The Lunar Observer

A Publication of the Lunar Section of ALPO

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

June 2022

Online readers, click on images for hyperlinks

In This Issue

Be sure to check out the ALPO conference July 22-23, 2022.

Many thanks to all who contributed to this issue of *The Lunar Observer*! It seems to be growing in size and contributors, which I think is a very good thing! In this issue, Rik Hill, Alberto Anunziato and Howard Eskildsen take us on lunar adventures that we can join with just a small telescope. Darryl Wilson provides us another article on lunar imaging techniques and exploring for titanium with a small telescope. Jim Hill did such in the pre-Space Age, check out his results! In France, Jean Francois Gely won the Earth Science Photo of the Day with a most remarkable lunar image. Many thanks to all who contributed to the Recent Topographic Studies and submitting eclipse photos as well. As always, Tony Cook provides another interesting article on Lunar Geologic Change and starts his new Basins and Buried Project. Don't forget to send observations of lunar rays (northern disk) to Alberto Anunziato and myself by June 20th. Please be sure to note the ALPO Virtual Conference on page 5. I certainly hope that all can attend. This conference will be most special for us lunar observers!

Clear skies,

-**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
Esteban Andrada	Mar del Plata, Argentina	Images of the lunar eclipse (2).
Alberto Anunziato	Paraná, Argentina	Article and images *What I Have Seen on the Floor of Plato, Wrinkle Ridges Near Mons Piton* and *Reiner Gamma and Wonders of the West*.
Rafael Benavides	Posadas Observatory MPC J53, Córdoba, Spain	Images of Lacus Mortis, Montes Apenninus, Archimedes and Rupes Recti.
Ioannis (Yannis) A. Bouhras	Athens, Greece	Image of Plato.
Jairo Chavez	Popayán, Colombia	Images of the waxing gibbous Moon (2) and Aristarchus.
Maurice Collins	Palmerston North, New Zealand	Images of Archimedes, 9-day old Moon, Copernicus (2), Tycho, Clavius (2), Letronne, Mare Humorum (2), 12-day old Moon, Schickard, Aristarchus (2), Marius Hills, Sinus Iridum (2), 11-day old Moon and Schiller
Walter Ricardo Elias	AEA, Oro Verde, Argentina	Images of Gassendi, Plato and Mare Tranquillitatis.
Howard Eskildsen	Ocala, Florida, USA	Article and images *Cauchy Region* and *Römer and G. Bond Rilles.*
István Zoltán Földvári	Budapest, Hungary	Drawings of Picard, Stiborius, Goddard, Mare Smythii, Keldysh and Hermite.
Jean-François Gely	Observatory of Saint-Veran, Hautes-Alpes, France	Article and image of the *Projection of the Full Moon.*
Marcelo Guarda	Santa Fe, Argentina	Images of the Lunar eclipse (6).
James Hill	French Camp, Mississippi, USA	Images of Vallis Schröteri and Schickard.

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

Lunar Topographic Studies

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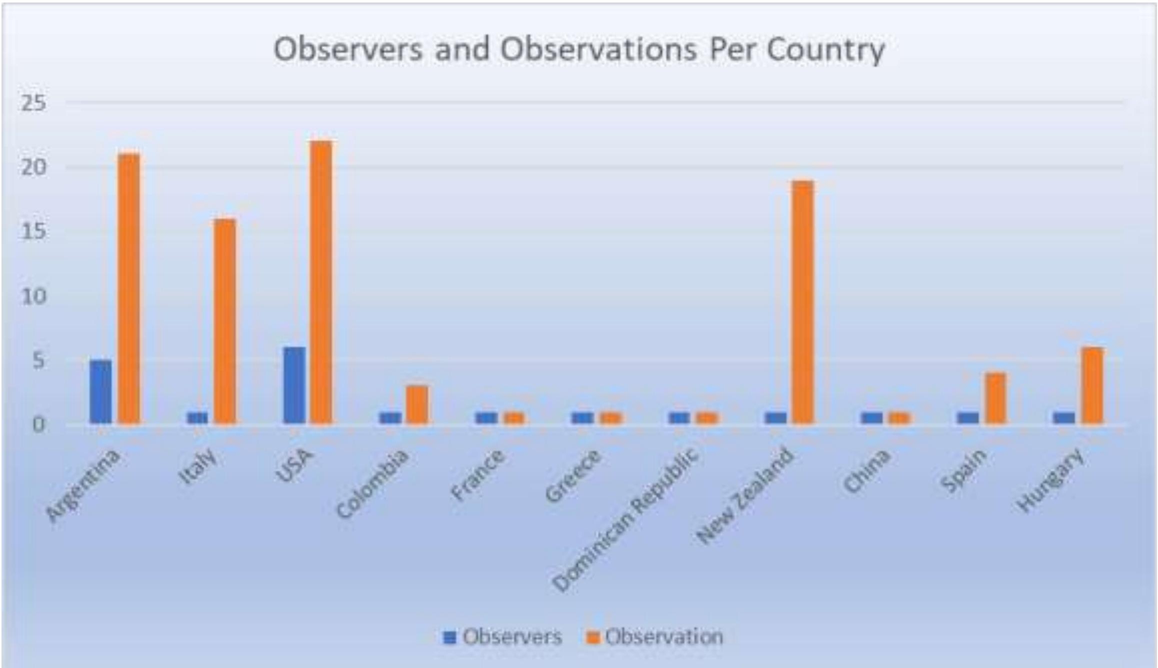
Observations Received

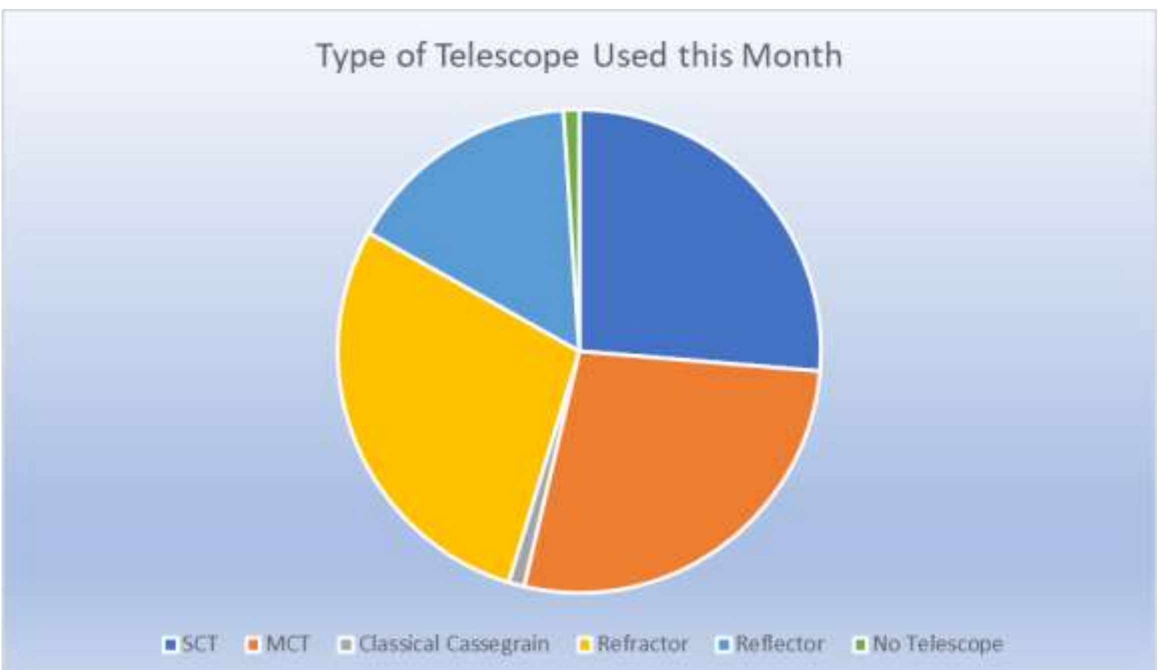
Name	Location and Organization	Image/Article
Rik Hill	Loudon Observatory, Tucson, Arizona, USA	Article and image *Pythagoras, Hortensius and Milichius Domes, Plato to Vallis Alpes* and image of the lunar eclipse.
Felix León	Santo Domingo, República Dominicana	Article and image *Reiner Gamma and Wonders of the West.*
Ron May	El Dorado Hills, California, USA	Images of Aristarchus, Vallis Alpes and the lunar eclipse.
KC Pau	Hong Kong, China	Image of Schickard.
Guido Santacana	San Juan, Puerto Rico, USA	Images of Janssen (2), Mare Serenitatis, Piccolomini, Posidonius, Theophilus (2), Mares Se-
Guillermo Scheidereiter	Rural Area, Concordia, Entre Ríos, Argentina	Images of Lunar X and V, Langrenus, Mare Crisium, Sinus Iridum, Pitiscus, drawings of Archimedes, Maurolycus and the lunar eclipse.
Fabio Verza	SNdR, Milan, Italy	Images of Maurolycus, Aristoteles, Eudoxus, Lacus Mortis, Mare Nectaris, Posidonius, Theophilus, Montes Apenninus, Ptolemaeus, Vallis Alpes, Aristarchus, Plato (2), Bullialdus, Gassendi and Copernicus.
Darryl Wilson	Marshall, Virginia, USA	Article and images *A Simple, Easy to Use Algorithm for Qualitative Titanium Mapping of the Lunar Surface.*

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

June 2022 *The Lunar Observer*
By the Numbers

This month there were 95 observations by 20 contributors in 11 countries.



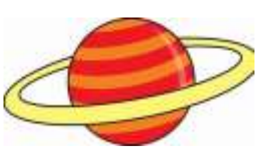


ALPO 2022 Conference
July 22-23, 2022

Due to the continuing nearly worldwide quarantining caused by the Covid-19 pandemic, the 2022 Conference of the ALPO will be held online on Friday and Saturday, July 22 and 23. 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 astronomy papers or presentations must (1) already 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, so as to qualify to present their work at this conference. Digital ALPO memberships start at only $18 a year. To join online, go to http:// www.astroleague.org/store/ index.php?main_page=product_info&cP ath=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 22. 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 presentations of the Walter Haas Observing Award and the Peggy Haas Service Award. 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 (JALPO64-3). 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.

To all with interest in the Moon (that is everybody reading this!), Ken Poshedly has allowed me to announce that the keynote speaker is none other that **Charles A. Wood**, the author of The Modern Moon, A Personal View, the Lunar Picture of the Day and many more. This is an incredible opportunity to gain your lunar knowledge!



Basin and Buried Crater Project

Dr. Anthony Cook

Have you ever come across the 500 km diameter "Werner-Airy" impact basin on the near side of the Moon? Probably not as it a highly degraded Pre-Nectarian suspected impact basin. Take a look in Fig 1 and you can see that under the right illumination conditions you can just about make out the circular structure of this suspected impact basin that was named by Don Wilhelm, and whom had some doubts about it being a basin. That is the way of a lot of basins, much careful research is needed, using many different types of observational data, to eventually confirm their existence – something that Don Wilhelms did not have many years ago.

So welcome to a new project within the BAA Lunar Section. The aim here is to image/sketch and characterize known, suspected, and unknown impact basins (i.e. greater than or equal to 300 km across – but there are some multi-ring crater exceptions), and also to catalogue as well as measure the diameters of unnamed buried craters. At this stage we do not intend to do any immediate science with this, at least until we have reached our cataloguing objectives, but to put the catalogue on-line for ourselves, and other researchers to use and reference, and hopefully cite the contribution of the BAA lunar Section.

Figure 1. *The Werner-Airy suspected impact basin as imaged by Anthony Cook on: 2021 Dec 24 UT 00:04-00:11 using a colour web-camera on an undriven Questar telescope. The SW part of the Nectaris impact basin is in the upper right of the image.*

Impact Basins

Why are we doing this? Surely after all these years, all impact basins, and buried craters have been mapped and made it into the International Astronomical Union (IAU) catalogue of named lunar formations? Well amazingly this is not the case as far as I can make out. Many Impact basins do have names – usually after the Mare (if they have this – otherwise a couple of craters that span the basin e.g., Bailly-Newton), but the basin, as a whole, does not have an entry in the IAU database. Planetary scientists have produced catalogues of impact basins, but there are several lists, each by a different group of researchers, and does not appear to be coordinated. Although we are limiting ourselves to 300 km as the cut-off between a basin and a large crater, the demarcation is a little blurred and large craters that have two or more rings can be included too.

Buried Craters

Similarly, there are catalogues of craters and the IAU keeps a list up-to-date of all named craters, but there is relatively little on craters that have been buried by lava, and are barely visible except under shallow illumination. A good example is "Ancient Newton", an unofficial name for what sometimes resembles a crater beneath Mare Imbrium, located between Plato and Mons Pico. Ancient Newton is only visible under shallow illumination close to the morning or evening terminator.

Why is this important? This applies to basins too - it gives us an idea of what was there before the lava flooded the impact basins. So, we are effectively looking back in time a few hundred million to billions of years.

A good example of a buried crater can be found in Bill Leatherbarrow's image of the Rupes Recta and Birt area, shown elsewhere in this circular.

Work to be done

I see four areas that amateur astronomers can contribute to this project:

- Compile a catalogue of all known impact basins and buried craters using the lists published by e.g. Paul Spudis, or mentioned in scientific papers of new spacecraft mission results.
- To read through old copies of the Lunar Section circular, and other amateur publications, looking for accounts of suspected impact basins and buried craters, so we can attribute discoverers/proposers of these geological structures.
- Using the basins and buried craters that we know about, to image/sketch these at the telescope, trying to find the best selenographical colongitudes to see them at.
- If you do not have a telescope, or it is cloudy, then to use tools such as LTVT or NASA/ACT QuickMap, to visualize the surface at different illumination angles and directions to spot suspected basins/buried craters, and to characterize/measure their centre location and the diameters of any basin rings, or buried crater perimeters.

Please send any images of the basins/buried craters or your thoughts on what might be basins, to me, and every month I will talk about a specific basin from the list below and show what image or visualization evidence exists for this.

This will be an iterative process and we may find that some basins/buried craters that we thought were previously unknown, had been discovered earlier. I will put the list of basins that we know about, known, suspected, and buried craters onto the following website: https://users.aber.ac.uk/atc/basin_and_buried_crater_project.htm

Basin	Far/Near Side	Lon	E/W	Lat	E/W	Diam (km)	Status	Age	No. Rings	Col-SR1	Col-SR2	Col-SS1	Col-SS2
Al-Khwarizmi-King	F	112	E	1	N	590	Uncertain	PN	2				
Amundsen-Ganswindt	F	120	E	81	S	335	Probable	PN	2				
Antoniadi	F	172	W	70	S	140	Known	UIm	2				
Apollo	F	152	W	36	S	537	Known	PN	3				
Australe	N	93	E	39	S	880	Probable	PN	2				
Bailly	N	69	W	67	S	300	Probable	N	2				
Bailly-Newton	N	41	W	77	S	402	Uncertain	PN	2				
Balmer-Kapteyn	N	70	E	15	S	500	Uncertain	PN	4				
Birkhoff	F	146	W	59	N	325	Probable	PN	2				
Compton	F	104	E	55	N	175	Known	LIm	2				
Coulomb-Sarton	F	123	W	52	N	440	Uncertain	PN	4				
Crisium	N	59	E	17	N	740	Known	N	5				
Cognitum	N	22	W	11	S	350	Uncertain	PN					
Cruger-Sirsalis	N	66	W	15	S	400	Proposed						
Dirichlet-Jackson	F	158	W	14	N	470	Proposed						
Fecunditatis	N	51	E	8	S	690	Uncertain	PN	2				
Fitzgerald-Jackson	F	170	W	23	N	400	Proposed						
Flamsteed-Billy	N	45	W	7	S	570	Uncertain	PN	2				
Fowler-Charlier	F	139	W	37	N	316							
Freundlich-Sharonov	F	175	E	19	N	600	Uncertain	PN	1				
Grimaldi	N	68	W	6	S	172	Known	PN	3				
Grissom-White	F	161	W	44	S	600	Uncertain	PN	1				
Hertzsprung	F	129	W	3	N	570	Known	N	4				
Humboldtianum	N	82	E	57	N	650	Known	N	6				
Humorum	N	39	W	24	S	425	Known	N	6				
Imbrium	N	16	W	33	N	1160	Known	Im	6				
Ingenii	F	164	E	34	S	315	Probable	PN	4				
Insularum	N	31	W	8	N	600	Uncertain	PN	2				
Keeler-Heaviside	F	162	E	10	S	500	Uncertain	PN	4				
Kohlschutter-Lenov	F	158	W	13	N	400	Proposed						
Korolev	F	157	W	4	S	440	Known	N	4				
Lomonosov-Fleming	F	105	E	19	N	620	Proposed	PN	1				
Lorentz	F	95	W	33	N	365	Known	PN	2				
Marginis	N	86	E	13	N	580	Uncertain	PN	1				
Mendeleev	F	142	E	5	N	325	Probable	N	2				
Mendel-Rydberg	N	94	W	50	S	630	Known	N	1				
Milne	F	113	E	31	S	272	Probable	PN	2				
Moscoviense	F	148	E	27	N	420	Known	N	5				
Mutus-Vlacq	N	21	E	52	S	700	Probable	PN	2				
Nectaris	N	36	E	15	S	333	Known	N	5				
Nubium	N	17	W	21	S	690	Uncertain	N	1				
Orientale	N	93	W	19	S	930	Known	Im	6				
Pingré-Hausen	N	82	W	56	S	300	Uncertain	PN	1				
Planck	F	137	E	58	S	314	Probable	PN	2				
Poincaré	N	164	E	57	S	325	Known	PN	2				
Procellarum	N	15	W	23	N	3200	Uncertain	PN	1				
Riemann-Fabry	F	99	E	41	N	320	Uncertain						
Schiller-Zucchius	N	45	W	56	S	335	Known	PN	2				
Schrödinger	F	132	E	75	S	312	Known	Im	2				
Schrödinger-Zeeman	F	165	W	81	S	250	Proposed		2				
Schwarzschild	F	121	E	70	N	212	Probable	N	2				
Serenitatis	N	18	E	28	N	920	Probable	N	5				
Sikorsky-Rittenhouse	N	111	E	68	S	310	Uncertain	N	1				
Smythii	N	88	E	1	N	740	Probable	PN	5				
South Pole-Aitken	F	169	W	53	S	2500	Known	PN	2				
Sylvester-Nansen	N	45	E	83	N	400	Proposed		2				
Tranquillitatis	N	31	E	9	N	700	Uncertain	PN	2				
Tsiolkovskiy-Stark	F	128	E	15	S	700	Uncertain	PN	1				
Wegner-Winlock	F	109	W	42	N	300	Uncertain						
Werner-Airy	N	12	E	24	S	500	Uncertain	PN	1				

Table 1. Known/Probable/Uncertain lunar impact basins – much of the information has come from : http://the-moon.us/wiki/Lunar_Basins_List , but we shall use this as an initial starting block to refine the database. Do not worry too much about the status column – this was the best knowledge I could find when compiling the table, undoubtedly new images and spacecraft data will help us refine this. "Age" corresponds to the geological era of formation e.g. Lim, UIM, and Im are Lower Imbrium, Upper Imbrium, and Imbrium.

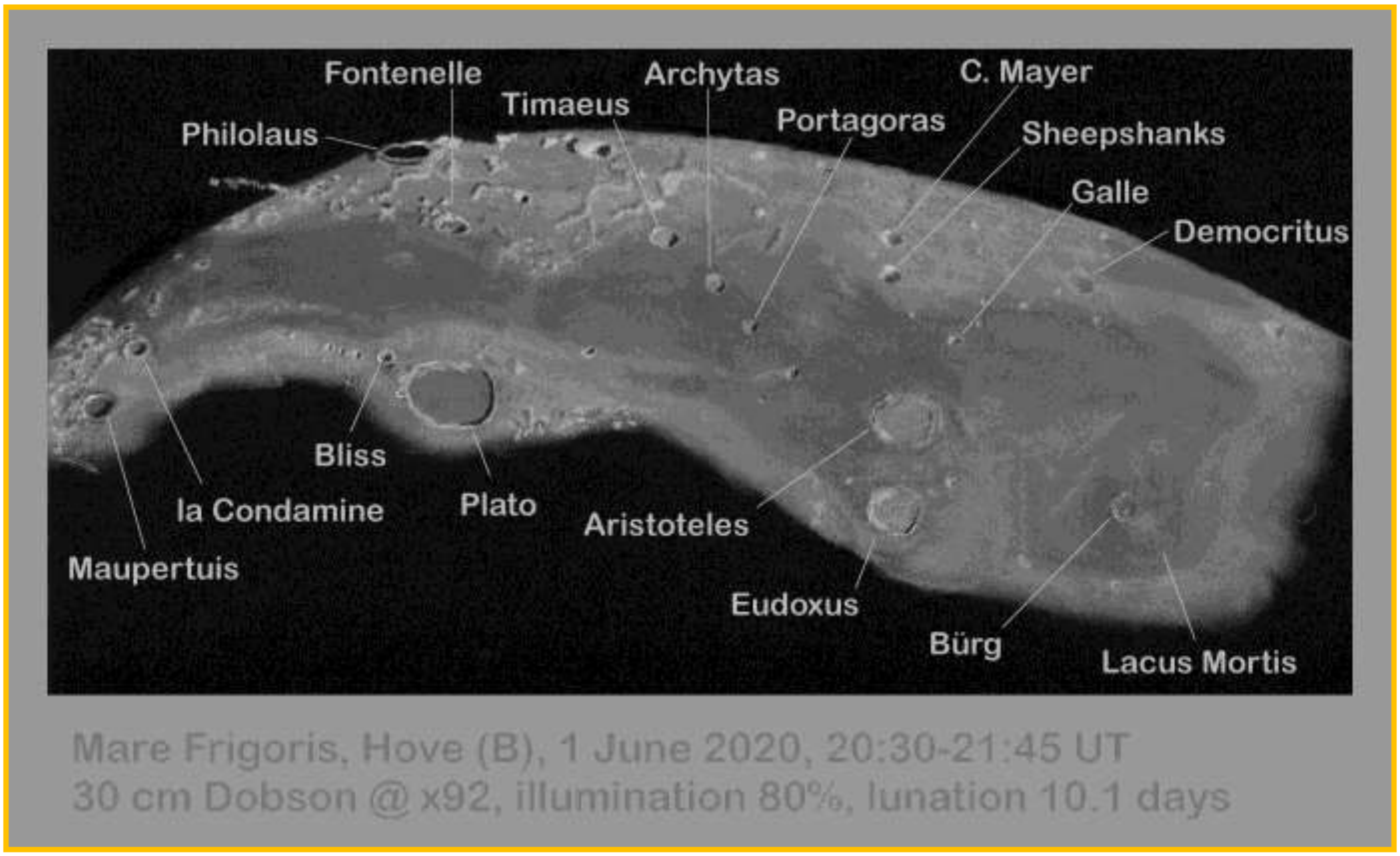
N is Nectarian, and PN is Pre-Nectarian. We will add selenographical colongitudes into the last four columns when we establish the best start and end times to see the basins at sunrise and sunset conditions on the Moon.

Crater	Far/Near Side	Lon	E/W	Lat	N/S	Diam (km)	Status	Age	Col-SR1	Col-SR2	Col-SS1	Col-SS2
Ancient Newton	N	8.4	W	47.3	N	125	Uncertain					
Nicolet-Thebit	N	6.8	W	22.3	S	212	Proposed					
Sinus Asperitatis	N	28.2	E	5.4	S	87	Proposed					

Table 2. Buried Impact Craters. This catalogue has only just begun, and there are a lot more buried craters on the Moon than these three. Again, the headings are similar to the impact basin catalog, except the craters do not have rings.

Erratum

On page 34 of the May 2022 *The Lunar Observer*, the following was written and attributed to Michel Deconinck. It should have been attributed to **Jef de Wit** of Hove, Belgium. Both are such talented artists!



My apologies for the mix up! -David Teske-

Peter Grego (page 134) notes that "The dusky, gray tract of Mare Frigoris can be seen without optical aid by those with average eyesight", as we see in the IMAGE 2, a work of art of Michel Deconinck, and in the IMAGE 3 by Walter Elias.

***Image 2, Mare Frigoris,** Michel Deconinck, Aquarellia Observatory - Artignosc-sur-Verdon - Provence - France. 2020 June 01 20:30-21:45 UT. 30 cm Dobsonian reflector telescope, 92 x.*

Plato to Vallis Alpes

Rik Hill

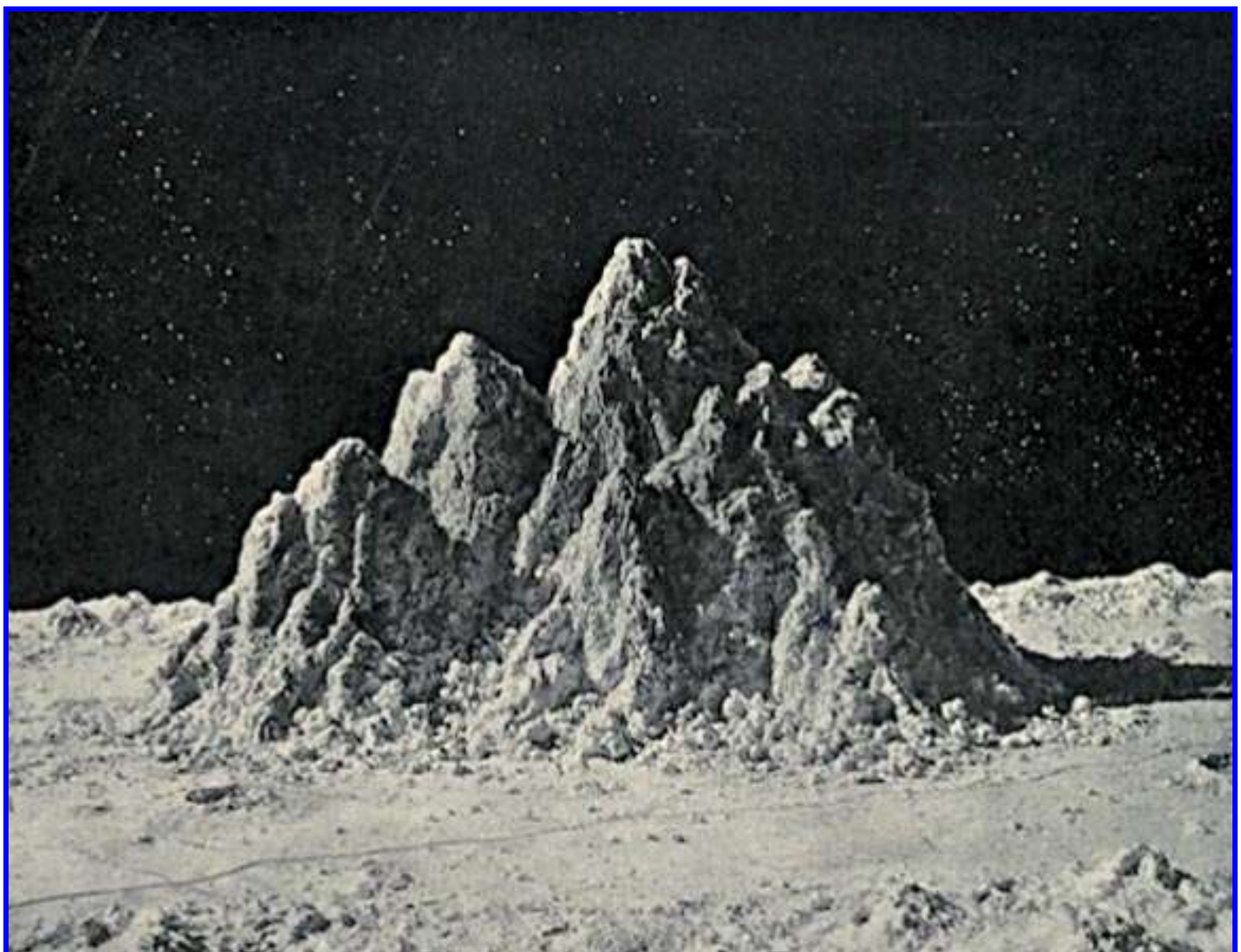
When on the terminator, this region catches attention of all lunar observer. I have imaged it many times at many librations. This was not a particularly favorable libration but many features were well shown in this image. First, we have the large crater Plato (104 km) on the left side of this image with the dramatic collapse features on its west (left) wall and on the floor, you can see 4 of the famed craterlets. To the right are "Plato Rilles" according to Wood in his Atlas of the Moon, but the LROC QuickMap and Virtual Moon Atlas show them to be smaller rimae south of this. I have used the term Rima Plato to refer to the larger rille for years. Moving further to the right or east, we come to the magnificent Vallis Alpes at the bottom of which you can see the kilometer wide rima which meanders its length.

