THE LUNAR OBSERVER

A PUBLICATION OF THE LUNAR SECTION OF THE A.L.P.O.

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RECENT BACK ISSUES: http://moon.scopesandscapes.com/tlo_back.html

FEATURE OF THE MONTH – APRIL 2019
TYCHO-ZUCCHIUS-CASSATUS

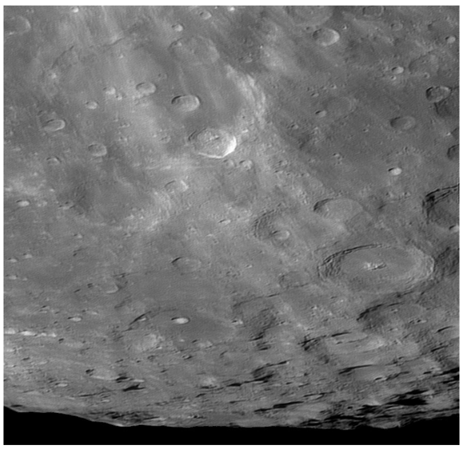


Image and text by Howard Eskildsen - Ocala, Florida USA
March 23, 2019 09:52 UT, 6" f/8 refractor, 2x barlow, DMK41AU02-AS, W-8 yellow filter. Seeing 6/10, transparency 6/6.

This area of the Moon under this illumination just looks like a tortured, burned out cinder. The dark halo of impact melt around Tycho, at the top of the image, contrasts with the bright rays that the impact cast across the darker lunar surface. While most seem centered on the crater, the brightest ray angling downward traces to a point just to the left of Tycho's rim. Another bright ray crossing Clavius (largest cater on the right side of the image) seems to angle towards the left wall of the crater. Might these be related to migration of the center of pressure at the time of impact? I believe I once read an article suggesting this.

Clavius looks seriously abused in this illumination with the rays infringing over the varying shades of its floor, which is pocked with younger craters. Casatus rests on the lower right of the image, with a bright, small crater on its interior. On the left lower part of the image, Zucchius has a relatively bright interior with a dark semicircle around its lower right rim. Some dark streaks, like rays, radiate from the rim towards the central lower part of the image. I wondered if this could be similar to the dark rays of Dionysius, or if it could be pyroclastic. However, the Clementine color-ratio layer on the LROC Quickmap, suggests that the "rays" are of different composition to the partial ring around Zucchius. Something to ponder. Also, it make me wonder what else lies hidden in plain sight on bright, neglected face of the Moon.

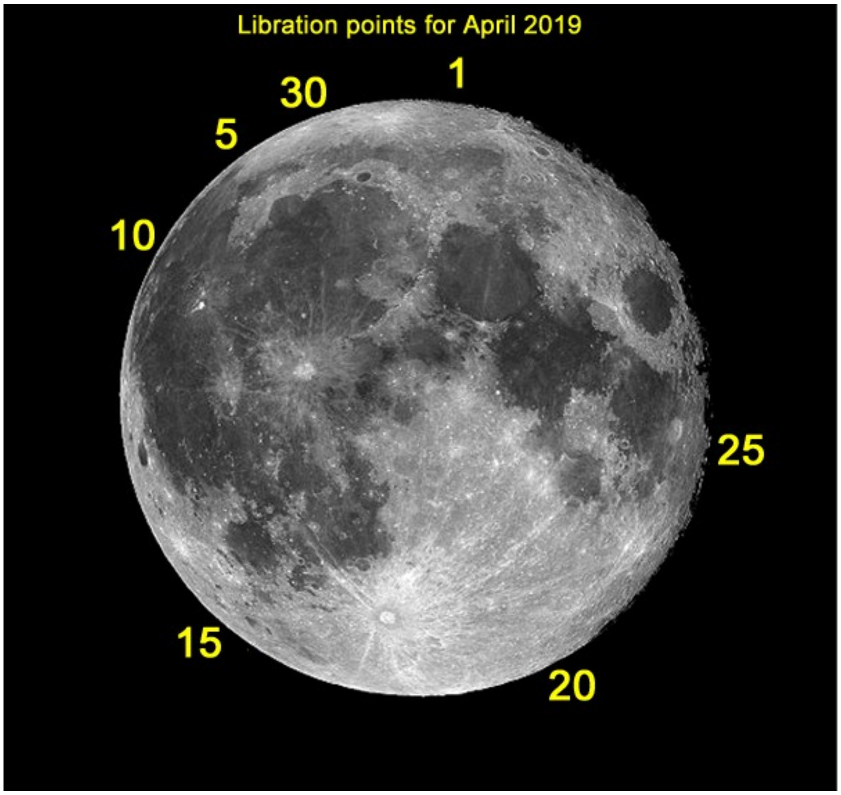
LUNAR CALENDAR

2019	U.T.	EVENT
Apr 01	00:14	Moon Apogee: 405600 km
02	04:17	Moon-Venus: 3° N
02	23:01	Moon-Mercury: 4° N
05	08:50	New Moon
09	06:40	Moon-Mars: 5° N
11	23:59	Moon North Dec.: 22° N
12	18:08	Moon Ascending Node
12	19:06	First Quarter
16	22:02	Moon Perigee: 364200 km
19	11:12	Full Moon
23	11:36	Moon-Jupiter: 1.8° S
24	21:22	Moon South Dec.: 22.1° S
25	14:38	Moon-Saturn: 0.4° N
25	15:02	Moon Descending Node
26	22:18	Last Quarter
28	18:20	Moon Apogee: 404600 km

2019	U.T.	EVENT
May 02	11:39	Moon-Venus: 3.9° N
04	22:45	New Moon
07	23:36	Moon-Mars: 3.3° N
09	05:46	Moon North Dec.: 22.2° N
09	18:50	Moon Ascending Node
12	01:12	First Quarter
13	21:53	Moon Perigee: 369000 km
18	21:11	Full Moon
20	16:54	Moon-Jupiter: 1.8° S
22	06:41	Moon South Dec.: 22.3° S
22	21:12	Moon Descending Node
22	22:25	Moon-Saturn: 0.6° N
26	13:27	Moon Apogee: 404100 km
26	16:33	Last Quarter

LUNAR LIBRATION

APRIL 2019



Size of Libration

04/01	Lat	+03°13'	Long	+00°35'
04/05	Lat	+06°24'	Long	-04°04'
04/10	Lat	+04°01'	Long	-05°55'
04/15	Lat	-03°28'	Long	-02°47'
04/20	Lat	-06°19'	Long	+04°22'
04/25	Lat	-00°55'	Long	+04°48'
04/30	Lat	+05°12'	Long	-01°30'

NOTE:
Librations are based on a geocentric position at 0 hr. Universal Time.

2019 ALPO MEETING

The 2019 Annual Meeting of the Association of Lunar and Planetary Observers will be held, combined with the South East Region Astronomical League, at Gordon College in Barnesville, GA the weekend of July 12-14.

Additional information will be available in the JALPO and included here as it becomes available.

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 nonmembers free of charge, but there is more to the A.L.P.O. than a monthly lunar newsletter. If you are a nonmember you are invited to join our organization for its many other advantages.

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

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

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

SUBMISSION THROUGH THE ALPO IMAGE ARCHIVE

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

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

It is helpful if the filenames follow the naming convention :

FEATURE-NAME_YYYY-MM-DD-HHMM.ext

YYYY {0..9} Year
MM {0..9} Month
DD {0..9} Day
HH {0..9} Hour (UT)
MM {0..9} Minute (UT)
.ext (file type extension)
(NO spaces or special characters other than "_" or "-". Spaces within a feature name should be replaced by "-".)
As an example the following file name would be a valid filename:

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

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

If the filename does not conform to the standard, the staff member who uploads the image into the data base will make the changes prior to uploading the image(s). However, use of the recommended format, reduces the effort to post the images significantly.

Observers who submit digital versions of drawings should scan their images at a resolution of 72 dpi and save the file as a 8 1/2"" x 11" or A4 sized picture.

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

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

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 both
Wayne Bailey – wayne.bailey@alpo-astronomy.org
and Jerry Hubbell –jerry.hubbell@alpo-astronomy.org

Hard copy submissions should be mailed to Wayne Bailey at the address on page one.

CALL FOR OBSERVATIONS:
FOCUS ON: Apollo 12 Region – Ocean of Storms

Focus on is a bi-monthly series of articles, which includes observations received for a specific feature or class of features. The subject for the **May 2019** edition will be the Apollo 12 Region – Ocean of Storms**.** 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):

Jerry Hubbell –jerry.hubbell@alpo-astronomy.org
Wayne Bailey - wayne.bailey@alpo-astronomy.org

Deadline for inclusion in the Apollo 12 Region – Ocean of Storms article is April. 20, 2019

FUTURE FOCUS ON ARTICLES:

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

Subject	TLO Issue	Deadline
Apollo 11 Region – 50th Anniversary – Sea of Tranquility	July 2019	June 20, 2019

FOUNDATION OF THE LUNAR SOCIETY ARGENTINA

On March 1 at 7:00 pm in the city of Paraná, Argentine Republic, la Sociedad Lunar Argentia-Argentine Lunar Society (SLA) was formally inaugurated. The first Latin American association specifically dedicated to lunar studies was born under the auspices of the Liga Iberoamericana de Astronomía-Ibero-American League of Astronomy (LIADA), the entity that has gathered amateur and professional astronomers from 19 Latin American countries, Spain and Portugal for 60 years, and with the support from the Centro de Observadores del Espacio-Center for Space Observers (CODE), the Faculty of Chemical Engineering of the National University of the Litoral and the Nova Persei II Observatory of Formosa. The main objectives of the SLA are: to disseminate the collaborative activities between professional astronomers and amateur astronomers (PRO-AM), starting from valuing rigorous lunar observation by amateurs within the framework of observation programs with the control or sponsorship of professionals, disseminating the history of astronomy in general and of planetary and lunar astronomy in particular, especially that related to astronautics and space exploration and, within the framework of a federative structure, to promote the creation of lunar centers or societies in Argentina and abroad. The new astronomical association will have its headquarters shared between the cities of Santa Fe and Paraná, very close geographically to each other. The SLA aims to expand the participation of Latin American lunar observers, especially Argentines, in the lunar programs of ALPO, as the Lunar Section of the Liga Iberoamericana de Astronomía has been doing since 2015, and also intends to make known the marvelous adventure of lunar exploration, from Earth and on the surface of our satellite, the past exploration and the one that will come.

The inaugural event included three lectures: "Lunar Observation and Exploration: Past, Present and Future" (Alberto Anunziato), "Lunar Movements" (Prof. Dr. Raúl Roberto Podestá) and "A Clock on the Moon" (Dr. Roberto Aquilano). The Argentine Lunar Society already has members in the provinces of Entre Ríos, Santa Fe, Córdoba, Formosa and San Juan.

Inaugural meeting group photo. 1.-Jorge Coghlan, 2.-Juan Carlos Dovis, 3.-Clider Razovich, 4.-Sandra Muchetti, 5.-Ignacio Ingaramo, 6.-Hugo Lanas, 7.-Walter Latrónico, 8.-Yelem Jorge, 9.-María Razovich, 10.-Alan Trumper, 11.-Ignacio Podestá, 12.-Roberto Aquilano, 13.- Damián Langhi, 14.- Andrés Cagliani, 15.-Raúl Podestá, 16.-Carlos Costa, 17.-Gustavo Blettler, 18.- Juan Manuel Biagi, 19.-Alberto Anunziato, 20.- Desiré Godoy, 21.- Emiliano Rodríguez, 22.- Walter Rodríguez, 23.-Francisco Alsina Cardinali, 24.- Betiana Puisler, 25.- Romano Anunziato, 26.-Atina Anunziato, 27.- Gabriel Kloster, 28.-Adriana Pacheco, 29.- Susana Reviriego, 30.- Ingrid Puisler, 31.-Federico Kemerer, and Rodrigo de Brix took the picture.

