ASSOCIATION OF LUNAR & PLANETARY OBSERVERS
ALPO
Founded in 1947

THE LUNAR OBSERVER

A PUBLICATION OF THE LUNAR SECTION OF THE A.L.P.O.
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14120 S. Mica Place, Tucson, AZ 85736
RECENT BACK ISSUES: http://moon.scopesandscapes.com/tlo_back.html

FEATURE OF THE MONTH – JULY 2019

PEEKING IN A KEYHOLE

Hainzel. Richard Hill, Tucson, Arizona USA.
March 17, 2019 03:42 UT. Seeing 8/10, Colongitude 39.8°.
8" f/20 Mak-Cass. Skyris 445M, 610nm filter

About the same time you see Kepler and Gassendi on the terminator you will find this keyhole shaped crater in the south. Hainzel (70km dia.) is the southern lobe of this figure-8 shaped feature that consists of 3 craters. The northern beautifully terraced lobe is Hainzel A and in the shadow side (east) of Hainzel itself is Hainzel C who's west wall can be seen on the floor of Hainzel. This is a very identifiable feature making it a landmark for exploring this region. To the right of Hainzel is a small crater Epimenides (27km). South of this crater is a similar sized crater, Epimenides B (26km) with a curious bulge on it's floor. North of these is a small mare, Lacus Timoris that winds its way east from Hainzel. Note the nice rima that proceeds north from Hainzel A into Palus Epidemiarum near the crater Capuanus (61km) at the top of the image. You can see one of its 3 domes on the floor of that crater.

Below Hainzel is the large crater Mee. It is perhaps the oldest formation in this image going back to Pre-Nectarian times 4.55-3.92 billion years ago!

LUNAR CALENDAR

2019	U.T.	EVENT
Jul 02	19:16	New Moon
02	19:23	Total Solar Eclipse
02	22:02	Moon North Dec.: 22.4° N
03	06:53	Moon Ascending Node
04	10:34	Moon-Mercury: 3.3° S
05	04:54	Moon Perigee: 363700 km
09	10:55	First Quarter
13	19:43	Moon-Jupiter: 2.5° S
15	22:49	Moon South Dec.: 22.4° S
16	07:27	Moon-Saturn: 0.2° N
16	09:05	Moon Descending Node
16	21:31	Partial Lunar Eclipse
16	21:38	Full Moon
21	00:01	Moon Apogee: 405500 km
25	01:18	Last Quarter
30	09:10	Moon North Dec.: 22.4° N
30	17:02	Moon Ascending Node

2019	U.T.	EVENT
Aug 01	03:12	New Moon
02	07:08	Moon Perigee: 359400 km
07	17:31	First Quarter
09	22:53	Moon-Jupiter: 2.6° S
12	04:28	Moon South Dec.: 22.4° S
12	10:05	Moon-Saturn: 0°
12	14:45	Moon Descending Node
15	12:29	Full Moon
17	10:50	Moon Apogee: 406200 km
23	14:56	Last Quarter
26	17:53	Moon North Dec.: 22.5° N
27	01:50	Moon Ascending Node
30	10:37	New Moon
30	15:57	Moon Perigee: 357200 km

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.

ASSOCIATION OF LUNAR & PLANETARY OBSERVERS

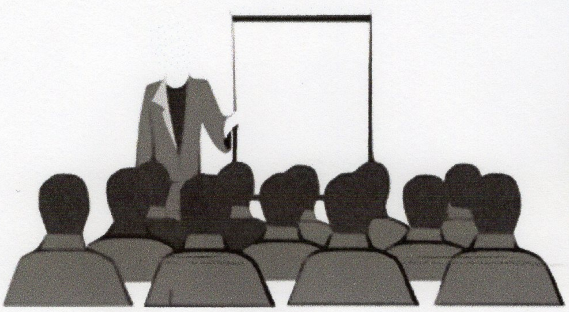
ALPO

Founded in 1947

ALPO '19

July 12-13, 2019

A joint conference of the
Assn of Lunar & Planetary Observers and the
Southeast Region of the Astronomical League



Venue: Gordon State College, in picturesque
Barnesville, Georgia (near Atlanta)

Look for conference details via regular and e-mail soon!

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: Alphonsus & Aristarchus

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 2019** edition will be **Alphonsus & Aristarchus,** two of the ALPO Selected Areas**.** 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 Alphonsus & Aristarchus article is August. 20, 2019

FUTURE FOCUS ON ARTICLES:

In order to provide more lead time for contributors the following future targets have been selected:
The next series of three will concentrate on subjects of the Selected Areas Program.

Subject	TLO Issue	Deadline
Atlas & Copernicus	November 2019	October 20 ,2019
Plato & Theophilus	January 2020	December 20, 2019
Tycho & Herodotus	March 2020	February 20, 2020

Focus On: Apollo 11 – The Sea of Tranquility

Jerry Hubbell

Assistant Coordinator, Lunar Topographical Studies

This is the sixth and final article in a series of six TLO Focus On articles on the Apollo lunar landing missions. This series started with the first issue on Apollo 17 in the September 2018 issue of the TLO. To learn about the background and thinking behind this series of articles to commemorate the Apollo program see that issues Focus On article. A prior version of this article also appears in the July 2019 issue of *The Strolling Astronomer*, the *Journal of the Association of Lunar and Planetary Observers.*

Figure 1. *Apollo 11 Mission Logo/Patch, NASA image.*

On September 12, 1962, in Houston, Texas, President John F. Kennedy called on the nation to commit itself to placing a man on the Moon and returning him safely to the Earth. His speech, called the "We choose to go to the Moon" speech issued the following challenge:

> "…We choose to go to the Moon! We choose to go to the Moon...We choose to go to the Moon in this decade and do the other things, not because they are easy, but because they are hard; because that goal will serve to organize and measure the best of our energies and skills, because that challenge is one that we are willing to accept, one we are unwilling to postpone, and one we intend to win, and the others, too…" – John F. Kennedy

The Apollo program was the final push in the "Space Race" between the United States and the Soviet Union started with the launch of Sputnik on October 4, 1957. During this period in the "Cold War", the Soviet Union was perceived to be leading the race up until the Apollo 8 mission in December 1968 when three astronauts, Jim Lovell, Frank Borman, and William Anders circumnavigated the Moon. Up until this point the Soviet Union had several space firsts to its name, most notably the first satellite launched into space, the first man in space, and the first spacewalk. What made Apollo 8 that more significant is that the United States had just recovered from the Apollo 1 fire which in January 1967 took the lives of astronauts Gus Grissom, Edward White, and Roger Chaffee. This was a significant setback and a blow to the American people. Kennedy's goal was successfully completed on July 24, 1969 and became a prime source of pride and confidence in the American people going forward and I believe, led to the explosive development in electronic technology in the decades following the Apollo program.

Apollo 11 was launched on July 16, 1969 at 9:32 AM EDT from the Kennedy Space Center. The crew consisted of Commander Neil Armstrong, Command Module Pilot Edwin “Buzz” Aldrin, and Lunar Module Pilot Michael Collins. (Figure 2.) The astronauts had a trouble-free 76-hour journey to the Moon and arrived in lunar orbit at 01:22 PM EDT on July 19, 1969.

Figure 2. *Apollo 11 Astronauts. from left to right, Neil Armstrong, Michael Collins, and Edwin “Buzz” Aldrin. NASA image.*

Apollo 11 was the first manned lunar landing on the Moon. After an exhilarating landing (my description) in the southwest region of Mare Tranquilitatis (Sea of Tranquility) (Figure 5) on July 20, 1969 at 4:18 PM EDT the astronauts prepared for a stay of just under 24 hours. Neil Armstrong took manual control of the final approach to landing when the LM computer was leading them to crater West. Armstrong used up most of the last minute of fuel finally setting the LM down with only about 15 seconds of fuel left. During the landing computer alarms, the famous “1201” and “1202” alarms, also interrupted the proceedings and was caused by the landing radar being in the wrong mode causing the computer to become too busy. This caused the computer to reboot itself a few times during the landing approach.

The Apollo 11 Lunar Module (LM) landed approximately 400 meters west of crater West and 20km south-southwest of the crater Sabine D at selenographic coordinates 0° 40’ 27” N latitude and 23° 28’ 23” E longitude. The landing site is also 109 miles (175 km) south of crater Arago 16 miles (26 km), and 236 miles (380 km) north of crater Theophilus 61 miles (101 km.) The lunar module crew only spent a little 0.9-days on the surface and performed one 2h32m EVA during their stay. (Figure 3) At 10:56 PM EDT on July 20, 1969, Neil Armstrong became the first man to walk on the Moon. He stepped off the LM and uttered this famous line: “That’s one small step for (a) man, one giant leap for mankind.”

In his book, “*To a Rocky Moon*”, geologist Don Wilhelms discusses the process by which Apollo landing sites were chosen.

> *“…After Apollo 12, scientific considerations were given considerable weight but, for the very first landing (ed. Apollo 11), the site was chosen entirely for operational reasons. During the Lunar Orbiter missions, the high-resolution cameras had been focused on promising sites strung out along a 10-degree-wide band straddling the lunar equator. Equatorial sites were of interest because they could be reached with a minimal expenditure of fuel. Sites were also sought at least 45 degrees west of the east limb of the Moon - the right edge as seen from the northern hemisphere on Earth - because the landers were going to orbit from east to west and Houston was going to need several minutes of tracking data so that the landing computer could be updated prior to the descent. As Jack Schmitt related during a review of this introduction, "The targeted point for Apollo 8 was picked as the easternmost site that the Flight Control Division thought they could handle, the easternmost certified (acceptably smooth) site for which they*

thought there would be enough time after AOS (Acquisition of Signal) to track the Lunar Module, update its state vector, and get a successful landing. So Apollo 8 was targeted for that site (designated as Apollo Landing Site 1) and, when it came time for Apollo 10, they targeted it to the same site, because they already had a rough data package (that is, data on orbits and the timing of events during the mission) that they could refine based on the relative positions of the Earth and Moon at the planned time of launch. (Launch times were picked in part, so that, at the time of landing, the Sun would be between 5 and 13 degrees above the landing site horizon, low enough to give good shadow definition of the terrain and not so low that everything would be obscured by overly-long shadows. Lighting conditions at the Cape and at abort recovery sites were also factors) …"

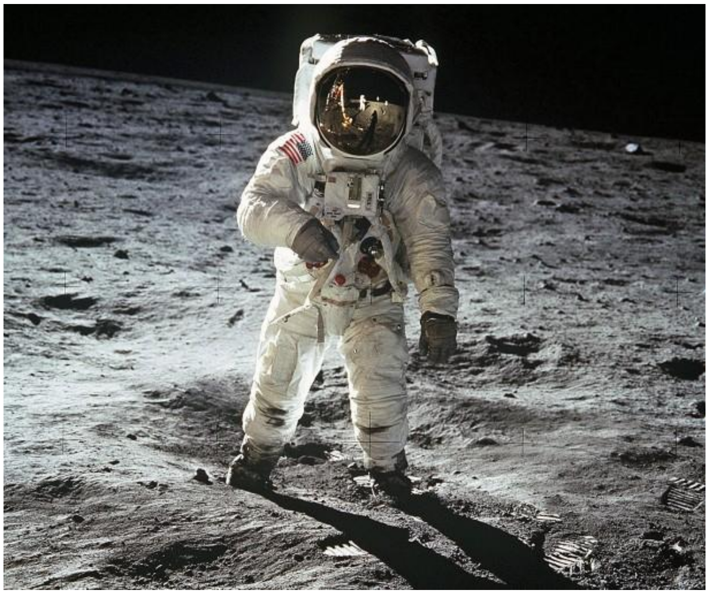


Figure 3. *Apollo 11 Astronaut Edwin "Buzz" Aldrin on the surface of the moon on July 20, 1969 during their two and a half-hour EVA. NASA image.*

The main mission and program objective was to successfully complete Kennedy's challenge to *land a man safely on the Moon and return him safely to the Earth*. The secondary objectives included exploring the southwest region of the Sea of Tranquility and set up and activate the first lunar surface scientific experiments, a predecessor to the Apollo Lunar Surface Experiment Package (ALSEP) used in later mission called the Early Apollo Scientific Experiments Package (EASEP). The EASEP consisted of 3 experiments: A *Laser Ranging Retroreflector experiment*, a *Passive Seismic experiment*, and a *Lunar Dust Detector experiment*. They also deployed a camera system, a solar wind experiment, and deployed the first American flag on the Moon's surface.

The early Apollo mission site selection criteria was based on the need to sample sites that were representative of the lunar surface and could provide materials to start to understand the origin of the moon.

According to the *Criteria for Lunar Site Selection*, Report No. P-30 (reference)

"…According to the rationale of level 2, the individual mission sites must be chosen to represent homogeneous provinces and/or scientifically significant features. The homogeneous sites must have characteristics, in so far as can be determined from the orbital reconnaissance of level 1 which are typical of the province in which they lie, so that the information obtained from each site is of significance regarding a large portion of the Moan, or hopefully the entire Moon. By this definition it is to be understood, once such a homogeneous province has been defined, that the actual location of the landing site within the province is not critical and that from a scientific stand point extensive traverse capability is not require. Large fractions of the various lunar maria, the majority of exposed ejecta from Imbrium or Oriental, and portions of the cratered upland plains between Maurolycus and Janssen are examples of areas where level 2 landing sites would yield the desired scientific information."

The Sea of Tranquility is in the northeastern quadrant of the moon and the Apollo 11 landing site is in the southwest region of the quadrant (Figure 6.) The northeast quadrant of the moon has a wealth of features that are suitable for a small telescope to observe and anytime between a 1-day old and a 7-day old Moon will give the best views because of the long shadows near the terminator. The list of craters that are viewable even with a 70 mm refractor, or a 10x60 set of binoculars is large. Some of the most prominent are the craters Plato 61 miles (98 km), Aristoteles 53 miles (85 km), Eudoxus 41 miles (66 km), Cassini 35 miles (56 km), Archimedes 50 miles (80 km), Hercules 42 miles (68 km), Atlas 53 miles (85 km), Posidonius 58 miles (93 km), Aristillus 33 miles (53 km), Delambre 32 miles (51 km), Theophilus 61 miles (98 km), Cyrillus 59 miles (95 km), and Agrippa 28 miles (45 km). Details on these and more, can be obtained by using the program *Virtual Moon Atlas* (see References). This is an excellent program for those wanting to learn the features of the moon and identify those features in your own or other's photographs.