Plato to Vallis Alpes, *Richard Hill, Loudon Observatory, Tucson, Arizona, USA. 2022 May 11 02:31 UT, colongitude 31.0°. 8 inch TEC f/20 Maksutov-Cassegrain telescope, 665 nm filter, SKYRIS 132M camera. Seeing 8/10 with gusty wind.*

In the lower right of this image is the impressive massif Mons Piton (alt. 2250 m). There was a spectacular oblique view of this mountain taken by the Apollo 15 orbiter, looking north with the Montes Alpes in the distance. It is worth looking it up. The crater to the left of this is Piazzi Smith (22 km). Then moving further left is an unnamed mountain and further, Mons Pico (2400 m), every bit as impressive as Mons Piton. It was the subject of a famous drawing by the astronomer James Nasmyth (1874) and another Apollo 15 image.

Lastly, we have the Montes Teneriffe south of Plato to the left on Mons Pico, just the tops of the gigantic mountains that were flooded by the Imbrium lavas. They are quite a sight in the early morning lunar light.

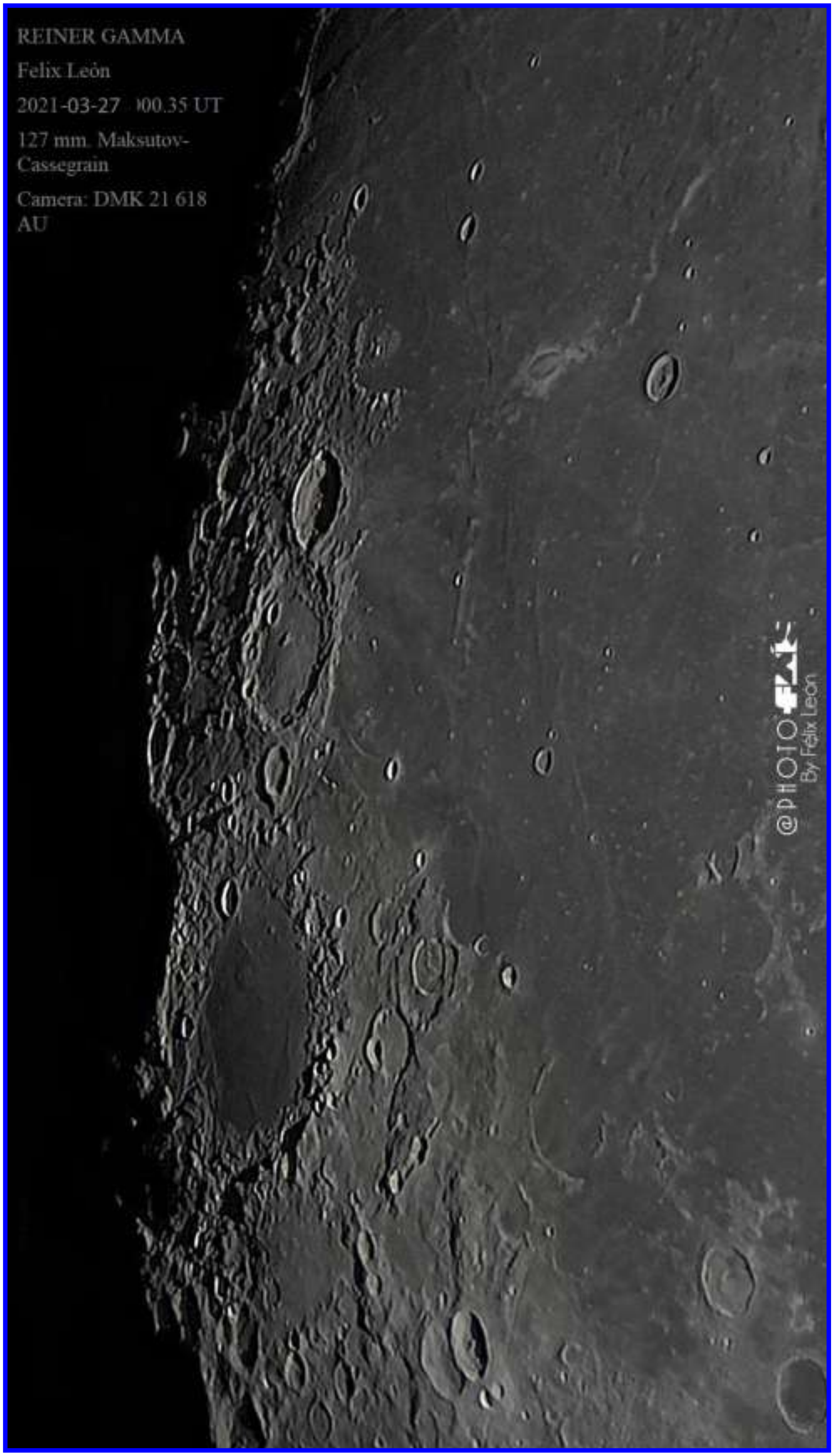
Mons Piton from Apollo 15



Mons Pico by James Nasmyth (1874)

Reiner Gamma and the Wonders of the West

Alberto Anunziato and Félix León



Reiner Gamma, the most famous lunar swirl, is the first feature we admire in this image (IMAGE 1). Moon swirls are fashionable nowadays. The cause of its formation remains uncertain, although theories always revolve around a strong magnetic field linked to the location (the Moon does not have a global magnetic field), which prevents the surface from being worn away by the solar wind. What then caused this magnetic anomaly? There is an endogenous and an exogenous explanation. The exogenous hypothesis posits that the amplification of the localized magnetic field was produced by an impact, from a comet (the most accepted hypothesis) or a massive impactor, the size of those that create basins (the most obvious candidate is Mare Imbrium, the youngest basin on the visible face, capable of generating ejecta rich in iron). The endogenous hypothesis does not imply impacts, but is related to the topography of the place and the volcanic rocks (with high iron content) that supposedly would be abundant in the area and would have preserved the ancient global magnetic field of the Moon.

Image 1, Reiner Gamma, *Felix León, Santo Domingo, República Dominicana. 2021 March 27 00:35 UT. 127 mm Maksutov-Cassegrain telescope, DMK 21 618AU camera.*

And why are they fashionable? Because a recent study made things more complicated. The provisional consensus about the lack of correlation between lunar swirls and the surface topography is not strong anymore. The abstract of a recent study reads: “evidence that these features do not necessarily cross the surface without regard to topography or local terrain. Within portions of Mare Ingenii on the lunar far-side, brighter on-swirl areas have statistically lower mean elevations than adjacent, darker, off-swirl lanes (.,,). This correlation with topography argues for highly mobile dust transport across the lunar surface” ("Domingue, D., Weirich, J., Chuang, F., Sickafoose, A., & Palmer, E. (2022). Topographic correlations within lunar swirls in Mare Ingenii. Geophysical Research Letters, 49, e2021GL095285. https:// / doi.org/10.1029/2021GL095285.

They are also fashionable because there is little time left to a lander and rover landing on Reiner Gamma to try to unravel the mystery. The first of the missions of NASA's Commercial Lunar Payload Services (CLPS) Program will be Lunar Vertex and hopefully it can be completed in 2024.

IMAGE 2 is a detail of IMAGE 1 showing Reiner Gamma in all his glory. But there is more. The wrinkle ridges concentric to the border of Oceanus Procellarum. The area of partially submerged craters (Flamsteed P, Letronne, Wichman R) at the bottom of the image. Also, a luxury trio. In IMAGE 3, we start with Cavalerius (58 km in diameter). As it is an Eratosthenian crater, its walls do not have the typical terracing of Copernican craters, rather its rim is high and instead of terraces we see cliffs and a floor full of hills and a small central peak. Before going south, let's go north to see a curiosity. Just to the left of Reiner Gamma and above Cavalerius is Cavalerius F, a secondary crater 7 km in diameter within a much larger half-buried crater, of which we only see the western rim. Around Cavalerius F (IMAGE 4) there is a brighter zone, in which some elevations seem to be distinguished. It is a kipuka, an area of older land surrounded by more recent lavas.

Image 2, Reiner Gamma, *Felix León, Santo Domingo, República Dominicana. 2021 March 27 00:35 UT. 127 mm Maksutov-Cassegrain telescope, DMK 21 618AU camera. Detail of image 1.*

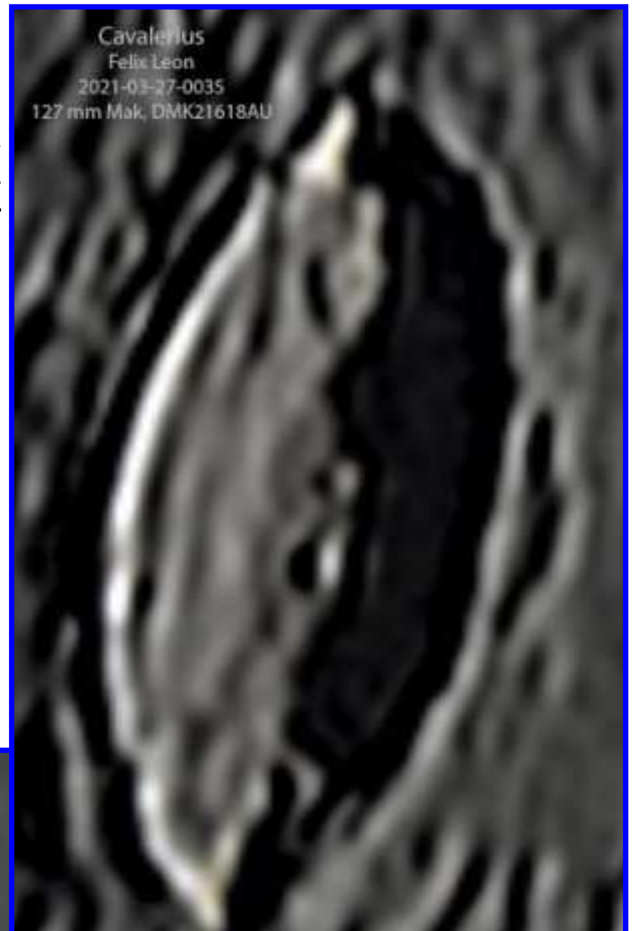


Image 3, Cavalerius, *Felix León, Santo Domingo, República Dominicana. 2021 March 27 00:35 UT. 127 mm Maksutov-Cassegrain telescope, DMK 21 618AU camera. Detail of image 1.*

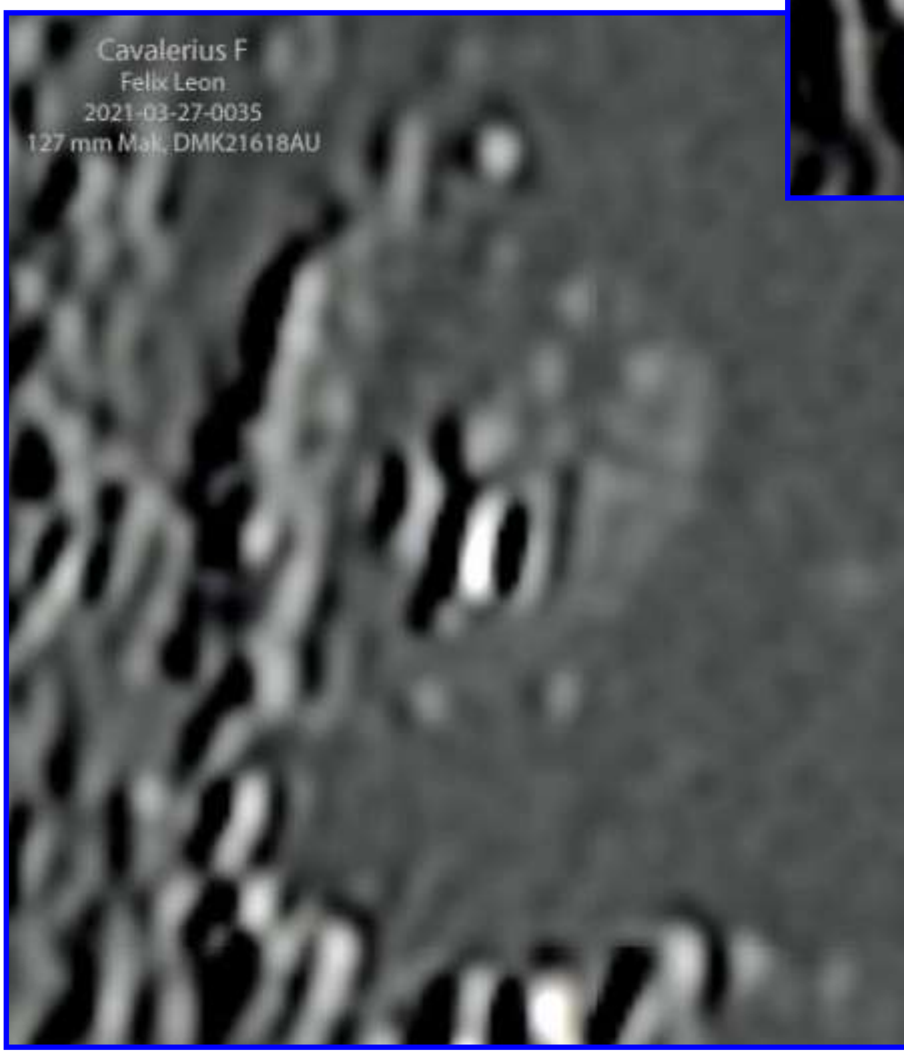


Image 4, Cavalerius F, *Felix León, Santo Domingo, República Dominicana. 2021 March 27 00:35 UT. 127 mm Maksutov-Cassegrain telescope, DMK 21 618AU camera. Detail of image 1.*

The second member of the trio is Hevelius (IMAGE 5), an old crater from the Nectarian period of 106 kms. in diameter, named after our favorite astronomer, Johannes Hevelius, author of the first detailed description of the lunar surface: "Selenographia" (1647). Its walls are obviously worn and full of impacts. The most interesting thing is the system of rilles that cross its floor (forming an "X") and its east rim (Rimae Hevelius).

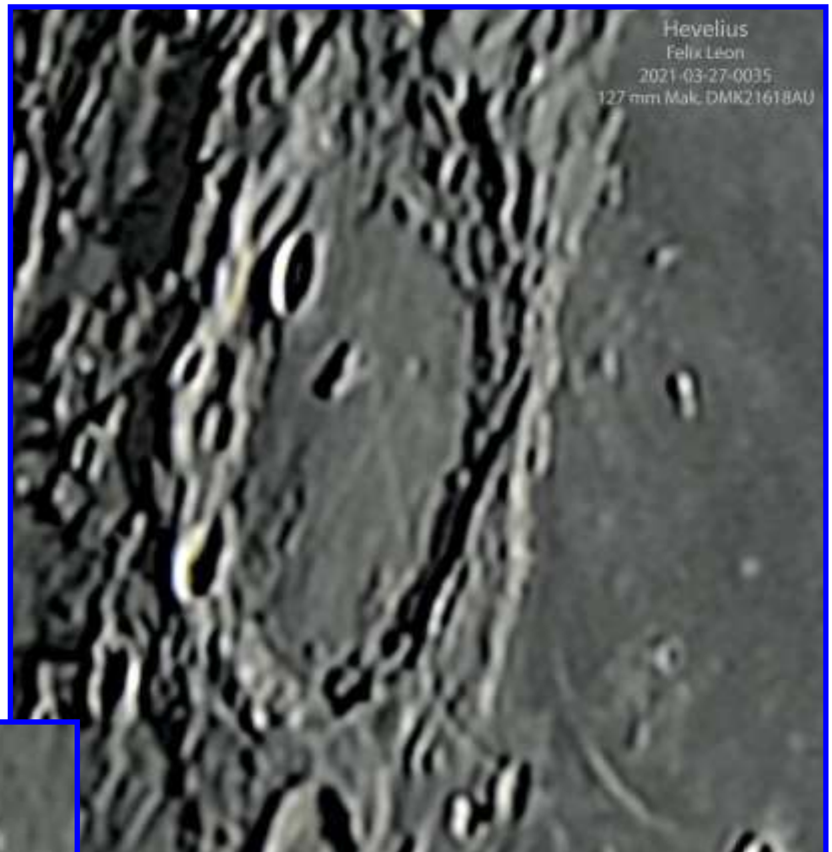


Image 5, Hevelius, *Felix León, Santo Domingo, República Dominicana. 2021 March 27 00:35 UT. 127 mm Maksutov-Cassegrain telescope, DMK 21 618AU camera. Detail of image 1.*

Finally, we reach one of the craters, in our opinion, more difficult to observe due to its proximity to the west limb, the giant pre-Nectarian Grimaldi, 222 kms. in diameter (IMAGE 6). It is the inner ring of a two-ring basin called Grimaldi Basin. Its walls have practically disappeared, there are low and high areas. Grimaldi's floor is extremely dark, which makes it always conspicuous. It is almost completely smooth, or at least it usually appears that way. Personally, I was never able to observe the details of the Grimaldi floor. That's why we found it interesting to review our image for its level of detail. Grimaldi is one of the few craters with wrinkle ridges inside (we talked about Wargentin in the previous issue). At the bottom of IMAGE 6 we see two wrinkle ridges that cast shadows and reflect sunlight in their tops. At the top there seems to be a glimpse of the profile of a buried crater (we noted it for the Basin and Buried Crater Project announced by Anthony Cook in the previous issue). We also see a dome with a pit crater at its top. All these are characteristics of volcanic activity, recent in geological terms, which leads us to think that Grimaldi was geologically active in the Copernican period, in which he had a second youth as "Mare Grimaldi".

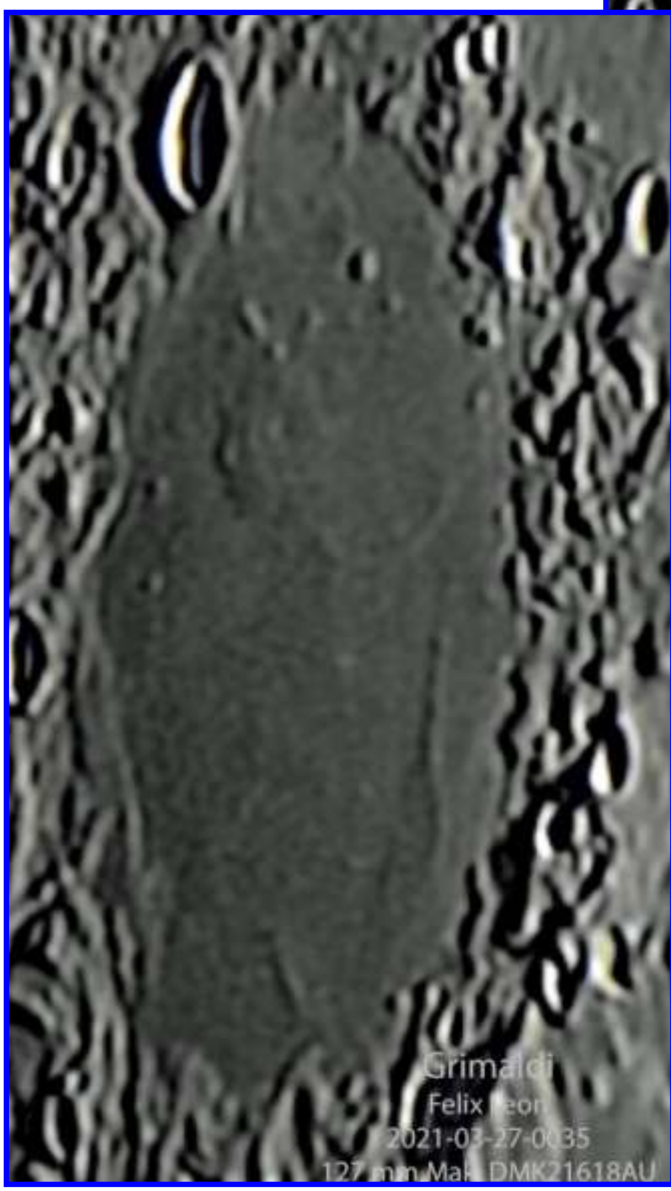


Image 6, Grimaldi, *Felix León, Santo Domingo, República Dominicana. 2021 March 27 00:35 UT. 127 mm Maksutov-Cassegrain telescope, DMK 21 618AU camera. Detail of image 1.*

Projection of the Full Moon

Jean-Francois Gely

Photographer: Jean-François Gely
Summary Author: Jean-François Gely

You've perhaps observed a solar eclipse projected onto a white background; that is, the telescope was pointed at the Sun and its light was projected onto a white sheet or board. I had never done this with the Moon before, but the above is the result of my attempt to do so on the night of February 16, 2022.

That evening, a few hours before the full Moon, I decided to point the famous 62 cm telescope of the Saint-Véran Observatory at the Moon – I used a 100 mm eyepiece. The telescope, with a focal length of 9 m, was then fitted with a 90 x zoom, which allowed me to view the entire Moon, or rather, a representation of the Moon. I needed to be patient; however, I was finally able to obtain a 70 cm projection onto a wooden board.

Photo details: Single exposure of 8 seconds; ISO 1600; and f/4.0; unfiltered Canon 6D + Samyang 24mm f/1.4 lens.

Used with permission of the author.

What I Have Seen on the Floor of Plato

Alberto Anunziato

Plato is probably the most unusual crater on the Moon. We are amazed by its almost completely flat and dark floor. Sunken two kilometers from the area of the Alps in which it is located, interrupted only by a few craterlets (very difficult to discern), its floor is a dark and enormous mass filled of lava, an oval (or so it seems to us) of more than 100 kilometers in diameter. So smooth and so dark, as a black mirror, it is not surprising that it has always attracted the attention of lunar observers and that "The search for the Holy Grail of lunar change focused for a time on the tantalizing features of the smooth floor of the lunar crater Plato" (W. Sheehan and T. Dobbins, Epic Moon, Willmann-Bell, Richmond, 2001, page 194), since "smooth and uniform to a cursory examination, it betrayed to closer scrutiny-like all regions of the Moon-an ever increasing number of minor variations in shade as well as a host of minute features" (page 192). During the years in which we have tried to observe the sites indicated by the "Project for the Verification/Elimination of Past Transient Lunar Phenomena Reports", carried out by the Association of Lunar and Planetary Observers (ALPO), the British Astronomical Association (BAA) and the Aberystwyth University, we have had numerous occasions to observe Plato and especially its floor. Most of the time we don't observe the strange events reported by other observers, but other times we do. One of the great debates in classical selenography is beyond the reach of my telescope: the elusive craterlets, which in the 19th century appeared and disappeared according to the observer and the telescope. I now share the oddities that I was able to observe on the floor of Plato in my few years as a visual observer.

1.-The western part is brighter than the eastern part.

At least at colongitude 145.4º (IMAGE 1). The Project required to repeat an observation of none other than Gruithuisen, in 1825, included as LTP in the catalogues. In the February 2018 issue of *The Lunar Observer*, Anthony Cook commented on our observation and compared it to a photograph by Brendan Shaw (BAA) in which both zones can be distinguished (IMAGE 2). As an interesting fact, IMAGE 3 (obtained with the LROC Quickmap) shows that the eastern part is higher than the western part.