THE APOLLO 14 LANDING SITE AT FRA MAURO:A PLACE SELECTED TO ELUCIDATE THE ARM-WRESTLING BETWEEN VOLCANISTS AND METEORISTS

Alberto Martos, Antonio Noya, Jorge Arranz, Raquel R. Mediavilla, Jaime Izquierdo and Carlos de Luis, members of the Lunar Group of the Madrid Amateur Astronomy Society.

...after all, every idiot knows that basalts are volcanic.
D. E. Wilhelms, *To a Rocky Moon*.

Comment made by the reviewer of a lunar paper after reading the term *volcanic basalt*.

From the remembrance.

At the time of the Apollo 14 flight, the supporters of two geological hypotheses still debated and not without some acrimony, the origin of lunar basins and craters. The most widely held theory by lunar scientists alluded to an exogenous phenomenon, meteorism, to explain the formation of all those features, as impact structures. And the one supported by the rest of the experts (a long lived minority), to an endogenous phenomenon, volcanism. The late stated that most of the lunar features were huge volcanoes that covered a large part of the lunar surface with an extensive layer of basalts, no matter the smallness of the Moon to set them all in such a fiery eruption. Lunar samples brought back to Earth by previous expeditions of Apollo 11 and Apollo 12 (mainly basalts and regolith breccias), had been collected in mare type soils and therefore, were inconclusive. A new type of soil must be selected as landing site, to solve this dilemma.

And such site existed 6 degrees south of the lunar Equator, well within the restriction of equatorial orbit imposed on the early Apollo flights to land on the Moon: the Fra Mauro Formation. This so-called geological target was identified by telescopic observations and is located 1150 km south of the center of Imbrium multiringed basin (on the fifth ring), or 360 km south of Copernicus crater. It extends about 200 km north-south and contains three large impact craters, Fra Mauro, Bonpland and Parry, all of them very old, worn out and flooded by lava from Mare Insularum and Mare Cognitum. Two morphologically distinct kinds of soils (*facies*) were differentiated at the eyepiece: an old highland soil represented by some hummocky terrain deposits, most likely of impact origin, which became the Fra Mauro Formation, as dubbed by geologists; and a younger light plain soil supposedly formed by volcanism, which became the Cayley Formation, for a more difficult reason to explain (the eponym crater Cayley is far away from Fra Mauro, but lunar geology mappers identified this kind of soil in its neighborhood). Our photo 1 shows the general aspect of the area at sunset. The hummocky terrain can be seen north of crater Fra Mauro and surrounding its western side, as an island of highland soil amidst a sea of lava soil. Therefore, everything else around the three craters is light plain soil. A multiple-branch course of lava, Rimae Parry, can be seen pinpointed in white on the picture.

Searching through the digital images provided by Lunar Orbiter IV, members of the NASA GLEP (Group for Lunar Exploration Planning) found an interesting target for EVA-2 (Extra Vehicular Activity-2): a young 370 m wide and 75 m deep crater, appropriately called Cone. This crater sits on a regolith deposit, whose thickness had been estimated between 5 m and 12 m (as inferred by the shape of the floor of the smaller neighboring craters), so that the crater Cone should have penetrated the regolith layer and perforated the bedrock, hurling fragments onto the surface. Astronauts might be able to collect them and bring them back home, if only they be trained in rock identification to pick up the right ones.

The training of the astronauts in geology posed some kind of disconformities to them. Initially, Alan Sheppard and Edgar Mitchell had been trained for a different kind of target, one near crater Littrow, located in Montes Taurus, that's to say in the lunar highlands. However, the failure of Apollo 13 expedition, the prime flight assigned to the Fra Mauro site, left this target void of science, an unacceptable circumstance for the GLEP, who retargeted the Apollo 14 expedition to Fra Mauro. Owing to this change, both astronauts had to be retrained in geology, an aspect of the work that was not at all of their preference

Apollo 14 Lunar Module, christened Antares by the crew, landed 80 km north of Fra Mauro (photo 1) and 1.1 km SE of the crater Cone. Astronauts Sheppard and Mitchell explored the lunar surface and fulfilled almost all the tasks that they had been scheduled for during EVA-1 (mainly sample collection and deployment of ALSEP-2 scientific equipment), while Stuart Roosa flew around the Moon taking pictures of geological features. However during EVA-2, a deceiving landscape that showed the horizon sometimes only at about 100 meters away, misled the landed crew, who roamed their way pulling, pushing and lifting off the ground a rickshaw carrier with plenty of special tools for field work. At last, the lack of oxygen due to the stressing run forced them to return to Antares, without reaching the crater Cone. This setback prevented the scientific community from analyzing the potentially valuable samples from the Fra Mauro bedrock. Perhaps the legacy of their scant interest in geology?

Nevertheless, when the Apollo 14 crew returned home they carried 43 kg of lunar samples, rocks and soil. The radiometric analysis of the rocks yielded two epochs, 3.85 and 3.87 billion years, which allowed the scientists to set the time of the Imbrium impact and the age of the Fra Mauro Formation. Although some samples with low-potassium content were initially classified as feldespathic basalts, a precocious basaltless magma, their high KREEP contents and the presence of some meteoritic contaminants, revealed their impact-melt origin. As a conclusion: most of the rocks were KREEP-rich breccias that formed during the solidification of the magma ocean and impact melt breccias (a new class of breccias found at Fra Mauro for first time, that strongly resembles volcanic lava) from imbrian ejecta. From the Fra Mauro time on, the volcanic theory progressively faded, although still lingers.

Our observation.

We had observed the Fra Mauro area many times in the past and had obtained some pictures of acceptable quality for selenology studies. We nevertheless planned two new sessions of widefield photography and sketching on days 13 and 14, especially intended for this paper. Photos 2, 3 and 4 show the Fra Mauro area at sunrise, at noon and at sunset, respectively. It is amazing to observe how these large, but low rimmed craters, Fra Mauro (95 Km/1860 m), Bonpland (60 Km/900 m) and Parry (48 Km/560 m), fade away under vertical illumination. We consider that the widely accepted limit of 15 degrees of distance to the terminator for an object to be observable with some profit, must be reduced to 12 or 10 degrees in the particular case of low rimmed structures.

By enjoying this panoramic view (see photo 5 and sketch 1), it came to our minds one of the better objections raised by volcanists, to the possibility of an impact origin for the hummocky deposits: the enormous distance for the large ejecta to travel from the zero zone at the center of the Imbrium basin (top of the photo), to the Fra Mauro formation (bottom of the photo): 1200 km! However, an answer was immediately found: the very long rays of crater

Tycho, a crater thousands of times smaller than the Imbrium basin, run across de lunar surface reaching far longer distances. The one running towards northeast crosses Mare Serenitatis, reaching 1500 km! What could be wrong with 1200?

A closer observation of the Fra Mauro Formation near the terminator and under high power optics (240x), allowed us to discern some more details of the triple group (photo 6). Fra Mauro is not so round as it looks like under low power optics. Its rim is flattened at south by intrusions produced by the two younger companions Bonpland and Parry. And the whole Fra Mauro seems to have smashed an older and smaller crater, whose north rim protrudes partially below it. Besides this, the rim has been severely damaged by ejecta and interrupted at two points, at the eastern border, leaving a clear pass (a "strait") to lavas from Mare Insularum and Mare Nubium to invade the interior; and at north, where a long cleft, a branch of Rimae Parry, penetrates the wall and traverses the floor from north to south. This rille splits the floor in two semicircles; the eastern part is overlaid by light plains soil and presents a few secondary craters of concave floor. The western part is covered by a layer of hummocky terrain that extends from the flat floored crater Gambart (or even from the magnificent Copernicus) to the western rim of Bonpland. We could see only two small craters on this part. This hummocky layer that has buried the remnant of the older crater located underneath Fra Mauro and overlies the western half of it, is the so-called Fra Mauro Formation.

The old Bonpland crater has also its rim disturbed by the formation of the younger Parry. Both east and south parts of the rim look squared and the common angle, detached from the general lineation. The western half of the rim is buried under the hummocky Fra Mauro Formation and has collapsed at south, where mare lavas have gone overboard and flooded the floor. This light plains soil is the so-called Cayley Formation and weirdly has received no secondary impact, despite it is older than Parry. A branch of the rille Rimae Parry seems to mysteriously traverse the crater northern rim, without breaking or staining it. It should be older than Parry (but younger than Fra Mauro, because it crosses its floor) to explain how it can pass through, but it also runs across its floor!

The younger crater Parry lies semi-engulfed by the two older members of the group. Its rim has its loftier point to the northeast and although is impacted in the contact points, keeps its periphery complete, except in two points, one to the north, where another branch of Rimae Parry passes through, and the second to the west, where a small impact crater (Parry E, difficult to see due to the long shadow cast by the eastern wall) gives a three-way pass to several branches of Rimae Parry. The floor, flooded by light plains layer (Cayley Formation), shows two secondary craters of concave bottom.

In the six-branch Rimae Parry (photo 7 and sketch 2), Rima Parry I is the best visible one, even under vertical illumination (photo 8). We saw it with little difficulty, thanks to the small crater Fra Mauro E, which occupies the exact center of Fra Mauro and the rille passes west of it. The other rilles were visible only under favorable illumination. Rima Parry II crosses the southern part of Parry crater and converges with Rima Parry III through the opening made in the wall by the small crater Parry E. Rima Parry V branches from Rima Parry I near crater Fra Mauro E and as already said, passes mysteriously through the wall to Bonpland, running southwards and cutting the wall of Bonpland at south. Rima Parry IV branches from Rima Parry V in a point located in the northern sector of Bonpland and runs southwards. Rima Parry VI branches from the same point of the northern sector of Bonpland Rima Parry VI is the shortest one and vanishes inside this crater.

As it has been seen, all the branches run through the craters on straight, non-concentric, non-sinuous paths. Straight paths are not characteristic of lava flows, since flows usually change direction before obstacles. Straight paths are characteristic of lava dikes, which means that the true geologic nature of Rimae Parry rilles is a system of grabens. This solves a lot of headaches to hardheaded geologists claiming volcanic material in the area: Procellarum lavas underlie the Fra Mauro Formation. Not volcanoes.

References:

Donald E. Wilhelms. “To a Rocky Moon”. The University of Arizona Press.

Donald E. Wihelms. “The Geologic History of the Moon”. USGS p.p. 1384.

Paul D. Spudis. “The Once and Future Moon”. Smithsonian Institution Press.

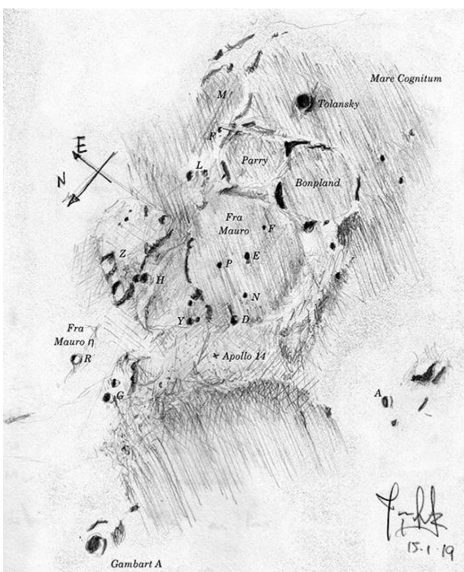
Fred Corno. “Magnificent Fra Mauro”. The Lunar Observer, June 2010.

