The Lunar Observer

A Publication of the Lunar Section of ALPO

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

April 2022

Online readers, click on images for hyperlinks

In This Issue

I hope that this issue of *The Lunar Observer* finds you and your loved ones in good health. In this issue, we find a wealth of lunar information contributed from across the globe. It is always exciting when new observers send in material. A new contributor to us, István Zoltán Földvári of Budapest, Hungary, has been actively sketching the Moon since 2007. A handful of his wonder lunar drawings are in the Recent Topographic Studies. Also in this issue, there are a number of interesting articles, drawings and images. Robert H. Hays, Jr. has a wonderful observation of Torricelli C. Alberto Anunziato discusses wrinkle ridges in three articles. It always amazes me the data that he can mine from ALPO observations and even Apollo spacecraft images. Rik Hill provides two great essays and articles on lunar topography. Darryl Wilson provided the fifth article in his series of lunar imaging. As always, Tony Cook provides a very thorough discussion in his Lunar Geologic Change. To all of our contributors, thank you very much!

Recently, the founder of *The Lunar Observer*, William Dembowski retired as assistant coordinator of the ALPO Lunar Topographic Section Studies Program. I thank William for all the help he provided through the years and developing the newsletter that you are reading. Best of luck and wishes with all of your future endeavors William!

Please keep in mind the future Focus-On topics outlined at the end of this issue. The deadline for Mare Frigoris material (articles, observations, drawings, images (old or new)) are due by April 20, 2022. Also, future Focus-On topics will include the many rayed craters of the Moon. We look forward to all these observations!

-David Teske

Lunar Topographic Studies

Coordinator – David Teske - david.teske@alpo-astronomy.org
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Observations Received

Name	Location and Organization	Image/Article
Alberto Anunziato	Paraná, Argentina	Article and images *The Wrinkle Ridge that Ends In Herodotus A, Revisited, Euclides C In the Terminator* and *Two Dorsa Northeast of Bliss (and a Remark on Moon Sketching)*
Sergio Babino	Montevideo, Uruguay	Image of Herodotus A.
Ignacio Barzola	AEA, Oro Verde, Argentina	Image of Aristoteles.
Luis Francisco Alsina Cardinalli	Oro Verde, Argentina	Image of Herodotus A.
Rodrigo De Brix	Santa Fe, Argentina	Image of Mare Crisium.
Walter Ricardo Elias	AEA, Oro Verde, Argentina	Image of Aristarchus (3), Grimaldi, Mare Crisium (2), Alphonsus (2), Copernicus (2), Moltke and Plato.
Howard Eskildsen	Ocala, Florida, USA	Image of Herodotus Omega.
István Zoltán Földvári	Budapest, Hungary	Drawings of Hevelius, Endymion B, Messier, Grimaldi, Byrd and Perry, Lubiniezky, Wallace, Macrobius and Bonpland.
Facundo Gramer	AEA, Oro Verde, Argentina	Image of Curtis.
Robert H. Hays, Jr.	Worth, Illinois, USA	Article and drawing *Torricelli C.*
Rik Hill	Loudon Observatory, Tucson, Arizona, USA	Article and image *From Walther to Geber, Endymion to the Edge,* image of Aristarchus.
Eduardo Horacek and Esteban Andrada	Mar del Plata, Argentina	Image of Herodotus A (2).
Raf Lena	Rome, Italy	Images of Herodotus A (2).
Geoff McNamara	MSATT, Mount Stromlo Observatory,	Image of Mare Orientale.

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

Lunar Topographic Studies

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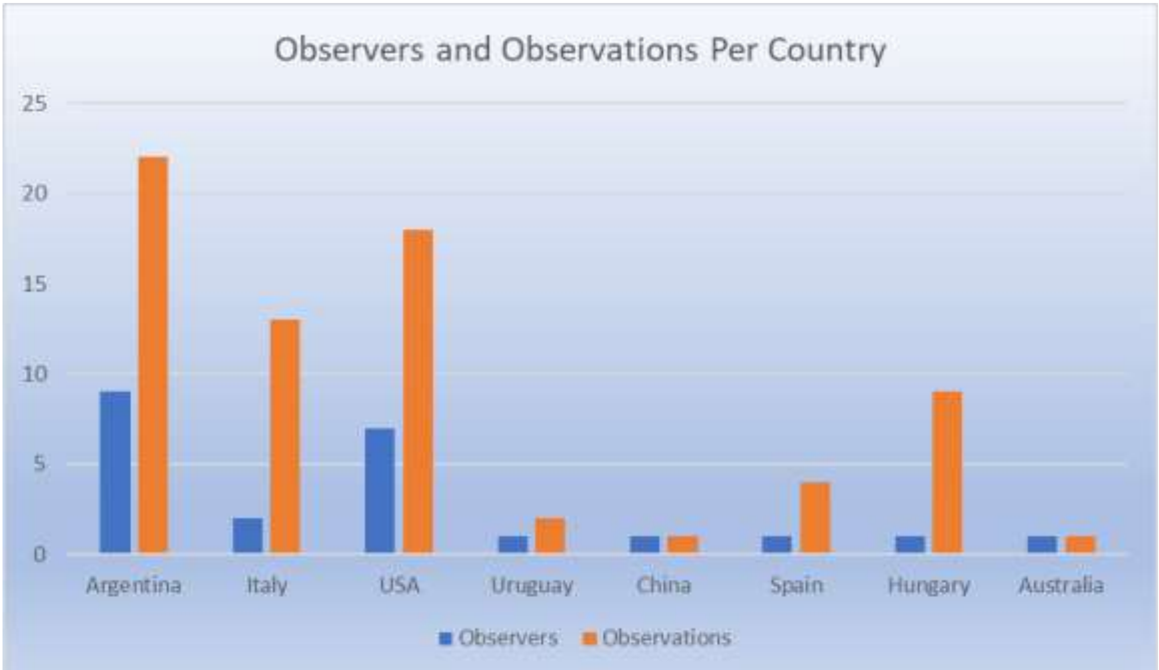
Observations Received

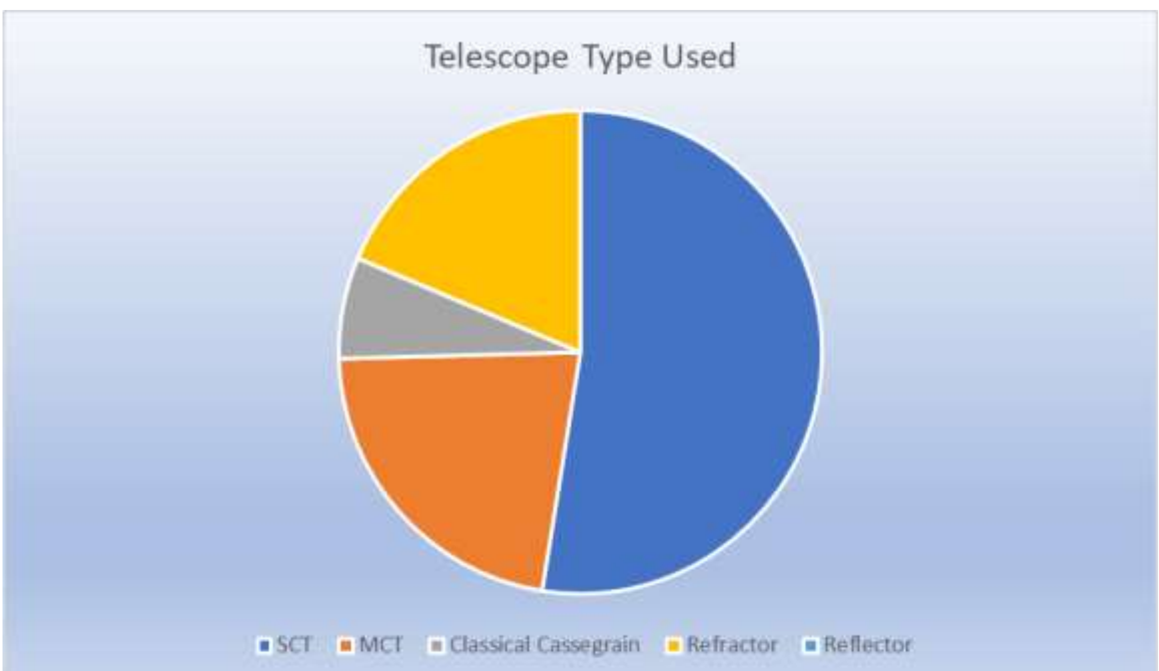
Name	Location and Organization	Image/Article
Luigi Morrone	Agerola, Italy	Image of Moretus.
Rafael Benavides Palencia	Cordoba, Spain	Images of Endymion, Lacus Mortis, Julius Caesar and Lade.
KC Pau	Hong Kong, China	Images of Rupes Recta and Hippalus.
Guido Santacana	San Juan, Puerto Rico, USA	Images of Clavius (2), Copernicus, Kies, Plato and Pitatus.
Michael Sweetman	Sky Crest Observatory, Tucson, Arizona, USA	Images of Albategnius, Deslandres and Copernicus (2).
David Teske	Louisville, Mississippi, USA	Images of Aristarchus and the Lunar South Pole.
Alan Trumper	AEA, Oro Verde, Argentina	Images of Aristarchus and Copernicus.
Fabio Verza	SNdR, Milan, Italy	Images of Posidonius, Menelaus, Lacus Mortis, Theophilus, Mare Crisium, Sinus Iridum, Aristoteles, Ptolemaeus, Mare Frigoris, Copernicus and Tycho.
Darryl Wilson	Marshall, Virginia, USA	Article and images *Examination of HSV Colorspace Enhanced Imagery of Oceanus Procellarum, Mare Humorum, and the Western Limb*.

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

April 2022 *The Lunar Observer*
By the Numbers

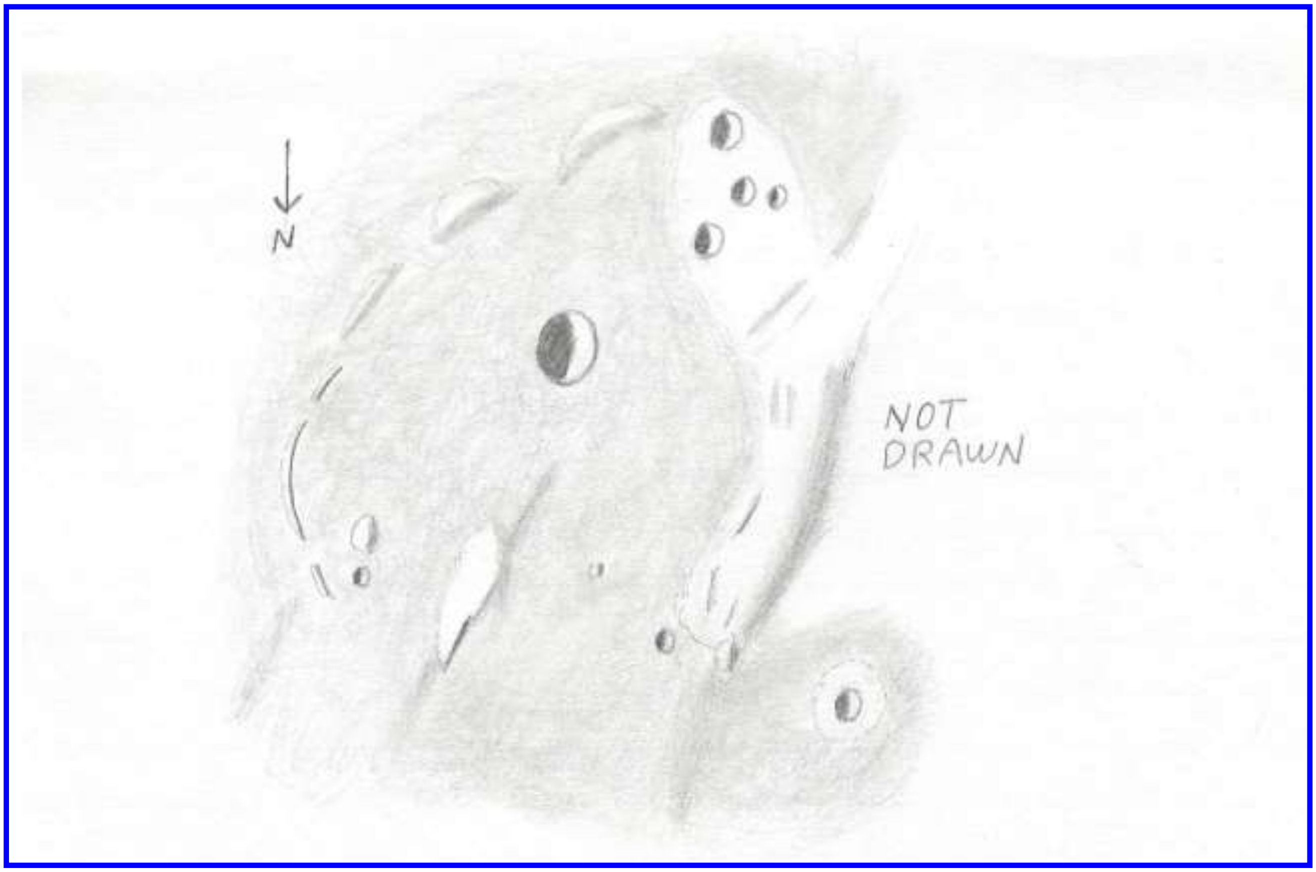
This month there were 70 observations by 25 contributors in 8 countries.





Torricelli C

Robert H. Hays, Jr



Torricelli C, *Robert H. Hays, Jr., Worth, Illinois, USA. 2022 February 08 01:34-01:48; 02:03-02:31. 15 cm reflector telescope, 170 x. Seeing 8/10, transparency 6/6.*

I drew this crater and vicinity on the evening of February 7/8, 2022. This area is in extreme southern Mare Tranquillitatis. Torricelli C is the largest crater in this sketch. This is a very ordinary, crisp crater in what may be a flooded ring. A group of four craters is southwest of Torricelli C. Three of them from north to south are: Torricelli H, J and K, according to the Lunar Quadrant map. An unlabeled crater is just west of J. All of them are smaller versions of Torricelli C. This quartet is in a bright area adjoining the mare. This bright area curves around Torricelli C, and ends at a peak near the pit Moltke B. Several patches of shadow are within this area. Moltke itself is the haloed crater west of Moltke B. An 'island' of sorts is north of Torricelli C. The north end of this island' showed darker, crisper shadowing than its southern end. A tiny peak is between this 'island' and Moltke B. A conspicuous peak is east of the 'island', and Torricelli G is the craterlet just to its north. What may be parts of an old ring are east and south of Torricelli C. These remnants are very narrow and delicate near Torricelli G, but they are wider with diffuse shadowing south of Torricelli C. Perhaps these bits were once connected to the bright curved area west of Torricelli C.

Examination of HSV Colorspace Enhanced Imagery of Oceanus Procellarum, Mare Humorum, and the Western Limb

Darry Wilson

In this fifth article in the multiband image processing series, we examine western Oceanus Procellarum and Mare Humorum. As usual, the color images presented here were processed according to the process flow diagram presented in the January, 2022 issue of "The Lunar Observer" (TLO).

Figure 1 is a grayscale mosaic of the entire area covered by the two images. It was formed by co-registering the two red bands. The names of a number of craters have been annotated according to Sky and Telescope's Moon Map for reference.

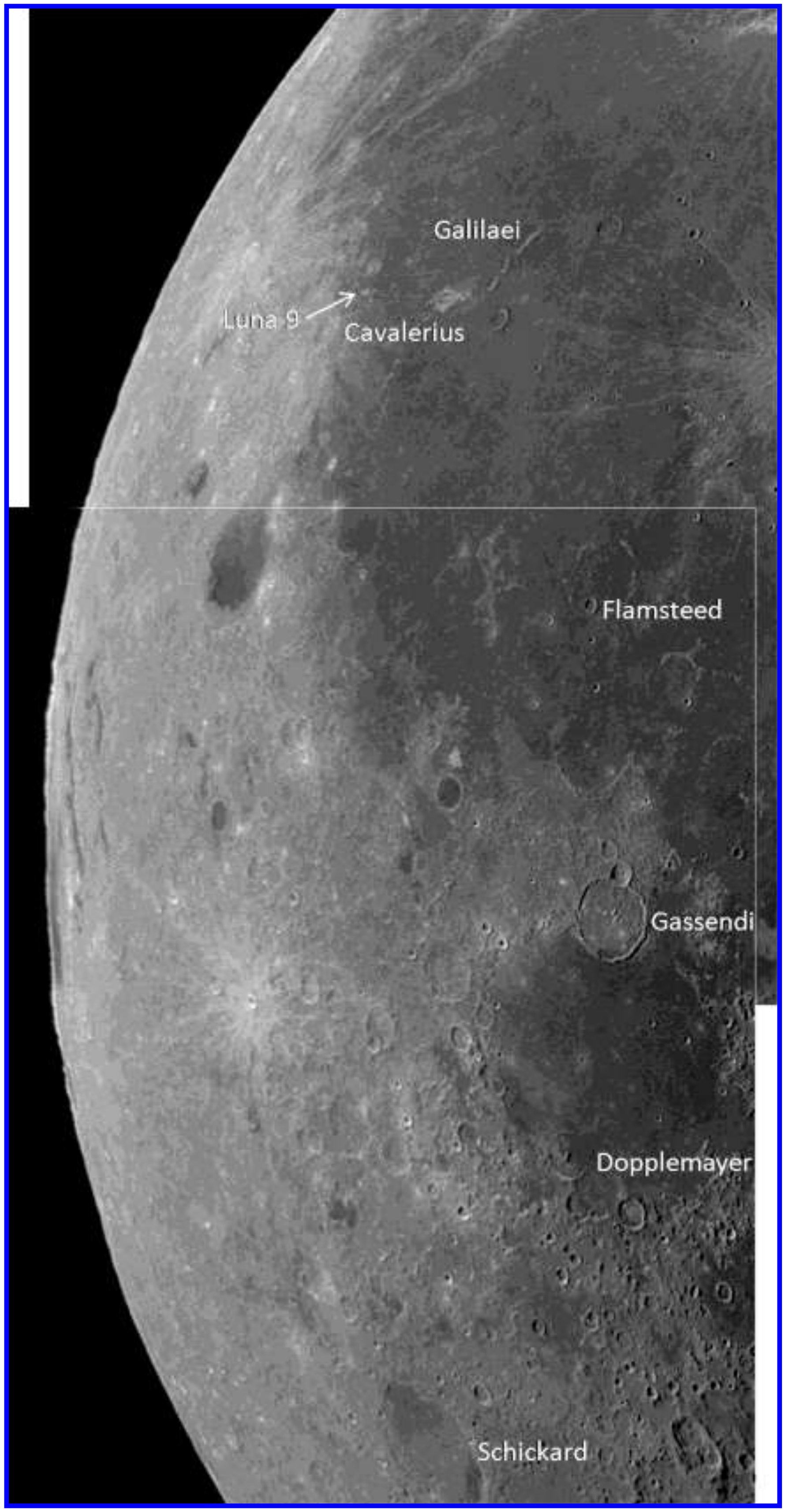
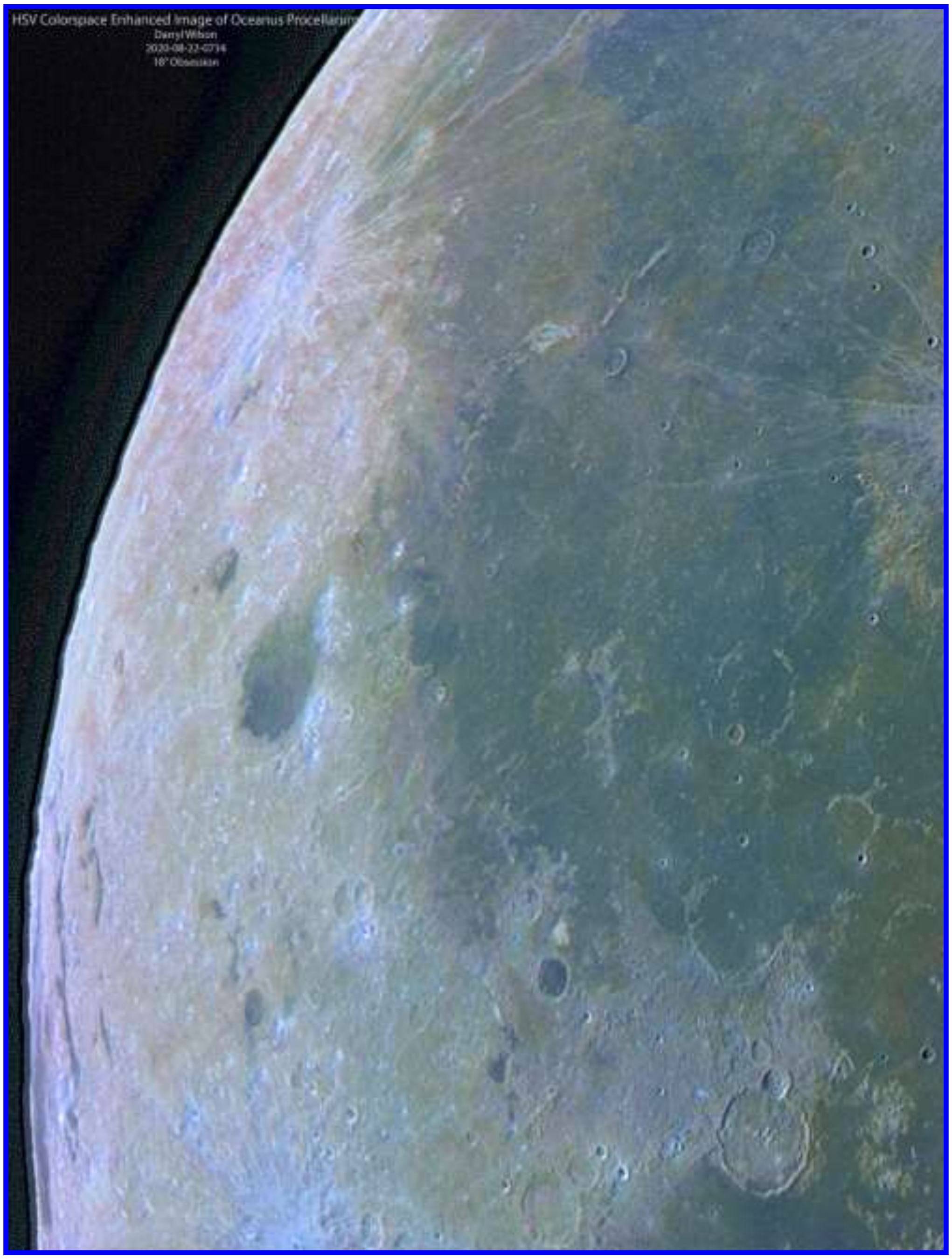


***Figure 1, Annotated mosaic of lunar images**, Darryl Wilson, Marshall, Virginia, USA. Red band of RGB images 18 inch Obsession*

Figure 2 shows southwestern Oceanus Procellarum from a point just southwest of Aristarchus, southward to Gassendi, and westward to the limb. Unlike the clear, sharp color boundaries we previously examined in Mare Imbrium, the patterns and distributions of bluish and brownish lunar surface colors in southern Oceanus Procellarum and Mare Humorum defy simple description. They are better mixed, more irregular, and frequently subtle. The brownish areas are less (color) saturated than they are in northern Mare Imbrium and Sinus Iridum. As usual, the highlands have less color variability. They generally appear brownish except in areas that are highly reflective, where they are light gray to white.