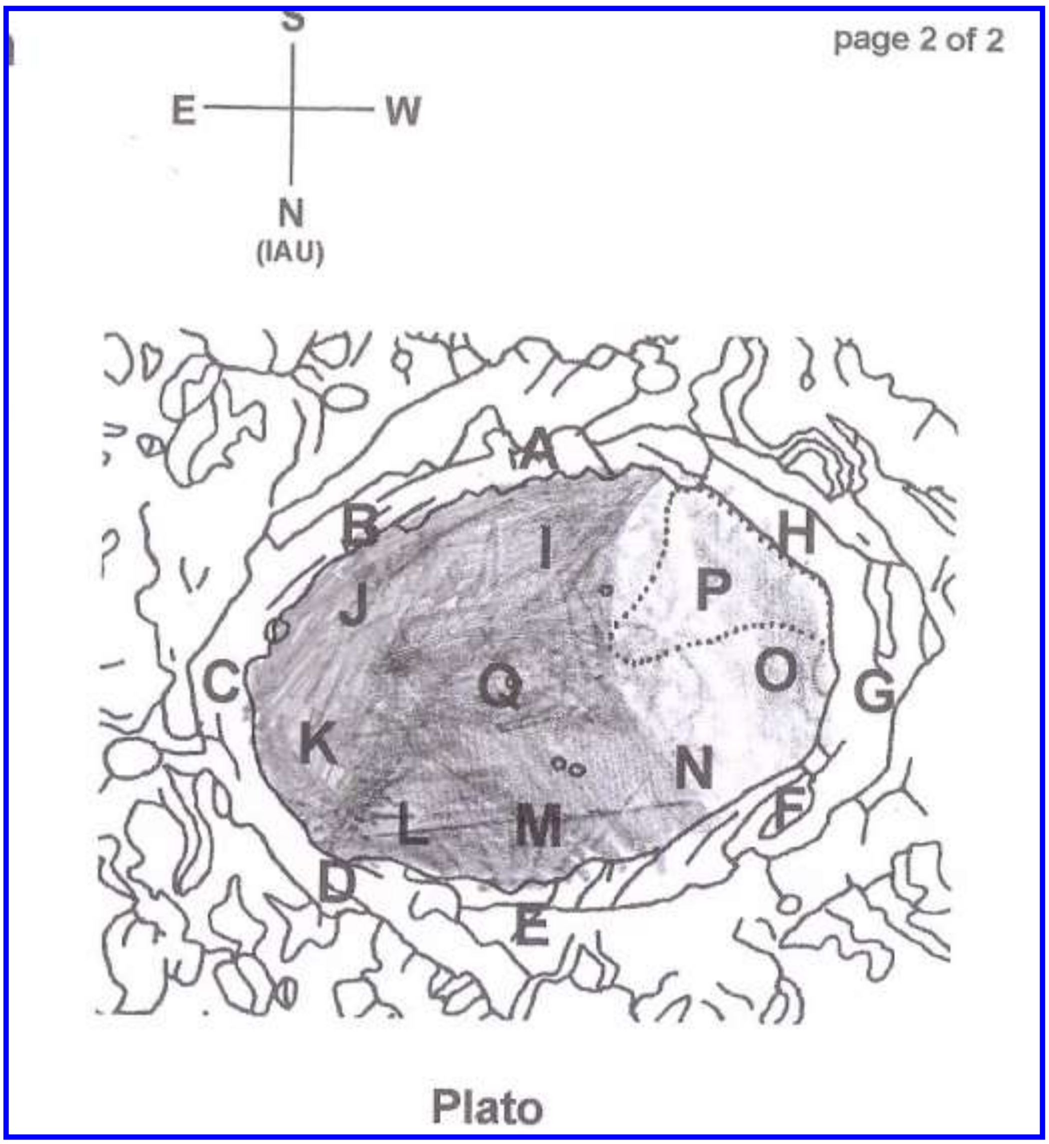


Image 1, Plato, *Alberto Anunziato, Paraná, Argentina. 2017 December 08 05:15-05:30 UT. Meade EX105 mm Maksutov-Cassegrain telescope, 154 x.*

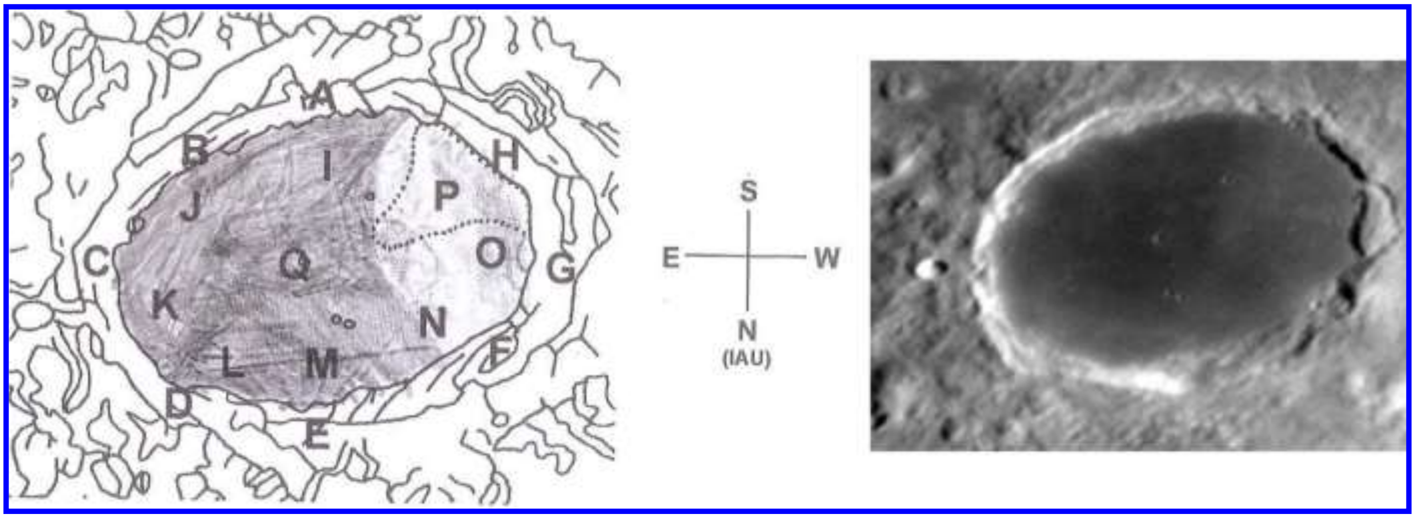


Image 2, Plato, *Alberto Anunziato, Paraná, Argentina. 2017 December 08 05:15-05:30 UT. Meade EX105 mm Maksutov-Cassegrain telescope, 154 x and image by Brendan Shaw (BAA).*

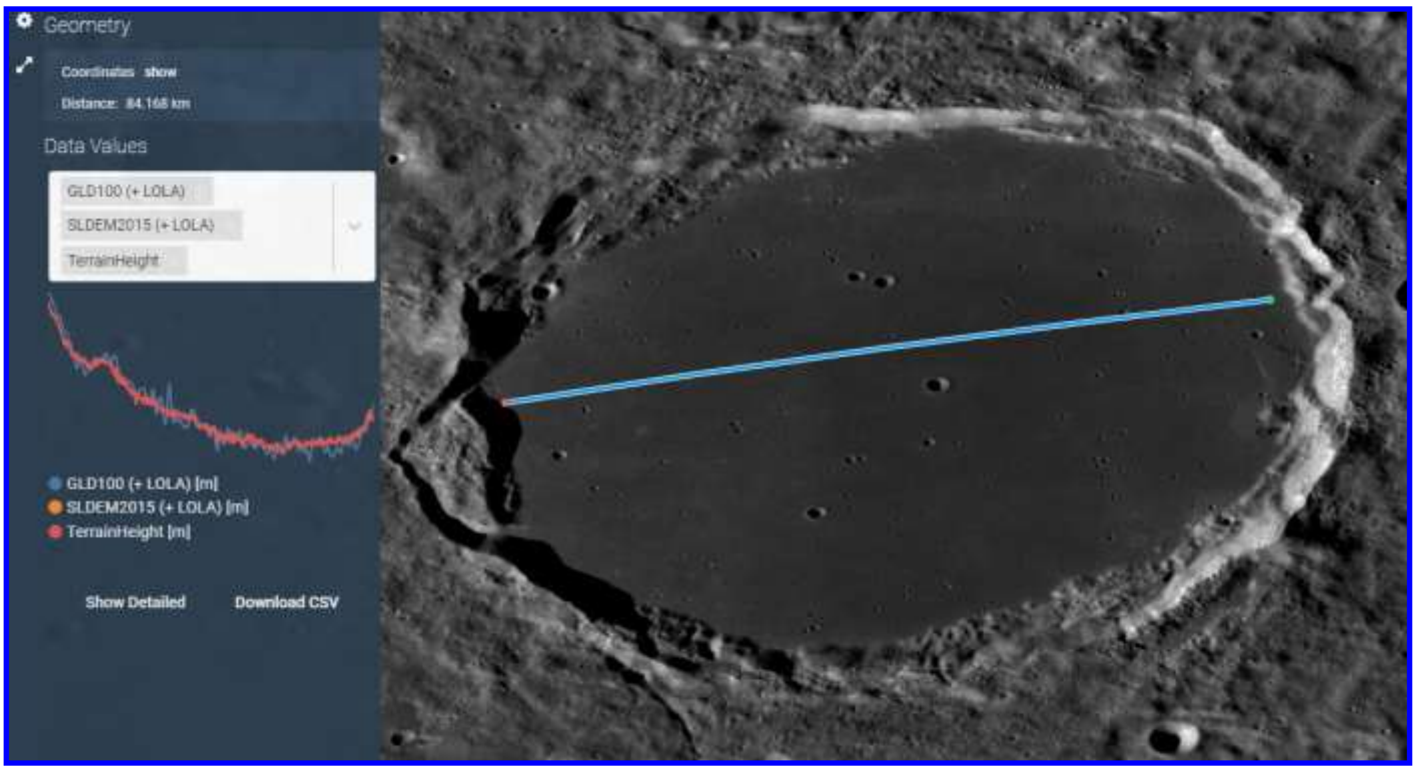
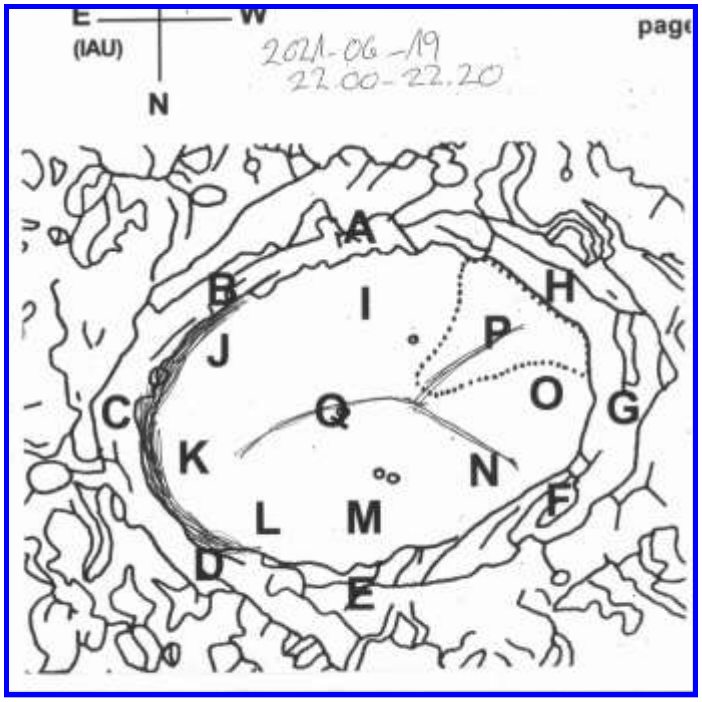


Image 3, Plato, *LROC QuickMap, east to west.*

2.-Thin streaks.

Another classic of selenography from the time of visual observation, regarding peculiarities in the Plato floor, are the "veins and streaks" that have been reported many times. Observing at 28.3º colongitude, that is, with Plato's floor completely illuminated, I could see a very faint streak (indicated in the sketch), barely visible (IMAGE 4). I was observing under the same illumination conditions in which two English observers (Barker and Fox) observed "many veins and thin streaks" in 1937. I strongly suspected an observation bias, as I read the description of the Barker and Fox report prior to the observation, and reported this thought to the Project.



In the catalogs of Transient Lunar Phenomena there are several similar reports. In the "Chronological Catalog of Reports Lunar Events" (Barbara M. Middlehurst et al., NASA, Washington DC, 1968) there are reports of streaks on the Plato floor, sometimes reddish, sometimes yellow, sometimes bright, sometimes even while Plato's floor was in shadow. See the cases cataloged with the numbers 9 (Bianchini), 14, 117 (Elger), 130, 163, 247, 248 (another observation of Barker) and 557.

Image 4, Plato, *Alberto Anunziato, Paraná, Argentina. 2021 June 19 22:00-22:20 UT. Meade EX105 mm Maksutov-Cassegrain telescope, 154 x.*

Barker and Fox in 1937 observed "many veins and thin streaks" with larger telescopes, I would have seen only two. Let us remember that the floor of Plato is extraordinarily smooth, so no selenographic accident would explain these diffusely bright lines. IMAGE 3 and 5 are relief profiles of Plato from the LROC Quickmap, from east to west and north to south, showing that Plato's floor decreases in height from south to north and east to west, but that the the only perceptible relief are the craterlets. And let's not forget that the thin streaks are seen with Plato's floor illuminated. Perhaps the explanation refere to brighter materials.

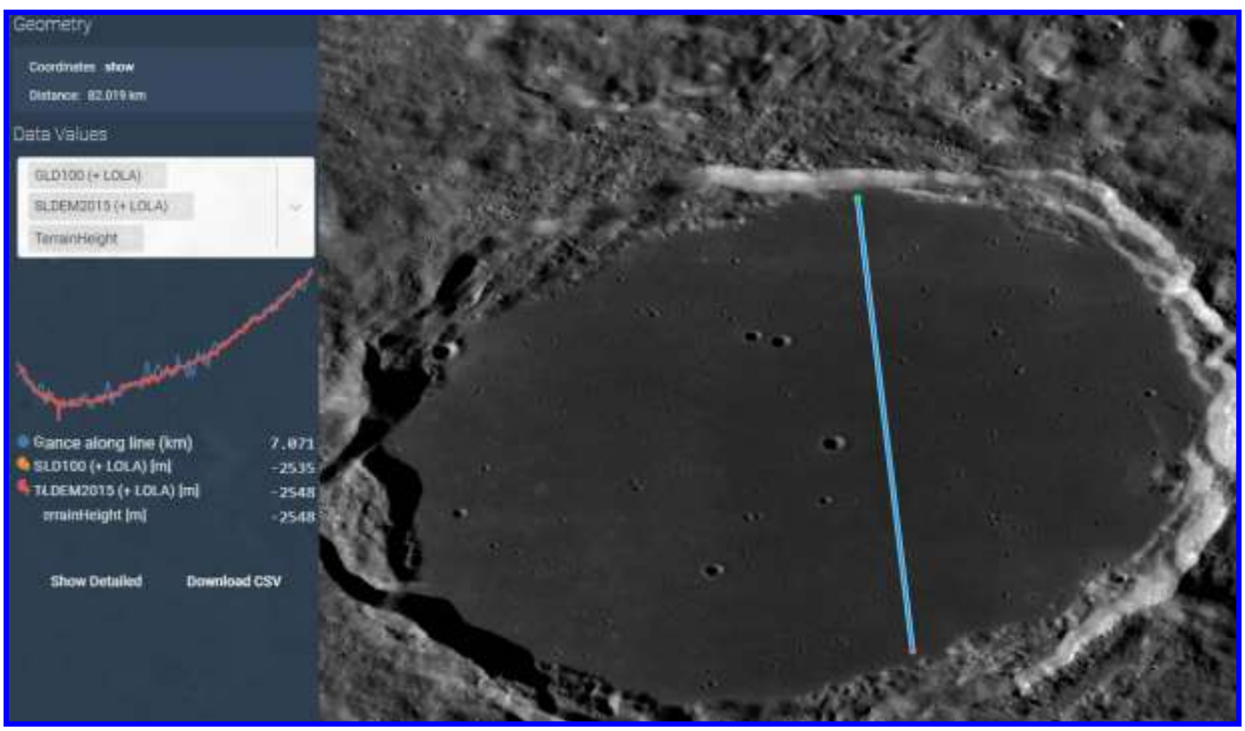


Image 5, Plato, *LROC QuickMap, north to south..*

3.-Bright bands in the shadows.

Observing Plato, in January 2021, while the terminator passed through its center, in the same conditions in which a Russian observer surnamed Markov observed in 1925 "light bands in bottom seen in shadow & did not seem to be elevations", I could distinguish from 23.30 to 23.35 a narrow stripe, not too bright, in the shadowed part (west) of the floor of Plato, marked as 1 in the IMAGE 6, and another stripe, even less bright (sometimes invisible), in the brighter part of the floor (east), marked 2. A few minutes later, from 23:54 TO 00:07, a new stripe appeared in the darker (west) part of the floor, marked 3, and the strpe marked 1 grew wider (marked as an extension). This observation was repeated in April 2022, the bands, always running from east to west, were 4, or two separated into two sections each (IMAGE 7). Both observations are made at sunrise over Plato.

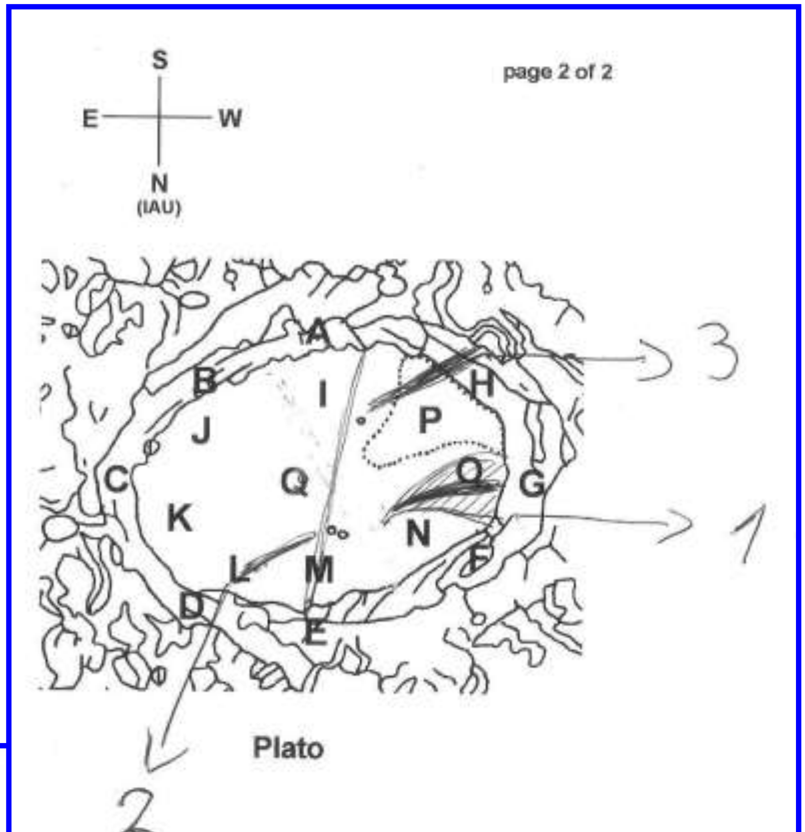


Image 6, Plato, *Alberto Anunziato, Paraná, Argentina. 2021 January 21 23:30-23:35; 23:45-00:07 UT. Meade EX105 mm Maksutov-Cassegrain telescope, 154 x.*

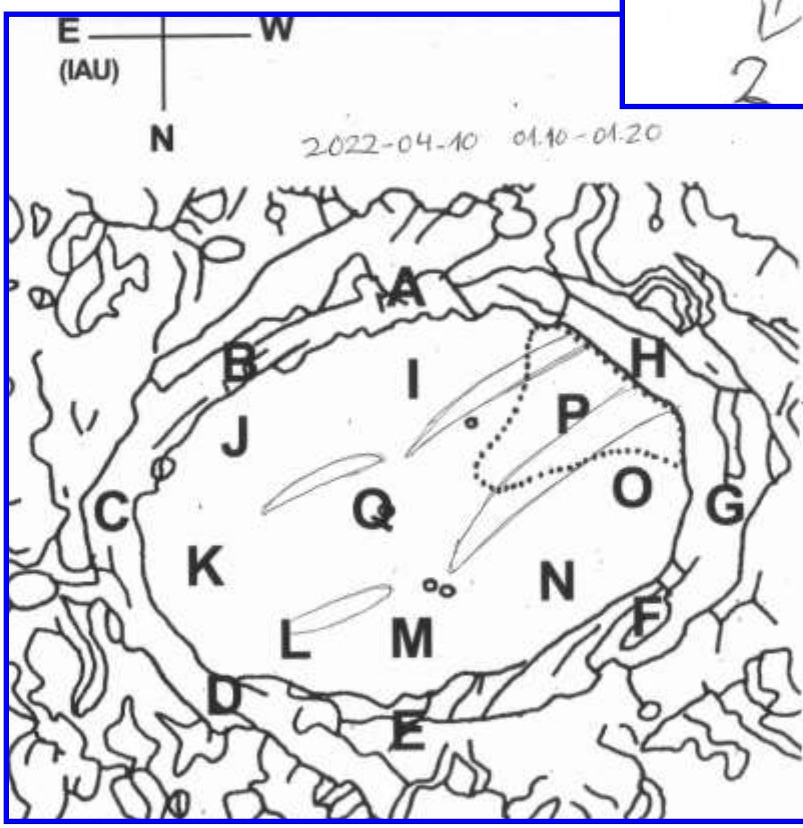


Image 7, Plato, *Alberto Anunziato, Paraná, Argentina. 2022 April 10 01:10-01:20 UT. Meade EX105 mm Maksutov-Cassegrain telescope, 154 x.*

In Volume 49, number 4, of the *Lunar Section Circular* of the British Astronomical Association there is an article by Nigel Longshaw (pages 5 and 6) called "Sunrise on Plato", in which a Gerald North sketch is reproduced (IMAGE 8) quite similar to IMAGE 6. Unlike the "streaks and veins", these bands seem to have an explanation: ashen light projected from the jagged edges of Plato. And if we compare the bright bands in the shadows with the shadows cast by the edges of Plato they are quite similar.

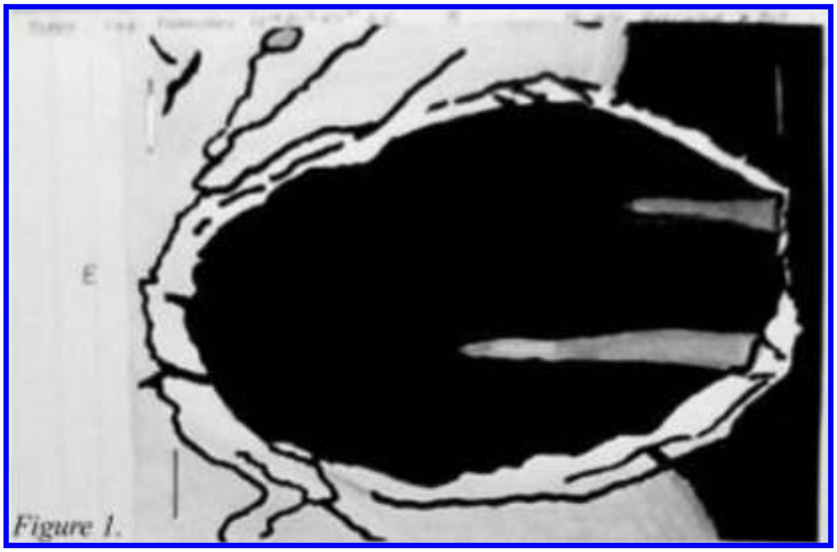


Image 8, Plato, *Gerald North. 1981 February 12 18:54-20:56 UT. 464 mm Newtonian reflector, 86-576 x.*

4.-Diffusely bright spots on the edge of the shadow.

This was perhaps the rarest case. On March 12, 2022 (01.35 to 01.40) I observed Plato to see if I could record what N. King had observed in 1983 from Winersh, Berkshire, UK, using a 150 cm f/8 reflector "a just detectable faint green color just after the dark shade around the inner eastern crater rim". Just in the limit of the Eastern shadow I could see two faint white spots, as indicated in the IMAGE 9.

Of course, we can think of the same confirmation bias that we mentioned for the case of "streaks and veins". And also in the numerous reports of "clouds" in Plato, will they be similar observations? In the aforementioned Middlehurst catalog, the events cataloged with the numbers 42, 131, 137, 236 and 271 would be similar to the two supposed diffuse spots on the edge of the shadows.

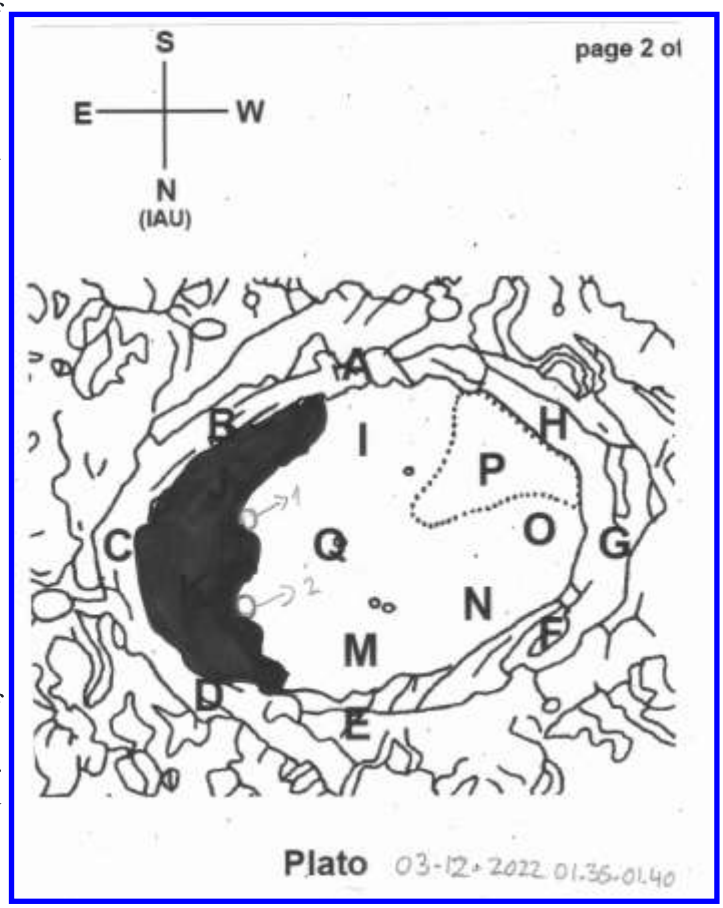
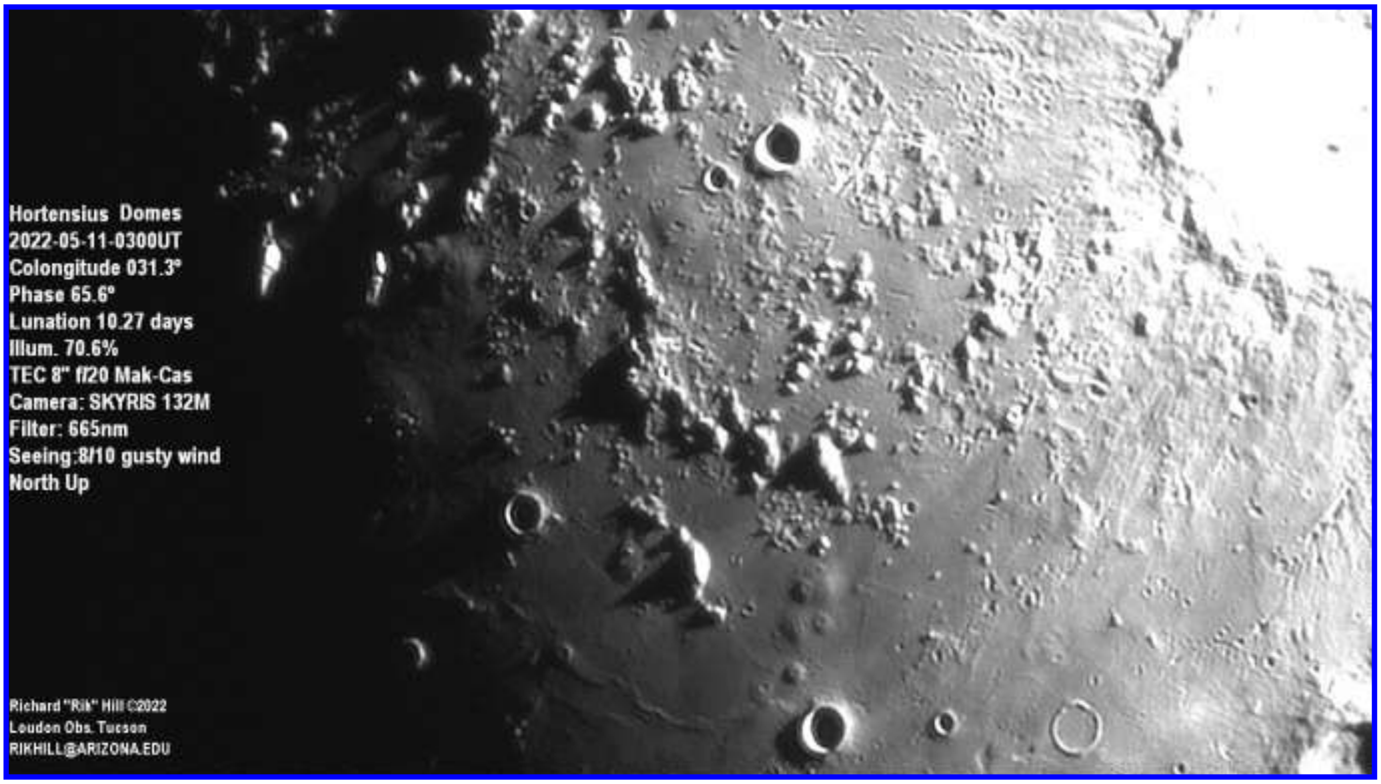


Image 9, Plato, *Alberto Anunziato, Paraná, Argentina. 2022 March 12 01:35-01:40 UT. Meade EX105 mm Maksutov-Cassegrain telescope, 154 x.*

A final consideration. Diffuse brightness observations appear to be closely related to visual observation. Analyzing the Middlehurst catalog of anomalous lunar events, we realize that the Plato events we cite are visual observations, prior to the rise of photographic observation. It is a two-sided problem. We can think that visual observation is more apt to capture these subtle brightnesses, or that when observing visually, one is more attentive to what is observed. And also, that they are faulty observations, a product of observation bias, confirmation bias of previous reports, or misinterpretations of what is seen at the edge of the maximum resolution of our instrument. The truth, as always, is probably somewhere in the middle.