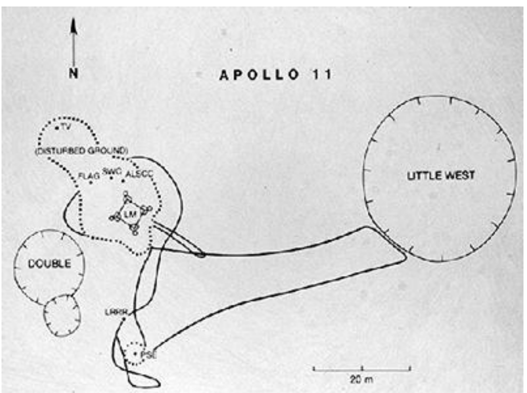


Figure 4. *Apollo 11 Landing Site – EVA Traverse Map, Surface Operations Overview NASA.*

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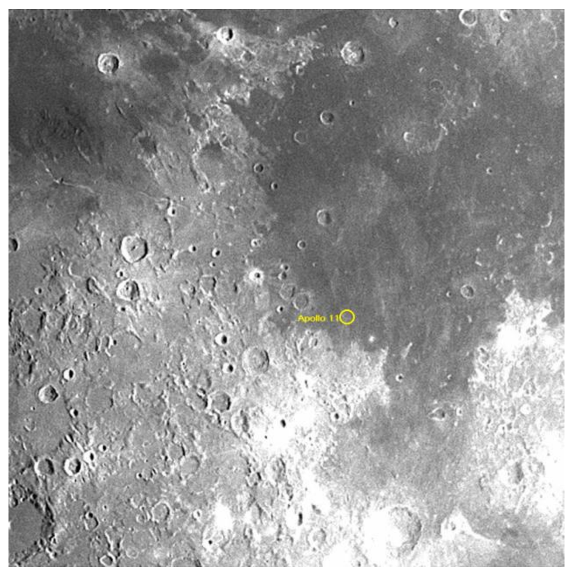


Figure 5*. Apollo 11 Landing Site and Surrounding Area, Jerry Hubbell, Locust Grove, Virginia, 03 April 2009, 1926 UT. Colongitude, 17.6°, SkyWatcher 12-cm f/7.5 APO refractor, ATIK 314e CCD Camera. Visibility, 4/5 Transparency, 3/5. (ed. this is a crop of Figure 6.)*

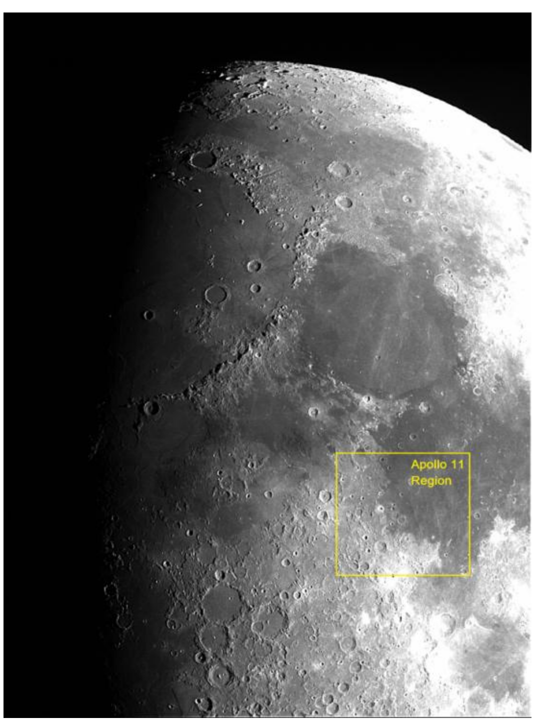


Figure 6. *Mare Tranquilitatis (Sea of Tranquility), Jerry Hubbell, Locust Grove, Virginia, 03 April 2009, 1926 UT. Colongitude, 17.6°, SkyWatcher 12-cm f/7.5 APO refractor, ATIK 314e CCD Camera. Visibility, 4/5 Transparency, 3/5.*

Alberto Martos submitted Figures 7 and 8, the Sea of Tranquility and Tranquility Base from an observing session over 11 years ago. He provided the following notes for the observation:

> *"…I remember a strong difficulty in viewing the small craterlets dedicated to the three astronauts, Armstrong, Collins and Aldrin. A mild turbulence, I live in a small village close to a large town (Madrid) prevented me to see those craterlets, only a glimpse from time to time. I observed the heavily eroded crater Julius Caesar, whose flat lava flooded surface was proposed for landing site at once and the Ritter and Sabine lack of secondaries as well as rays, but none of the small ones. Then, I decided to take a few pictures with Phillips TouCam Pro camera. Photo 1 (Figure 7) was stacked out of 100 frames and shows the area of SW Mare Tranquillitatis. Crater Maskelyne was cut half, but Ritter and Sabine were well centered. In this photo I have annotated the chief craters visible. Having lost the opportunity to introduce a Barlow lens, I have recently enlarged this photo by means of InPixio Photo Maximizer, in an attempt to take a look to the craters. The result can be seen in photo 2 (Figure 8), but I request the indulgency of the reader, to guess the situation of the three craters. I'm sure they can be perceived, at least I can!"*

Rik Hill provided some great views of the Sea of Tranquility and Tranquility Base also (Figures 9, and 10):

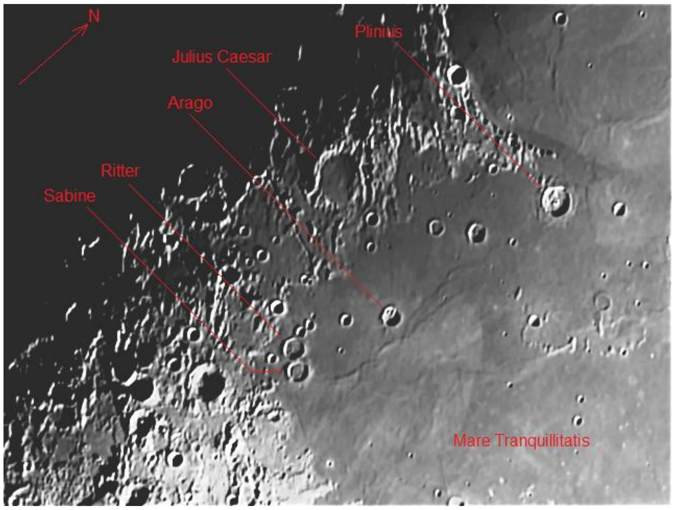


Figure 7. *Mare Tranquillitatis (Sea of Tranquility), Alberto Martos, Madrid, Spain, 11 May 2008, 2147 UT, Colongitude, 350.2°, 20 cm f/7.2 Newtonian, Phillips TouCam Pro, Visibility, 3/5 Transparency, 4/5.*

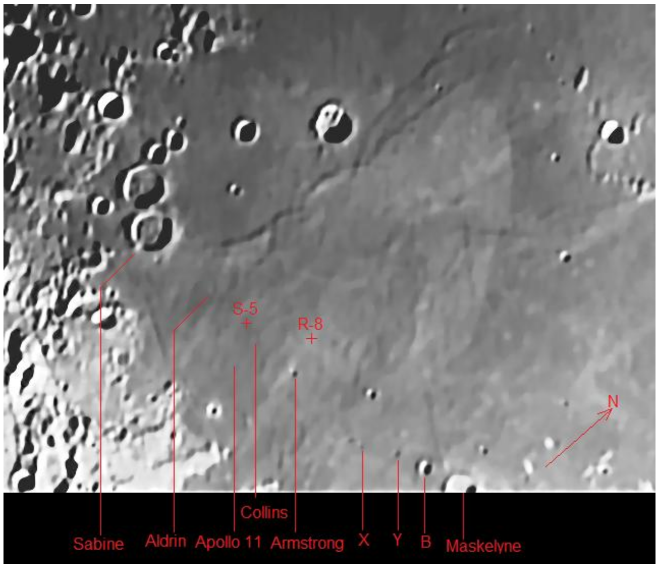


Figure 8*. Statio Tranquillitatis (Tranquility Base), Alberto Martos, Madrid, Spain, 11 May 2008, 2147 UT, Colongitude, 350.2°, 20 cm f/7.2 Newtonian, Phillips TouCam Pro, Visibility, 3/5 Transparency, 4/5.*

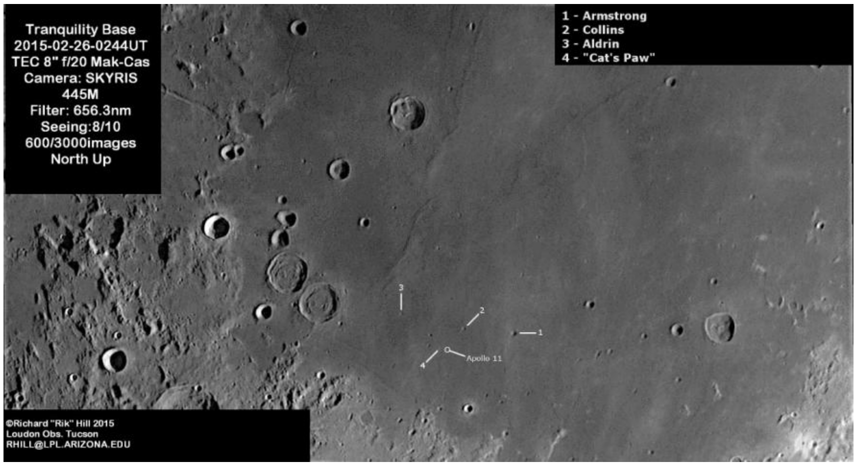


Figure 9. *Mare Tranquillitatis (Sea of Tranquility), Rik Hill, Tucson, Az USA, 25 February 2015, 0244 UT, Colongitude, 357.9°, TEC 8-inch f/20 Maksutov-Cassegrain, SKYRIS 445M, 656.3nm Filter, Seeing, 8/10, North Up, East Right.*

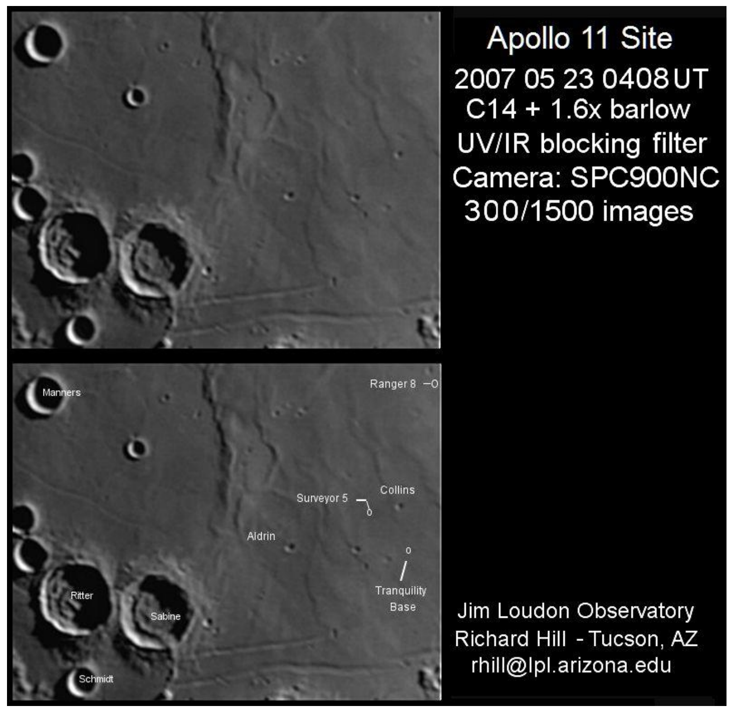


Figure 10. *Statio Tranquillitatis (Tranquility Base), Rik Hill, Tucson, Az USA, 23 May 2007, 0408 UT, Colongitude, 345.6°, Celestron C14, 1.6x Barlow, SPC900NC camera, North Up, East Right.*

All these craters are fascinating in their own way and will provide many hours of enjoyment while studying their special characteristics. Figure 11 lists all the Apollo Lunar missions and the features that are located near each of the landing sites.

NASA's Apollo Program was probably mankind's greatest adventure up till now, and nothing will rival it until we land on Mars within the next couple of decades. It is ironic that this great space adventure started as a competition between two political ideologies that continue to this day. It is best to remember what was brought to the Moon on a plaque fixed to the landing leg of the Apollo 11 LM:

HERE MEN FROM THE PLANET EARTH

FIRST SET FOOT UPON THE MOON

JULY 1969, AD

WE CAME IN PEACE FOR ALL MANKIND

Apollo Mission Information

prepared by G.R. Hubbell - Assistant Coordinator, Lunar Topographical Studies, Lunar Section, ALPO

