ASSOCIATION OF LUNAR & PLANETARY OBSERVERS
ALPO
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THE LUNAR OBSERVER

A PUBLICATION OF THE LUNAR SECTION OF THE A.L.P.O.
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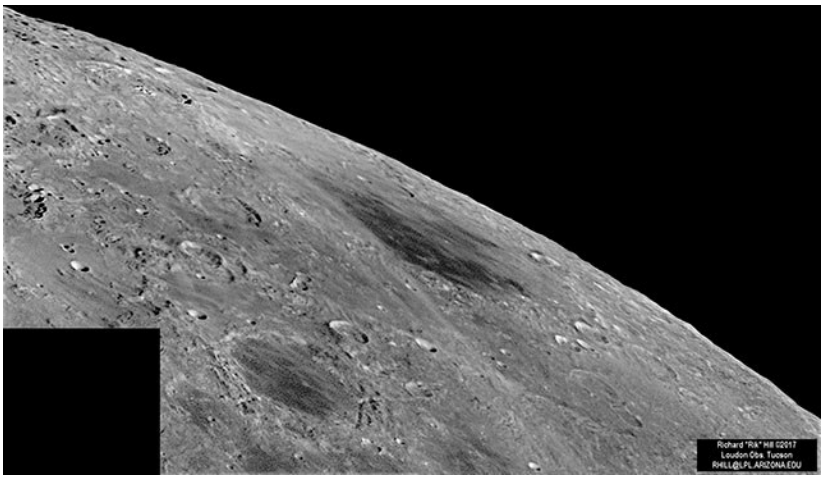
17 Autumn Lane, Sewell, NJ 08080
RECENT BACK ISSUES: http://moon.scopesandscapes.com/tlo_back.html

FEATURE OF THE MONTH – APRIL 2017
HUMBOLDT

Richard Hill – Tucson, Arizona, USA
March 7, 2017 02:01 UT. Seeing 8/10. 8" Mak-Cass, f20, SKYRIS 445M.



It was a good night for observing on this part of the limb and I noticed that I did not have any good images of Mare Humboldtianum. It's not a difficult feature to find if the libration is favorable. You go to Atlas and Hercules, more move east (lunar east) to the large, 129km diameter crater Endymion, seen in the lower middle of this image with its floor streaked with rays from the Thales impact to the north, and a little further on is the Mare. Endymion is an ancient crater possibly over 4 billion years old. Notice the unnamed rille that goes from the southeast wall of Endymion to the 20km crater Endymion farther to the east. Mare Humboldtianum is just over 270 km in diameter but it sits in Humboldtianum basin that is nearly three times larger. You can see a large ray crossing the northern end of . Tracing the ray back it appears to come from the region of Mare Crisium, possibly the bright recent crater Proclus?

The large flat expanse north of the mare is Bel'Kovich (204km) and a little further on is the very clear crater Hayn (90km) with very clear central peak and a dark shadow on the southern wall. This central peak is a curious formation clearly divided into quadrants by wide valleys. That's only hinted at in this image. The crater beyond Hayn is Bel'Kovich K (47km). Seems a shame that a crater of this size is given such an inferior name but then it is not often visible due to libration.

LUNAR CALENDAR

APRIL-MAY 2017 (UT)

2017		UT	EVENT
Apr	01	08:49	Moon-Aldebaran: 0.3° S
	03	06:12	Moon Extreme North Dec.: 19° N
	03	18:39	First Quarter
	07	04:30	Moon-Regulus: 0.8° N
	10	21:20	Moon-Jupiter: 2.4° S
	11	06:08	Full Moon
	15	10:05	Moon Apogee: 405500 km
	16	18:39	Moon-Saturn: 3.6° S
	17	13:12	Moon Extreme South Dec.: 19.1° S
	19	09:57	Last Quarter
	23	17:59	Moon-Venus: 5.3° N
	26	12:16	New Moon
	27	16:18	Moon Perigee: 359300 km
	28	17:20	Moon-Aldebaran: 0.5° S
	30	13:33	Moon Extreme North Dec.: 19.2° N
May	03	02:47	First Quarter
	04	09:49	Moon-Regulus: 0.6° N
	07	21:24	Moon-Jupiter: 2.3° S
	10	21:43	Full Moon
	12	19:51	Moon Apogee: 406200 km
	13	23:07	Moon-Saturn: 3.4° S
	14	20:29	Moon Extreme South Dec.: 19.3° S
	19	00:33	Last Quarter
	22	12:32	Moon-Venus: 2.4° N
	24	01:20	Moon-Mercury: 1.6° N
	25	19:44	New Moon
	26	01:23	Moon Perigee: 357200 km
	27	23:36	Moon Extreme North Dec.: 19.4° N
	31	16:08	Moon-Regulus: 0.3° N

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.

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, dd/mm/yyyy)
Size and type of telescope used Magnification (for sketches)
Filter (if used)
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 compress, or 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: Concentric Craters

Focus on is a bi-monthly series of articles, which includes observations received for a specific feature or class of features. The subject for the **May 2017** edition will be **Concentric Craters**.
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 this 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 Concentric Craters article is April 20, 2017

FUTURE FOCUS ON ARTICLES:

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

Subject	TLO Issue	Deadline
Messier & Messier A-Oblique Craters	**July 2017**	**June 20, 2017**
Lunar Domes	**September 2017**	**August 20, 2017**

NEPER

David Teske

The crater Neper (fig. 1) was on the sunset terminator at the time of this drawing. Though almost completely in shadow, Neper stood out dramatically into the terminator. Perhaps most amazing, was the central peak and its dramatic shadow cast upon the eastern wall. The observation was made on 12, January 2017 between 9:11 PM and 10:04 PM CST (colongitude $91.0^{o} – 91.4^{o}$) using the 60 mm f/16.7 refractor telescope using a 10 mm Tele Vue Radian eyepiece for 100 x. The skies were clear and the seeing was 5/10, with 10 being perfect. North is up; east is to the right, so this is correct orientation as seen with the unaided eye. The medium was Strathmore Artagain black paper, white pastels, white and black conté pencils.

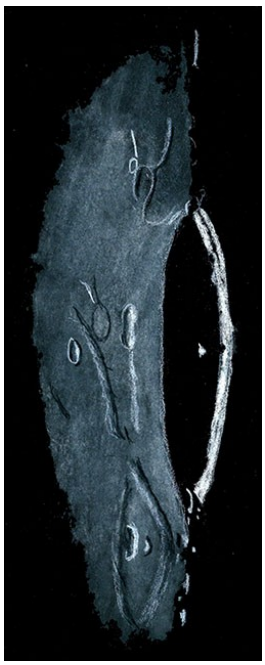


Figure 1*. RUPES RECTA, Starkville, MS, January 12, 2017 – David Teske, 06:11—07:04 UT. Colongitude 91.0-91.4º. 60mm f/16.7 refractor, 100X . Clear Sky, Seeing 5/10.*

Neper is the giant crater in this drawing with a diameter quoted at 137 km to 144 km. Neper lies between and on ejecta of two pre-Nectarian mares, Mare Smythii to its south and Mare Marginis to its north. Neper is slightly younger than these mares with and age of the Nectarian Period, 3.92 to 3.85 billion years old. The crater itself is shadow-filled as it is a very deep crater that is very foreshortened as seen from Earth. Charles Wood says of Neper that *when the sun is setting on Neper, telescopic observers are treated to an oblique view of an impact crater with its peak shining like a beacon in the inky darkness.* This is what I saw! The eastern wall shined brightly in the setting sun. This wall was strongly terraced, especially towards the northern third. Poking up through the shadows was a massive central peak that is 2.3 km tall. This peak cast a very noticeable shadow on the eastern wall. North of Neper was the southern end of Mare Marginis. Mare Marginis had a surface darker than the surrounding area. Northwest of Neper on the shores of Mare Marginis was a flat floored crater with low rims. A ridge extended northeast of this onto the mare. A brighter ridge extended north of this crater. A small crater was at the southwest of this bright ridge. The area west of Neper was bright highlands. The first crater visible west of Neper was the elongated crater Neper D with a diameter of 38 km, perhaps two craters connected together. These craters had bright eastern walls and some shadow on their western floor. Emanating south of this crater was a bright line of material. West of this Neper D was a shallow crater that was outlined by shadow. A bright ridge and a dark depression extended northwest of this crater. A slightly smaller, but fresher crater was to the west of this crater. A ridge aligned southeast to northwest was west of this crater. A larger ridge was between the two craters mentioned above. This ridge extended southeast towards a large crater Banachiewicz.

Banachiewicz was a large crater southwest of Neper. This crater had a flat floor and walls with some terracing. With a diameter of 99 km, Banachiewicz lies just inside the main ring-rim of Mare Smythii. It is a crater of pre-Nectarian age, at 4.6 to 3.92 billion years old. Its rim is well worn, its terraces are minimal, and it has no central peak. On its floor were the craters Knox-Shaw and B Banachiewicz. The crater B Banachiewicz appeared to be the larger and deeper of the two. Its inner rim is almost always bright. The crater Knox-Shaw was to its east and was smaller and less defined, as it is the older of the two craters. Knox-Shaw with a diameter of 13 km has a floor level 600 m lower that of Banachiewicz B's level. This crater may have destroyed the central peak of

Banachiewicz. West of Banachiewicz towards the terminator was a small unnamed crater and a few hills rising above the setting sun.