Robert H. Hays. “Fra Mauro A”. Feature of the Month. TLO, Dec. 2016 & Jan. 2017.

Antonín Rükl. “Atlas of the Moon”. Hamlyn.

USGS Geological Map, quadrant III, charts D5 and E5.

Images



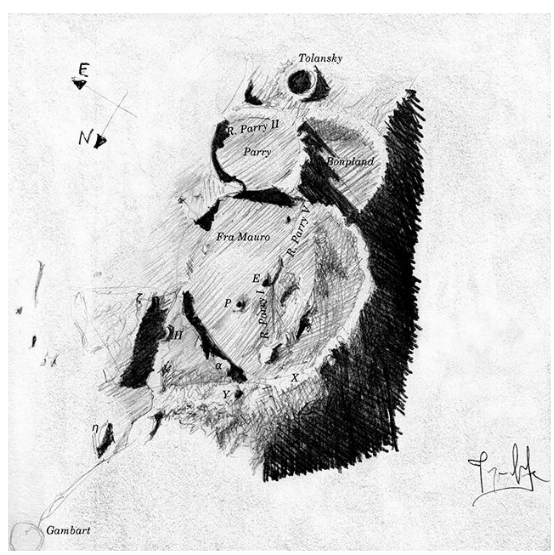
Sketch 1. Madrid, Spain. January 15, 2019 19:15-20:33 UT. 25 cm, f/5 dob. X2 barlow, 312x. Seeing 4/5, transparency 4/5, colongitude 25.9°.

The vertical illumination easies the identification of the triple target. A large number of secondaries is observed. The hummocky terrain resembles an extensive erosion, that had originated Fra Mauro eta and zeta scarps. This last one shows some flat aspect as if it were a small tableland, that holds the Fra Mauro Z crater on top. The shadows produce the impression that this hill were separated from Fra Mauro Formation by a “gully”, broad enough to lodge crate Fra Mauro H. This “groove” seems to run all the way south, until it reaches crater Parry M, at the top of the sketch.

Rimae Parry was almost invisible. Only the branch Rima Parry II has been depicted, traversing the southern bright part of crater Parry and over-passing its rim.

The Apollo 14 landed is the so-called hummocky terrain, different from highland and mare terrains.

Sketch 2. Madrid, Spain. February 13, 2019 18:34-19:15 UT. 25 cm, f/5 dob. X2 barlow, 312x. Seeing 4/5, transparency 3/5, colongitude 18.2°.

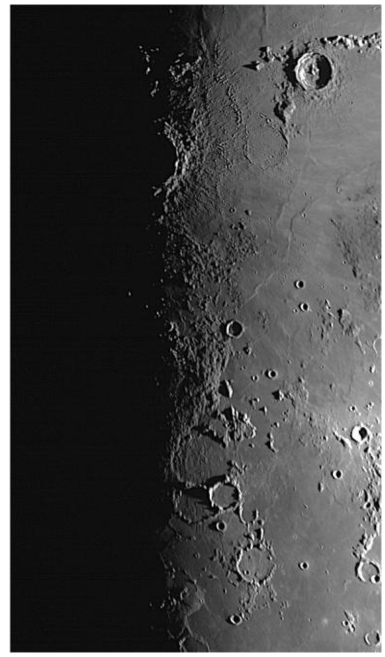


The proximity of the terminator suggests to expedite the work, avoiding too many fine details. The main proposal for this observation was to capture the full Rimae Parry, whose visibility was deficient during last observation (only Rima II was portrayed).

Sketch 2 shows clearly Rima Parry I and Rima Parry V, running north-south across crater Fra Mauro and converging at the center, just in crater Fra Mauro E. Rima Parry V traverses the rim between Fra Mauro and Bonpland, but the shadow cast by the wall prevents its observation.

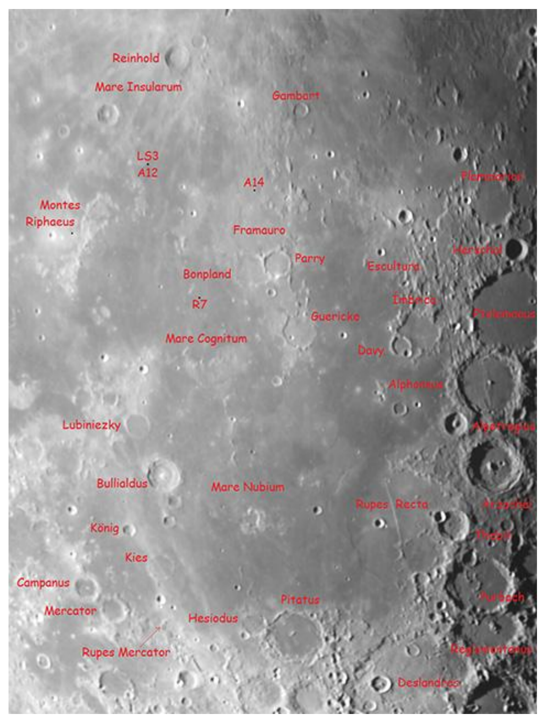
Under this illumination, the “gully” that seems to separate the scarps Fra Mauro ζ (zeta) and Fra Mauro η (eta), offers an aspect even more dramatic, although the twin Fra Mauro H craters lie under the shadow.

The same impressive phenomenon occurs in the landing area.

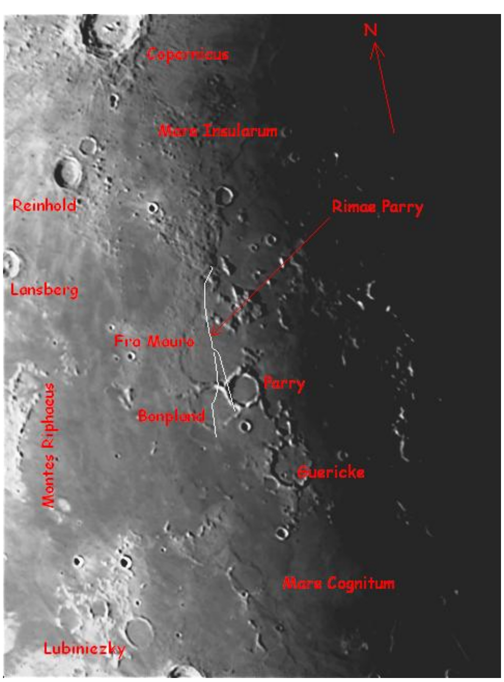


<u>Photo 1</u>. Fra Mauro panorama. Madrid, Spain. February 13, 2019 20:04 UT. Takahasi 130mm.QHY 5LII. Seeing 4/5, transparency 4/5, Colongitude 19.2°.

Photo 2. Fra Mauro at sunrise. Madrid, Spain. September 29, 2017 21:47 UT. 102mm ED refractor, Nikon 5200, ISO 500. Seeing 4/5, transparency 4/5.



<u>Photo 3.</u> Fra Mauro at noon. August 21, 2011 03:43 UT 20cm f/7.3, x2 barlow Newtonian, Canon 1000D. Seeing 3/5, transparency 3/5, colongitude 75.4°, moon altitude 60°.



<u>Photo 4.</u> Fra Mauro at sunset. September 5, 2007 04:42 UT. Observatory, 40º 22’ N; 03º 54’ W; Alt. 655 m. 20cm, f/7.3 Newtonian, Phillips TouCam Pro. Seeing 3/5, transparency 4/5, colongitude 188°.

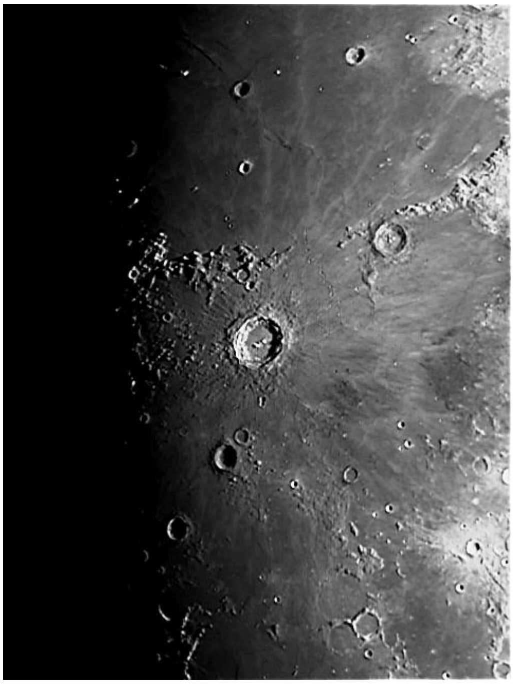


Photo 5. Fra Mauro panarama. February 18, 2005 21:55 UT. Observatory, 40º 22’ N; 03º 54’ W; Alt. 655 m. 20cm, f/7.3 Newtonian, Phillips TouCam Pro. Seeing 3/5, transparency 4/5, colongitude 30°.

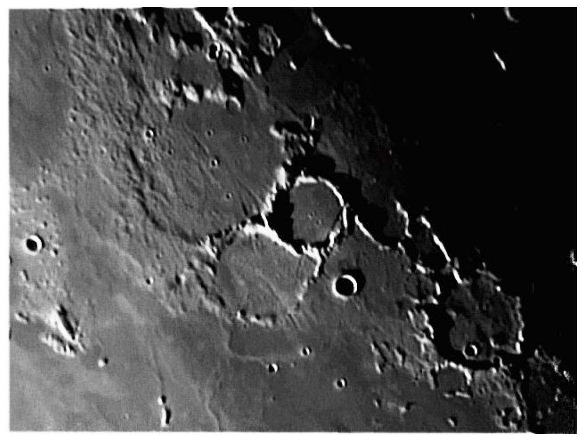


Photo 6. Close up. December 10, 2009 04:25 UT. Observatory, 40º 22’ N; 03º 54’ W; Alt. 655 m. 20cm, f/7.3 Newtonian, Phillips TouCam Pro. Seeing 4/5, transparency 4/5, colongitude 191°.

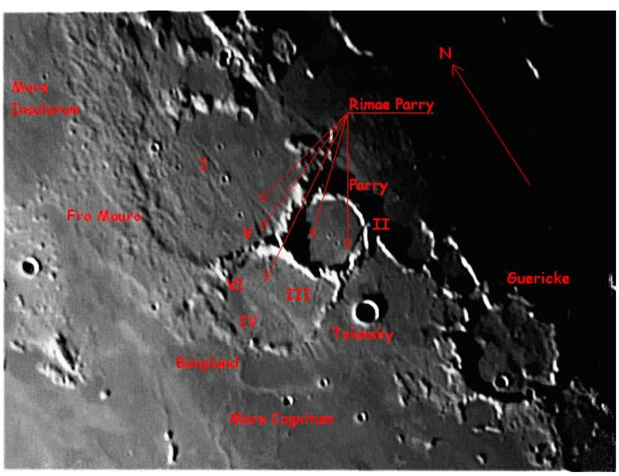


Photo 7. Rimae Parry. December 10, 2009 04:25 UT. Observatory, 40º 22’ N; 03º 54’ W; Alt. 655 m. 20cm, f/7.3 Newtonian, Phillips TouCam Pro. Seeing 4/5, transparency 4/5, colongitude 191°.