Mission	Apollo 11	Apollo 12	Apollo 14	Apollo 15	Apollo 16	Apollo 17
Mission Launch	16-Jul-1969 13:32:00 UTC	14-Nov-1969 16:22:00 UTC	31-Jan-1971 21:03:02 UTC	26-Jul-1971 13:34:00 UTC	16-Apr-1972 17:54:00 UTC	07-Dec-1972 05:33:00 UTC
Lunar Landing	20-Jul-1969 20:18:04 UTC	19-Nov-1969 06:54:35 UTC	05-Feb-1971 09:18:11 UTC	30-Jul-1971 22:16:29 UTC	21-Apr-1972 02:23:35 UTC	11-Dec-1972 19:54:57 UTC
Lunar Departure	21-Jul-1969 17:54:00 UTC	20-Nov-1969 14:25:47 UTC	06-Feb-1971 18:48:42 UTC	02-Aug-1971 17:11:23 UTC	24-Apr-1972 01:25:47 UTC	14-Dec-1972 22:54:37 UTC
Splashdown	24-Jul-1969 16:50:35 UTC	24-Nov-1969 20:58:24 UTC	09-Feb-1971 21:05:00 UTC	07-Aug-1971 20:45:53 UTC	27-Apr-1972 19:45:05 UTC	19-Dec-1972 19:24:49 UTC
Mission Duration	8d 03h 18m 35s	10d 04h 36m 24s	9d 00h 01m 58s	12d 07h 11m 53s	11d 01h 51m 05s	12d 13h 51m 59s
Time on Lunar Surface	21h 36m 00s	31h 31m 12s	33h 30m 31s	66h 54m 54s	71h 02m 12s	74h 59m 40s
Number of EVAs	One	Two	Two	Four - One EVA in space	Four - One EVA in space	Four - One EVA in space
EVA Time on Lunar Surface	2h 31m 40s	7h 45m 18s	9h 22m 31s	18h 30m 00s	20h 14m 14s	22h 03m 57s
Mission Commander	Neil Armstrong	Charles Conrad	Alan Shepard	David Scott	John Young	Eugene Cernan
Lunar Module Pilot	Buzz Aldrin	Alan Bean	Edgar Mitchell	James Irwin	Charles Duke	Harrison Schmidt
Command Service Module Pilot	Mike Collins	Richard Gordon	Stuart Roosa	Alfred Worden	Ken Mattingly	Ronald Evans
Mission Goals	First manned landing on the moon, Early Apollo Surface Experiement Package (EASEP)	Precision Landing near Surveyor 3 spacecraft, Apollo Lunar Surface Experiments Package(ALSEP), lunar orbital experiements and photography H-mission type	First use of the "Lunar Rickshaw", Examination of Cone Crater, lunar surface experiments (ALSEP) and lunar orbital experiments and photography H-mission type	First use of the Lunar Rover, lunar surface experiments (ALSEP) and lunar orbital experiements and photography first J-mission type	lunar surface experiments (ALSEP) and lunar orbital experiments and photography J-mission type	lunar surface experiments (ALSEP) and lunar orbital experiments and photographym last mission to the moon
Landing Site Name	Sea of Tranquility	Ocean of Storms	Fra Mauro Highlands	Mare Imbrium-Hadley Rille	Descartes - Cayley Plains	Sea of Serenity
Landing Site Selenographic Coordinates	0.674°N 23.473°E	3.0124°S 23.4216°W	3.654°S 17.471°W	26.132°N 3.634°E	8.973°S 15.500°E	20.191°N 30.772°E
Landing Site Features	Flat plain, near southern edge of Mare Tranquilitatis	Surveyor 3 spacecraft	First mission to lunar highlands, volcanic activity	Mt Hadley, Hadley Delta, Hadley Rille	Lunar Highland material older than previous missions, volcanic activity in area	Lunar Highland material older than Mare Imbrium, volcanic activity in the area
Focus On Observations	Delambre, Sabine, Ritter, Godin, Agrippa, Maskelyne, Lamont, Theophilus, Torricelli	Copernicus, Reinhold, Lansberg, Ptolemaeus, Alphonsus, Arzachel, Bullialdus, Montes Riphaeus	Fra Mauro, Parry, Bonpland,Guericke, Rimae Parry, Gambart, Lansberg, Reinhold, Tolansky	Hadley Rille, Hadley Delta, Archimedes, Aristillus, Autolycus, Conon, Galen, Aratus,	Ptolemaeus, Alphonsus, Arzachel, Rupes Recta, Albategnius, Klein, Hipparchus, Herschel, Abulfeda, Delambre	Posidoius, Plinius, Dawes, Cleomedes, Macrobius, Romer, Jansen, Dorsa Smirnov, Dorsa Lister
Observing Equipment - Minimum to observe all objects listed	50 - 100 mm Telescope	50 - 100 mm Telescope	50 - 100 mm Telescope	50 - 100 mm Telescope	50 - 100 mm Telescope	50 - 100 mm Telescope
Submissions - Images	N/A	3 - 8 images + comments	1 - 13 images + comments	5 - 19 images + comments	3 - 5 images + comments	4 - 13 images + comments
NASA Mission Surface Operations Page	NASA Apollo 11 Mission	NASA Apollo 12 Mission	NASA Apollo 14 Mission	NASA Apollo 15 Mission	NASA Apollo 16 Mission	NASA Apollo 17 Mission
TLO - Focus On Article	Apollo 11 Not Yet Written	Apollo 12	Apollo 14	Apollo 15	Apollo 16	Apollo 17

Figure 11. Apollo Manned Lunar Landing Mission Information compiled by Jerry Hubbell.

REFERENCES:

Wilhelms, Don E. 1993. *To a Rocky Moon: A Geologist's History of Lunar Exploration*, The University of Arizona Press, Tucson. https://www.lpi.usra.edu/publications/books/rockyMoon/ (retrieved June 13, 2019)

Lunar and Planetary Institute, *Apollo 11 Mission Surface Operation Overview*, https://www.lpi.usra.edu/lunar/missions/apollo/apollo_11/surface_opp/ (retrieved June 13, 2019)

James L. Lewis, Charles D. Wheelwright, September 1965, *Lunar Landing and Site Selection Study*, NASA Technical Note TN D-2999, Manned Spacecraft Center, Houston, TX. https://www.lpi.usra.edu/lunar/documents/nasa_tn_d2999_1965.pdf (retrieved May 01, 2019)

A. B. Binder, D. L. Roberts, January 1970, *Criteria for Lunar Site Selection*, Report Number P-30, section 3.2 Landing Site 7, Apollo Lunar Exploration Office, National Aeronautics and Space Administration, Washington, D. C. https://www.lpi.usra.edu/lunar/documents/criteria_ls_selection.pdf (retrieved May 02, 2019)

Chen, James L. 2014. *How to Find the Apollo Landing Sites*. Springer, New York.

Lunar Reconnaissance Office ACT-REACT Quick Map, http://target.lroc.asu.edu/q3/ (retrieved October 31, 2017)

Patrick Chevalley, Christian Legrand, *Virtual Moon Atlas*, http://ap-i.net/avl/en/start (retrieved June 30, 2018)

Lunar and Planetary Institute, *Digital Lunar Orbiter Photographic Atlas of the Moon*, http://www.lpi.usra.edu/resources/lunar_orbiter/ (retrieved September 1, 2017).

ADDITIONAL READING:

Bussey, Ben & Paul Spudis. 2004. The Clementine Atlas of the Moon. Cambridge University Press, New York.

Byrne, Charles. 2005. Lunar Orbiter Photographic Atlas of the Near Side of the Moon. Springer-Verlag, London.

Chong, S.M., Albert C.H. Lim, & P.S. Ang. 2002. Photographic Atlas of the Moon. Cambridge University Press, New York.

Chu, Alan, Wolfgang Paech, Mario Wigand & Storm Dunlop. 2012. The Cambridge Photographic Moon Atlas. Cambridge University Press, New York.

Cocks, E.E. & J.C. Cocks. 1995. Who's Who on the Moon: A biographical Dictionary of Lunar Nomenclature. Tudor Publishers, Greensboro

Gillis, Jeffrey J. ed. 2004. Digital Lunar Orbiter Photographic Atlas of the Moon.. Lunar & Planetary Institute, Houston. Contribution #1205 (DVD). (http://www.lpi.usra.edu/resources/lunar_orbiter/).

Grego, Peter. 2005. The Moon and How to Observe It. Springer-Verlag, London.

IAU/USGS/NASA. Gazetteer of Planetary Nomenclature. (http://planetarynames.wr.usgs.gov/Page/MOON/target).

North, Gerald. 2000. Observing the Moon, Cambridge University Press, Cambridge.

Rukl, Antonin. 2004. Atlas of the Moon, revised updated edition, ed. Gary Seronik, Sky Publishing Corp., Cambridge.

Schultz, Peter. 1972. Moon Morphology. University of Texas Press, Austin. The-Moon Wiki. http://the-moon.wikispaces.com/Introduction

Wlasuk, Peter. 2000. Observing the Moon. Springer-Verlag, London.

Wood, Charles. 2003. The Moon: A Personal View. Sky Publishing Corp. Cambridge.

Wood, Charles & Maurice Collins. 2012. 21st Century Atlas of the Moon. Lunar Publishing, UIAI Inc., Wheeling.

TARUNTIUS AND MASKELYNE IN THE WORDS OF NEIL ARMSTRONG

Alberto Anunziato

The Sociedad Lunar Argentina wishes to pay tribute to the three members of the Apollo 11 mission, true heroes whom we will always admire with kid's eternal eyes. For that we decided to look in our archive images of craters that the astronauts of that mission had observed in the Mare Tranquilitatis and we discovered the following images of Taruntius (fig. 1) and Maskelyne (fig. 2).

FIGURE 1. ***TARUNTIUS*** *– Alberto Anunziato, Oro Verde, Argentina. August 21,, 2016 05:16UT. 250mm Meade LX-200 SCT, QHY5-II, Astronomics 742nm IR-pass filter.*

In the transcription of the Technical Air-to-Ground Voice Transmission (GOSS NET 1) from the Apollo 11 mission (https://www.hq.nasa.gov/alsj/a11/a11transcript_tec.html), we read how Neil Armstrong mentions Taruntius while the Lunar Module "Eagle" approaches its landing site, the Tranquility Base: "Apollo 11 is getting its first view of the landing approach. This time we are going over the Taruntius crater, and the pictures and maps brought back by Apollo 8 and 10 have given us a very good preview of what to look at here. It looks very much like the pictures, but like the difference between watching a real football game and watching it on TV. There's no substitute for actually being here. "

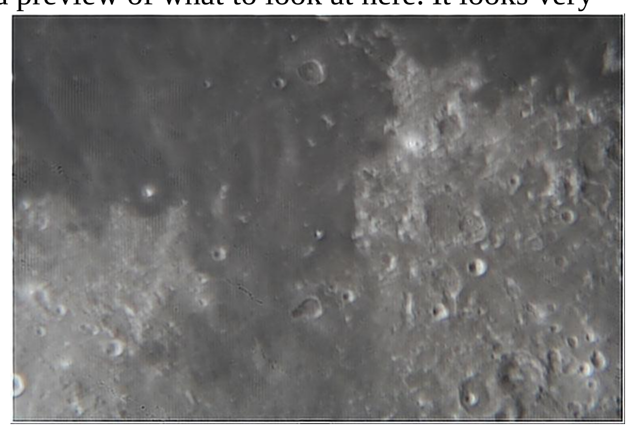


FIGURE 2. ***MASKELYNE*** *– Alberto Anunziato, Oro Verde, Argentina. March 4,, 2018 65:10 UT. 280mm Celestron CPC 1100 SCT, Canon EOS Digital Rebel XS..*

We can see why Armstrong recognized Taruntius among the countless craters that observed from the lunar module: its particular shape and the difference in size compared to the countless smaller craters of Mare Tranquilitatis.

The mention of Maskelyne can be found in "The First Lunar Landing as Told by the Astronauts" a NASA brochure containing "a transcript of the Apollo 11 post-flight press conference, in which the astronauts discussed the scenes shown in 40 photographs taken during the mission". On page 13 Armstrong says: "This is a view of the descent trajectory area as viewed through the LM window during our activation. (Photo 7.) In the bottom right if the photograph is the crater Maskelyne and the bottom center is the -mountain called Boot Hill. Immediately above Boot Hill is a small Sharp rimmed crater called Maskelyne W that was the crater we used to determine our downrange and crossrange position prior to completing the final phases of the descent".

APOLLO 11: THE GRAND ADVENTURE

Alberto Martos
Lunar Group, Madrid Amateur Astronomy Society

Project Apollo was at once the driving force behind the lunar geologic program, the focus of geologically based forecast about lunar terrains and rock types, the emotional culmination of many careers, and the source of massive new data that would propel and redirect post-Apollo investigations…. While armies of engineers tackled the never-ending challenge of building and rebuilding new rockets, platoons of scientists were assembling their wish lists of objectives for Apollo and its hoped-for successors.

Donald E. Wilhelms, *To a Rocky Moon*.

From remembrance.

NOTE: Being this media a geology committed forum for lunar observers, I will not tackle the political implications that surrounded the birth of the Apollo Project. Besides this, and since there was a total opacity for contacts or data exchanges between scientists from US and USSR Lunar Programs, I deal here only with the US probes.

Attaining a geological explanation of the formation of the Moon and a description of its surface features, as well as its internal structure, were the strong concerns of planetologists at mid-twentieth century. Telescopic observations had until then provided ambiguous information about a certain type of lunar typical features: the craters. As a result of the geologic interpretation of their telescopic appearance, at the end of 19th century a heated discussion had arisen about their origin, whether endogenous (volcanic) or exogenous (meteoritic), which should have been resolved by the middle of the 20th century (1967) for the successes of space exploration through unmanned exploring devices.

Indeed, as forerunners of Man, the Moon received the visits of three armadas of unmanned ships, Lunar Rangers (impact probes), Lunar Surveyors (landers) and Lunar Orbiters (photographers from orbit), intended to increase the knowledge provided by telescopes to humans, in order to pave the way for men to land in its surface. These machines digitally mapped and photographed the entire lunar surface (no-longer *terra incognita*) and landed at several key-points to physically and chemically prove the nature of the lunar soil. Although the outcome of this research endeavor favored the impact hypothesis, it remained unaccepted for a minority of the scientific community. Issues as the discovery by the Russian astronomer Kozyrev of a gaseous eruption from the crater Alphonsus' peak (1958), had refueled the discrepancy (Sky & Telescope Sept. 1999). It seemed necessary an on-lab analysis of lunar soil samples to clarify this disagreement between supporters of both hypotheses and the Apollo Project was expected to provide this possibility: bring home lunar rock and soil samples.

The Kozyrev's issue enforced scientists Harold Urey and Gerald Kuiper, members of the [Lunar] Surveyor Scientific Evaluation Advisory Team, to retargeting the Ranger 8 impact probe to fly over crater Alphonsus and Ranger 9 (the last in this series), originally aimed to Vallis Schrötery, to crash land in this crater. As those spacecraft lacked a spectrograph on-board, they were unable to detect the feldespathic nature of Alphonsus' peak, and Ranger 9 neither to photography any pit or slit where the volcanic eruption might have come out from, but succeeded in taking photographs of five dark spots in the crater floor, undoubtedly of basaltic nature, and

Ranger 8 took pictures of two other objects located along its flight path, the twin young craters Ritter and Sabine, whose absence of secondary craters and rays, despite their youth, were taken as tokens of their volcanic origin.

As the volcanic root of craters origin bloomed, a new device was needed to scoop basaltic evidences in the area: Lunar Surveyor 5, the firs probe of its kind outfitted with a pantograph arm carrying a radioactive (alpha particles) soil analyzer, was sent to Mare Tranquillitatis and landed successfully 60 km far from the Ranger 9 impact point. Its spectroscopic device signaled evidence of basalts of a type commonly found on Earth and its mechanical tests indicated that the regolith layer was tough enough to hold a lunar manned vehicle standing up on top. These results rejected the severe critics from a third party of spoilers, who believed the Moon surface too porous and the mantle too froth to be able to hold any man-made device standing up in it.