The area in the upper right corner of Figure 2, NW of Kepler, covers some of the most titanium rich surface areas of the entire lunar surface. Unfortunately, the dynamic range of the source images was not large enough to reveal subtle color differences to their fullest extent. These images were taken with exposure and gain settings that would avoid saturation. That insured relatively low digital number values for the areas in the mare. The RGB-to-HSV transformation is sensitive to this, and the result is less dynamic spacing in color space.



For a historical note, we can focus our attention on a location about 30 miles NNE of Cavalerius. Cavalerius itself is about 35 miles in diameter. Slightly less than one Cavalerius diameter to the upper right of the crater, on a line from Cavalerius to Galilei, are two bright spots, side-by-side and almost touching in the image. They are the northeastern extent of Planitia Descensus, and they mark the position of Luna 9 - the first space probe to soft-land on the Moon. Beyond confirming the rock-solid nature of the lunar surface, hard-landings fail to produce scientifically useful data. So, Luna 9 was a breakthrough. Readers who were astronomers at the time may recall that there was active debate among scientists in the decades leading up to the Apollo landings regarding the exact nature of the lunar surface. Some believed that there could be a soft layer of dust deep enough to completely engulf a lunar lander.

Figure 2, HSV Colorspace Enhanced Image of Oceanus Procellarum, *Darryl Wilson, Marshall, Virginia, USA. 2020 August 22 07:34 UT. 18 inch Obsession reflector, 0.45"/pixel.*

Figure 3 shows southwestern Oceanus Procellarum from Flamsteed down to Schickard, and westward to the limb. Tan, yellowish-brown, and chalky white colors dominate the highlands - which comprise about 3/4 of the area in the scene. Schickard, visible at the bottom of Figure 3, presents an interesting interior due to its partly flooded nature. Few craters contain a mixture of blue and tan color on their floors.

Mare Humorum displays the same shade of blue that we associate with titanium rich lunar surface material. At some point, an attentive reader may think that this author sound like a broken record - always referring to "areas of bluish tint that indicate titanium rich lunar surface regolith". Is it really important to know where the titanium-rich areas are on the surface of the Moon? Does anyone really plan to go to the Moon to mine titanium? Eventually, yes, but first things first. Efficient mining of oxygen would have immediate value for any human colony, and oxygen could also be used as a propellant component for return missions.

Figure 3, HSV Colorspace Enhanced Image of Mare Humorum, *Darryl Wilson, Marshall, Virginia, USA. 2020 August 22 07:35 UT. 18 inch Obsession reflector, 0.45"/pixel.*

Oxygen is present in almost all of the minerals on the surface, and NASA knows of more than 20 processes that can extract it from the regolith, some more practical than others. One promising technique uses ilmenite as the source material. Ilmenite ($TiFeO_3$) is the blue surface material in these images. It is possible to separate the oxygen from the metals using solar power (and some suitable machinery). Tiltable solar panels can capture 1340 watts of solar power per square meter, two weeks out of every month. That's enough to power a process to extract oxygen from the regolith. So, the blue areas are places where oxygen might be more easily extracted.

Doppelmayer displays unusual coloration near its eastern wall suggesting that the surface mineral composition is notably different there, compared with other areas. Unfortunately, three-band RGB color imagery rarely provides sufficient information to identify minerals. Alone, it has insufficient spectral resolution to detect absorption features, not enough bands to reject false positives, and fails to cover regions of the spectrum that contain absorption features that are diagnostic for many minerals. (The characteristic bluish color that indicates relatively high concentrations of titanium dioxide on the lunar surface is only possible due to contextual constraints.) In the case of Doppelmayer, we can say that the surface mineral content appears to be different around the crater, but we don't know what it is. About 65 miles NNW of Doppelmayer, along the western edge of Mare Humorum, is an area about 40 miles in N-S extent that seems similar in hue. The dark areas on the floor of Schickard may also have this tint, suggesting similar mineralogy - whatever it may be.

Although these two-color enhanced images are less spectacular than some we have seen before, they send an important message when compared to the grayscale image in Figure 1. The grayscale image only shows minor albedo variations that are barely visible in many places. To be fair, we note that Figure 1 was formed from the red bands. If the blue bands had been used (red bands were used due to their higher SNR), more albedo variations would be visible in the mare. Even so, color images display more information related to surface material composition. With color information, we can now know when the mineral composition of the surface material has changed, not just that the surface brightness is different. A greater quantity of useful information is presented to the human eye in the color enhanced image.

In summary, we examined color enhanced images of southwestern Oceanus Procellarum and Mare Humorum. We noted that the color variations of the surface were morphologically more complex, but less striking than those of northern Mare Imbrium. The landing site of Luna 9 was located in Figure 2. We recalled that scientists 60 years ago were unsure about the solid nature of the lunar surface. We recognized that the importance of mapping the titanium abundance on the Moon is related to the need to find the most economically available oxygen. An unusual coloration in Doppelmayer reminded us that color imagery alone, even when enhanced, contains insufficient spectral information to identify surface minerals. We concluded that color imagery provides more visual information related to lunar surface material composition.

References:

Giguere, T., Taylor, G. J., Hawke, B. R., and Lucey, P. G. (2000) The titanium contents of lunar mare basalts. *Meteoritics and Planetary Science,* vol. 35, p. 193-200.
http://www.psrd.hawaii.edu/June00/lunarMaria.html

Rukl, Antonin, Atlas of the Moon, Kalmbach Publishing Co., 1992.

Sky and Telescope Media, LLC, 2012.

Wilson, Darryl G., "A Sharpening Technique in HSV Colorspace for Lunar Surface Material Discrimination, RGB->HSV; enhance S; replace V; HSV->RGB", January, 2022, "The Lunar Observer", 7-10.

Wilson, Darryl G., " A Basic Color Enhancement Technique for Lunar Surface Material Discrimination, RGB->HSV; enhance S; HSV->RGB", December, 2021, "The Lunar Observer", 5-7.

Euclides C In the Terminator

Alberto Anunziato

After a brief observing session for the Project for the Verification/Elimination of Past Transient Lunar Phenomena Reports, and before the Moon fell further to the horizon and was covered by the inconvenient neighbor's wall, I went to the terminator of that night of 12 March (it was already March 13 in universal time) to look for some prominent wrinkle ridge and what caught my eye was what looked like an abstract pattern of light and shadow at the southern end of Oceanus Procellarum, near the Mare Cognitum boundary. The terminator passed a little further east of Herigonius. A crater of modest size was visible, with the typical configuration of craters less than 15 km in diameter near the terminator: very bright rim, completely black interior and very long shadow towards the opposite side of the illumination. But the most fascinating thing was the pattern of dark tones of the shadows, very dark those projected by the crater and less dark those projected by elevated areas that shone not as strongly as the rim of the crater. In my drawing (IMAGE 1) I was not able to accurately reproduce the pattern of shadows of different shades, I only approximately reproduce the darkest and least dark shadows.

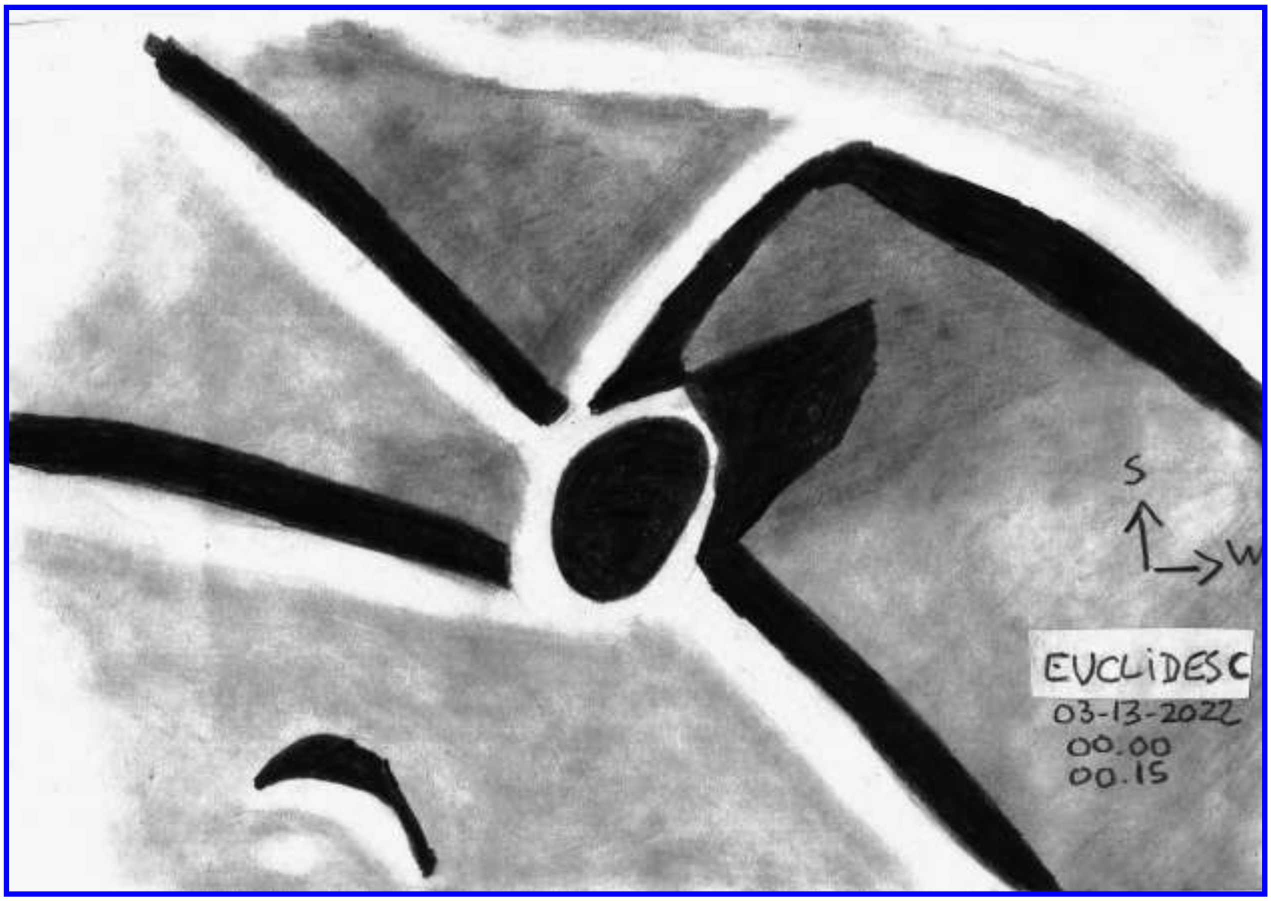


***Image 1, Euclides C**, Alberto Anunziato, Paraná, Argentina. 2022 March 13, 00:00-00:15 UT. Meade 105 mm EX Maksutov-Cassegrain telescope, 154 x.*

It seems to me that it is time to improve the technique of my drawings. At the time of observation, I identified that crater as Norman, but after completing the drawing, and based on the wrinkle ridge framework (because the bright lines correspond to wrinkle ridges) so characteristic that I had drawn, I realized that it was Euclides C, a crater of the same diameter (10 kms) located a little further south. Like any visual observer, I was moved to see that my drawing coincided with the selenographic reality: the wrinkle ridges network I had drawn did not intersect Norman but Euclides C, so I had to change the name in the drawing.

It was in the wonderful "Photographic Moon Atlas for Lunar Observer" by Kwok C. Pau that I was able to locate the wrinkle ridges around Euclides C (Volume 2, page 292), as we see in IMAGE 2, which is a detail of the image shown on the cited page. My drawing is inaccurate about the wrinkle ridges boundaries (for example, the east-west segments don't touch the crater in the Pau image), but that's probably because I was pushing the resolution of my little telescope. In this regard, it is interesting to note that the wrinkle ridges don't generally touch the rims of the craters, which are already high, which would be explained stratigraphically because the wrinkle ridges are geologically very recent, more recent than craters not as old as Euclides C. The region shows an oddity, a segment of wrinkle ridge running perpendicular to the traditional north-south direction, which makes this southern zone of Oceanus Procellarum a fascinating zone.

Image 2, Euclides C, *"Photographic Moon Atlas for Lunar Observer" by Kwok C. Pau, Volume 2 page 292.*

Endymion to the Edge

Rik Hill

The center of this image is dominated by the large flat floored crater Endymion (129 km), one of the earlier features you can identify only 3 days after new moon. Its dark floor helps in the identification. Down below are two equally familiar craters, Atlas (90 km) an the right and Hercules (71 km) on the left with the nice secondary crater Hercules G (17 km) on its floor. Just above these two craters are the easternmost shores of Mare Frigoris.

Beyond Endymion near the limb is the large flat region Mare Humboldtianum but beyond the Mare is the limb of the Moon and it's not a sharp curve. It's quite irregular and rough. Those are the huge peaks on the far side of the Mare, over the lunar horizon. As a kid in the early 1960s, armed with my 2.4" Tasco refractor, I used to love to look for these irregularities to the limb and when I saw ones of a shallow "W" shape I'd fancy that I was seeing the profile of some large crater. Maybe yes, likely no. Moving to the north end of the Mare we see more irregularities, likely the high craters walls of Bel'kovich A and B on the far side of the Mare.

You can explore features like these by using the Gazetteer of Planetary Nomenclature (planetarynames.wr.usgs.gov/Page/Moon1to1MAtlas) but you'll have to be patient because there's a lot of hunting around you need to do identifying known features to find unknown.

Endymion, *Richard Hill, Loudon Observatory, Tucson, Arizona, USA. 2022 March 09 02:04 UT, colongitude 342.9°. 8 inch f/20 TEC Maksutov-Cassegrain telescope, 665 nm filter, SKYRIS 132M camera. Seeing 8/10.*

Two Dorsa Northeast of Briggs (and a Remark On Moon Sketching)

Alberto Anunziato

Instrumented visual observation through a drawing has advantages that I suspect, and that I would like to demonstrate at some point, derived from this sentence by Charles Wood, in the introduction to his "Modern Moon. A Personal View": "One of the ironies of lunar observing is that a 6-inch homemade reflector is capable of revealing much of the detail that can be photographed through the largest telescopes on Earth…. Your brain can dismiss periods of blurry vision and focus on fleeting moments of sharp vision." But it also has obvious disadvantages compared to the reliability of photographic images. And one of the disadvantages is that, for the result to be acceptable, an execution of the drawing is necessary that makes it interpretable as the selenographic feature that is reproduced. For that there are two paths and one of them is the best: having the ability to draw in such a way that the drawing as looking through the eyepiece is the definitive one. The other way is to make a sketch and then work more carefully on that sketch. I would love to achieve the ability to make an acceptable drawing while the observation session is developing, which allows avoiding biases (still unconscious) derived from "reworking" the observation, something that must always be avoided. For now, I work with a sketch that establishes relief and shades in as much detail as possible. Years of experience lead us to sense the data that may be more significant in the visual information that emerges from the observation. And the drawing comes later. It is a golden rule not to let too much time pass between the sketch and the drawing. But the sketches accumulate in the observation log and then it takes time to take them to a more structured drawing. And time flies, and these lost sketches become uncomfortable memories of the drawings we still have to do. This was the case with this strange set of lights and shadows that I observed when the terminator passed along the western edge of Oceanus Procellarum almost a year ago (IMAGE 1).

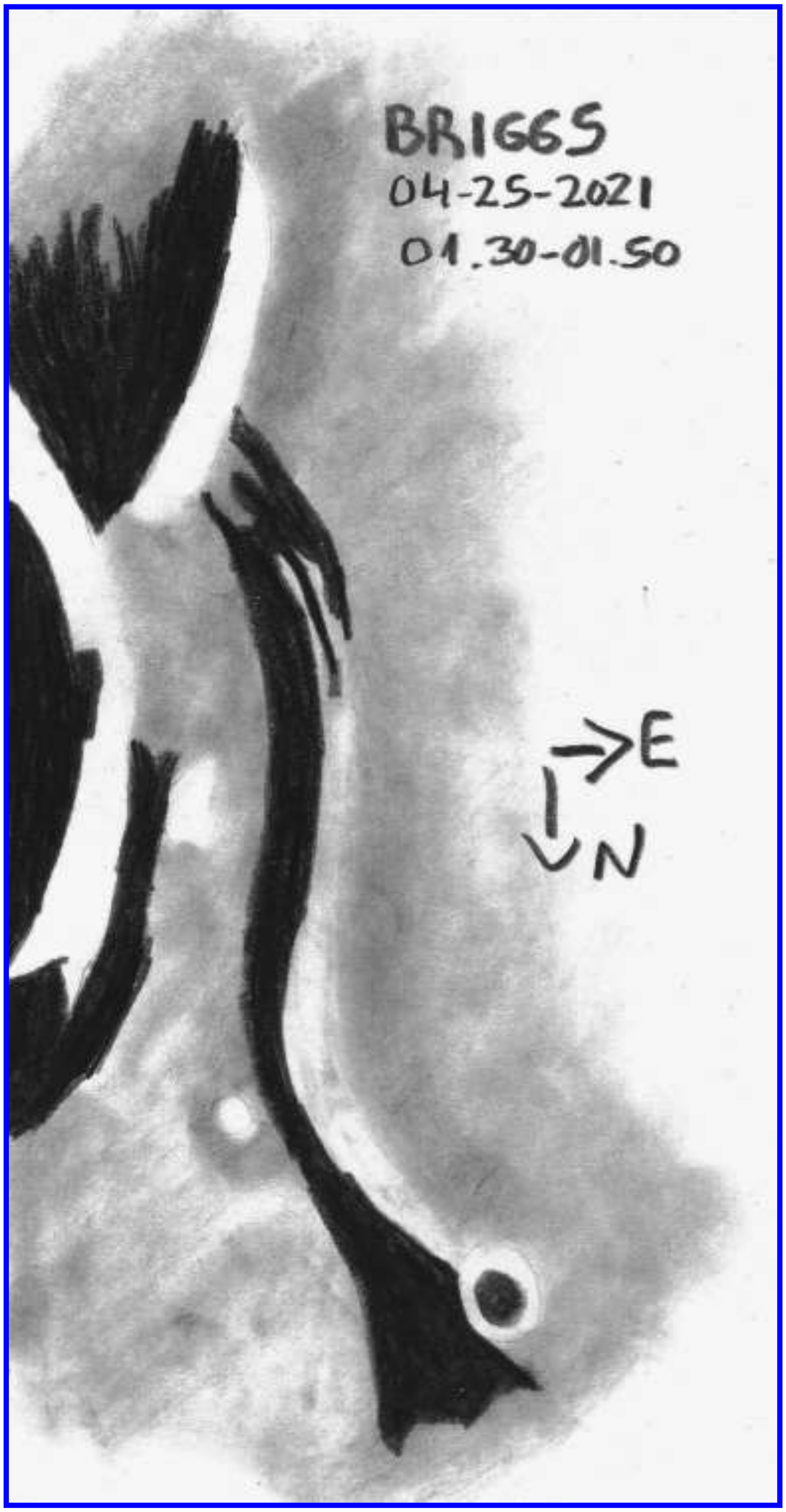


Image 1, Briggs*, Alberto Anunziato, Paraná, Argentina. 2021 April 25, 01:30-01:50 UT. Meade 105 mm EX Maksutov-Cassegrain telescope, 154 x.*

Using the Virtual Moon Atlas at the time of observation, I thought that bright semicircle emerging from the terminator (represented by the left edge) was the eastern rim of Briggs crater. So what were the other two arcs, the brighter one to the south and the less bright one to the north, longer? The atlases I have consulted show no elevations or wrinkle ridges so close Briggs. Until the doubt vanished by consulting, once again, the LROC Quickmap of the Lunar Reconnaissance Orbiter mission and especially its Map of Wrinkle Ridges, and there appeared two wrinkle ridges (IMAGE 2), whose shape coincides with the bright elevations of the IMAGE 1. That is, I had not observed the Briggs edge on the terminator, but the westernmost wrinkle ridge of those indicated in the LROC Quickmap, which, by the way, have a complex and interesting structure to observe again.

Image 2, Briggs, *LROC.*

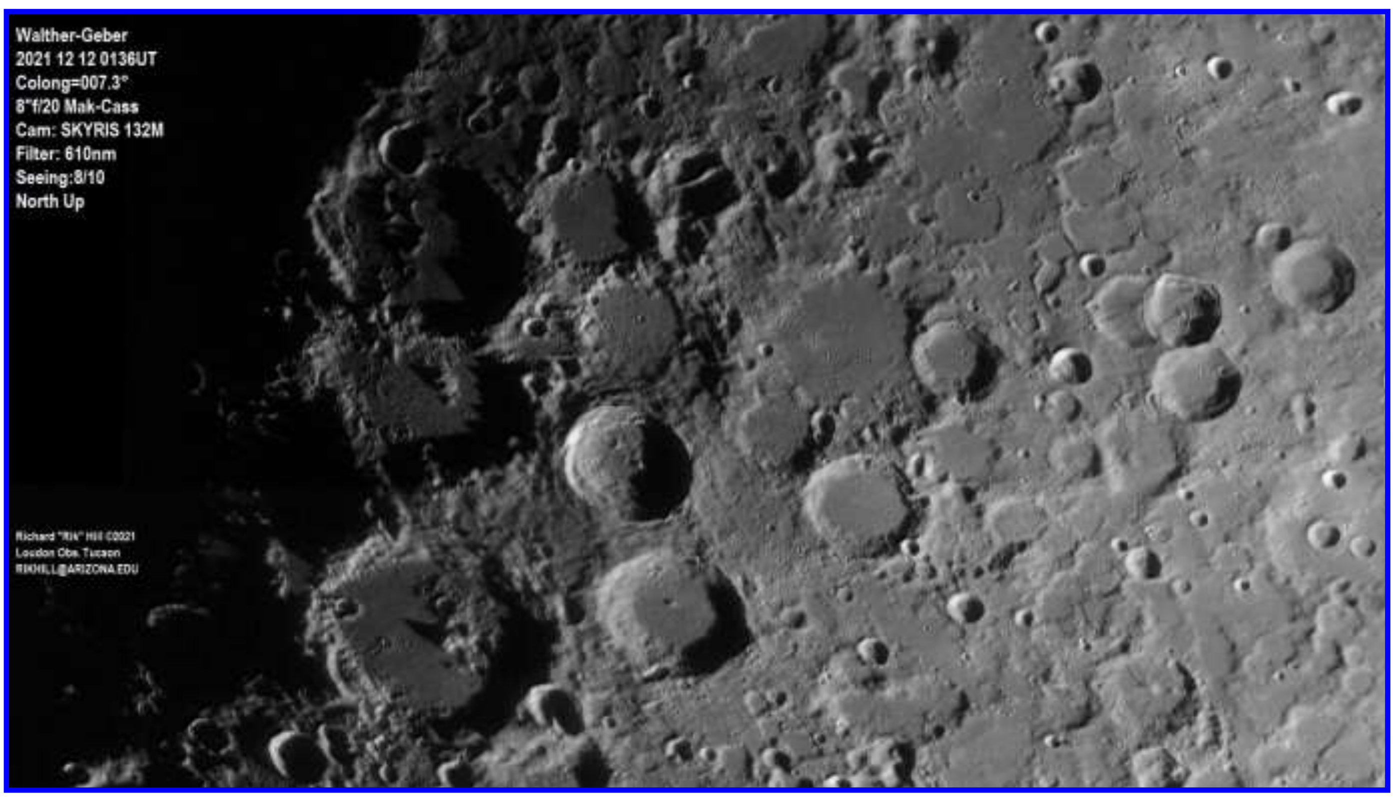
Walther to Geber

Rik Hill

We have an interesting field here from Walther (145 km) in the lower left, with its strange off-center mountains casting a nice shadow, to Geber (46 km) near the right edge. First there is the alignment of 3 vertical craters starting with Walther. All three have similar polygonal shapes with the crater above Walther being Regiomontanus (129 km) and above that Purbach (121 km). It's a striking alignment. To the right of Walther are two more vertically aligned, similar sized craters, Aliacensis (82 km) the flat floored crater below and Werner (71 km) above. Further right is another crater, Apianus (65 km) also of similar size, forming a triangle with the previous two. Above Werner is a heavily eroded Blanchinus (70 km) and above it is La Caille (70 km) on the right wall (east) of Purbach. Notice that the northern crater wall of Blanchinus and southern wall of La Caille form a crude "X" with the bright (east) wall of Purbach. This is the famous "Lunar X" that would have been much more obvious and striking an hour or two earlier. To the right of La Caille is the crater Delaunay (48 km) with its curious wall bisecting the crater. The outer walls of this crater are heavily modified by post impact erosion from subsequent impacts like the large crater on its southern wall, La Caille E (27 km).