Neper was named after John Napier, a Scottish mathematician who lived from 1550 to 1617. Banachiewicz was named after Tadeusz Banachiewicz, a Polish astronomer and mathematician who lived from 1882 to 1954. Knox-Shaw was named after Harold Knox-Shaw, a British astronomer who lived from 1885 to 1970.

References

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

Moore, John. 2014. Craters of the Near Side Moon. CreateSpace Independent Publishing Platform.

Rükl, Antonin. 1990. Atlas of the Moon, ed. Dr. T. W. Rackham, Kalmbach Publishing Co. Waukesha.

Wilkinson, John. 2010. The Moon in Close-Up. Springer-Verlag, Berlin.

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

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ANALYSIS OF A 1609 GALILEO LUNAR SKETCH

Stephen Tzikas

Recently I completed the Astronomical League's Galileo observing program that included an observation and sketch of the Moon under the circumstances to which Galileo would have been restricted with his telescope. Essentially this is an observation under 20x magnification with a small telescope similar to his.

Galileo's sketches seem to have been drawn more as representations of the Moon than as accurate replicas of what one sees through a telescope. For example, in the illustration provided in Table 1, the size of the circular crater on the terminator (perhaps Albategnius) is greatly exaggerated. It is speculated that Galileo represented it this way in order to emphasize the effect of shadowing in creating a three-dimensional image. But, it's not difficult to make errors in lunar feature sizes and locations. Recreating Galileo's mind set and approach, therefore, has a bit of speculation to it. He had burden of being first to make such observations, and that undoubtedly influenced his choices on how best illustrate the Moon to a completely ignorant public. In my sketch (Table 1), I did not have Galileo's illustration next to me, and I had not looked at it in a while. I was interested in completing my own unbiased sketch under these conditions. Even under low power, the Moon offers an unbelievable amount of feature details, even in daylight. There are terminator details, craters, bright spots, mountains, "countless" smaller craters, and rays. Galileo also had to contend with the optical quality of his time. For my sketch I estimated 250 daylight features could be seen, 500 features in twilight, perhaps even more in night conditions. Even at a rate of sketching a feature every minute, approximately 10 hours would be required for an accurate sketch. Hence with this time limitation and other restrictions such as weather and changing co-longitude, Galileo, like myself, had to decide on styling shortcuts. I was not about to draw every craterlet I saw and accurately map them into a grid on a piece of paper. Instead one attempts first a few key anchor craters, main mare outline, and main tomes. Galileo would have noticed the colongitude changes every month in the same features. He would have known that he could not wait to next month to continue the same sketch. The month before my sketch (March 2016), the half phase Moon was very much like the image of Galileo's sketch with that large central crater. One month later, see how the Moon changed for the closest phase

I matched for this observation. There is no sign of that crater. Slight colongitude changes make big differences to anyone who is familiar with crater sketching. Finally, we can assume that whatever bias Galileo had in what he thought the features were, probably influenced his style in sketching them. That is, Galileo probably made small adjustments to his sketches to fit his preconceived idea of what the feature must really look like if it was just a little larger to see. This is not unlike the scientist who tries to select only the data that fits his or her perceived conclusion. Scientists ought not to do this, but it happens.

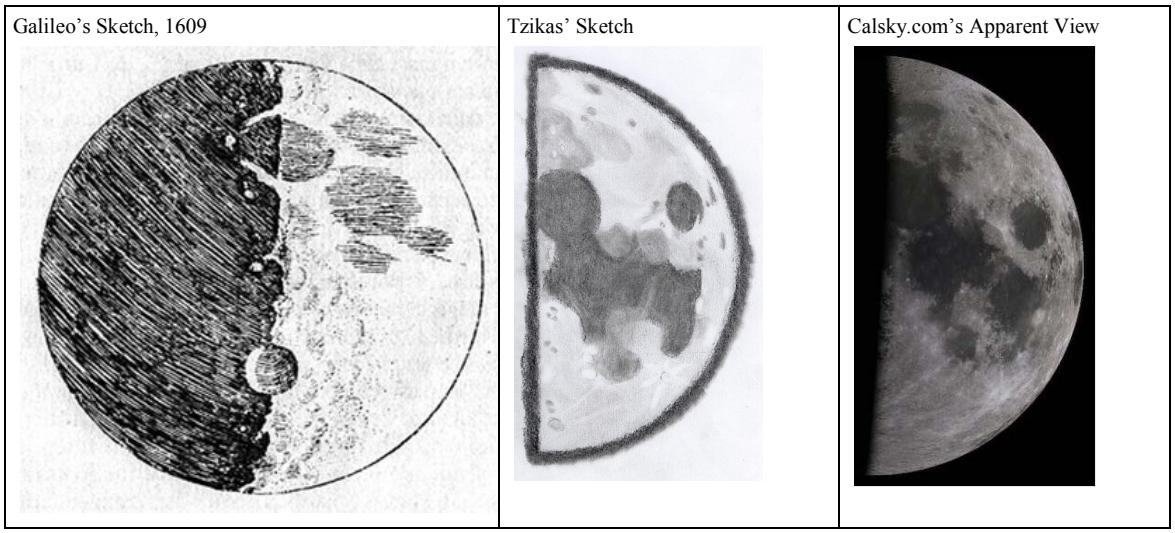

Figure 1: The Moon: Illustrations and Photograph. *The specifics of my sketch are: location-Reston, VA USA. April 13, 2016, 22:55-23:40 UT. Moon phase 48%. Selsi 60mm Refractor (750mm FL), 40 mm eyepiece, 18.75x, Seeing: Excellent. Colongitude: 350.25*

For better context, I included a screen shot of the Moon at the same time and location of my image, through the apparent view feature of Calsky.com. From the Calsky.com website, the Moon axial tilt to orbit was 6.68 degrees, the Earth axial tilt to orbit was 28.44 degrees, and the inclination of Moon orbit to Earth orbit was 5.14 degrees.

Even this Calsky.com image does not capture all the detail that the human eye sees. This can be one of the advantages of sketching over photography. The Moon is heavily cratered in the north and south polar regions. So much so that I decided not to attempt sketching these craters. Trying to sketch the whole lunar disk offered an interesting change of perspective too, quite different than that of a crater. I think that change in perspective probably lead me to be somewhat inaccurate on the tonal shades (too light). However, I think the photograph suffered similarly in tonal inaccuracy (in this case, too dark). During the sketch I thought my geographic bearings were off, but actually the features I sketched aligned reasonably well with the photograph. Unfortunately Galileo did not have such evaluative tools. The terminator was relatively smooth at this colongitude, as I have seen rougher. Proclus crater was a bright feature, and elsewhere on the surface bright rays were evident. One shouldn't underestimate the impact of a low power view. That same Astronomical League observing program required an observation of Saturn. Under the same power, I probably witnessed my most amazing view of Saturn. Because the ring system was nearly full tilt, I saw a solid yellow oval image of Saturn. The rings could not be resolved, so I observed a solid bright oval. I could only wonder what Galileo might have thought at that sight, if his first glimpse of Saturn was done under the same conditions. In conclusion, I would definitely recommend an observation of the Moon at low power, and participate in an opportunity that most people might prematurely conclude is uninteresting, but is really anything but uninteresting.

LUNAR TOPOGRAPHICAL STUDIES

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Assistant Coordinator – William Dembowski - dembowski@zone-vx.com

Assistant Coordinator – Jerry Hubbell – jerry.hubbell@alpo-astronomy.org

Website: http://moon.scopesandscapes.com/

OBSERVATIONS RECEIVED

ALBERTO ANUNZIATO—PARANÁ,, ARGENTINA. Drawings of Bessel, Curtius & Sulpicius Gallus.

MAURICE COLLINS - PALMERSTON NORTH, NEW ZEALAND. Digital images of 6 day moon, Aristoteles, Descartes, Maurolycus & Montes Caucasus.

JOHN DUCHEK – St. LOUIS, MISSOURI, USA. Digital images of Posidonius, Rupes Altai & Theophillus-Catharina.

HOWARD ESKILDSEN - OCALA, FLORIDA, USA. Digital images of waxing crescent moon(2).

RICHARD HILL – TUCSON, ARIZONA, USA. Digital images of Hainzel, Humboldt & Jannsen.

JERRY HUBBELL – LOCUST GROVE, VIRGINIA, USA. Digital images of full & 3rd quarter moon..

MICHAEL SWEETMAN – TUCSON, ARIZONA USA. Digital images of full moon & Gassendi-Mare Humorum.

DAVID TESKE - STARKVILLE, MISSISSIPPI, USA. Drawing of Neper.

STEVE TZIKAS - RESTON, VIRGINIA, USA. Drawing of 1st quarter moon..