The selection of lunar landing points for the Apollo flights had to comply with two restrictions, one imposed by flight dynamics (FD), which based in the pictures from the first three Lunar Orbiters, had signaled out an equatorial band 90 degree long and 10 degree wide, located between ±5 degree of lunar latitude and ±45 degree of lunar longitude, for all the potential landing sites. This constraint would provide the safer path to land in the lunar surface, for a vehicle that reaches the Moon from the Lunar Transfer Orbit. The other one was imposed by the Manned Space Center (MSC) that favored the eastern sites, in order that in the case of unexpected difficulties that delayed or postponed the scheduled launch date, a new landing site could be found to the west, along the signaled band (the launch was always considered during the waxing phase). However, the first landing site, officially named Apollo Landing Site 1 (ALS 1), should not be "too Eastern", as for example in Mare Fecunditatis, due to FD drawbacks. Taken all these restrictions into account the ALS 1 was initially selected in a smooth spot East of crater Maskelyne, near satellite-crater Maskelyne DA, in Mare Tranquillitatis. Nevertheless the light hue of the terrain posed some uncertainty, ¿was it a piece of *mare* or *terra*? Jim Lovell, flying the Moon with Apollo 8, was asked to look down and provide an answer. He responded: "It seems *mare* to me". ALS 1 belongs to Mare Tranquillitatis.

In spite of this, Mare Tranquillittis had more soft spots within the safe band, all of them visible even at the telescope eyepiece. One of them (ALS 2) located 68 km SSW of Ranger 8 impact point and 25 km SE of Surveyor 5 landing site, showed a promising darker hue. At the time of Apollo 8 flight, it was already well known for the people in charge of the selection of landing sites, that dark soil (maria-like) signifies smooth soil, while bright soil (terrae-like) meant roughness, so the GLEP (Group for Lunar Exploration Planners) aimed Apollo 11 to land in ALS 2.

Besides the two restrictions mentioned above, a new one sprung for landing expeditions: landing time should occur whenever the Sun altitude over the landing site were between 8 and 13 degrees (a restriction fully understandable for lunar observers). Otherwise, the flat illumination (with hardly any shadows) would make indiscernible the soil roughness to the Lunar Module Pilot (LMP). Under this limitation in the Sun altitude, a delay in the launch implied a shift to west in the landing site band to a site located about 24 degrees west (the terminator displacement in one day) from the original landing site. In the worst case, when no landing sites were available at the west, the launch must be postponed a full month.

In December 1968, Apollo 8 made the first feat: it cut the umbilical cord that held Humankind tied to planet Earth, overcoming its gravitational attraction and flying to the Moon carrying three men on board (Francis Borman, James Lovell and William Anders) and a dummy lunar module. The goal of Apollo 8 was not to land on the Moon, but to enter orbit around it, encircle it during 20 hours, completing 10 revolutions around and return to Earth. And effectively, after accomplishing this gesta, it won the "primus me circumdedisti" prize in the Lunar Realm.

Five months after the flight of Apollo 8, Apollo 10 flew to the Moon, carrying another crew of three men (Thomas Stafford, John Young and Eugene Cernan) and a real lunar module (already tested by Apollo 9), but without fuel that allowed the landing on the Moon. Once in lunar orbit, its goal was to transfer both the Commander (Stafford) and the Lunar Module Pilot (Cernan) to the Lunar Module, undock it from de Command Module, fly it over the landing point at a height of about 15 km, recognizing the lunar path from crater Maskelyne to the landing point, (so called after that the US-1), to get back on with the Apollo spaceship, to meet the Command Module Pilot (Young) and return home all together.

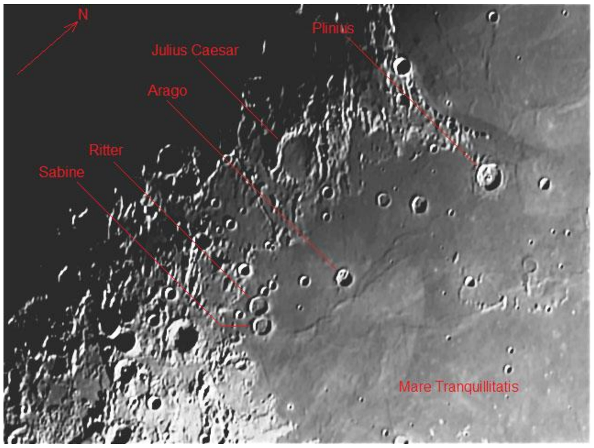
Finally, on July 20th, 1969, Apollo 11 was targeted to point ALS-2. However, it landed between 7 and 8 km beyond and 2 km across, the landing site certified by the Lunar Surveyor 5. The Lunar Module was tracked flying somehow higher and faster than expected by the entry point (High Gate) in the US-1 and thus the same in the point to switch command to manual (Low Gate). Hence the difficulties experienced by its crew to find a suitable point to land. These failures in speed and height control justified the adoption of the free return path to fly to the Moon. Nevertheless the good execution of the commander (Neil Armstrong), the cool blood of the Lunar Module Pilot (Edwin Aldring) and the remote help of the Command Module Pilot (Michael Collins), managed to weather the situation and land, when the LOW FUEL alarm had already been heard.

My observation.

Clouds of diurnal evolution have prevented the Lunar Group of Madrid Amateur Astronomy Society, observe the landing zone of Apollo 11, in the last two opportunities, first with waning Moon and last with waxing Moon. So I will recall my own observation made eleven years ago, when I was writing a book on the space race. The situation was the same as today, I was preparing to narrate a historical event, stimulated by the possibility of seeing at the telescope the small craters that defined the way to the landing point. No geological involvement guided me. Fortunately, the story I have told above contains three impact craters of considerable size, whose visibility is beyond doubt, even with a small telescope: Maskelyne, Ritter and Sabine.

I remember a strong difficulty in viewing the small carterlets dedicated to the three astronauts, Armstrong, Collins and Aldrin. A mild turbulence, I live in a small village close to a large town (Madrid), prevented me to see those craterlets, only a glimpse from time to time. I observed the heavily eroded crater Julius Caesar, whose flat lava flooded surface was proposed for landing site at once and the Ritter and Sabine lack of secondaries as well as rays, but none of the small ones. Then, I decided to take a few pictures with Phillips TouCam Pro camera. Photo 1 was stacked out of 100 frames and shows the area of SW Mare Tranquillitatis. Crater Maskelyne was cut half, but Ritter and Sabine were well centered. In this photo I have annotated the chief craters visible.

Having lost the opportunity to introduce a Barlow lens, I have recently enlarged this photo by means of InPixio Photo Maximizer, in an attempt to take a look to the craters. The result can be seen in photo 2, but I request the indulgency of the reader, to guess the situation of the three craters. I'm sure they can be perceived, at least I can!



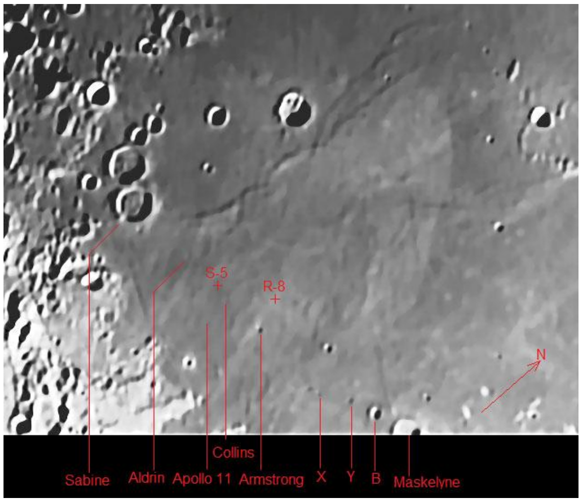


PHOTO 1 (left) SOUTHWEST MARE TRANQUILITATIS. *Alberto Martos. Madrid, Spain. May 11, 2008 21:47 UT. Colongitude 350.3°. Seeing 3/5, Transparency 4/5. 20cm f/7.2 Newtonian, Phillips TouCam Pro.*

PHOTO 2 (right) ENLARGEMENT OF THE APOLLO 11 REGION.

Sources:

Donald E. Wilhelms, "To a Rocky Moon". The University Press of Arizona.

Eduardo García Llama, "La odisea del primer aterrizaje en la Luna. https://www.elmundo.es/blogs/elmundo/apuntesnasa/2016/07/26/la-odisea-del-primer-aterrizaje-en-la.html

THE RAY SYSTEM OF PYTHEAS

Alberto Anunziato

Pytheas is a crater of the Copernican period. It has a diameter of approximately 20 kilometers and is located north of Copernicus, in a straight line and surrounded by material ejected by the impact that generated the neighboring giant. But as you can see in figure 1, that material from the impact generated by Copernicus does not overlap with Pytheas or its particular ray system. The rays of Pytheas are doubly asymmetric. They are practically non-existent to the south and to the north they are divided into two lobes, a brighter east lobe and a west lobe wider and more diffuse (this difference between the two lobes is not seen in figure 1 but is seen at other times of the lunation, in which the west lobe practically disappears). We try to reproduce the complex morphology of the ray system and the radial bands of Pytheas at 129.4º colongitude (fig. 2), after enlarging figure 1. In figure 3 the rays observed in figure 1 are recorded in the E3 chart (fig. 3) of the Lunar and Planetary Laboratory's Lunar Quadrant, according to the protocol of the Bright Lunar Rays Project of the Lunar Section of ALPO.

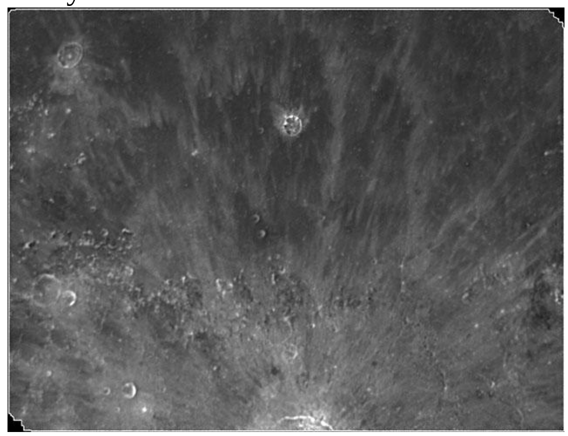


FIGURE 1. ***PYTHEAS Region. August 24 2016 05:34 UT.***

FIGURE 2. **PYTHEAS Rays.** *Sketch based on figure 1.*

In figure 4 the rays of Pytheas can be seen at different colongitudes. In addition to the asymmetry of distribution, it is observed in 4-1 (16.1º colongitude) and in 4-2 (29.4º colongitude) that even in the vicinity of the terminator, with sunlight incising obliquely, the rays of the east lobe are visible, and those of the west lobe are not. In 4-3 (collongitude 79.2º) the illumination of the lunar surface is 98% and the rays, saturating the image, appear clearly differentiated towards the north: extended and less bright to the west and short and very bright to the east, as they appear in 4-4 (129.4º colongitude), where we see that the rays start from the edge of the crater but towards the east there are darker areas near the edge that are not observed in the west lobe. Inside the crater, you can see the dark areas that classify it as a banded crater.

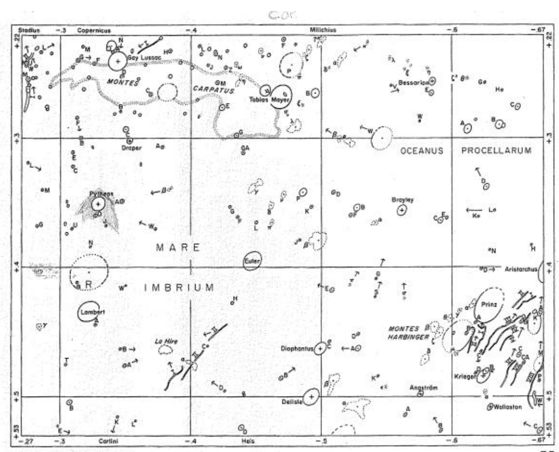


FIGURE 3. ***LUNAR QUADRANT CHART E3*** *with Pytheas rays added.*

At 177.1º colongitude (4-5), the rays are almost invisible, but the west lobe is more visible than in figures 4-1 and 4-2, so this part of the ray system would appear to have an appearance different in quarter waning (4-5) with respect to the last quarter. Undoubtedly this conclusion is provisional and merits adding new observations, which we will continue to compile for a second report. In 4-6 we can observe an image of the Lunar Reconaissance Orbiter, in which we observe the structure of the outlined ray system.

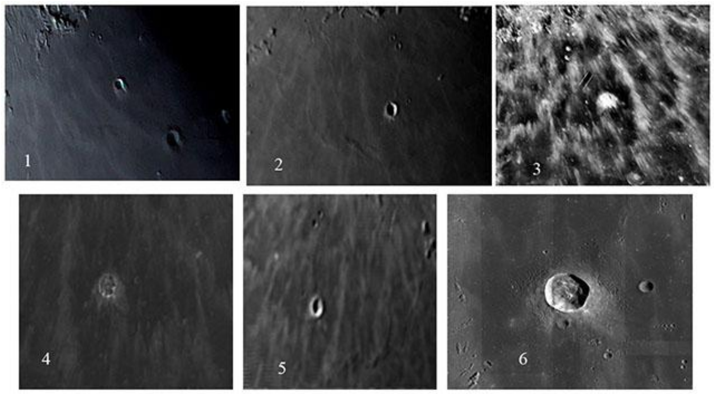


FIGURE 4. ***PYTHEAS Rays at various colongitudes:*** *1-16.1°, 2-29.4°, 3-79.2°,* ***4****-129.4°, 5-177.1°, 6-LRO image* (*https://quickmap.lroc.asu.edu/)*

This preliminary analysis of the Pytheas ray system is the first result of the "Estudio Comparativo de Cráteres con Rayos Brillantes" Program of the Sociedad Lunar Argentina and the Asociación de Aficionados a la Astronomía (Uruguay), sponsored by the Lunar Section of the Liga Iberoamericana de Astronomía (LIADA). It is based on images from the archives of both institutions and from now on a campaign will be started to collect new images that allow us to analyze the Pytheas rays in more moments of the lunation. Francisco Alsina Cardinali, Juan Manuel Biagi, Jairo Andrés Chavez and Alberto Anunziato of the Sociedad Lunar Argentina and Sergio Babino of the Asociación de Aficionados a la Astronomía de Uruguay participated in this study.