Below Apianus is a curious kidney bean shaped crater (if it can be called a "crater") that is Poisson, listed as 82 km diameter but is anything but round. It is more like 82 km long and 15 km wide. The western or left side is listed as Poisson T but in such case, it makes Poisson much less than 82 km. Moving further right or east and north of Apianus we see another flat-floored crater, Playfair (49 km). Then, continuing on, there is another pair of north-south craters with Azophi (49 km) on the bottom and Abenezra (43 km) above it with its flat north wall and swirled grooves on its floor not seen here because of the shadow. The last crater in the line is the aforementioned Geber (46 km), a very circular flat floored crater with an interesting 1.5 km central crater.

There are more named features here but this should give you a good roadmap to explore further.



Walter to Geber, *Richard Hill, Loudon Observatory, Tucson, Arizona, USA. 2021 December 12 01:36 UT, colongitude 7.3°. 8 inch f/20 TEC Maksutov-Cassegrain telescope, 610 nm filter, SKYRIS 132M camera. Seeing 8/10.*

The Wrinkle Ridge That Ends in Herodotus A, Revisited

Alberto Anunziato

Rainy season in my region, a time of little observation, ideal for diving into the images in our database. And resume old projects. In the March 2021 issue, we published "The wrinkle ridge that ends in Herodotus A (visually and photographically"), in which we analyzed the morphological structure of this unnamed wrinkle ridge in Oceanus Procellarum from the comparison between an initial visual observation and a detail of a photographic image of the area in which it is located, with emphasis on the comparative advantages of both types of observation. From the Lunar Section of the Liga Iberoamericana de Astronomía (LIADA) we launch an alert to add observations of this wrinkle ridge, with the aim of knowing its morphological components more precisely. We collect some images, and now we share them. We found it interesting to use the images at our disposal, not only those from missions such as Apollo or Lunar Reconnaissance Orbiter, but also those from ALPO amateurs, belonging to our Lunar Gallery and the Jim Loudon Observatory's Lunar Image Archive. Moreover, we find it more interesting to start with telescopic images and then look for information to interpret them in images from orbit, to improve our interpretation expertise of the lunar features that we observe. I find it very gratifying to be able to analyze images that other amateurs share, it is the spirit with which we add observations to ALPO, hoping that they will be useful to others. The story of this collaboration begins in the aforementioned March 2021 issue of *The Lunar Observer*, on whose page 14 IMAGE 1 appeared (which began our search), composed of a drawing by Alberto Anunziato and a photograph by Sergio Babino.

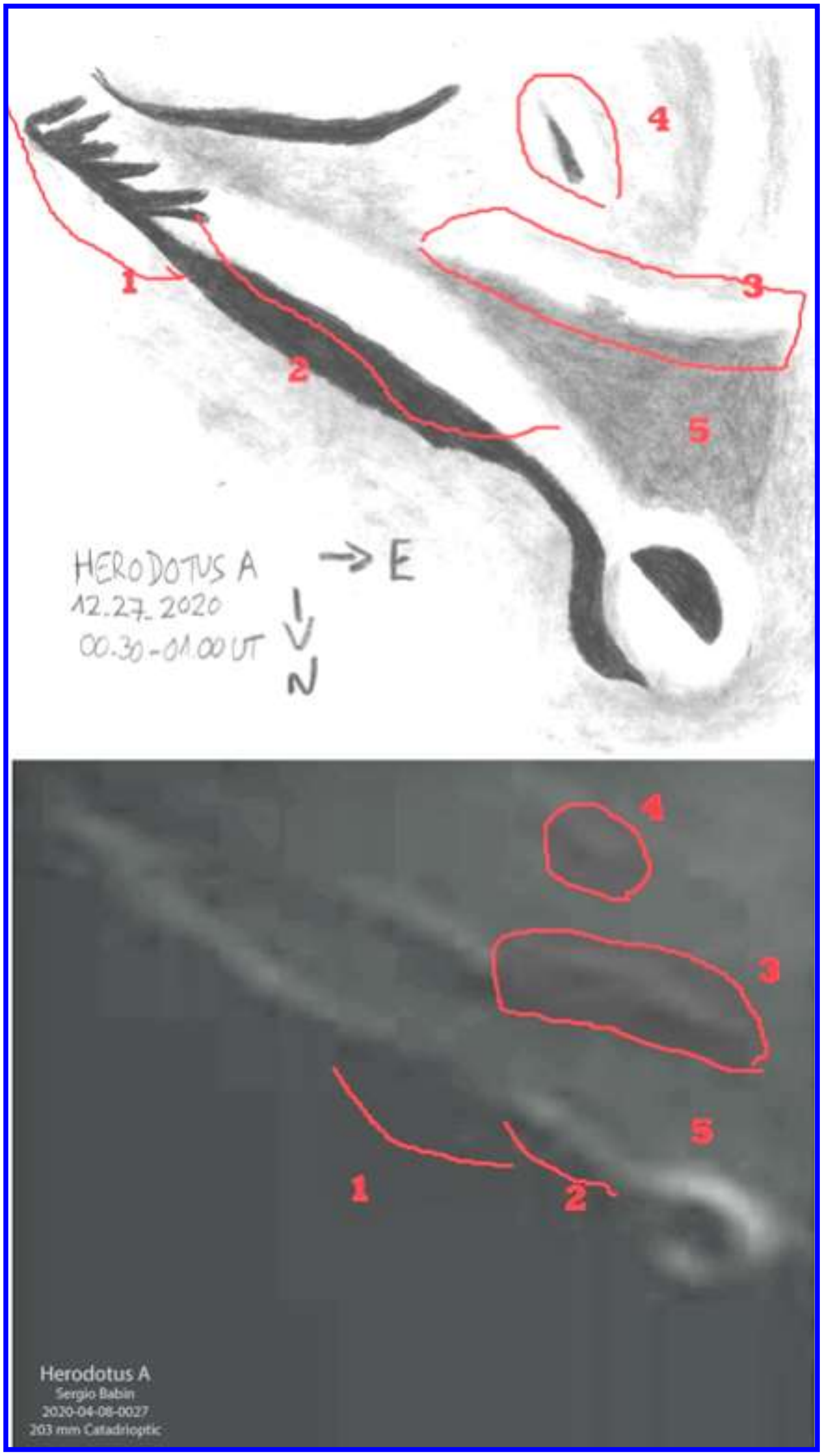


***Image 1, Herodotus A**, Alberto Anunziato, Paraná, Argentina. 2020 December 27, 00:30-01:00 UT. Meade 105 mm EX Maksutov-Cassegrain telescope, 154 x and Herodotus A, Sergio Babino, Montevideo, Uruguay. 2020 April 08 00:27 UT. 203 mm catadrioptic telescope. North lower right, west upper right.*

We start by analyzing the morphological structure of this wrinkle ridge. Let us remember what we can identify in a wrinkle ridge: the two components, arch and crest: "a broad arch and sharp ridge and sometimes secondary ridges of smaller magnitude" (Thompson) (IMAGE 2), and the steepest slope and the smoothest slope (IMAGE 3). In the same month of March 2021 David Teske added an observation and also located our wrinkle ridge in the Lunar Chart Series of the Lunar and Planetary Institute (LAC 38 Seleucus). IMAGE 4 is a detail of said chart, in which we insert the indications east-west, because they will be relevant for the analysis.

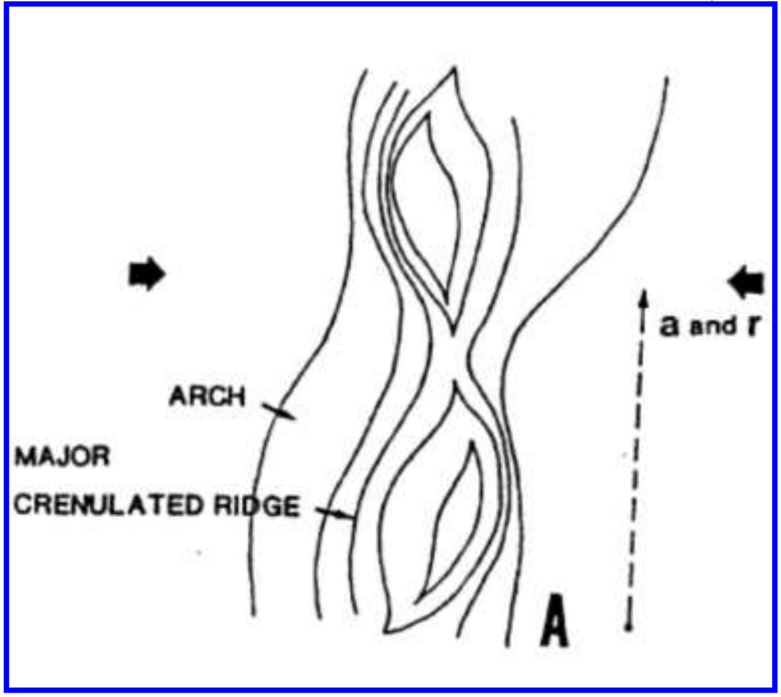


Image 2, *Aubele 1989.*

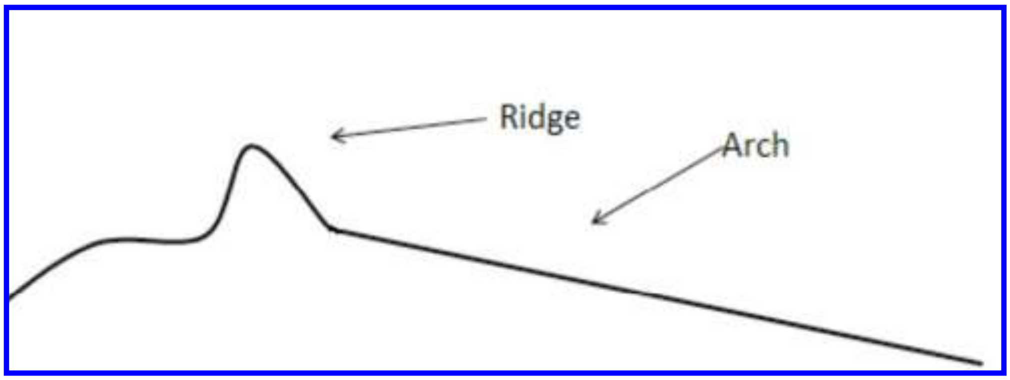


Image 3 *Thompson et al, 2017.*

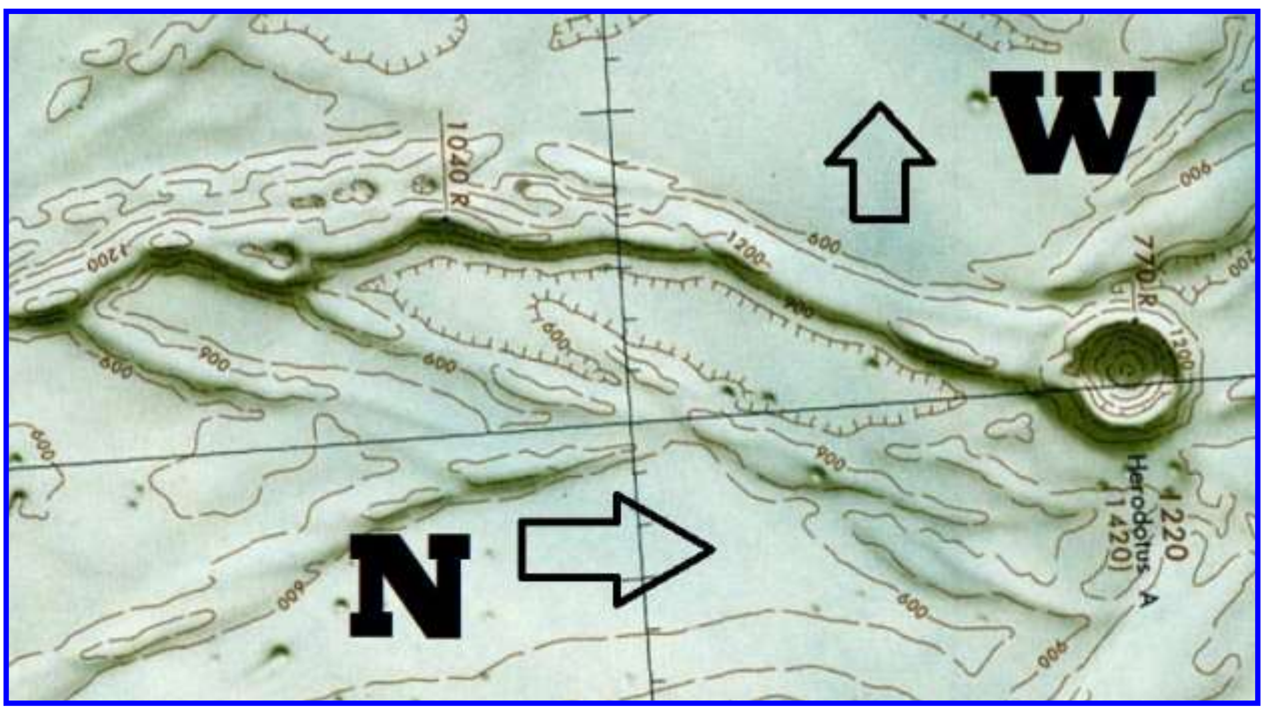


Image 4, https://www.lpi.usra.edu/resources/mapcatalog/LAC/

IMAGE 5 is extracted from the LROC Quickmap. We note that it is a frontal illumination image, which does not present much detail. IMAGE 6 also belongs to the LROC Quickmap, in which the segments identified as wrinkle ridges in the Map of lunar wrinkle ridges digitized from LROC Wide Angle Camera (WAC) are indicated.

***Image 5**, Herodotus A LROC.*

***Image 6** Herodotus A LROC.*

IMAGE 7 is the relief (using the Lunar Orbiter Laser Altimeter-LOLA altitude data available in the LROC Quickmap) of the two segments ending at Herodotus A, the right side of the image. We see that the segment closest to the crater is higher than the segment furthest to the left – south (it looked so visually bright near the terminator in IMAGE 1 for this reason). We also see in the south-north relief that the two segments are joined by fairly high ground, giving the impression that the two segments are actually a geological unit (and perhaps they are). IMAGE 8 and 9 also use the LOLA data, but to analyze both slopes, east and west. IMAGE 9 is a detail of IMAGE 8. What do we see? Remember that there is a difference in elevation between the ground surface on either side of the wrinkle ridge. In the case of our wrinkle ridge, we see that the surface of the Oceanus Procellarum to the west of the dorsum is lower than the surface to the east. The difference, as in any wrinkle ridge, is a few tens of meters, so it is difficult to appreciate from Earth. There is another fact that emerges from IMAGE 9: the steepest slope is the east and the gentlest is the west. This is indeed an observationally important fact: "Although not very high (100 to 300 meters), ridge crests are often sufficiently steep that they cast shadows, and their sunward-facing slopes are brighter than those with gentler arches" (Wood, page 44).

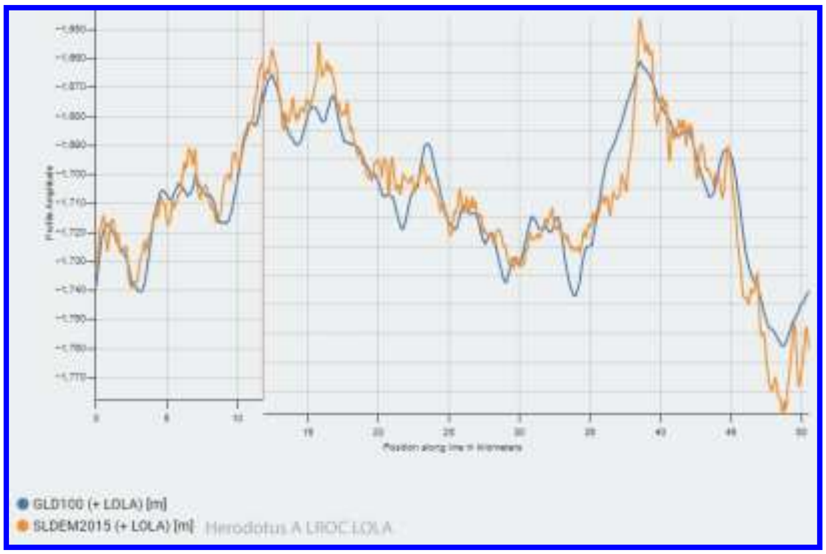


***Image 7**, Herodotus A LROC, LOLA.*

***Image 8**, Herodotus A LROC. LOLA.*

***Image 9**, Herodotus A LROC. LOLA, close-up of image 8.*

Unfortunately, there is an observational bias in all of our images; the illumination comes from the east, casting shadows to the west. This is explained because the observation of an area near the western limb is much more frequent in the first quarter (in the first hours of the night) than in the last quarter (last hours of the night). To which we must add that our wrinkle ridge is practically invisible when the terminator is not in the vicinity. Therefore, in our images the westward shadows cast by the entire wrinkle ridge (arch and crest) obscure the gentler west slope. In turn, oblique illumination at dawn illuminates the steeper eastern slope, so in all our images sunlight falls on the narrower side of the dorsum and thus appears elongated. Likewise, seeing the relief of the wrinkle ridge in IMAGE 9, it appears that the difference in slope between both sides is minimal, unlike most of the wrinkle ridge, which have two sides with slopes that are very different from each other. Let's start with the first images that came to us, from friends of ALPO. On page 92 of the same March 2021 issue that IMAGE 1 appeared, there is an image by Howard Eskildsen of Herodotus Omega (IMAGE 10), showing this magnificent dome (including its pit) in incredible detail. In this very precise image, our wrinkle ridge is seen in all its extension with absolute clarity.

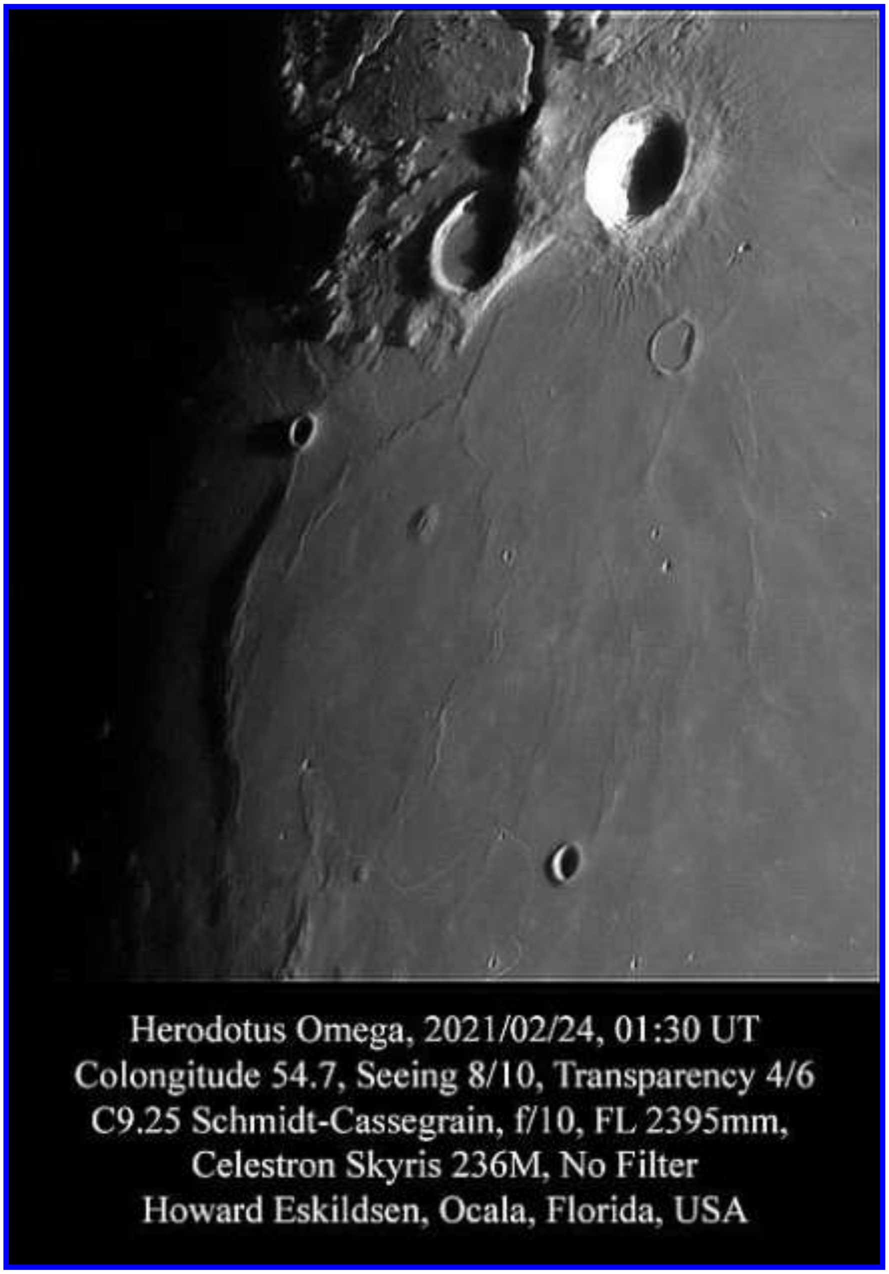


Image 10, Herodotus Omega, *Howard Eskildsen, Ocala, Florida, USA. 2021 February 24 01:30 UT, colongitude 54.7^o. Celestron 9.25 inch Schmidt-Cassegrain telescope, SKYRIS 236M camera. Seeing 8/10, transparency 4/6.*

We will focus on the final part of the dorsum, which ends in Herodotus A. IMAGE 11 is a detail of IMAGE 10, in which you can see the different morphology of the two segments, the southern one (left) has a crest that changes along the arc, while in the northern segment (right, near Herodotus A) the crest follows a rectilinear direction along the arch. In the northern segment the crest is much brighter than in the southern segment (left). David Teske was the first to add an image to our search (IMAGE 12).