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CURTIUS– Alberto Anunziato, Paraná, Argentina. March 5, 2017 00:30-01:15 UT. ETX-105 Mak-Cass, 154x.

The observation started in a luminous point in the terminator area corresponding to the south pole. As the minutes go by and I focused the view through the 9.5 mm eyepiece, other illuminated areas emerged from the shadows. I thought it might be of interest to record the illuminated areas as indicators of the highest points at this colongitude (352.1). A quick query to Virtual Moon Atlas on my laptop indicated that the crater in the shadows was Curtius. Curtius is about 100 kilometers in diameter and is located in a densely cratered region. The highest area of Curtius is the top of the western rim (left). Sunlight was illuminating an increasingly large area of the rim, but the summit remained extremely bright. The high points of the north and south rims can also be distinguished, including shadows in a crater on the northern rim. To the east the sketch includes the highlands that extend to the neighboring crater, Pentland A.

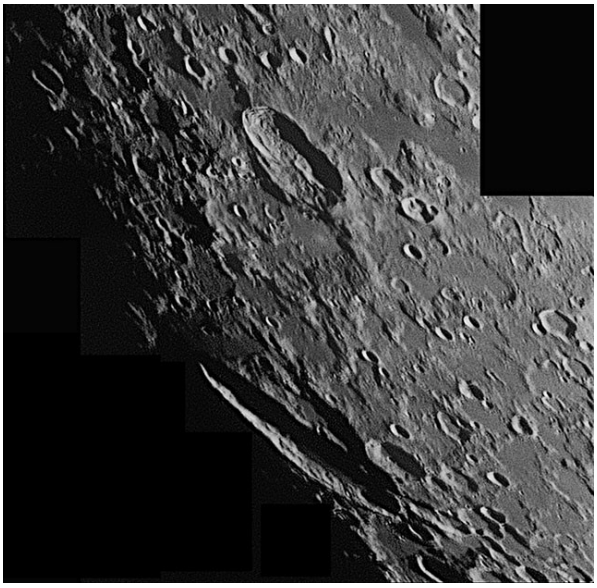
RECENT TOPOGRAPHICAL OBSERVATIONS

DESCARTES - Maurice Collins,- Palmerston North, New Zealand. February 3, 2017 08:15 UT. FLT-110, 3X barlow, f/21.

POSIDONIUS - John Duchek—Carrizozo, NM, March 5, 2016 . 01:41UT. 7" Skywatcher Mak-Cas, ZWO-178MC CCD, Seeing 6/10, Transparency 6/6. Color Saturation enhanced.

WAXING CRESCENT - Howard Eskildsen, Ocala, Florida, USA. March 2, 2017 0121 UT. Seeing 6/10, Transparency 5/6. 6" Refractor, f/8,. Canon 60D SLR.

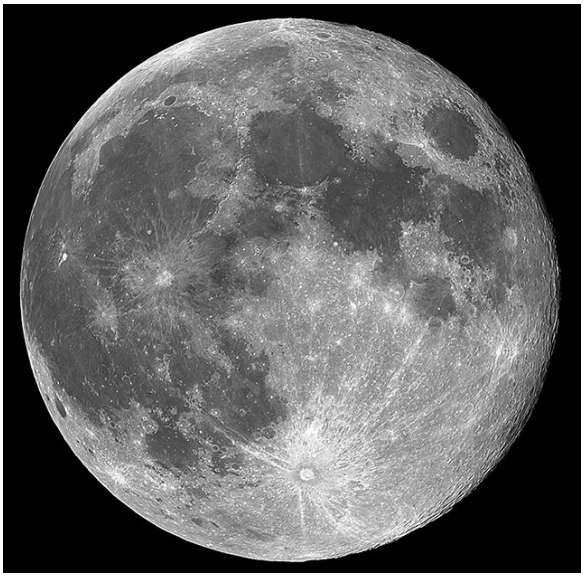
RECENT TOPOGRAPHICAL OBSERVATIONS



HAINZEL – Richard Hill – Tucson, Arizona, USA January 9, 2017 02:33 UT. Seeing 8/10. 8" Mak-Cass, f20, 656.3 nm filter, SKYRIS 445M.

When the moon is only about 3 days from full (in this case 84% illuminated), we get this nice view of several very interesting features in the lunar southwestern quadrant. The first one is the double lobed crater just above center. The lower lobe is the 71km diameter Hainzel with the odd linear mountain on its floor. The upper lobe is Hainzel A (55km) with great terracing in its walls. On the LROC images you can see that the linear mountain is actually the wall of a rather squarish crater on the floor of Hainzel labeled Hainzel C. Notice the elongated crater just to the right of Hainzel. It is a single crater this time named Epimenides (22km in the long direction). Below it is a curious feature that resembles a cat's paw print. This was formed from a few impact features two of which are named Epimenides B (10km) the smaller
crater to the right and the larger feature, Epimenides S (26km) to the left only 1km smaller that the listed size for Epimenides itself. Above Hainzel is the flat irregularly shaped Lacus Timoris. On it's left end can be seen a rille that is the southern end of one of the longer Rimae Ramsden whose origin is over 150km to the north.

Just below Hainzel is the ruined crater Mee (136km). This ancient crater may be older than 4 billion years! Farther down on the terminator is a very elongate hole, Schiller. It's listed as having a 179-184km "diameter" by different sources. Its length is that, but the width maximum is around 70km. This is the result of at least 3 impacts and further modification during the formation of the Schiller-Zucchius Basin in shadow here. Notice the crater half filled with shadow on the southern wall. This is Bayer (49km). Take a moment to enjoy the sunlit crater wall on Schiller before finishing.



FULL MOON – Jerry Hubbell · Wilderness, Virginia USA.. March 13,, 2017 03:00 UT. Seeing 6/10, transparency 3/6. 152mm APO refractor, f/8. QHY163c.

GASSENDI-MARE HUMORUM Michael Sweetman - Tucson, Arizona, USA, March 10, 2017 UT. Seeing 6/10, transparency 3/6. 60mm f/15 refractor. Skyris 132M, Baader fringe killer filter.

LUNAR GEOLOGICAL CHANGE DETECTION PROGRAM

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

Assistant Coordinator – David O. Darling - DOD121252@aol.com

News: At the time of writing, I am still under a heavy teaching workload, but will try to catch up on the February and March observations received, by next month.

.We have received an email from Gene Cross, saying that he has come across some photographs that he took of a 1967 Nov 15 Aristarchus LTP:

> ***Aristarchus-Cobra Head, 1967 Nov 15 UT 05:40-06:00 Observed by Cross, Tombaugh (Las Cruces, NM, 12" reflector x800), Harris (Tucson, AZ), and Dunlap (Organ Pass, NM, 24" reflector with Moon blink). "Obs. reddish color N. & E. of Aris. & more intense color nr. E.(IAU?) rim of Cobra Head. Red color nr. C.H. confirmed by Tombaugh. Obtained 10 photos between 0543-0549h in 3 spectral bands (blue, yellow, red, & integ. light). No change dur. obs. per. but spot got smaller at moments of good seeing. Isodensitometry of photos. At Corralitos 0152-0155 on 24-in image intensifier & filter sys. photos at 0320-0330h. Harris at Tucson got spectra. Neither of latter 2 show anything unusual. Its edges were nebulous even at best seeing. Size @ that of Cobra's Head." NASA catalog weight=5. NASA catalog ID #1053. ALPO/BAA weight=4.***

Although not confirmed at Corralitos, as they appear to have been observing at a different time, and nothing unusual appeared on the spectra by Harris (uncertain if this was taken at the same time?), both Gene Cross and Clyde Tombaugh, saw color visually. Hence the report has been given a high weight of 4. Gene took some photos in blue, yellow, and white light using a 12" Cassegrain reflector, one of which is shown in Fig 1 (Centre) – though at present I am uncertain what color filter it was taken through.

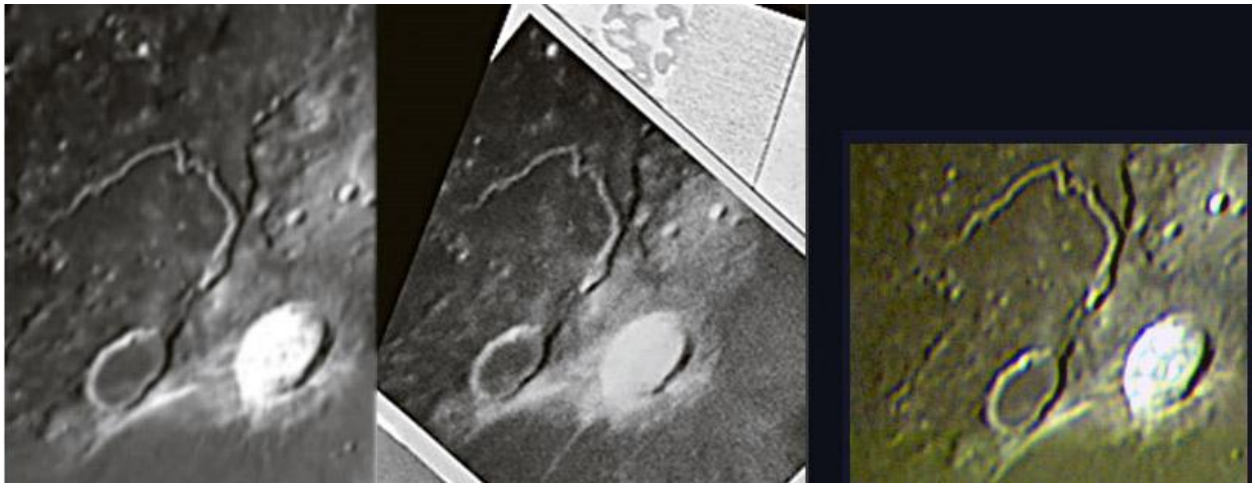


Figure 1. Aristarchus images, orientated with north towards the top and under similar illumination conditions, to within ±0.5˚. (Left) Monochrome image by Franco Taccogna (UAI) taken on 2015 Aug 27 UT 20:59 which has been modified in contrast and resolution to match the 1967 photo. (Centre) a photograph taken by Gene Cross (ALPO) from the 1967 Nov 15 LTP. (Right) Color image by Derrick Ward (BAA) taken on 2015 Aug 27 at 21:30 UT.