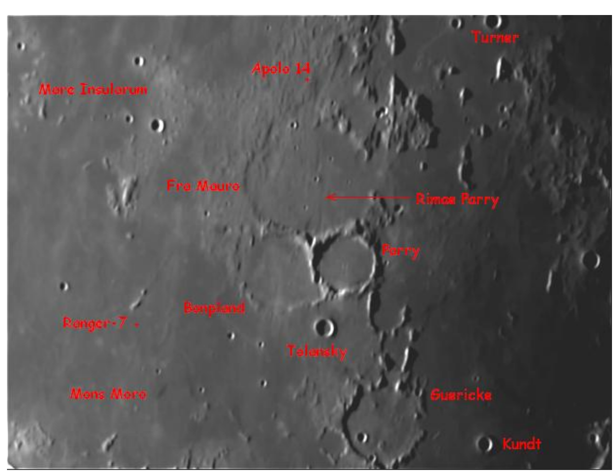


Photo 8. Rima Parry I. October 1, 2010 02:42 UT. Observatory, 40º 22’ N; 03º 54’ W; Alt. 655 m. 20cm, f/7.3 Newtonian, Phillips TouCam Pro. Seeing 3/5, transparency 3/5, colongitude 185°.

CLAVIUS, MORETUS & CABEUS

Howard Eskildsen

Clavius dominates the upper left of the image (fig. 1) with its floor littered with younger craters and streaked by rays from Tycho, which is not on the image. Beautifully formed Moretus is at the right bottom third of the image. It shows little space-weathering and has a distinct central peak and terraced walls and sharp rim. I sometimes think of it as “Tycho-down-under,” sans the rays.

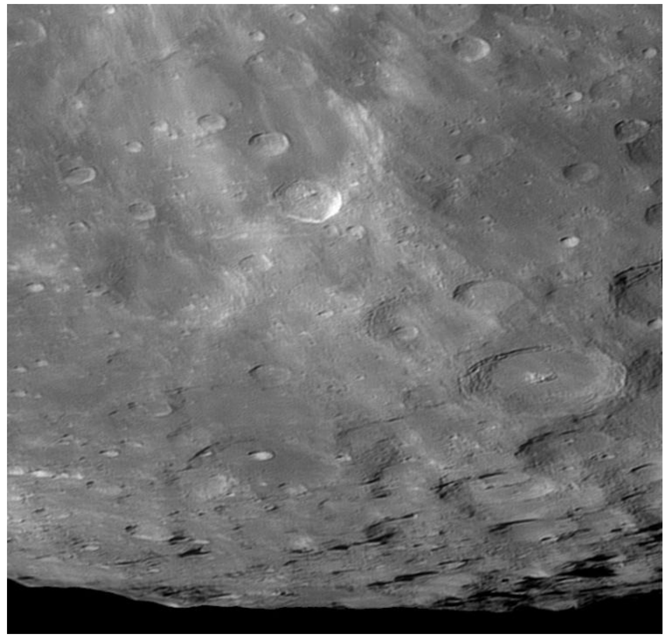


FIGURE 1. CLAVIUS-CABEUS *– Howard Eskildsen, Ocala, Florida USA. March 23, 2019 09:54 UT Seeing 6/10. 6” f/8 refractor, 2x barlow, DMK 41AU02.AS, W-8 Yellow filter.*

Just below Moretus, lies crater Short. To its left and slightly lower, four overlapping craters of Newton and its satellite craters angle downwards and slightly to the right. At the bottom of the chain, a small bright-rimmed crater resembles the open mouth of a guppy.

Sound fishy? Well, below and to the right of it, the largest shadow between it and the lunar horizon is the site of eternally-dark Cabeus where the LCROSS mission impact on October 9, 2009, showed evidence of water in the plume of its ejecta. So, maybe the little “guppy” is truly a fish out of water, but just barely.

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FLAMSTEED P & OCEANUS PROCELLARUM

Howard Eskildsen

Every time I see this area of Oceanus Procellarum and see Flamsteed P (fig. 1), I think: "Oh no, Mr. Bill!" Flamsteed is the crater that looks like the open mouth of the plaintiff, while the outer ring of its face is Flamsteed P. Strangely, in eons past when I was much younger, I saw hypotheses suggesting that features like Flamsteed P. were craters in the process of forming. Even though I didn't know much about lunar morphology then, I couldn't help thinking: They must be nuts.

To the lower right of Flamsteed, Wichmann R looks like an inverted goblet or possibly a broken spur (since I grew up in Nebraska and was familiar with cowboys). It is one of the features that always seems to leap out at me when I see the high-sun Moon. Since it resembles the broken spur, perhaps it came from a cowboy chasing the cow...

At the top of the image, Kepler spews its bright rays across the dark basalts of Oceanus Procellarum, the Ocean of Storms. I have heard tell that Riccioli, who named the crater as well many others, cast Kepler (and Copernicus for that matter) into the Ocean of Storms for the

controversy they aroused with their heliocentric theories. Of course, Ptolemy was prominently set on the solid ground of the southern highlands (not visible on this image).

FIGURE 1. ***FLAMSTEED*** *– Howard Eskildsen, Ocala, Florida USA. March 23, 2019 10:15 UT Seeing 6/10. 6" f/8 refractor, 2x barlow, DMK 41AU02.AS, W-8 Yellow filter.*

Crater Letronne, at the bottom right of the image, opens it semicircle towards Wichmann R. At the bottom center, a small, bright triangular area known as Mons Hansteen. It is believed to be composed of rhyolite, an unusual, silica-rich, volcanic intrusion very different from the mare basalts. An interesting discussion (for rock-hound nerds like me) of the area can be seen at http://lroc.sese.asu.edu/posts/972

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MONTES RIPHAEUS, MARE COGNITUM

Howard Eskildsen

Overhead sun provides contrasting albedo of the lunar surface. The central feature that resembles a turkey drumstick with a bite out of it is Montes Riphaeus. Above it on the image the largest visible crater is Lansberg. To the lower right of

FIGURE 1. ***MARE CONGNITUM****– Howard Eskildsen, Ocala, Florida USA. March 23, 2019 10:14 UT Seeing 6/10. 6" f/8 refractor, 2x barlow, DMK 41AU02.AS, W-8 Yellow filter.*

Lansbert, the dark maria area, Apollo 12 landed in "Pete's Parking Lot", near Surveyor 3. Pete Conrad and Al Bean explored the area and bought back the camera from Surveyor 3 lunar lander. Studies of the camera at first suggested that a microbe, Streptococcus mutus, had somehow survived in the camera for over 2 years in the lunar surface. Later evaluation suggested that it was a contaminant introduced when the camera was evaluated back on earth. Since S. mutus is a common part of normal human microbial flora, perhaps any claims that the microbe survived on the moon could be considered to be a little "tongue-in-cheek."

CLAVIUS & FRIENDS

Rik Hill

Another one of those breathtaking scenes (fig. 1) that sneak up on you on the terminator. Of course the huge crater just right of center is Clavius at a whopping 231km diameter. On the northeast wall (upper right) is Porter (54km) and on the southeast wall is Rutherfurd (56km) the youngest of the three craters as the ejecta splash might hint. The distinctive arc of craters on the floor of Clavius that start with Rutherfurd, arcing to the left (west) are Clavius D, C, N and J. Between C and N notice the curious formation of mountains.

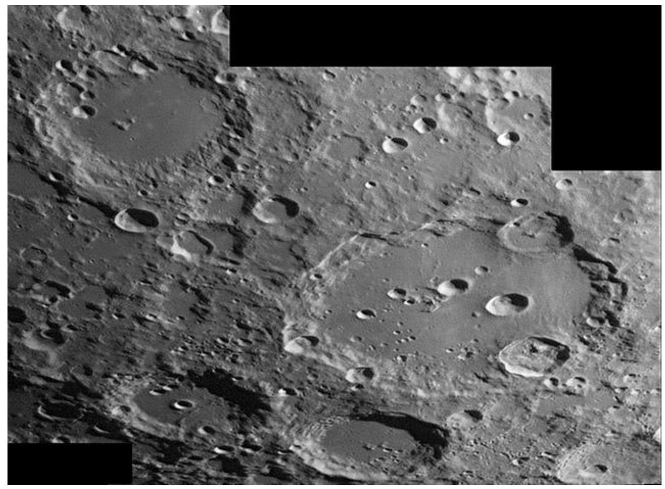

***FIGURE 1. CLAVIUS** – Richard Hill – Tucson, Arizona, USA March 17, 2019 03:38 UT. colongitude 39.8°. Seeing 8/10. TEC 8" f/20 Mak-Cass, SKYRIS 445M, 610 nm filter.*

The crater below Clavius is Blancanus (109km) and to the and west of it is slightly larger Scheiner (114km). Above and to the west of Clavius is another larger crater Longomontanus (150km). All three of these craters, like Clavius, are Nectarian (3.85-3.92 billion years old) or Pre-Nectarian (3.92 to 4.55 b.y.o.), or roughly 16 to 18 rotations of our galaxy ago! Notice the crater in the lower right corner, Gruemberger (97km). Between it and Blancanus is a wonder field of secondary cratering. Lots of great things to explore here!

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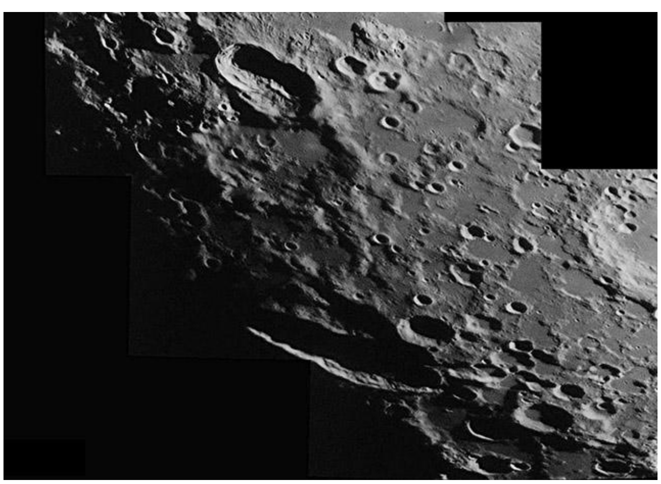
FOOTPRINTS

Rik Hill



This busy region has a couple of the more odd features on the moon. The first, most obvious is at the top of the image looking like a footprint. This is the wonderful landmark Hainzel with a listed 'diameter' of 71km which refers to the lower lobe of this two lobed feature. Notice the mountain chain on its floor. This delineates Hainzel from Hainzel C which is still in shadow to the right. The upper lobe is Hainzel A (53km) with well defined terraces on its northern wall. Two craters lie to the east (right). The northern one is Epimenides (27km) and to the south, Epimenides B (10km). It's funny but they don't look this

***FIGURE 1. HAINZEL-SCHILLER** – Richard Hill – Tucson, Arizona, USA March 17, 2019 03:38 UT. colongitude 39.8°. Seeing 8/10. TEC 8" f/20 Mak-Cass, SKYRIS 445M, 610 nm filter.*

dissimilar in size.

Adjacent to the south of Hainzel you can see the large soft appearing crater Mee (136km), much older than the Hainzel cluster. This crater looks soft because it has been pummeled by the billions of years of smaller impacts ruining its once crisp mountainous walls and then it was overlain by ejecta from more recent nearby impacts. Going further south to the terminator itself you will see a large crater just coming into view. This is Schiller (179x71km) also shaped like a giant footprint. The sunlight is just hitting the interior western wall showing the slumping there. Near the south end of this footprint, next to the heel as it were, is the shadow filled Bayer (49km) and following the long dimension of the footprint to the south you come to a slightly larger crater Rost (51km). The whole area is peppered with interesting secondary craterlets and gashes. Well worth some observing time.!

