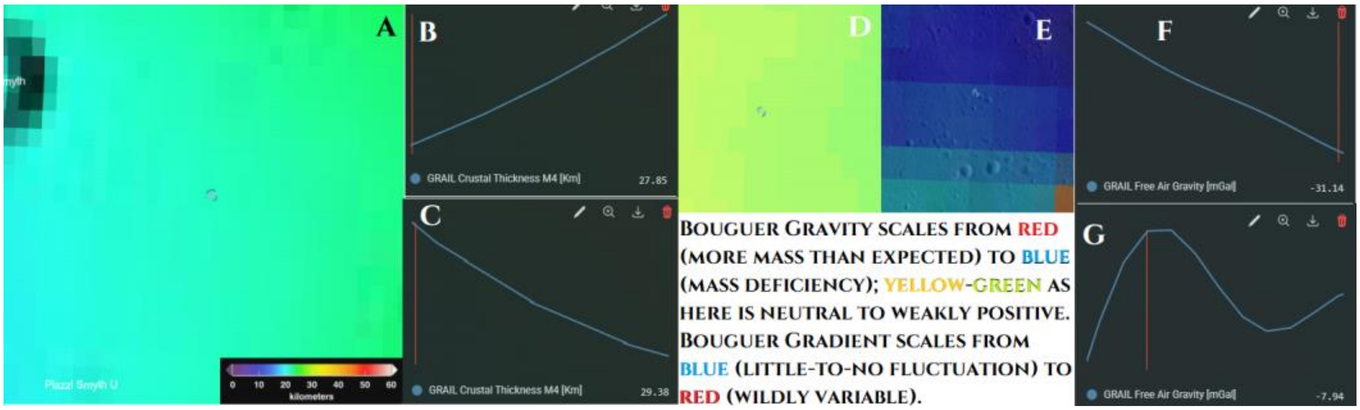


Fig.4 *QuickMap's GRAIL gravity data. (a-c) Crustal Thickness, latitudinal and longitudinal plots through the same axes as in Fig.2(d). (d,f,g) Bouguer Gravity Anomaly and latitudinal and longitudinal plots through the same axes as in Fig.2(d). (e) Bouguer Gradient. No edits to contrast or brightness.*

GRAIL gravity data in Fig.4 above is also inconclusive. The crustal thickness (Fig. 4a-c) increases from west to east, while decreasing at a similar rate from north to south; these range from around 15-28km in both cases. This would partially be explained by erosion from mare and basalt emplacement, but Bouguer Gravity (Fig.4d,f,g) - while somewhat decreasing laterally and fluctuating longitudinally – remains comfortably within the neutral gravity range (0-30mGal). Bouguer Gradient (Fig.4e) also suggests very weakly varying gravity. While this could be explained by significant infilling and solidification by the mare so to return the crater to pre-impact levels, this is not supported by the widespread ~2700m absolute depth everywhere in the area.

Barata et al (2012) classified ghost craters on Mars as "flat-floored, rimless, extremely shallow, without central peaks, and would probably represent what remains after erosion". Assuming that this definition holds for the Moon, it is unlikely to be a ghost crater. There are suggestions of a rim, it is not particularly shallow at 2700m absolute depth and appears to have some remaining central fixture. Its floor is flat in terms of slope, albeit coarse-grained and discontinuous in azimuthal terms. There are indications that a structure exists, but the evidence does not seem to support it as a palimpsest – in fact, if it predated the mare, greater thickness and height (e.g. from basaltic flow) would be expected from infilling. Because it cannot be definitively ruled out and a flat floor in both slope and gravity profiles exist, we will weight this as a 2.

[1] Barata, T. et al (2012). "Characterization of palimpsest craters on Mars". *Planetary and Space Science*. **72**(1):62–69. DOI: 10.1016/j.pss.2012.09.015.

