



# THE LUNAR OBSERVER

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

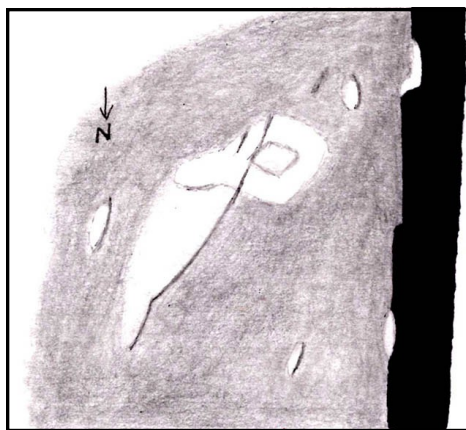
**EDITED BY: Wayne Bailey [wayne.bailey@alpo-astronomy.org](mailto:wayne.bailey@alpo-astronomy.org)**

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**RECENT BACK ISSUES: [http://moon.scopesandscapes.com/tlo\\_back.html](http://moon.scopesandscapes.com/tlo_back.html)**

## **FEATURE OF THE MONTH – JULY 2018**

### **REINER $\gamma$**



**Sketch and text by Robert H. Hays, Jr. - Worth, Illinois, USA**

**June 30, 2004 03:32-03:50 UT, 15 cm refl, 170x,**

**seeing 8/10, transparency 6/6.**

I observed this feature on the evening of June 29/30, 2004 after watching the moon hide 6th-magnitude *zc* 2328. This feature was near the terminator this evening, so I decided to check it again (after having observed it before). It looked much as usual with a large, diamond-shaped area and a smaller eastern lobe. The larger portion has a dusky, oval interior patch; the edge of this patch is darker than the center. The eastern lobe has a grayish northern edge. There was a narrow, sharp strip of shadow that evening, appearing like a crack through Reiner gamma. From the south point of the diamond area, it went almost due north to the east edge of the dusky oval, then it angled northeasterly until it turned northerly again near its end. A relatively bright area extends northward from the eastern lobe, and adjoins this shadow. It is brighter than the surrounding mare, but not as bright as Reiner gamma. I have to wonder if this brighter area is a relief feature as well as an albedo feature. (Reiner gamma itself appears to be purely an albedo feature.) A small bit of shadow is just east of the long shadow's southern end in a slightly brighter area within Reiner gamma. I had not seen this sharp, narrow shadowing previously; the terminator's proximity must have made the difference. There are a few low hills in the area, some of them causing irregularities in the terminator.

# LUNAR CALENDAR

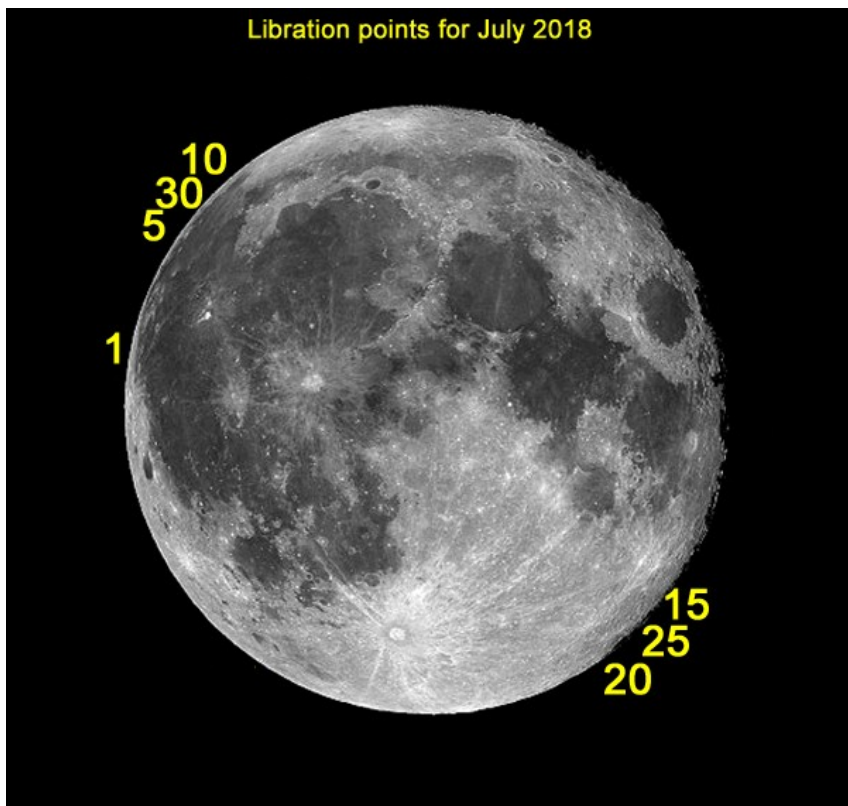
2018	U.T.	EVENT
Jul 06	07:51	Last Quarter
12	12:01	Moon Extreme North Dec.: 20.8° N
13	02:48	New Moon
13	03:01	Partial Solar Eclipse
13	08:28	Moon Perigee: 357400 km
14	02:50	Moon Ascending Node
14	22:04	Moon-Mercury: 2.2° S
16	03:31	Moon-Venus: 1.6° S
19	19:52	First Quarter
20	23:57	Moon-Jupiter: 4.8° S
25	06:10	Moon-Saturn: 2.2° S
25	20:55	Moon Extreme South Dec.: 20.8° S
27	05:44	Moon Apogee: 406200 km
27	20:21	Full Moon
27	20:22	Total Lunar Eclipse
27	22:40	Moon Descending Node

2018	U.T.	EVENT
Aug 04	18:18	Last Quarter
08	22:33	Moon Extreme North Dec.: 20.8° N
10	13:40	Moon Ascending Node
10	18:05	Moon Perigee: 358100 km
11	09:47	Partial Solar Eclipse
11	09:58	New Moon
14	13:35	Moon-Venus: 6.4° S
17	10:38	Moon-Jupiter: 4.8° S
18	07:49	First Quarter
21	09:55	Moon-Saturn: 2.4° S
22	02:58	Moon Extreme South Dec.: 20.8° S
23	011:23	Moon Apogee: 405700 km
24	04:51	Moon Descending Node
26	11:56	Full Moon

# LUNAR LIBRATION

## JULY-AUGUST 2018

Libration points for July 2018



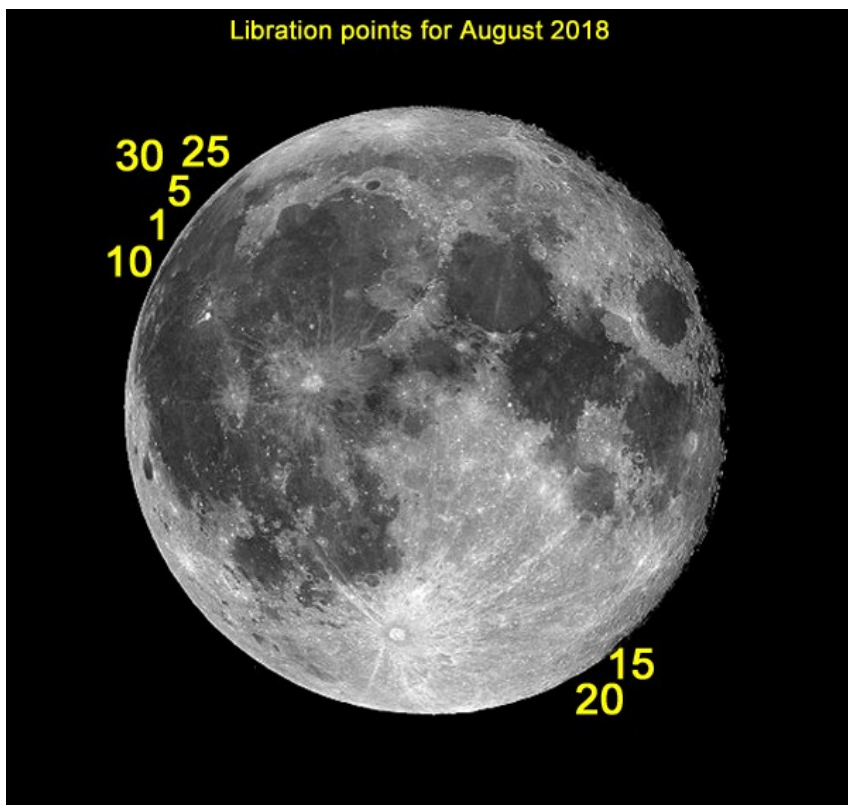
Size of Libration

07/01	Lat +00°23'	Long -04°41'
07/05	Lat +05°18'	Long -07°01'
07/10	Lat +06°01'	Long -06°02'
07/15	Lat -01°33'	Long +02°56'
07/20	Lat -06°47'	Long +07°14'
07/25	Lat -03°55'	Long +03°12'
07/30	Lat +02°49'	Long -03°39'

**NOTE:**

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

Libration points for August 2018



Size of Libration

08/01	Lat +05°08'	Long -05°52'
08/05	Lat +06°45'	Long -07°23'
08/10	Lat +01°01'	Long -01°27'
08/15	Lat -06°12'	Long +06°31'
08/20	Lat -05°12'	Long +05°31'
08/25	Lat +01°09'	Long -01°09'
08/30	Lat +06°23'	Long -05°57'

**NOTE:**

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

## **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 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](mailto:lunar@alpo-astronomy.org) (lunar images).

It is helpful if the filenames follow the naming convention which, for the lunar gallery is:

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 “-”)

As an example the following file name would be a valid filename:

Copernicus\_2018-04-25-0916.jpg

(Feature Copernicus, Year 2018, Month 04, Day 25, UT Time 0916)

Additional information requested for lunar images (next page) should 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 correction prior to uploading the image(s). However, if they come in the recommended format, it would reduce the effort to post the images a lot.

Observers who submit 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

Full resolution images are 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](mailto:wayne.bailey@alpo-astronomy.org)

and Jerry Hubbell – [jerry.hubbell@alpo-astronomy.org](mailto: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 17 Region—Sea of Serenity

*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 **September 2018** edition will be the **Apollo 17 Region—Sea of Serenity** 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](mailto:jerry.hubbell@alpo-astronomy.org)

**Wayne Bailey** - [wayne.bailey@alpo-astronomy.org](mailto:wayne.bailey@alpo-astronomy.org)

**Deadline for inclusion in the Apollo 17 Region—Sea of Serenity article is August 20, 2018**

## FUTURE FOCUS ON ARTICLES:

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

<u>Subject</u>	<u>TLO Issue</u>	<u>Deadline</u>
Apollo 16 Region – Descartes and Cayley Plains	November 2018	October 20, 2018
Apollo 15 Region – Mare Imbrium and Hadley Rille	January 2019	December 20, 2018
Apollo 14 Region – Fra Mauro	March 2019	February 20, 2019
Apollo 12 Region – Ocean of Storms	May 2019	April 20, 2019
Apollo 11 Region – 50th Anniversary – Sea of Tranquility	July 2019	June 20, 2019



# Focus On: Magnetic Anomalies – Reiner Gamma

**Jerry Hubbell**

Assistant Coordinator, Lunar Topographical Studies

One of the strangest visible artifacts on the lunar surface must be the various magnetic anomalies or “lunar swirls” as they are sometimes called. These albedo features are not the typical physical topographical structures observed on the moon. These features do not cast shadows.