Gene has kindly offered to scan his note book and images, at higher resolution and send them to us so that we can make direct comparisons with similar illumination (Fig 1 Left and Right) images. A preliminary visual check of Fig 1 shows that the appearance of Aristarchus in 1967 and 2015 was very similar, though there is maybe an extra ray coming off the SSW of Aristarchus, however this is possibly a scratch on the film, or a reflection off of the photograph surface? However we will not know for sure about colors until we have the color filter negatives scanned in, and are able to normalize these to the modern day images and hence look for any subtle colors in the locations that Gene Cross and Clyde Tombaugh sighted these visually.

March was a busy month, as I have given a radio interview on BBC Radio Wales about what is thought to be the first confirmed observation of a lunar impact flash from the UK, (See Fig 2). If you would like to take part in impact flash observing please contact Brian Cudnik, ALPO's lunar impact flash coordinator.

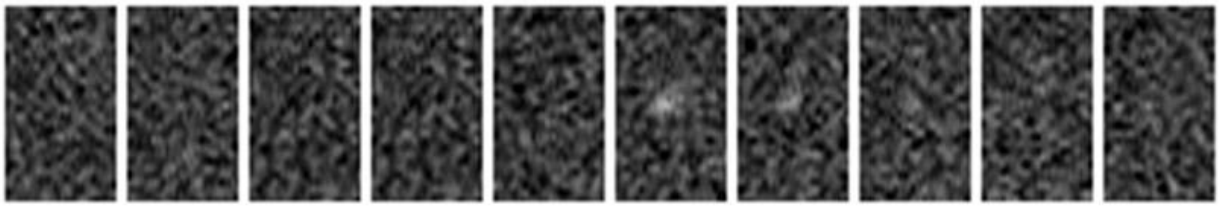


Figure 2. *Time lapse of the lunar impact flash, NW of Wolf crater, as imaged by Aberystwyth University on 2017 Jan 01 UT 17:47. TV fields are 1/60th sec apart. North is towards the right. The impact was discovered by Stafano Sposeti, as part of a GLR impact flash observing team: Lena Raffaello, Iten Marco, and Sposetti Stefan. Aberystwyth University confirmed their discovery with an independent observation of a flash at the same location, but in doing so has probably resulted in this being the first confirmed impact flash recorded from the British Isles.*

I have also been asked to do a Podcast for ALPO on the topic of LTP, and will be presenting some tips on LTP observing, at a lunar session of the observing workshop of the British Astronomical Association, to be held in London at the end of September. More about these, next month.

LTP Reports: Two reports have been received, though they both turn out not to be LTP:

South Pole Cusp: On 2017 Jan 13 UT 17:07, Franco Taccogna took an interesting image of the lunar south pole (See Fig 3) showing a very detached sunlit peak. Although not a LTP, I have included it to illustrate how some past LTP reports of similarly detached points, far from the crescent. Franco thinks that the sunlit peak could either be from Scott or Amundsen craters?

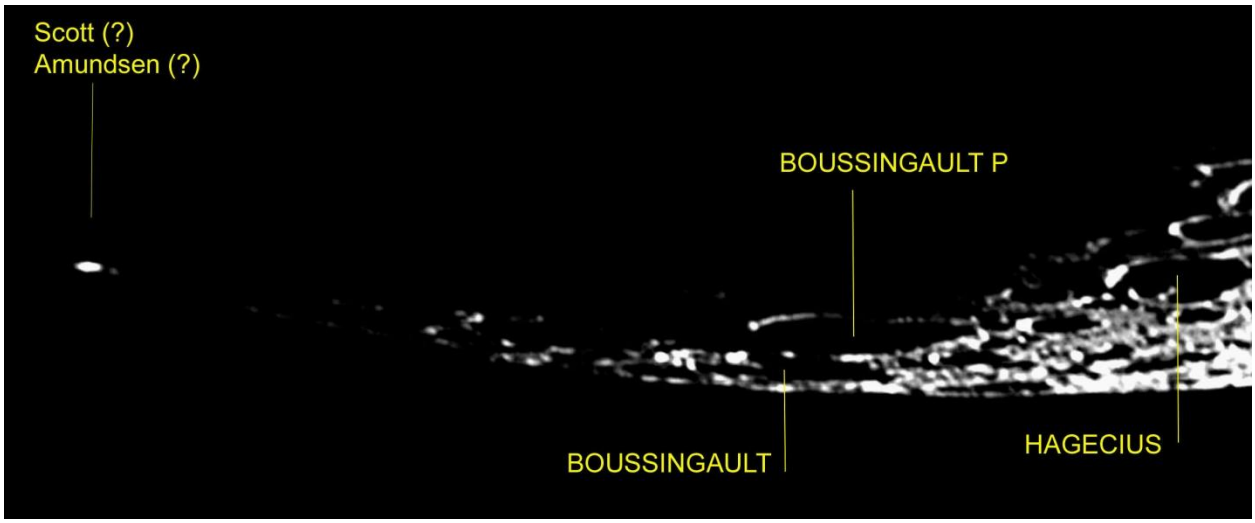


Figure 3. *A sunlit peak on the south polar lunar cusp as imaged by Franco Taccogna (UAI) on 2017 Jan 13 UT 17:07.*

On 2017 March 05 UT 01:23 John Duchek (ALPO) imaged Theophilus at high resolution, despite only having a 7" aperture scope, and was very curious about a lack of detail seen on the N-NE and SE floor of the crater (see Fig 4 – bottom left). He compared these areas to the floor of Cyrillus and Catherina, and found that these had a lot more detail visible. He also examined some spacecraft imagery, and again found these had a detail on the N-NE and SE floor which perhaps should have been visible at telescopic resolution. Plenty of other detail can of course be seen in John's image on the western area of the floor, so could this be what was referred to in the LTP community of the past as an "obscuration" of detail?