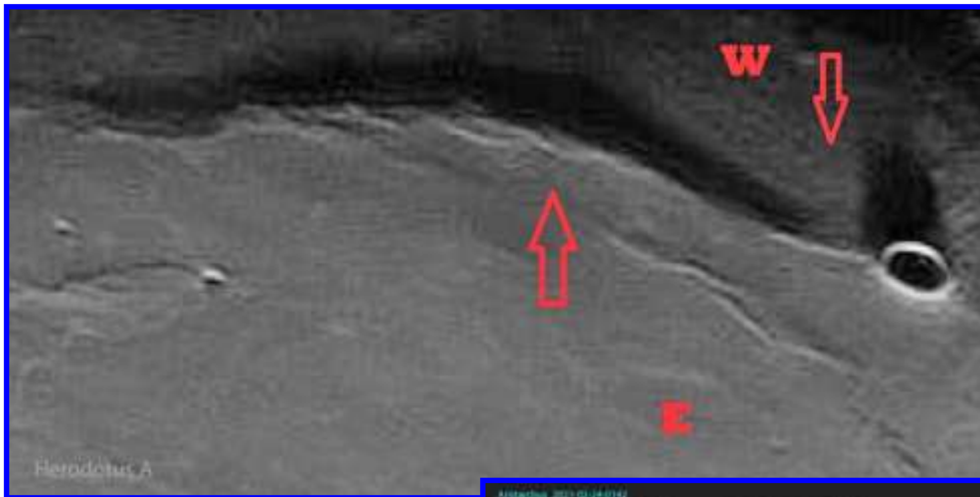


Image 11, Herodotus Omega, *Howard Eskildsen, Ocala, Florida, USA. 2021 February 24 01:30 UT, colongitude 54.7º. Celestron 9.25 inch Schmidt-Cassegrain telescope, SKYRIS 236M camera. Seeing 8/10, transparency 4/6. Close-up of image 10. North to the right.*

Image 12, Aristarchus, *David Teske, Louisville, Mississippi, USA. 2021 February 24 01:42 UT, colongitude 52.2º. 4 inch f/15 refractor, IR block filter, ZWO ASI120mm/s camera. Seeing 8-9/10.*

IMAGE 13 is a detail of IMAGE 12. The 3 red arrows indicate the two segments and the separation between them. We also enjoyed browsing the images in the Jim Loudon Observatory's Lunar Image Archive, where several images capture our wrinkle ridge, such as IMAGE 14.

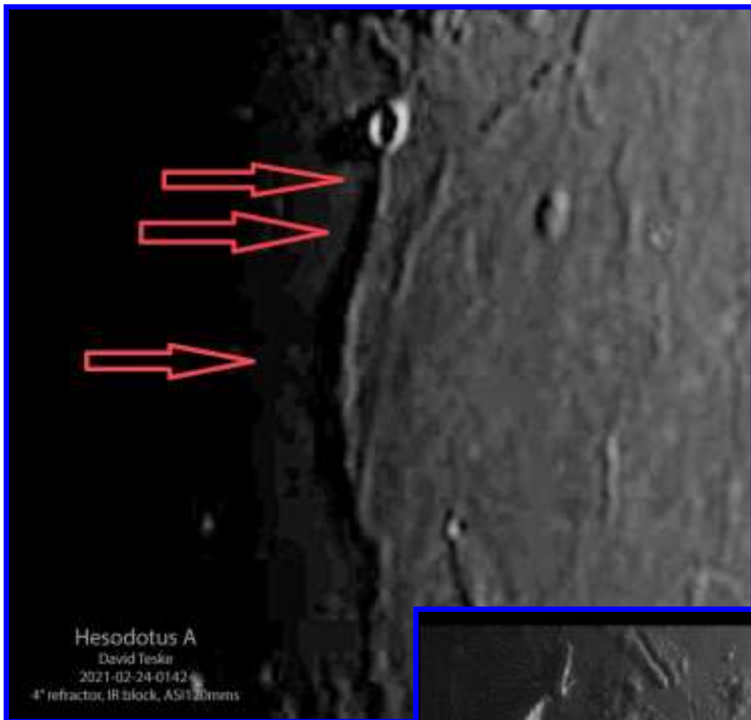


Image 13, Aristarchus, *David Teske, Louisville, Mississippi, USA. 2021 February 24 01:42 UT, colongitude 52.2°. 4 inch f/15 refractor, IR block filter, ZWO ASI120mm/s camera. Seeing 8-9/10. Close-up of image 12.*

Image 14, Aristarchus, *Rik Hill, Loudon Observatory, Tucson, Arizona, USA. 2012 May o3 02:39 UT. TEC 8 inch f/20 Maksutov-Cassegrain telescope, UV/IT blocking filter, DMK21AU04 camera. Seeing 7/10.*

Trapecio Austral, a fellow association from the city of Mar del Plata, Argentina, joined the search (as always, they are very active observers). Eduardo Horacek and Esteban Andrada added two very valuable series of observations (July and August 2021) to our study. We select IMAGE 15, from July 2021, in which, although the wrinkle ridge is illuminated frontally, we clearly see the bright zone (the crest) to the east and the shadows to the west. IMAGE 16 shows the same, but, with more oblique illumination and near the terminator, with a higher degree of detail. This IMAGE 16 will also be useful for a future Focus On (Northern Bright Ray Craters), as the black arrow shows a unique detail: a thick bright ray from Kepler passes over a wrinkle ridge near Diophantus.

Image 15, Herodotus A, *Eduardo Horacek and Esteban Andrada , Mar del Plata, Argentina . 2021 July 22, 22:04 UT. 150 mm Maksutov-Cassegrain telescope, Can EOS Rebel T5i camera. North to the left.*

Image 16, Herodotus A, *Eduardo Horacek and Esteban Andrada , Mar del Plata, Argentina . 2021 August 20, 00:26 UT. 150 mm Maksutov-Cassegrain telescope, Can EOS Rebel T5i camera. North to the left.*

We also found an old image from the Sociedad Lunar Argentina (SLA), which we have used previously, a panoramic view of the very attractive area of Herodotus and Aristarchus, in which our wrinkle ridge appears (IMAGE 17). What I found interesting is the appearance of unity of both fragments of the wrinkle ridge, as seen visually-beyond the bright crests on both segments. The same can be seen in IMAGE 18, from the Sociedad Astronómica Octante of Uruguay.

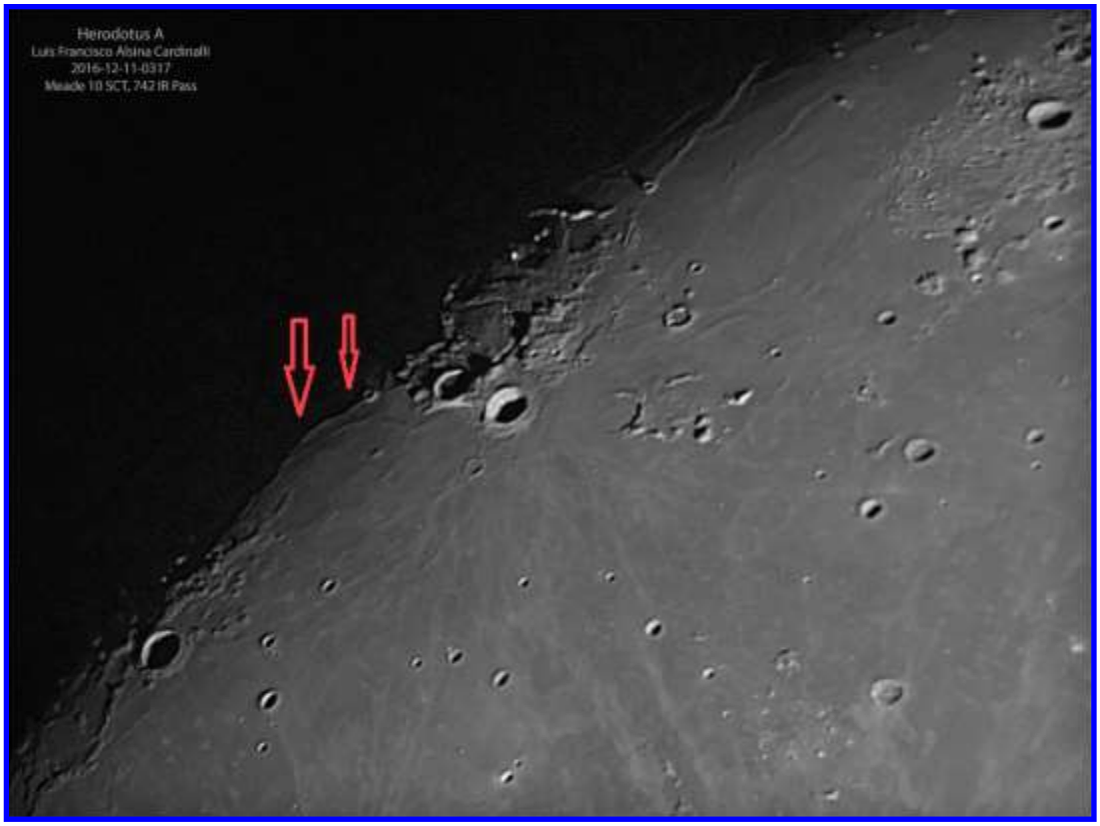


Image 17, Herodotus A, *Luis Francisco Alsina Cardinalli, Oro Verde, Argentina. 2016 December 11 03:17 UT. 10 inch Meade LX200 Schmidt-Cassegrain telescope, Astronomik ProPlanet 742 IR-pass filter.*

Image 18, Herodotus A, *Sergio Babino, Montevideo, Uruguay. 2020 April 08 01:26 UT. 203 mm catadrioptic telescope, ZWO ASO178mm camera..*

We use another image of the friends of ALPO, by Raffaello Lena, whom everyone knows for his leadership in a lunar project as successful as the Lunar Domes Program. IMAGE 19, despite the fact that the illumination on our wrinkle ridge is frontal, shows a high degree of detail, especially showing the beginning of the slope of the arch, especially in the farthest segment of Herodotus A (IMAGE 20).

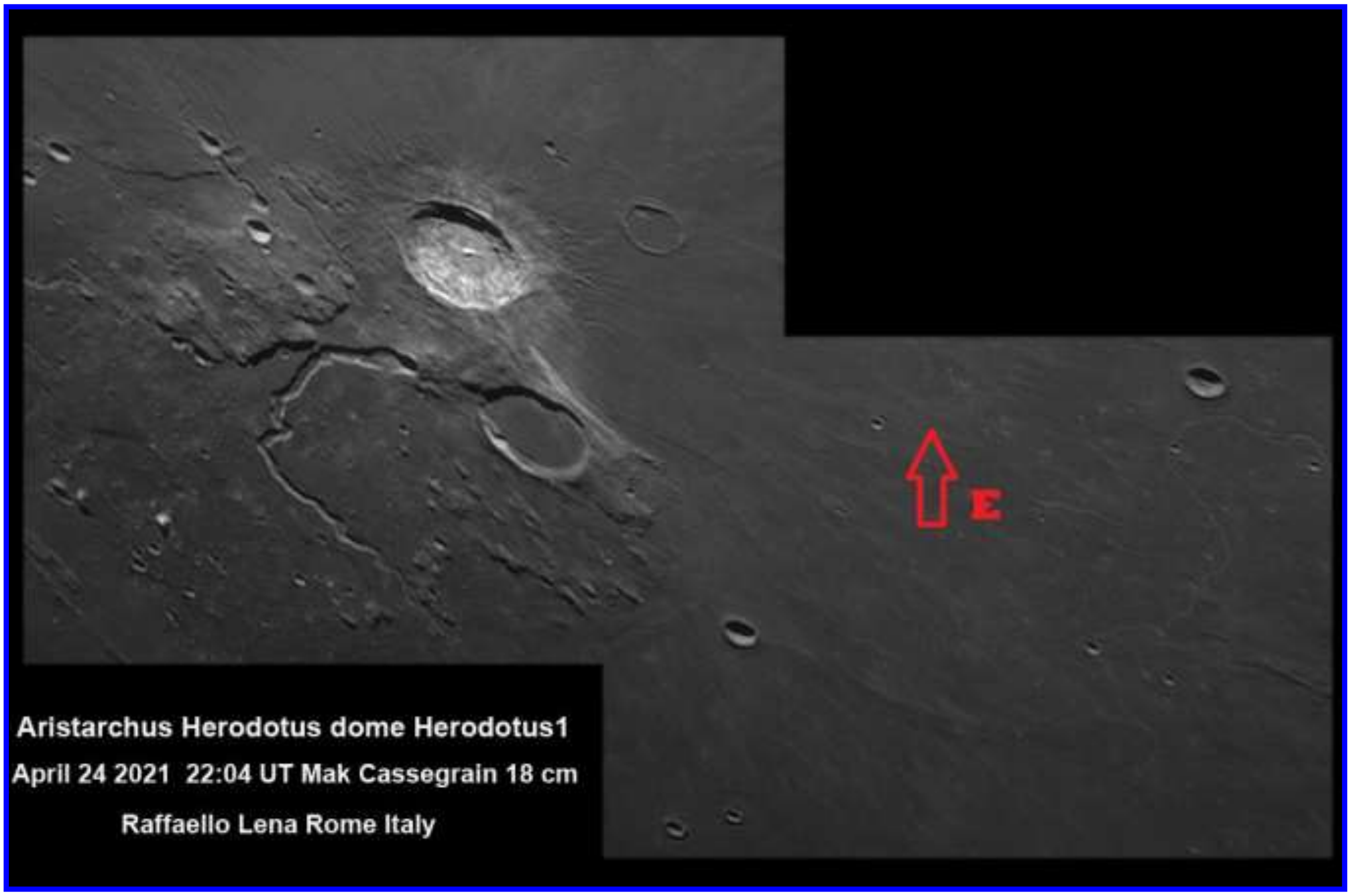


Image 19, Above, Aristarchus, Herodotus dome Herodotus 1, *Raffaello Lena, Rome Italy. 2021 April 24 22:04 UT. 18 cm Maksutov-Cassegrain telescope. North left, west down.*

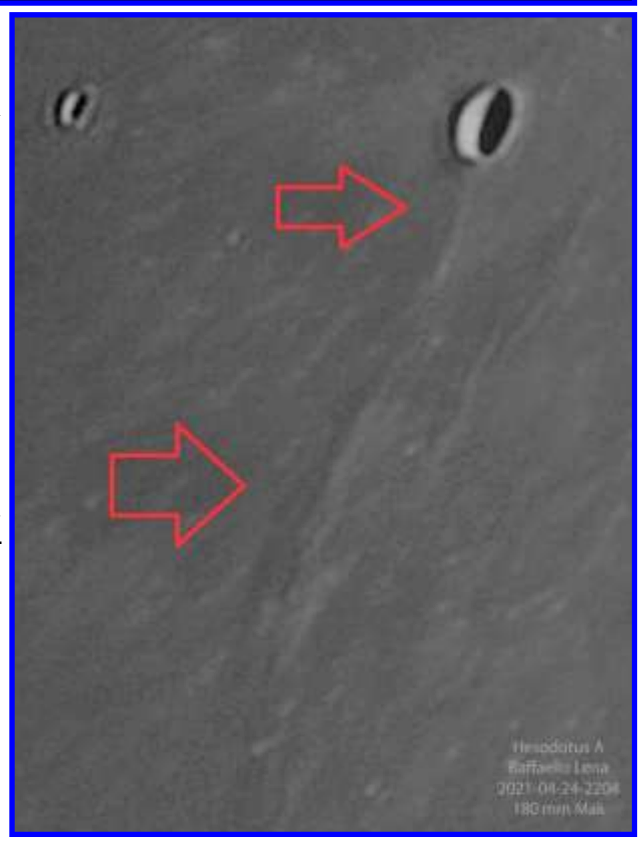


Image 20, Above, Aristarchus, Herodotus dome Herodotus 1, *Raffaello Lena, Rome Italy. 2021 April 24 22:04 UT. 18 cm Maksutov-Cassegrain telescope. North up, west left. Close-up of image 19.*

Raffaello Lena's image allows us to see a detail that we don't see in the previous images: the gentle west slope. Which leads us to end our search with an image taken from lunar orbit by the Apollo XV mission (IMAGE 21), in which we also see the entire wrinkle ridge. Surely the target was the stars in the area, Herodotus, Aristarchus and Vallis Schröteri, but our wrinkle ridge is seen in great detail (IMAGE 22). The red arrow points to the southern segment, in which the crest migrates in direction over the arch, the blue arrow the northern segment (whose straight crest appears brighter, as seen from Earth), and the yellow arrow the lowest area, which according to the Map of wrinkle ridges of the LROC Quickmap it is an intermediate zone between two segments and that in the images and in the relief of the zone obtained by LOLA (IMAGE 7) it seems rather to be a lower zone of a wrinkle ridge than covers the two mentioned segments. It remains for us to specify observations with a waning moon, that is, with illumination from the west. It would also be interesting to think about how future long-range lunar voyages will be planned taking into account these heights that are not very high, but very long, which would hinder projects such as a future lunar railway.

Image 21, *AS15-88-11980.*
https://www.lpi.usra.edu/resources/apollo/frame/?AS15-88-11980

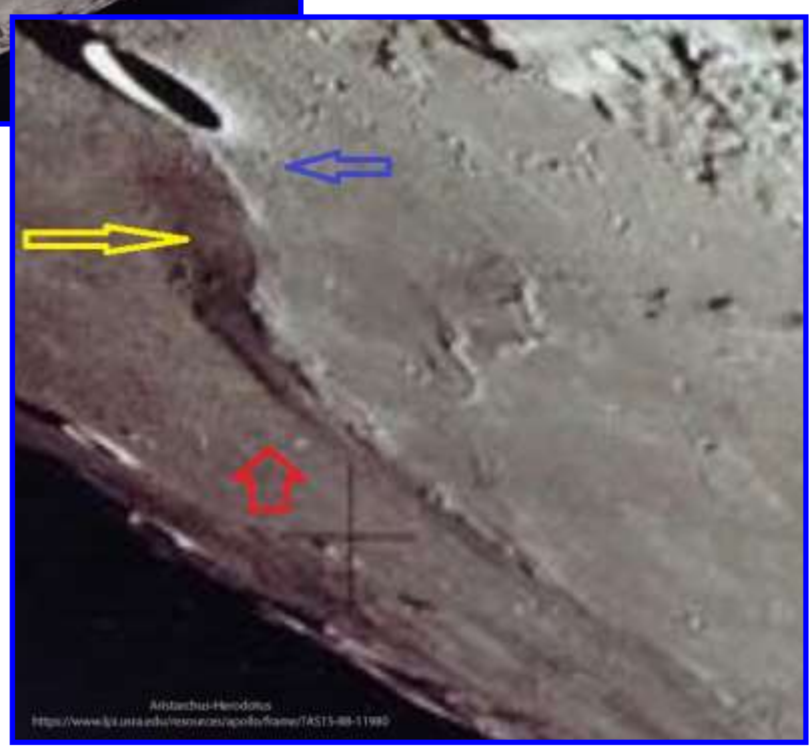


Image 22, *AS15-88-11980.*
https://www.lpi.usra.edu/resources/apollo/frame/?AS15-88-11980

I found this tour of a particular wrinkle ridge interesting for three reasons. First, the possibility of applying data and images from space probes (in this case the distant Apollo and the nearby Lunar Reconnaissance Orbiter) to a study based on images by amateur astronomers from Earth. Second, to specify one of the possibilities that we had foreseen in our participation in the 2021 ALPO Conference ("Amateur Observation of Lunar Wrinkle ridges"). Third, the possibility of taking advantage of the resources offered by the ALPO databases. I thank Sergio Babino, Howard Eskildsen, David Teske, Eduardo Horacek, Esteban Andrada, Raffaello Lena, Luis Francisco Alsina Cardinalli, and Rik Hill for their contributions.

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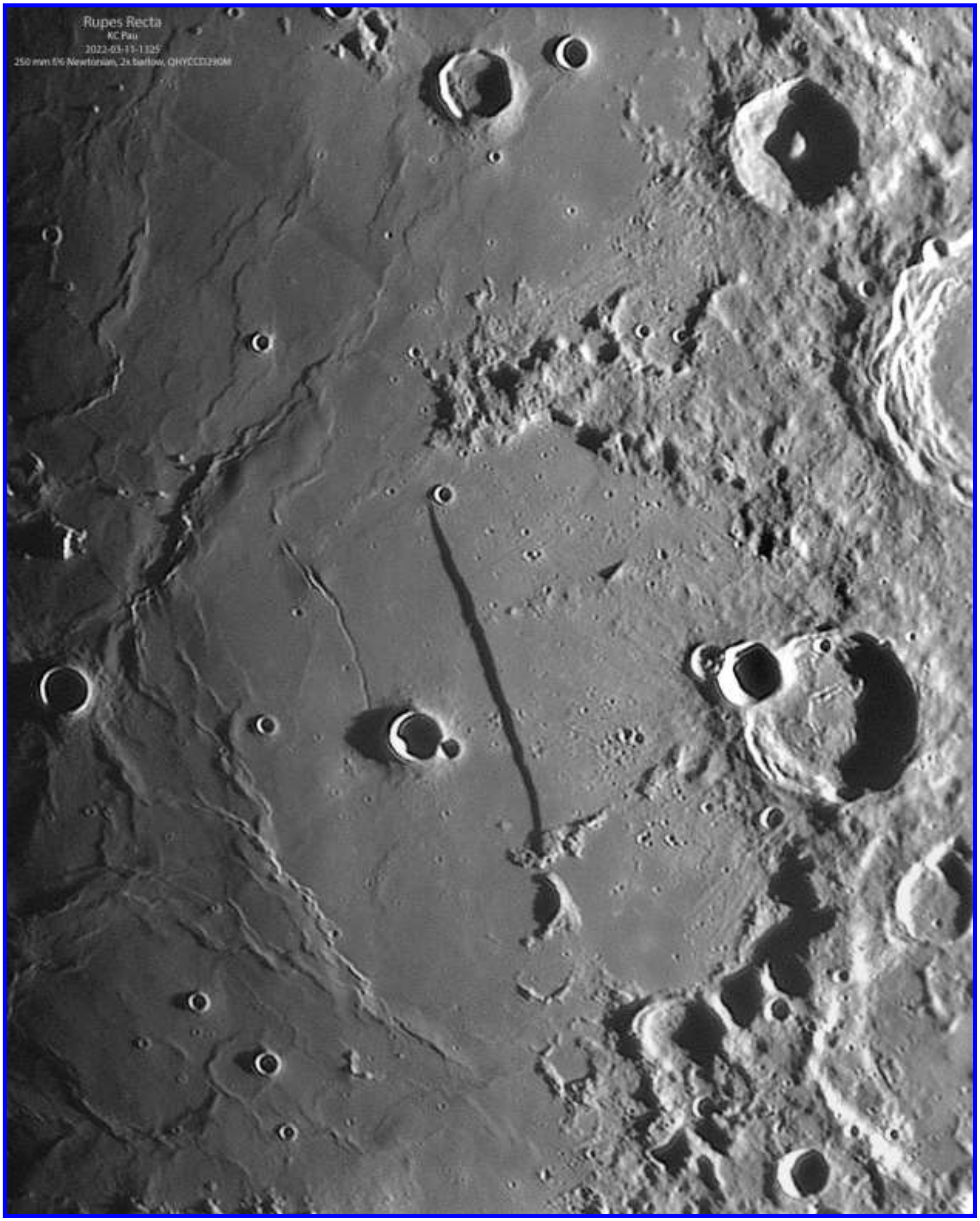
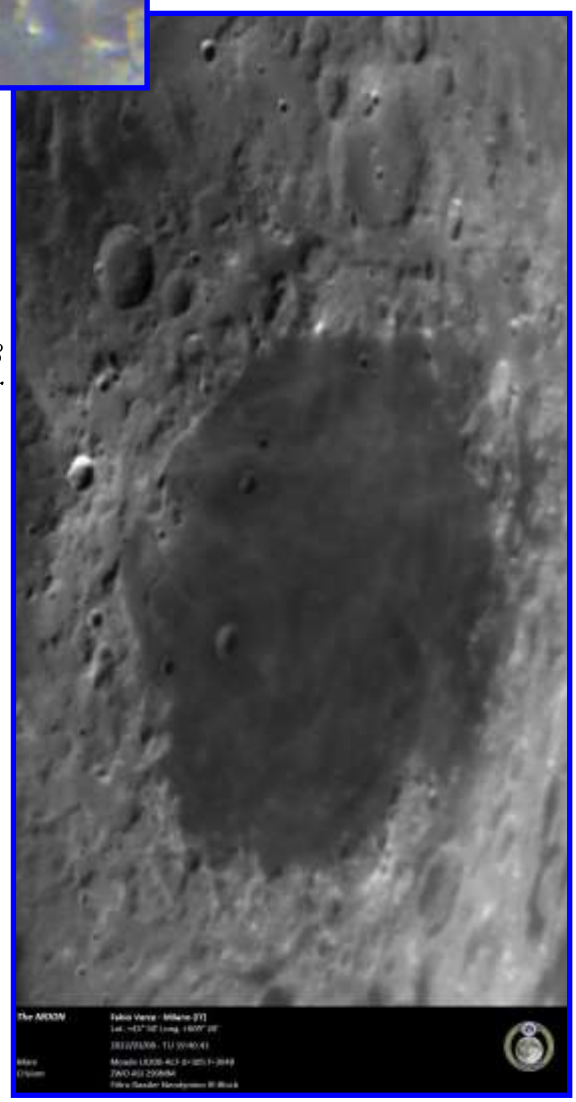
Thompson, T.J. et al. (2017) Global lunar wrinkle ridge identifications and analysis. In: Lunar and Planetary Science XLVIII. Disponible en: https://www.hou.usra.edu/meetings/lpsc2017/pdf/2665.pdf