Reiner Gamma (Figure 1) is the most famous of all the lunar swirls and is a favorite object for those that observe the moon regularly. Visible 5 days after first quarter and located on the western edge of Mare Insularum at selenographic coordinates Longitude: 59.0° West, Latitude: 7.4° North, this object is easily visible in telescopes as small as 50 mm. Reiner Gamma stretches 24 x 18 miles (40 x 30 km).



*Figure 1. Reiner Gamma, Rik Hill, Tucson, Arizona, 16 February 2011 0449 UT, 0.36-m Schmidt-Cassegrain (Celestron C14) + 2x Barlow f/22, Imaging Source DMK21AU04 CCD video camera, UV/IR blocking filter, seeing 7/10, north/up, east/right.*

David Teske provided this recent observation and thoughts on Reiner Gamma:

“...Sources give slightly different dimensions for Reiner Gamma. The entire feature is very large, with a northern tail extending about 180 km to the edge of the Marius Hills through the central oval about 40 km wide to twisted splotchy

spots of brightness extending 235 km to the south. The core is a rather dark elliptical feature ringed by an irregular halo of bright deposits.”



*Figure 2. Reiner Gamma – Mare Insularum, David Teske, Louisville, Mississippi, USA, 06 June 2018 1016 UT, Colongitude 179.6 degrees, Seeing 4/10, 4-inch APO refractor, 2.5x Powermate*

During Apollo missions 15 and 16, lunar satellites were released from the service module to orbit the moon and measure local gravity and magnetic fluctuations in the lunar crust. It was at that time that the connection between the lunar swirl Reiner Gamma and high magnetic flux was discovered.



There are 3 theories as to the formation of these albedo features the leading being that there are magnetic anomalies in the lunar crust that “shield” the lunar surface from the solar wind – ions that are emitted by the sun. Typically, the solar wind “weathers” the lunar surface over eons to darken the surface and reduce the albedo. Fresh impacted surface material is characterized by a high albedo, Aristarchus is a prime example of this fresh material being exposed. Bright impact crater ray systems also demonstrate the exposure of this material on the surface.

The theory is that early in the life of Mare Insularum, a highly magnetic object located where Reiner Gamma is now and was subsequently covered up by lava flow forming the maria. This material was then shielded from the solar wind by the local magnetic field inhibiting the weathering of the surface, thus maintaining its high albedo character. The imprint of the magnetic lines of flux can be seen in the curvilinear features of the swirl.

A more technical explanation and further discussion of the 3 theories of lunar swirl formation is provided by “The Lunar Swirls A White Paper to the NASA Decadal Survey” (ref.)

“The solar wind deflection model proposes that the swirls represent exposed silicate materials whose albedos have been selectively preserved over time via deflection of solar wind ion bombardment by preexisting strong crustal magnetic fields. According to this model, optical maturation of exposed silicate surfaces in the inner solar system is at least partly a function of the solar wind ion bombardment. This model suggests that swirl formation is a continuing process, which dates from the era of basin formation.

The cometary impact model argues that the high albedo of the swirls depicts scouring of the topmost surface regolith and exposure of fresh material by relatively recent cometary impacts. According to this model, the associated strong magnetic anomalies are the result of magnetization of near-surface materials heated above the Curie temperature through hypervelocity gas collisions and micro-impacts. Proponents of the cometary impact model consider the occurrence of many swirls antipodal to relatively young, major basins to be coincidental or the result of incomplete mapping of swirl locations.

The meteoroid swarm model is a variation of the cometary impact model. Here the cometary nuclei are fragmented by tidal forces attributed to the Earth and/or Sun before they encounter the lunar surface. During and immediately after impact, inter-particle collisions in the cloud of debris and regolith particles of the ejecta collide with each other, forming the curvilinear swirl features. The final dust fragments of a swarm may form a halo with albedo and color differences from the substrate around the main part of the swirl. The meteoroid swarm hypothesis does not account for magnetic anomalies associated with lunar swirls nor the occurrence of several swirls antipodal to major basins.”

There is further conjecture that these magnetic anomalies may form antipodal to large impact basins on the lunar surface. Recent evidence for this was obtained from the Lunar Reconnaissance Orbiter (LRO). As discussed further in the NASA white paper:

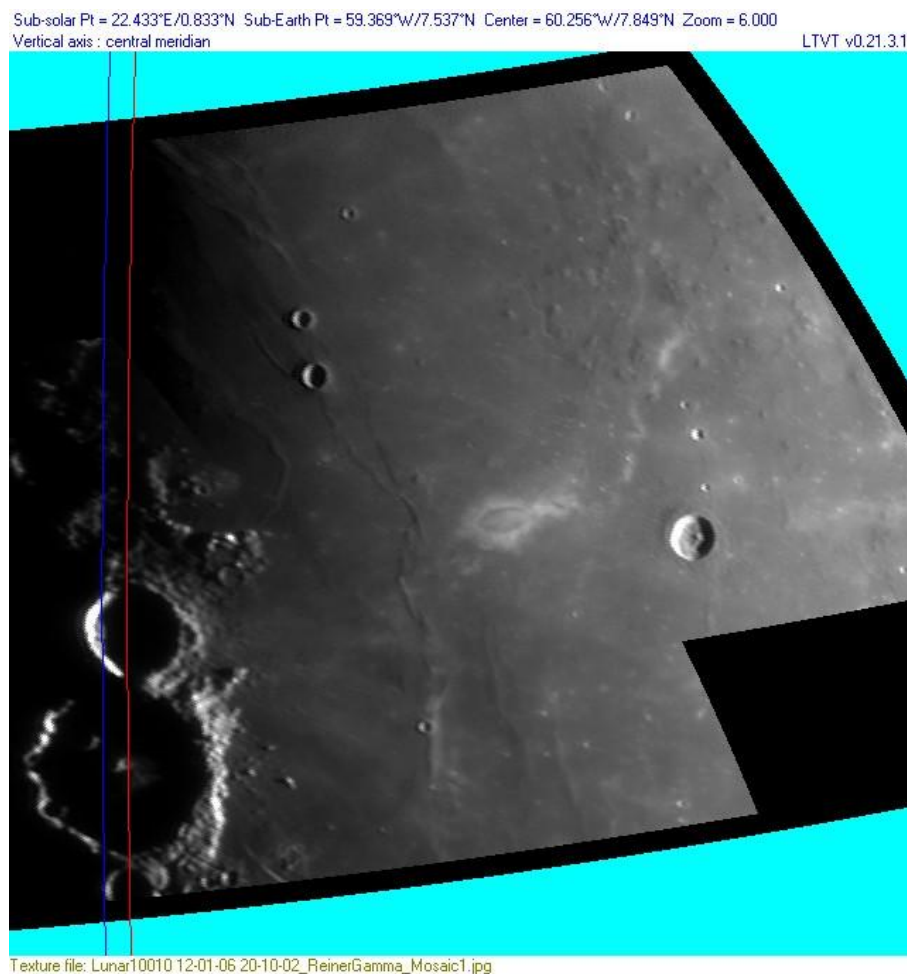
“...The Moon has no currently active dynamo with which to generate a magnetic field, and it is debated whether one ever existed [8, 9, 10, 11]. Nevertheless, orbital mapping by the Apollo 15 and 16 subsatellites and Lunar Prospector show regions of remanent magnetism antipodal to several large impact basins formed between 3.8-3.9 Ga [12]. Magnetization of these antipodal regions could occur in the presence of an amplified magnetic field.”

Further work is needed to really come to a firm conclusion on the formation of these lunar swirls. One interesting thought is to consider that Reiner Gamma is a natural “force field” shielding the surface from the solar wind and other highly charged particles. This may provide

some amount of protection to future missions to the moon and to any lunar base that may be constructed within the zone of the magnetic field. Precise mapping of the local conditions would need to be accomplished to determine if this is even a reasonable hypothesis.

A different view of the Reiner Gamma anomaly is shown in Figure 3. This is a projection of the region around Reiner Gamma showing an overhead aerial view of the feature as processed using the Lunar Terminator Visualization Tool (LTVT). This view gives a true picture of the proportions and symmetry of the feature as the magnetic lines-of-force form the pattern on the surface.

One of the interesting things about this feature is the orientation of the long axis of the swirl pattern. It seems to be aligned nearly east/west. Could it be possible that the object that is creating this magnetic field below the surface is a single object that broke up into a series of objects and impacted billions of years ago? If this was a series of objects, then the orbit of the impactor may be proven to be in the orbital plane of the Solar System.



*Figure 3. Aerial View of Reiner Gamma, Jerry Hubbell, Locust Grove, VA, USA, 06 January 2012 1016 UT, 0.13-m APO Refractor (Explore Scientific 5-inch ED APO), Imaging Source DMK21AU04 CCD, 4x Powermate. Seeing 8/10, Transparency 5/6, north/up, east/right.*

## **REFERENCES:**

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# **PROCLUS AND ITS RAYS**

Bill Dembowski - ALPO Assistant Coordinator  
Lunar Topographical Studies

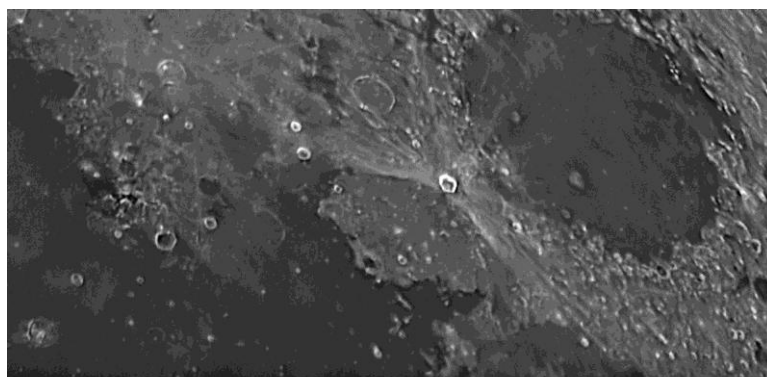
Proclus is an 18 mile (28 km) crater which lies just beyond the western boundary of Mare Crisium at 16.1° N & 46.8° E. It has a distinctly polygonal shape and is considered to be one of the very brightest craters on the Moon, second only to Aristarchus. When close to the terminator, Proclus stands out well from the surrounding features, because it has a particularly sharp and well-defined rim (See Figure 1). When away from the terminator it is quite unmistakable due to its notable ray system.



**Figure 1**  
**Proclus near the terminator**

William M. Dembowski, FRAS - Elton Moonshine Observatory  
20 June 2007 - 01:45 UT - Colong: 339.2 - Seeing: 4/10  
8 inch f/10 SCT - 2x Barlow - Orion StarShoot II Camera

Its remarkable ray system contains a 120° area of exclusion to the west (See Figure 2); very similar to that of the crater Tycho (See Figure 3).