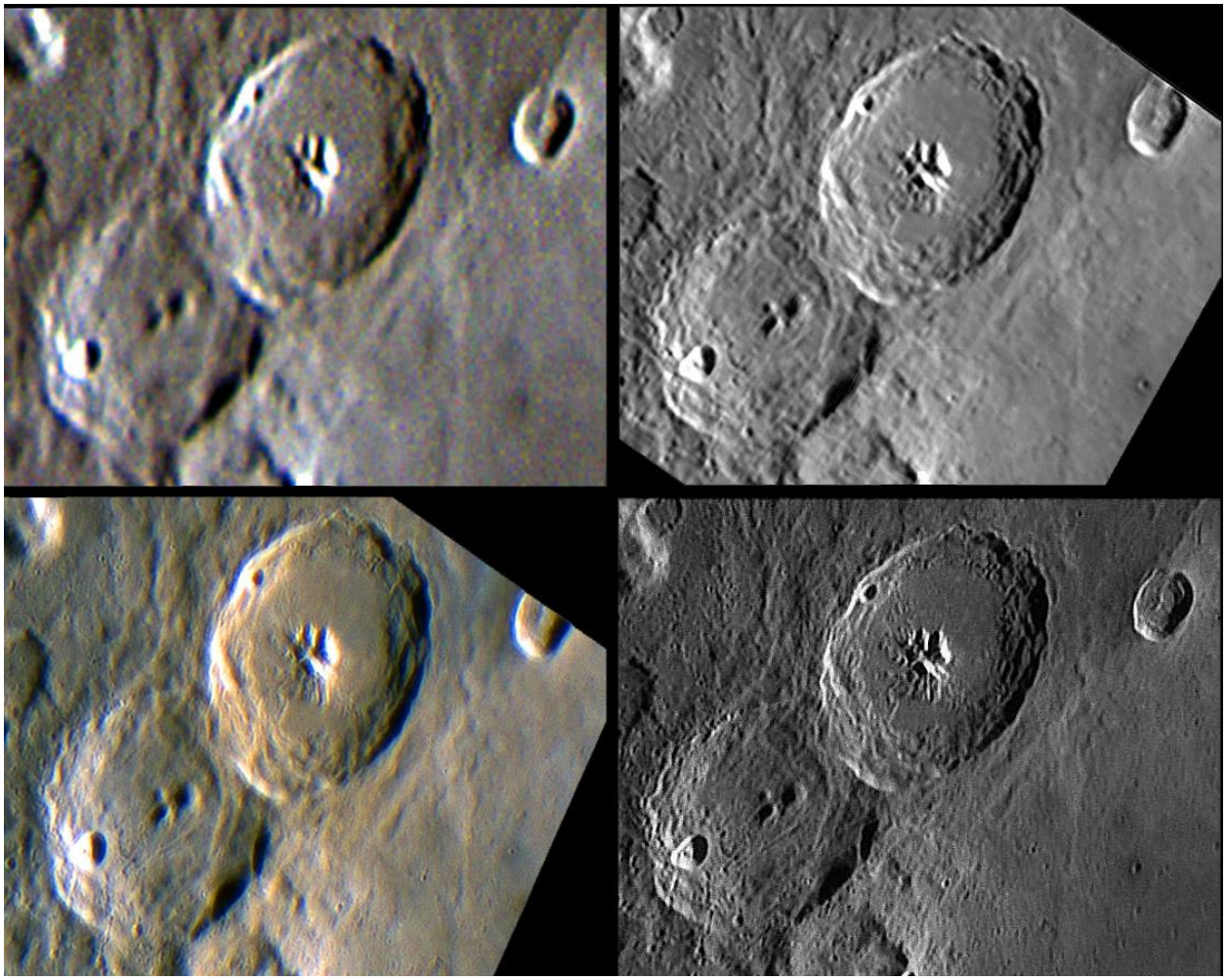


Figure 4. *Theophilus orientated with north towards the top.* ***(Top Left)*** *2015 Mar 27 UT 07:05 color image by Maurice Collins (ALPO) taken using a 4.5" refractor, at Selenographic Colongitude: 353.0˚.* ***(Top Right)*** *2010 Jul 18 UT 08:15-09:55 from part of a mosaic made by Maurice Collins (ALPO) using an 8" SCT during, during Selenographic Colongitudes: 353.3˚-353.9˚.* ***(Bottom Left)*** *2017 Mar 05 UT 01:23 a color image taken by John Duchek (ALPO) using a 7" Mak-Cass, at Selenographic Colongitude: 353.5˚.* ***(Bottom Right)*** *2012 May 27 UT 18:32 as imaged by Mike Brown (BAA) using a 10" Newtonian, at Selenographic Colongitude: 354.3˚ - from p16 of the 2012 June BAA Lunar Section Circular.*

John did the correct thing to notify me about this for checking, as I was able to search through the ALPO/BAA observational archive for similar illumination matches. Nothing much came up with a tolerance of ±0.5˚, so I increased the tolerance to ±1˚ similar illumination, and found three other sets of images (See Fig 4 – top left, top right, and bottom right). Examining these, especially Mike Brown's image, I think it is fair to say that at this colongitude range, indeed the N-NE and SE floor of Theophilus can indeed appear to be rather lacking in detail, but that this is the normal appearance. Incidentally, if anybody was wondering, the dark spot on the floor, just north of the central peak in Fug 4 (Top Left) s a dust speck – I got Maurice Collins to check his original imagery! I would really like to see a lot more ultra high-resolution images, like you can see in Figure 4 sent in for repeat illumination events, as these can really help us eliminate many past LTP reports.

Routine Reports: Below is a selection of reports received for January that can help us to re-assess unusual past lunar observations. We will try to catch up with both February and March observations next month.

East of Picard: On 2017 Jan 02 UT 15:55-16:55 Brian Halls (BAA) checked visually, and imaged the region east of Picard as this corresponded to the same illumination conditions (to within ±0.5˚) to the following report from 1877:

> ***On 1877 Jun 15 at UT 20:00 Birt (England, UK) observed a bright spot east of Picard. The reason why this was regarded as a LTP, according to Cameron was that it was supposed to be faint or invisible. The Cameron 1978 catalog ID=193 and the weight=3. The ALPO/BAA weight=3.***

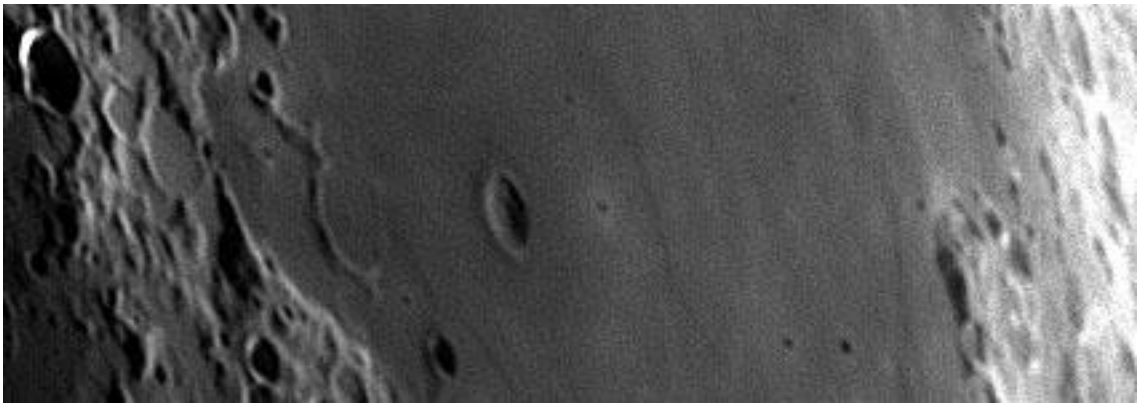


Figure 5. *An image by Brian Halls (BAA) from 2017 Jan 02 UT 16:07, orientated with north towards the top. Picard is just left of the centre.*

Brian comments that his seeing was relatively steady, and he had a clear view of the terracing inside Picard. The only bright area to the east of Picard was the light halo surrounding Curtis crater, but as you can see from his image (Fig 5), it was not bright as the 1877 report suggests. Brian continued to observe over the suggested time period but no bright spots formed. We shall keep the weight of that report at 3.

Figure 6. *A monochrome image of Descartes, located in the centre, with north towards the top. Taken by UAI observer: Pasquale D'Ambrosio on 2017 Jan 04 UT 19:44. Zöllner and Kant are to the top right of this, but before you get to Theophilus.*

Descartes: On 2017 Jan 04 UT 17:07-20:45 Pasquale D'Ambrosio (UAI) imaged (Fig 6) this crater, and from 18:27-20:49 UT it matched illumination (to within ±0.5˚) to a 2010 LTP report from Minsk, Belarus:

> ***On 2010 Apr 20 sometime between UT 22:00 and 23:00 I. Bryukhanov (Minsk, Zeiss Refractor at the Minsk Planetarium) observed an orange-brown tint a little to the west of Zollner and Kant craters. Apparently images were obtained.***

If we ever come across the 2010 image from Mink, then it would be interesting to compare these to Pasquale's image, in order to narrow down the time that the LTP occurred, and to remove any atmospheric spectral dispersion or chromatic aberration effects that might be present. Or alternatively we could simulate some of these effects on Pasquale's image above.

Bessel: On 2017 Jan 05 UT 09:28 Maurice Collins imaged (Fig 7) this crater at the same illumination (to within ±0.5˚) to the following Brazilian report:

North of Bessel 1969 May 1969 May 23 UT 22:54. Nelson Travnik (Observatorio Flammarion, located at 45.58W, 21.87S, f/15 10cm refractor, Kodak Tri-X, 1/15 sec exposure, sky conditions excellent). Dark spot photographed just north of Bessel - could be a photographic defect?. ALPO/BAA weight=1.

Figure 7. *Bessel crater with north towards the top as imaged by Maurice Collins (ALPO) on 2017 Jan 05 UT 09:28.*

Clearly there is no dark spot north of Bessel in Maurice's image. Without knowing too much about the Travnik report, for example whether more than one photograph showed the dark spot, it is difficult to know if it was just a chance alignment with a flying bug or a bird, in our atmosphere, when the photograph was taken, or simply a dust speck on the film – both of which would affect one image only. I will leave the report at its current weight of 2 for now.

Mons Pico: On 2017 Jan 05/06 both Alberto Anunziato (AEA, 23:20-23:30 UT) and Jay Albert (ALPO, 01:50-02:00 UT) observed Mons Pico at the same illumination angle (to within ±0.5˚) to the following two respective reports:

2009 Apr 13 UT 18:55-20:00 J. Adee (UK) and later A. Jarwaski (UK) saw Mons Pico to be incredibly bright. Adee reported naked eye visibility, though this does not show up in later CCD images. Jarwaski saw another nearby Mt very bright as well. This has been assigned an ALPO/BAA weight of 2, though I suspect it is just normal for Pico to get quite bright at sunrise.

SW of Pico 1844 Apr 25 UT 20:00? Observed by Schmidt (Athens, Greece, ? refractor) "A bluish glimmering patch of light not quite within the dark side" NASA catalog weight=4 (high). NASA catalog ID #123. ALPO/BAA weight=3.