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



Rupes Recta, *KC Pau, Hong Kong, China. 2022 March 11 13:25 UT. 250 f/6 reflector telescope, 2.5x barlow, QHY-CCD290M camera.*

Aristarchus, *Walter Ricardo Elias, AEA, Oro Verde, Argentina. 2022 February 13 23:36 UT. Helios 114 mm reflector telescope, QHY5 II C camera.*



Mare Crisium, *Fabio Verza, SNdR, Milan, Italy. 2022 March 08 19:40 UT. Meade LX200 ACF Schmidt-Cassegrain telescope, Baader Neodymium IR block filter, ZWO ASI290MM camera.*

Clavius, *Guido Santacana, San Juan, Puerto Rico. 2022 March 13 01:04 UT. 3.5 inch Questar telescope, IR filter, ZWO ASI224C camera. Seeing 8/10, transparency 4/6.*

Mare Orientale, *Geoff McNamara, MSATT, Mount Stromlo Observatory, Canberra, Australia. 2022 March 17 15:16 UT, colongitude 86.9º. Meade 12 inch LX200 Schmidt-Cassegrain telescope, IR pass filter, ZWO ASI120mm/s filter. Seeing 8/10, transparency 6/6.*

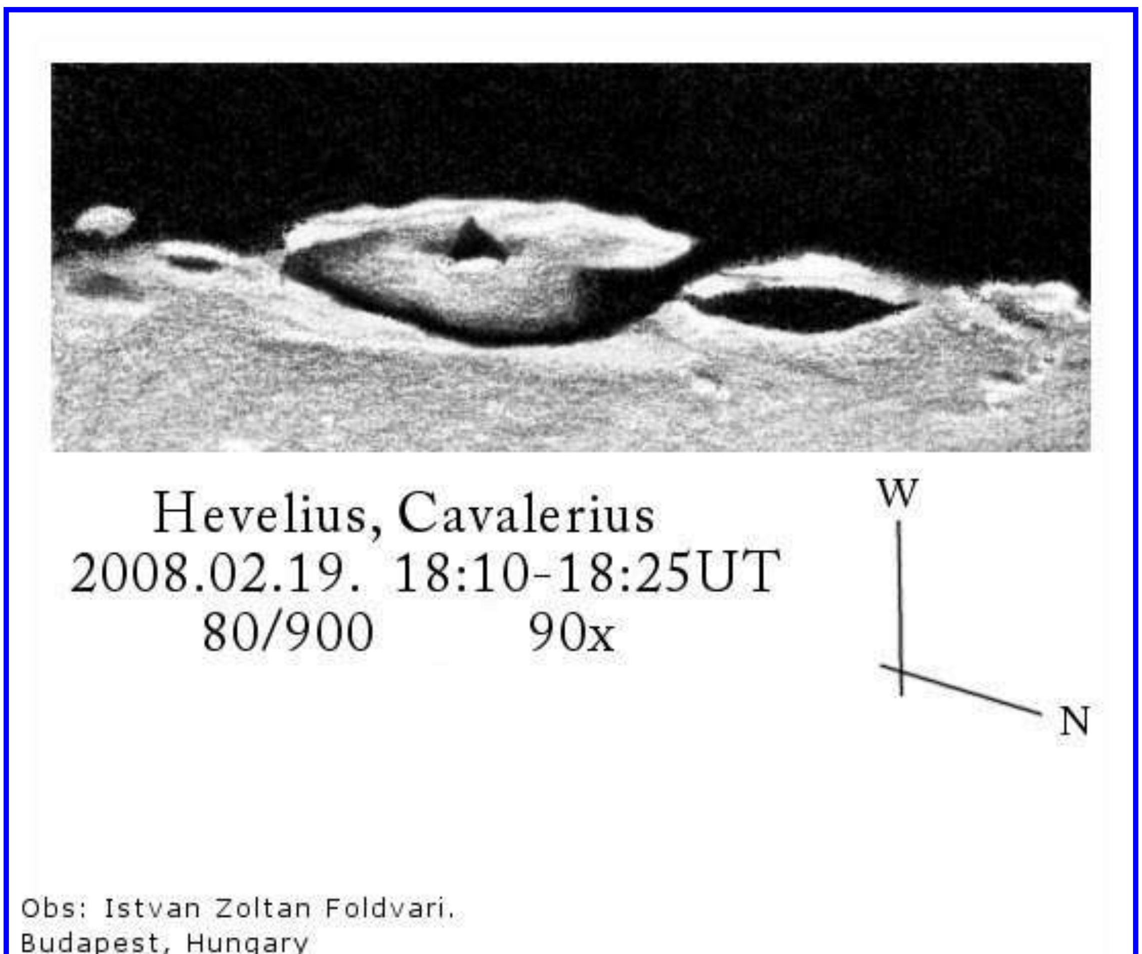
Geoff adds: I thought you might be interested in this image of Mare Orientale. The libration was favorable (8.3 degrees), permitting a panoramic view of the feature. The colongitude was 86.9 degrees, providing sufficient shadow to reveal Montes Cordillera and Montes Rook (outer and inner). Grimaldi is to the upper right (northeast), while the prominent crater on the rim of Montes Cordillera is Eichstadt. The large crater on the top edge of the image (north) is Schlüter.

The only negative aspect was the mare itself was still in shadow; sadly, cloud intervened the following day and prevented a second image being taken.

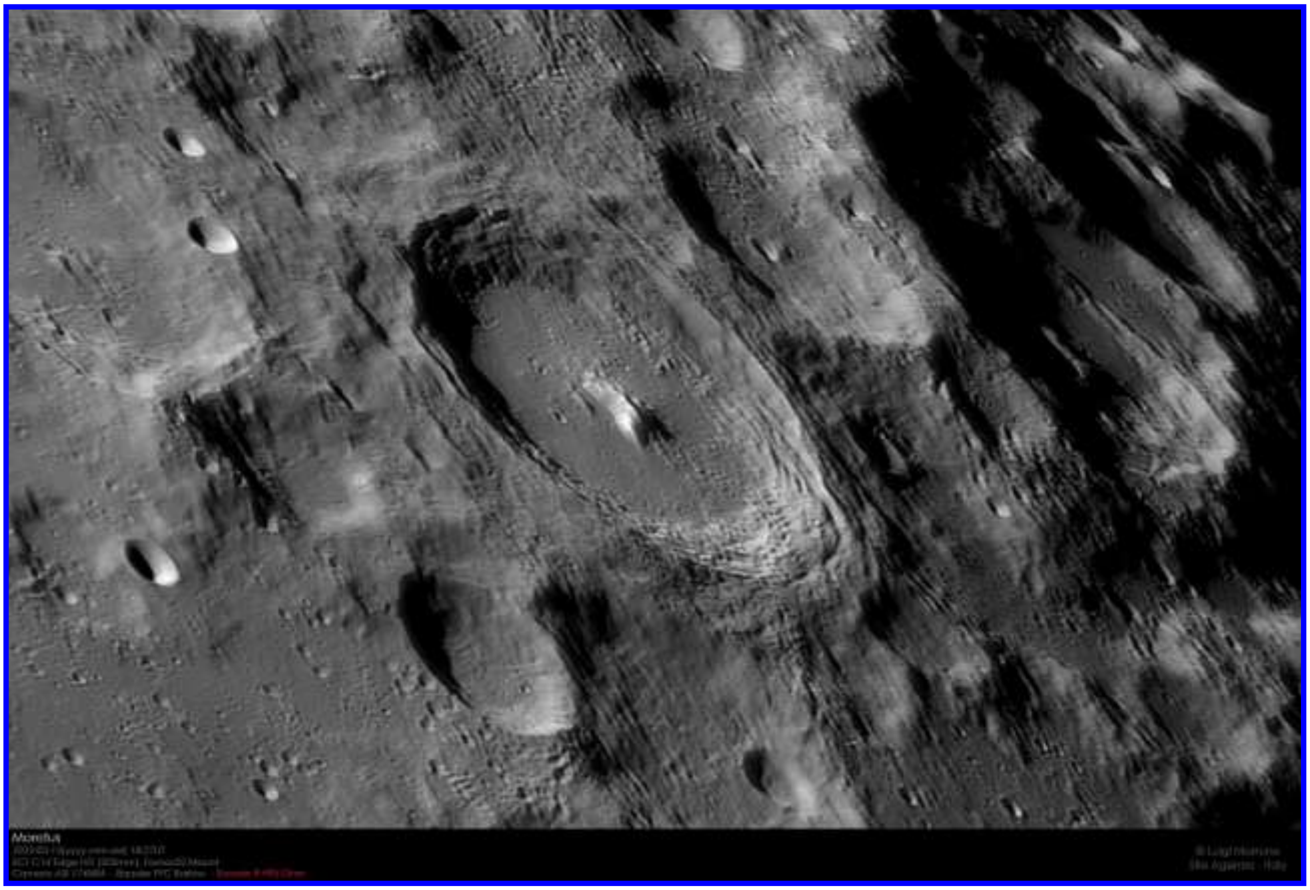
Hippalus, *KC Pau, Hong Kong, China. 2022 March 13 12:49 UT. 250 f/6 reflector telescope, 2.5x barlow, QHYCCD290M camera.*

Menelaus, *Fabio Verza, SNdR, Milan, Italy. 2022 March 09 20:38 UT. Meade LX200 ACF Schmidt-Cassegrain telescope, Baader Neodymium IR block filter, ZWO ASI290MM camera.*

Clavius, *Guido Santacana, San Juan, Puerto Rico. 2022 March 13 01:16 UT. 3.5 inch Questar telescope, 2 x barlow, IR filter, ZWO ASI224C camera. Seeing 8/10, transparency 4/6.*

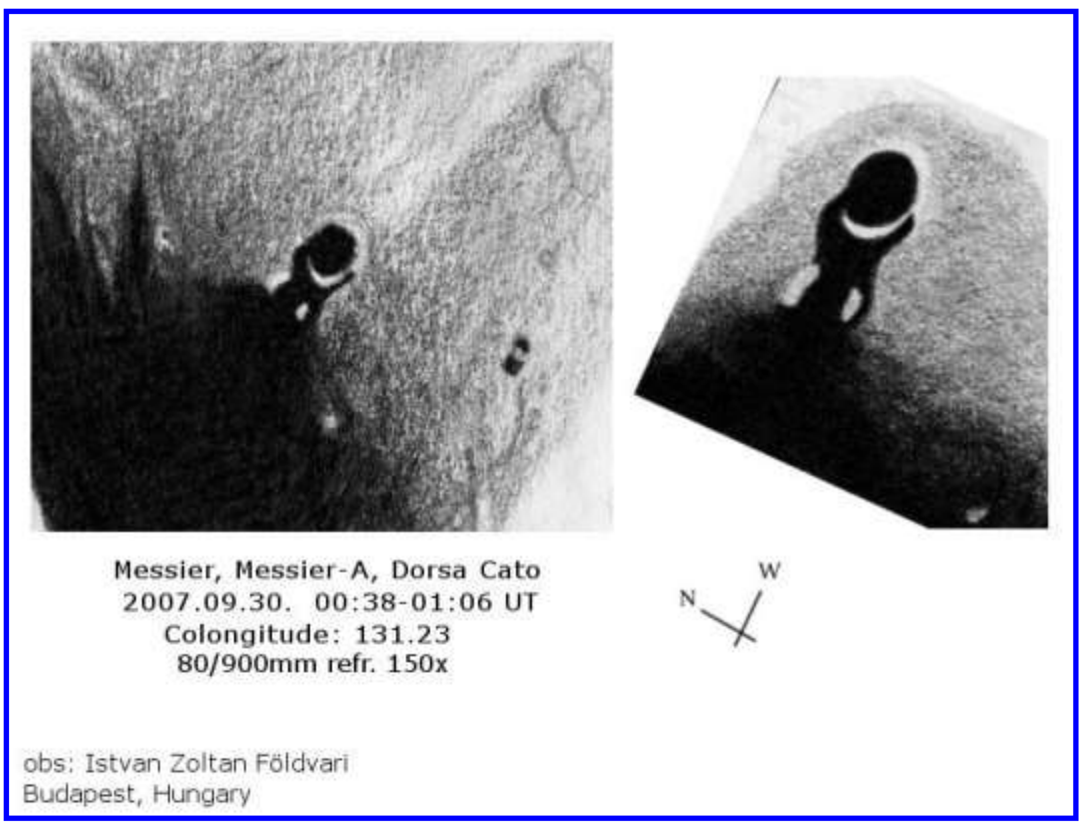


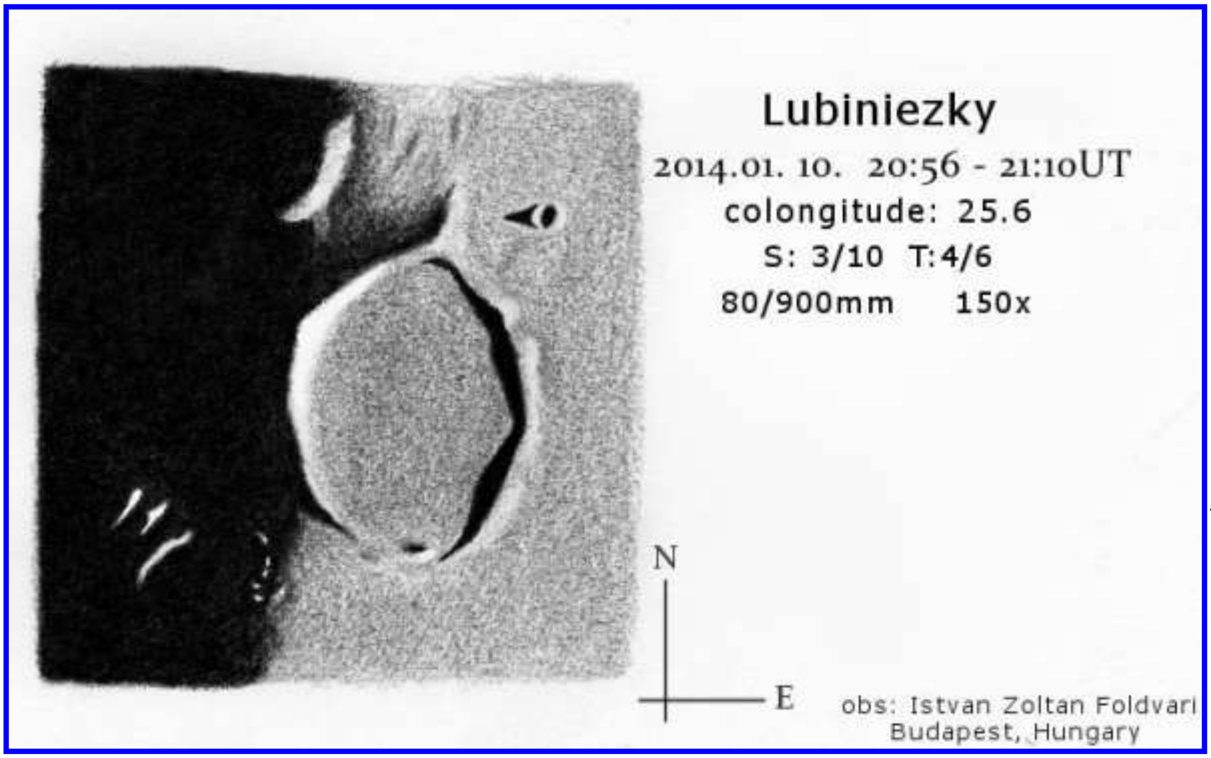
Hevelius and Cavalerius, *István Zoltán Földvári, Budapest, Hungary. 2008 February 19, 18:10-18:25 UT, colongitude 68.7°. 80 mm refractor telescope, 900 mm focal length, 90 x.*



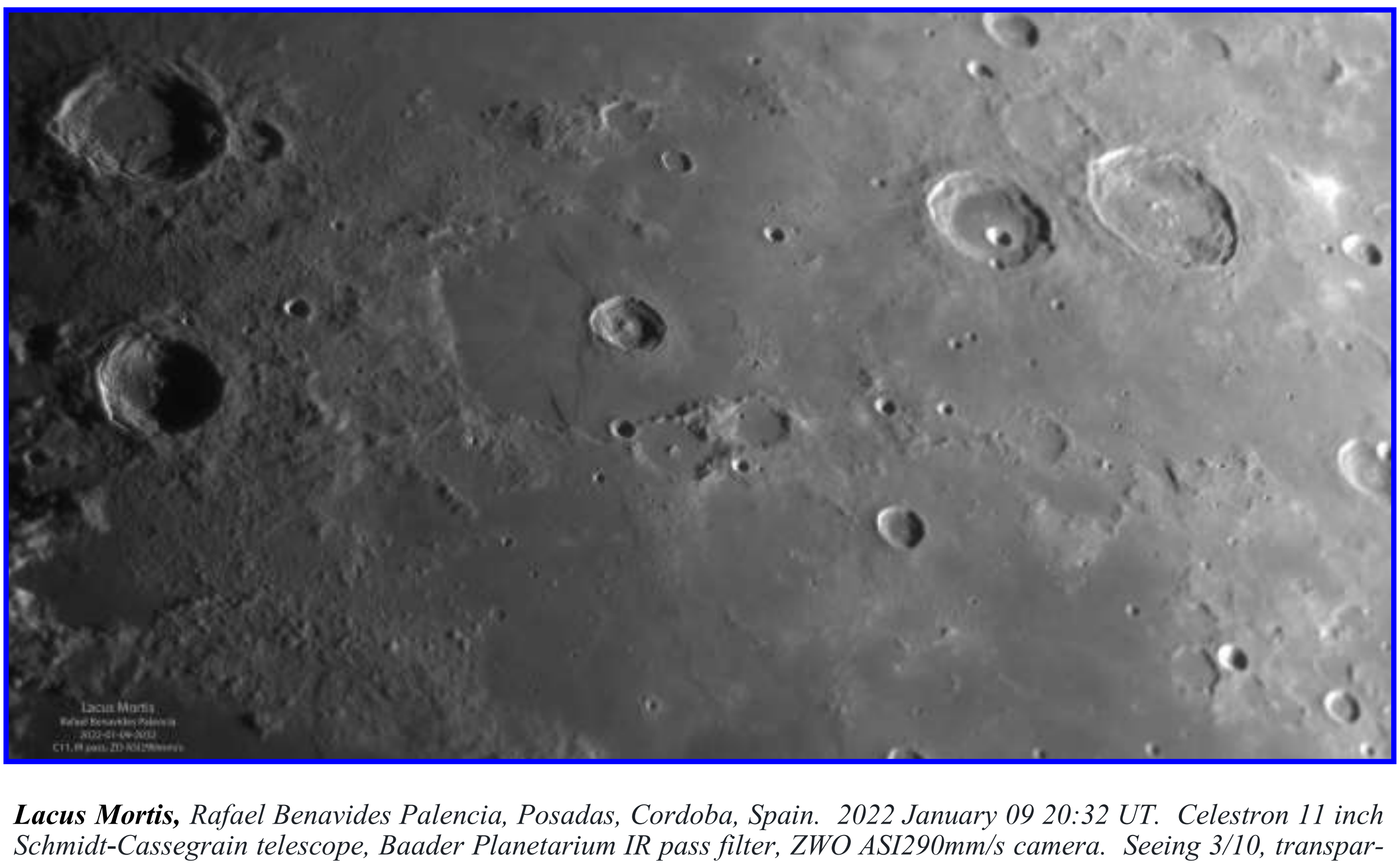
Moretus, *Luigi Morrone, Agerola, Italy. 2022 March 13 18:27 UT. Celestron 14 Edge HD Schmidt-Cassegrain telescope, Fornax 52 mount, Baader FFC barlow, Baader R + IR610 nm filter, ZWO ASI174MM camera. North lower-left, west lower right.*

Messier, Messier A and Dorsa Cato, *István Zoltán Földvári, Budapest, Hungary. 2007 September 30, 01:06 UT, colongitude 131.23º. 80 mm refractor telescope, 900 mm focal length, 150 x. Seeing 9/10, transparency 5/6.*





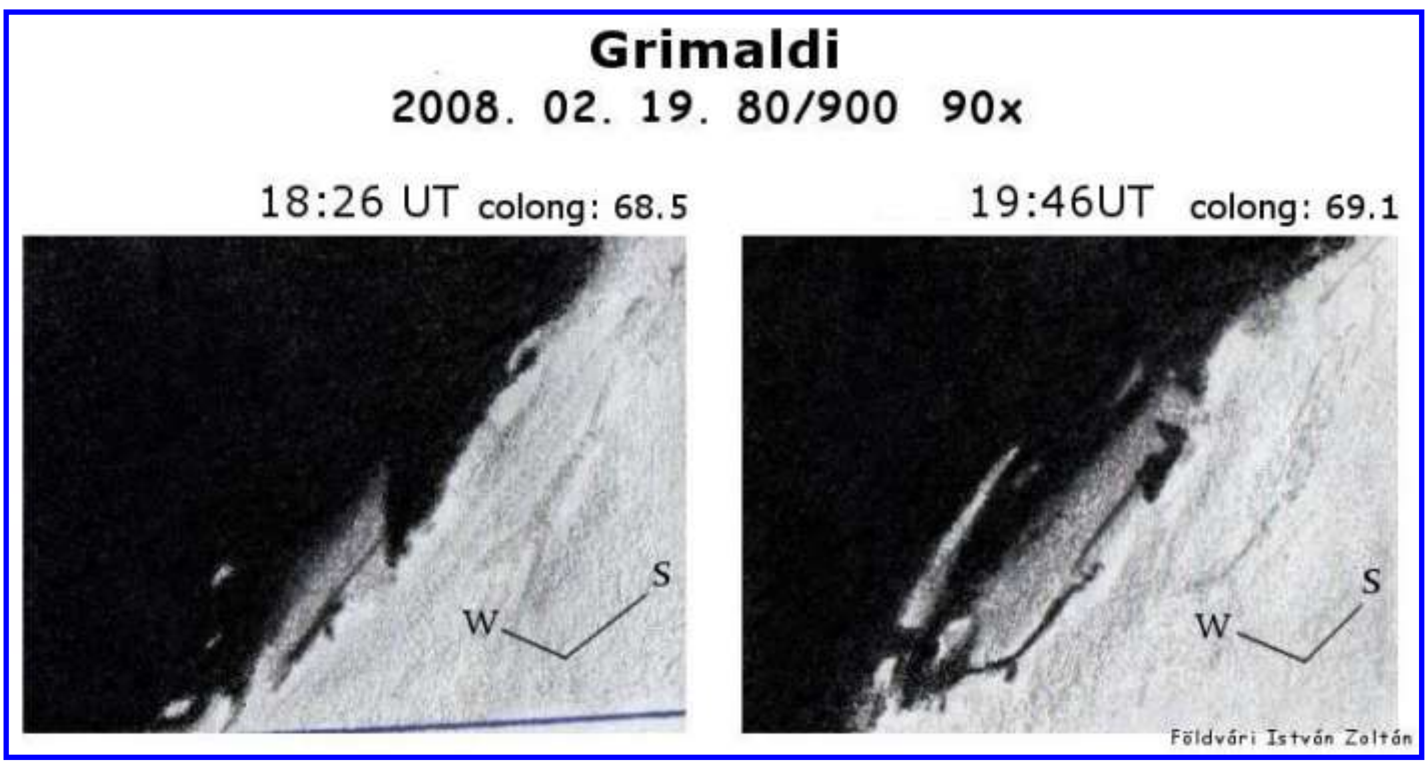
Lubiniezky, *István Zoltán Földvári, Budapest, Hungary. 2014 January 10, 01:06 UT, colongitude 25.6°. 80 mm refractor telescope, 900 mm focal length, 150 x. Seeing 3/10, transparency 4/6.*