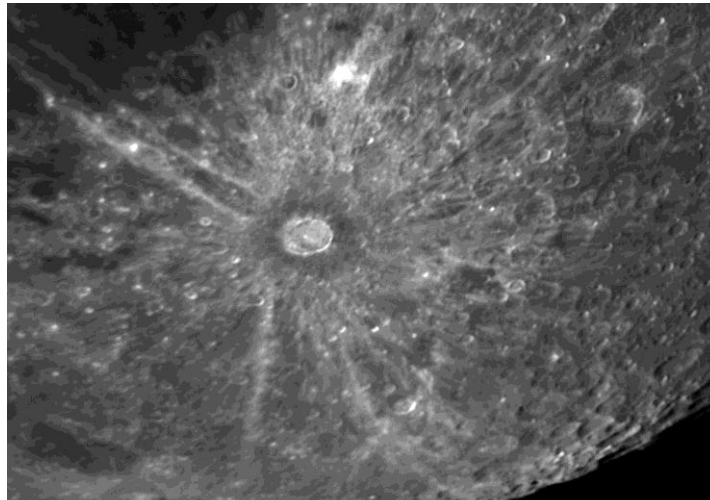


**Figure 2**  
**Proclus Rays**

William M. Dembowski, FRAS - Elton Moonshine Observatory  
12 August 2011 - 01:49 - Colong: 65.1 - Seeing: 4/10  
Celestron 9.25 f/10 SCT - ImagingSource DMK41 - UV/IR Filter

Although some theorize that this odd ray pattern is solely the result of a shallow angled impact (less than 20 degrees), there are those who argue for a surface feature obstructing the flight of the ray producing ejecta. On the NASA website they state: "The cause of this striking layout and symmetry is uncertain but, in the light of the observations from Apollo 15, the leading theory suggests the exclusion zone is due to the effects of the surrounding landforms and faults on the ejection of material from the impact."

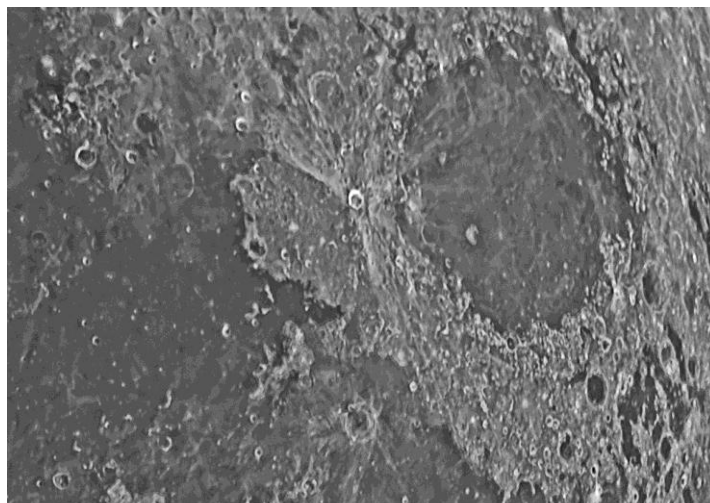
The Proclus system displays three main spikes or rays, two of which, to the Northwest and the West, mark the borders of the Palus Somnii (Marsh Of Sleep). (See Figure 4) The southernmost of these rays extends Southeast for approximately 200 miles (320 km) in the direction of the crater Carmichael. The other travels North-northwest for 150 miles (240 km) towards the crater Asada. To the East the rays cross over into the Mare Crisium itself, intermingling with hills, craters and fine wrinkle-ridges. Here, under good seeing and ideal lighting conditions, the rays can be seen as more extensive and structured than they appear to be at first sight.



**Figure 3**

Ray System of Tycho

William M. Dembowski, FRAS - Elton Moonshine Observatory  
9 July 2009 - 03:45 UT - Colong: 111.1 - Seeing 4/10  
Celestron 8 inch f/10 SCT - ImagingSource DMK41 - UV/IR Cutoff & W58



**Figure 4**

Proclus & Mare Crisium

William M. Dembowski, FRAS - Elton Moonshine Observatory  
19 August 2010 - 01:33 UT - Colong: 20.9 - Seeing: 3/10  
Celestron 9.25 f/10 SCT - ImagingSource DMK41

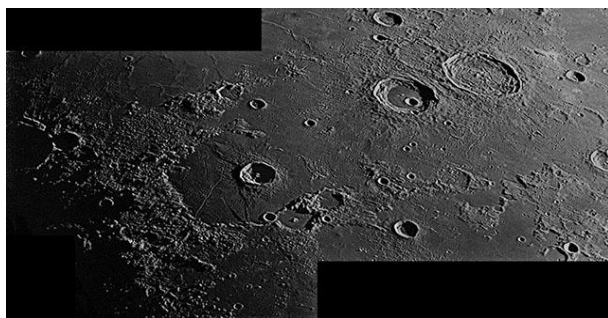




# CRACKS IN THE LAKE

**Rik Hill**

A view that is as breathtaking as the Montes Alpes, or Archimedes to the Montes Apenninus is frequently missed in the early waxing crescent phases of a lunation because the moon is in the evening sky for a short time. Here (fig. 1) you see large crater Atlas (90km) on the right side of the image with the nice system of Rimae Atlas on the floor. To the left is Hercules (71km) identifiable with the crater Hercules G (13km) on its floor. Up above them both to the north, on the edge of this image is Keldysh (34km). On the opposite side of Hercules, near the bottom of the image is the crater Grove (29km) a little smaller than Keldysh.



**FIGURE 1.** *Atlas-Lacus Mortis* - Richard Hill – Tucson, Arizona, USA May 21, 2018 02:07 UT. Seeing 8/10. Colongitude 342.5°. TEC 8" f/20 Mak-Cass, 610 nm filter, SKYRIS 445M.

Much further to the left from Hercules, is the distinctive crater Burg (41km) with its herringbone ejecta blanket. It sits in the middle of a hexagonal feature that is Lacus Mortis surrounded by the many Rimae Burg of different types and origins. Below Burg are two craters I find fascinating. The one on the left is Plana (46km), with a tiny central peak and to the right of it is Mason (44km) almost exactly the same size with no central peak. Then on the left edge of this image is Aristoteles (90km) with little Mitchell (31km) on its right (east) wall. So when the moon is 5 days old, make the effort to see this region, it's well worth it.

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# THIS IS NO BULL-IALDUS

**Rik Hill**

When on the terminator Bullialdus (63km dia.) makes a wonderful sight (fig. 1) with nicely terraced walls and is easily identified by the configuration of three craters to the south: A, B and Konig (24km) the farthest from Bullialdus. There's a nice radial splash pattern from ejecta surrounding this crater too. Note the line of secondary craters to the right of Bullialdus roughly radial to the crater. On its western or left end it has a bend in the line and is crossed nearly orthogonally by another line of secondary craters forming a rough "X". To

**FIGURE 1.** *Kies-Bullialdus* - Richard Hill – Tucson, Arizona, USA April 24, 2018 01:55 UT. Seeing 8/10. Colongitude 26.3°. TEC 8" f/20 Mak-Cass, 610 nm filter, SKYRIS 445M.

see this you may need to go to a full resolution copy of this image at:

[www.lpl.arizona.edu/~rhill/images\\_moon/Kies\\_610nm\\_2018-06-23-0303\\_finB.jpg](http://www.lpl.arizona.edu/~rhill/images_moon/Kies_610nm_2018-06-23-0303_finB.jpg).

Further right is the ruined crater Wolf with its unusual apron on the south side. Below Bullialdus and its three companions is a ghost crater Kies (46km) with its mountainous southern appendage. Just to the west of





this crater you can see one of the more impressive domes on the Moon, Dome Kies Pi. In the center of this dome, again in the full resolution image, is a central pit or vent. A little further left on the other side of the wrinkle ridge (dorsum) that goes south out of Konig, is what appears to be another dome though I cannot find a designation for this one if it is in fact a dome.

At the bottom of the image is a nice rima (graben) that cuts completely across the mountains on its west end. This is Rima Hesiodus with its namesake, Hesiodus (44km) being the crater at it's upper tip with a central craterlet. Look below this crater to see Hesiodus A (15km) one of the best examples of a "concentric crater" or a double walled crater. The big crater further east is Pitatus which has an impressive system of rimae running along the inner side of its wall.

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## ON THE BANKS OF THE RIMA

### Rik Hill

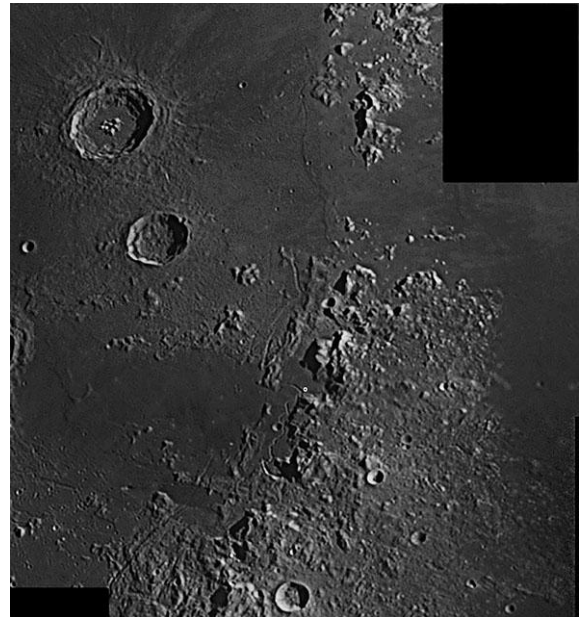
So where were you on July 30, 1971? This was 2 years and 6 days after Apollo 11 did the first lunar landing and the date of the landing of Apollo 15 on the eastern bank of Hadley Rille or as we now know it, Rima Hadley. It was a fun mission to watch with improved live video, great shots of the rima and brought back just over 76kg of samples, over three times as much as Apollo 11. Great Lunar Reconnaissance Orbiter imagery of the landing site can be seen at:

<https://sservi.nasa.gov/articles/lro-sees-apollo-15-rover-tracks/>

In this image we see the crater Aristillus (56km) in the upper left portion of the image and below it

**FIGURE 1.** *Apollo 15 Site- Richard Hill – Tucson, Arizona, USA May 24, 2018 02:43 UT. Seeing 8/10. Colongitude 19.6°. TEC 8" f/20 Mak-Cass, 610 nm filter, SKYRIS 445M.*

Autolycus (41km). At the bottom of the image is the crater Conon (22km). Just off the left edge is Archimedes and running down the center of the image are the Montes Apenninus and part of the Montes Caucasus at top. The flat area below Autolycus is Palus Putredinis. Just about the center of this image is a little white circle that marks the landing site of Apollo 15 and below it is Rima Hadley snaking off to the south where it ends in a sickle shaped gash. Note Mons Hadley above the landing site with its brightly lighted flanks facing the sunrise. Just above it is the 9km crater Santos-Dumont. Above this crater are two mountains at almost right angles to each other. This forms Promontorium Fresnel with Rima Fresnel just to the left (west) of this.



Be sure to spend some time looking up these features and others in this very busy area!