Lunar Calendar March 2025

Date	Time	Event
1	0400	Mercury 0.4˚ north of Moon, occultation Australia
1	0540	Moon at ascending node
1	2100	Moon at perigee 361964 km
1	2300	Venus 6˚ north of Moon
5	1300	Moon 0.6˚ north of Pleiades
6	1200	Jupiter 6˚south of Moon
6	1632	First Quarter Moon
7		South limb most exposed -6.8˚
7		Greatest northern declination +28.7˚
9	0000	Mars 1.7˚ south of Moon
9		East limb most exposed +6.1˚
9	1200	Pollux 2.0˚ north of the Moon
14	0655	Full Moon **total lunar eclipse visible worldwide except India, China, central Russia**
14	1345	Moon at descending node
16	2000	Spica 0.4˚ north of Moon, occultation Africa and Australia
		Moon at apogee 404882 km
20	1700	Antares 0.5˚ north of Moon, occultation Indonesia to South America
22		North limb most exposed +6.9˚
22		Greatest southern declination -28.7˚
22	1129	Last Quarter Moon
24		West limb most exposed -7.5˚
28	1629	Moon at ascending node
29	1058	New Moon lunation 1265, partial solar eclipse Europe
30	0500	Moon at perigee 358128 km Large tides

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.

CONTRIBUTION GUIDELINES

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

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

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

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

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

Please send images/drawings/text to drteske@yahoo.com or lunar@alpo-astronomy.org

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

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

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

drteske@yahoo.com

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: Volcanic Features

Focus on is a bi-monthly series of articles, which includes observations received for a specific feature or class of features. The subject for the May 2025, will be Volcanic Features. 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 Volcanic Features Focus-On article is April 20, 2025

FUTURE FOCUS ON ARTICLES:

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

Subject	TLO Issue	Deadline
Volcanic Features	**May 2025**	**April 20, 2025**
Rupes Recta	**July 2025**	**June 20, 2025**
Mare Humorum	**September 2025**	**August 20, 2025**