Lacus Mortis, *Rafael Benavides Palencia, Posadas, Cordoba, Spain. 2022 January 09 20:32 UT. Celestron 11 inch Schmidt-Cassegrain telescope, Baader Planetarium IR pass filter, ZWO ASI290mm/s camera. Seeing 3/10, transparency 5/6.*

Pitatus, *Guido Santacana, San Juan, Puerto Rico. 2022 March 13 01:03 UT. 3.5 inch Questar telescope, IR filter, ZWO ASI224C camera. Seeing 8/10, transparency 4/6.*

Grimaldi, *István Zoltán Földvári, Budapest, Hungary. 2008 February 19 18:26 UT, colongitude 68.5°. 80 mm refractor telescope, 900 mm focal length, 90 x. Seeing 6/10, transparency 4/6.*

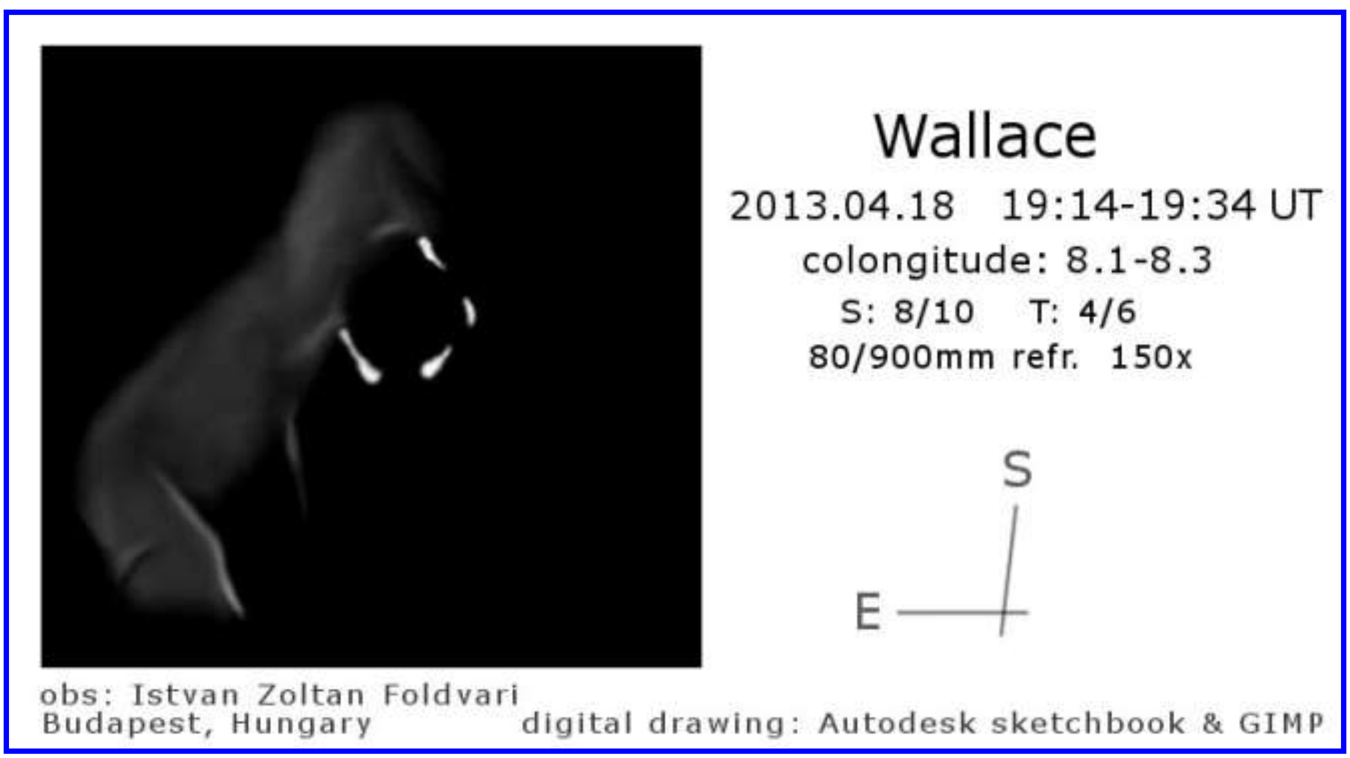


Moltke, *Walter Ricardo Elias, AEA, Oro Verde, Argentina. 2022 March 12 23:41 UT. Celestron CPC1100 11 inch Schmidt-Cassegrain telescope, ZWO ASI120mm/s camera.*

Copernicus, *Fabio Verza, SNdR, Milan, Italy. 2022 March 26 04:23 UT. Meade LX200 ACF Schmidt-Cassegrain telescope, Baader Neodymium IR block filter, ZWO ASI290MM camera.*

Copernicus, *Guido Santacana, San Juan, Puerto Rico. 2022 March 13 01:04 UT. 3.5 inch Questar telescope, 2 x barlow, IR filter, ZWO ASI224C camera. Seeing 8/10, transparency 4/6.*

Wallace, *István Zoltán Földvári, Budapest, Hungary. 2013 April 18 19:14-19:34 UT, colongitude 8.1º-8.3º. 80 mm refractor telescope, 900 mm focal length, 150 x. Seeing 8/10, transparency 4/6.*



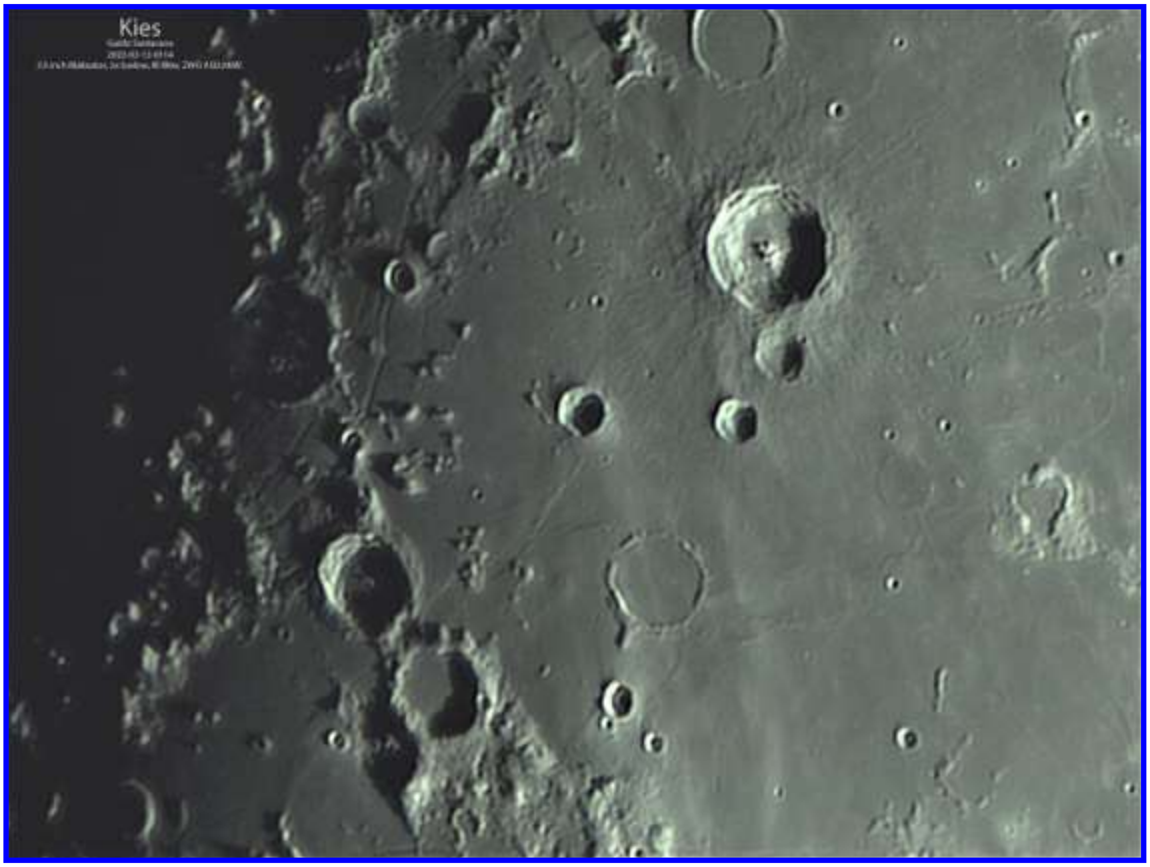
Plato Region, *Guido Santacana, San Juan, Puerto Rico. 2022 March 13 01:08 UT. 3.5 inch Questar telescope, IR filter, ZWO ASI224C camera. Seeing 8/10, transparency 4/6.*

Aristarchus, *Walter Ricardo Elias, AEA, Oro Verde, Argentina. 2022 March 21 01:35 UT. Helios 114 mm reflector telescope, QHY5 II C camera.*

Bonpland γ, ω, *István Zoltán Földvári, Budapest, Hungary. 2014 January 10 20:39-20:55 UT, colongitude 25.4°. 80 mm refractor telescope, 900 mm focal length, 150 x. Seeing 5/10, transparency 4/6.*

Copernicus, *Alan Trumper, AEA, Oro Verde, Argentina. 2022 February 13 22:54 UT. 130 mm Heritage reflector telescope, Nikon D5100 camera.*

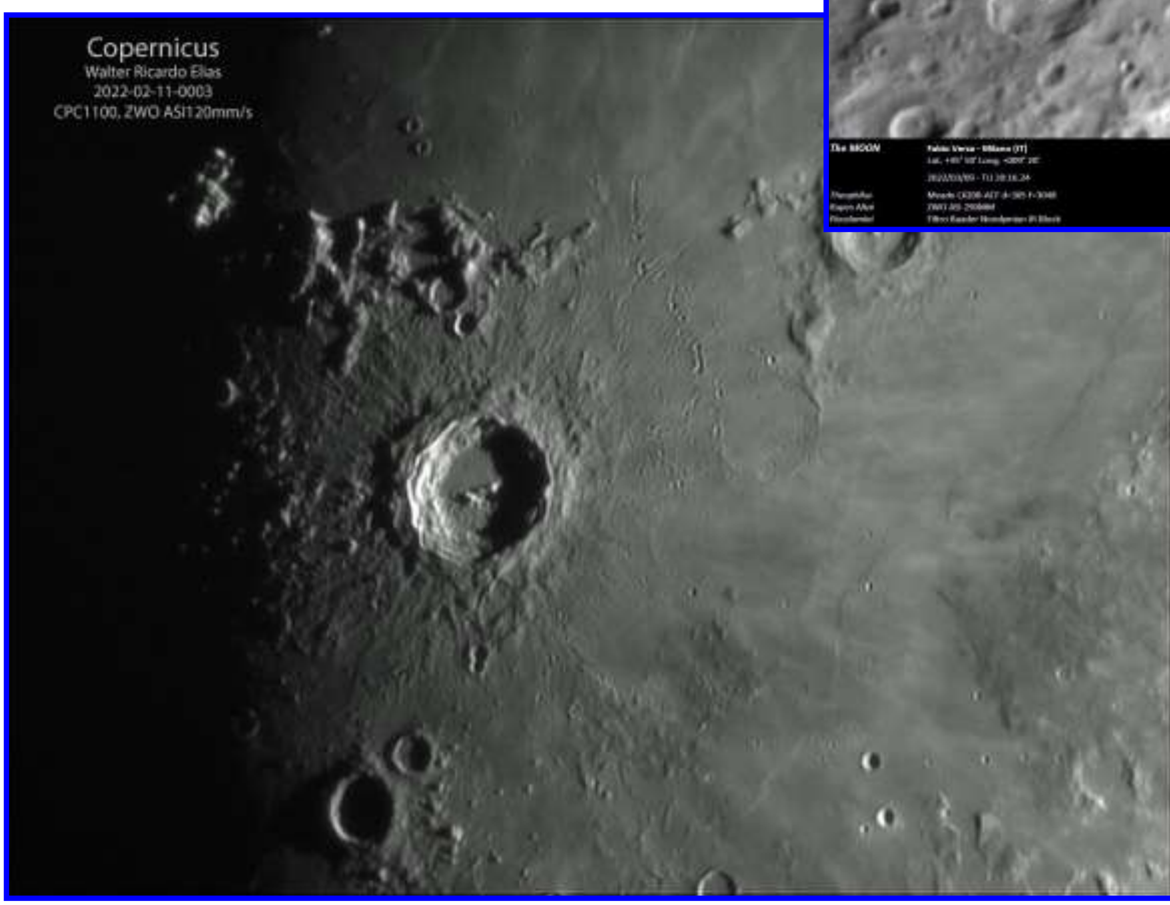
Kies, *Guido Santacana, San Juan, Puerto Rico. 2022 March 13 01:14 UT. 3.5 inch Questar telescope, 2 x barlow, IR filter, ZWO ASI224C camera. Seeing 8/10, transparency 4/6.*

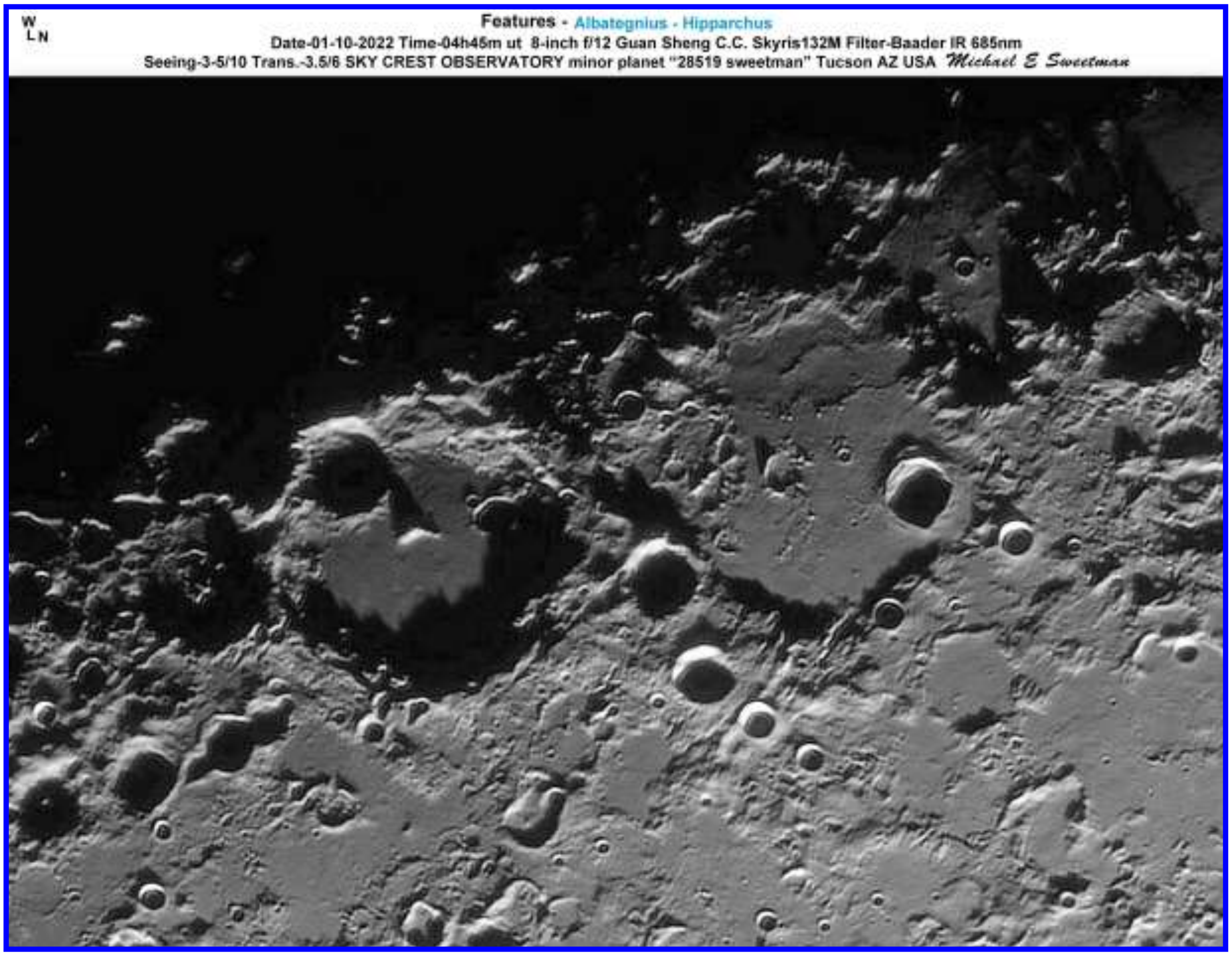


Julius Caesar, *Rafael Benavides Palencia, Posadas, Cordoba, Spain. 2022 January 09 19:48 UT. Celestron 11 inch Schmidt-Cassegrain telescope, Baader Planetarium IR pass filter, ZWO ASI290mm/s camera. Seeing 3/10, transparency 5/6.*

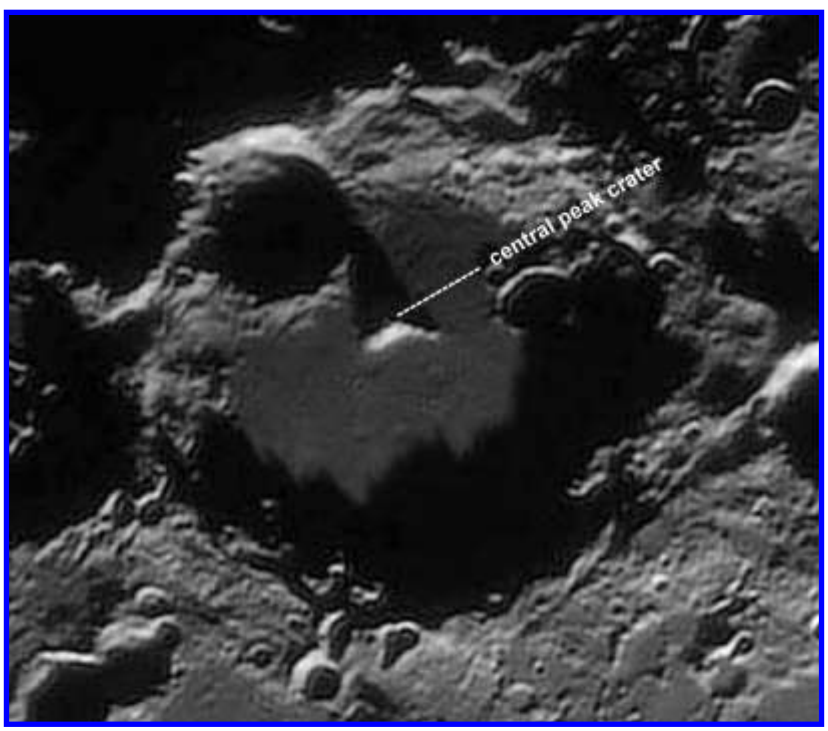
Theophilus, *Fabio Verza, SNdR, Milan, Italy. 2022 March 09 20:16 UT. Meade LX200 ACF Schmidt-Cassegrain telescope, Baader Neodymium IR block filter, ZWO ASI290MM camera.*

Copernicus, *Walter Ricardo Elias, AEA, Oro Verde, Argentina. 2022 February 11 00:03 UT. Celestron CPC1100 11 inch Schmidt-Cassegrain telescope, ZWO ASI120mm/s camera.*

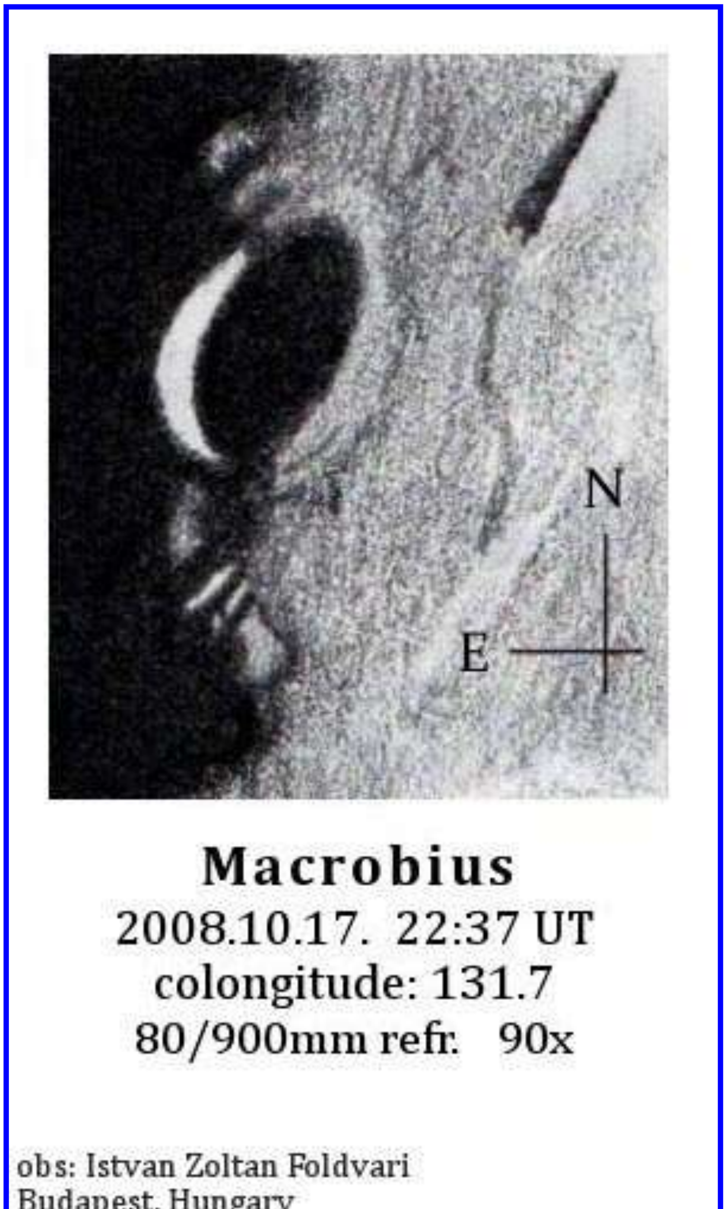




Albategnius-Hipparchus, *Michael Sweetman, Sky Crest Observatory, Tucson, Arizona, USA. 2022 January 10 04:45 UT. 8 inch f/12 Guan Sheng Classical Cassegrain telescope, Baader IR 685nm filter, Skyris 132M camera. Seeing 3-5/10, transparency 3.5/6. Below, an enlargement of the Albategnius central peak with a crater on its top. North right, west up.*