# LUNAR TOPOGRAPHICAL STUDIES

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## OBSERVATIONS RECEIVED

ABEL CIAN - PARANÁ, ARGENTINA. Digital images of Alphonsus, Archimedes-Aristillus, Arzachel-Alpetragius, Censorinus, Clavius, Montes Appenineus, Proclus(2) Rupes Recta, & Tycho.

MAURICE COLLINS - PALMERSTON NORTH, NEW ZEALAND. Digital images of 8, 12, 13, 14 & 17 day Moon, Alphonsus, Aristarchus, Clavius-Tycho, Deslandres, Full Moon, Langrenus, Manilius, Mare Crisium, Mare Imbrium, Mare Nectaris, Mare Orientale, Rupes Recta, Southern Limb, Stevinus & Tycho.

ROBERT HAYS - WORTH, ILLINOIS, USA. Drawings of Oppolzer & Reiner  $\gamma$ .

RICHARD HILL – TUCSON, ARIZONA, USA. Digital images of Apollo 15 area, Atlas-Lacus Mortis, Kies & Montes Alpes.

MICHAEL SWEETMAN—TUCSON, ARIZONA, USA. Digital images of Janssen & Tycho.

ROBERT STUART—RHAYADER, WALES, UNITED KINGDOM. Digital image of Endymion

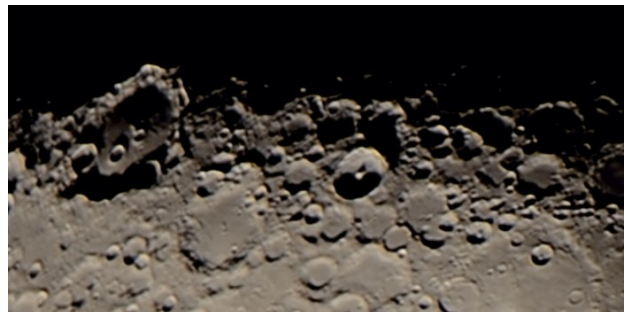
DAVID TESKE - LOUISVILLE, MISSISSIPPI, USA. Digital image of Reiner  $\gamma$ .

ALAN TRUMPER - ORO VERDE, ARGENTINA. Digital images of Daniell, Moltke & Torricelli.

GARY VARNEY - PEMBROKE PINES, FLORIDA, USA. Digital image of Endymion.

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**TYCHO**– Abel Gonzalez Cian, Paraná, Argentina.  
May 23, 2018 22:16UT. 10" Meade Lightbridge,  
Nikon D3100.

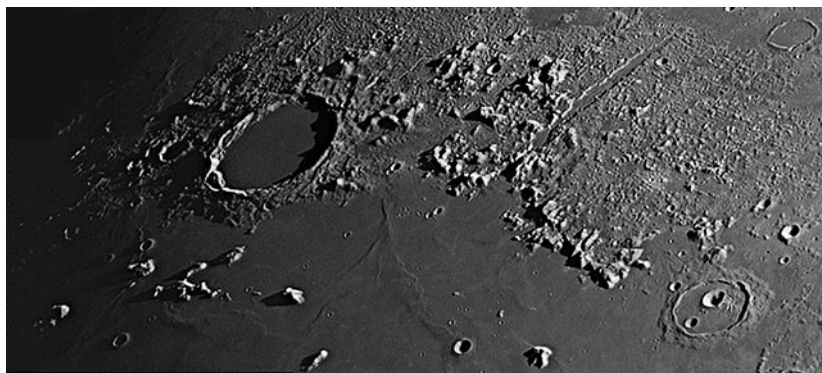


## RECENT TOPOGRAPHICAL OBSERVATIONS



**CLAVIUS-TYCHO** - Maurice Collins,-  
Palmerston North, New Zealand. June 22, 2018  
06:04 UT. FLT-110 f/14. ASI120M.C North down.

**MANILIUS**- Maurice Collins,- Palmerston North, New  
Zealand. June 22, 2018 06:31 UT. FLT-110 f/14.  
ASI120M.C North down.



**MONTES ALPES** - Richard  
Hill – Tucson, Arizona, USA  
May 24, 2018 03:06 UT.  
Seeing 8/10. Colongitude  
19.7°. TEC 8" f/20 Mak-Cass,  
610 nm filter, SKYRIS 445M.

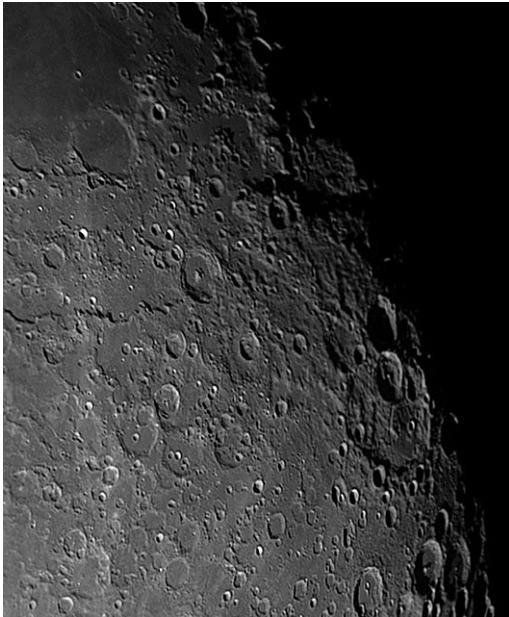
Some scenes on the Moon never grow old to us. The Montes Alpes in morning sunlight is one of those scenes. From the beautiful large crater Plato (104km dia.)

seen on the left (west) here to Cassini (60km) with it's wonderful internal ridges and craterlets, on the right (east). In between is the magnificent Vallis Alpes (166km long) with it's delicate rima on the floor of the Vallis. This rille is 1km wide at best and in many places narrower which is why you can only see portions of it here, being near the limit of resolution for this aperture. Near Cassini is a right angled point to the mountain range named Promontorium Agassiz. Due west of Cassini is the spectacular isolated peak Mons Piton (altitude 2.25km) rivaled only by Mons Pico just south of Plato (altitude 2.4km). To the west of this latter peak are the sparkling Montes Teneriffe, which with Pico must have formed a marvelous mountain range before the Imbrium flood. One last thing to notice is the nice sinuous rille northeast of Plato, part of the Rimae Plato system.



# RECENT TOPOGRAPHICAL OBSERVATIONS

**ENDYMION** - Robert Stuart– Rhayader, Wales, United Kingdom April 20, 2018 18:56 UT. 25cm f/6.3 Newtonian, seeing A III. ZWO 1178 MC Neodymium filter.



**JANSSEN** – Michael Sweetman - Tucson, Arizona, USA, June 2, 2018 11:33 UT. Seeing 4/10, transparency 3/6. 3” Celestron achromatic refractor, f/11. Skyris 132M, Baader fringe killer filter.



**MOLTKE**. Alan Trumper, Paraná, Argentina. May 26, 2018 00:26 UT. 10” Meade SCT, Nikon D5100.



**ENDYMION** - Gary Varney– Pembroke Pines, Florida USA. April 22, 2018 02:54 UT. CPC800XLT, Altair GPCAM130 mono camera.

# **BRIGHT LUNAR RAYS PROJECT**

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Bright Lunar Rays Website: <http://moon.scopesandscapes.com/alpo-rays.html>

## **RECENT RAY OBSERVATIONS**

**13 day Moon**- Maurice Collins,- Palmerston North,  
New Zealand. June 27, 2018 10:06-10:09 UT. FLT  
-110. ASI120M.C North down.



**TYCHO** - Michael Sweetman - Tucson,  
Arizona, USA. June 2, 2018 11:27 UT. Seeing  
4/10, transparency 3/6. 3" f/11 refractor.  
Skyris 123M, Baader Fringe Killer filter..

# **LUNAR GEOLOGICAL CHANGE**

## **DETECTION PROGRAM**

**Coordinator – Dr. Anthony Cook – [atc@aber.ac.uk](mailto:atc@aber.ac.uk)**

**Assistant Coordinator – David O. Darling - [DOD121252@aol.com](mailto:DOD121252@aol.com)**

Reports have been received from the following observers: Jay Albert (Lake Worth, FL, USA - ALPO) observed: Alphonsus, Archimedes, Censorinus, Plato, and Proclus. Alberto Anunziato (Argentina - AEA) observed: Alphonsus, Aristarchus, Bullialdus, Busching, Daniell, Gassendi, Mare Crisium, Plato, Proclus, Sinus Iridum, Stevinus, Tycho and several features. Jerzy Bohusz (Poland – PTMA) observed: Messier and several features. Maurizio and Francesca Cecchini (Italy – UAI) imaged Herodotus. Abel Gonzalez Cian (Argentina – AEA) imaged: Censorinus, Daniell, Plato, Proclus, and Ross D. Maurice Collins (New Zealand – ALPO/BAA/RASNZ) imaged: Aristarchus, Bailly, Mare Orientale, Tycho and Several Features. Anthony Cook (Newtown, UK - ALPO/BAA) videoed earthshine and imaged several features. Marie Cook (Mundesley, UK – BAA) observed: Deslandres. Les Fry (West Wales, UK – NAS) imaged earthshine. Walter Elias (Argentina – AEA) imaged Herodotus. Rik Hill (Tucson, AZ, USA – ALPO/BAA) imaged: Rima Hadley, Lacus Mortis, Montes Alpes, and several features. Robert Stuart (Rhayader, UK – BAA) imaged: Agrippa, Aristoteles, Boscovich, Cyrillus, Hahn, Janssen, Julius Caesar, Lacus Sominorum, Lindsay, Macrobius, Mare Crisium, Mare Humboldtianum, Mare Undarum, Maurolycus, Messala, Messier, Petavius, Plutarch, Posidonius, Romer, Theophilus, Vendelinus, and several features. Franco Taccogna (Italy – UAI) imaged Herodotus. Alan Trumper (Argentina – AEA) imaged Censorinus, Menelaus, Proclus, and several features.

**News:** This year's European Planetary Science Congress has five abstracts that maybe of interest to readers. Firstly you can read up on the [distribution of lunar impact flashes](#) across the Moon in an abstract by my former MPhys student, Calum Sweeney. Secondly there is a talk on [repeat illumination observations](#), in an amateur astronomy session. Thirdly the LROC team discuss the detection of temporal changes on the Moon, as seen in NASA LROC images, taken several months to years apart. Though despite detecting [76 thousand changes](#), they concentrate on the ones which clearly show new impact craters, of which over 200 have been definitely identified. Another abstract is concerned with a reanalysis of [Apollo surface LACE experiment data](#) and discusses spikes in lunar exospheric density at the surface. Lastly, if you ever wondered about evidence for “mists” (or optically thin near surface haze) on airless bodies, produced from sub-surface volatiles, some members of the DAWN team describe the reflective properties part of [Occator's Faculae](#), on Ceres?

Over the last month I have been in correspondence with Robert Garfinkle about the LTP chapter in his new [Lunar Cognita](#) book (due to be published in 2019) and Jill Scambler has kept me informed of her progress on LTP statistical analysis.