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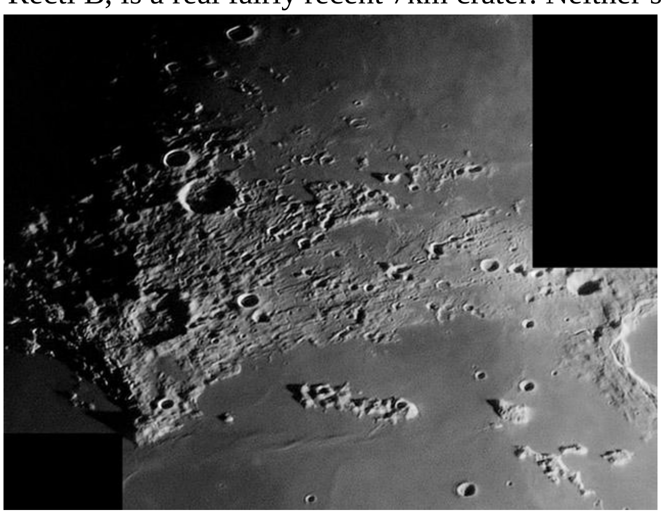
STUCK BETWEEN

Rik Hill

Areas between the more fantastic lunar formations, get ignored and the contain some very interesting features that deserve attention. This region (fig.1) is between Plato, seen peeking in the right edge of this image and Sinus Iridum in the lower left corner.

First are the beautiful mountains at the bottom of the image. The longer range in the middle are the Montes Recti or the "Strait Mountains" some 90x20km in size with peaks 1.8km high with what appear to be craters on each end. The western (left) crater seen with the on line LROC Quick Map is actually just a chance positioning of some mountain peaks but the eastern crater, Montes Recti B, is a real fairly recent 7km crater. Neither seem to be volcanic in origin. The mountains in the lower right corner are the Montes Teneriffe, taller than the previous mountains by over half a kilometer. The isolated peak to the northwest of these is unnamed.



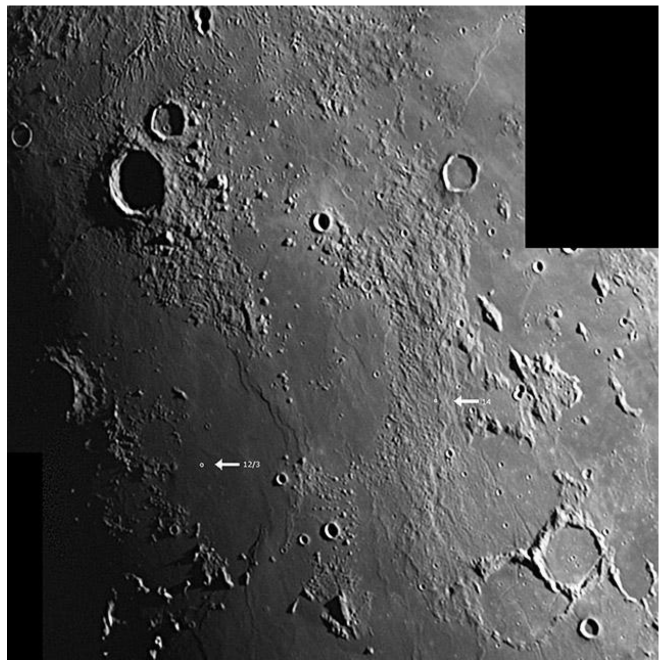
<u>FIGURE 1.</u>* *MAUPERTUIS – *Richard Hill – Tucson, Arizona, USA January 27, 2018 01:59 UT. colongitude 27.5°. Seeing 8/10. TEC 8" Mak-Cass, SKYRIS 445M, 610 nm filter.*

Over on the left we see a point of land pointing down. This is Promontorium LaPlace even higher than the M. Teneriffe by 200 meters, and one of the sentinels at the entrance to Sinus Iridum. Nestled in the vertex of this promontorium is the tortured crater Maupertuis (48km dia.) from the pre-Nectarian age nearly 4 billion years old. Above Maupertuis is another similar sized crater La Condamine (37km) around half a billion years younger. The whole region to the east (right) of these two craters is pockmarked with much oddly shaped secondary cratering and ejecta scars probably from the Imbrium impact but possibly one of the smaller impacts like Iridum. Above this is the western end of Mare Frigoris, the longest of the mare in terms of longitude.

<u>SOUTH OF COPERNICUS</u>

Rik Hill

South of Copernicus there is a lot to look for and see (fig. 1). The big crater in the upper left is Reinhold (49km dia.) and below it deep in shadow is Lansberg (41km). Just east of Lansberg is the landing site for my favorite moon mission, Apollo 12 which landed 360m from Surveyor 3 that landed two and a half years earlier. I followed the Surveyor program for it's short life and was thrilled at this close landing. This took on greater meaning when I found many year later that Ewen Whitaker, a friend who lived about a mile from me in the 1980s and also worked at Lunar & Planetary Lab. (Univ. of AZ) was the person who figured out the precise location of Surveyor 3 and thus the landing site of Apollo 12 near it (see: https://www.researchgate.net/publication/281244327_A_Pinpoint_on_the_Ocean_of_Storms_Finding_the_Target_for_Apollo_12_with_Ewen_A_Whitaker).



***<u>FIGURE 1.</u> REINHOLD-FRA MAURO** – Richard Hill – Tucson, Arizona, USA April 24, 2018 02:55 UT. colongitude 26.3°. Seeing 8/10. TEC 8" f/20 Mak-Cass, SKYRIS 445M, 610 nm filter.*

In the lower right corner is an important trio of craters. The largest, almost a ghost crater, is Fra Mauro (99km). Below right is the best defined of the three craters, Parry (49km) and next to it on the left is Bonpland (61km). Note the beautiful system of Rimae Parry that cut across the bottom of that crater and they along one side up across Fra Mauro. There's another small rima cutting over the north wall of Bonpland too. North of Fra Mauro, in the eject debris from the Imbrium and Copernicus impacts is the landing site for Apollo 14 noted by the arrow. This was originally the site intended for the ill fated Apollo 13 but was moved to Apollo 14 which was scheduled for Taurus-Littrow (which site was assigned to Apollo 17). The distance between Apollo 12 and Apollo 14 landing sites is 181km or a little under the distance from Memphis to Nashville or London to Bristol, a mere afternoon's drive, if you ignore the 350,000 km commute!

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<u>DANCES WITH WOLF</u>

Rik Hill

A little south of center inMare Nubium lies a curious feature, the 26km diameter "crater" Wolf, sitting there like a lunar interior retainer snap ring. Now I'll pause a moment while you scramble to your search engines to see what *that* is. This crater is named after the astronomer with the unpretentious name Maximilian Franz Joseph Cornelius "Max" Wolf. It's a pre-Imbrium feature maybe as old as 4.5 billion years which was probably highly modified during the Nubium flooding event about the same time. The southern wall of this heart-shaped crater, was obviously breached making it *look like* the ejecta blanket was something that flowed out of the interior but, looks can be deceiving. This is really the remnants of two, possibly three, overlapped craters. The walls only rise to 700 m above the surrounding plain. A low angle image taken with Apollo 16 shows how flat this feature is.

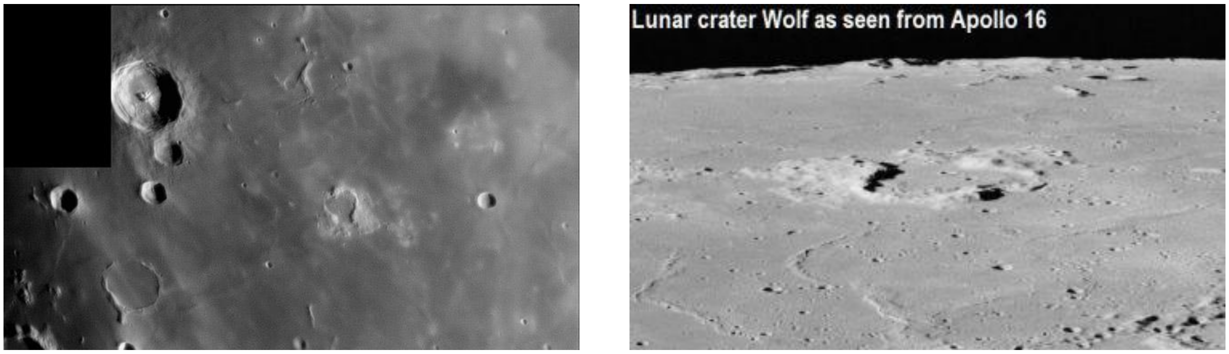

FIGURE 1. ***WOLF*** *– (left) Richard Hill – Tucson, Arizona, USA January 27, 2018 01:20 UT. colongitude 27.5°. Seeing 8/10. TEC 8"Mak-Cass, SKYRIS 445M, 610 nm filter. (right) APOLLO 16 oblique image.*

A few other features in this image are, in the upper left, the big crater Bullialdus (63km) with it's wonderful central peak reminiscent of the one in Theophilus. Just below Bullialdus is Bullialdus A (26km) and Bullialdus B (21km) a little farther out. To the left of these is Konig (24km). Directly above Wolf is an angled mountain that is the western wall of Gould (36km), Even at this sun angle you can still see the gash that cuts almost east-west through the south half of Gould. Due east or right of Wolf is Nicollet (15km) and lastly south west of Wolf is the ghost crater Kies (46km) and just west of that the beautiful Kies 1 dome also called Dome Kies. Unfortunately you cannot see the central pit in the some as it is just below the 2km resolution of this image..

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SCHICKARD AND ITS SURROUNDINGS

David Teske

Near Full Moon, my attention turns to the southwestern terminator. The most obvious crater in this area is the giant crater Schickard (fig. 1). With a diameter of around 227 km, it seems to be older and shallower than familiar Clavius, though similar in size. Schickard is only 1.5 km deep, whereas Clavius is 5 km deep. Most spectacularly, Schickard has stripes! It is dark on its north and south ends, but there is a wide central stripe of lighter material. The dark material on both ends has the spectral characteristics of lunar mare lava, while the older, lighter swath resembles highland material. By using crater counts, the age of the light material seems to be similar to that of the Orientale basin, some 3.84 billion years old. The chronology of what is seen here is that after Schickard was formed by impact, lava rose through fractures under the crater and flooded the crater with lavas. Following the Orientale basin formation 1,200 km away, a veneer of excavated highland material spread across the floor of Schickard. Millions of years later, the northern and southern portions of Schickard's floor were covered by additional mare materials covering the Mare Orientale ejecta. Later, small craters impacted into this central light swath excavating the underlying mare lava that is still visible as dark haloes around small craters. The Orientale ejecta on the convex floor of Schickard and the western wall exhibit radial, linear furrows and grabens oriented to the center of Mare Orientale.