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AGASSIZ'S MENTOR

Rik Hill

When the libration is right you get a rare view of a huge crater that is normally out of sight. Here (fig. 1) you can see it as a large oval near the limb with black basaltic flooded areas on its floor and a sparkling white offset central peak. This is the great crater Humboldt (213km dia.) named after the explorer, naturalist and geographer that was the mentor of Louis Agassiz. This presentation gives us a nice demonstration of just how shallow these grand depressions are. It has huge cliffs on the far side and a floor covered with rimae just barely seen from earth view here. These were likely caused from settling of the flooded floor as it cooled. Adjacent to the near side of Humboldt is the ghostly outline the crater Phillips (128km). Just beyond Phillips is a small bright floored crater Phillips A (13km).

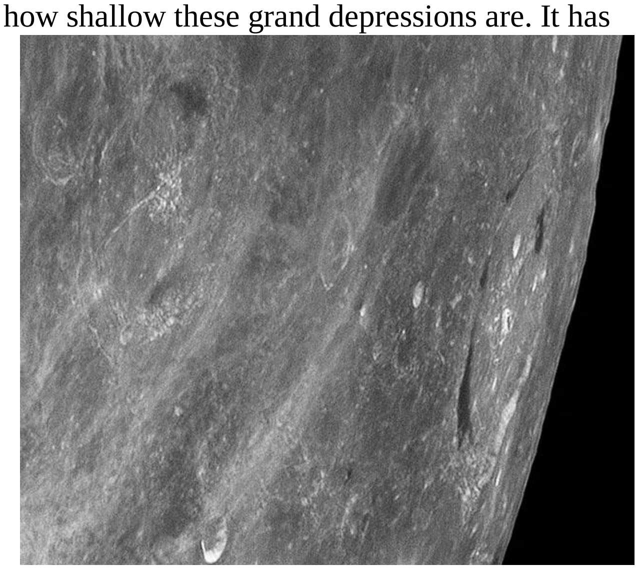

FIGURE 1. ***HUMBOLDT*** *– Richard Hill – Tucson, Arizona, USA May14, 2019 02:40 UT. Colongitude 27.0°. Seeing 8-9/10. TEC 8" f/20 Mak-Cass, SKYRIS 445M, 610 nm filter.*

In the upper left corner of this image is the fabulous crater Petavius with the famous large rima running out to the lower left from the bright splatter of the central peaks. Then directly between Petavius and Humboldt is the outline of the crater Legendre (82km).

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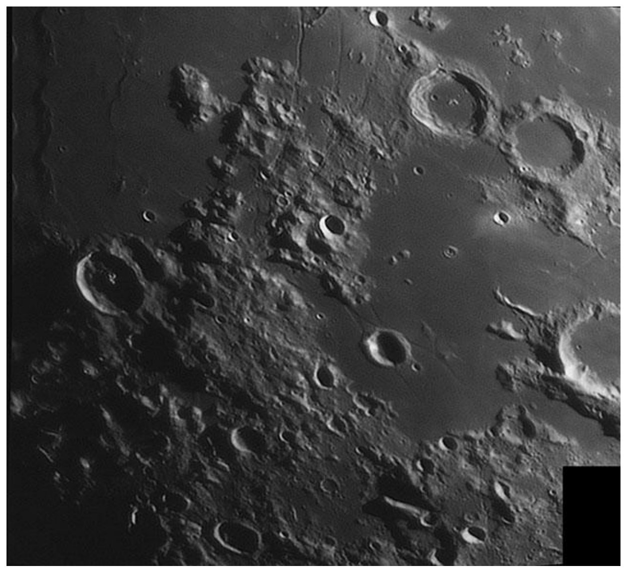
EYEPIECE & A CRATER

Rik Hill

Just below and right of center (fig 1) is the 26km diameter crater Ramsden named for the famous 18th century instrument maker Jesse Ramsden who invented the Ramsden eyepice which was a good advancement at the time he developed it, but in comparison to our contemporary eyepieces has fallen into disuse. It sits in the western reaches of Palus Epidemiarum surrounded by a rimae, known appropriately enough as Rimae Ramsden. Above it are two roughly equal sized 49km craters, Campanus left and Mercator to the right. Below them we can see half of Capuanus (61km) with the interesting mountains reaching west, out from the crater into the Palus. In the very upper right corner of the image you can catch sight of the mild swelling of Dome Kies Pi with the little pit in the summit. The Lunar Domes Atlas cites the diameter of this pit as 3.6km but it seems smaller in the LROC QuickMap images.



<u>FIGURE 1.</u> RAMSDEN *– Richard Hill – Tucson, Arizona, March 17, 2019 03:50 UT. colongitude 39.8°. Seeing 8/10. TEC 8" f/20 Mak-Cass, SKYRIS 445M, 610 nm filter.*

Above and slightly left (west) of Ramsden is a younger crater Dunthorne (17km) to the east of it almost forming an equilateral triangle with these two craters is the small double walled crater Marth (7km). Use your high powers and enjoy the view of this crater in any telescope larger than 4" aperture. It looks like a little military fort sitting on the plain. Due west of Dunthorne and Ramsden is a large crater, near the terminator, with a small central peak. This is Vitello (43km) whose central peak is very interesting, sitting on an elevated plateau left when the lavas that filled this crater slumped during cooling. It is unfortunately in shadow here. North and east of Vitello there is the isolated large mountain in Mare Humorum, Promontorium Kelvin and the valley running from southeast of Vitello to east of P. Kelvin known as Rupes Kelvin. West of Ramsden is a nice little valley about 20km wide connecting M.Humorum and the Palus. It leads to the south end of a system of rimae that go north out of this image. These are the Rimae Hippalus that lead to the crater Hippalus toutside the bounds of this image. The rimae are concentric to M. Humorum and are thought to have been formed during the cooling of the mare when the lava cooled and contracted.

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FORE!

Rik Hill

Somewhere near the large crater Fra Mauro (fig. 1) are two golf balls. That is what most people remember best from the Apollo 14 mission, the third manned mission to land on the moon. Not only did Commander Alan Shepard hit those two golf balls during over 9 hours of EVA (Extra Vehicular Activity) but they also brought back a then record 42.8kg of rocks. The landing site was north of the crater Fra Mauro (99km dia.) seen here just left of center with a small central crater, Fra Mauro E (4km) in the center and is marked with a small circle in the fairly rugged terrain (compared to the previous two landing sites of Apollo 11 and 12).

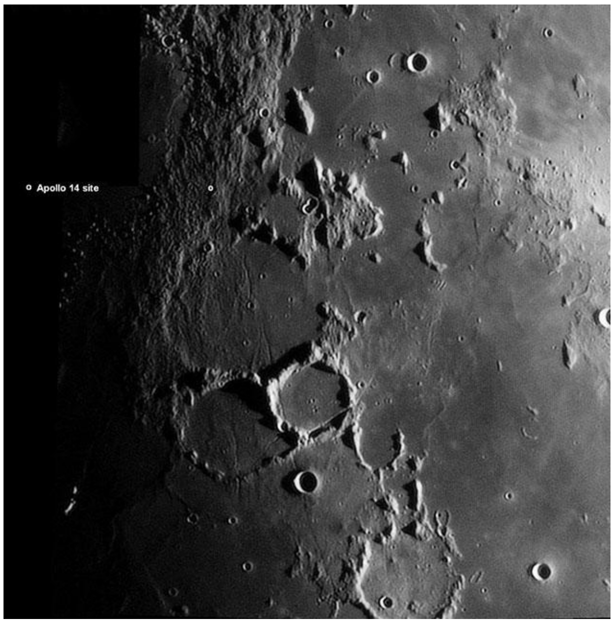

FIGURE 1. ***FRA MAURO*** *– Richard Hill – Tucson, Arizona, USA April 14, 2019 02:25 UT. colongitude 21.1°. Seeing 8/10. TEC 8" f/20 Mak-Cass, SKYRIS 445M, 610 nm filter.*

Below Fra Mauro are two craters, one with two large rimae almost at right angles to each other. This is Parry (49km) with the Rimae Parry and to the left of it is Bonpland (61km). These three are old craters, maybe over 4 billion years old. Below these ancient rings is a smaller, obviously younger crater, Tolansky (14km) about a billion years younger. At the bottom of the image is another ruined crater, Guericke (60km). To the right of Guericke is a very young crater Kundt (12km) possibly less than a billion years old. Before leaving this scene look to the upper right of Fra Mauro and the odd mountainous terrain there. The largest mountain, shaped like a spearhead, is Fra Mauro Eta which has a small crater Fra Mauro R (3km) on top (unfortunately in the shadow in this image). It was speculated, at one time, that this might be a volcanic vent but LROC QuickMap imagery shows it to be little different from surrounding craters of similar diameter.

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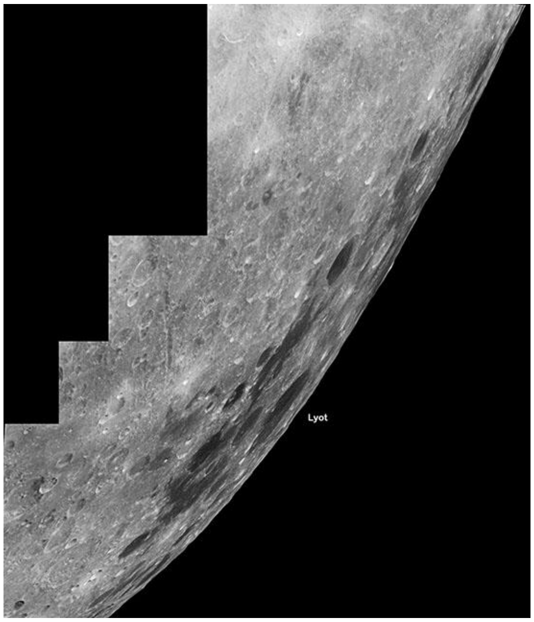
THE SOUTHERN SEA

Rik Hill

This last lunation had a night where Mare Australe (fig. 1) was very well displayed. This is a mare unlike others, consisting of a collection of craters with flooded floors rather than a broad expanse of basalts like Imbrium and Humorus. In the middle of this collection of black spots is one larger one, the crater Lyot (145km dia.). In the early 1960s I learned that Lyot was the prominent 9km crater on the floor of Ptolemaeus, now known as Ammonius. I've labeled Lyot as a reference point. Above Lyot is a very circular dark crater half the size of Lyot. This is Oken (75km) with the bright crater Hamilton (60km) between it and the limb. Above these two is another dark patch, Marinus (also 60km). At the very top limb of this image is the dark floored crater, Abel (117km).

***FIGURE 1.* MARE AUSTRALE** *– Richard Hill – Tucson, Arizona, USA May 14, 2019 02:47 UT. colongitude 27.0°. Seeing 8-9/10. TEC 8" f/20 Mak-Cass, SKYRIS 445M, 610 nm filter.*



Going back to Lyot we see a very dark crater on the western edge of this mare, Brisbane (46km). Further out from this in the same direction we see a nearly vertical gash. This is end of Vallis Rheita. Lastly, on the far lower left end of this field of dark floored craters, is an isolate one Hanno (58km). You can hunt out more features using some of the online atlases like the 1:1 Million-Scale Maps of the Moon at: https://planetarynames.wr.usgs.gov/Page/Moon1to1MAtlas

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A CURIOUS FEATURE NEAR RUPES ALTAI

John Sabia

It's been a long time since I sent photos to the ALPO Lunar Section, but features in this one caught my attention when stacking the 4 images (fig. 1). My first impression was that the small bright linear feature near Altai Rupes on images taken 2019-04-10 UT was a artifact from stacking of the 4 images. Until 2019 June 9 at 0:49 UT when I and others viewed it using the 9.5 inch (24.13 cm) F/15 Alvan Clark refractor at 172 magnification.

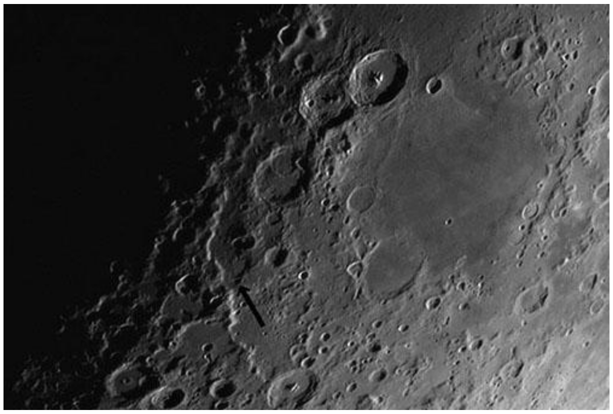

***FIGURE 1.* LINEAR FEATURE NEAR RUPES ALTAI** *– John Sabia – Fleetville, Pennsylvania, USA April 10, 2019 00:49 UT. Seeing 9/10. 9.5" f/10 Alvan Clark refractor, Canon T5 EOS Rebel.*

Checking LROC online (fig. 2) shows a mound rim that is illuminated in my image. The dark crater that I tried to identify using my numerous Lunar maps came up empty. LROC also provide an answer, it's not a crater in shadow as it appears.