We have a total [lunar eclipse](#) coming up on 27<sup>th</sup> July 2018 with a penumbral eclipse (P1) starting at 17:14 UT, first contact (P1) at 18:24 UT, totality lasting from 19:30-21:13 UT with mid eclipse at 20:22UT. The umbral and penumbral phases end respectively at 22:19 & 23:29 UT. The Lunar Eclipse will not be visible from the US, but those in Eastern Europe, Russia, Asia, Africa, Eastern Australia, and South America should get good views. Many past LTP have been reported during lunar eclipses. Some have argued that these are due to a combination of strong tidal effects at perigee, passage through a stream of charged particles in the Earth's magneto tail, and extreme thermal stress. On the other hand obtaining reliable, quantitative measurements of brightness and color, not related to density variations in the umbra/penumbra is quite difficult. The best way to be sure is monochrome or color time lapse imaging of a particular region of the Moon. Others have used the occasion of lunar eclipses to hunt for impact flash – though as a lunar eclipse is relatively bright in the near IR this can make detecting impact flashes, which are bright in the near-IR anyway, problematic!

**LTP Reports:** No LTP reports were received in May. However the NEOLITA observatory in Greece have detected [6 flashes](#) on 23<sup>rd</sup> Mar 2018 UT 17:24 (52E, 1S), 10<sup>th</sup> Apr 2018 UT 03:37 (75W, 22N), 9<sup>th</sup> Jun 2018 UT

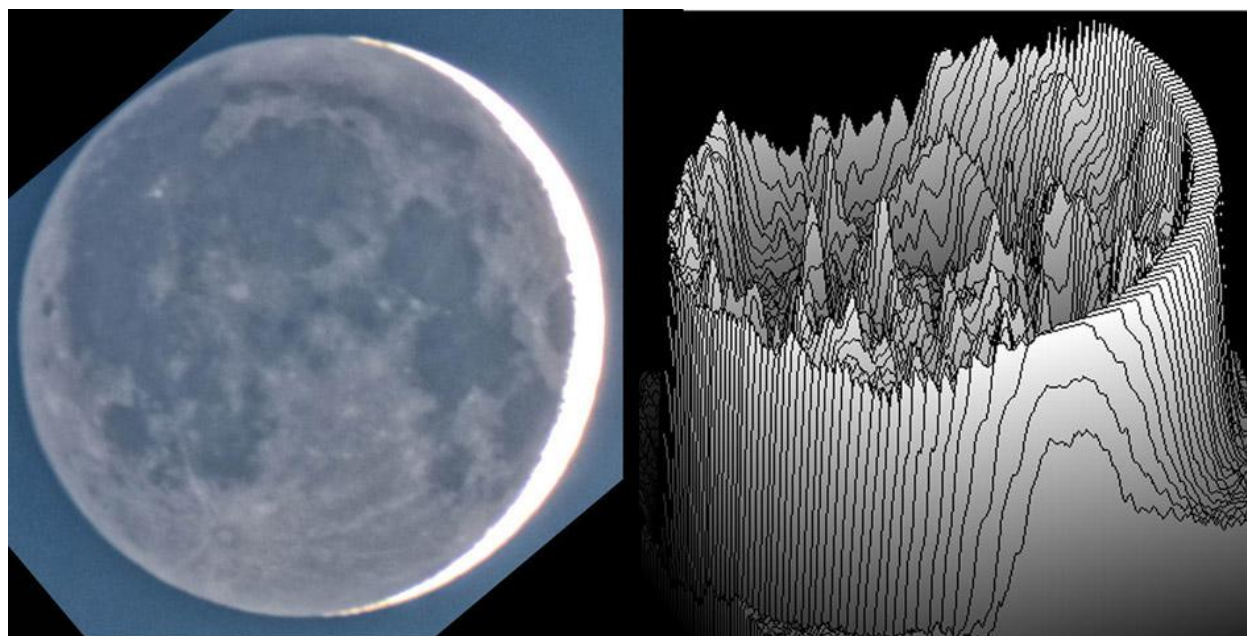


02:29 (25W, 4N), 19<sup>th</sup> Jun 2018 UT: 19:12 (4W, 59S), 20:01 (17W, 58N) & 20:04 (20E, 2.5N). A professional impact flash observatory in Spain may have detected an impact flash on 2018 Mar 21 UT 21:44 in Mare Insularum. Lastly NASA's Marshall Space Flight Center, lunar impact flash programme has detected a Lyrid impact on the Moon on [2018 Apr 20 UT 04:08](#). So please check any videos you have of the night side around these dates times, and also check out the candidate impact flashes mentioned in last month's newsletter too.

**Routine Reports:** Below is a selection of reports received for May (and one from April) 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.

**Earthshine:** On 2018 Apr 17 UT 19:06 Leonardo Mazzei (UAI / Gruppo Astrofili Montagna Pistoiese) took an image under the requested selenographic colongitude range, on the [Lunar Schedule](#) web site, in order to see if there was any sign of a light ring around the earthlit limb:

*BAA Request: Please try to image the Moon as a very thin crescent, trying to detect Earthshine. A good telephoto lens will do on a DSLR, or a camera on a small scope. We are attempting to monitor the brightness of the edge of the earthshine limb in order to follow up a project suggested by Dr Martin Hoffmann at the 2017 EPSC Conference in Riga, Latvia. This is quite a challenging project due to the sky brightness and the low altitude of the Moon. Please do not attempt if the Sun is still above the horizon. Do not bother observing if the sky conditions are hazy.*



**Figure 1.** (Left) The lunar earthshine and crescent Moon taken by Leonardo Mazzei (UAI / Gruppo Astrofili Montagna Pistoiese). Taken from the top of a 1 km tall mountain, on 2018 May 17 UT 19:06 with a 12cm f/12 refractor with Canon 80D attached – ISO 800, ¼ sec exposure. The image has been reorientated so that north is towards the top. (Right) a logarithmic 3D brightness plot of the earthshine and illuminated crescent.

We saw some imagery from Valerio Fontani (UAI), taken on the same date, in last month's newsletter. Leonardo's image was taken from a much higher altitude with less scatter of light and absorption on the horizon. You can see in Fig 1 left that there is a band of light along the earthlit limb, and Fig 1 right shows that for the most part this is brighter than much of the interior of the earthlit disk. However this could be attributed easily to high albedo highland areas visible on the limb. The band of light on the NW I know for a fact varies in width with topocentric libration as the amount of NW highland appears/disappears on the nearside. What I do find of interest is the circular band of light around the earthlit limb, still being visible in the south, as the latitudinal extent of highland here is considerable – so presumably one should not see a thin arc on the limb? We need to compare the appearance with full Moon images at a similar topocentric libration before considering whether this supports Prof Hoffmann's proposed ideas of the detection of a [dusty lunar exosphere](#) from Earth. So please keep on attempting to take images of earthshine under similar very small phases, and for comparison, Full Moon images, so we can study the effect of the brightness of highland on the limb regions.

**Earthshine:** On 2018 May 18 UT 21:24 Les Fry (NAS) imaged the Moon about 30 min after the  $\pm 0.5^\circ$



repeat solar illumination window for the dayside of the Moon for the following report:

*On 1979 May 30 at UT 02:50-02:57 D. Darling (Sun Prairie, WI, USA, 12.5" reflector, x80, S=II=I and transparency=good-poor) observed Aristarchus to be glowing in the dark at magnitude 3 and at its maximum it was dazzling. The glow vanished at 02:57UT. The Cameron 2006 catalog ID=54 and weight=1. The ALPO/BAA weight=2.*



**Figure 2.** Earthshine as imaged by Les Fry (NAS) on 2018 May 18 UT 21:24, using a Canon 1100d with a 600 mm lens, with a 0.6 sec exposure at ISO 200. Orientated with north towards the top. The image has been non-linearly contrast stretched to bring out earthshine detail.

As you can see from the image that Les took (Fig 2), Aristarchus is not too dissimilar in brightness to Copernicus and Kepler, though there is some camera noise present. However it does not look as bright as a 3<sup>rd</sup> magnitude star, if one were next to the Moon, for comparison. Sometimes when people refer to the magnitude of Aristarchus, they can also mean how bright it would be if you turned your head away from the telescope and looked with the naked eye at the sky for a similar magnitude star. We shall keep the weight of the 1979 observational report at 2, as either definition for the magnitude of Aristarchus, shows a discrepancy between the image Les took and what David Darling described.

**Fracastorius and Petavius:** On 2018 May 20 UT 18:30-19:50 Jerzy Bohusz (Poland – PTMA) observed these craters under similar illumination, to within  $\pm 0.5^\circ$  to the following reports:

*Fracastorius: On 1980 Apr 20 at UT21:12-22:45 J-H Robinson (Teignmouth, UK, 10.5" reflector, x180) found, using a Moon Blink device, evidence of color on the floor patches of Fracastorius crater, brighter in blue than in red. Also the floor to center varied in brightness in blue and in red. Peters observed in white light and found the south east-south wall had a slight orange cast and when a Moon blink was used it was less bright in blue than in red light. M. Cook found spurious color on the south rim and also on Mons Pico. There was a color blink reaction on the southeast floor of Fracastorius - this was both faint and blurred and not seen in white light. A.C. Cook detected the permanent blink in the south east floor of the crater at 21:47 and a fainter one in the north west (marginally brighter in red than in blue). J.D. Cook found no color with the Moon blink device. 21:22-22:10 P.W. Foley got a strong color reaction with the Moon Blink device - brighter in red than in blue and detected a pink color visually on the south east wall 22:10-22:45 (this did not give a blink effect though). Cameron 2006 catalog ID=88 and weight=4. ALPO/BAA weight=2.*

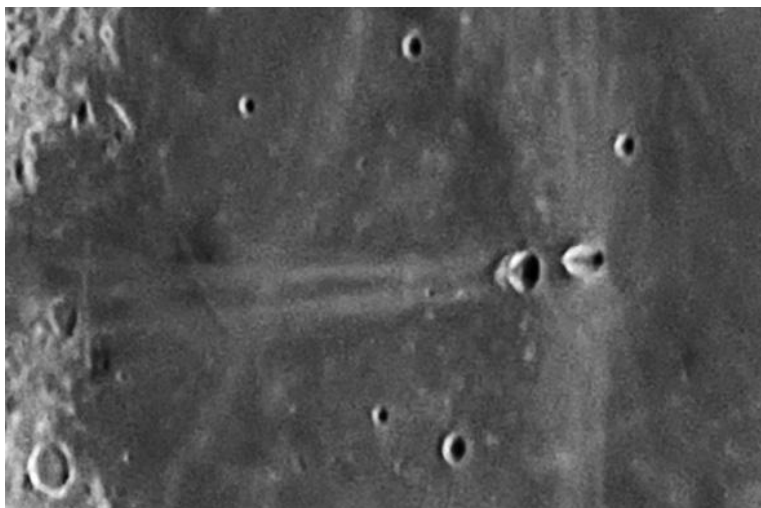
*Petavius: On 1980 Apr 20 at UT21:38-21:50, Blair of Renfrewshire, Scotland (used an 8" reflector and seeing=III) saw three patches in Petavius and they could still be seen 7 minutes later. At 21:50UT he used a filter and found the "northern one was brighter in blue, the southern one was brighter in red and the central one was the same shade in both filters." Cameron comments that the central patch was a permanent one, then goes on to say that the crater is described as having dark patches that are opposite to what one would expect from Fitton's theory applied to dark features. Cameron 2006 extension catalog ID=88 and weight=4. ALPO/BAA weight=3.*

Jerzy comments that for Fracastorius, dark spots were seen on its floor to be darker through a red (Antares 23A) filter than through the blue (Antares 80A). The slightly brighter central spot (looks like "central peak", north of Fracastorius M), appears brightest in the white light, than in the red, and it's darkest in the blue light. A visual inspection failed to detect any color. For Petavius he did not see anything unusual – the northern volcanic spot looked darker in red light than in blue. For the observations he used: a combination of eyepieces: x128, x159, x208 on a 180/2700 mm Maksutov. Fracastorius is a well known permanent blink site amongst LTP observers in that using a Moon Blink device (rotating red and blue filters), they could normally detect the floor was brighter in one filter than the other. Interestingly, when you look at color images of the region, taken by NASA's LROC camera, Fracastorius does not look especially colorful, compared to Aristarchus. Because Jerzy's description of color contradicts what was seen in the 1980 report, we shall leave the weight at 2 for now.