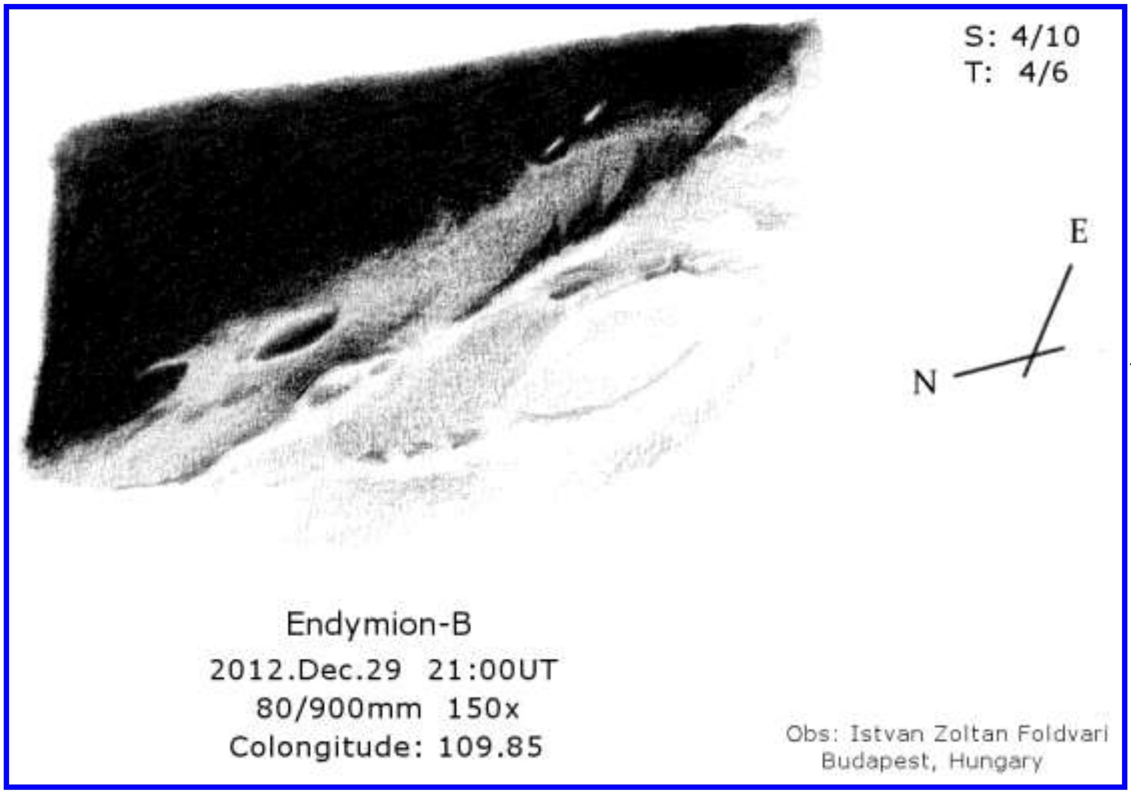
Posidonius, *Fabio Verza, SNdR, Milan, Italy. 2022 March 09 20:30 UT. Meade LX200 ACF Schmidt-Cassegrain telescope, Baader Neodymium IR block filter, ZWO ASI290MM camera.*



Macrobius, *István Zoltán Földvári, Budapest, Hungary. 2008 October 17, 22:37 UT, colongitude 131.7°. 80 mm refractor telescope, 900 mm focal length, 90 x. Seeing 5/10, transparency 3/6.*

Lacus Mortis, *Fabio Verza, SNdR, Milan, Italy. 2022 March 08 19:52 UT. Meade LX200 ACF Schmidt-Cassegrain telescope, Baader Neodymium IR block filter, ZWO ASI290MM camera.*

Aristarchus, *Alan Trumper, AEA, Oro Verde, Argentina. 2022 February 13 22:59 UT. 130 mm Heritage reflector telescope, Nikon D5100 camera.*

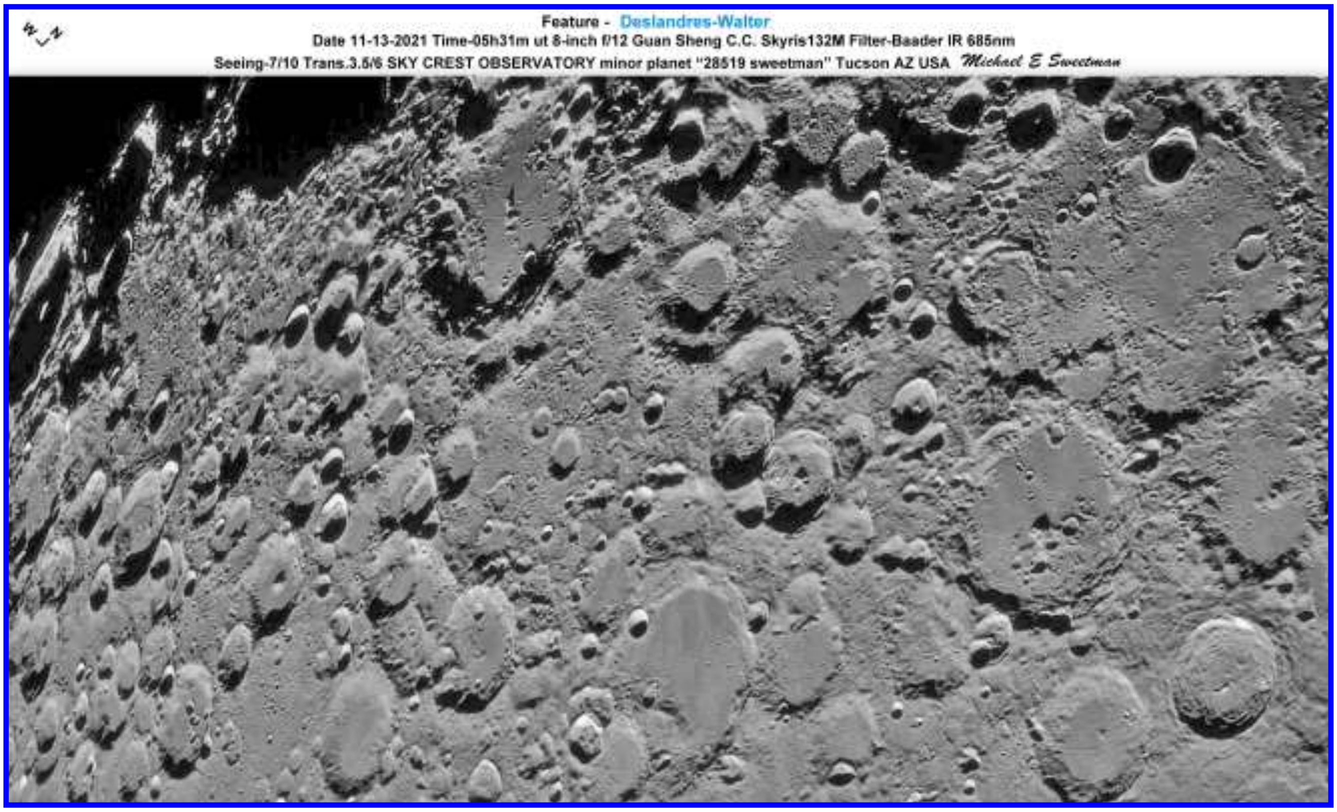


Endymion B, *István Zoltán Földvári, Budapest, Hungary. 2012 December 29, 21:00 UT, colongitude 109.85°. 80 mm refractor telescope, 900 mm focal length, 90 x. Seeing 4/10, transparency 4/6.*

Endymion, *Rafael Benavides Palencia, Posadas, Cordoba, Spain. 2022 January 09 20:37 UT. Celestron 11 inch Schmidt-Cassegrain telescope, Baader Planetarium IR pass filter, ZWO ASI290mm/s camera. Seeing 3/10, transparency 5/6.*

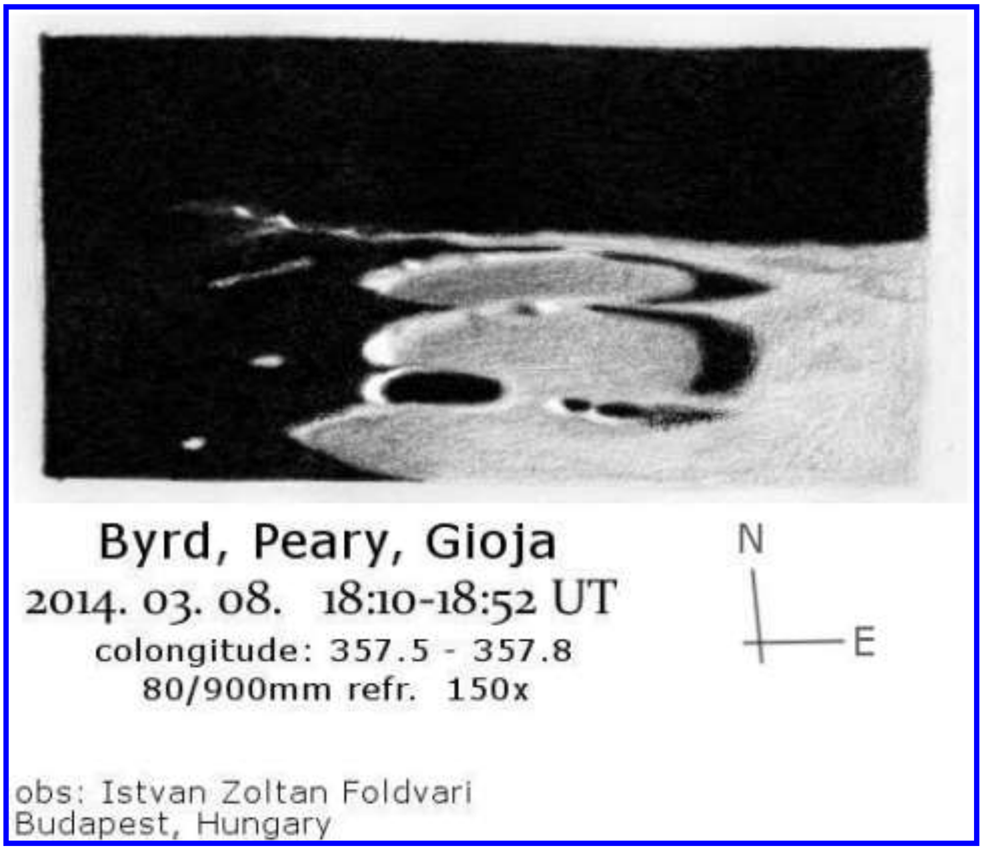
Alphonsus, *Walter Ricardo Elias, AEA, Oro Verde, Argentina. 2022 February 11 01:35 UT. Celestron CPC1100 11 inch Schmidt-Cassegrain telescope, ZWO ASI120mm/s camera.*

Sinus Iridum, *Fabio Verza, SNdR, Milan, Italy. 2022 March 26 04:37 UT. Meade LX200 ACF Schmidt-Cassegrain telescope, Baader Neodymium IR block filter, ZWO ASI290MM camera.*



Deslandres-Walter, *Michael Sweetman, Sky Crest Observatory, Tucson, Arizona, USA. 2021 November 13 05:31 UT. 8 inch f/12 Guan Sheng Classical Cassegrain telescope, Baader IR 685nm filter, Skyris 132M camera. Seeing 7/10, transparency 3.5/6. North right, west up.*

Curtis, *Facundo Gramer, AEA, Oro Verde, Argentina. 2022 March 12 22:50 UT. Celestron CPC1100 11 inch Schmidt-Cassegrain telescope, ZWO ASI120mm/s camera.*



Byrd, Peary, Gioja, *István Zoltán Földvári, Budapest, Hungary. 2014 March 08, 18:10-18:52 UT, colongitude 357.5°-357.8° 80 mm refractor telescope, 900 mm focal length, 150 x. Seeing 7/10, transparency 5/6.*

Lade, Agrippa, Godin, d' Arrest, Ritter and Sabin, *Rafael Benavides Palencia, Posadas, Cordoba, Spain. 2022 January 09 19:53 UT. Celestron 11 inch Schmidt-Cassegrain telescope, Baader Planetarium IR pass filter, ZWO ASI290mm/s camera. Seeing 3/10, transparency 5/6.*

__Aristoteles,__ Ignacio Barzola, AEA, Oro Verde, Argentina. 2022 March 12 23:06 UT. Celestron CPC1100 11 inch Schmidt-Cassegrain telescope, ZWO ASI120mm/s camera.

__Mare Crisium,__ Walter Ricardo Elias, AEA, Oro Verde, Argentina. 2022 February 05 23:53 UT. Celestron CPC1100 11 inch Schmidt-Cassegrain telescope, ZWO ASI120mm/s camera.

Aristarchus, Walter Ricardo Elias, AEA, Oro Verde, Argentina. 2022 February 13 23:00 UT. Helios 114 mm reflector telescope, QHY5 II C camera.

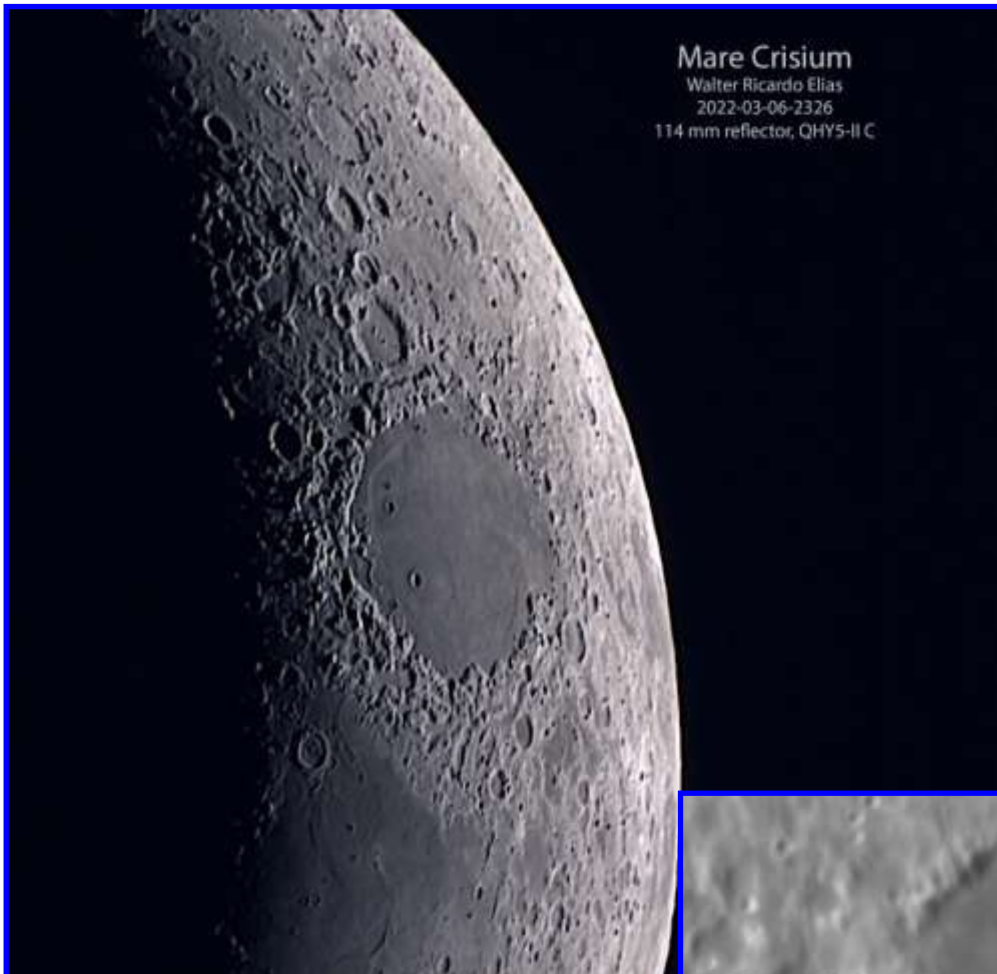
Aristoteles, *Fabio Verza, SNdR, Milan, Italy. 2022 March 23 03:58 UT. Meade LX200 ACF Schmidt-Cassegrain telescope, Baader Neodymium IR block filter, ZWO ASI290MM camera.*

Alphonsus, *Walter Ricardo Elias, AEA, Oro Verde, Argentina. 2022 March 13 03:50 UT. Celestron CPC1100 11 inch Schmidt-Cassegrain telescope, ZWO ASI120mm/s camera.*

Lunar South Pole, *David Teske, Louisville, Mississippi, USA. 2022 February 12 02:25 UT, colongitude 36.2°. 4 inch f/15 Skylight refractor telescope, IR block, ZWO ASI120mm/s camera. Seeing 8/10.*

Copernicus, *Walter Ricardo Elias, AEA, Oro Verde, Argentina. 2022 March 12 23:15 UT. Celestron CPC1100 11 inch Schmidt-Cassegrain telescope, ZWO ASI120mm/s camera.*

Mare Frigoris, *Fabio Verza, SNdR, Milan, Italy. 2022 March 23 04:40 UT. Meade LX200 ACF Schmidt-Cassegrain telescope, Baader Neodymium IR block filter, ZWO ASI290MM camera.*



Mare Crisium, *Walter Ricardo Elias, AEA, Oro Verde, Argentina. 2022 March 06 23:26 UT. Helios 114 mm reflector telescope, QHY5 II C camera.*

Ptolemaeus, *Fabio Verza, SNdR, Milan, Italy. 2022 March 23 04:33 UT. Meade LX200 ACF Schmidt-Cassegrain telescope, Baader Neodymium IR block filter, ZWO ASI290MM camera.*

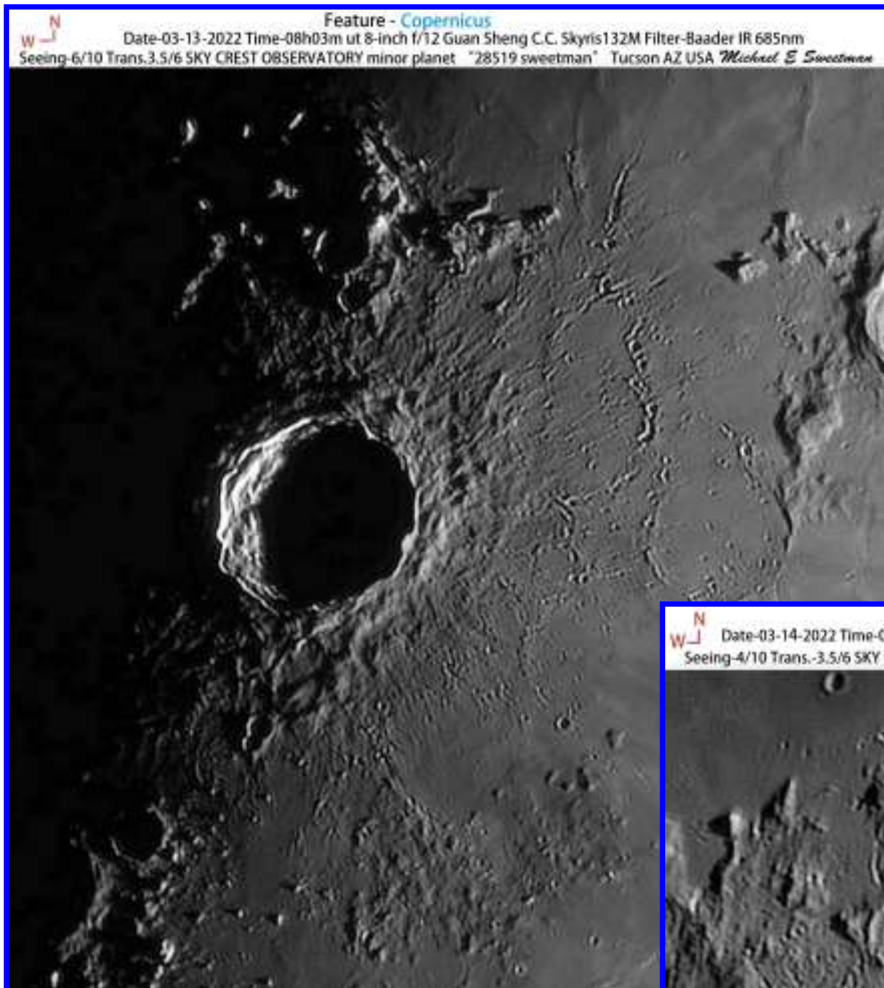
Plato, *Walter Ricardo Elias, AEA, Oro Verde, Argentina. 2022 March 12 23:45 UT. Celestron CPC1100 11 inch Schmidt-Cassegrain telescope, ZWO ASI120mm/s camera.*

Tycho, *Fabio Verza, SNdR, Milan, Italy. 2022 March 23 04:43 UT. Meade LX200 ACF Schmidt-Cassegrain telescope, Baader Neodymium IR block filter, ZWO ASI290MM camera.*

Grimaldi, *Walter Ricardo Elias, AEA, Oro Verde, Argentina. 2022 March 21 01:34 UT. Helios 114 mm reflector telescope, QHY5 II C camera.*

Mare Crisium, *Rodrigo De Brix, Santa Fe, Argentina. 2022 March 17 23:17 UT. 115 mm Schmidt-Cassegrain telescope, Samsung SM-A51F.*

Two Views of Copernicus



Copernicus, *Michael Sweetman, Sky Crest Observatory, Tucson, Arizona, USA. 2022 March 13 08:03 UT. 8 inch f/12 Guan Sheng Classical Cassegrain telescope, Baader IR 685nm filter, Skyris 132M camera. Seeing 6/10, transparency 3.5/6.*

Copernicus, *Michael Sweetman, Sky Crest Observatory, Tucson, Arizona, USA. 2022 March 14 08:36 UT. 8 inch f/12 Guan Sheng Classical Cassegrain telescope, Baader IR 685nm filter, Skyris 132M camera. Seeing 4/10, transparency 3.5/6.*

Lunar Geologic Change Detection Program

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

2022 April

LTP reports: No LTP reports have been received for February

Routine Reports received for February included: Alberto Anunziato (Argentina – SLA) observed: Alphonsus, Aristarchus, Censorinus, Eratosthenes, and Plato. Massimo Alessandro Bianchi (UAI) imaged: Mons Vinogradov. Anthony Cook (Newtown – ALPO/BAA) videoed earthshine and imaged several features in visible light and the thermal IR. Walter Elias (Argentina – AEA) imaged: Alphonsus, Aristarchus, Copernicus, Eratosthenes, Mare Crisium and Plato. Valerio Fontani (Italy – UAI) imaged: Aristarchus, Copernicus, Montes Teneriffe, and Plato. Kris Fry (West Wales – NAS) imaged the lunar crescent. Les Fry (West Wales – NAS) imaged: De La Rue, Dorsa Aldrovandi, Endymion, Hercules, Montes Pyrenaeus, Palus Somni, Piccolomin, Posidonius and Theophilus. Leandro Sid (Argentina – AEA) imaged: several features and Vallis Schroteri. Trevor Smith (Codnor, UK – BAA) observed: Aristarchus and Mare Crisium. Franco Taccogna (Italy – UAI) imaged: Montes Teneriffe, Plato, and Tycho. Aldo Tonon (UAI) imaged: Copernicus and Plato.