Hortensius and Milichius Domes

Rik Hill



Hortensius Domes, *Richard Hill, Loudon Observatory, Tucson, Arizona, USA. 2022 May 11 03:00 UT, colongitude 31.3^{o}. 8 inch TEC f/20 Maksutov-Cassegrain telescope, 665 nm filter, SKYRIS 132M camera. Seeing 8/10 with gusty wind.*

This is a fun region at this one day after sunrise on Copernicus. In fact, that is Copernicus in the upper right corner of this image, grossly overexposed on purpose, processed to bring out low contrast details along the terminator. At the bottom middle edge of this image is the crater Hortensius (15 km) and just above it are some lunar domes. Five are readily visible at first glance but below and to the left of the bottom one is yet another, lower or flatter dome bringing the total to 6 domes in a cluster! Five of them have central pits, ranging 2-3 km in diameter, and all these domes are in the 6-8 km diameter range. These domes are pyroclastic vents formed by very viscous lava similar to small shield volcanoes. The height of these domes is only a few hundred meters which is why they are best seen when the Sun is low.

Above and to the left of Hortensius is another similar sized crater, Milichius (14 km) which has a nice dome to the left of it, still in shadow here. Forming a right angle with these two craters, to the upper right, is another similar sized crater, Tobias Mayer C (16 km) with a grand dome (Milichius 4 or M$) to the right of it, double the size of the Hortensius domes. Moving on a line from TB-C through the M4 dome and double that distance you'll see another large dome (Milichius 2) among the mountain peaks. There are many more domes in this area. You can see many of them at: Lunar Dome Atlas ALPO/BAA (https://lunardomeatlas.blogspot.com/). So go out and search whenever the Sun is low in this area, and you will be rewarded!

Wrinkle Ridges Near Mons Piton

Alberto Anunziato

Mare Imbrium near Mons Piton has a deceptively flat appearance, which disappears in oblique illumination. The star is Mons Piton (2,200 height), with its splendid brightness and its spectacular expressionist shadow that extends far to the west. For centuries it was thought that mountains like Piton and Pico were very steep because of the shadows they cast, remember how science fiction movies before Apollo 11 showed a moon full of small mountains like stalagmites. The complicated relief that we see in the image is explained quite simply, they are the highest areas of the relief prior to the formation of the Mare Imbrium by lava filling of the pre-existing basin. Mons Piton is a top of the ancient submerged mountains, as is Montes Spitzbergen, it is the same inner ring in Mare Imbrium basin. The landscape is much the same, rocky (but mountain-sized) outcroppings, glowing brightly when the terminator is near, overlying or adjoining wrinkle ridges, which are due not to subterranean thrust faulting but to relief submerged by lava. These wrinkle ridges are less steep and do not generally have the steepest upper structure ("crest"), but rather appear (at least visually in a small telescope) as a mere arch. The section of the inner ring of Mare Imbrium that we see begins with Mons Piton, then follows a wrinkle ridge segmented into three sections, the first passing to the east of Piton A (6 km diameter), while Piton B (5 km diameter) is on the eastern slope, the second section is barely distinguishable, the third section (to the south) appears to be the highest, casts considerable shadow, and appears to have a small crest in the middle. The right half of the image reproduces the same pattern. South of Piazzi Smyth (22 km diameter), which is the largest crater in the image, two mountainous fragments are joined by a small wrinkle ridge. Mons Piton itself is fascinating, in oblique illumination it shines so brightly it seems to shimmer, its northern part has always seemed to me to be dimmer than its southern part and the gap seems to be in shadow. But it can be as illusory as the steep shape that its shadow indicates, it is actually a rounded hill.

Dorsa Near Mons Piton, *Anunziato, Paraná, Argentina. 2022 May 08 22:55-23:20 UT. Meade EX105 mm Maksutov-Cassegrain telescope, 154 x.*

Imaging Techniques

A Simple, Easy-To-Use Algorithm for Qualitative Titanium Mapping of the Lunar Surface

Darryl Wilson

An important goal of these multiband image processing articles is to present methods that can be used to process more than three bands of input imagery at a time, and to display the results in a single image product. With this seventh article in the multiband image processing series let's take a brief detour from the progression towards processing more bands of input imagery, and examine a two-band algorithm that can be used to generate a (mostly) qualitatively correct titanium map of the lunar surface. In the interest of ease-of-use, this author made (partially justified) approximations (described below) at some key stages that could be construed as "coloring outside the lines" of good scientific practice. If not for the (surprisingly?) good results, this effort would have been discarded. As it is, the value here is that this technique should be easy enough for almost anyone with a small telescope, a color imager, and image processing software to reproduce quickly.

The algorithm used in this article is based on the work presented in reference 1. *Lucey et al.* correlated laboratory spectrometer measurements of samples returned by the Apollo 11 and Apollo 14 crews with multiband imagery acquired by the Clementine orbiter. They then derived a band-ratio formula that reproduced the lab findings when applied to the spacecraft data.

Their algorithm is based on the ratio of the 415 nanometer reflectance values divided by the 750 nanometer reflectance values squared. That roughly means divide the violet band by the near-infrared (NIR) band squared. Since lunar surface materials do not have sharp absorption features in the solar -reflective region of the spectrum, one might wonder whether the results would be similar if a blue (close to violet) band were divided by a red (close to NIR) band. This paper explores that idea.

Equation 1 describes the process used by *Lucey et al.* in their paper to calculate what they call the spectral titanium parameter (Θ_{Ti}). Their equation includes a term that is omitted here because a reading of the article reveals that it was zeroed out.

$$\Theta_{Ti} = \arctan\left(\left(R_{415} / R_{750}\right) - 0.42\right) / R_{750} \qquad \text{Eqn. 1}$$

Exploring the possibility of using an RGB imager to approximate their results was easy. The Celestron Skyris 274C is a one-shot RGB imager, so the red and blue bands are automatically coregistered.

What about the spectral bandpasses? This author paired a close-focus C-mount lens with the Celestron imager, pointed the apparatus toward the viewport of a handheld spectrometer, and captured a digital image of the result. The color BMP image that resulted showed red, yellow, green, cyan, blue and some other faint hues - just as you would see with your eye if you were using the spectrometer according to the instruction manual. Separation of the three-color bands on the computer allowed image brightness transects to be taken for each of the bands. Peak and half-max values were retrieved - one set for each color - that yielded the following values:

Band	HalfMax	Peak	HalfMax
Blue	430 nm	460 nm	505 nm
Green	485 nm	534 nm	575 nm
Red	550 nm	595 nm	700 nm

Obviously, the spectral bandpass values were not well matched to the Clementine bands. The sensitivity of the blue band is negligible at 415 nm, and the sensitivity of the red band is likewise negligible at 750 nm. Essentially, the experiment using the Celestron imager would involve the 460/595 ratio - not the 415/750 ratio. Not to be deterred, this author reasoned that since the absorption features of lunar surface materials are fairly broad and gentle in this wavelength range, the primary effect to the algorithm might be simply that some sensitivity would be lost due to the smaller wavelength difference between the numerator and the denominator. Although the reflectivity of lunar regolith is certainly somewhat nonlinear as a function of wavelength, as long as there are no sharp and/or strong absorption features, one might get away with ignoring the effect of the nonlinearities.

One other matter had to be addressed. Their equation assumes calibrated reflectance imagery. Amateur astronomers do not normally work with reflectance data. In this case, as usual, the units for the image data were simply digital numbers (DNs) as recorded by the Skyris imager, not watts per square meter per steradian - the SI standard for reflectance data. The constant value of 0.42 in Equation 1 was derived from the use of reflectance units, so it is certainly not correct for units of uncalibrated DNs.

Undaunted, this author made two assumptions and pressed onward. The first was that the lunar albedo is roughly wavelength-independent in this spectral range, so the digital values of the blue band were set to be about the same as the values of the red band. The second was that the solar spectrum convolved with the earth's atmosphere was roughly flat and about equally intense for both the blue and the red bands. These assumptions might be reasonable enough so that the error they induce is a second order effect.

Equation 2 expresses the equation used in this paper. The solution is called the pseudo-titanium parameter to distinguish it from the solution of Equation 1. The 0.42 constant was retained simply as a starting point, and was not removed because time constraints prevented performing a sensitivity analysis by varying its value while observing he results.

$$\text{pseudo}\Theta_{Ti} = \arctan\left(\left(DN_{460} / DN_{595}\right) - 0.42\right) / DN_{595} \qquad \text{Eqn. 2}$$

The reference paper contains processed images showing titanium content of the moon in areas near the Apollo 11 and 14 sites. If our processed images match those well, it suggests that our assumptions were reasonable enough. Perhaps it seems unlikely that this should work at all, but let's look and see.

Figure 1 is composed of four images of Mare Tranquillitatus. The upper-left is a 750 nm grayscale image from their paper that is used as the denominator image in their algorithm. The lower-left is the spectral titanium parameter image as calculated by *Lucey et al.* using Equation 1. The left column contains the "truth" images. Figure 1 also presents results from processing the imagery acquired with a 3" refractor and a Celestron imager. The right column contains the ground-based images. In the upper-right, the red band has been stretched to approximate the brightness level of the Clementine 750 nm band. Although the bandpass peak is shifted by 155 nm, and there is essentially no spectral overlap between the Clementine NIR and the Celestron red band, the relative brightness of the visible features is quite similar, suggesting that substituting a 595 nm band for the 750 nm one might work. The lower right image is the calculation of the pseudo-spectral Ti parameter using equation 2. Their published spectral Ti parameter image is so bright that it saturates in places. To avoid saturation and preserve more detail, the pseudo-spectral Ti parameter image has been stretched to a lower brightness level. That considered, most of the features in their image are also visible in this one. Although not perfect, the correspondence seems good.

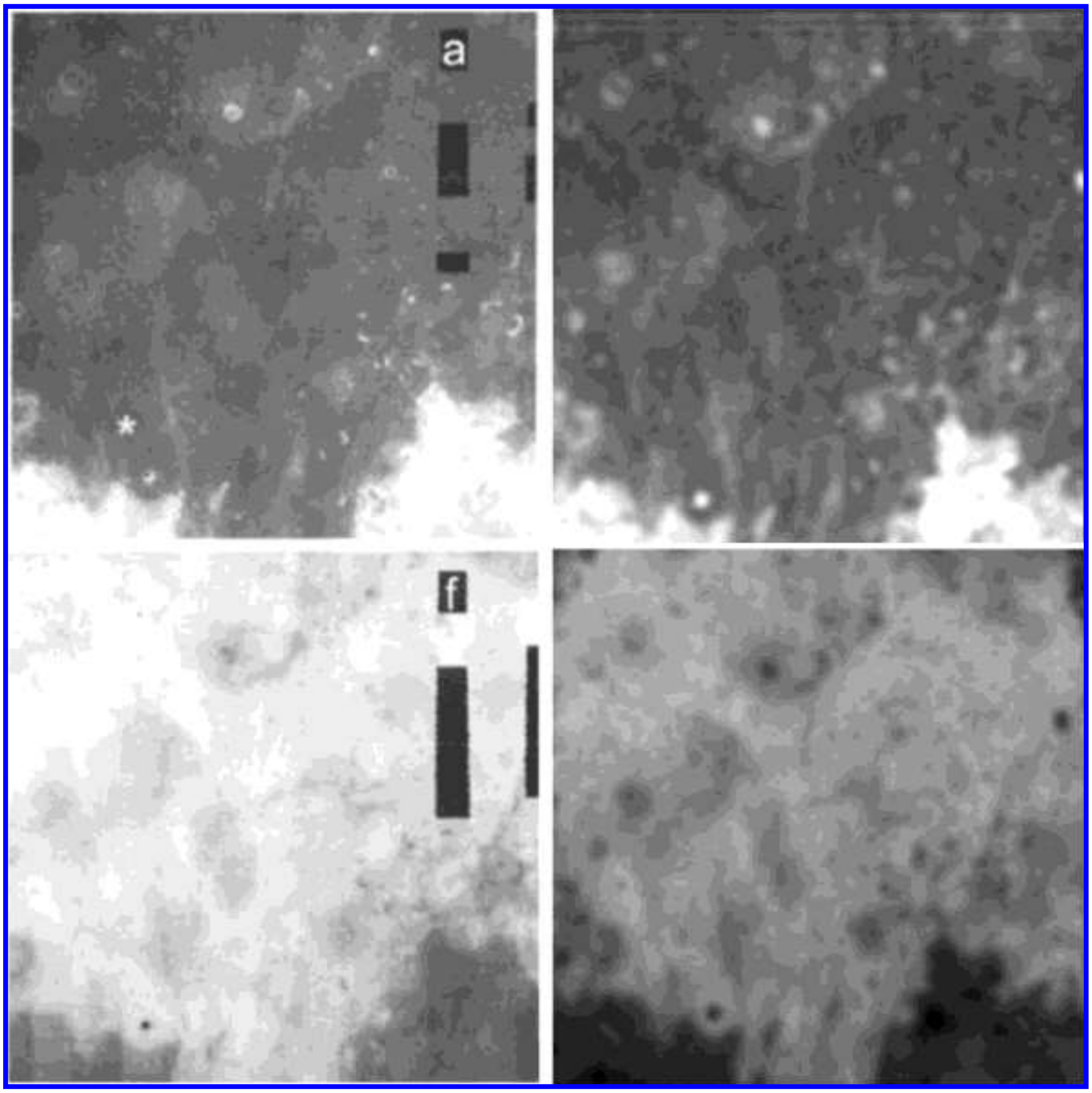


Figure 1 - Mare Tranquillitatis
Upper left - 750 nm Clementine image
Upper right - 595 nm ground-based image
Lower left - Clementine Spectral Titanium Parameter Image
Lower right - pseudo-Spectral Titanium Parameter Image

Figure 2 is organized exactly as Figure 1. It covers the Fra Mauro region surrounding the Apollo 14 site. Again, the red band was stretched to match the brightness level of the 750 nm band so that albedo features can be compared for differences. The correlation is not as good for this pair as it was for the Tranquility Ti maps. The pseudo-spectral Ti parameter band has more brightness discrepancies, and some of them indicate more error than one would like to see. Nevertheless, the correlation of the two images seems interestingly high.

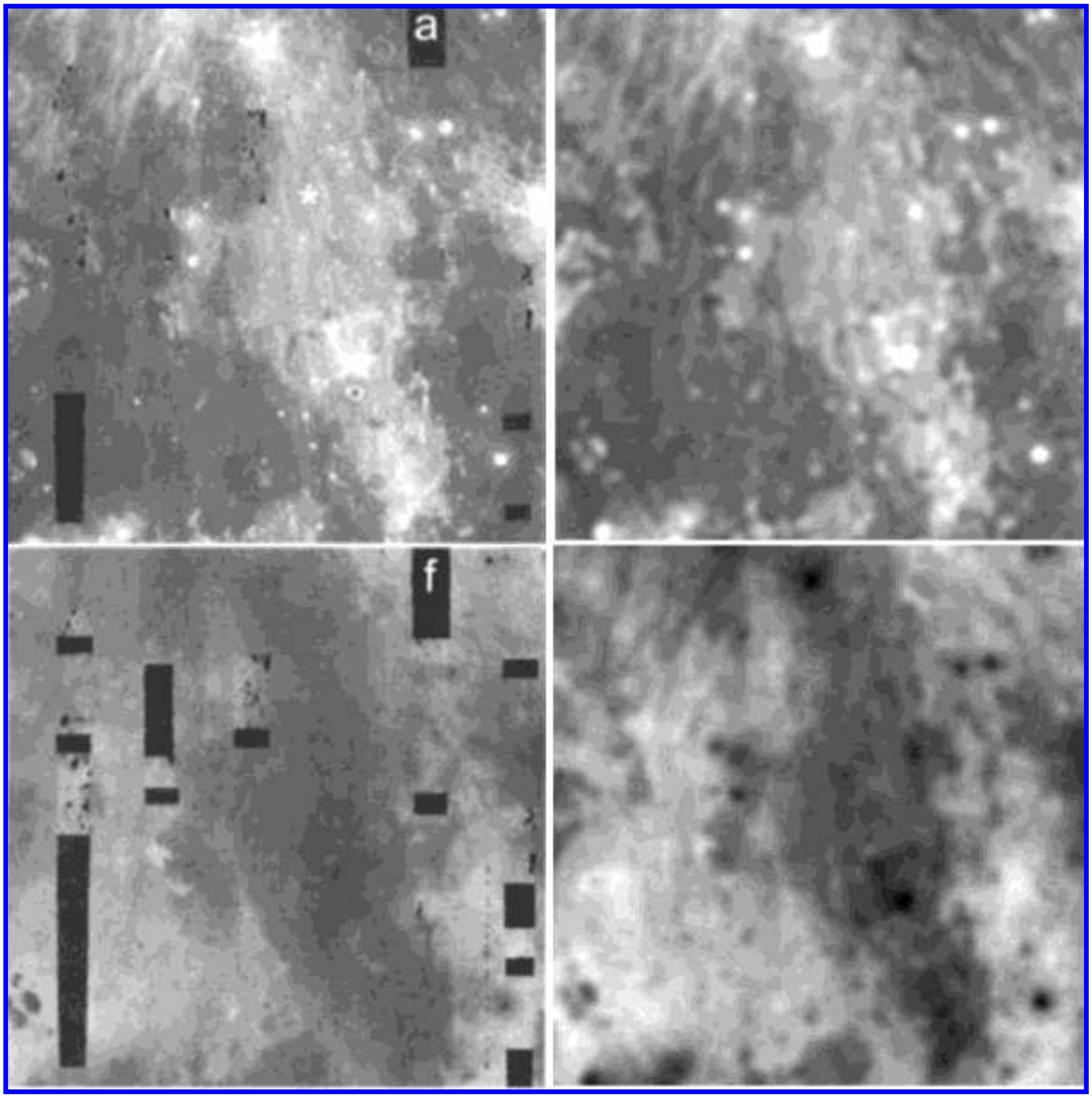


Figure 2 - Fra Mauro
Upper left - 750 nm Clementine image
Upper right - 595 nm ground-based image
Lower left - Clementine Spectral Titanium Parameter Image
Lower right - pseudo-Spectral Titanium Parameter Image

"Interestingly high", "indicate more error", and "correspondence seems good" are rather vague, wishy-washy phrases that are seldom found in good scientific papers. Can't we quantify these concepts and express them precisely? In principle, yes. But in practice there is a difficulty that this author has not yet been able to remedy with reasonable effort. It goes as follows. If our processed Ti parameter image were precisely coregistered with the one published by *Lucey et al.*, then a pixel-by-pixel comparison would yield a correlation value between the two images. The image-to-image correlation value would allow us to speak quantitatively about the accuracy of our results. Just what we need!

The difficulty lies in achieving a precise coregistration between the two images. Coregistration errors result in decreased correlation values. Two factors combine to make the problem significant. First, the imaging geometry was different for the 3" refractor and the Clementine imager. Second, the Moon's surface is curved, so standard image warping algorithms do not generally work well. A potential solution is to calculate the latitude and longitude of each image pixel and compare it to the pixel from the other image that corresponds to the same lat-long. One difficulty in this approach is figuring out the transformation that will calculate the lat-long of each pixel in the ground-based images. This author does not have software to perform that function, and other sampling-related difficulties would still remain.

Lucey et al. described how the weight percent of TiO_2 in the regolith can be calculated using the spectral Ti parameter. That calculation was, in fact, the main point of their work. The numerous approximations and simplifications introduced in this paper eliminated any possibility of a quantitative result here. That's O.K. as long as the new algorithm is easily useable by the average amateur astronomer. Since the ground-based results are substantially similar to the Clementine results for the two study areas, it seems reasonable to apply the technique of Equation 2 to other areas on the Moon. Let's do it and see what we get.

Figure 3 shows the results of global application of the algorithm. Brighter areas have higher Ti concentration at the surface. The patterns of Ti deposition in northern Mare Imbrium and Oceanus Procellarum are familiar to anyone who has examined color enhanced lunar imagery. In the opinion of this author, this grayscale Ti abundance map is superior to color-enhanced imagery for display of relative Ti abundance.

Figure 3- Pseudo-Spectral Titanium Parameter Image *Nearly Full Moon April 16, 2022 01:54 UT. 3" refractor 2.25 arc seconds / pixel. Celestron Skyris 274C.*

Other brands and types of one-shot RGB imagers will have bandpass transmission values for the red, green, and blue filters that will differ from the Celestron Skyris, and from the Clementine filters, but this work shows that they may be sufficient for this application. The same is true if you image with separate red, green, and blue color filters. One important caveat must be noted: this author used an IR-Block filter to eliminate NIR radiation from the focal plane detectors. If your blue band has significant transmission from 0.7 microns to 1.1 microns (some blue filters do), Equation 1 will be violated and this approach will probably work poorly. Do use an IR-Block filter.

In summary, this article presented a simple, easy-to-implement algorithm for transforming a color image of the Moon to a map of the fractional abundance of titanium in the regolith. The simplified approach was derived from an algorithm by *Lucey et al.* based on sample returns from the Apollo 11 and 14 missions that can be used to calculate the TiO_2 weight percent in lunar soil using a two-band ratio-based calculation. Several simplifying assumptions and approximations were made in the process of substituting blue and red color bands for the two Clementine bands that were used in the study. Measured bandpass values presented for the Celestron imager showed proximal spectral regions, but no spectral overlap between Clementine and this work. The pseudo-spectral titanium parameter images were surprisingly good reproductions of their published images. An approach to quantitative assessment of accuracy was described that was not used due to the difficulties of coregistering ground-based images with those from the Clementine orbiter. A global Ti abundance map generated with the pseudo-spectral titanium parameter was presented. Finally, amateur astronomers wishing to reproduce this work were encouraged that they may achieve satisfactory results with any RGB imager, as long as they also use an IR-blocking filter.

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P. Lucey., D. Blewett, and B. Jolliff. "Lunar iron and titanium abundance algorithms based on final processing of Clementine ultraviolet-visible images", Journal of Geophysical Research, Vol. 105, No. E8, Pages 20,297-20,305, August 25, 2000
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Römer and G. Bond Rilles

Howard Eskildsen

Rima G. Bond and Rimae Römer are featured in this photo along with rilles crossing the crater Chacornac. The LROC QuickMap Free Air Gravity Overlay was reviewed to see if it shed any light on the rilles' origins.

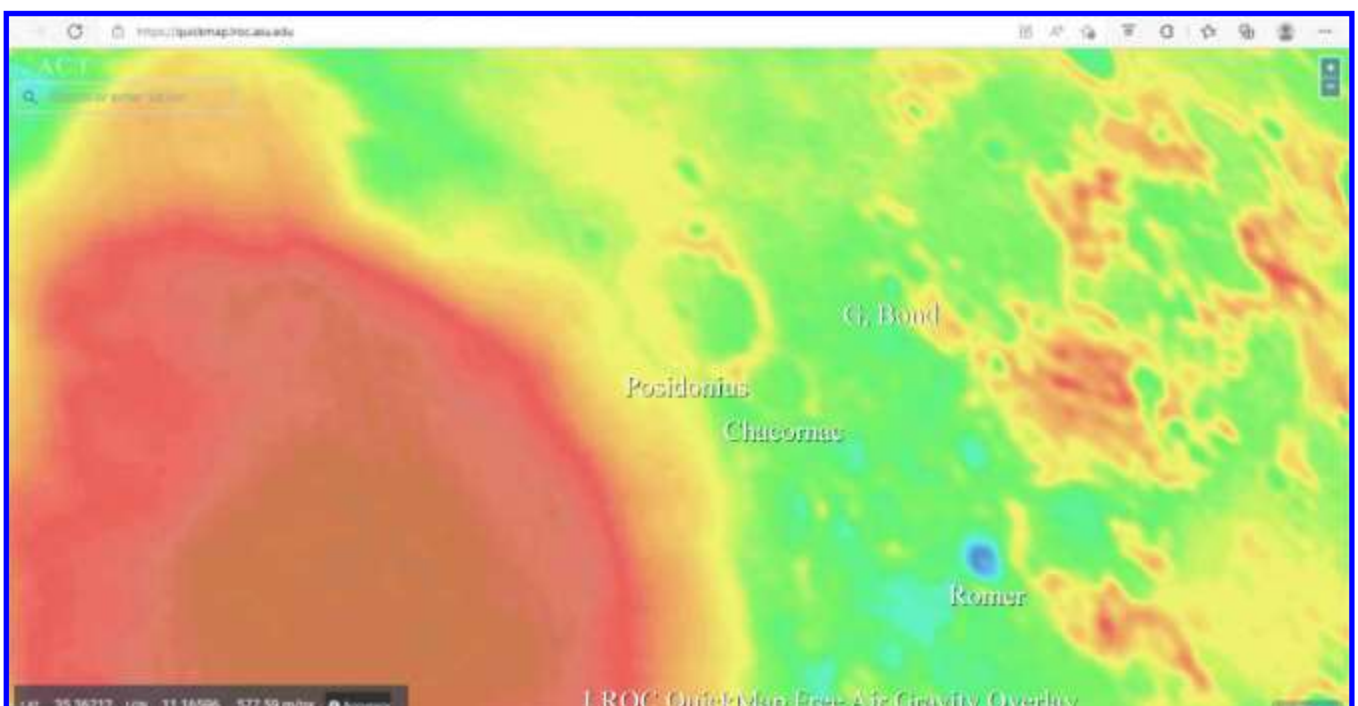
The 150 km long Rima G. Bond and 110 km Rimae Römer course vertically across the right central image and appear as if they may connect just south southeast of crater G. Bond. Near the center of the image, other arcuate rilles cross the crater Chacornac which abuts the SE corner of Posidonius. The rilles all appear to be graben, suggesting tension across the crust, and the rilles in Chacornac appear to be older, more worn than the two linear rilles. To the left of Posidonius in Mare Serenitatis, Dorsa Smirnov, a wrinkle ridge belies compression of the crust at that location.

The LROC QuickMap with Grail Free Gravity Overlay shows mass concentration in Mare Serenitatis as expected with its basalt filling, and the areas of the rilles have a low mass concentration. The rilles crossing Chacornac are probably related to stresses from the sagging of the Serenitatis basin, but the origins of Rima G. Bond and Rima Römer are unclear.