For Petavius crater, Jerzy says that he did not see anything unusual, though the northern volcanic spot looked brighter in blue light than in red. As this is in agreement with the Blair observation, we shall lower the weight from 3 to 2, as Jerzy did not see an opposite color reaction on the southern spot.

**Messier:** On 2018 May 21 UT 20:25 Bob Stuart (BAA) imaged this crater under similar illumination, to within  $\pm 0.5^\circ$  to the following Victorian era observation:

*Messier 1878 Nov 01 UT 20:00? Observed by Klein (Cologne, Germany, 6" refractor?) "Shaped like a half moon with E. edge missing. Appeared diffuse. Messier A was sharp & completely defined. Was sure there was fog there. Next day same appear. Shadow was diffused before noon, Mess. A is more yellow after noon, greener near Mess. At noon, both are same color." NASA catalog weight=4. NASA catalog ID #206. ALPO/BAA weight=3.*



**Figure 3.** Messier A and Messier imaged by Bob Stuart (BAA) on 2018 May 21 UT 20:25 and orientated with north towards the top.

You can very clearly see from Bob's image (Fig 3) that Messier (the right most of the crater pair, has a brightly illuminated crescent shaped west rim. Its eastern rim by contrast is not catching the sunlight so well, and under poorer observing conditions it could quite arguably appear to be "missing". In terms of the description of a fog, bob's high resolution image shows nothing of this – though it is probably an issue of poorer resolution visible in the 1878 observation. The weight of Klein's LTP report definitely needs a demotion, partly because of Bob's image shows the appearance is normal, but also because the Cameron catalog's estimate of 20:00 UT for the original observation was only an estimate – though as the mention of color remains a mystery we will only lower it to 2

**Mare Crisium:** On 2018 May 21 UT 23:40 Alan Trumper (AEA) took a whole Moon image under similar illumination, to within  $\pm 0.5^\circ$ , to the following Schroter report:

*Schroter, from Lillenthal in Germany, in 1789 (possibly it was 1788) Sep 26 UT 04:30 saw a small nebulous bright spot on the northern edge of Mare Crisium. Cameron 1978 catalog ID=50 and weight=3. ALPO/BAA weight=2.*



**Figure 4** The Mare Crisium area as imaged by Alan Trumper (AEA) on 2018 May 21 UT 23:40 and orientated with north towards the top.

Although the resolution in Alan's image (Fig 4) was far from ideal, we can at least see some of the bright spots on the northern shore of Mare Crisium. I suppose it could be either the bright ray craterlet on the NW shoreline, or Eimmart. We shall lower the weight of the 1789 (or 1788?) report to 1 due to the uncertainty in the year and the time.

**Archimedes:** On 2018 May 23 UT 02:00-02:15 Jay Albert (ALPO) observed this area under similar illumination, to within  $\pm 0.5^\circ$ , to the following 1960's report:

*Archimedes 1966 Mar 29 UT 21:00 Observed by Dr. E.G. Hill (England, 24" reflector, x250, S=E) "Brightening of E-W bands across floor. (Obscuration accord. to Moore)" NASA catalog ID #923. NASA catalog weight=3. ALPO/BAA weight=2.*

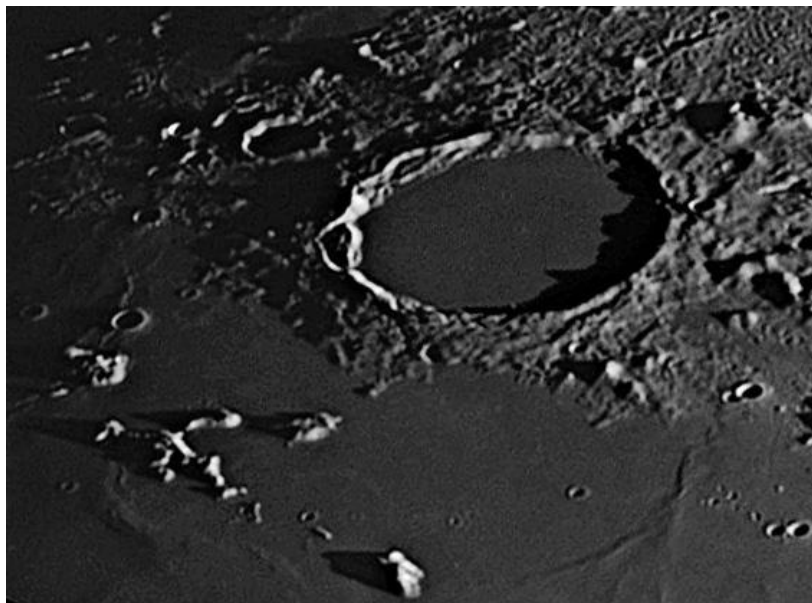
Jay was using a Celestron NexStar Evolution 8" SCT. Transparency was magnitude 2 and seeing was fair at 6/10. He found that Archimedes floor was roughly 60% in shadow from inside the east wall. The shadow was very uneven due to differences in elevation along the eastern rim. The E-W light bands were easily seen and appeared to be bright, sunlit areas of the floor between the long shadows of the peaks on the eastern rim. Just out of interest I looked up the original report, which was published in a BAA Lunar Section circular (LSC Vol 1 No. 6, p4) and this stated:

*"On the evening of 1966 Mar 29 the terminator had reached a position so that the whole outer rim of Archimedes was illuminated, leaving the floor of the crater "a pool of darkness". A few minutes later, when the sunlight had crept about half-way down the eastern wall, I was astonished to see the famous floor bands light up quite brightly. At first I thought that I was seeing very elongated shadows from the Western [Eastern IAU] wall, but soon realised that this could not be the case, as the bands were quite wide and parallel-sided, and they extended across the floor where no direct sunshine could possibly have reached. I think I was observing a very transient phenomenon when the ultra violet component of sunlight reflected from the Eastern [Western IAU] peaks on to the floor caused the bands to fluoresce strongly...."*

So what are we to make of this? Did Dr Hill just see the gaps between shadow spires, as Jay saw, or perhaps scattered light off of the brightly illuminated eastern rim, illuminating the dark floor? The solar altitude for 1966 Mar 29 UT 21:00 was  $1.6^\circ$ , and at the times that Jay observed were  $1.8^\circ$ - $1.9^\circ$  i.e. just a  $0.2^\circ$  to  $0.3^\circ$  higher above the horizon. I did find an interesting follow on observation in the BAA Lunar Sections Vol 2, No. 5, p4, by Rev. Delano of the USA: "you may be interested in an observation I made of Archimedes on the night of January 17/19<sup>th</sup>, 1967. I was out observing the crater as a follow up on Dr. E. Hill's report of fluorescence in Archimedes in lunar section Circular No 6, p4 (May 1966). On January 18 at 23.00 at col.  $5.24^\circ$ , when the entire floor was in black shadow, there was no trace of fluorescent bands on Archimedes floor. At this time the upper west (IAU sense) rim was entirely visible with my  $12\frac{1}{2}$ " reflector at 300X under poor seeing conditions but with a very clear sky. Then next observed at 1.15 U.T. (Jan 19) at col.  $6.38^\circ$ , I did detect three practically parallel light streaks in Archimedes' floor running from the base of the western wall to a little east of the middle of the crater. These faint bands of illuminosity though nearly parallel sided, seemed to taper to a point in the direction of the sun, which led me to believe that the bands were the results of enfeebled light of the partially-obscured sun, which from the floor of Archimedes would be only partially visible between peaks on the east rim. This opinion was confirmed by continual observations lasting until 1.45 U.T. .... My observations at this particular sun-rise upon Archimedes offers no confirmation of Dr. Hill's report, but it does present reason to be cautious about the deceptive appearance given by shafts of penumbral-like sunlight falling on the otherwise totally dark floor of Archimedes."

The aspect of E.G. Hill's observation which makes it interesting is that he described the bands as "quite wide", and extended across the floor to where "no sunlight could reach". I have checked back through the archives and cannot find an observation that matches that description. However I also cannot find any other observations from this astronomer, despite them having written a paper (JBAA, 1973, Vol 73, No.8, p328-334) about building an inexpensive 24" reflector, so they may not have been an experienced lunar observer. In view of this I will lower the weight from 2 to 1. If you know anything about E.G. Hill, which would contradict this, then please let me know.

**Plato:** On 2018 May 24 UT 03:06 Rik Hill (ALPO/BAA) imaged the Montes Alpes region of the Moon, but by chance this coincided with the following two repeat illumination events, to within  $\pm 0.5^\circ$ :



**Figure 5.** Plato from a subsection of a much larger image of the Montes Alpes area, taken by Rik Hill (ALPO/BAA), and orientated with north towards the top. Taken on 2018 May 24 UT 03:06 through a TEC 8" f/20 Mak-Cass, using a SKYRIS 445M camera, and a 610 nm filter.