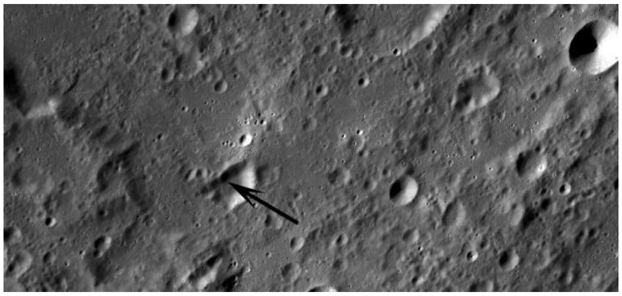

***FIGURE 1.* LUNAR RECONNAISSANCE ORBITER (LRO) IMAGE.**
(*https://quickmap.lroc.asu.edu/*)

GOING UP NORTH

David Teske

This excursion brings us to the far north of Luna, above Mare Imbrium to the Sea of Cold, Mare Frigoris and the giant crater John Herschel. Mare Frigoris is a most unusual lunar sea, being about 1,000 km long east to west and at widest 300 km north to south, rather than the rather circular form of other lunar maria. This is about the size of Mare Tranquillitatis. In Earthly terms, this is about the size of the Black Sea. Mare Frigoris surrounds the northern third of the Imbrium Basin as a band of dark lava and the mare fills an annular depression surrounding the Imbrium Basin. A low region also occurs south of Imbrium's rim as well, filled in by the lavas from Mare Aestuum and Mare Vaporum. It seems that Frigoris's lavas were erupted after the formation of the Imbrium Basin as it covers Imbrium ejecta. On Mare Frigoris the mare ridges do not have a consistent pattern. Because of its elongated, rather than circular shape, Mare Frigoris challenges observers with its origin. Perhaps it is a compound feature consisting of two or three separate formations fused into one by lava flows in far distant times. Perhaps the northern shore of the Sea of Cold is the northern rim of the Imbrium Basin. Most interesting to me is that because the northern boundary of Mare Frigoris has an intriguing curve to it, it may support the "Gargantuan hypothesis". It has been suggested that Frigoris is the northern rim of an enormous Pre-Nectarian feature called Gargantuan Basin that spanned about 1,500 km from the western shores of Procellarum to the middle of Mare Serenitatis. This is nearly 70% of the Moon's diameter. Maybe someday explorers of the future will bring back rock hard evidence of the origin of Mare Frigoris. Until then, we will continue to gaze and contemplate its history.

In this image (fig. 1), to the northwest of Mare Frigoris just above Sinus Iridum is the enormous crater John Herschel with a diameter of 156 km. Of course, this crater was named after William Herschel's famous astronomer son, who lived from 1792-1871. The floor of John Herschel is covered with rubble from the Imbrium impact; otherwise its relatively flat floor contains a wealth of crevasses, hills, rilles, and craterlets. The central floor is slightly convexed upwards, due to perhaps a dump of Imbrium ejecta or volcanism under the crater. The largest crater on the floor of John Herschel is north of its center. On the far western parts of its floor are some dark albedo markings. Its low, ruined crater wall is has a relatively tall mountain on its eastern border and is overlapped in the south by the crater Horrebow with a diameter of 24 km. English selenographer Edmund Neison characterized the region of John Herschel as "no true formation, merely a portion of the surface surrounded by elevated regions."

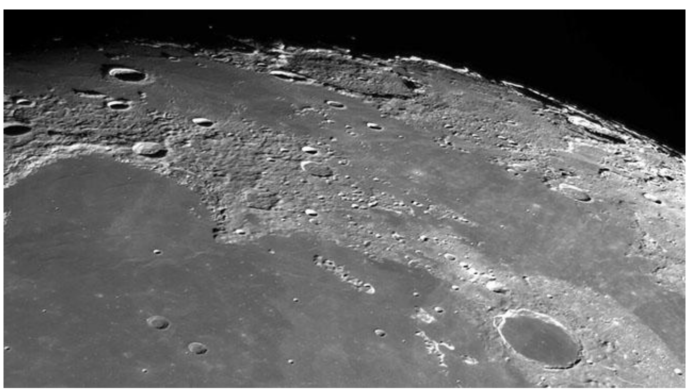

FIGURE 1. ***NORTHERN MOON*** – *David Teske, Louisville, Mississippi, USA, May 16, 2018 02:28 UT. Colongitude 49.0°, seeing 6/10, 180 mm Takahashi Mewlon , ZWO ASI120mms*

References

Chu, Alan, Wolfgang Paech, Mario Wigand & Storm Dunlop. 2012. The Cambridge Photographic Moon Atlas. Cambridge University Press, New York.

Grego, Peter. 2005. The Moon and How to Observe It. Springer-Verlag, London.

Kitt, Michael T. 1992. The Moon: An Observing Guide for Backyard Telescopes. Kalmbach Books, Waukesha.

Lacroux, Jean and Legrand, Christian. Discover the Moon. Cambridge University Press.

Moore, John. 2014. Craters of the Near Side of the Moon.

Rükl, Antonin. 1990. Atlas of the Moon, Kalmbach Books, Waukesha.

Planck, Andrew. 2015. What's Hot on the Moon Tonight? Moonscape Publishing LLC.

Shirao, Motomaro and Charles Wood. 2011. The Kaguya Lunar Atlas: The Moon in High Resolution. Springer, New York.

Wilkinson, John. 2011. The Moon in Close-Up. Spinger, Heidelberg.

Wlasuk, Peter. 2000. Observing the Moon, Springer

LUNAR TOPOGRAPHICAL STUDIES

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OBSERVATIONS RECEIVED

ALBERTO ANUNZIATO - ORO VERDE, ARGENTINA. Digital images & drawing of Pytheas (5).

JAIRO CHEVEZ - POPAYÁN,COLUMBIA. Digital images of 1st Qtr Moon, waxing gibbous Moon & Theophilus..

MAURICE COLLINS - PALMERSTON NORTH, NEW ZEALAND. Digital image of 4 day Moon,

RICHARD HILL – TUCSON, ARIZONA, USA. Digital images of Fra Mauro, Hainzel, Humboldt, Mare Australe & Ramsden.

ALBERTO MARTOS - MADRID, SPAIN. Digital images of Apollo 11 landing region

JOHN SABIA - FLEETVILLE, PENNSYLVANIA, USA. Digital image of Rupes Altai.

DAVID TESKE - LOUISVILLE, MISSISSIPPI, USA. Digital image sof Apollo 11 landing region & Mare Frigoris.

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RECENT TOPOGRAPHICAL OBSERVATIONS

1st Qtr. MOON – Jairo Chavez,- Popayán Columbia. June 9, 2019 23:16 UT. 10” Dobsonian, Sony DSC-WX50.

RECENT TOPOGRAPHICAL OBSERVATIONS

WAXING GIBBOUS MOON – Jairo Chavez, - Popayán Columbia. June 11, 2019 01:23 UT. 10" Dobsonian, Sony DSC-WX50.

THEOPHILUS – Jairo Chavez,- Popayán Columbia. June 10, 2019 01:18 UT. 10" Dobsonian, Sony DSC-WX50.

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4-day MOON - Maurice Collins,- Palmerston North, New Zealand. June 7, 2019 05:44 UT. FLT-110, f/14, ASI 120MC.

LUNAR GEOLOGICAL CHANGE DETECTION PROGRAM

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Reports have been received from the following observers for May: Jay Albert (Lake Worth, FL, USA - ALPO) observed: Aristarchus, Bullialdus, Gassendi, Herodotus, and Mersenius. Maurice Collins (New Zealand – ALPO/BAA/RASNZ) imaged: Alphonsus, Clavius, Eratosthenes, Langrenus, Plato and several features. Marie Cook (Mundesley, UK – BAA) observed: Copernicus. Rob Davies (Devils Bridge, UK – BAA) imaged Clavius, Copernicus, Mare Crisium and Plato. Valerio Fontani (Italy – UAI) imaged: Aristarchus. Les Fry (Mid Wales, UK – NAS) imaged: Mare Imbrium and several features. Rik Hill (Tucson, AZ, USA – ALPO/BAA) imaged Catena Davy, Humboldt, Mare Australe, Moretus and Tycho. Nigel Longshaw (Oldham, UK – BAA) observed Censorinus, Cutis, Eratothenes, Hyginius, Mons Piton, Proclus and Ramsden. Dave Storey (Douglas, Isle of Man, BAA/IoMAS) imaged Montes Teneriffe and Tycho. Robert Stuart (Rhayader, UK – BAA) imaged: Alphonsus, Aristarchus, Arzachel, Boussingault, Clavius, Copernicus, Curtis, Deslandres, Epigenes, Flamsteed, Gambart, Gassendi, Gauricus, Heinsius, Hertaclitus, Hyginius, Kepler, Letronne, Maginus, Manzinus, Mare Imbrium, Mare Serenitatis, Moretus, Palus Putredinis, Pitatus, Plato, Rima Birt, Rima Hadley, Rupes Recta, Scheiner, Schiller, Triesnecker, Tycho, Vallis Alpes, Vitello, Walther and several features. Ivor Walton (Cranbrook, UK - CADSAS) imaged several features.

News: Chandrayaan-2, India's 2nd lunar mission should be launching on 2019 Jul 14th at 21:21 UT and will consist of an orbiter, a lander and a rover. The latter two are intended to explore the primary site midway between Simpelius and Manzius (or between Manzius C and Boguslawsky C) or if decided otherwise aim for a backup site further to the west, midway between Klaproth and Gruemberger. Keep an eye open for details of when the landing will be as its always worth monitoring such events using a telescope, just in case dust clouds get kicked up for some reason. Though there have been no sightings for past spacecraft. I will be giving a talk on lunar impact flash observing at the Royal Astronomical Society's "National Astronomy Meeting" in Lancaster University, UK on 4th July. The details are given in the abstract here. If any of you are also attending then I look forward to meeting you.

LTP reports: No LTP were observed in May

Routine Reports: Below are a selection of reports received for May 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.

Tycho: On 2019 May 12 UT 22:13 Dave Storey (BAA/IoMAS) imaged this area to see if they could detect the central peak in the interior shadow. This was part of a lunar schedule request:

BAA Request: How early can you see the central peak of this crater illuminated by scattered light off the crater's west illuminated rim? High resolution and/or long exposures needed to capture detail inside the floor shadow.

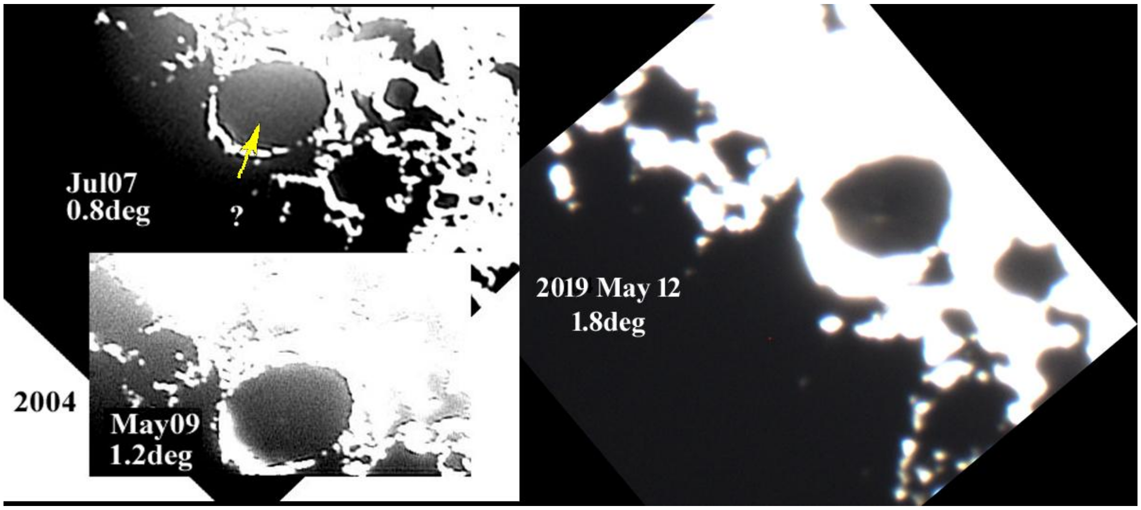

Figure 1. *Contrast stretched versions of an image of Tycho with north orientated towards the top left. These all exhibit a light spot on the floor of the shadow filled crater. The 2004 images were taken by Brendan Shaw (BAA) and an arrow is used to highlight where the light spot was located in the 2004 Jul 07 image. The image by Dave Storey (BAA/IoMAS) was taken on 2019 May 12 UT 22:13.*

Dave's image (Fig 1) clearly shows the central peak area and was taken when the solar altitude was just 1.8°. This can be compared with as images taken at lower solar altitude, by Brendan Shaw in 2003, which may show the peak at a solar altitude of 0.8°, and definitely at 1.2°. The peak in images by Brendan is certainly not directly illuminated by the Sun, but probably from light scattered off the western rim and into the interior of the crater. We have covered this issue before in the 2014 Oct and 2016 Mar newsletters, and so far, find that the results are not always repeatable – sometimes when you expect to see the central peak at very low solar altitudes, from diffuse scattered light off the western rim it simply is not visible. At other times it is? A possible explanation is that it is simply down to observing conditions, or maybe the strength of earthshine, which can be another source of illumination in shadowed areas. Another curious thing to note is that in Dave's image the light patch in the crater is very central to the crater's rim, where as in the Shaw image it is offset slightly further to the west – why should this be – libration perhaps? We desperately need more images of Tycho at sunrise at the dates and times stipulated in the Lunar Schedule web site, to better understand how scattered light illuminates the central peak of Tycho when it's in a shadow filled floor state.

Sulpicius Gallus: On 2019 May 12 UT 22:04 Les Fry (NAS) imaged the northern hemisphere of the Moon under a similar illumination (to within ±0.5°) to the following report by Dawes:

> *Sulpicius Gallus 1867 Jun 10 UT 22:00? Observed by Dawes (England?) "3 distinct roundish black spots. Absent on 13th" NASA catalog weight=3. NASA catalog ID #184. ALPO/BAA weight=1.*

Les' images (Fig 2) show no sign of "3 distinct black spots", but the resolution may not be good enough. We have covered this LTP report before in the 2015 Jul newsletter and the best theory we had then were that they were due to three small dark shadow spots quite far to the SE of the crater. These would be included in the shadowed area in Fig 2 (Left), though there is not enough resolution here to resolve these on this occasion. We shall leave the weight at 3 for now, at least until we come across some sketches by Dawes which might offer some explanation of where to look.