Posidonius, Rimae G. Bond and Römer, *Howard Eskildsen, Ocala, Florida, USA. 2022 April 20 09:47 UT, colongitude 138.5°. Celestron 9.25 inch Schmidt-Cassegrain telescope, SKYRIS 236M camera. Seeing 5/10, transparency 4/6.*

Posidonius, Rimae G. Bond and Römer, *Howard Eskildsen, Ocala, Florida, USA. 2022 April 20 09:47 UT, colongitude 138.5^o. Celestron 9.25 inch Schmidt-Cassegrain telescope, SKYRIS 236M camera. Seeing 5/10, transparency 4/6.*

Posidonius, Rima G. Bond and Römer, *LROC Grail*



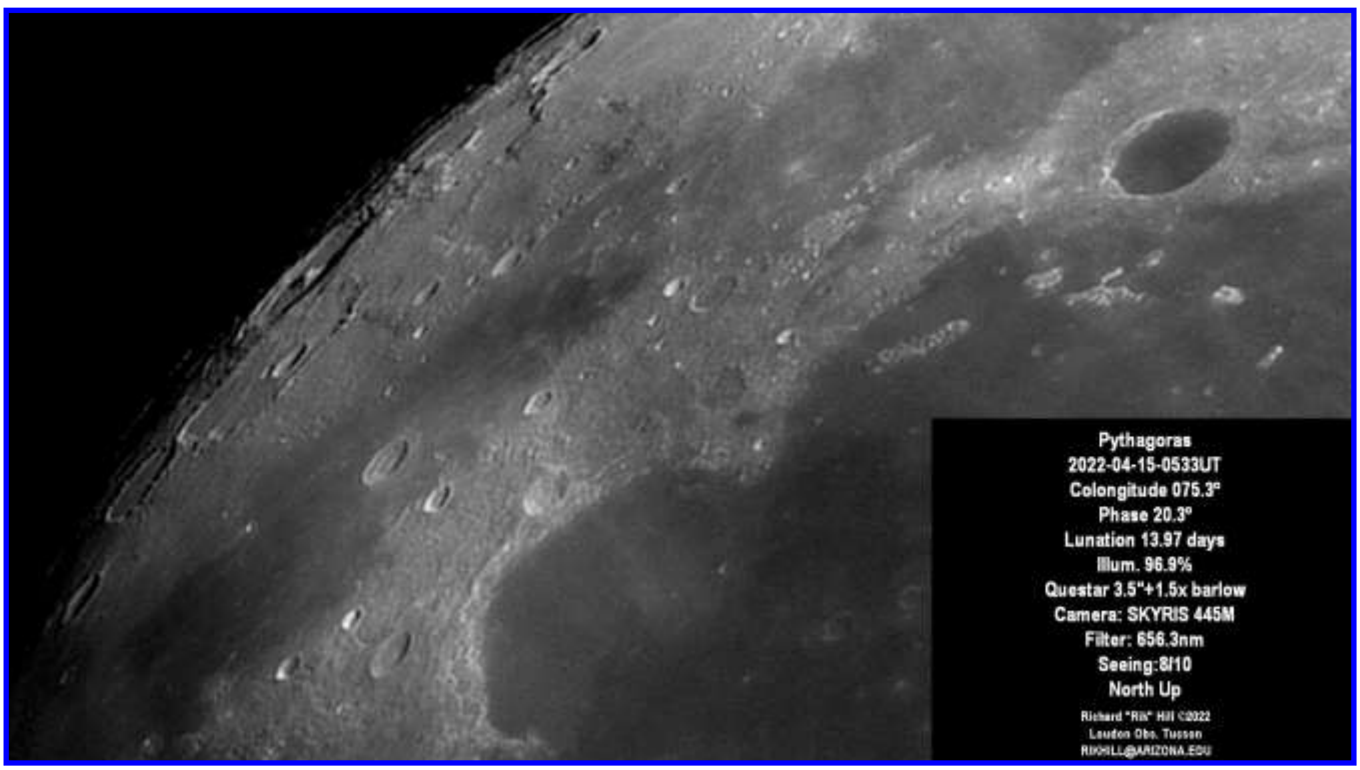
Pythagoras

Rik Hill

This is a lot more than Pythagoras but our eyes are instantly drawn to that handsome 133 km diameter crater seen here on the edge of the terminator. I always like watching the shadow of the central peak as it shrinks on the crater floor with the rising Sun. Because of its position on the limb, we can only see one interior wall (western) and have never seen the eastern wall from Earth. We have seen it from spacecraft and it shows this crater to be as magnificent as Copernicus. The large area outlined by the low walls to the lower right of Pythagoras is the equally huge, ancient Babbage (148 km), maybe as old as 4.5 billion years! It was covered over by a lot of the ejecta from the Pythagoras impact. Below Babbage is the well defined Oenopides (70 km) and farther Markov (43 km).

Above right of Pythagoras is a large irregular area that is Anaximander, 70 km diameter for the foreground portion. It is an overlap of about 3 large craters all the rest of which have satellite names (Anaximander B, Anaximander X, etc.). Farther up is the crater Carpenter (61 km) near the upper edge of this image.

Two large commanding features in this image are Sinus Iridum (411 km) the large cirque at the bottom of this image. Between this bay or sinus and Pythagoras is the crater Harpalus (41 km) sitting in the middle of the west end of Mare Frigoris, which displays a nice radial ray pattern during Full Moon. The distinctive dark oval in the upper right of the image that is Plato (104 km). You might notice a couple of small white dots on the floor of Plato that are several of the small craterlets that are the goal to so many lunar imagers. LROC QuickMap shows the larger craterlets to be 2-3 km in diameter, about the limit for this telescope. Below Plato are the nice island mountains, Montes Teneriffe on the right with Mons Pico, the roughly triangular island to the far-right end, and the larger elongated mass on the far left that are Montes Recti. The changes in appearance of these mountains are enjoyable to observe during the course of the lunar day.



Pythagoras, *Richard Hill, Loudon Observatory, Tucson, Arizona, USA. 2022 April 15 05:33 UT, colongitude 20.3°. 3.5 inch Questar Maksutov-Cassegrain telescope, 1.5 x barlow, 656.3 nm filter, SKYRIS 132M camera. Seeing 8/10.*

Cauchy Dome Region

Howard Eskildsen

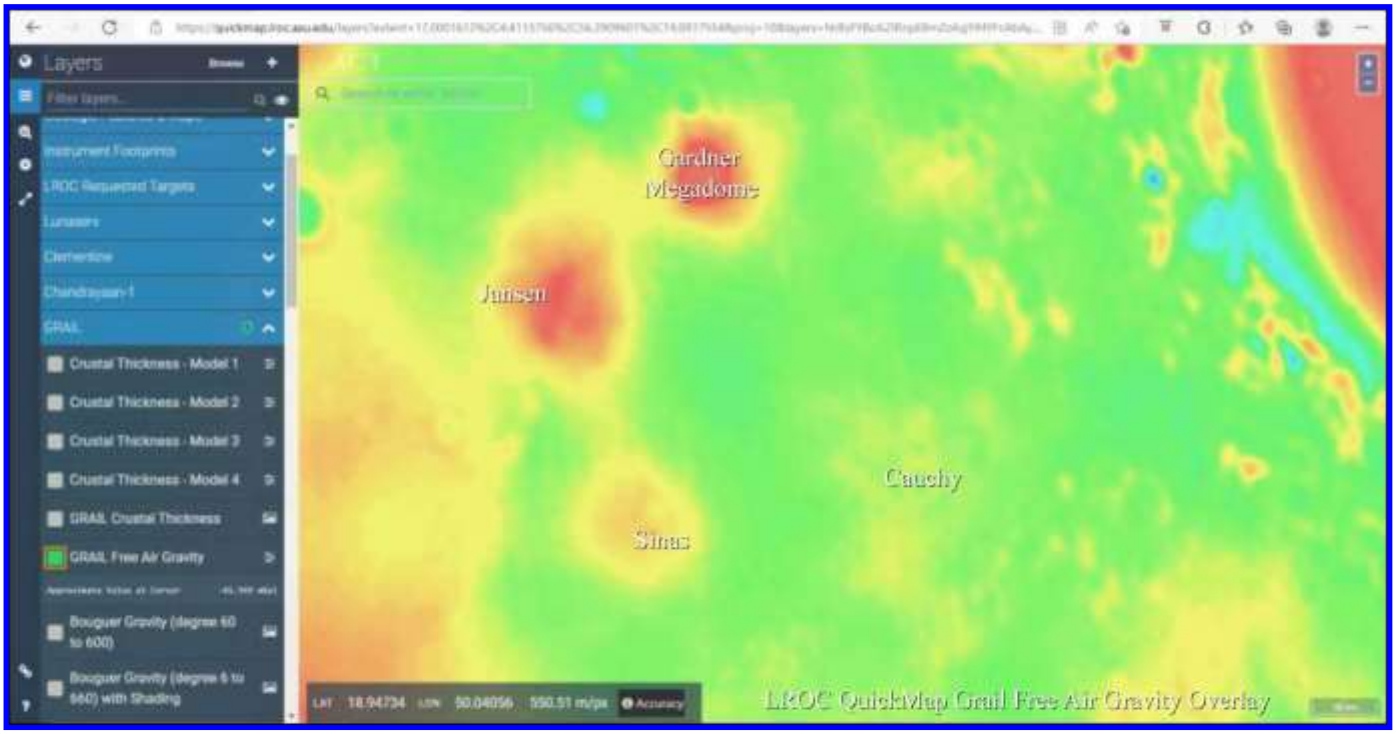
Cauchy domes are visible in the first image, which was taken last night, May 6, 2022, and illuminated by a rising sun. Multiple domes are visible as are the rille and fault on either side of the crater Cauchy. The next image was obtained April 20, 2022 and shows a setting sun illumination. A great number of domes are visible in the images, and a third image dated October 17, 2019, has most of the domes in the region labeled for comparison to the two more recent images.

Cauchy Domes, *Howard Eskildsen, Ocala, Florida, USA. 2022 May 6 00:31 UT, colongitude 329.2°. Celestron 9.25 inch Schmidt-Cassegrain telescope, SKYRIS 236M camera. Seeing 5/10, transparency 4/6.*

Gardiner-Cauchy Domes, *Howard Eskildsen, Ocala, Florida, USA. 2022 April 20 09:42 UT, colongitude 138.4°. Celestron 9.25 inch Schmidt-Cassegrain telescope, SKYRIS 236M camera. Seeing 5/10, transparency 4/6.*

Cauchy Domes, *Howard Eskildsen, Ocala, Florida, USA. 2019 October 17 09:29 UT, colongitude 135.3°. Celestron 9.25 inch Schmidt-Cassegrain telescope, 2x barlow, W-25 Red Filter, DMK41AU02.AS camera. Seeing 7/10, transparency 4/6.*

Out of curiosity, I checked the GRAIL Free Air Gravity overlay on the LROC QuickMap to see if any mascons were associated with the domes. Mass concentrations were not associated with the majority of the low domes, but was concentrated at the Gardner Megadome and in the vicinity of the crater Jansen (crater not visible on first image). There is also a lesser concentration near the craters Sinas and Sinas E, located near the terminator, mid image on the first photo. I wonder as to the cause of the mascons in those locations, but will defer speculation until I had more time to search for possible references.



LROC QuickMap Grail Free Air Gravity Overlay of the Cauchy region.

Two Most Remarkable Lunar Images

Vallis Schröteri (right) and Schickard (below), *James Hill, French Camp, Mississippi, 1956-57. 6 inch f/8 reflector telescope.*

What makes these two lunar photos so remarkable? Look at the date, this was film in the pre-Space Age. Jim adds:

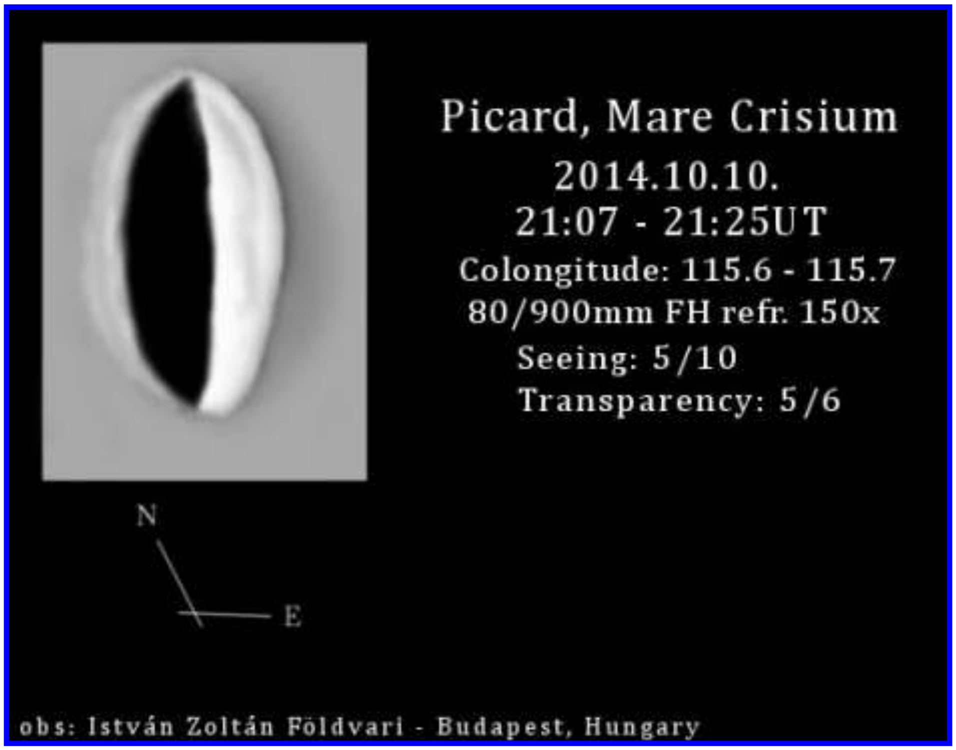
I really don't have the details of those images I sent you. It was probably 1957 since I was still in high school. I was imaging the Moon through standard Johnson filters doing reflectance spectrometry as part of my science fair project to determine the mineralogy of the lunar surface. (It got me into college and second place in the state science fair. The friend who won built a proton linear accelerator!)

Moon shots getting one into college-COOL!

Schickard, *KC Pau, Hong Kong, China. 2022 April 13 12:39 UT. 10 inch f/6 reflector, 2.5 x barlow, QHYCCD290M camera.*

KC adds: Enclosed is the photo of Schickard at dawn. The photo is taken on 13 April 2022 at 12h39m UT with 250mm f/6 Newtonian with 2.5X barlow and QHYCCD290M camera. The eastern rim of the crater cast splendid shadows on the floor. The western rim leaves a big gap under the oblique morning sunlight and the floor shows many details.

Janssen, *Guido Santacana, San Juan, Puerto Rico, USA. 2022 April 08 01:27 UT. Questar 3.5 inch Maksutov-Cassegrain telescope, ZWO ASI224MC camera. Seeing 8/10, transparency 3/6..*

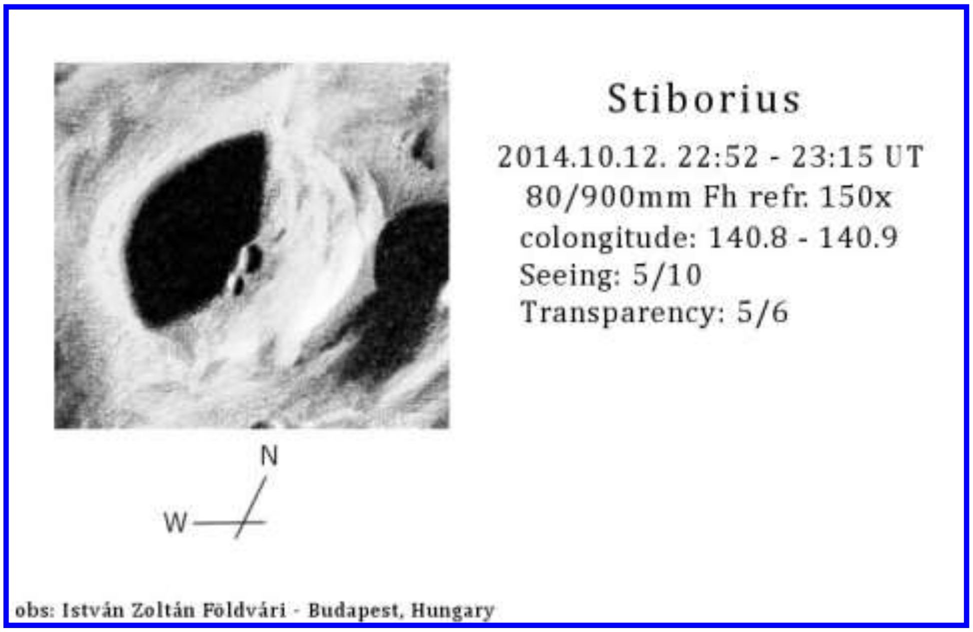


Picard, Mare Crisium, *István Zoltán Földvári, Budapest, Hungary. 2014 October 10, 21:07-21:25 UT. 80 mm refractor telescope, 900 mm focal length, 150 x. Seeing 5/10, transparency 5/6.*

Copernicus, *Maurice Collins, Palmerston North, New Zealand, 2022 May 10 07:46 UT. FLT 110 mm f/21 refractor telescope, QHY5III462C camera.*

Archimedes, *Maurice Collins, Palmerston North, New Zealand, 2022 May 10 07:47 UT. FLT 110 mm f/21 refractor telescope, QHY5III462C camera.*

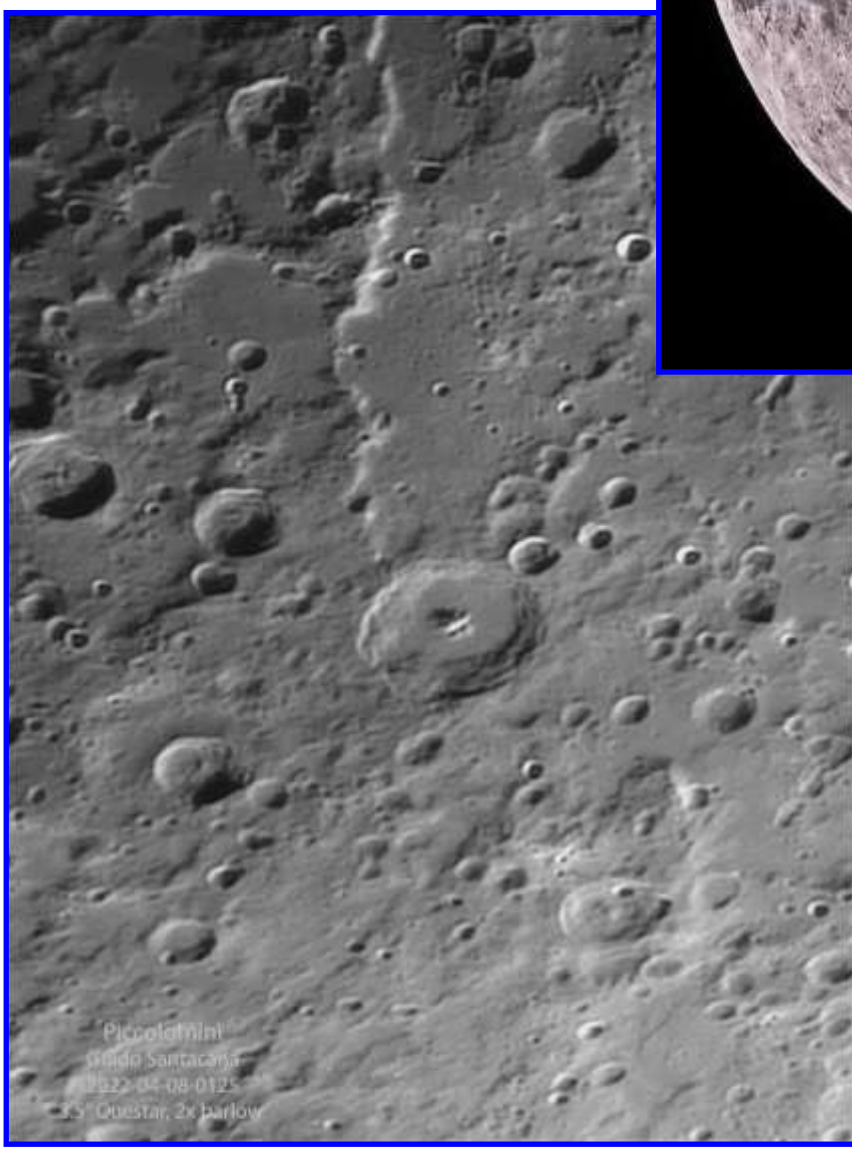
Janssen, *Guido Santacana, San Juan, Puerto Rico, USA. 2022 April 08 01:29 UT. Questar 3.5 inch Maksutov-Cassegrain telescope, 2x barlow, ZWO ASI224MC camera. Seeing 8/10, transparency 3/6.*



Stiborius, *István Zoltán Földvári, Budapest, Hungary. 2014 October 12, 22:52-23:15 UT, colongitude 140.8º—140.9º. 80 mm refractor telescope, 900 mm focal length, 150 x. Seeing 5/10, transparency 5/6.*

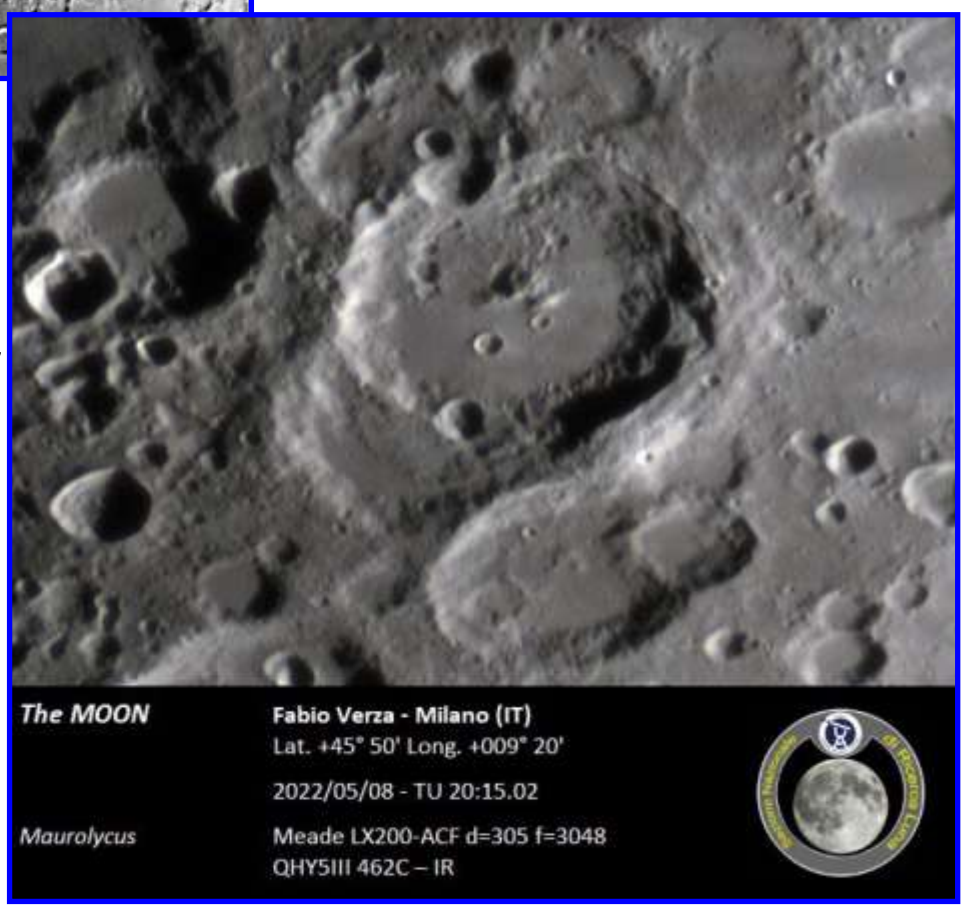
Clavius, *Maurice Collins, Palmerston North, New Zealand, 2022 May 10 07:44 UT. FLT 110 mm f/21 refractor telescope, QHY5III462C camera.*

9-day old Moon, *Maurice Collins, Palmerston North, New Zealand, 2022 May 10 07:30-07:31 UT. FLT 110 mm f/21 refractor telescope, QHY5III462C camera. North down, west right.*



Piccolomini, *Guido Santacana, San Juan, Puerto Rico, USA. 2022 April 08 01:25 UT. Questar 3.5 inch Maksutov-Cassegrain telescope, 2x barlow, ZWO ASI224MC camera. Seeing 8/10, transparency 3/6.*

Mare Serenitatis, *Guido Santacana, San Juan, Puerto Rico, USA. 2022 April 08 01:15 UT. Questar 3.5 inch Maksutov-Cassegrain telescope, ZWO ASI224MC camera. Seeing 8/10, transparency 3/6.*



Maurolycus, *Fabio Verza, SNdR, Milan, Italy. 2022 May 08 20:15 UT. Meade 12 inch LX200 ACF Schmidt-Cassegrain telescope, QHY-III462C camera, IR filter.*

***Tycho,** Maurice Collins, Palmerston North, New Zealand, 2022 May 10 07:43 UT. FLT 110 mm f/21 refractor telescope, QHY5III462C camera.*

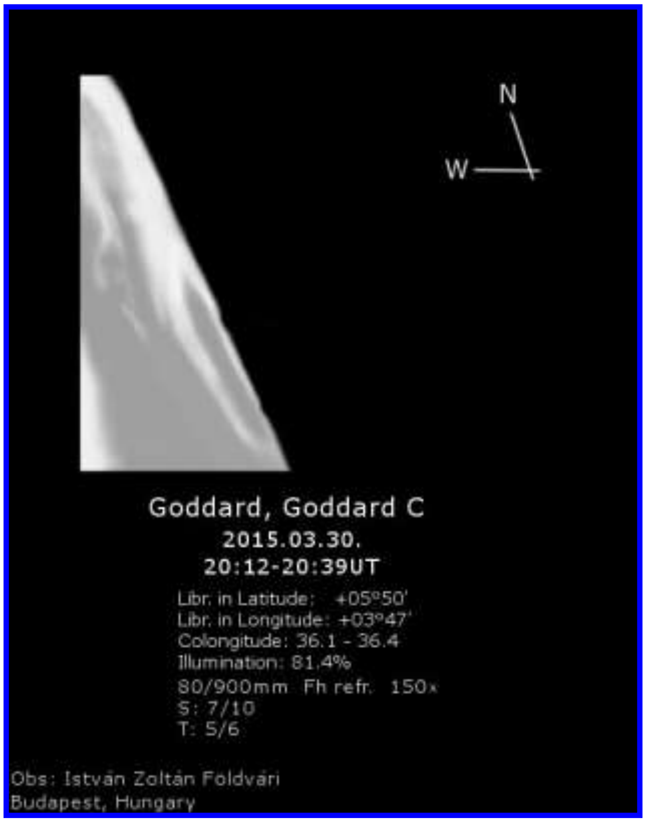
***Aristarchus,** Fabio Verza, SNdR, Milan, Italy. 2022 May 12 21:17 UT. Meade 12 inch LX200 ACF Schmidt-Cassegrain telescope, QHY-III462C camera, IR filter.*