*On 1983 Apr 21 at UT 21:55-22:05 N. King (Winnersh, Berkshire, UK, using a 150cm f/8 reflector, with seeing 1 and transparency good, little spurious color, just a little in Plato). Although observing since 21:25UT the observer noticed a very, very slight, barely detectable, faint green color just after the dark shade around the inner eastern crater rim. The effect faded and by 22:05UT had completely gone. This report is not in the Cameron 2006 catalog. It is a BAA report. The ALPO/BAA weight=2.*

*On 1995 Sep 03 at UT19:40-20:15 P. Moore (Selsey, UK, 15" reflector at x400) observed that the floor of Plato was much darker than he would normally expect and furthermore no interior craterlets were seen. There was however a white patch that was barely visible at the location of the central craterlet should have been. G. North (UK) attempted to observe but the Moon was too low and seeing terrible. F. Doherty reported Plato normal. Cameron 2006 catalog ID=475 and weight=3. ALPO/BAA weight=2.*

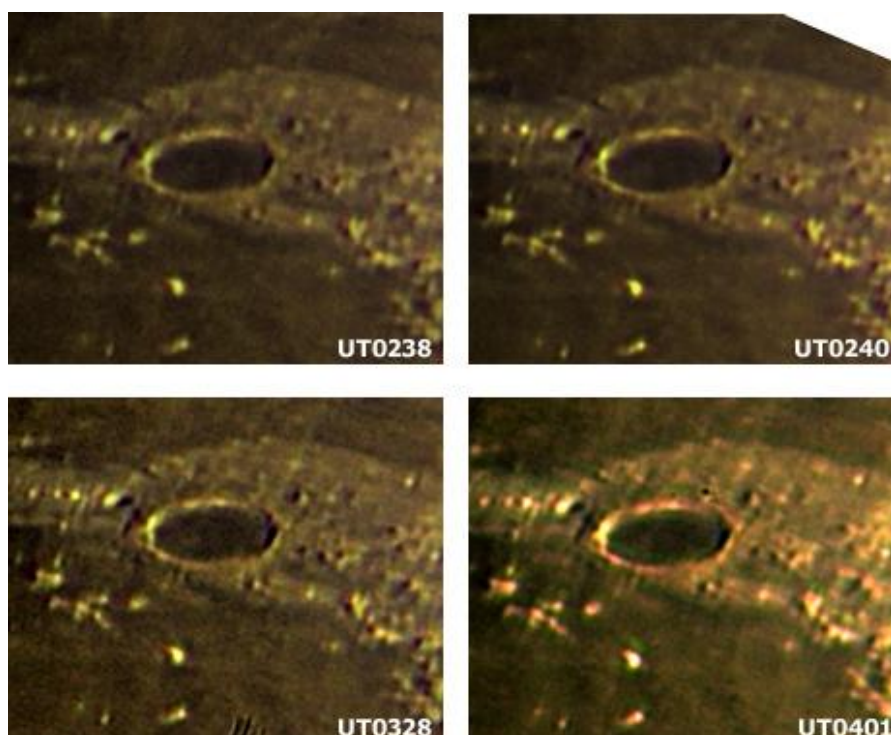
Rik's monochrome image (Fig 5) does not help us greatly in diagnosing the King report, as color was involved in that, but at least we have a depiction of where the shadows were and general appearance of the crater. For Patrick Moore's observation, Neither does Rik's image really show the floor of Plato to be any darker than the Mare Imbrium to the south or Mare Frigoris to the north. However I think you would agree that the floor craterlets are not especially well presented. There is a hint of a white fuzzy area at the center of the crater. I will lower the ALPO/BAA weight from 2 to 1 as Rik's image doesn't really explain Patrick Moore's comment that the floor was darker than expected, though Patrick was observing in white light and Rik was using a red filter.

**Plato:** On 2018 May 25 at four times between 02:38-04:01UT, Abel Gonzalez Cian (AEA) imaged this area under similar illumination, and topocentric libration (to the nearest  $\pm 1^\circ$ ) to the following US report:

*Plato 1976 Sep 04 UT 02:35-03:35 Observed by Porter (Sarragansett?, Rhode Island, USA, 6" reflector x100, S=5, T=?) "At 0235h albedo of floor was est. at 3. At 0325h the pt. was albedo =1, 2 whole steps darker than earlier & noticeable to the obs. 10-15 min later it returned to normal. (the few meas. of albedo for this age were 1.5-2 which suggests that the meas. of 3*



was the anomalous one. Another pt. did darken -- as reported). NASA catalog weight=3. NASA catalog ID #1448. ALPO/BAA weight=2.



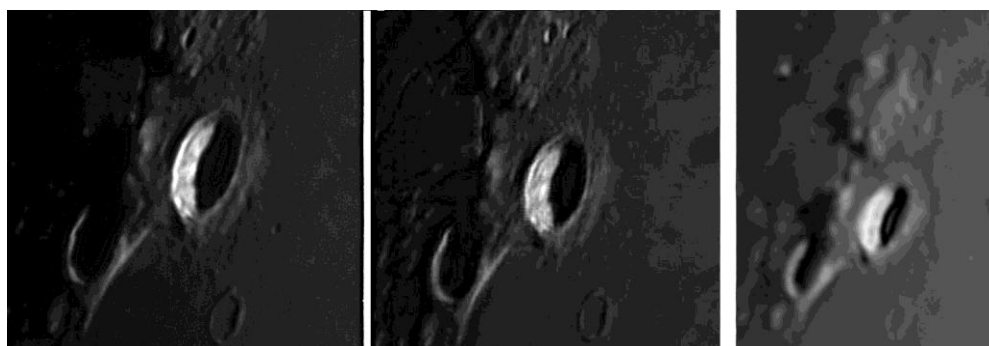
**Figure 6.** Plato as imaged Abel Gonzalez Cian (AEA) on 2018 May 25 at the UT's given. Images have been re-orientated with north towards the top. The reds on bright narrow ridges in the 04:01 UT images are probably processing artifacts, as these appear everywhere and the image contrast/color balance differs to the earlier images.

The images that Abel took (Fig 6) do definitely show that the floor of Plato is darker than the Mare Imbrium to the south and the Mare Frigoris to the north. I see no obvious sign of variation in darkness which can't be explained by changes in image contrast, so I shall lower the weight of the 1976 report to 1.

**Herodotus:** On 2018 May 26 UT 19:46-21:54 Franco Taccogna and Maurizio and Francesca Cecchini (UAI) imaged this crater under similar illumination ( $\pm 0.5^\circ$ ) to two past reports (See below) and Walter Elias (AEA) 22:10-22:11 for the latter report:

*1957 Sep 06 - Observed by Bartlett (Baltimore, MD, USA, 5" reflector x180, S=1-5, T=5) Pseudo peak visible within floor shadow at 03:10h" NASA catalog weight=4. NASA catalog ID #671. ALPO/BAA weight=3.*

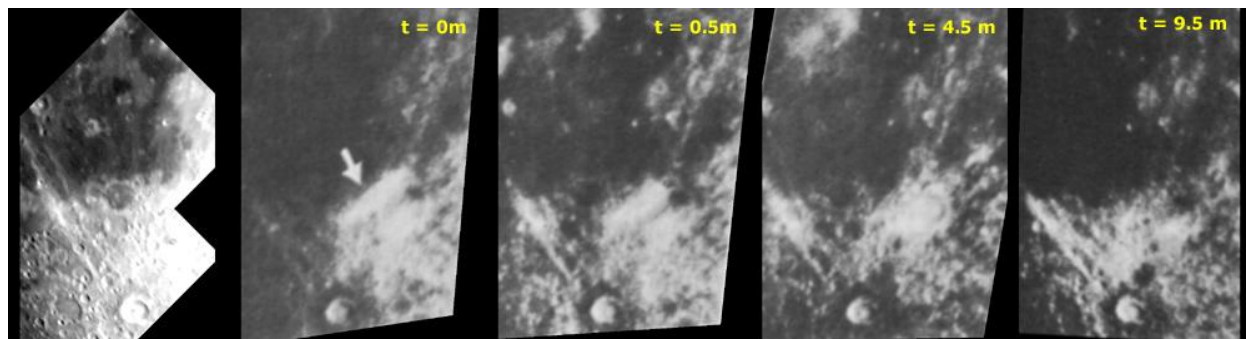
*On 2002 Feb 24 UT 05:15-05:35 & 06:05-06:20 W. Haas (Las Cruces, NM, USA) observed an obscuration in Herodotus - the shadow was, almost, but not completely black. ALPO/BAA weight=2.*



**Figure 7.** Aristarchus and Herodotus as imaged on 2018 May 26 and orientated with north towards the top. **(Left)** Taken by Maurizio and Francesca Cecchini (UAI) at 19:50 UT. **(Centre)** Taken by Franco Taccogna (UAI) at 21:54 UT. **(Right)** Taken by Walter Elias (AEA) at 22:20 UT.

No sign of a central pseudo peak, or any shadow in Herodotus which is lighter than that in Aristarchus, can be found in Fig 7 (Left & Centre) by the UAI observers. Therefore the weights of all three

LTP reports will remain the same. However for the image by Walter Elias (AEA) the shadow in Herodotus is not quite as dark as that in Aristarchus – however it is possible that this might be a light scattering effect in our atmosphere as the shadows of other features, a similar distance from the terminator have been affected similarly. I will therefore lower the Walter Haas observation weight from 2 to 1 as in the 2002 transparency is considered as a possible cause.



**Figure 8.** The SW corner of the Mare Nubium, orientated with north towards the top. **(Left)** Image mosaic by Anthony Cook taken on 2018 May 26 UT 20:30 & 20:47. **(Other Images)**  $t = 0\text{m}$  to  $9.5\text{m}$  are from Fig 4 on p305, of Geake and Mills article: “Possible Physical Processes Causing Transient Lunar Events” from Physics of the Earth and Planetary Interiors, 14, (1977). and shows a time sequence of the Moon during the impact of Luna 5 on 1965 May 12. The images have been affine transformed to the CCD image on the left. The arrow shows the location of the claimed impact at  $t = 0$  minutes. The 1965 images were taken by Prof. E. Penzel of the Rodewische Observatory, in former East Germany.

**Deslandres:** On 2018 May 26 UT 20:50-21:05 Marie Cook (BAA) observed this crater under the same illumination and topocentric libration to the following report from 1965:

*On 1965 May 12 at UT 19:10 E. Penzel (Rodewisch, East Germany) was taking a sequence of images during the impact of the Soviet Luna 5. He detected a tens of km scale elongated cloud after the impact over a duration of 9.5 minutes. However there are differences between the images elsewhere on the Moon, possibly due to different exposures or some other effects and it is not 100% sure that what he detected was impact debris/cloud?. The ALPO/BAA weight=3.*

We have discussed this event before, in the [2009 Jul newsletter \(p16-17\)](#), but this is the first time we have had a repeat illumination/libration observation. Marie Cook, who used a 90mm Questar scope (x180 to 130, transparency very hazy with a halo around the Moon, seeing Antoniadi III), comments that although local haze left features less than sharp, there was no elongated cloud seen in the crater. I too was observing that night with a monochrome PC23C camera, through a near IR Wratten 87C filter. It is interesting to compare my image (Fig 8 – left) with the sequence obtained in 1965. You can clearly see the elongated feature, as indicated by the arrow, and in the next frame taken 0.5 min later. However if you compare all the frames from 1965 there are considerable differences. In the 2009 newsletter I considered the possibility that this was due to the Moon being imaged through broken cloud here on Earth. However with hindsight, it could also be due to the replication of the photo in their printing process used in the original paper i.e. if they used a camera to photograph the 4 images next to each other, and the photographs were on glossy paper, then we might be picking up reflections from lights in the room?