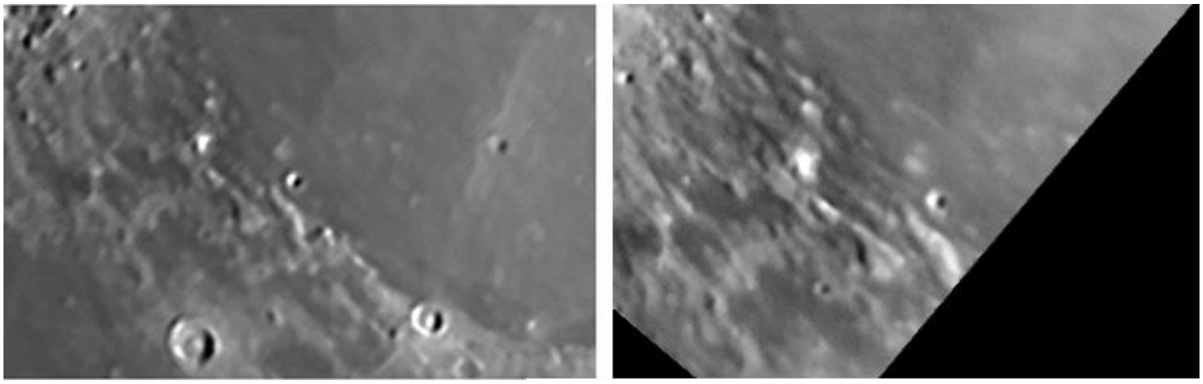

Figure 2. *Sulpicius Gallus from larger images of the Moon taken by Led Fry (NAS) on 2019 May 12 and orientated with north towards the top.* ***(Left)*** *Taken at UT 22:04* ***(Right)*** *Taken at UT 22:30.*

Copernicus: On 2019 May 13 UT 19:40-20:00 Marie Cook (BAA) observed visually this crater within ±0.5 °similar illumination of the following two events:

Copernicus 1969 Nov 18 UT 21:10-21:11 Observed by Hedervari (Budapest, Hungary, 3.5" refractor) "Yellowish-red stripe on inner W. wall (chrom. aberr.? Apollo 12 watch)." NASA catalog weight=2. NASA catalog ID No. 1217. ALPO/BAA weight=1.

On 1995 Jul 07 at UT 04:22 R. Spellman (Los Angeles, CA, USA) noted that the floor of Copernicus was slightly darker in blue light. The ALPO/BAA weight=1. This report came from R. Spellman's web site.

Marie was using a 90 mm Questar scope (x80 and x130 magnification) in Antoniadi III seeing conditions, under poor transparency. She did not see a yellow-red stripe on the inner west wall or on any other wall, and the crater just looked normal to her. For the Spellman report she tried using Cinemoid gelatin filters No. s 61 (blue) & 35 (red) and commented that the floor may have been slightly darker in blue light, but in view of the local observing conditions we should not take this too be definite. We shall leave both these reports at weights of 1.

Plato: On 2019 May 13 UT 20:01 Bob Stuart (BAA) imaged this crater under similar illumination (to within ±0.5°) to the following report:

Plato 1878 Oct 05 UT 21:40 Observed by Klein (Cologne, Germany, 6?" refractor) "Fog in W. part of crater. Faint shimmer like thin white cloud" NASA catalog weight=4. NASA catalog ID #203. ALPO/BAA weight=3.

Fig 3 (Left) shows no obvious sign of "fog" on the western rim, and Fig 3 (Right) shows no fog-like effect or lack of detail on the western floor either. So whatever Klein saw in 1878, which caught his attention, remains a puzzle. We shall therefore leave the weight at 3.

Alphonsus: On 2019 May 14 UT 02:33 Rik Hill (ALPO/BAA) was targeting Catena Davy, but his image encompassed the crater Alphonsus at a time when the illumination was similar (to within ±0.5°) to the following report:

Alphonsus 1969 Nov 19 UT 03:30 Observed by Argus/Astronet (CA?, USA) Brightening in W. rim & S. central floor, seen by 2 obs. (Apollo 12 watch)" NASA catalog weight 3. NASA catalog ID #1219.

Although Rik's image (Fig 4) is of very high resolution, I did produce a resolution degraded version (not shown here) and can confirm that the western rim, and south of the central floor area, are not especially bright, Alas we do not have any specific details of this ARGUS (Radio Amateur alert network) report other than what is in the Cameron catalog. It is possible that additional details may be buried in the archives of the Smithsonian where they kept details of project LION, an early forerunner of our current LTP alert network. We shall therefore keep the weight at 1, but at least we have a good quality image of the normal appearance of this crater at the same selenographic colongitude as was observed back in 1969.

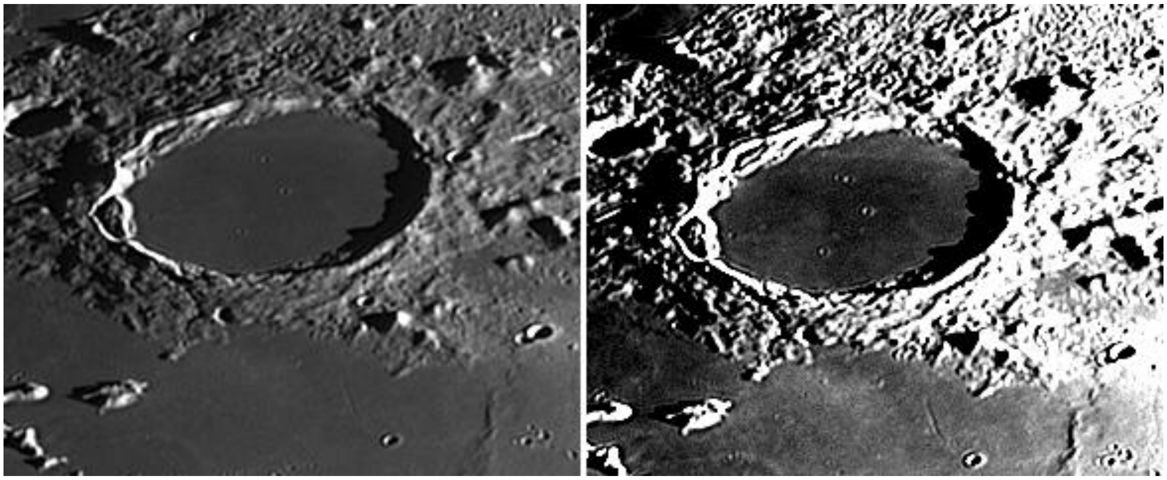

Figure 3*. Plato on 2019 May 13 UT 20:01, taken by Bob Stuart (BAA) and orientated with north towards the top.* ***(Left)*** *Image supplied.* ***(Right)*** *Image contrast stretched to bring out detail on the floor.*

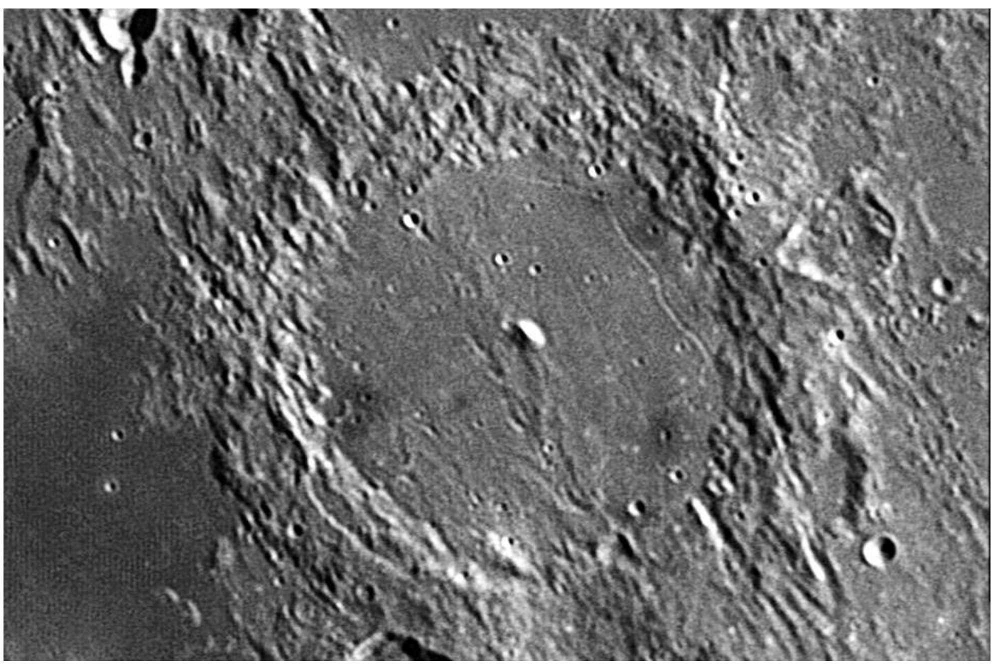

Figure 4. *Alphonsus by Rik Hill (ALPO/BAA) taken from a larger mosaic and orientated with north towards the top. Image taken on 2019 May 14 UT 02:33.*

Mons Piton. On 2019 May 14 UT 20:28 Rob Davies (BAA) imaged the region of north Mare Imbrium and captured the area around Mons Piton under similar illumination (±0.5°) to the following Apollo 12 watch observation by BAA observer Richard Baum:

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

weight=2. NASA catalog ID #1221. ALPO/BAA weight=2.

Rob's image (Fig 5) is quite sharp and detailed and shows nothing of what Richard Baum reported in 1969. Interestingly, although just 13 minutes beyond the repeat illumination window Nigel Longshaw, using a 10cm achromatic refractor (only 0.5" smaller than the one that Baum used) x160, under Antoniadi seeing III, found that detail on the slopes of Piton appeared clear and well defined. No haziness was visible on the eastern slopes and no evidence of lighter patches were visible on the Mare surface. At 22:05 U.T. he increased the magnification to x176, which was perhaps a little too much for the seeing conditions. However, this produced a slight 'flare' off the N.E. peak (brightest area) which at times appeared superimposed on the Mare surface. Nigel wonders whether Baum saw a similar effect back in 1969? We need more observations to be sure of this, so I will leave the weight at 2 for now,

Figure 5. *Mons Piton as imaged by Rob Davies (BAA). Taken on 2019 May 14 UT 20:28 and orientated with north towards the top.*

Gassendi: On 2019 May 15 UT 01:50-02:13 Jay Albert (ALPO) observed visually this area under similar illumination (to within 0.5°) of the following observation by Peter Grego, a renowned author of astronomy books:

On 2011 Oct 07 UT 21:45 Gassendi observed by P. Grego (St Dennis, UK,300m Newtonian, x150, seeing III, intermittent cloud) - whilst producing some sketches of the crater - observer noticed a faint point of light inside the shadow filled interior, two thirds of the way out from where the central peaks should have been, towards the SE rim. Some uncertainty in being sure about this spot and after interruption by cloud it was not seen later that evening. ALPO/BAA weight=1 to reflect uncertainty of observer.

Jay was using a Celestron NexStar Evolution 8" SCT (x226) under very poor transparency and 5-6 out of 10 seeing. Upon looking he quickly noted a distinct but faint point of light within the interior shadow about two thirds of the way out from the central peaks toward the eastern wall. Unlike in the Grego report (See Fig 6), Jay noted that this point of light held steady throughout his observing session. Jay believes that this confirms Peter Grego's observation. Jay observed visually for quite a while to see if the point of light would get brighter as the Sun rose over the crater, but evidently not long enough for that to happen. Unfortunately, photographing it was not an option as the clouds covered the Moon before he could even try. For a comparison with Jay's observation, here is the original sketch by Peter Grego in Fig 6 and the one with the light dot in the shadow is on the right. The only discrepancy we have between Jay's observation and Peter's one is that in Peter's sketch the spot is about 1/2 way out from the central peak area where as in Jay's report it is mentioned as being 2/3rds of the way out, but I suppose allowing for a bit of artistic license the difference between 1/2 and 2/3 is not so much, so I think we should change the weight of this LTP report to 0 and remove it from the database of LTP.

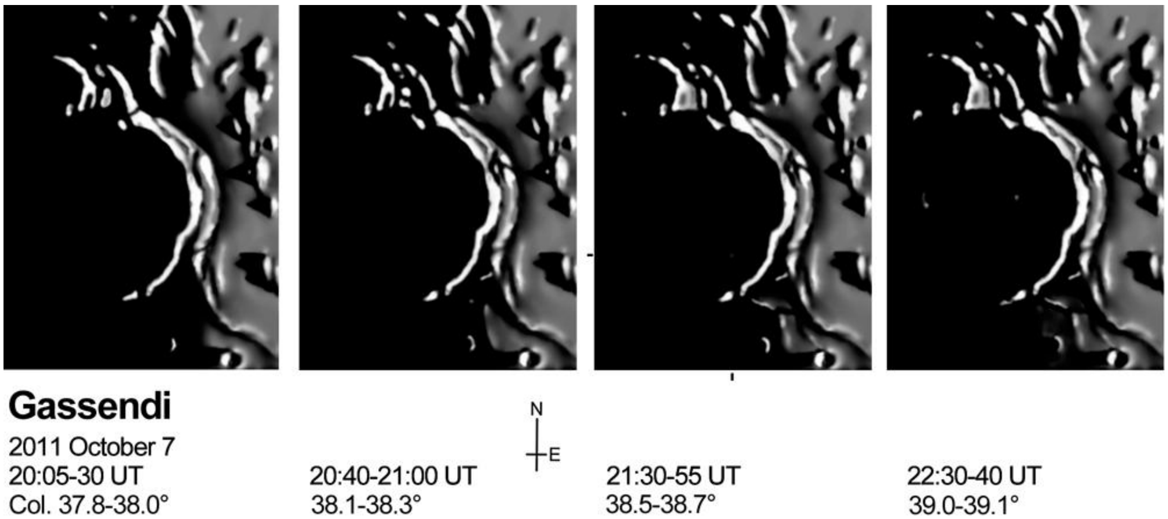

Figure 6 *A sequence of sketches of Gassendi crater by Peter Grego (BAA/SPA) on the date and UTs given in the sketches above. All sketches orientated with north towards the top.*

Aristarchus and Herodotus: On 2019 May 15 three observers (Valerio Fontani (UAI): 19:51, 20:11, 20:36, 21:21, Ivor Walton (CADSAS): 21:20, and Bob Stuart (BAA): 21:13-21:16) imaged this area under both similar illumination and topocentric libration (viewing angle) to within: ±1.0° of the following:

On 1968 Dec 31 at UT 03:30-03:45 Taboada (Mexico) observed the terminator between Aristarchus and Herodotus was diminishing in brightness at 03:45UT over the edge of Herodotus. Two darker spots were seen over same place. Alerted by Middlehurst for tidal predict? The Cameron 1978 catalog ID=1112 and weight=1. The ALPO/BAA weight=1.