Focus On Announcement: Volcanic Features: An Inventory of Past Chaos

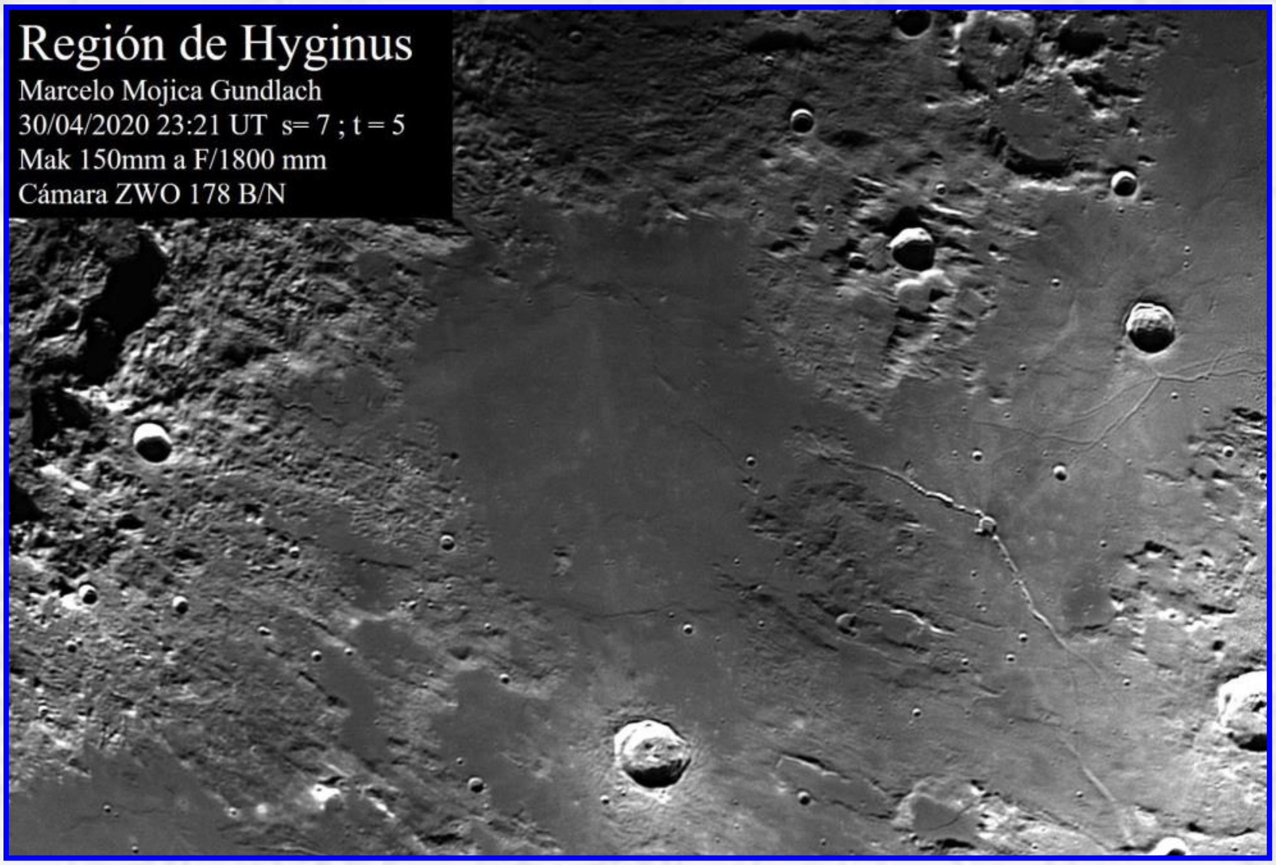
There was a (geological) time when the Moon was a real chaos, a new chaos, after the chaos of the great meteorite impacts that formed the basins. A volcanic chaos. We invite our observer friends to send their favorite images of the entire selenographic spectrum of volcanic features, from maria (including cryptomaria) to the smallest and most elusive, such as domes, passing through rilles, faults, volcanic craters, dark mantle deposits, fractured floor craters, including those of possible volcanic origin, such as wrinkle ridges and irregular mare patches. **We also invite you to share the reasons why you have sent images of your favorite volcanic features, to give a more personal touch to our Focus On.**

MARCH 2025 ISSUE-Due February 20 2025: CLAVIUS

MAY 2025 ISSUE-Due April 20 2025: VOLCANIC FEATURES

JULY 2025 ISSUE-Due June 20, 2025: RUPES RECTA

SEPTEMBER 2025 ISSUE-Due August 20, 2025: MARE HUMORUM



Marcelo Mojica Gundlach

Focus On Announcement:
Rupes Recta: The Biggest Pareidolia On the Moon

Rupes Recta, The Straight Wall, The Railroad, The Sword, so many names for one site that has been dreamed of (yes, why not? dreamed of) by so many observers over the decades. The most notorious of the lunar pareidolias is the most notorious example of a lunar fault (a crack with one edge higher than the other). Rupes Recta varies greatly according to illumination and we will analyze the images sent to us in search of details of this great wall, along with the other interesting formations in this region of eastern Mare Nubium.