Copernicus, *Maurice Collins, Palmerston North, New Zealand, 2022 May 10 07:35 UT. FLT 110 mm f/21 refractor telescope, QHY5III462C camera.*

Theophilus, *Guido Santacana, San Juan, Puerto Rico, USA. 2022 April 08 01:19 UT. Questar 3.5 inch Maksutov-Cassegrain telescope, ZWO ASI224MC camera. Seeing 8/10, transparency 3/6.*

Posidonius, *Guido Santacana, San Juan, Puerto Rico, USA. 2022 April 08 01:17 UT. Questar 3.5 inch Maksutov-Cassegrain telescope, 2x barlow, ZWO ASI224MC camera. Seeing 8/10, transparency 3/6.*

Aristoteles, *Fabio Verza, SNdR, Milan, Italy. 2022 May 08 20:11 UT. Meade 12 inch LX200 ACF Schmidt-Cassegrain telescope, QHYIII462C camera, IR filter.*



Goddard and Goddard C, *István Zoltán Földvári, Budapest, Hungary. 2015 March 30, 20:12-20:39 UT, colongitude 36.1º—36.4º. 80 mm refractor telescope, 900 mm focal length, 150 x. Seeing 7/10, transparency 5/6.*

Aristarchus, *Maurice Collins, Palmerston North, New Zealand, 2022 May 12 07:42 UT. FLT 110 mm f/21 refractor telescope, QHY5III462C camera.*

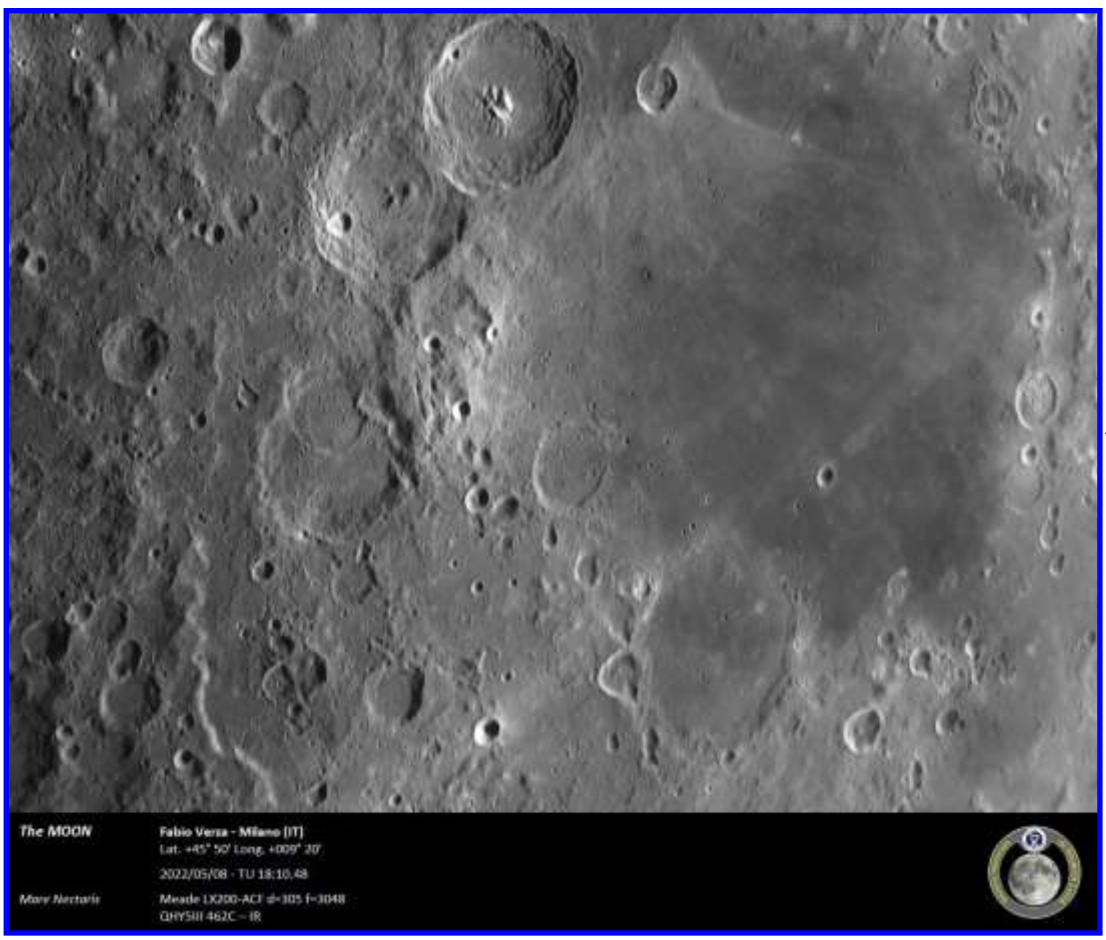
Letronne, *Maurice Collins, Palmerston North, New Zealand, 2022 May 13 05:49 UT. FLT 110 mm f/21 refractor telescope, QHY5III462C camera.*

Lacus Mortis, *Fabio Verza, SNdR, Milan, Italy. 2022 May 08 20:03 UT. Meade 12 inch LX200 ACF Schmidt-Cassegrain telescope, QHYIII462C camera, IR filter.*

Mare Humorum, *Maurice Collins, Palmerston North, New Zealand, 2022 May 13 05:49 UT. FLT 110 mm f/21 refractor telescope, QHY5III462C camera.*

Plato, *Fabio Verza, SNdR, Milan, Italy. 2022 May 11 21:11 UT. Meade 12 inch LX200 ACF Schmidt-Cassegrain telescope, QHYIII462C camera, IR filter. Mosaic of two images.*

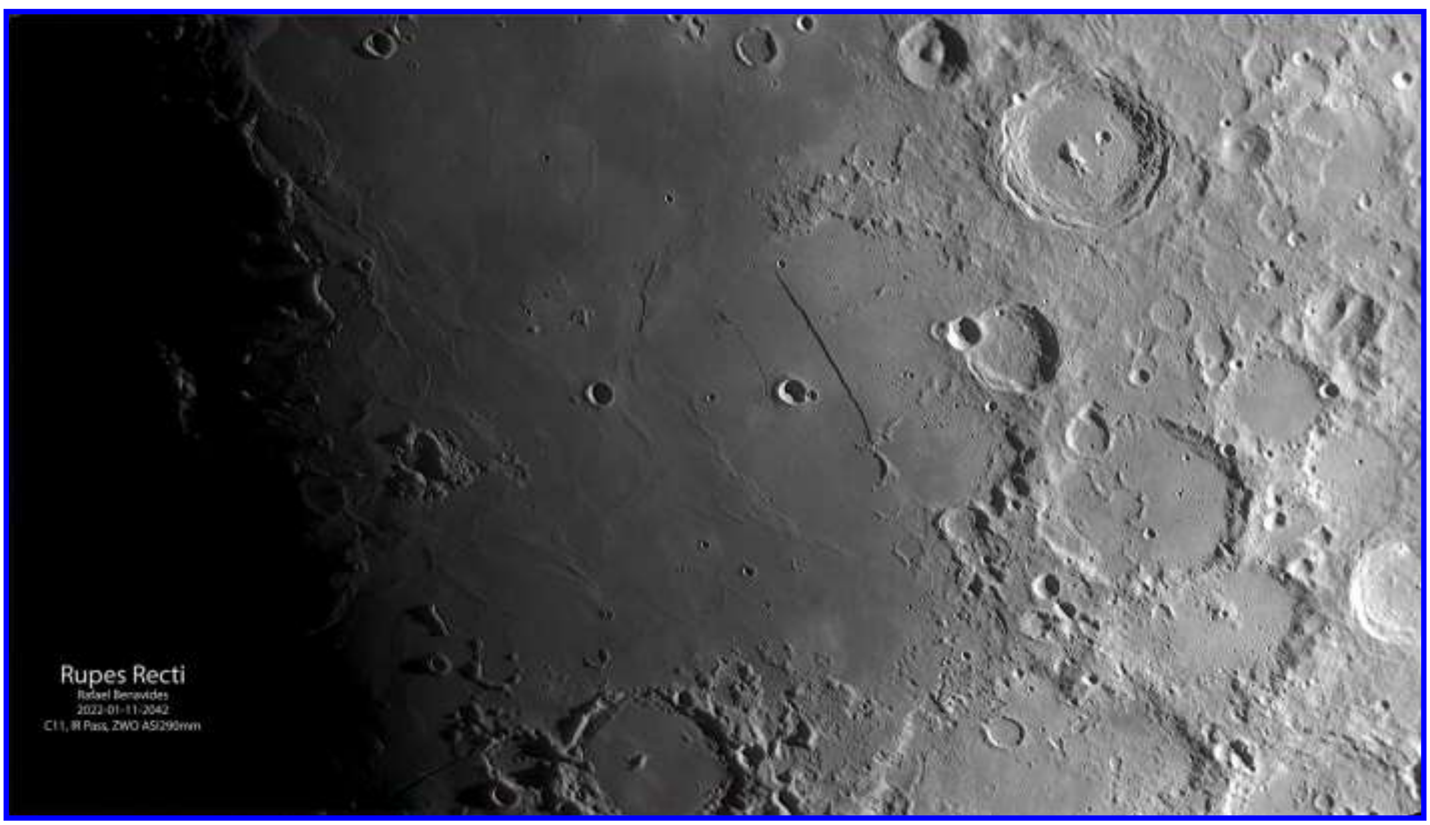
12.4 day old Moon, *Maurice Collins, Palmerston North, New Zealand, 2022 May 13 05:55 UT. FLT 110 mm f/21 refractor telescope, QHY5III462C camera. North down, west right.*



Mare Nectaris, *Fabio Verza, SNdR, Milan, Italy. 2022 May 08 18:10 UT. Meade 12 inch LX200 ACF Schmidt-Cassegrain telescope, QHYIII462C camera, IR filter.*

Aristarchus, *Maurice Collins, Palmerston North, New Zealand, 2022 May 13 05:47 UT. FLT 110 mm f/21 refractor telescope, QHY5III462C camera.*

Rupes Recti*, Rafael Benavides, Posadas Observatory MPC J53, Córdoba, Spain. 2022 January 11. 20:42 UT. Celestron 11", Baader Planetarium IR Pass filter, ZWO ASI 290 MM. Seeing 6/10, transparency 5/6.*



Marius Hills, *Maurice Collins, Palmerston North, New Zealand, 2022 May 13 05:49 UT. FLT 110 mm f/14 refractor telescope, QHY5III462C camera.*

Archimedes*, Rafael Benavides, Posadas Observatory MPC J53, Córdoba, Spain. 2022 January 11. 20:36 UT. Celestron 11", Baader Planetarium IR Pass filter, ZWO ASI 290 MM. Seeing 6/10, transparency 5/6.*

Sinus Iridum, *Maurice Collins, Palmerston North, New Zealand, 2022 May 13 05:48 UT. FLT 110 mm f/21 refractor telescope, QHY5III462C camera.*

Posidonius, *Fabio Verza, SNdR, Milan, Italy. 2022 May 08 18:44 UT. Meade 12 inch LX200 ACF Schmidt-Cassegrain telescope, QHYIII462C camera, IR filter.*

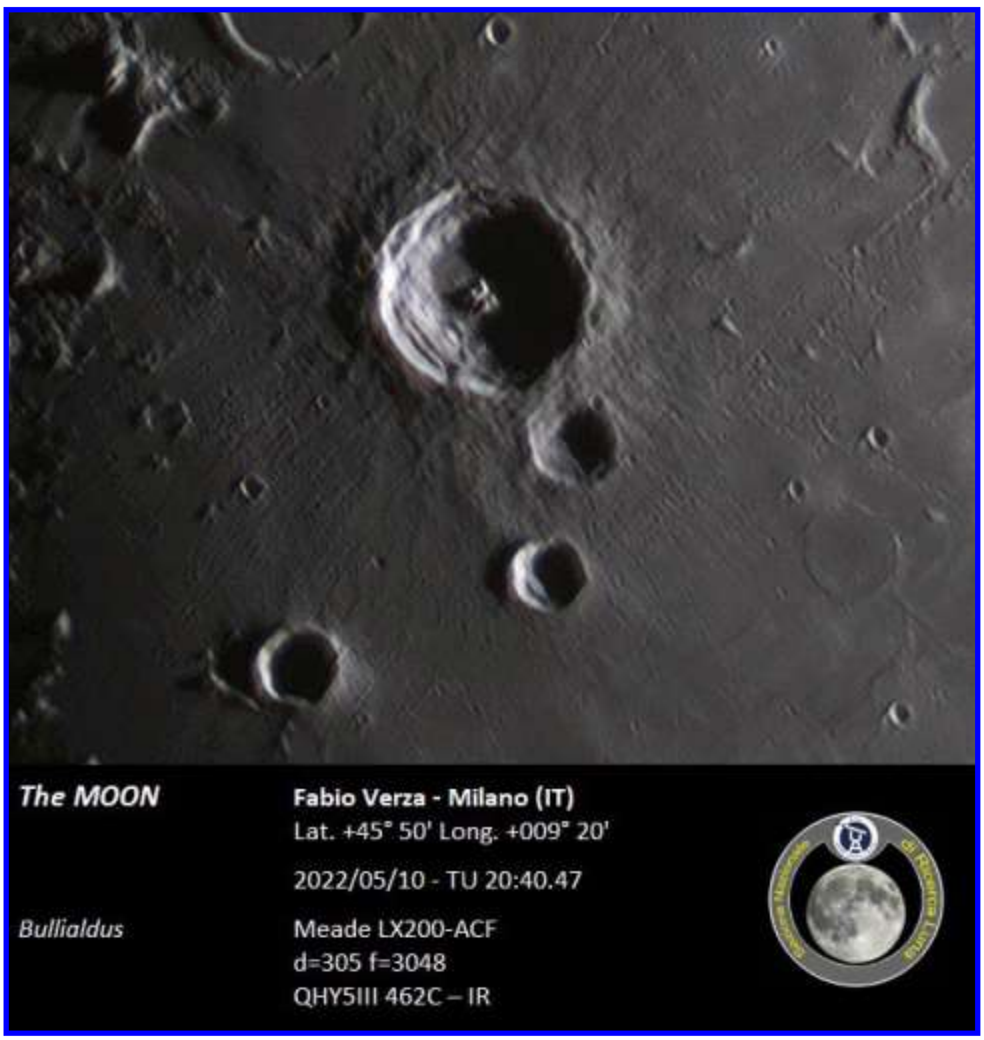
Eudoxus, Fabio Verza, SNdR, Milan, Italy. 2022 May 08 19:49 UT. Meade 12 inch LX200 ACF Schmidt-Cassegrain telescope, QHY-III462C camera, IR filter.

Sinus Iridum, Maurice Collins, Palmerston North, New Zealand, 2022 May 12 07:33 UT. FLT 110 mm f/21 refractor telescope, QHY5III462C camera.

Theophilus, *Guido Santacana, San Juan, Puerto Rico, USA. 2022 April 08 01:23 UT. Questar 3.5 inch Maksutov-Cassegrain telescope, 2x barlow, ZWO ASI224MC camera. Seeing 8/10, transparency 3/6.*

Mare Humorum, *Maurice Collins, Palmerston North, New Zealand, 2022 May 12 07:45 UT. FLT 110 mm f/21 refractor telescope, QHY5III462C camera.*

Mare Smythii, *István Zoltán Földvári, Budapest, Hungary. 2015 March 30, 19:48-20:11 UT, colongitude 33.7º—36.1º. 80 mm refractor telescope, 900 mm focal length, 150 x. Seeing 6/10, transparency 5/6.*



Bullialdus, *Fabio Verza, SNdR, Milan, Italy. 2022 May 10 20:40 UT. Meade 12 inch LX200 ACF Schmidt-Cassegrain telescope, QHYIII462C camera, IR filter.*

Theophilus, *Fabio Verza, SNdR, Milan, Italy. 2022 May 08 18:14 UT. Meade 12 inch LX200 ACF Schmidt-Cassegrain telescope, QHYIII462C camera, IR filter.*

Vallis Alpes, *Ron May, El Dorado Hills, California, USA. 2022 May 12 00:57 UT. 7 inch Questar telescope, iPhone 12 camera.*

Hermite, *István Zoltán Földvári, Budapest, Hungary. 2015 October 01, 22:14-22:33 UT, colongitude 136.0º—136.0º. 80 mm refractor telescope, 900 mm focal length, 150 x. Seeing 7/10, transparency 4/6.*

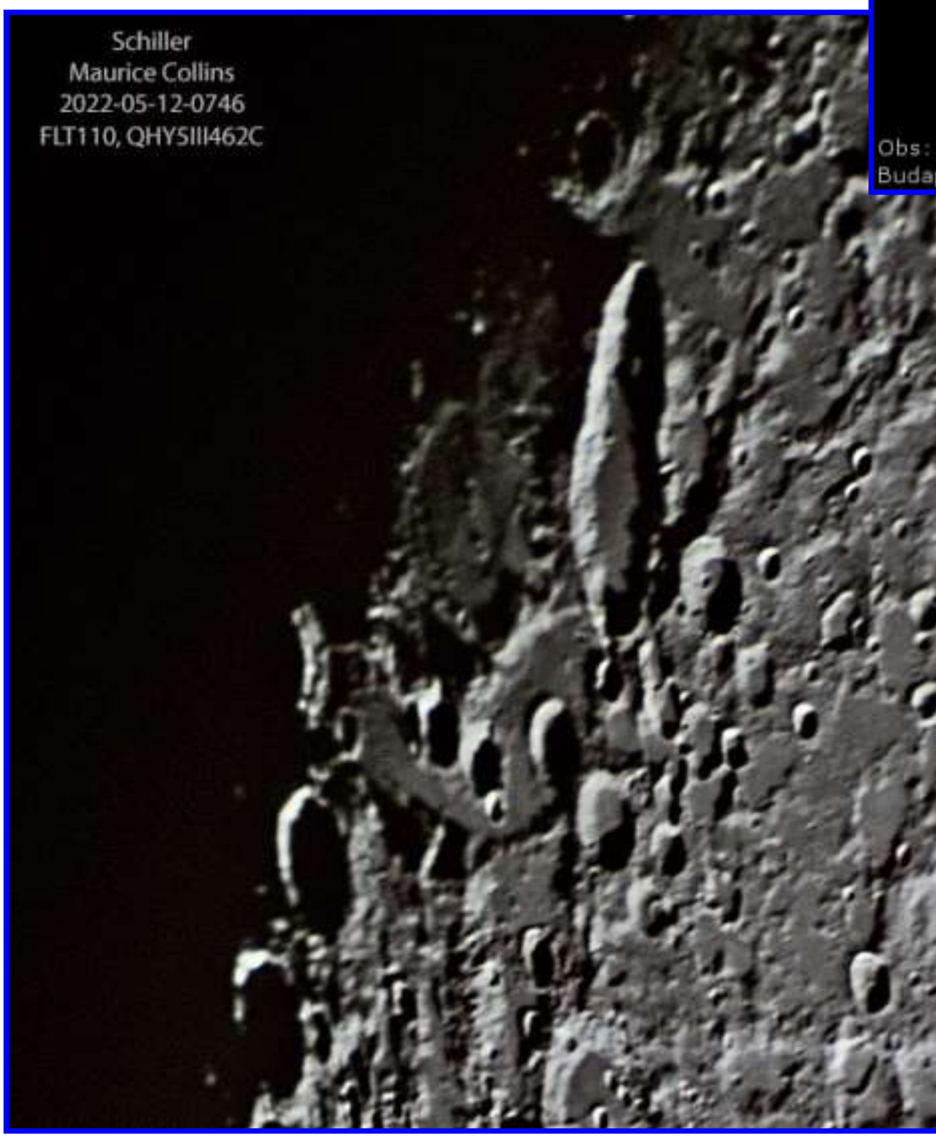
Mare Humorum, *Fabio Verza, SNdR, Milan, Italy. 2022 May 12 20:30 UT. Meade 12 inch LX200 ACF Schmidt-Cassegrain telescope, QHYIII462C camera, IR filter.*

Montes Apenninus, *Fabio Verza, SNdR, Milan, Italy. 2022 May 09 20:30 UT. Meade 12 inch LX200 ACF Schmidt-Cassegrain telescope, QHYIII462C camera, IR filter.*

11.5 day old Moon, *Maurice Collins, Palmerston North, New Zealand, 2022 May 12 07:27-07:30 UT. FLT 110 mm refractor telescope, 2x barlow, QHY5III462C camera. North down, west right.*

Aristarchus, *Ron May, El Dorado Hills, California, USA. 2022 May 13 04:00 UT. 3.5 inch Questar telescope, iPhone 12 camera. Below, the equipment set-up.*

Keldysh, *István Zoltán Földvári, Budapest, Hungary. 2015 October 01, 21:45-22:05 UT, colongitude 135.7º—135.9º. 80 mm refractor telescope, 900 mm focal length, 150 x. Seeing 7/10, transparency 4/6.*

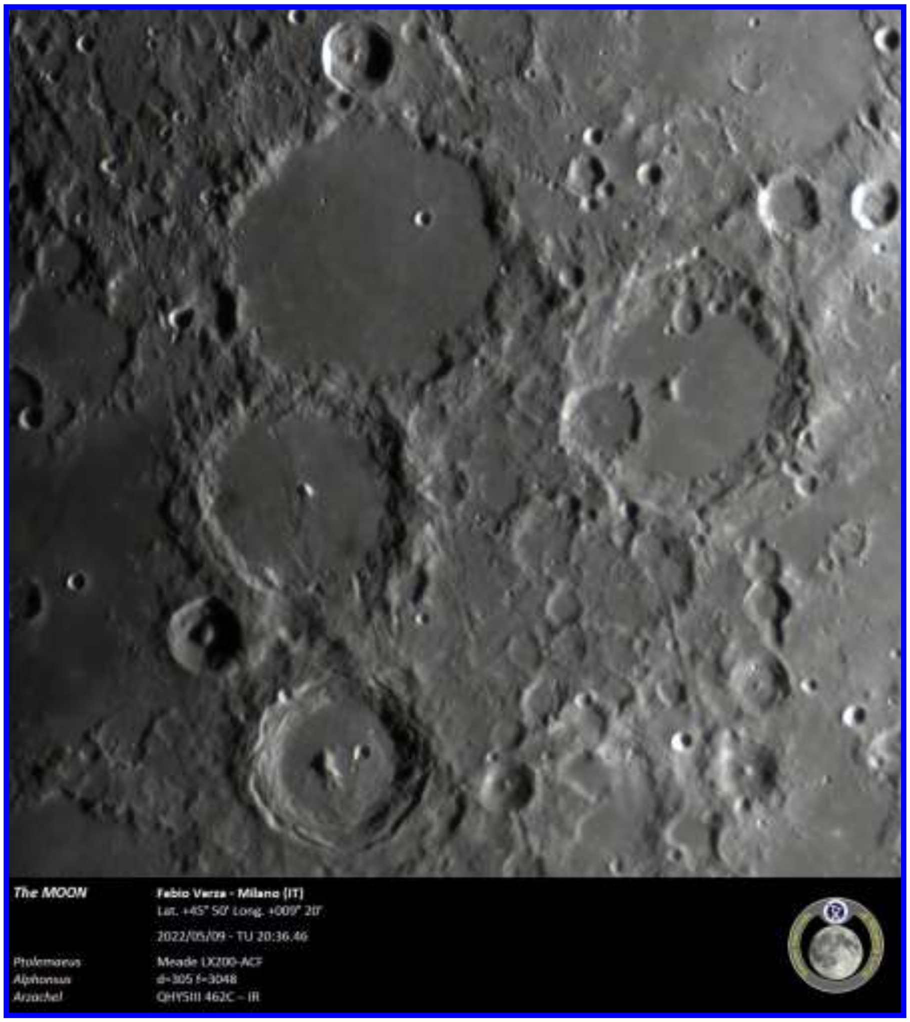


Schiller, *Maurice Collins, Palmerston North, New Zealand, 2022 May 12 07:46 UT. FLT 110 mm f/21 refractor telescope, QHY5III462C camera.*

Schickard, *Maurice Collins, Palmerston North, New Zealand, 2022 May 13 05:50 UT. FLT 110 mm f/21 refractor telescope, QHY5III462C camera.*

Vallis Alpes, *Fabio Verza, SNdR, Milan, Italy. 2022 May 09 19:51 UT. Meade 12 inch LX200 ACF Schmidt-Cassegrain telescope, QHY-III462C camera, IR filter.*

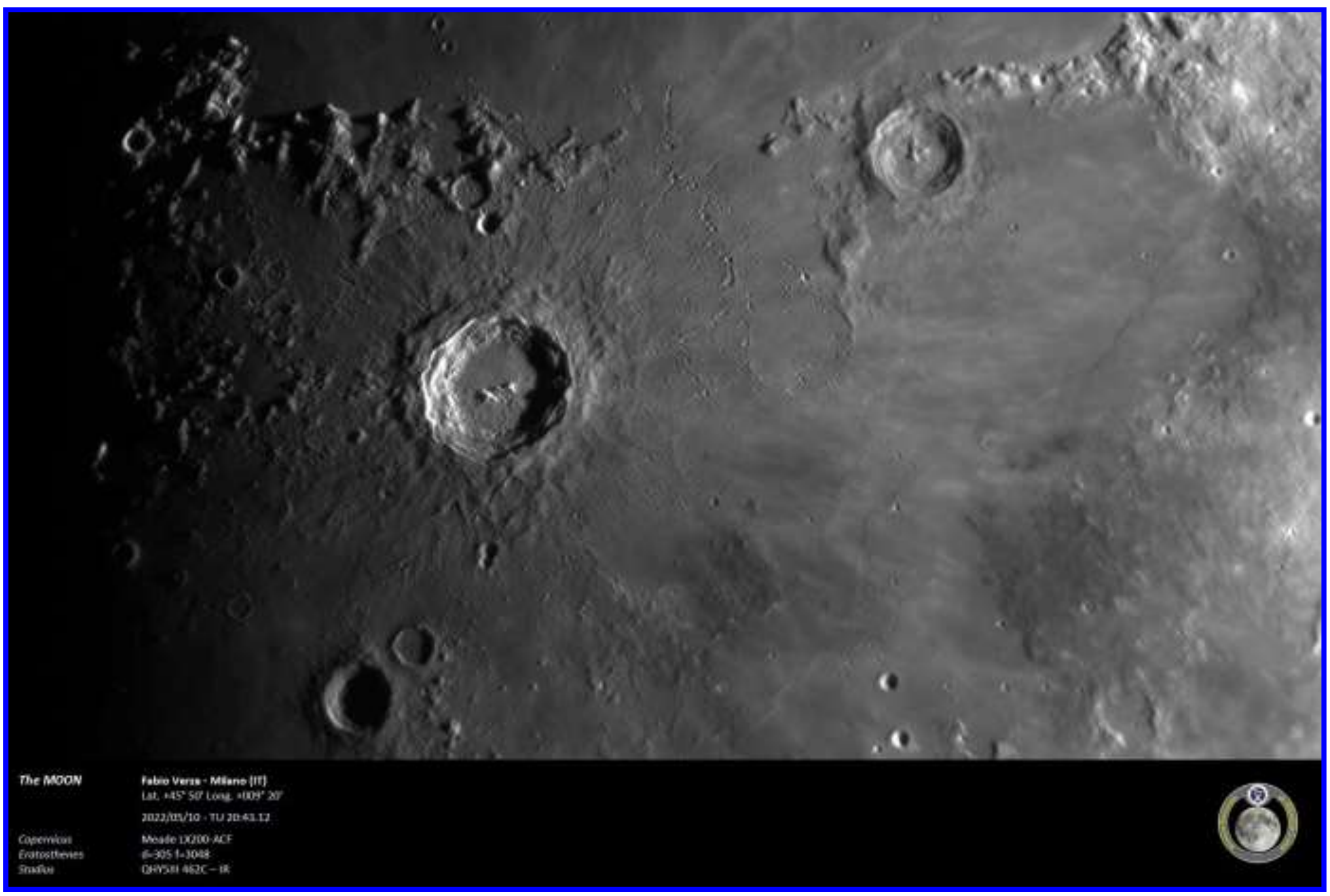
Ptolemaeus, *Fabio Verza, SNdR, Milan, Italy. 2022 May 09 20:36 UT. Meade 12 inch LX200 ACF Schmidt-Cassegrain telescope, QHYIII462C camera, IR filter.*