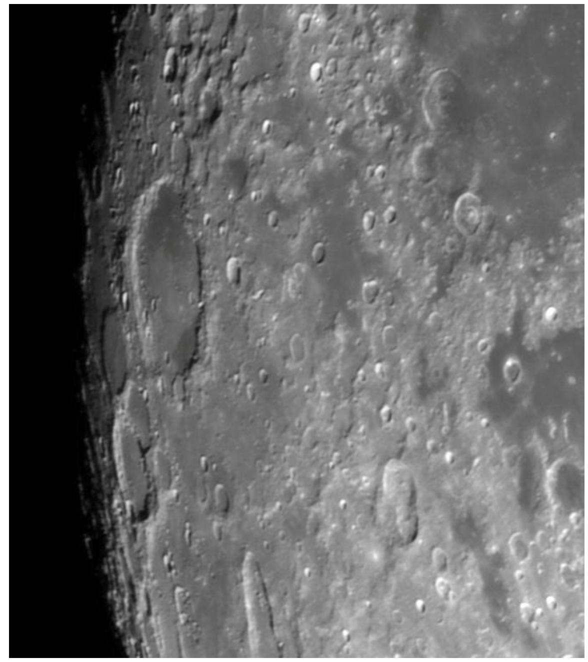

FIGURE 1. ***SCHICKARD & SURROUNDINGS** – David Teske, Louisville, Mississippi, USA, November 21, 2018 02:35 UT. Colongitude .65.5°, seeing 8/10, 102 mm APO refractor, 2.5 x Power Mate, ZWO ASI120mms*

Just west of Schickard is the most remarkable crater Wargentin. With a diameter of 84 km, Wargentin is by far the largest of an extremely rare class of highlands impact crater that has filled with lava, giving it the appearance of a mesa. The lava has a Y shaped, or bird's foot mare ridge. The presence of mare these mare ridges in this crater gave astronomers clues pointing to a common origin for the floor of Wargentin and lunar mare, namely the flow of lava from the lunar mantle. This lava rose through fissures to fill Wargentin's empty bowl to the brim. The material filing the crater's floor crests and overflows the western and northern rims, but the southern rim rises a few hundred meters above the elevated floor. Wargentin's floor lies about 400 m above the surrounding terrain.

To the south of Schickard appears to be a giant boot-print. Phocylides with a diameter of 114 km is a large, lava filled crater. Its walls rise to 2.1 km tall, but its eastern wall has been completely eroded. Nasmyth, the "heel" of the boot, is 76 km in diameter. This lava filled crater has portions of its western wall overlapped by Phocylides and Wargentin.

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OBSERVATIONS RECEIVED

JAIRO CHEVEZ - POPAYÁN,COLUMBIA. Digital images of Copernicus(2) & waxing gibbous Moon(2).

HOWARD ESKILDSEN - OCALA, FLORIDA, USA. Digital images of Clavius-Cabeus, Flamsteed, Full Moon, Oceanus Procellarum, Montes Riphaeus, Tycho-Zucchius.

RICHARD HILL – TUCSON, ARIZONA, USA. Digital images of Clavius, Hainzel-Schiller, Maupertuis, Reinhold-Fra Mauro, Sinus Iridum & Wolf.

ALEXANDER MASSEY – SYDNEY, AUSTRALIA. Drawings of 4 day Moon, Bailly, Copernicus, Drygalski(2), Mare Humorum-Gassendi, Maurollycus, Schickard & Straight Wall.

FRANK MELLILO - HOLTSVILLE, NEW YORK, USA. Digital image of Ina.

DAVID TESKE - LOUISVILLE, MISSISSIPPI, USA. Digital image of Schickard.

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<u>COPERNICUS</u> – Jairo Chavez,- Popayán Columbia. March 16, 2019 02:45 UT. 10" Dobsonian, Sony DSC-WX50.

<u>WAXING GIBBOUS MOON</u>– Jairo Chavez,- Popayán Columbia. March 16, 2019 02:43 UT. 10" Dobsonian, Sony DSC-WX50

RECENT TOPOGRAPHICAL OBSERVATIONS

WAXING CRESCENT MOON– Alexander Massey, Sydney, Australia. August 18, 2019. 8” dobsonian f/4, 57x.

STRAIGHT WALL– Alexander Massey, Sydney, Australia. May 8, 2018. 8” SCT, 200x.

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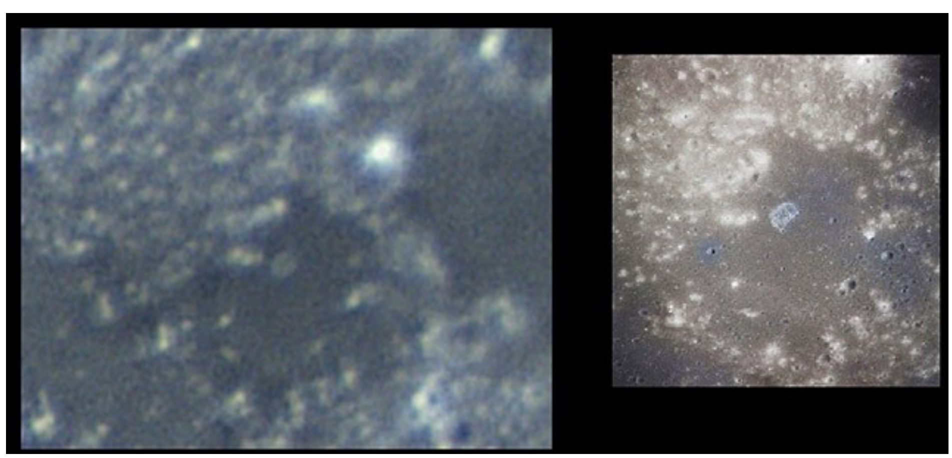
INA - (left) Frank Melillo, Holtsville, New York, USA. March 18, 2019 01:45 UT. Meade 10” SCT, Seeing 6/10. ZWO ASI120MC (right) Lunar Reconnaissance Orbiter image..

Ina itself is the "D" shaped figure pointing toward upper left



LUNAR GEOLOGICAL CHANGE DETECTION PROGRAM

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Reports have been received from the following observers for February: Jay Albert (Lake Worth, FL, USA - ALPO) observed: Aristarchus, Copernicus, earthshine, Fracastorius, Mare Crisium, Picard, Proclus, the lunar south pole area, and Tycho. Francisco Alsina Cardinali (Argentina – SLA) images Aristarchus, Copernicus, La Condamine, Mare Serenitatis, and Plato. Maurizio and Francesca Cecchini (Italy – UAI) imaged Herodotus and Vallis Schroteri. Jairo Andres Chavez (Columbia – LIADA) imaged: Eudoxus, Mare Serenitatis, Sinus Iridum, and several features. Maurice Collins (New Zealand – ALPO/BAA/RASNZ) imaged several features. Marie Cook (Mundesley, UK – BAA) observed Aristarchus, Proclus and Ptolemeaus. Walter Ricardo Elias (Argentina – AEA) imaged Alphonsus, Chacornac, Plato, Theaetetus, and Plato. Valerio Fontani (Italy – UAI) imaged Herodotus and Tycho. Trevor Smith (Codnor, UK -BAA) observed Aristarchus, Campanus, Hecataeus, Hevelius, Santbach, Mare Fecunditatis, Mare Crisium, Proclus, and Kant. Rob Stuart (Mid Wales, UK – BAA) imaged Alphonsus. Archimedes, Arzachel, Biela, Boussingault, Bullialdus, Cichus, Clavius, Copernicus, Fabricius, Franklin, Fraunhofer, Goldschmidt, Langrenus, Longomontanus, Mare Crisium, Mare Insularum, Maurolycus, Messier, Montes Riphaeus, Petavius, Plato, Ptolemaeus, Reinhold, Rima Birt, Rosenberger, Snellius, Stadius, Stevinus, Tycho, Vallis Alpes, and several features. Franco Taccogna (Italy – UAI) imaged Herodotus, Vallis Schroteri and several features. Also Tonon Aldo Tonon (Italy-UAI) imaged several features. Luigi Zanatta (Italy – UAI) imaged Vallis Schroteri and several features.

LTP reports: No LTP were observed in February.

January's Reports: Due to pressure of work, I am delaying reporting the extra observations and analysis until the May newsletter. Apologies to those observers affected by this delay.

Routine Reports: Below are a selection of reports received for February that can help us to re-assess unusual past lunar observations – if not eliminate some, then at least establish the normal appearance of the surface features in question.

Proclus: On 2019 Feb 10 UT 18:00-20:00 Trevor Smith (BAA) observed several features on the Moon, one of which was Proclus and this matched the illumination, to within ±0.5°, of the following report:

On 1989 Feb 11 at UT23:30-01:39 D. Darling (Sun Prairie, WI, USA, 12.5" reflector, x159, seeing=7/10) observed a linear east to west feature in Proclus. D. Weier (WI, USA, 11" reflector, x378) found the NNW part of the crater to be brighter than expected and confirmed the presence of the east to west feature - this crossed the shadow on the east floor and over into Mare Crisium. R. Manske (WI, USA) detected another "streak" parallel to this. All observers suspect that the linear features were due to raised topography on the floor of Proclus - however Cameron comments that there does not seem to be any linear features on the floor of Proclus to cause these effects. The Cameron 2006 catalog ID=351 and the weight=5. The ALPO/BAA weight=2.

Trevor comments that: *"Proclus is very bright as usual but not unusually so. There is a darkish linear feature roughly situated east to west. It is not central but offset to the east. This linear feature could only be seen at times due to the poor seeing of around ant IV."*. Just out of interest I managed to find a copy of David Darling's sketch from 1989 and replicate this in Fig 1 (Left) in comparison with a modern day LROC image in Fig 1 (Right). Although David's image and the LROC image differ in terms of illumination, they do show a fair agreement in terms of detail (allowing for the difference in resolution) and also the diagonal lineament running across the floor of Proclus. However, the LROC Quickmap view shows this to be slightly NW of the center, unlike in David's sketch, and not to the east as Trevor mentions. We shall keep the weight at 2 for now as we have left ourselves with a bit of a mystery – perhaps there are more than one diagonal lineaments visible – depending upon the illumination?

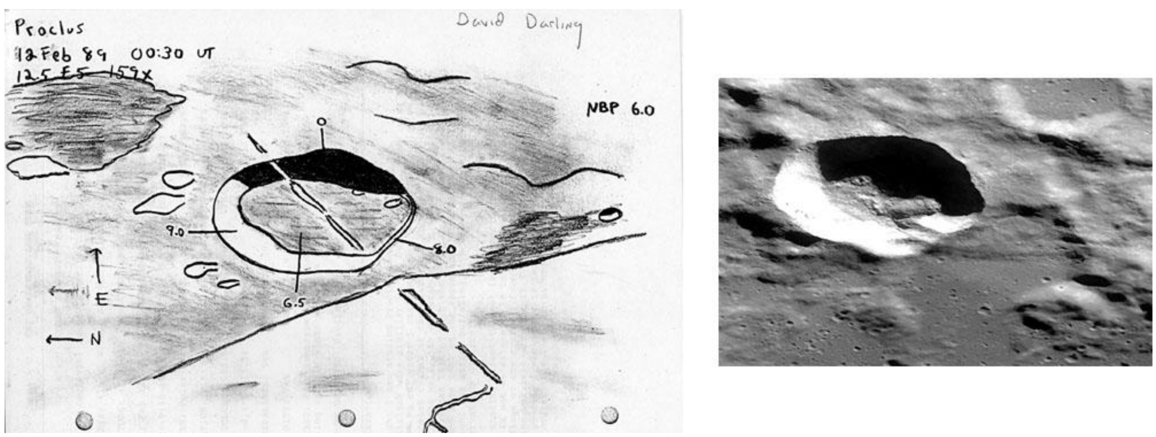

Figure 1. Proclus, orientated with north to the left. **((Left**) A sketch by David Darling (ALPO) from 1989 Feb 12 UT 00:30. **(Right)** From a NASA LROC WAC mosaic on Quickmap.