Routine Reports Received:

Note that time is unfortunately limited this month for a full analysis, so it will be left up to the reader to compare the original and modern-day observations:

Mare Crisium: On 2022 Feb 06 UT 18:40-18:55 Trevor Smith (BAA) observed this area under similar illumination to the following report:

On 1987 Feb 03 at 00:30UT J. de Carlo (Little Falls, NJ, USA, 4.5" refractor, x260, x350, seeing-very good) observed a very bright yellow light in the center of Mare Crisium (near a raised crevice), almost like a "gigantic nuclear bomb explosion "which expanded (to 1/8th the diameter of Mare Crisium) and then reduced in size. The flare flickered at a rate of 1/10s. apparently the edge of this LTP looked rough, almost like emitted debris. The LTP was fixed in position on the Moon. LTP confirmed by observer's father. The Cameron 2006 catalog ID=295 and the weight=3. the ALPO/BAA weight=2.

The above is an interesting report and sounds almost like a dayside impact flash in terms of the color, with a subsequent ejecta cloud? If so then the blackbody temperature would have been roughly equivalent to the surface of our yellow Sun or approximately 6000 K. However, we do not have much in the way of observations of dayside impacts. The only one I can think of is the Leon Stuart bright spot seen near Pallas crater in 1953, which hung around long enough to be photographed – though we do not know for sure that this was actually an impact event. The flickering may have been due to scintillation in our atmosphere? As for the expansion, 1/8th the diameter of Mare Crisium is about 50 km i.e., about twice the diameter of Proclus, no duration is given so we cannot determine a speed. The shrinking could simply be due to material fall out. Nothing obvious shows up on Clementine color ratio images of this area, though the ejecta maybe to thin to show up in any imagery.

Not surprisingly, Trevor's observational report was simply: No yellow lights seen anywhere and nothing unusual was seen. All looked normal to me. We shall leave the original report at an ALPO/BAA weight of 2.

Censorinus: On 2022 Feb 08 UT 01:00-01:10 Alberto Anunziato (SLA) observed this crater under similar illumination to the following report:

On 1988 Nov 15 UT 19:15 Holmes (Rockdale, UK, 215mm Newtonian) noticed the Censorinus apron (just east of the crater and including the rim) was fuzzy but the crater was clear - a sketch was provided. A BAA Lunar Section observation. Cameron 2006 Catalog Extension ID=339 and weight=3. ALPO/BAA weight=2.

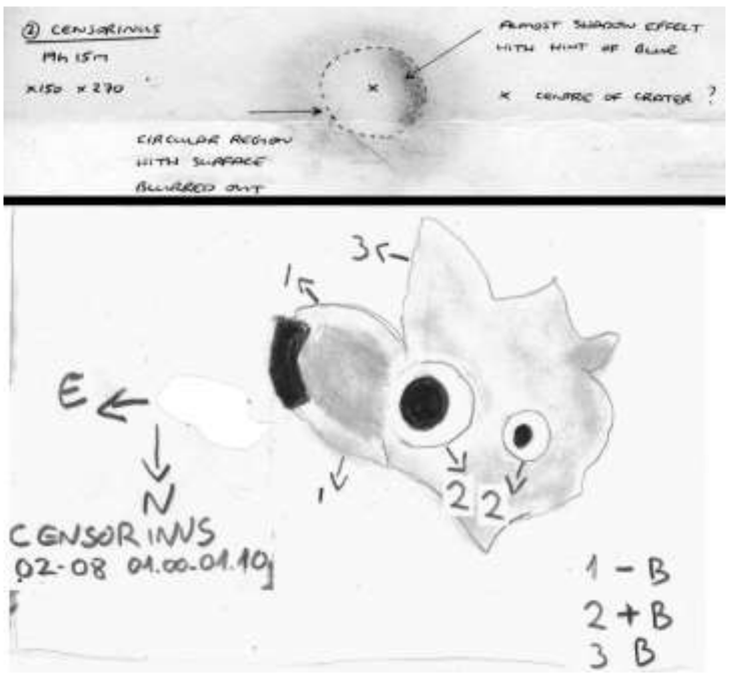


Figure 1. *Censorinus in sketches and orientated with north towards the bottom.* ***(Top)*** *By Mark Holmes (BAA) from 1988 Nov 15 UT 19:15.* ***(Bottom)*** *From Alberto Anunziato (SLA) from 2022 Feb 08 UT 01:00-01:10, with visual brightness estimates added – note that the sketch has been corrected for its mirror reversed appearance.*

Alberto, using a Meade EX105 scope at x154 noted that the ejection pattern was white, neat and bright. He provided a sketch (Fig 1 – Bottom) that can be compared to the original Mark Holmes sketch from 1988 (Fig 1 – Top). There appears to be quite a difference in appearance between Mark's and Alberto's sketches.

Tycho: On 2022 Feb 09 UT Franco Taccogna had a go at trying to capture the central peak of Tycho being illuminated by scattered light off the sunlit walls of the crater, despite being in a shadow filled floor. He took a sequence of images from 17:10-19:29 UT.

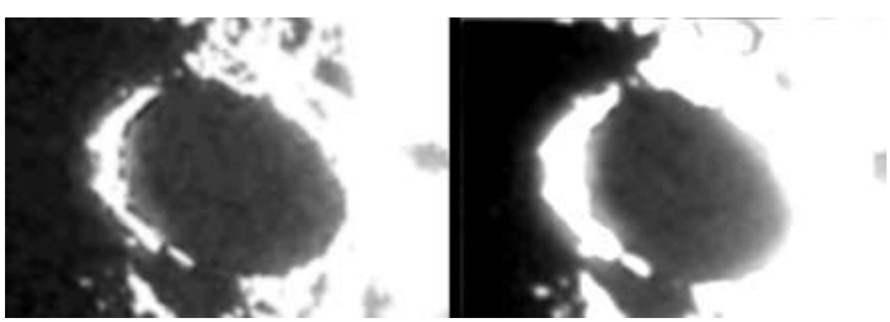


Figure 2. *Tycho as imaged by Franco Taccogna (UAI) on 2022 Feb 09 UT 19:12* ***(Left)*** *and 19:30* ***(Right).*** *Both images have undergone contrast stretching and Gaussian blurring to reduce image noise.*

This is in response to a 2003 May 09 observation where Brendan Shaw (BAA) recorded the central peak, against the shadow filled floor, when the Sun was just +1.3° above the horizon – too low for direct illumination. We have since attempted this again at repeat illumination and the results have only occasionally replicated what Brendan recoded. Fig 2 (Left) is with a solar altitude of +0.8° and Fig 2 (Right) with a solar altitude of +0.9°. The +0.8° solar altitude has no sign of a central peak, but there is a slight hint in the +0.9° one, but it could easily be image noise.

Copernicus: On 2022 Feb 10 UT 17:44 Aldo Tonon (UAI) imaged this crater under similar illumination to the following LTP report:

2012 Sep 24 UT 22:00-23:00 Copernicus. E. Horner (Salisbury, UK, 15cm reflector) observed a prominent red arc where the sunlit part of the interior wall met the shadow. Sometimes the arc was 1/4 the way around the interior, and sometimes half of the way around. Telescope moved, but the red arc stayed where it was. Eyepieces change, but the effect remained. Other parts of the Moon checked, but no red seen. There were however splashes of green e.g., Longomontanus on the terminator, elsewhere further inland from the terminator, and little splashes of green on Mare Frigoras - but lasting a brief time. The red colour was as strong as a red LED and the green similar to that of the northern lights. The observer's husband was asked to independently check Copernicus and remarked that he could see a little bit of green at the top and some red near the bottom, along the line of the internal shadow. Although there were checks for red elsewhere on the Moon and none were seen, the Moon was starting to get low and it is typical of spurious colour in a few respects. Therefore, the ALPO/BAA weight=1 for safety.

Figure 3 *Copernicus as imaged by Aldo Tonon (UAI) on 2022 Feb 09 UT 17:44. Colour saturation has been increased to 85%. North is towards the top.*

Despite a significant colour saturation increase, Aldo's image (Fig 3) certainly does not exhibit the red arc as described by Horner. We shall therefore leave the original report at a weight of 1.

Eratosthenes: On 2022 Feb 11 UT Walter Elias imaged the crater under similar illumination to the following report:

On 1936 Oct 25 at 01:35 UT W. Haas (Alliance, OH, USA, 12" reflector) saw small bright spots on the floor of Eratosthenes,(Pickering's atlas 9A, col. 30deg, shows no spots - according to Cameron). Cameron 1978 catalog LTP=417 and weight=4. ALPO/BAA weight=1.

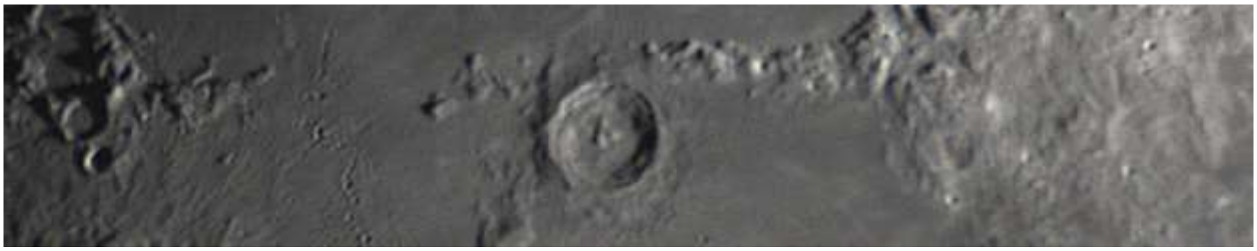


Figure 4. *Eratosthenes as imaged by Walter Elias (AEA) on 2022 Feb 11 UT 01:33 and orientated with north towards the top.*

As you can see from Fig 4 there are some white spots on the crater floor, but these are mostly peaks of the central peak area. There are hints of other white spots on the floor, but its difficult to say for certain.

Aristarchus: On 2022 Feb 12 UT 20:34, 20:53, 21:12 and 21:31 Valerio Fontani imaged the crater for the following Lunar Schedule request:

ALPO Request: On 2013 Apr 22 Paul Zellor noticed that the two closely spaced NW dark bands in Aristarchus had some (non-blue) color to them. Can we confirm his observation of natural colour here? Ideally you should be using a telescope of 10" aperture, or larger. Please send any high resolution color images, detailed sketches, or visual descriptions to: a t c @ a b e r . a c. u k .

Figure 5. Aristarchus orientated with north towards the bottom. **(Left)** Image by Valerio Fontani (UAI) from 2022 Feb 12 UT 20:34. **(Center)** Sketch by Paul Zellor (ALPO) from 2013 Apr 22 UT 01:43. **(Right)** Image by Paul Zellor (ALPO) from 2013 Apr 22 UT 01:43

Valerio's image (Fig 5 – Left) , although within the lunar schedule observing window, looks as though it is perhaps a little early in terms of colongitude to Paul's image on the Right. Although no bands are visible in either image, you can see that the northern most band that Paul drew (Fig 5 – Center) corresponds to a dusky area on the NW rim of Aristarchus in Valerio's image.

The Full Moon: On 2022 Feb 16 UT 02:37 Leandro Sid (AEA) imaged the lunar disk as part of the Lunar Schedule request to monitor the brightness of different lunar features close to zero lunar phase angle. Some brightness's measured were as follows in order of dark to bright: Plato (61), Kepler (171), Copernicus (174), Tycho (211), Aristarchus (213), Proclus (214), Censorinus (239), Bright Spot near Hell (250).

Mons Vinogradov: On 2022 Feb 16 UT 21:21-21:22 Massimo Alessandro Bianchi 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.

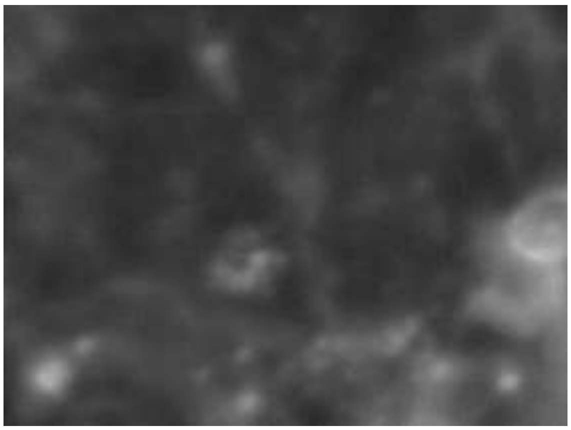


Figure 6. *Mons Vinogradov as imaged by Massimo Alessandro Bianchi (UAI) on 2022 Feb 16 UT 21:21 and orientated with north towards the top.*

I had a look in the archives to see if I could find an image of what T. Bakowski had imaged, but alas all I could find was an email forwarded onto me from the observer by ALPO's lunar impact flash observer, Brian Cudnik. There was a link in the email to a video sequence, but as it was 16 years old, the link no longer works and I could not find it in the Internet Archive (https://archive.org/web/) either. On the plus side we now at least have Massimo's image (Fig 6) of what the area normally looks like and can confirm that there is no dark lava pond east of Mons Vinogradov which might have shown up nice and sharp, during a good moment of seeing, in one of the original video frames. Almost certainly what we had back in 2006 was probably a bird or bug flying across the field of view and appearing dark against the bright lunar disk. As it was flying fast it would appear in just one of the frames from the video sequence. As exposure at Full Moon is short, due to the Moon's brilliance, any object getting in the way does not have to be motion blurred. To illustrate how common, it is to have objects in our atmosphere passing across the Moon, during March this year, from the UK I saw several dark migrating birds crossing the line of sight to the Moon when I was observing with a thermal imaging camera! Birds are very well insulated, and so appear dark in the thermal IR compared to the heat of the lunar surface. Even if I had been observing in the visible light, then they still would have appeared dark due to the silhouette effect against the lunar surface!

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

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

Lunar Calendar April 2022

Date	UT	Event
1		East limb most exposed +4.9°
1	0624	New Moon Lunation 1228
3	1700	Uranus 0.6° north of Moon, occultation southeast South America to central Africa
6	0900	Ceres 0.2° north of Moon, occultation Madagascar to Micronesia
7	1900	Moon at Apogee 404,438 km
8		Greatest northern declination +26.8°
9	0648	First Quart Moon
12		South limb most exposed -6.8°
14		West limb most exposed -6.0°
16	1855	Full Moon
19	1500	Moon at perigee 365,143 km
22		Greatest southern declination -26.9°
23	1156	Last Quarter Moon
24	2100	Saturn 5° north of Moon
25	2200	Mars 4° north of Moon
25		North limb most exposed +6.8°
27	0200	Venus 4° north of Moon
27	0800	Jupiter 4° north of Moon
28		East limb most exposed +5.5°
30	2028	New Moon, Lunation 1229, Partial Solar Eclipse Southern Ocean

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

Comments and suggestions? Please send to David Teske, contact information page 1. Need a hard copy, please contact David Teske.

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

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

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

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

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

SUBMISSION THROUGH THE ALPO IMAGE ARCHIVE

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

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

It is helpful if the filenames follow the naming convention :

FEATURE-NAME_YYYY-MM-DD-HHMM.ext

YYYY {0..9} Year

MM {0..9} Month

DD {0..9} Day

HH {0..9} Hour (UT)

MM {0..9} Minute (UT)

.ext (file type extension)

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

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

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

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

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

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

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

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

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

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

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

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

CALL FOR OBSERVATIONS: FOCUS ON: Mare Frigoris

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 2022 Focus-On will be the craters Mare Frigoris. 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 Frigoris Focus-On article is April 20, 2022

FUTURE FOCUS ON ARTICLES:

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

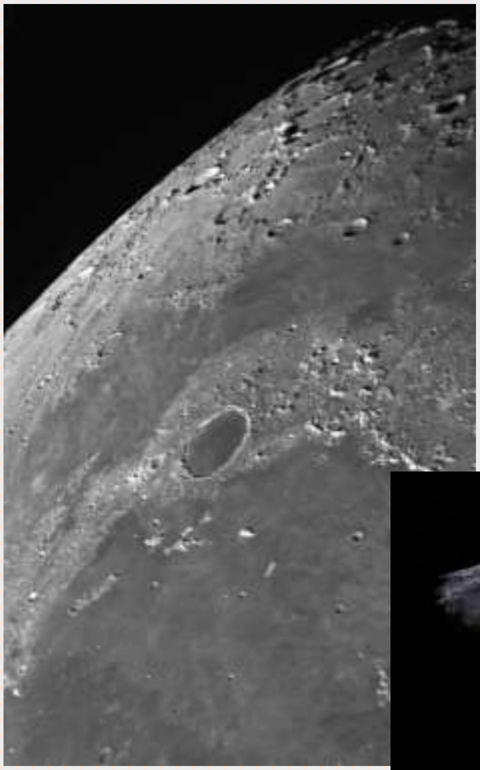
Subject	TLO Issue	Deadline
Mare Frigoris	**May 2022**	**April 20, 2022**
Bright Rays North	**July 2022**	**June 20, 2022**
Bright Rays South	**September 2022**	**August 20, 2022**

Focus-On Announcement

TRAVELING FROM EAST TO WEST ON THE MARE FRIGORIS

Mare Frigoris is the only mare that does not occupy a circular basin, it is an elongated strip of approximately 1500 kilometers that extends from the Lacus Mortis at its eastern end, passing through Aristoteles, Galle, Protagoras, Archytas, Timaeus, Birmingham, Fontenelle, La Condamine, Harpalus all the way to Sinus Roris in the west, with wonders like Plato and Sinus Iridum nearby. Mare Frigoris would be part of the Imbrium impact basin, and its north coast is covered by the material ejected by this impact. Let's share images of this area of the lunar north, sometimes forgotten due to its proximity to much more photogenic areas.

Please send articles, drawings, images, etc. to Alberto Anunziato and David Teske by **April 20, 2022** for the May 2022 issue of The Lunar Observer.



Sergio Babino

Michel Deconinck

Focus-On Announcement

WONDERS OF THE FULL MOON

The full moon is loved by almost everyone, except for the majority of astronomers. But when the near side is illuminated almost completely by frontal light, it is the opportunity to enjoy a unique spectacle: the bright ray craters. It is a field of study favorable to amateur observation with scientific value: how far does each bright ray reach? Are some rays brighter than others coming from the same crater? Are they altered by the relief over which they pass? And many other questions that ALPO's Bright Lunar Rays Project has as its objectives.

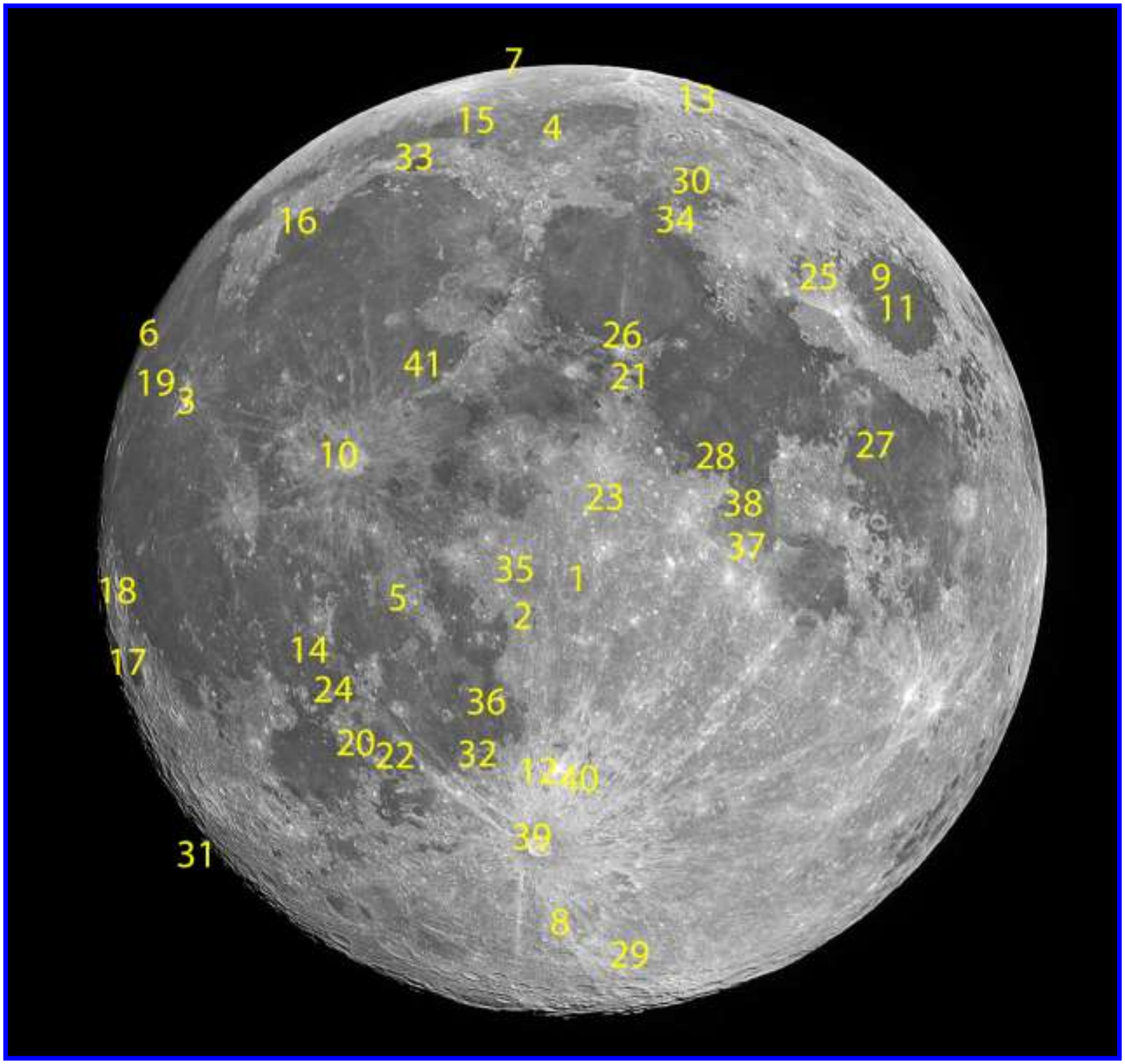
Bright Lunar Rays Project Objectives:
https://moon.scopesandscapes.com/ALPO%20Rays%20Project.htm

List of rayed craters and other non-crater features:
https://moon.scopesandscapes.com/alpo-rays-table.pdf

JULY 2022 ISSUE-Due **June 20th, 2022**: **NORTHERN BRIGHT RAY CRATERS**
SEPTEMBER 2022 ISSUE-Due **August 20th, 2022: SOUTHERN BRIGHT RAY CRATERS**

Leandro Sid

Key to Images In This Issue



1. Albategnius
2. Alphonsus
3. Aristarchus
4. Aristoteles
5. Bonpland
6. Briggs
7. Byrd
8. Clavius
9. Crisium, Mare
10. Copernicus
11. Curtis
12. Deslandres
13. Endymion
14. Euclides
15. Frigoris, Mare
16. Grimaldi
17. Iridium, Sinus
18. Hevelius
19. Herodotus
20. Hippalus
21. Julius Caesar
22. Kies
23. Lade
24. Lubiniezky
25. Macrobius
26. Menelaus
27. Messier
28. Moltke
29. Moretus
30. Mortis, Lacus
31. Orientale, Mare
32. Pitatus
33. Plato
34. Posidonius
35. Ptolemaeus
36. Recta, Rupes
37. Theophilus
38. Torricelli
39. Tycho
40. Wallace
41. Walther