Since the 2009 newsletter I have also come across a 6 page BELLCOMM INC report, dated Aug 3, 1965, by J.S. Dohnanyi NASA contractor report (NASA CR-156595) which analyses these images, but despite saying that no impact clouds had been observed from the NASA Ranger impacts, they considered the Luna 5 impact photos as proof of a cloud and suggest that the 230x80 km extent of the cloud was caused by a combination of dust kicked up from the kinetic energy of the impact and the exploding fuel. One final twist to the story, write ups of the impacts differ as to the impact site. Officially the crash site was at  $8^{\circ}\text{W}$ ,  $31^{\circ}\text{S}$ , but apparently this was later refined to (see <https://solarsystem.nasa.gov/missions/luna-05/in-depth/>)  $23^{\circ}\text{W}$ ,  $8^{\circ}\text{N}$  (just NW of Copernicus B) – in which case whatever was photographed in 1965 would not have been the impact? Luna 5, if it had succeeded would have been the first lander on the Moon, prior to Luna 9. Apparently the Luna5, suffered an engine malfunction on the way to the Moon and didn’t fire its retro-rockets in time, missed the designated landing point and came down at an oblique angle. We will lower the weight to 1 in view of the uncertainty and landing site, but this will at least keep it on record so that we can investigate further the paper trail regarding the landing site location, and also to establish what exactly was photographed from Rodewische Observatory? Perhaps if we have any German members who live nearby, maybe they could pop over to the observatory and see if they hold better

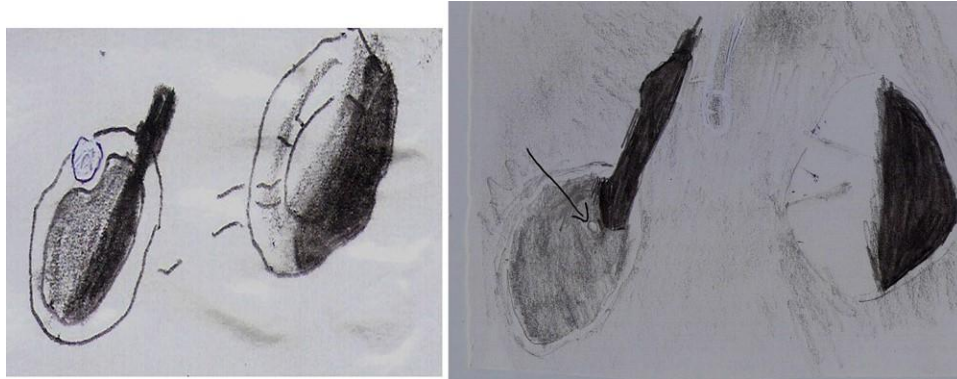
quality photos and look into the observing log to see if it was partly cloudy that night?

**Aristarchus & Herodotus:** On 2018 May 27 UT 00:00-00:55 Alberto Anunziato (AEA) observed these two craters to the nearest  $\pm 0.5^\circ$  in terms of illumination for the following past observational reports:

*Aristarchus 1973 Aug 10 UT 20:14 observed by Baumeister (48.63N, 9.25E, 110mm reflector, T=2, S=2) "Orange to red colors at the crater floor disappeared until 21:04" - Hilbrecht and Kuveler, Earth, Moon & Planets, 30 (1984), p53-61. ALPO/BAA weight=2.*

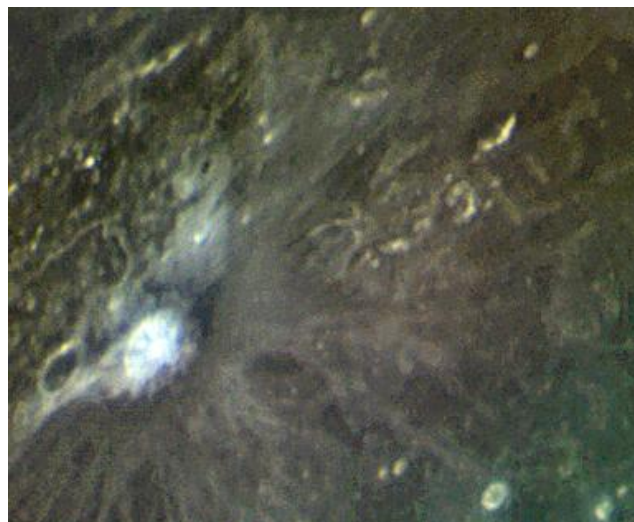
*Aristarchus 1981 Mar 17 UT 22:40-23:25 Observed by Moore (Selsey, England, 15" reflector, seeing III) "Aristarchus very bright according to Crater Extinction Device and a colored blink detected" BAA Lunar Section LTP report. ALPO/BAA weight=2.*

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



**Figure 9.** Sketches of Aristarchus and Herodotus by Alberto Anunziato, orientated with north towards the top. **(Left)** 2018 May 26 UT 00:00-00:15. **(Right)** 2016 Jun 17 UT 05:00.

Alberto was using a Meade EX 105 telescope at x154 under 8/10 seeing. Color was looked for but nothing was seen, so the Baumeister LTP shall remain at a weight of 2. Aristarchus was certainly very bright, and the bands were difficult to see, so it is fair to lower the weight of the Moore LTP report from 2 to 1. Alberto commented that shadows on both craters were reducing over the course of the observing session. Over time, as the seeing got worse the bands of Aristarchus became invisible, but Herodotus N was apparently brighter than the previous observation. Studying the two sketches that Alberto produced – there are two main differences: apart from the bright spot seen inside Herodotus back in 2016 (Fig 9 – Right), the shadow coming off the Vallis Schroteri area did not extend as far south, into the crater, as it does in the 2018 sketch (Fig 9 – Left). We shall leave the weight at 1 for now.



**Figure 10.** Aristarchus imaged by Maurice Collins (ALPO/BAA/RASNZ) on 2018 May 29 UT 09:25 with color saturation set at 60% and orientated with north towards the top.



**Aristarchus:** On 2018 May 29 UT 09:25 Maurice Collins (ALPO/BAA/RASNZ) imaged this crater under the same illumination (to within  $\pm 0.5^\circ$ ) to the following reports:

*Aristarchus 1972 Oct 21 UT 2:10-22:45 observed by Schnuchal (52.5N, 13.25E, 600mm f/11.7 reflector, T=1, S=3) "Bright spot with maximum intensity at 22:10 UT diminution in brightness well observable" - Hilbrecht and Kuveler, Earth, Moon & Planets, 30 (1984),p53-61. ALPO/BAA weight=1.*

*Aristarchus-Herodotus 1969 Jan 03 UT 03:20-03:50 Observed by Taboada (Mexico) "Brightness between craters dimmed at 0345. Change in coloration in N. part of Aris. -- gray & slightly pinkish. Became more remarkable at 0350 in almost all the extension of the cleft, (Sch. Vall. ?)." NASA catalog weight=3. NASA catalog ID #1114. ALPO/BAA weight=3.*

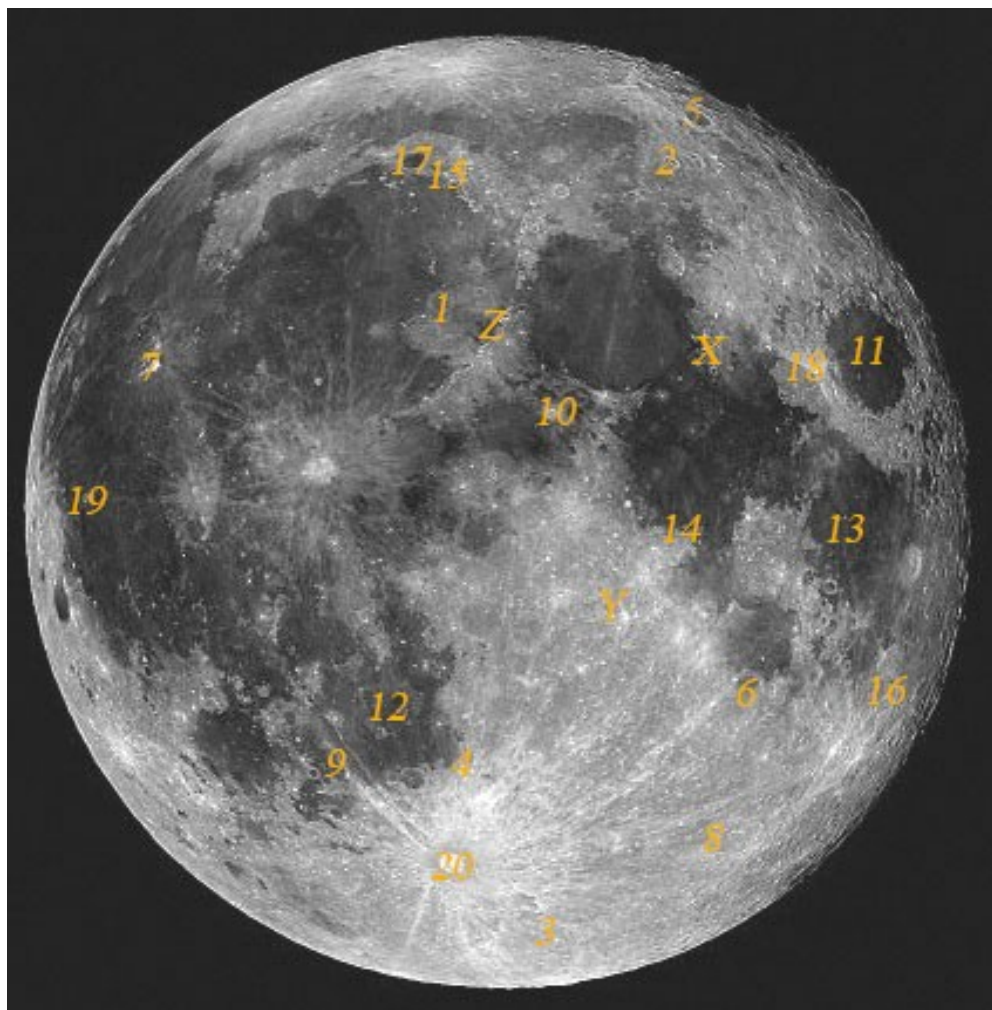
Maurice's image (Fig 10) shows several bright areas in between the bands and a bright area on the floor—so it is difficult to know which bright spot was seen by Schnuchal, and we cannot really comment on the variation in brightness, so it is best to leave the already low weight of 1 as it is. Similarly for the Taboada report, we cannot comment on the brightness change, but Maurice's image is useful in respect to the color in that the only pinkish areas to be seen are on the inner ejecta blanket, to the south, not to the north. We shall leave the weight of the 1969 report at 3, though it is possible that some/all of this might have been related to observing conditions/atmospheric spectral dispersion?

**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](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](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

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## KEY TO IMAGES IN THIS ISSUE

1. Archimedes
2. Atlas
3. Clavius
4. Deslandres
5. Endymion
6. Fracastorius
7. Herodotus
8. Janssen
9. Kies
10. Manilius
11. Mare Crisium
12. Mare Nubium
13. Messier
14. Moltke
15. Montes Alpes
16. Petavius
17. Plato
18. Proclus
19. Reiner  $\gamma$
20. Tycho



### **FOCUS ON targets**

**X = Apollo 17 Mare Serenitatis**

**Y = Apollo 16 Descartes-Cayley Plains**

**Z = Apollo 15 Mare Imbrium-Hadley Rille**