Mare Tranquillitatis, *Walter Ricardo Elias, AEA, Oro Verde, Argentina. 2022 May 10 18:17 UT. 114 mm Helios reflector telescope, QHY5IIC camera.*

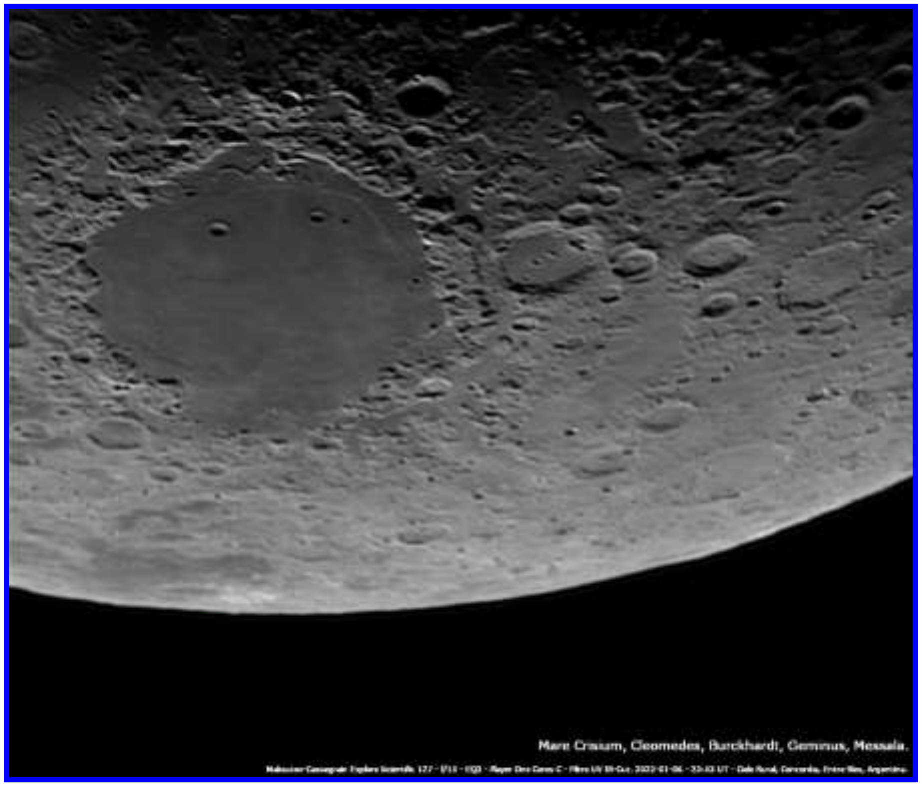
Lunar X and V, *Guillermo Scheidereiter, Rural Area, Concordia, Entre Ríos, Argentina. 2022 April 08 23:44 UT. 127 mm Maksutov-Cassegrain telescope, Nikon 5600 camera.*

Copernicus, *Fabio Verza, SNdR, Milan, Italy. 2022 May 10 20:43 UT. Meade 12 inch LX200 ACF Schmidt-Cassegrain telescope, QHYIII462C camera, IR filter.*



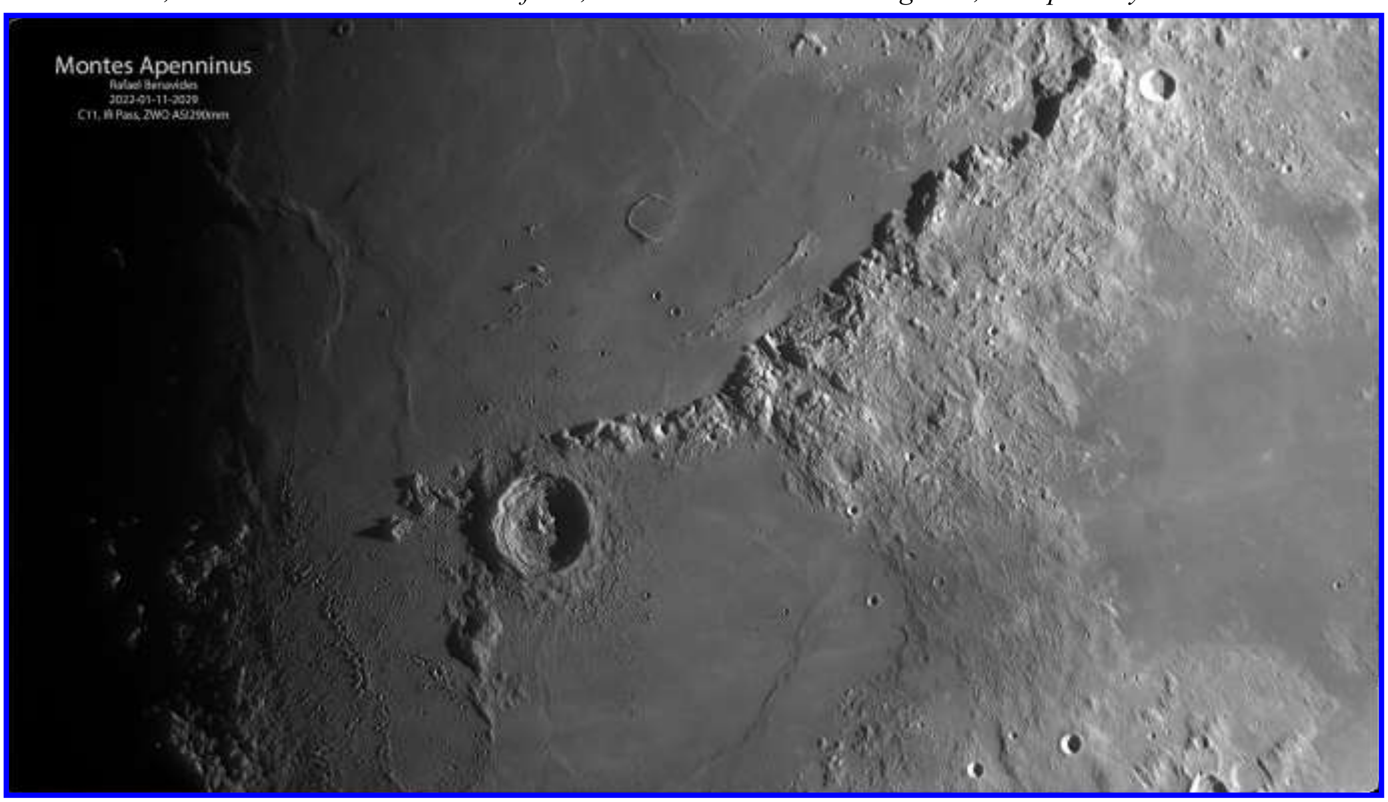
Langrenus, *Guillermo Scheidereiter, Rural Area, Concordia, Entre Ríos, Argentina. 2022 January 06 23:53 UT. 127 mm Maksutov -Cassegrain telescope, UV/IR cut filter Player One Ceres C camera. North lower right, west upper right.*

Plato, *Fabio Verza, SNdR, Milan, Italy. 2022 May 10 19:55 UT. Meade 12 inch LX200 ACF Schmidt-Cassegrain telescope, QHY-III462C camera, IR filter.*



Mare Crisium, *Guillermo Scheidereiter, Rural Area, Concordia, Entre Ríos, Argentina. 2022 January 06 23:53 UT. 127 mm Maksutov-Cassegrain telescope, UV/IR cut filter Player One Ceres C camera. North right, west up.*

Montes Apenninus*, Rafael Benavides, Posadas Observatory MPC J53, Córdoba, Spain. 2022 January 11. 20:39 UT. Celestron 11", Baader Planetarium IR Pass filter, ZWO ASI 290 MM. Seeing 6/10, transparency 5/6.*

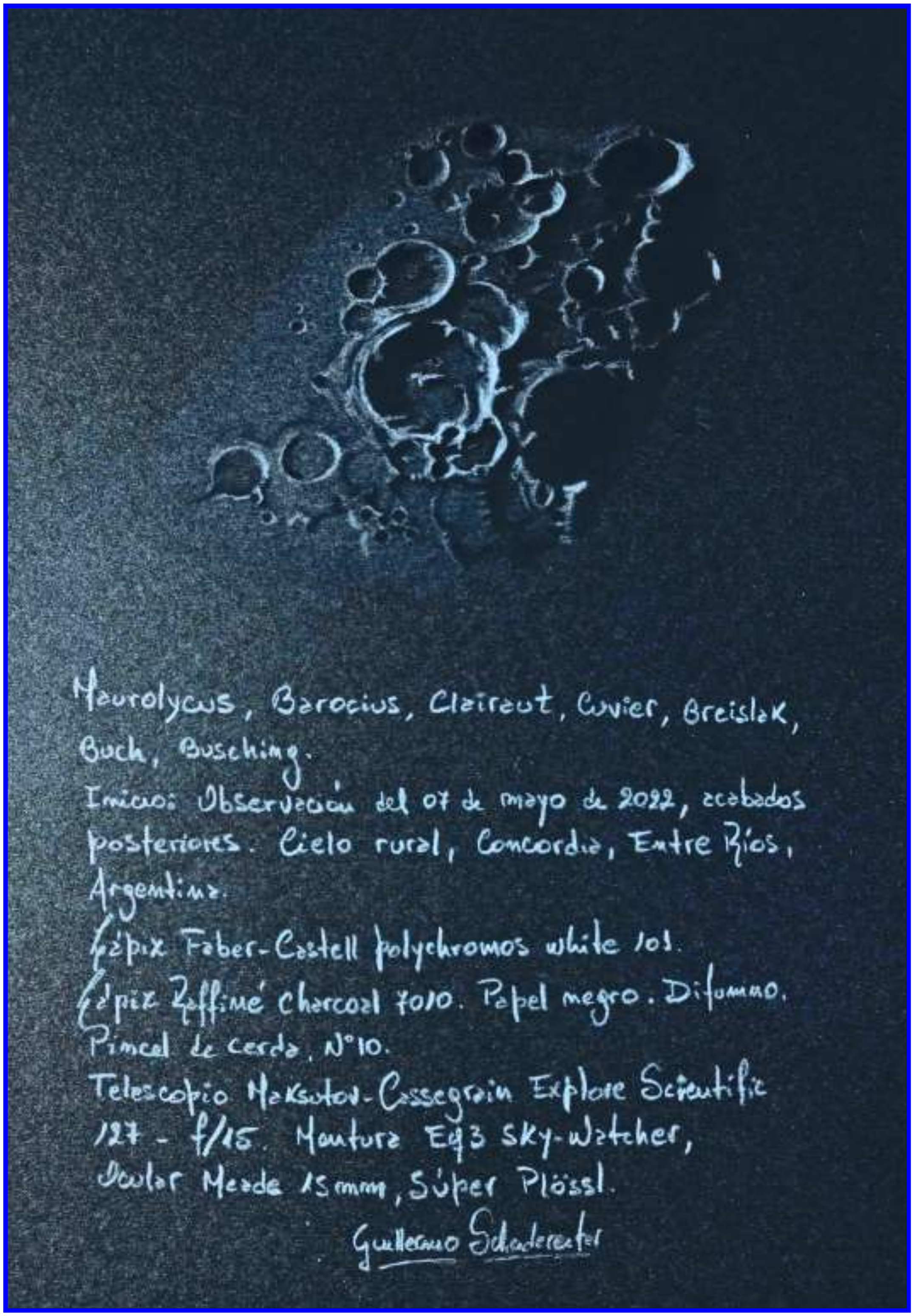


Sinus Iridum, *Guillermo Scheidereiter, Rural Area, Concordia, Entre Ríos, Argentina. 2022 January 14 02:11 UT. 127 mm Maksutov-Cassegrain telescope, UV/IR cut filter Player One Ceres C camera. North left, west down.*

87% Waxing Gibbous Moon, *Jairo Chavez, Popayán, Colombia. 2022 May 13 01:42 UT. 311 mm Dobsonian truss reflector telescope, Moto E5 play camera.*

Pitiscus, *Guillermo Scheidereiter, Rural Area, Concordia, Entre Ríos, Argentina. 2022 May 07 23:05 UT. 127 mm Maksutov-Cassegrain telescope, IR 685 nm filter Player One Ceres C camera. North down, west right.*

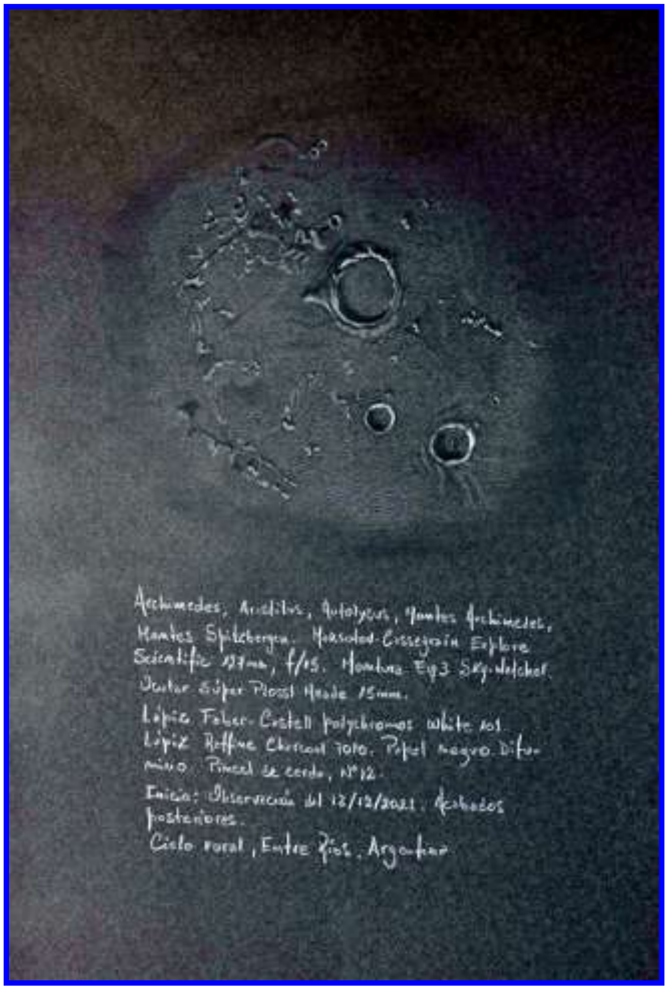
87% Waxing Gibbous Moon, *Jairo Chavez, Popayán, Colombia. 2022 May 13 01:42 UT. 311 mm Dobsonian truss reflector telescope, Moto E5 play camera.*



Maurolycus, *Guillermo Scheidereiter, Rural Area, Concordia, Entre Ríos, Argentina. 2022 May 07 23:30 UT. 127 mm Maksutov-Cassegrain telescope, Meade 15 mm Super Plössl. North down, west right.*

Plato, *Ioannis (Yannis) A. Bouhras, Athens, Greece. 2022 May 22 03:29UT. Celestron 11 XLT Schmidt-Cassegrain telescope, Powermate 2.5x, QHY462c camera. This image was taken in infrared during daylight.*

Aristarchus, *Jairo Chavez, Popayán, Colombia. 2022 May 13 01:42 UT. 311 mm Dobsonian truss reflector telescope, Moto E5 play camera.*



Archimedes, *Guillermo Scheidereiter, Rural Area, Concordia, Entre Ríos, Argentina. 2021 December 12 03:17 UT. 127 mm Maksutov-Cassegrain telescope, UV/IR cut filter Player One Ceres C camera. North right, west up.*

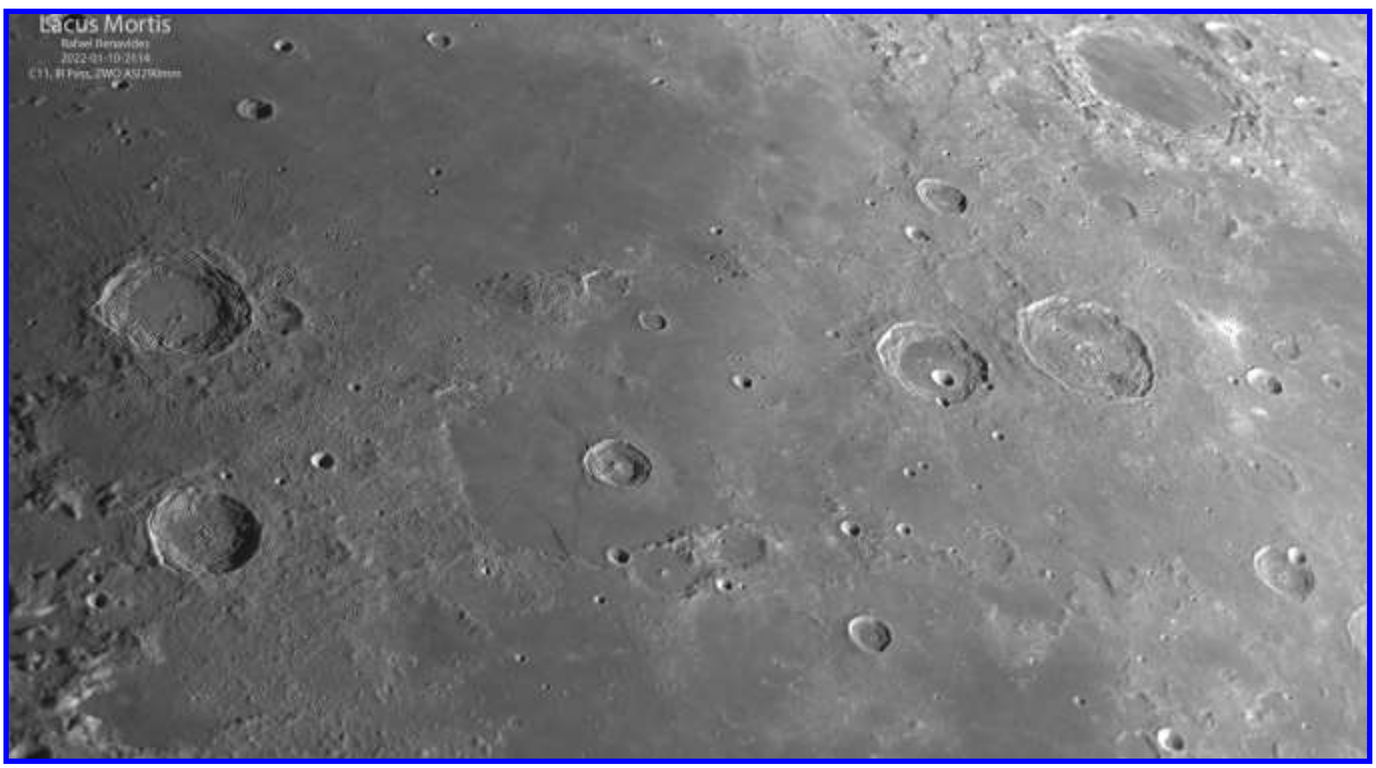
Clavius, *Maurice Collins, Palmerston North, New Zealand, 2022 May 12 07:47 UT. FLT 110 mm f/21 refractor telescope, QHY5III462C camera.*

Mare Serenitatis and Mare Tranquillitatis, *Guido Santacana, San Juan, Puerto Rico, USA. 2022 April 08 01:13 UT. Questar 3.5 inch Maksutov-Cassegrain telescope, ZWO ASI224MC camera. Seeing 8/10, transparency 3/6.*

Gassendi, *Walter Ricardo Elias, AEA, Oro Verde, Argentina. 2022 May 14 22:13 UT. 114 mm reflector telescope, QHY5IIC camera.*

Plato, *Walter Ricardo Elias, AEA, Oro Verde, Argentina. 2022 May 14 22:17 UT. 114 mm reflector telescope, QHY5IIC camera.*

Lacus Mortis*, Rafael Benavides, Posadas Observatory MPC J53, Córdoba, Spain. 2022 January 10. 21:14 UT. Celestron 11", Baader Planetarium IR Pass filter, ZWO ASI 290 MM. Seeing 8/10, transparency 5/6.*

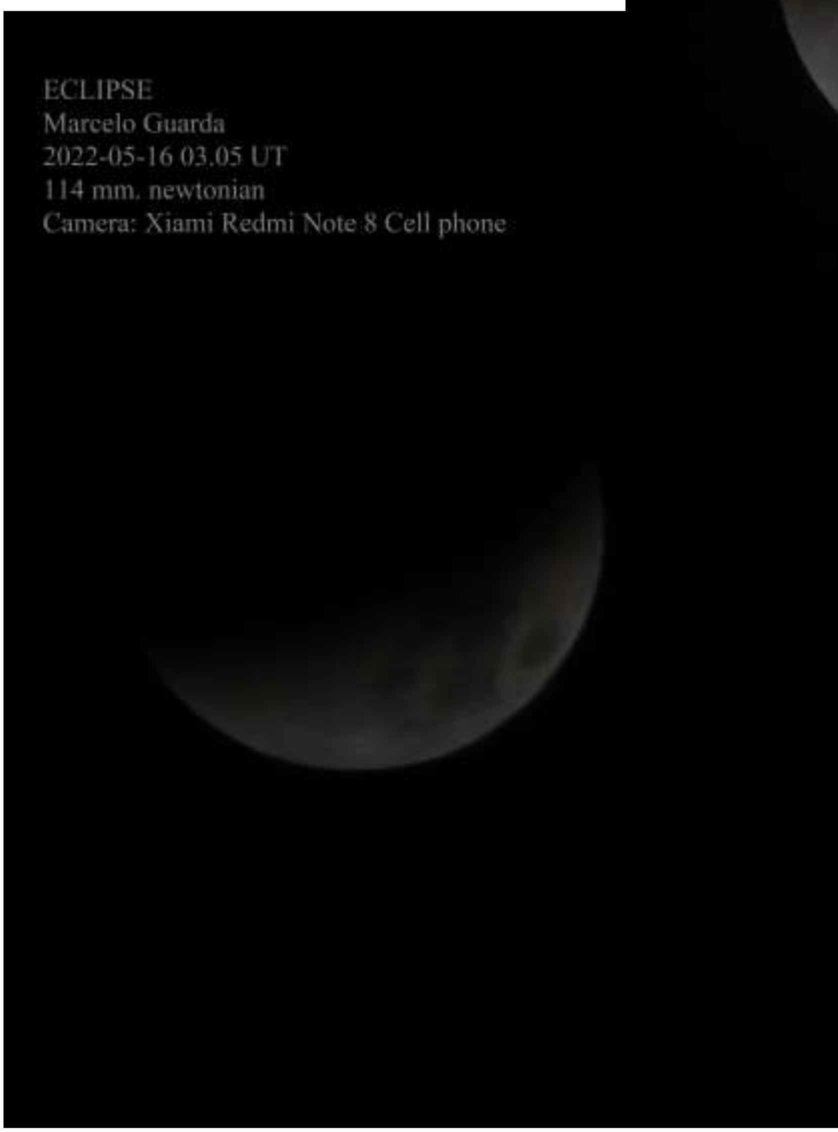


Lunar Eclipse composite, *Richard Hill, Loudon Observatory, Tucson, Arizona, USA. 2022 May 16. Canon Rebel with 150 mm lens. Rik comments that this was the darkest lunar eclipse that he saw since December 1964. Danjon scale between 1 and 2.*

Lunar Eclipse, *Ron May, El Dorado Hills, California, USA. 2022 May 16 04:33 UT. 3.5 inch Questar telescope, iPhone 12 camera.*

Lunar Eclipse, *Marcela Guarda, Santa Fe, Argentina. 2022 May 16 02:26 UT. 114 mm Newtonian reflector telescope, Xiami Redmi Note 8 cell phone camera. Sorry, no hyperlinks for this-DT.*

***Lunar Eclipse,** Marcela Guarda, Santa Fe, Argentina. 2022 May 16 02:46 UT (right) and 03:05 UT (below). 114 mm Newtonian reflector telescope, Xiami Redmi Note 8 cell phone camera. Sorry, no hyperlinks for this-DT.*



Lunar Eclipse, *Marcela Guarda, Santa Fe, Argentina. 2022 May 16 03:31 UT (left) and 04:02 UT (below). 114 mm Newtonian reflector telescope, Xiami Redmi Note 8 cell phone camera. Sorry, no hyperlinks for this-DT.*

Lunar Eclipse, *Marcela Guarda, Santa Fe, Argentina. 2022 May 16 04:19 UT. 114 mm Newtonian reflector telescope, Xiami Redmi Note 8 cell phone camera. Sorry, no hyperlinks for this-DT.*

Lunar Eclipse, *Estaban Andrada, Mar del Plata, Argentina. 2022-05-16 03:24 UT. 4 inch Maksutov-Cassegrain telescope, Nikon D5100 camera. North down, west right.*

Lunar Eclipse, *Estaban Andrada, Mar del Plata, Argentina. 2022-05-16 04:49 UT. 4 inch Maksutov-Cassegrain telescope, Nikon D5100 camera. North down, west right.*

Lunar Eclipse, *Guillermo Scheidereiter, Rural Area, Concordia, Entre Ríos, Argentina. 2022 May 16 04:18 UT. 80 mm Meade refractor telescope, f/5, Nikon 5600 camera. North down, west right.*

Lunar Geologic Change Detection Program

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

2022 June

LTP reports: No reports were received for May.

Routine Reports received for April included: Jay Albert (Lake Worth, FL, USA – ALPO) observed: Censorinus, Eratosthenes, Gassendi and Plato. Alexandre Amorin (Brazil) observed: Fracastorius. Alberto Anunziato (Argentina – SLA) observed: Plato. Anthony Cook (Newtown – ALPO/BAA) videoed earth-shine and imaged several features in visible light and the thermal IR. Maurice Collins (New Zealand – ALPO/BAA/RASNZ) imaged: The Moon, Ptolemaeus, and several features. John Duchek (USA – ALPO) imaged: Eudoxus and the Moon. Walter Elias (Argentina – AEA) imaged: Curtis, Gassendi, Hyginus, Lubbock, Mons Piton, Plato, Playfair and Schiaparelli. Les Fry (West Wales, UK – NAS) imaged: Alphonsus, Archimedes, Maginus, Mons Piton, Motes Alpes, Montes Apenninus, Moretus, Rima Flamarion, Rupes Recta, Triesnecker, and Walther. Massimo Giuntoli (Italy – BAA) observed: Cavendish E. Mark Radice (near Salisbury, UK – BAA) imaged: Bulliadus, Montes Recti, and Reiner Gamma. Aldo Tonon (Italy – UAI) imaged: Montes Teneriffe. Fabio Verza (Italy – UAI) imaged: Montes Teneriffe.