For the 2009 LTP, Alberto noted that Mons Pico was very bright, but also was very near to the terminator. For the 1844 LTP Jay commented that both Mons Pico and Pico B were extremely bright in the rising Sun and were just E of the terminator. The peaks were sharply detailed with a thin strip of black shadow separating the N peak from the rest of Pico. However he saw no glows, or hints of blue, or other colors. I think that I will leave the weights as they are for both of these reports; the 2009 report on the grounds that it was claimed to be bright enough to see with the naked eye, and the 1844 report because of the bluish color.

Archimedes: On 2017 Jan 05 UT Valerio Fontani (UAI) imaged (Fig 8) this crater from 18:56-19:35UT. During 19:03-19:27 it had similar illumination (to within ±0.5˚) to a New Zealand report from 2001:

Near Archimedes 2001 Sep 25 UT 08:30 Observed by Try (Whangarei, New Zealand, 4" f/10 reflector) "observed two possible L.T.Ps. on the edge of the terminator near the crater Archimedes. They appeared to be two bright points of light about the size of Mount Piton. They seem to form a triangle with Mount Piton. He observed them for two hours and they were still visible when he ended his observing session. He was observing with a 4" f10 reflector. Then Moon age was 7.9 days old and the colongitude was 4.83. submitted a drawing showing the area where the lights were observed." ALPO report. ALPO/BAA weight=1.

Figure 8. *Archimedes, orientated with north towards the top as taken by Valerio Fontani (UAI) on 2017 Jan 05 UT 19:20.*

Although not including Mon Piton, there is quite a considerable area covered between Archimedes and Aristillus, and to the north. Some mountains are present, such as the Montes Spitzbergen, but this clearly is not of the same size as Mons Piton. Alas we do not appear to have the sketch that was made, in our archives, so if anyone knows of Try from Whangerei, in New Zealand, then I would like to be put in touch in order to find out what was on the sketch?

Tycho: On 2017 Jan 07 UT 00:59-01:02 Rik Hill (ALPO-BAA) imaged this crater under the same illumination and topocentric libration conditions (to within ±1.0˚) to a report of greyness seen inside the interior of the shadow of this crater seen visually by at least two observers back in 1995:

> ***1995 Mar 10 UT 21:59-23:25 Tycho observed by G. North (18" reflector, x144,UK) seen to have greyness inside parts of its shadow. Confirmed by J.D. and M.C. Cook (8.5" x216, UK, seeing II-III – observed 22:20-22:45(JDC), 23:00-23:25(MC) & 23:30-23:45(MCC). Possibly light scattered of illuminated wall into shadow or highland starting to break through the shadow. ALPO/BAA weight=1.***

Rik took two image (Fig 9 c and d), and using stacking software was able to capture the appearance much sharper than visual observers can see. Other images from the ALPO/BAA archive, also at similar illumination, have been included for comparison and stretched in a non-linear way to see if we can bring out detail in the shadow. However despite contrast stretching, none seem to show any light areas inside the floor shadow, apart from near the immediate foot of the central peaks, and perhaps imaging artifacts clinging to the inner edge of deep shadows (Fig 9 b, e, f, i) – something that is sometimes seen on stacked images. There may also be some evidence of either glare from the bright side of the Moon in the telescope optics, or scattered light off sunlit parts of the crater, into the shadowed areas on Fig 9 b, e, h, i, in that the shadows in craters and terrain closer to the terminator, look darker, than those further to the east.

Back in 1995 all three sketches differed, however they were not all made at the same time. Gerald North's sketch was the earliest (21:59-22:10 UT – See BAA Lunar Section Circular (1995, p789, and Fig 9d above) and showed two large "slightly misty appearance" sections in the floor shadow, one on the SE and the other on the NE – however the effect was both "slight and delicate". His seeing was Antoniadi IV at the start, trending to V at the end, and likewise atmospheric transparency varied from "fair" to "poor" due to haze. He was using an 18" reflector though. Jeremy Cook's sketch (22:20-22:45 UT – Fig 9g), made with an 8.5" reflector, showed a single, but larger elliptical dark grey patch, covering much of the floor shadow, which on a darkness scale of 1 = "sunlit western inner rim", to 10 = "jet black shadow!, was: 9.5, so 5% away from being perfectly black . His seeing conditions were better at Antoniadi II-III, but he too had some slight haze. Marie Cook's sketch (23:00-23:25 UT – Fig 9j) depicted a larger but more, diffuse, less elliptical – but still dark grey area, she also used the 8.5" reflector, but transparency was now worse with atmospheric haze increasing.