I went back to the Cameron catalog and found the reference she used for this report. It came from the BAA Lunar Section Circular, 1969 Mar, p28. Upon examining this there is no additional information other than what she describes in her NASA catalog. I did however check for the time given, the Moon's altitude above the horizon from Mexico City, and it turned out to be 83°-85° - so therefore low altitude effects of our atmosphere cannot be the cause of the appearance described. The images in Fig 7 were taken by our observers under a wide range of observing conditions. The sharper the seeing, the brighter illuminated slopes appear. Maybe this is what Taboada saw in 1968, though it would have affected other crater rims as well? The closest image to the 1968 report, in terms of the Selenographic Colongitude is the 19:51 UT image by Valerio, however I see no sign of what the observer described as "two darker spots were seen over the same place". So, although the dimming seen in 1968 might be related to seeing conditions, the two dark spots remain a mystery. The Taboada report will therefore remain at a low weight of 1 for now.

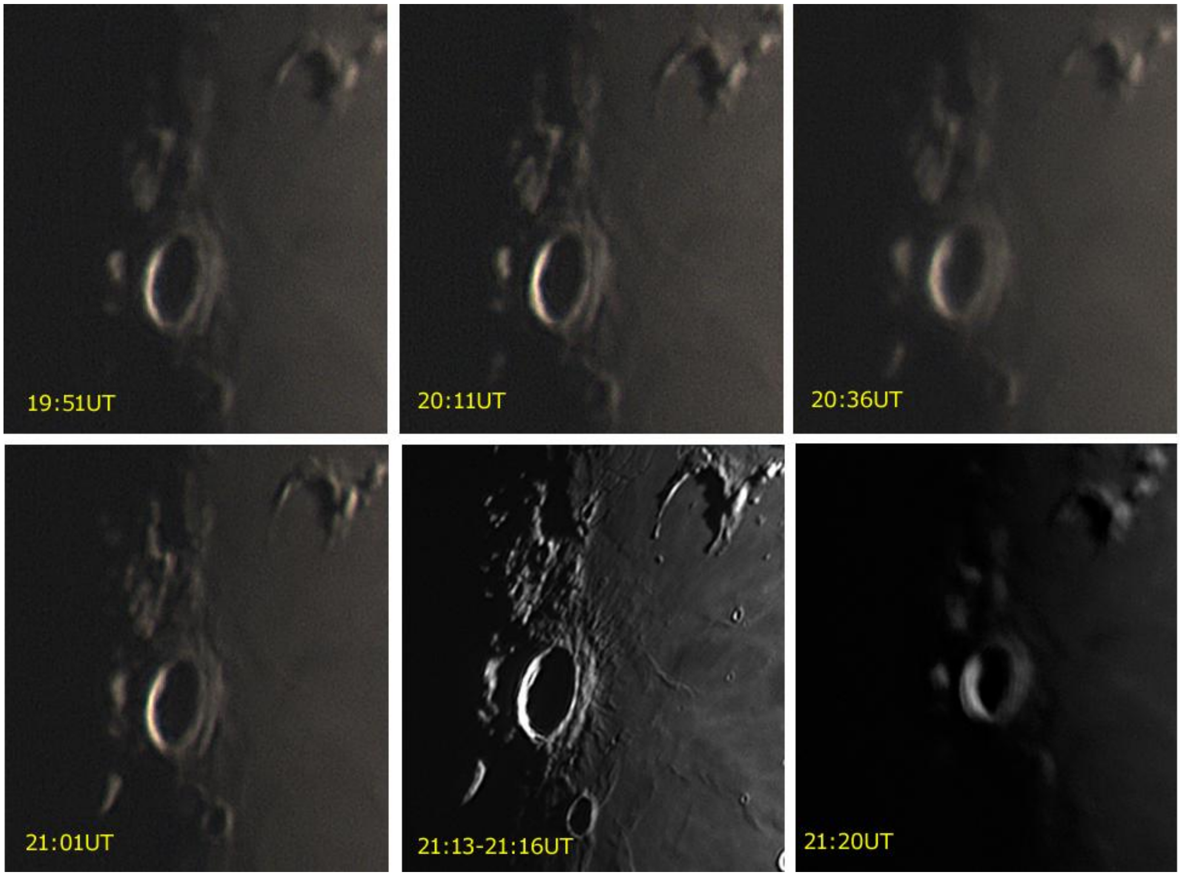

Figure 7. *The Aristarchus area on 2019 May 15, orientated with north towards the top.* ***(19:51-21:01 UT)*** *Taken by Valerio Fontani (UAI).* ***(21:13-21:16)*** *Taken by Bob Stuart (BAA).* ***(21:20)*** *Taken by Ivor Walton (CADSAS).*

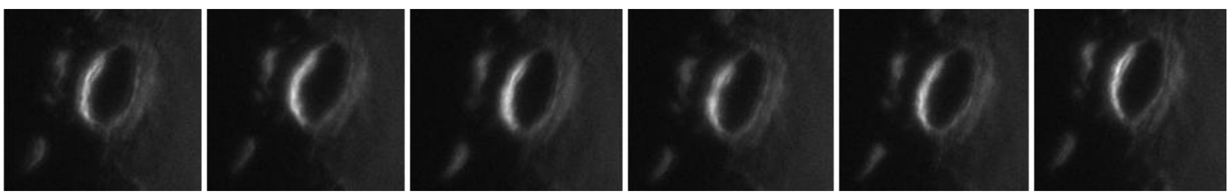

Figure 8. *2019 May 15 sample images of Aristarchus taken by Bob Stuart (BAA) sometime over the interval of 21:13-21:16 UT. Orientated with north towards the top,*

To show you the effects of atmospheric seeing conditions, Bob Stuart supplied a time sequence (Fig 8) which reveals quite easily see how thin crescent-like features, such as the western rim of Aristarchus can fluctuate in brightness due to atmospheric turbulence. Although not relevant to the Taboada report, it certainly might explain some other reports of brightness fluctuations in Aristarchus mentioned in past LTP.

Herodotus: On 2019 May 19 UT 09:32 and 09:37-10:41 Maurice Collins (ALPO/BAA/RASNZ) imaged the whole Moon, but by chance this was when both illumination and topocentric libration were similar to a 1971 report, and in doing so has possibly solved a 48-year-old mystery:

Herodotus 1971 Dec 02 UT 20:40 Observed by Kilburn (Manchester, UK, 8" refractor, x130, Transparency very good with a thin mist, seeing excellent, x130). Bright point *(considerably brighter than its surroundings) was seen on the SE of the illuminated floor of Herodotus in white light. It was quite close to the crater rim. The spot had no color. ALPO/BAA weight=2.*

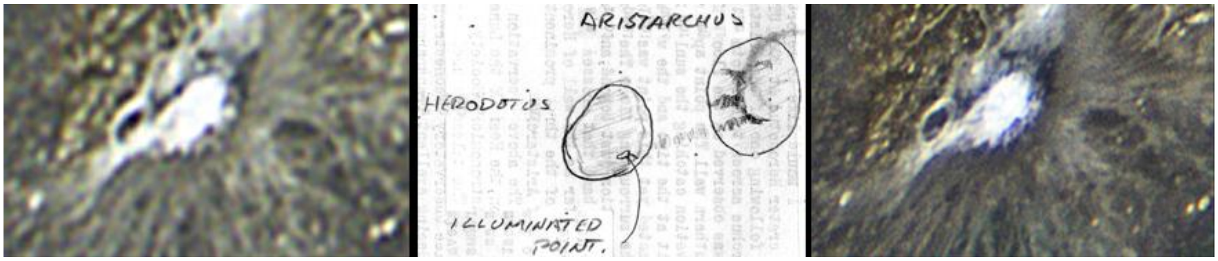

Figure 9. *The Aristarchus/Herodotus area, orientated with north towards the top.* ***(Left)*** *Image by Maurice Collins taken on 2019 May 19 UT 09:32 with color saturation increased to 50%.* ***(Center)*** *A sketch by Kevin Kilburn (BAA) made on 1971 Dec 02 UT 20:40. The sketch has been inverted to put north at the top and labels have been re-orientated to make them readable.* ***(Right****) Sub-section taken from a larger image mosaic by Maurice Collins on 2019 May 19 captured between 09:47-10:41UT – color saturation increased to 50%.*

Before going any further with this analysis, I checked our ALPO/BAA archives and came across Kevin Kilburn's original letter which states: *"... whilst following one of the Aristarchus bands from Aristarchus across to Herodotus, a bright point of light was observed on the floor of Herodotus close to the southern wall. The point appeared to be some sort of elevation catching the sunlight. The crater was well lit at the time and the whole floor was illuminated yet this point was considerably brighter than the surrounding floor. The impression given was of an elevation just beyond, and in line with the Aristarchus band that crosses the crater wall and extends as far as Herodotus. This is the southernmost of the prominent three bands on the west wall of Aristarchus. The above observation was confirmed by Mr. J.K. Bolton, the Head of the Lunar Section of the Manchester Astronomical Society. The telescope used was the 8 in. refractor at Godlee Observatory Manchester. Magnification about X 130. Seeing excellent, Transparency very good with a thin mist. Note that the object appeared as a bright point of light, no color seen".* Enclosed with the original letter was a sketch which is replicated in Fig 7 (Center) – you can quite clearly see why this struck an interest with the observers concerned and they did the right thing to report it to the BAA Lunar Section LTP coordinator, Patrick Moore. However, I cannot find a mention in the two Cameron catalogs or in the BAA Lunar Section circulars of that era, so maybe Moore filtered it out as a normal appearance? There was one observation, made by J.S. Burgess, the same night at 21:40-21:45 UT, i.e. an hour later, which reports Aristarchus as normal through an 8.5" reflector at x217 under "good" seeing conditions, however they were specifically looking for color using a Moon Blink device and perhaps not specifically at white light floor detail.

Anyway, Maurices' images firstly show in Fig 7 (Left), albeit at the lower of the resolutions, a bright blob on the SE rim of Herodotus which is considerably brighter than its surroundings, though the image is slightly over exposed here and low resolution. The area in the 09:47-10:41UT mosaic in Fig 7 (Right) is sharper and has better dynamic range. This clearly shows a patch on the SE floor of Herodotus which is brighter than the floor, it lies along some ray material from Aristarchus which bisects Herodotus, and you can also see the dark band extending from the western rim of Aristarchus out in the direction of Herodotus. In view of this, and despite the best intent of Kevin Kilburn at the time to report something which appeared unusual, you can see from Fig 7 that this effect is probably normal, as far as I can tell. We shall therefore set the weight to 0 and remove this report from the ALPO/LTP catalog.

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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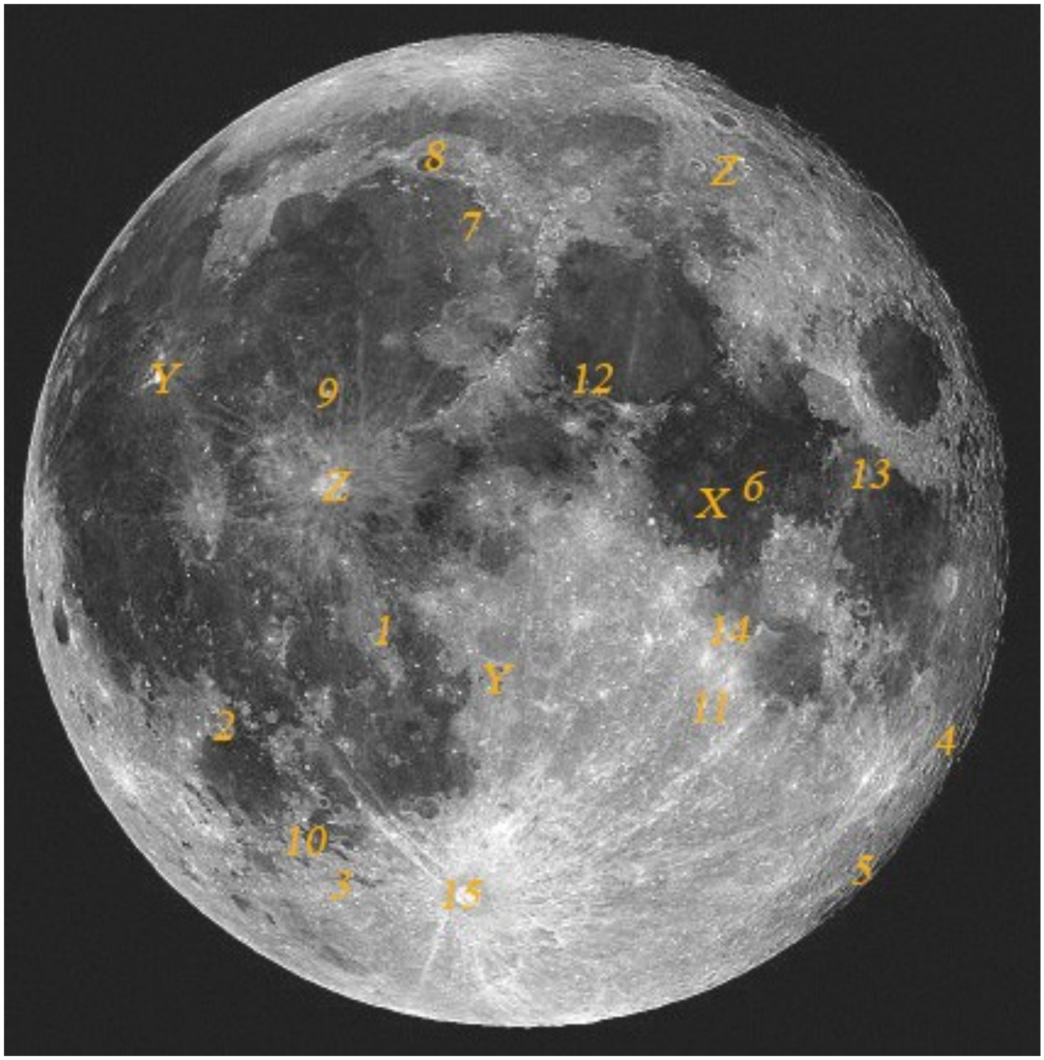
KEY TO IMAGES IN THIS ISSUE

1. Fra Mauro
2. Gassendi
3. Hainzel
4. Humboldt
5. Mare Australe
6. Maskelyne
7. Mons Piton
8. Plato
9. Pytheas
10. Ramsden
11. Rupes Altai
12. Sulpicius Gallo
13. Taruntius
14. Theophilus
15. Tycho



FOCUS ON targets

X = Apollo 11 Sea of Tranquility
Y = Alphonsus & Aristarchus
Z = Atlas & Copernicus