Routine Reports Received: Note that for this month it was not possible to do much analysis due to time constraints, so readers are invited to read the descriptions and make some interpretations of their own.

Eudoxus: On 2022 Apr 09 UT 01:58-02:01 and 02:14-02:17 John Duchek (ALPO) attempted a Lunar Schedule request for the following:

BAA Request: Eudoxus - please try to image the interior of this crater. We are trying to detect bright spots and a linear features within the shadow of the east wall at sunrise. Nigel Longshaw (BAA) suspects that this might explain Trouvelot's observation in 1877 of a luminous rope-like feature.

Eudoxus BAA Request: Eudoxus - please try to image or sketch the crater. This is to try to explain a line of light effect seen inside this crater by French astronomer Trouvelot back in Victorian times. The BAAs Nigel Longshaw says that this may be seen between colongitudes of 0.3 to 1.2 degrees. Please send any images or sketches to: a t c @ a b e r. a c. u k.

Figure 1. *Eudoxus as imaged by John Duchek (ALPO) on 2022 Apr 09 UT 01:58-02:01 and orientated with north towards the top.*

Ptolemaeus: On 2022 Apr 09 Maurice Collins imaged this crater under similar illumination to the following LTP report from the Cameron 1978 catalog:

Ptolemaeus 1866 Apr 22 UT 20:00? Observed by Ingalls (Champion Hills, London, UK) Crater seen on terminator - the surface showed a lot of detail. Normally it is very smooth. The Cameron catalog gets this interpretation around the wrong way. NASA catalog weight=3. NASA catalog ID = 142. ALPO/BAA weight=1.

Figure 2. *Ptolemaeus as imaged by Maurice Collins on 2022 Apr 19 UT 07:38 and orientated with north towards the top.*

Clearly, Ingalls, who was quite an accomplished astronomer, was perhaps not so experienced at lunar observing as Maurice's image infers, if you are prepared to wait for the right narrow range of selenographic colongitudes, near local sunrise/set on the lunar surface, and adequate seeing conditions, then you can capture a wealth of detail on the floor. We hall reassign the weight of this LTP report to 0 and effectively remove it from the ALPO/BAA database.

Montes Teneriffe: On 2022 Apr 9 Aldo Tonan (UAI) at 21:36UT, Les Fry (NAS) at 21:41UT, and Alberto Anunziato (SLA) at UT22:40-22:50 UT, observed this area under similar illumination to the following report:

Montes_Teneriffe observed by Hart_R on 1854-12-27 nr. Plato in Teneriffe Mountains 1854 Dec 27 UT 18:00-23:00 Observed by Hart & others (Glasgow, Scotland, 10" reflector)"2 luminous fiery spots on bright side on either side of a ridge, contrasting color. Seemed to be 2 active volcanoes. Ridge was normal color. Spots were yellow or flame color. Never seen before in 40 yrs. of observing." NASA catalog weight=4. NASA catalog ID #129. ALPO/BAA weight=2.

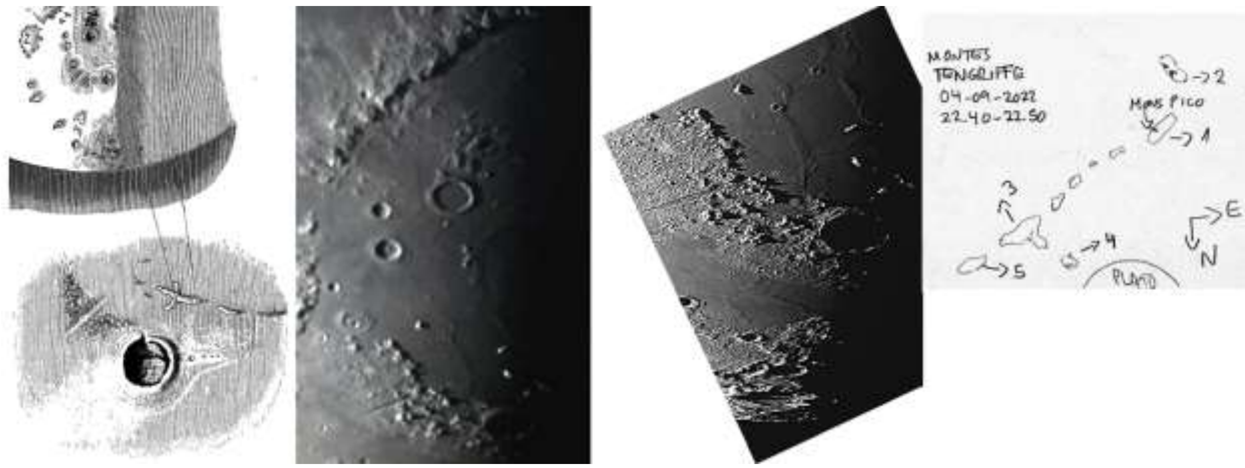


***Figure 3.** Montes Teneriffe orientated with north towards the bottom. **(Far Left)** A couple of sketches from the MNRAS 1855 publication by Hart. **(Left)** An image by Aldo Tonon (UAI). **(Right)** An image by Les Fry (NAS). **(Far Right)** A sketch my Alberto Anunziatio (SLA) but mirror reversed i.e. E is on the right and W is on the left.*

We have examined repeat illumination observations of this LTP several times before e.g. in the 2018 Dec, 2019 Feb, 2020 Aug, 2020 Dec and 2021 Jan newsletters. It is becoming clear that the sketches in the MNRAS publication (Fig 3 – Far Left) are at different times, the top far-left one more clearly represents the illumination that Aldo, Les and Alberto depict, and the far-left sketch is just a finder chart made on a later night – quite a poor one as they have drawn Plato as circular. If this is the case then the two dashed lines must represent the two "luminous fiery spots" that Hart saw. So, I think we are now a little clearer as understanding the location of the LTP.

Copernicus: On 2022 Apr 10 Franco Taccogna (UAI) imaged this crater under similar illumination to the following three events:

Copernicus 1955 Jul 28 UT 20:20 Observed by Firsoff (Somerset, England, 6.5" reflector x200) "Great brilliance of the terraces in E(IAU?) wall system(?) gets specular refl. (he gave 0820UT, but must have meant 2020" NASA catalog weight=4. NASA catalog No. #600.

On 1990 Aug 30 at UT02:11-02:36 D. Darling (Sun Praire, WI, USA, 3" refractor, x90, seeing conditions: "at,. boiling") noted a colored area on the west wall of Copernicus that was unusual in appearance - however other craters along the terminator had a similar effect. There was also a "dazzling bright spot on the E. rim and he witnessed 6 flashes from the lighted part of Copernicus over a very short time interval. Cameron comments that the color may well have been dur to chromatic aberration because a refractor was used. The Cameron 2006 catalog ID=408 and the weight=0. The ALPO/BAA weight=1.

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 Frigoris - but lasting a brief time. The red color 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 color in a few respects. Therefore the ALPO/BAA weight=1 for safety.

Figure 4. *Copernicus as imaged by Franco Taccogna on 2022 Apr 10 UT 20:07 and orientated with north towards the top. The color saturation has been increased to 20%.*

The western terraces appear to be bright, but not exceptionally so – so assuming Firsoff mean Classical East then this is normal. There is a white spot on the east rim, which I guess under exceptional moments of seeing may brighten in appearance. There is a hint of red on the west inner rim, which is due to atmospheric spectral dispersion but can also be seen on other features.

Gassendi: On 2022 Apr 12 UT 01:57-02:06 Jay Albert (ALPO) observed visually this crater under similar illumination to the following report:

Gassendi 1966 Apr 30 UT 21:30-23:28 Observed by Sartory, Ringsdore (England, 8.5" reflector, S=E), Moore, Moseley (Armagh, Northern Ireland, 10" refractor, S=VG), Coralitos Observatory (Organ Pass, NM, USA, 24" reflector, Moon Blink) "English moon blink system detected red spots with vis. confirm. Ringsdore says no coluor but saw obscuration. (LRL 60-in photos showed nothing unusual by my casual inspection). Indep. confirm. (even E. wall was in dark). Corralitos did not confirm by MB." N.B. event had finished by the time Corralitos came on-line. NASA catalog weight=5. NASA catalog ID #931. ALPO/BAA weight=4.

Jay was using a Celestron NexStar Evolution 8” SCT. The waxing Moon was 75.5% lit and nearly overhead. The sky was partly to mostly cloudy with no haze. Transparency varied from opaque to 4th magnitude depending on the fast-moving clouds. Seeing varied continually from 3 to 6/10. Filters were not used. Jay commented that the crater was right on the terminator. No red spots or other color was seen. The crater was mostly in deep shadow with only the exterior E walls of Gassendi and Gassendi A sunlit.

Tycho: On 2022 Apr 13 UT 21:37-231:55 Trevor Smith (BAA) observed this crater under similar illumination to the following report:

On 1980 Jul 24 at UT22:10-22:55 P. Moore (Selsey, UK, 15" reflector, x360 and x400) found an area just south east of the central peak (and up to the wall) to be quite dark in blue light, but normal brightness in red light or in white light. All other features were normal colour-wise. At 22:55UT Tycho was normal again. Cameron 2006 catalog ID=103 and weight=4. ALPO/BAA weight=3.

Trevor used a 16” reflector under Antoniadi III-IV seeing. He commented that in white light the crater and surrounding area looked normal with nothing unusual visible. However, in the Wratten 25 red filter the SE area near the central peak showed an obvious but slight darkening in blue Wratten 32A and also the darker blue Wratten 47. This area was seen to be much darker than the nearby terrain. The floor of Tycho was totally in shadow. It as plain to see that this area of darkness to the SE of the central peak is a slump or ancient landslip from the rim of the crater. This area of darker material was also seen to the S and SW of the central peak. Trevor considers this to be normal.

Plato: On 2022 Apr 14 UT 22:35 Walter Elias (AEA) imaged this crater under similar illumination to the following report:

Plato 1981 Jun 15 UT 21:30 Observed by Amery (Reading, England, 25cm reflector, seeing Antoniadi IV-V) At the 4 O'Clock position on the North West corner?, there was a dark smudge which reached from the floor across and over the wall and onto the terrain outside the crater. Foley, alerted by Amery, saw a dark show-like patch in the crater's north west corner, again lying across the rim. 2006 Cameron catalog extension ID=148 and weight=4. Foley used a 12" reflector and seeing was III-V. ALPO/BAA weight=3.

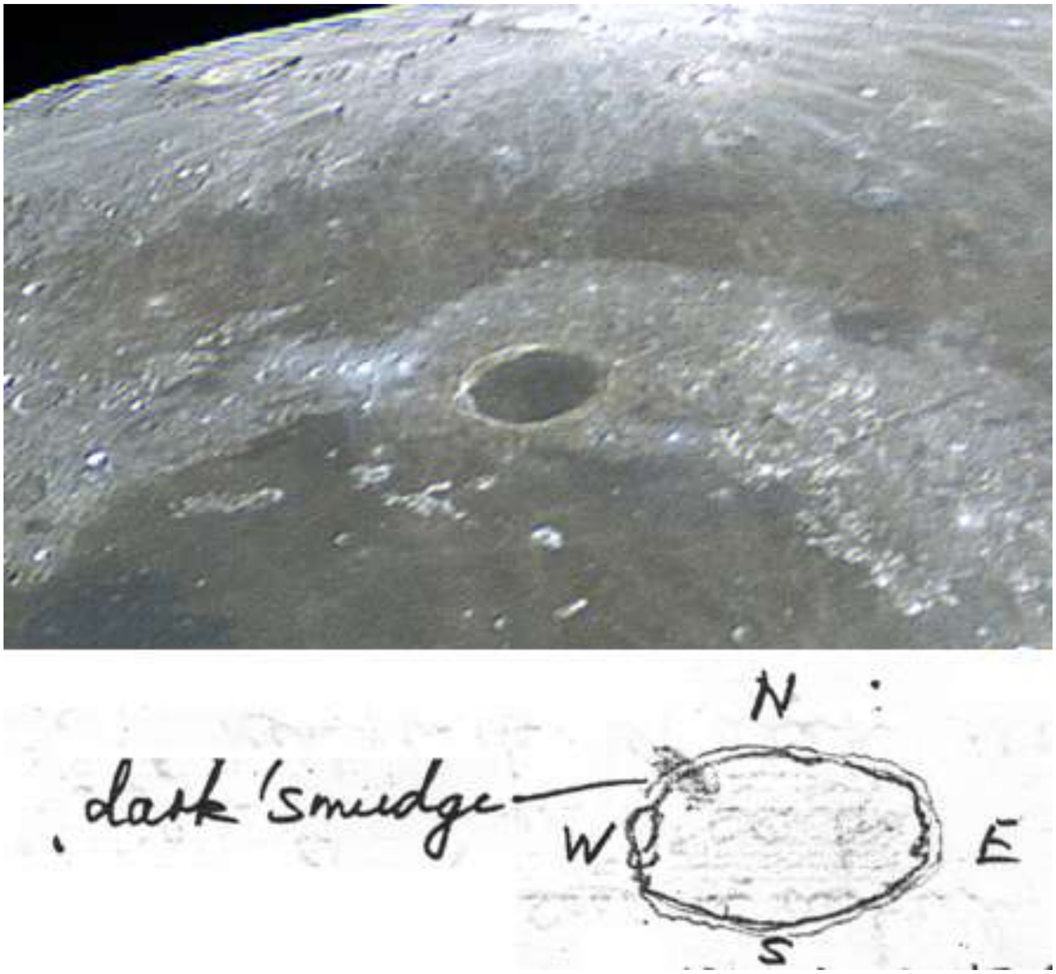


Figure 5. *Plato orientated with north towards the top.* ***(Top)*** *An image by Walter Elias (AEA) taken on 2022 Apr 14 UT 22:35 – this has been color normalized and then had its color saturation increased to 60%.* ***(Bottom)*** *The original LTP sketch of the dark smudge on the NW rim of Plato by Geoff Amery from 1981 Jun 15 – note that the writing has been rotated through 180 degree to match Walter's image orientation.*

No obvious sign of a dark smudge in Fig 5, so we shall leave the weight at 3 for now.

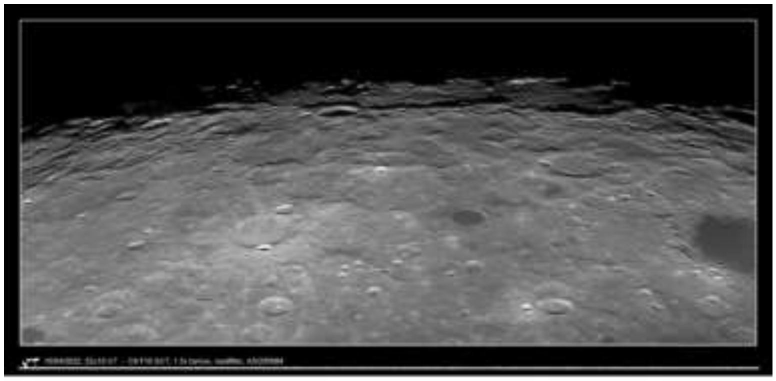
Cavendish E: On 2022 Apr 13 UT 21:10 Massimo Giuntili (BAA) continued to monitor this crater to see if it repeats a flare up in brightness that he saw in the past. On this occasion the northern floor of crater slightly brighter than usual but not brilliant. The seeing was IV-II (var.) / col. 60.1 / sub sol. lat. -0.8 / lat. -5.31 / long. -6.24. A 150mm OG - x240 used.

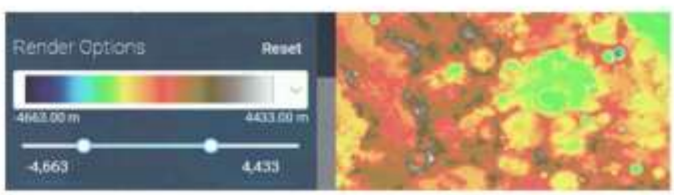
General Information: For repeat illumination (and a few repeat libration) observations for the coming month - these can be found on the following web site: http://users.aber.ac.uk/atc/lunar_schedule.htm . By re-observing and submitting your observations, only this way can we fully resolve past observational 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

Basin and Buried Crater Project

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





This month we have our first image of an impact basin sent in. This one is the obscure Cruger-Sirsalis basin (66W, 15S) and 400 km in diameter. Firstly, we have Alexander Vandenbohede's image taken on 2022 Apr 15 UT 22:10 and orientated with north to the right. As the basin is pre-Nectarian in age it is one of the earliest basins, and so has subsequently been heavily eroded by overlying, more recent craters. The basin is slightly more obvious in the centre image which is a visualisation from the LROC QuickMap web site with artificial illumination at 6 deg above the horizon and coming in on an azimuth of 77 deg. The lower figure is the definitive proof that this is a basin as there is a clear depression here. I cannot see any obvious signs of outer rings, though there may be an inner rim?

The website for our current lunar impact basins and buried craters is: https://users.aber.ac.uk/atc/basin_and_buried_crater_project.htm . Apologies over the web in last month's newsletter, but it contained an unnecessary space which unfortunately broke the link.

Lunar Calendar June 2022

Date	UT	Event
1	2100	Ceres 0.1°S of Moon, occultation Polynesia, North and Central America
2		Greatest northern declination +27.0°
2	0100	Moon at apogee 406,192 km
6		South limb most exposed -6.8°
7	1448	First Quarter Moon
9		West limb most exposed -7.5°
14	1152	Full Moon
14	2300	Moon at perigee 357,432 km, large tides
15		Greatest southern declination -26.7°
18		North limb most exposed +6.7°
18	1200	Saturn 4° north of moon
19	0800	Vesta 0.7° north of Moon, occultation Antarctica, South Africa
21		East limb most exposed +7.7°
21	0311	Last Quarter Moon
21	1400	Jupiter 3° north of Moon
22	1800	Mars 0.9° north of Moon, Antarctica to Polynesia
24	2200	Uranus 0.05° north of Moon, occultation Australia to Hawaii
26	0800	Venus 3° south of Moon
29	0252	New Moon, lunation 1231
29		Greatest northern declination +26.9°
29	0600	Moon at apogee 406,580 km

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

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

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

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

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

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

SUBMISSION THROUGH THE ALPO IMAGE ARCHIVE

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

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

It is helpful if the filenames follow the naming convention :

FEATURE-NAME_YYYY-MM-DD-HHMM.ext

YYYY {0..9} Year

MM {0..9} Month

DD {0..9} Day

HH {0..9} Hour (UT)

MM {0..9} Minute (UT)

.ext (file type extension)

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

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

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

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

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

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

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

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

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

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

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

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

CALL FOR OBSERVATIONS:
FOCUS ON: Wonders of the Full Moon

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 June 2022 Focus-On will be the craters rayed craters of the Moon's northern hemisphere. 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

FUTURE FOCUS ON ARTICLES:

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

Subject	TLO Issue	Deadline
Bright Rays North	**July 2022**	**June 20, 2022**
Bright Rays South	**September 2022**	**August 20, 2022**
Ever Changing Eratosthenes	**November 2022**	**October 20, 2022**

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**

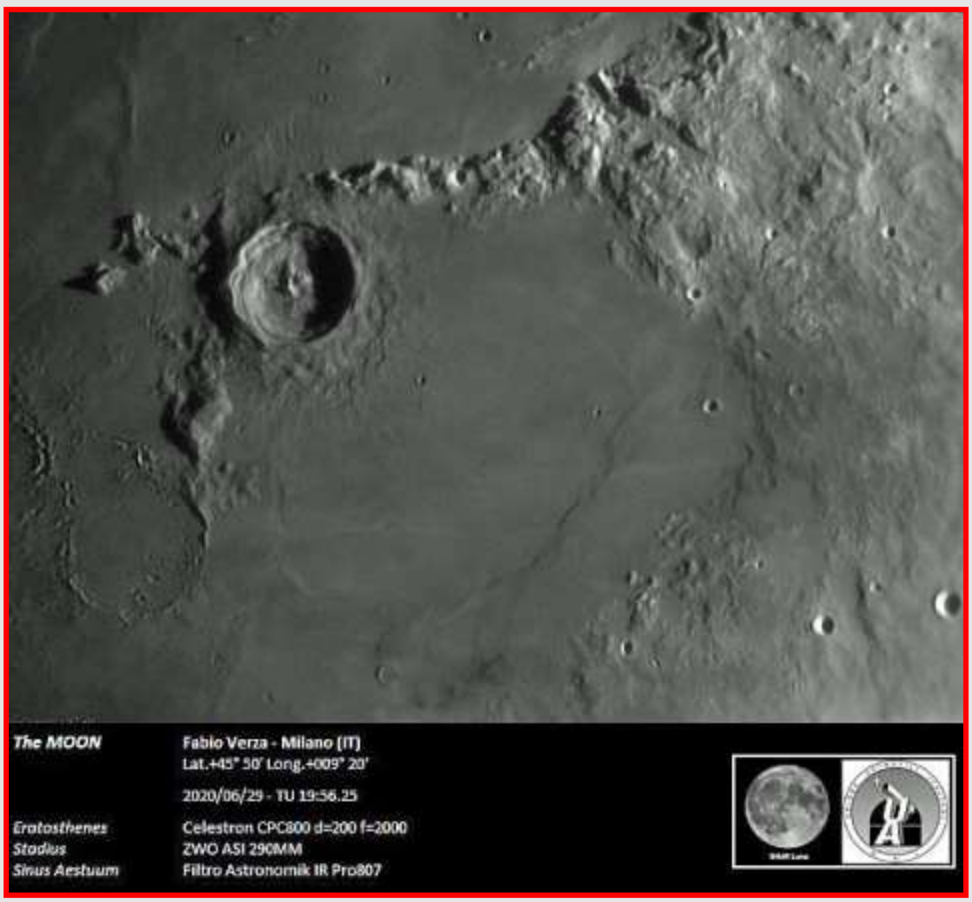
Leandro Sid

Focus-On Announcement

EVER CHANGING ERATOSTHENES

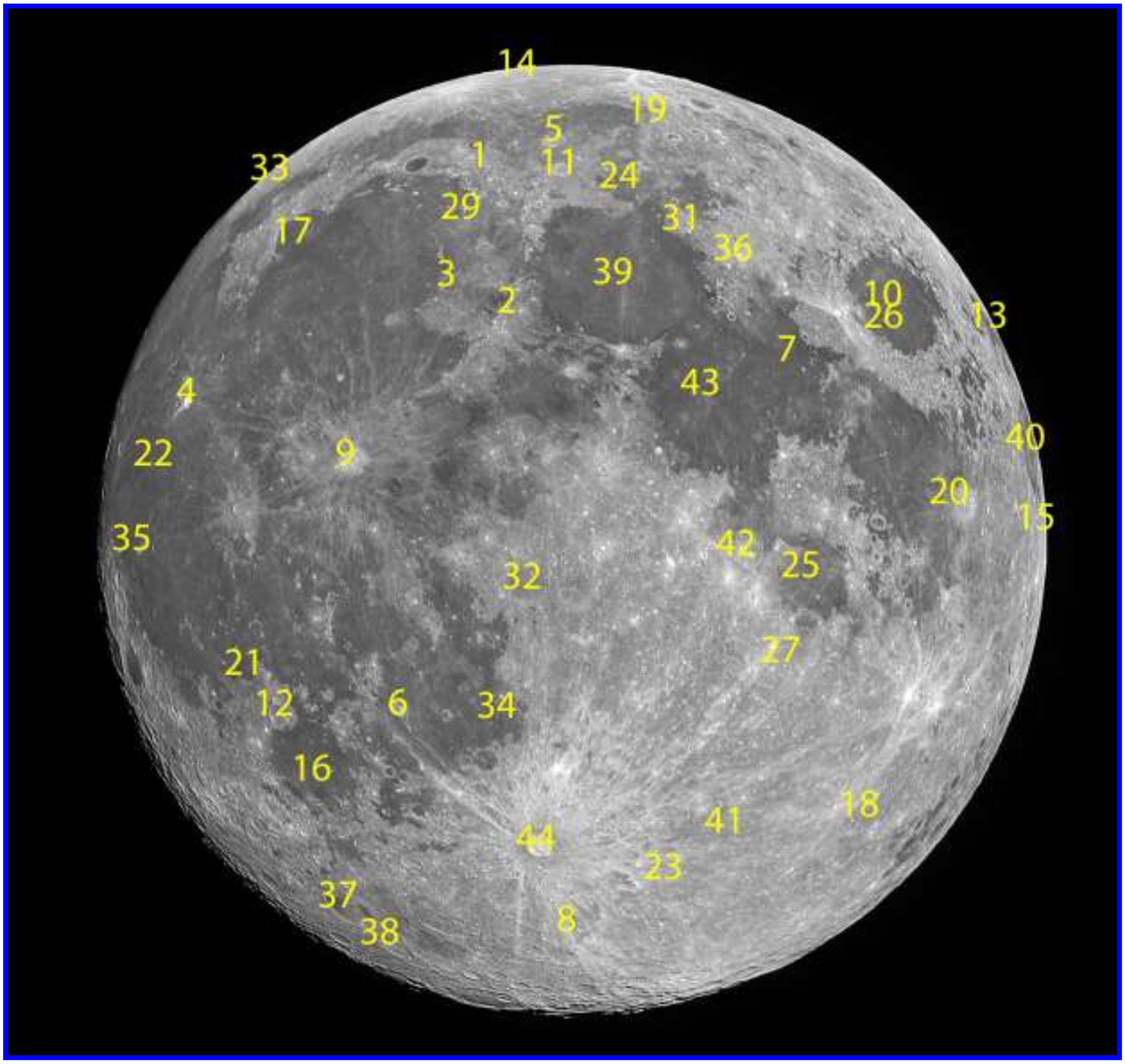
Eratosthenes is a model impact crater, albeit "unfairly" overshadowed by the younger Copernican craters. It is interesting to observe its rim, well defined and with linear segments, its spectacular terraced walls, the central peaks, its irregular and fractured floor full of mounds, and its majestic ramp-shaped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

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



Fabio Verza

Key to Images In This Issue



1. Alpes, Vallis
2. Apenninus, Montes
3. Archimedes
4. Aristarchus
5. Aristoteles
6. Bullialdus
7. Cauchy
8. Clavius
9. Copernicus
10. Crisium, Mare
11. Eudoxus
12. Gassendi
13. Goddard
14. Hermite
15. Hortensius
16. Humorum, Mare
17. Iridum, Sinus
18. Janssen
19. Keldysh
20. Langrenus
21. Letronne
22. Marius
23. Maurolycus
24. Mortis, Lacus
25. Nectaris, Mare
26. Picard
27. Piccolomini
28. Pitiscus
29. Piton, Mons
30. Plato
31. Posidonius
32. Ptolemaeus
33. Pythagoras
34. Recti, Rupes
35. Reiner, Gamma
36. Römer
37. Schickard
38. Schiller
39. Serenitatis, Mare
40. Smythii, Mare
41. Stiborius
42. Theophilus
43. Tranquillitatis, Mare
44. Tycho