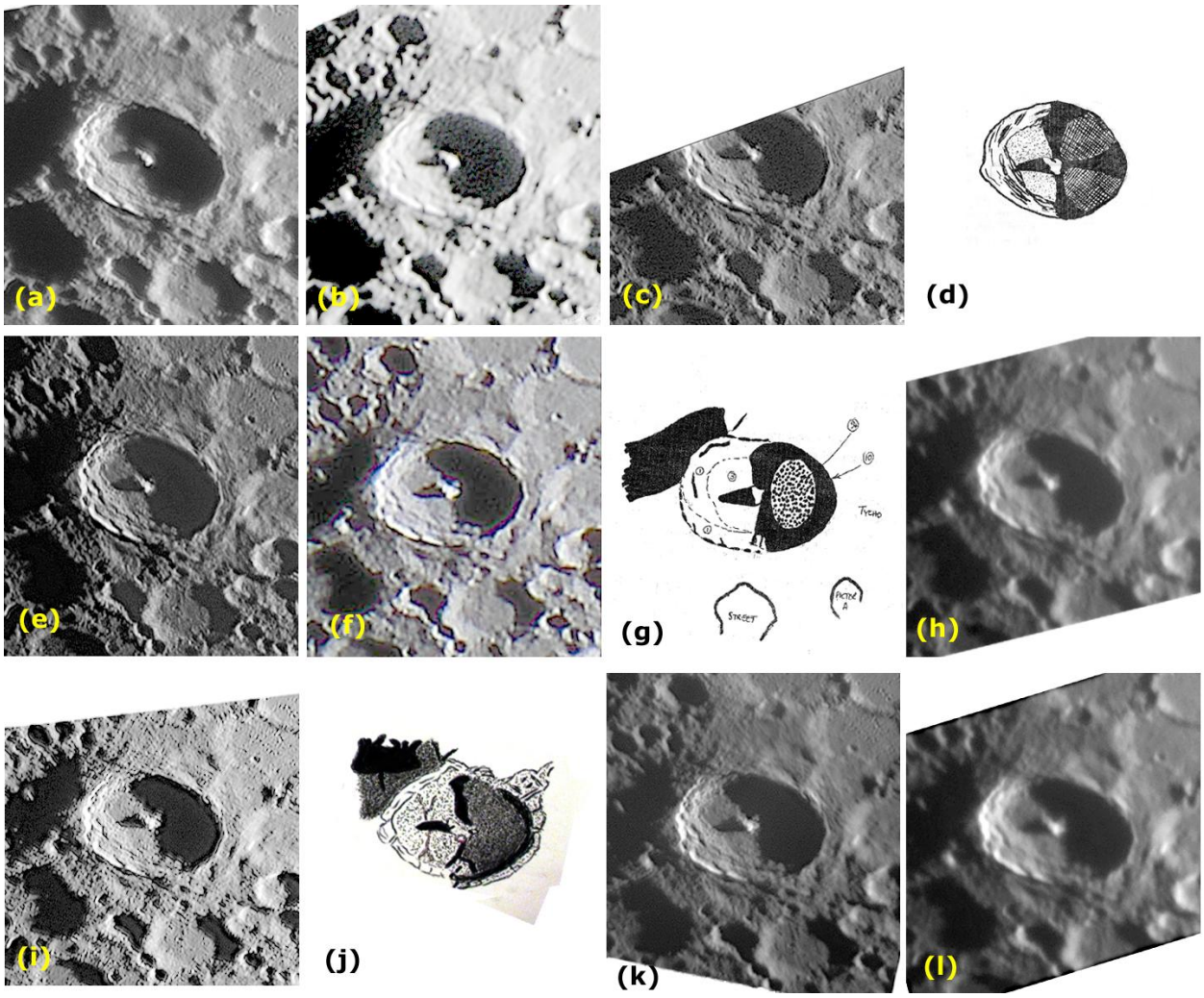


Figure 9. *Tycho images and sketches with similar illumination (to within ±0.5˚) to a LTP report from 1995 Mar 10. All are orientated with north towards the top. The images have under gone non-linear contrast stretching to bring out details in the shadow, and are sequenced by increasing solar altitude (Alt$_\odot$):* ***(a)*** *Alt$_\odot$ = 4.8˚: 2014 Dec 30 UT 16:38 by Brendan Shaw (BAA) – note that the "broad" light patch on the north east of the central peak, is probably an image stacking error.* ***(b)*** *Alt$_\odot$ = 4.8˚: 2015 Dec 20 UT 00:45 by Alberto Anunziato (AEA).* ***(c)*** *Alt$_\odot$ = 5.6˚: 2017 Jan 7 UT 00:59 by Rik Hill (ALPO-BAA)* ***(d)*** *Alt$_\odot$ = 5.6˚: 1995 Mar 10 UT 21:59-22:10 sketch by Gerald North (BAA) – the lighter areas in the floor shadow have been "greatly exaggerated" in tone and were much darker than this, but not completely black.* ***(e)*** *Alt$_\odot$ = 5.6˚: 2017 Jan 07 UT 01:02 by Rik Hill (ALPO-BAA).* ***(f)*** *Alt$_\odot$ = 5.7˚: 2012 Feb 01 UT 18:26 by Ralf Hempel (BAA).* ***(g)*** *Alt$_\odot$ = 5.8˚: 1995 Mar 10 UT 22:45 a sketch by Jeremy Cook (BAA) – again the brightness of the grey area in the shadow on the floor has been "greatly exaggerated" and was much darker than this.* ***(h)*** *Alt$_\odot$ = 5.9˚: 2016 Jan 18 UT 17:54 by Valeri Fontani (UAI).* ***(i)*** *Alt$_\odot$ = 5.9˚: 2013 Feb 19 UT 17:49 by Brendan Shaw (BAA).* ***(j)*** *Alt$_\odot$ = 5.9˚-6.1˚: 1995 Mar 10 UT 23:00-23:25 a sketch by Marie Cook (BAA) – any lightness in the floor shadow has been "greatly exaggerated". (k) Alt$_\odot$ = 6.0˚: 2009 May 03 UT 20:07-20:10 by Brill Leatherbarrow (BAA). (l) Alt$_\odot$ = 6.0˚: 2016 Jan 18 UT 18:25 by Valerio Fontani (UAI).*

There are only three purely visual repeat illumination observations, in our archives, made within ±0.5˚ in terms of similar illumination to the 1995 Tycho report. Firstly Don Spain (ALPO) on 2005 Jun 16 UT 01:27-02:52), examined several features (one of which was Tycho), using his 6" f/8 achromat x80, x160, and x240, under very good transparency – he reported nothing abnormal. Secondly Gerald North observing visually on 2009 Mar 05 UT 19:14-19:25, using a 10" reflector, x89, seeing Antoniadi IV (poor), and transparency poor ((haze and slight mist/fog) examined several features, including Tycho, and reported nothing unusual. Thirdly Jay Albert on 2010 Apr 23 UT 01:05, under 4th magnitude transparency conditions with a 6" SCT at x188, and he noted: "*While there were some intrusions of grey from the lit part of the crater floor, there were no grey areas within the deep shadow on the E floor. The central peak was sharp and its shadow sharp and black. Terracing was prominent on the W wall*".

So what might be going on during 1995 Mar 10?

Theory 1 : Internal scattered light from the illuminated parts of the crater: At the time of the BAA Lunar Section Circular article, Gerald, believed these to be due to light scattering into the shadowed areas from the western rim, and the central peak illumination the shadowed floor, and this is restated in his book: "Observing the Moon: The modern astronomer's guide", p343-344, and 348. He says, in email correspondence: *"Imagine standing in the shadowed region of a crater like Tycho under similar lighting to that in question. If you were turned towards the central peak you would see that looming large and partially (and brilliantly) sunlit a few miles away. Beyond you would see the far rim of the crater all brilliantly sunlit some miles beyond that. If you looked down you would have no trouble at all seeing your boots and the ground around you thanks to these sources of light*". Furthermore Gerald suggests that the reason why the CCD images have not detected it was perhaps due to the contrast setting in the image stacking software, not being amenable enough to enhance shadings inside the shadow. He wonders if longer exposures (pr 16 bit images) in future would reveal the delicate non-black shadings that visual observers saw? Unfortunately it is rather difficult to model the way that light would scatter inside the crater, without knowing photometric scattering functions of different parts of the crater wall and central peak – though I would imagine that from the central peak light flux would be extremely bright quite close to it, as Gerald says, but the light flux would subsequently fall off radially i.e. becoming weaker the further away from the central peak. For light from the large solid angle of the western illuminated rim, this would probably lead to a more homogeneous illumination over the dark shadowed floor. Even if CCD images so far do not have enough exposure to show detail in the dark shadow, we still have three visual observations which fail to show the effect either, though it could be that for two of them the visual inspections were not long enough to notice detail inside the shadow?

Theory 2: Earthshine illumination of the shadowed floor. Could this offer an explanation as to why modern day CCD cameras have so far failed to detect the effect under repeat illumination? Namely during 1995 Mar 10, earthshine may have been exceptionally bright, and this partly made the shadowed floor of Tycho show up? To test this I made a simulation in Fig 10 (Left) by adding a faint full Moon image of Tycho to Bill Leatherbarrow's image (Fig 9k). As you can see you can see a little bit of the floor in the shadow is visible, but no sign of the features depicted in sketches Fig 9d and g, which change in appearance anyway. Furthermore the effect would show up in other shadowed craters, and Gerald did check these at the time and did not find anything like what was seen in the shadow of Tycho. Earthshine can only really add a marginal slight overall background illumination to the shadowed area.

Theory 3: Seeing/Image Flare – here we have a situation whereby very faint ghost images of Tycho hover around, but are offset from the primary image. Although not really understanding the atmospheric mechanism behind this effect, I have occasionally seen it when observing Mars and other bright planets, so it must occur sometimes when observing the Moon too. A spur-like effect, coming out of Tycho's central peak, imaged by Robert Spellman on 2003 May 09, turned out to be this effect – though it was visible on other features too. The image/seeing flare effect has been simulated in Fig 10 (Right) with the flaring is to the SE and NE. You can certainly see double dark grey patch inside the shadowed floor, however it makes the western shadow of the central peak also non-black, and is also present in all other shadows on the Moon. Again this was not reported at the time elsewhere on the lunar disk.

Theory 4: A LTP? This is the least likely scenarios, as it would need an area of the shadowed floor, some 800 km^2 to be affected. The best known LTP mechanism – electrostatic dust particle levitation, can only raise particles a few cm to metres above the surface. Although the dust levitation effect has been proven to be most pronounced (In laboratory experiments and numerical simulation), on the terminator, the places where the shadings were seen would have been too low for the particles to make it into sunlight except close to the edge of the shadow. Dust kicked up by gas emission is another possibility, but is really difficult to model without knowing the quantities of gas, its velocity, size of dust particles etc, and there is not much good evidence for this from spacecraft data (elsewhere on the Moon) apart from the Radon leakage and Argon frosts on the night side, but these are at such low levels it is difficult to see them lofting dust?

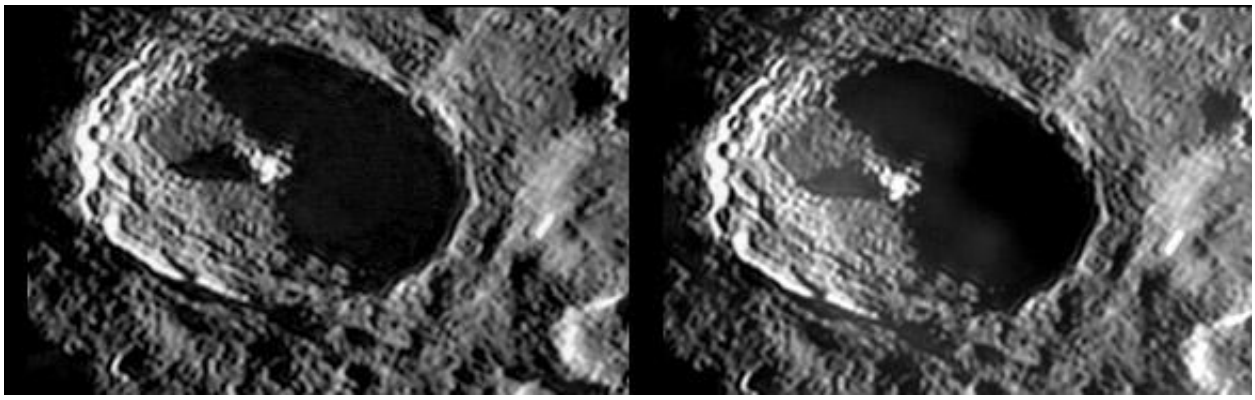


Figure 10. *"Simulations/special effects images" of a couple of mechanisms for producing greyness inside images of crater shadows.* ***(Left)*** *Earthshine illuminations of the floor shadow.* ***(Right)*** *Image/Seeing flare from two directions – towards the SE and NE.*

None of the theories satisfies what was seen, though perhaps a combination of theories 1, 2 and 3 might go some way in explaining. However the effect would have been seen elsewhere. I would therefore strongly urge observers to have a go at visually checking, and over exposed imaging of the dark shadowed floor of Tycho under the selenographic colongitude range of 20.0˚-20.4˚. Please attempt this under a variety of atmospheric transparencies and seeing conditions, as I am naturally very keen to see this effect repeated so that we can drop the observation from out LTP database – if it proves the case, or to raise the weight from its existing 1 level, to a 3 or 4 if we cannot reproduce it.