Plato: On 2019 Feb 13 UT 00:13 Walter Ricardo Elias (AEA) imaged this crater under similar illumination to the following ALPO report:

> *Plato 1949 Mar 09 UT 02:00-03:00 E.J. Reese (6" reflector x240) and one hour later T.R. Hake (5" refractor x300) both unable to see any detail on the floor of Plato, despite both being able to see a "difficult to see" cleft near to the crater Connon. Reese was able to see detail under similar illumination back in 1948 and 1947 and saw the floor craterlets in Plato clearly then. ALPO/BAA weight=1.*

Walter's image (Fig 2) shows the crater floor to be completely in shadow, so clearly there is a timing discrepancy here. I will look into this. It maybe that the 1949 report UT is correct, but that the date needs to be shifted forwards by one day?

Alphonsus: On 2019 Feb 13 UT 08:04 Maurice Collins took a whole Moon image which covered similar illumination, to within ±0.5° of the following report:

> *Alphonsus 1966 Apr 28 UT 21:58 Observed by Smith (England, 10" reflector) and Corralitos Observatory (Organ Pass, NM, USA, 24" reflector+Moon Blink) "Reddish patches, (not confirmed at Corralitos with MB tho they give feature as Gassendi in their report)." NASA catalog weight=2. NASA catalog ID #930. ALPO/BAA weight=1.*

No sign of red patches can be seen (Fig 3) in the floor of Alphonsus, so we shall leave the weight at the already low value of 1.

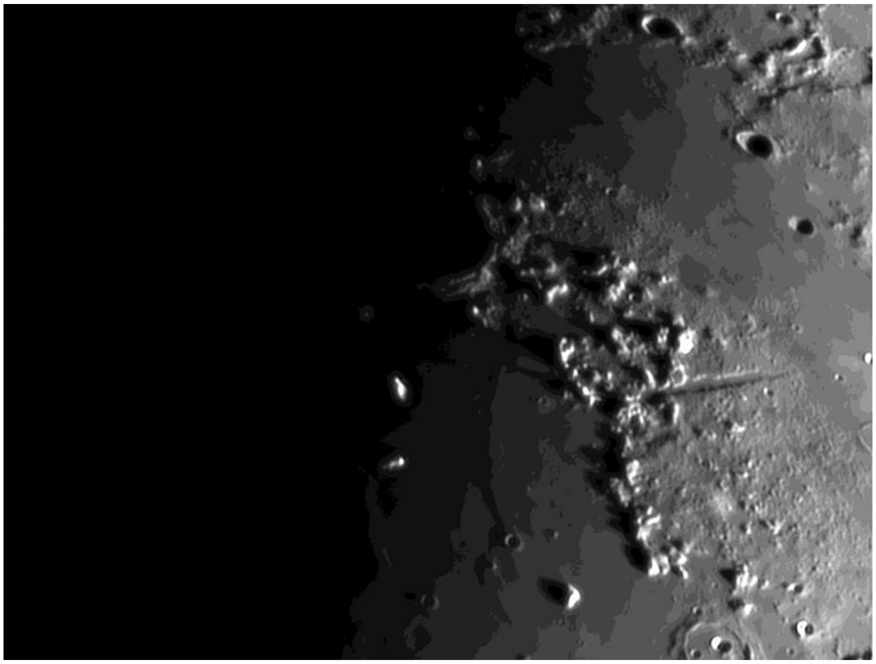

Figure 2. Plato as imaged by Walter Elias (AEA) on 2019 Feb 14 UT 00:13 and orientated with north towards the top.

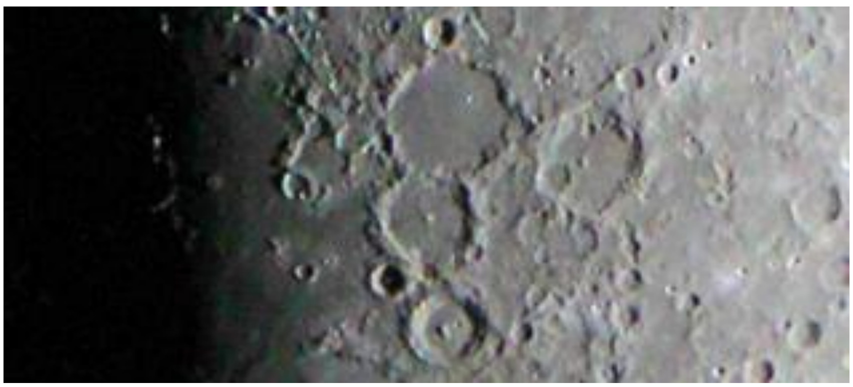

Figure 3. Alphonsus by Maurice Collins (ALPO/BAA/RASNZ) taken on 2019 Feb 13 UT 08:04 and orientated with north towards the top. Color saturation increased to 70%.

Carlini D: On 2019 Feb 14 UT 16:59 Bob Stuart (BAA) imaged the Mare Imbrium and captured this crater within ±0.5° similar illumination to a report of a flash seen on the Moon:

> *2004 Jan 02 UT 09:05 (approx) M. Collins (Palmerston North, New Zealand, ETX 90, seeing 3, clear) saw a possible(?) flash north of Carlini D at about 16W, 35N in adverted vision. It lasted only a split second. The ALPO/BAA weight=1.*

The reason why we are asking people to reimage this region is that there is a chance that the flash that Maurice saw might have been caused by a bright, but very small ray craterlet, that was only visible during a brief moment of excellent atmospheric seeing condition. However as you can quite clearly see from Bob Stewart's image (Fig 4 - Left) or the NASA LROC WAC mosaic (Fig 4 – Right) there is no obvious bright ray crater just to the north of Carline D. Alas nobody else was observing at the same time as Maurice. We are left to conclude that either Maurice saw a cosmic ray air shower flash of light in his eye, or he witnessed something on the

Moon, such as an impact flash. Given that cosmic ray air shower events are considerably more frequent than impact flashes, this seems the most likely cause. We shall leave the weight at 1.

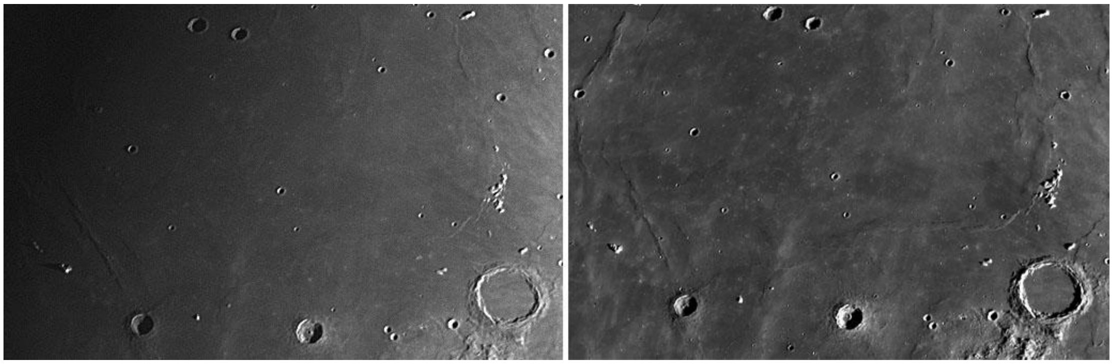

Figure 4. The northern part of Mare Imbrium, centered on the 8 km diameter crater Carlini D and orientated with north towards the top. **(Left)** An image by Rob Stuart, taken on 2019 Feb 14 UT 16:59. **(Right)** For comparison a LROC ACT Quickmap mosaic of the same area, albeit at a different illumination.

Alphonsus: On 2019 Feb 15 UT 01:50 Jario Andres Chavez (LIADA) imaged the Moon within about 20 minutes after the ±0.5° similar illumination window for the following report:

Alphonsus 1966 Apr 01 UT(?) 03:00-03:20 Observed by Jenning, Harris (Coral Estates, CA, USA, 12" reflector) "Red patch from c.p. to W. wall (no confirm. from Corralitos obs. moon blink device & obs. at that time)" NASA catalog weight=3. NASA catalog ID #924. ALPO/BAA weight=2.

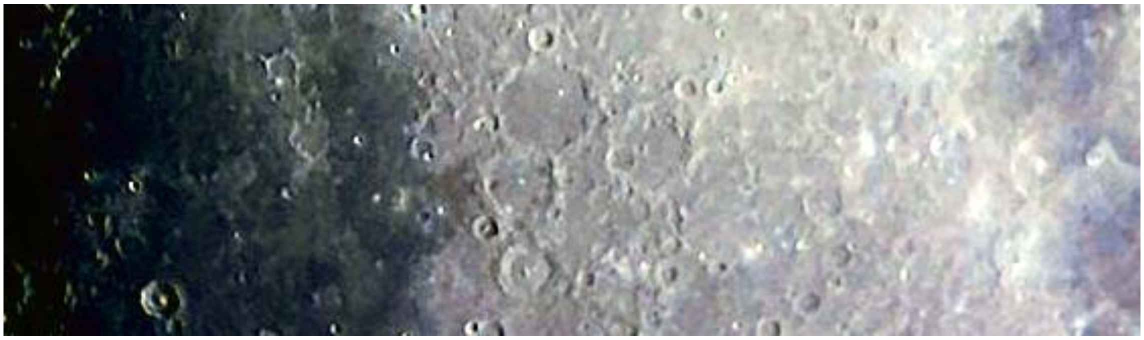

Figure 5. Alphonsus located at the center of the image from a whole Moon image obtained by Jario Andres Chavez (LIADA) on 2019 Feb 09 UT 01:50. Image orientated with north towards the top and color saturation increased to 50%.

You can see from Fig 5 that there is clearly no red patch between the central peak and the west wall. There is a dark spot, one of the usual three on the floor, and in higher resolution color images these can have slightly red or brown hues, but the necessary detail is not visible in Jario's image to discern this. We shall therefore leave the weight at 2 for now.

Herodotus: On 2019 Feb 16 UT 16:53 Valerio Fontani (UAI) imaged this crater when the illumination and topocentric libration were both similar (to within ±1.0°) to the following report:

1954 Aug 11 UT 02:18-02:39 Observed by Haas (Las Cruces, NM, USA) "Temporary greyness seen in interior shadow. However, by 05:09-05:18 the grey shadow of Herodotus, was now black". ALPO/BAA weight=3.

Figure 6. The Aristarchus area orientated with north towards the bottom. **(Left)** A color image by Valerio Fontani (UAI) taken on 2019 Feb 16 UT 16:53. **(Right)** A sketch by Walter Haas (ALPO) with annotated Pickering scale intensity values – made on 1954 Aug 11 UT 02:18-02:39.

Concerning the 1954 Herodotus observation of a transient grey shadow inside the crater, the image by Valerio is not only inside the ±1.0° similar illumination and topocentric libration window, but the colongitude was even close in precision to the 1954 colongitude. Fig 6 (Left) shows the shadow in Aristarchus appearing quite black, but the shadow inside Herodotus, by comparison looks slightly greyish, and its shape agrees very well with the Haas sketch (Fig 6 - Right). However, when I compare, using Adobe Photoshop, the intensity of the shadow in Aristarchus with that in Herodotus, I get respectively 34.4±2.3 and 30.3±1.5 (A big No. is bright and a small No. dark) i.e. the opposite. This suggests a possible visual illusion effect caused by the contrast with the bright western rim of Aristarchus. As Walter Haas was a highly experienced observer though, I have some doubt if he would have been tricked by this, and approximately three hours later said that the shadow of Herodotus was as dark as that in Aristarchus. Just for comparison Fig 7 (Bottom), taken approximately 3 hours after Fig 6 (Left), has the shadow of Herodotus again looking slightly lighter than that of Aristarchus, but intensity measurements show that Aristarchus had a slightly lighter shadow. We shall leave the weight at 3 for now.