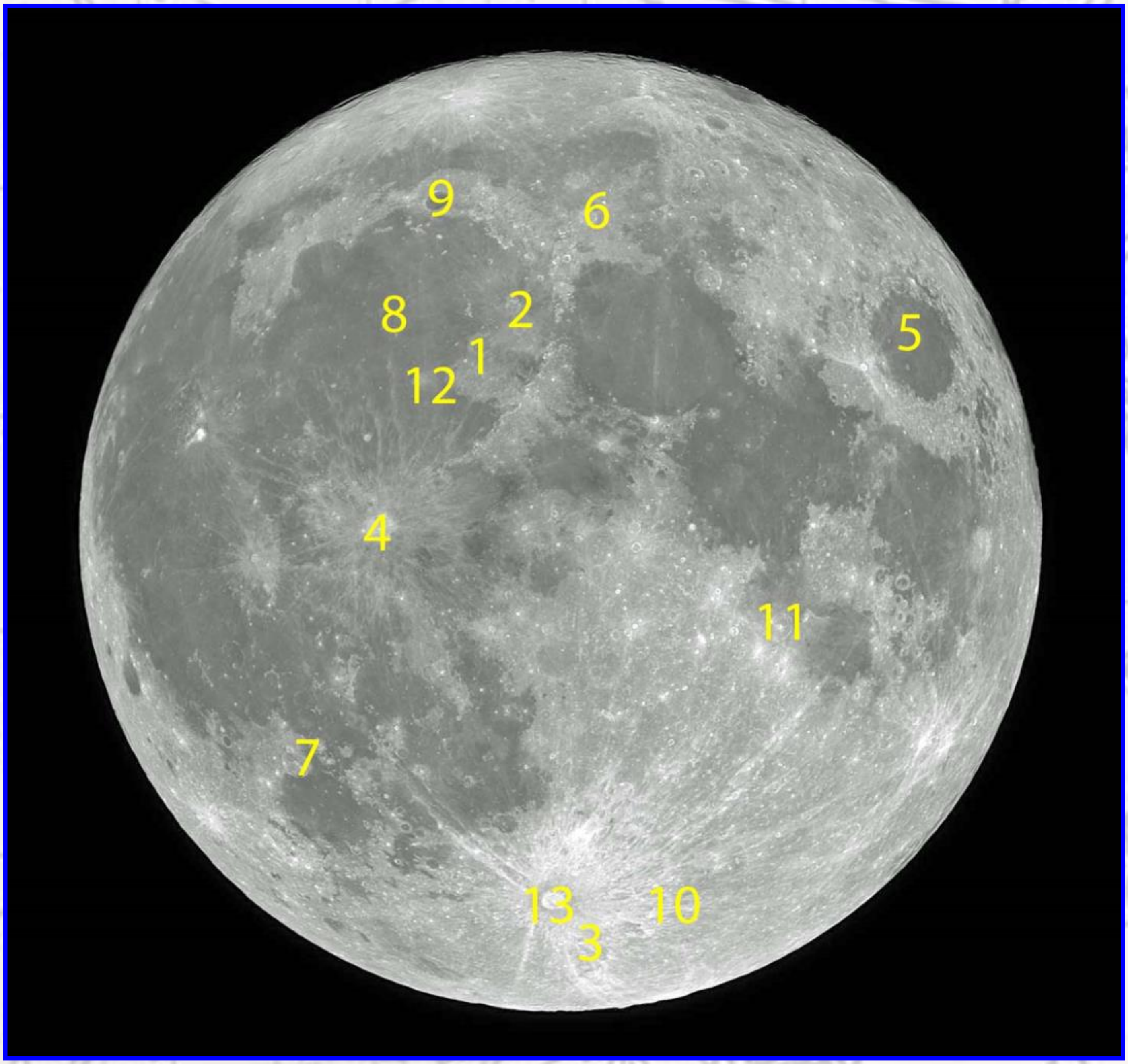
MAY 2025 ISSUE-Due April 20 2025: VOLCANIC FEATURES

JULY 2025 ISSUE-Due June 20, 2025: RUPES RECTA

SEPTEMBER 2025 ISSUE-Due August 20, 2025: MARE HUMORUM

Luis Francisco Alsina Cardinalli

Key to Lunar Images In This Issue



1. Archimedes
2. Aristillus
3. Clavius
4. Copernicus
5. Crisium, Mare
6. Eudoxus
7. Gassendi
8. Imbrium, Mare
9. Plato
10. Stöfler
11. Theophilus
12. Timocharis
13. Tycho