Alphonsus: On 2017 Jan 09 UT 19:54-20:31 Aldo Tonon (UAI) imaged this crater under the same illumination conditions to a visual report from 2001:

On 2001 Aug 30 at UT 20:35-21:15 C. Brook (Plymouth, UK) found a dimming in the central peak of Alphonsus, however it had returned to normal by Aug 31 UT 00:29-00:50UT when A.C. Cook (Alexandria, VA, USA, 8" reflector) examined the area, though there were some slight brightness variations that were attributed to seeing conditions. The ALPO/BAA weight=2.

In Fig 11 I have performed a quick normalization on five measured features in the images of Alphonsus. I have calibrated these using two standard deviations below the mean to represent 0.0 on the scale used in Fig 11 (Right), and 1.0 is two standard deviations above the mean. It shows quite a few variations which are no doubt caused by changes in seeing conditions (atmospheric blurring function), and measurement errors in determining the brightness of spot-like areas in the image (I used the magic wand tool in Adobe Photoshop – set to a threshold tolerance of 16). So please do not pay too much to the trend lines. I think what it tells us is that if one is attempting to determine the brightness visually, then one probably needs even more than five reference features to compare against. So I am always a bit skeptical over reports of fluctuations in brightness, especially of point-like object – notice how stable the dark SW floor patch on Alphonsus is in comparison. If looking for brightness variations in images alone, then every pixel in the region overlapping between the images would have to be normalized, so when dealing with several thousand measurements we would hopefully get some of the statistical noise errors reduced down compared to just 5 point measurements we used in Fig 11. So I will reduce the weight of the original LTP report from 2 to 1.

Plato: On 2017 Jan 11 UT 19:05-19:15 Marie Cook (BAA) observed the carter under similar illumination, to within ±0.5˚, to a LTP report from 1938:

Plato 1938 Feb 14 UT 00:25 Observed by Fox (Newark, England, 6.5" reflector, x240) "Prominent gold-brown spot on E. wall with yellow glow without definite boundary, spreading over floor." NASA catalog weight=3. NASA catalog ID #431.ALPO/BAA weight=3.

Marie states that "No prominent gold-brown spot seen on the east or west walls", no any "yellow glow". We will leave this LTP with a weight of 3.

Promonontoium Agarum: On 2017 Jan 13 UT 21:11 Ivan Walton (CADSAS) imaged (Fig 12) the area under the same illumination conditions (to within ±0.5˚) to the following report:

In 1958 Aug 20 at UT 20:00? an unknown observer noticed that Promontorium Agarum appeared filled with fog or mist. The Cameron 1978 catalog ID=510 and the weight=3. The ALPO/BAA weight=2.

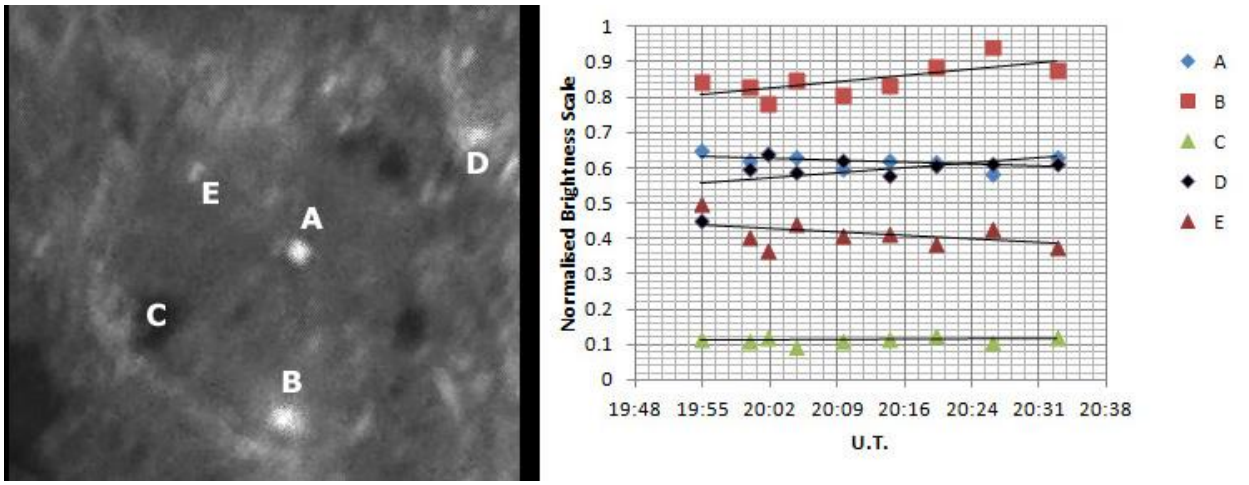


Figure 11. (Left) *Alphonsus as imaged by Aldo Tonon on 2017 Jan 09 UT20:02, orientated with north towards the top. Five labels have been added where brightness measurements have been obtained from this and other images taken during the night,* ***(Right)*** *A normalized plot of the brightness of the features A-E over time.*

Ivan's image shows that Promontoriu Agarum looks quite normal here though possibly one could stretch the desrciption to say that the western cliffs of this feature look a bit misty, though I think you would agree that is related to image resolution and one can in no way say that the feature had a "filled with fog" effect. I will keep the weight at 2 for now, but would really like to get my hands on a sketch if any exists?

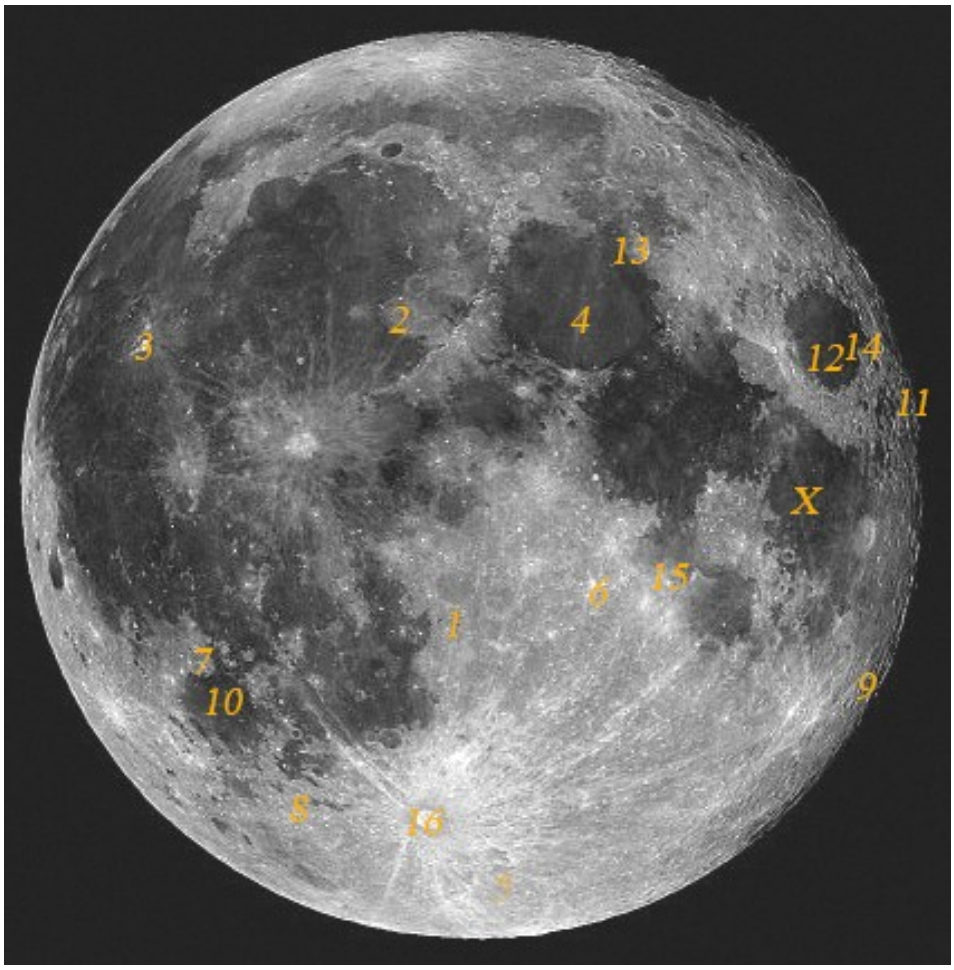
Figure 12. *Promontorium Agarum located at the centre of this image by Ivan Walton (CADSAS), taken on 2017 Jan 13 at UT 21:11, and orientated with north towards the top.*

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

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

KEY TO IMAGES IN THIS ISSUE

1. **Alphonsus**
2. **Archimedes**
3. **Aristarchus**
4. **Bessell**
5. **Curtius**
6. **Descartes**
7. **Gassendi**
8. **Hainzel**
9. **Humboldt**
10. **Mare Humorum**
11. **Neper**
12. **Picard**
13. **Posidonius**
14. **Promontorium Agarum**
15. **Theophilus**
16. **Tycho**



FOCUS ON targets

X = Messier-Messier A