Vallis Schroteri: On 2019 Feb 16, between UT 19:07-19:58 observers: Maurizio and Francesca Cecchini (UAI), Franco Taccogna (UAI), and Luigi Zanatta (UAI), observed this area when the selenographic colongitude matched that of the following LTP report:

> *Aristarchus Area 2004 Nov 22 UT 04:58-05:49 Observed by Gray (Winemucca, NV, USA, 152mm f/9 refractor, seeing 4-5, transparency 4-5, x114, x228) "Blinked Herodotus with Wratten filters Blue 38A and Red 25. The illuminated west crater wall stood out brilliantly in blue light, much more so than in white light. This was true also of Aristarchus. Red light did not increase contrasts in Herodotus any more than they were in white light. Shadows in Herodotus appeared as black as the night west of the terminator and remained that way throughout the observing period. No LTP seen in Herodotus tonight. A possible LTP was seen to the west of Herodotus near the terminus of Schroter's Valley. It was noted at the beginning of the observing period that there were four very bright spots of light, one near the end of Schroter's Valley, the other three grouped together a little farther north. Although not far from the terminator they were definitely east of it. It was noted that all of*

them nearly vanished in the Blue 38A filter while Aristarchus and the rim of Herodotus gleamed brilliantly. At 5:19UT it was noted that the most brilliant of the four lights, the one near the terminus of Schroter's Valley, had faded almost to invisibility in white light. When first seen it had been brighter than Aristarchus. It remained very dim after this through the remainder of the observing period, and was unchanged at 7:35-7:49UT when I again examined the area. The other three bright spots remained brilliant and unchanged."

Franco's image (Fig 7 - Top Left) shows that Aristarchus' west illuminated rim had a slight bluish cast, as one would expect, and so agrees with the Robin Gray's report though no color can be seen in Herodotus. Concerning the four bright spots, the one west of Herodotus cannot be seen, or at least is not obvious. There is nothing here that is as bright as Aristarchus? Indeed, even if we check earlier in Fig 6 (Left), there is no bright spot here! The three bright spots to the north of Herodotus are clearly visible, but as you see in Fig 7 (Top Left, Top Right & Bottom), there is no apparent sign of variation in brightness. Clearly, we should leave Robin Gray's report at a weight of 3.

Figure 7. Aristarchus on 2019 Feb 16 and orientated with north towards the top. **(Top Left)** 19:13-19:14 UT two color image by Franco Taccogna with color saturation increased to 70%. Red filter in red channel, blue filter in blue channel, and an average of red and blue in the green channel. **(Top Right)** 19:42UT UT image by Luigi Zanatta (UAI). **(Bottom)** UT 1946 monochrome image by Maurizio and Francesca Cecchini (UAI), taken in red light.

Figure 8. A monochrome image of Plato by Francisco Alsina Cardinali (AEA) taken on 2019 Feb 17 UT 02:42 and orientated with north towards the top,

Plato: On 2019 Feb 17 UT 02:42 Francisco Alsina Cardinali (AEA) imaged the crater under similar illumination (to within ±1.0°) to the following report:

Plato 1906 Mar 07 UT 22:00? Observed by Fauth (Germany? 6" refractor)"Color (brightness?) greatly enhanced as on the previous nite" NASA catalog weight=3. NASA catalog ID #324. ALPO/BAA weight=2.

Francisco's image (Fig 8) shows nothing unusual with Plato, so it's a bit of a mystery what Fauth saw back in 1906. We shall keep the weight at 2 for now.

Aristarchus: On 2019 Feb 22 UT 00:20-00:45 Marie Cook (BAA) observed the crater under similar illumination (to within ±0.5°) to the following report:

On 1990 Jan 13 at UT 22:15-23:05 J. Pedler (Bristol, UK, seeing=III and transparency=excellent, no spurious color) detected a blue region on the north of Aristarchus, varying in sharpness/diffuseness. The crater rim in this region could not be discerned. Elsewhere the crater rim was normal as too were other features. When a Moon blink device was used, no color blink was detected, however through the blue filter the suspected area was bright and the crater rim indistinct. Whereas through the red filter the area looked perfectly normal. At 22:30UT the effect had vanished and everywhere was normal. The Cameron 2006 catalog ID=388 and the weight=5. The ALPO/BAA weight=3.

Marie comments that without any filters, no blue region could be seen on the north of the crater, and when using red/blue color filters, no blink could be seen. However, the crater was sharper in blue light than in red, but this applied to the whole carter. No variance was detected. Everything looked normal. We shall therefore leave the weight at 3.

Mare Crisium: On 2019 Feb 22 UT 03:55-04:10 Jay Albert (ALPO) observed this area under similar illumination (to within ±0.5°) to the following report:

1774 Jul 25 Eysenhard (France & a pupil of Lambert) observed: "4 bright spots intersected term. On dayside only. 2 identified. Reciprocating motion of term. In 5 or 6 min. between pairs-touching in turn. The term. In M. Fecund. Was still. Similar phen. Seen on Jup. Satellite once. (Date 1774 in MBMW wrong?". Source: Middlehurst 1968 catalog LTP ID=16. Ref Web 1962 p62-76. & Cameron NASA catalog : weight=2. The ALPO/BAA weight=1.

Jay, using a Celestron NexStar Evolution 8" SCT at x226 (Transparency magnitude 2 and 3-4/10 seeing) noted visually that *"roughly the eastern third of Crisium was in shadow. A few bright peaks and ridges were lit just beyond the terminator, but no bright spots on the sunlit mare floor".* Although outside the repeat illumination window, he also took an iPhone image (Fig 9). Despite Cameron suspecting that the year that Middlehurst gives, 1774 was wrong, at least we can see that the terminator is on Mare Crisium, and as Jay states, no bright spots were visible. The Eysenhard description of motion of the terminator sounds like an atmospheric seeing effect, though it's a puzzle why this was not visible in Mare Fecunditatis. We shall keep the ALPO/BAA weight at a low value of 1 for now.

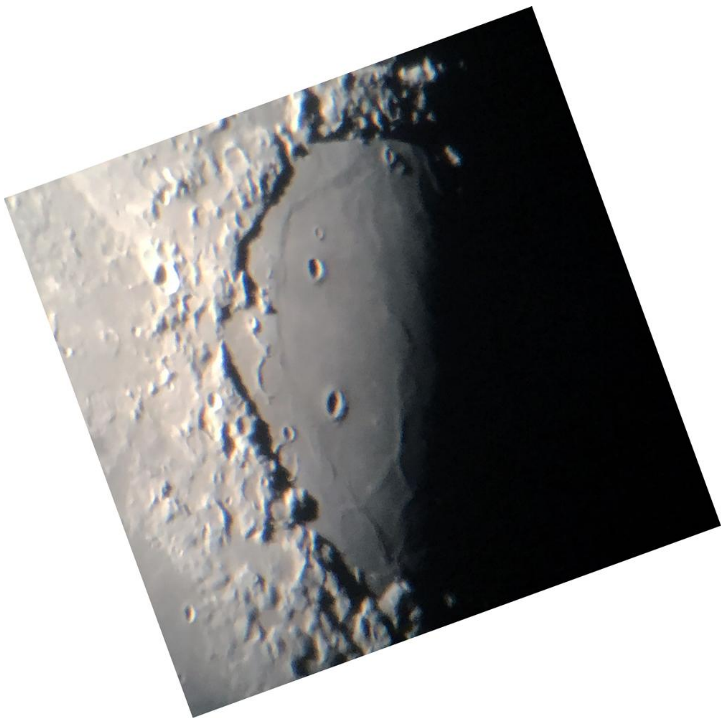

Figure 9. A color iPhone image of Mare Crisium obtained by Jay Albert (ALPO) on 2019 Feb 22 UT 04:35, orientated with north towards the top.

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

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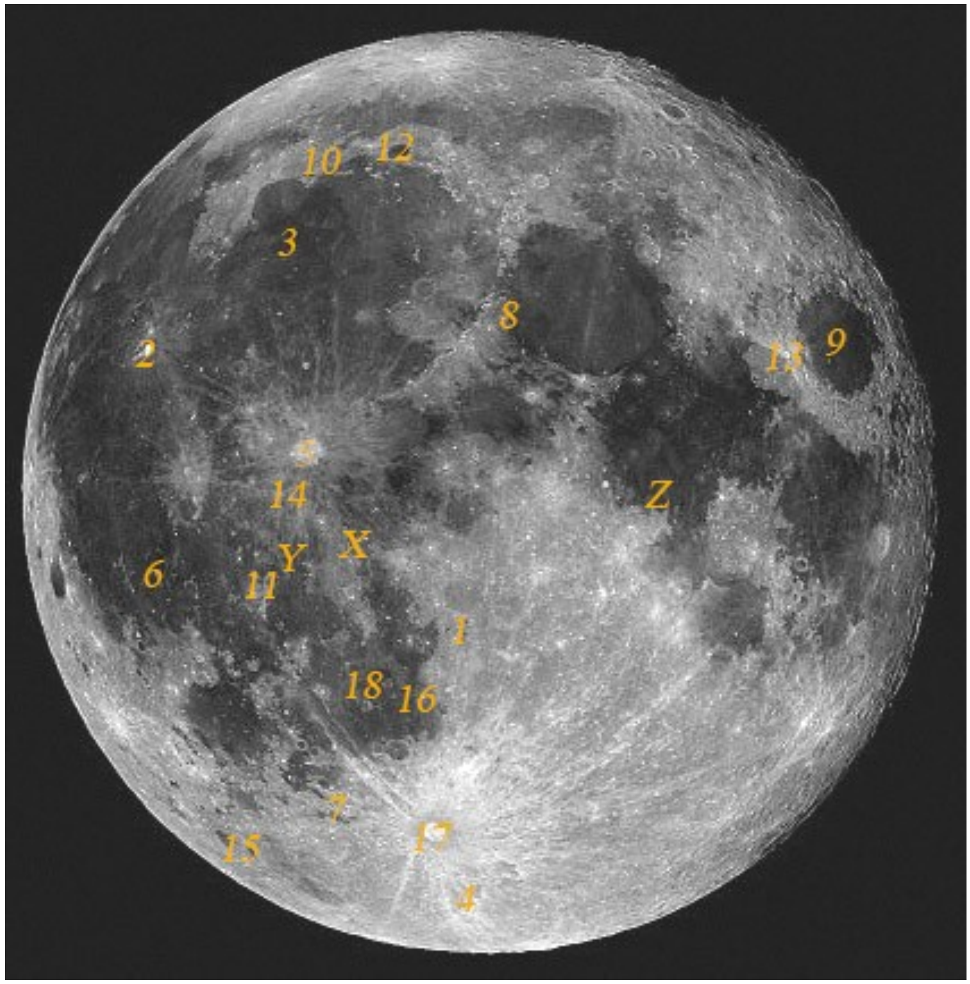
KEY TO IMAGES IN THIS ISSUE

1. Alphonsus
2. Aristarchus
3. Carlini
4. Clavius
5. Copernicus
6. Flamsteed
7. Hainzel
8. Ina
9. Mare Crisium
10. Maupertuis
11. Montes Riphaeus
12. Plato
13. Proclus
14. Reinhold
15. Schickard
16. Straight Wall
17. Tycho
18. Wolf



FOCUS ON targets

X = Apollo 14 Fra Mauro
Y = Apollo 12 Ocean of Storms
Z = Apollo 11 Sea of Tranquility