

## INTERESTING MOON'S SURFACE FEATURES. OUR STUDY AND SOME INFERENCES

Yu. N. Bondarenko

Astronomical observatory, Odessa National University,  
Shevchenko Park, Odessa, Ukraine, 65014

**ABSTRACT.** In this article the results of the long-term CCD observations of the Moon are presented. We describe some unusual features existing on the Moon's surface and discuss their possible origin.

Observations of the Moon's surface even with the small-size telescopes appear to be quite promising. It could be that the author of the present study succeeded in discovering peculiar circular structures in some places on the Moon's surface, extraordinarily round shape of some dark patches of the lunar maria and the dark stripe of unclear origin on the shore of Mare Humorum.

It is likely that peculiar craters of unknown origin, which are localized on the fissures, are the centre of activity in the crater Alphonsus, rather than the crater's central peak as it was suggested by N.A. Kozyrev (Fig.1,2). The mechanism of their formation and dark material ejecting can be hardly explained by the known processes.

To clarify the issue on the transient lunar phenomena (TLP), the author of this paper has been conducting observations of the Moon at the Mayaki observational site for several years already. For that purpose, the Cassegrain reflector with the primary mirror diameter of 40 cm and the 3 m equivalent focus length was used. It was mounted on the astronomical parallactic tripod (APSh-6) and equipped with the VAC-135 video camera with the 8x10 mm black-and-white CMOS sensor of the progressive scanning type. The tripod redesign was narrowed down to the replacement of the gravity-powered clock drive by the equivalent electric-motor drive with mounting of electric motors instead of mechanical alignment devices. That reflector is also used for the photographic meteor observations.

It is mainly those lunar regions were photographed, which were reported to be the most active by the literary sources. The video footages made up of several hundred frames are processed in VirtualDab and RegiStax4. Our device allows of conducting observations in 4 optical light filters: 420 nm, 550 nm, 700 nm and 1000 nm. The best spectral resolution is obtained in the red and yellow-green regions of the spectra. Composing of two or three images, which were recorded with a time interval, allowed of implementing a specific comparator as any visible changes in the image that occurred within that interval will be highlighted in colour. Besides, the colour image

appears to be visually sharper than the black-and-white one.

Unfortunately, we did not manage to apply such a method of composing of different colour images to the full extent due to problems with the software available. Therefore, the colour images were recorded mainly at the large Moon's phases when it was possible to detect weak colour variations in albedo.

The procedure of observations contains initial recording of observations, their viewing and further processing. 20-30 sharp final images can be made during one night of observations. Between recording images, the Moon is real-time displayed on the screen. Predominantly, the bright side of the Moon was observed. Meanwhile, the possibility of the Moon's surface observation in the Earthshine has been considered.

High turbulence in the Earth's atmosphere makes the image processing more difficult; however, we succeeded in obtaining images of the Moon's surface with the ground resolution of several kilometres with the reflector available. A large amount of interesting images are gathered, and they are available for all interested in their processing.

The issue on the transient lunar phenomena was managed to be solved just partially. The major part of the corresponding reports on those phenomena is evidently associated with ambiguities and inaccuracies in observations. Some information on the mentioned phenomena can be found at <http://www.ufo.obninsk.ru/moon5.htm>.

The issue regarding the crater Eratosthenes, at the bottom of which the dark patches that vary over a lunar day were observed, was slightly clarified. As the pattern of such variations recurs every lunar day, it was concluded that it could be just due to the light effects. The same is fair for the so-called 'champion' of such phenomena - the crater Aristarchus; its appearance changes in a regular manner over each lunar day.

It should be noted that the same Moon's surface features appear in very different manner relative to the lighting conditions, and that can be one of the factors causing misinterpretations of the detected phenomena.

The occurrence of the transient lunar phenomena was neither confirmed nor disproved during our observations. Moreover, peculiar circular features were detected on the Moon's visible surface. Those are apparently the albedo features, and they appear regularly at the near full Moon

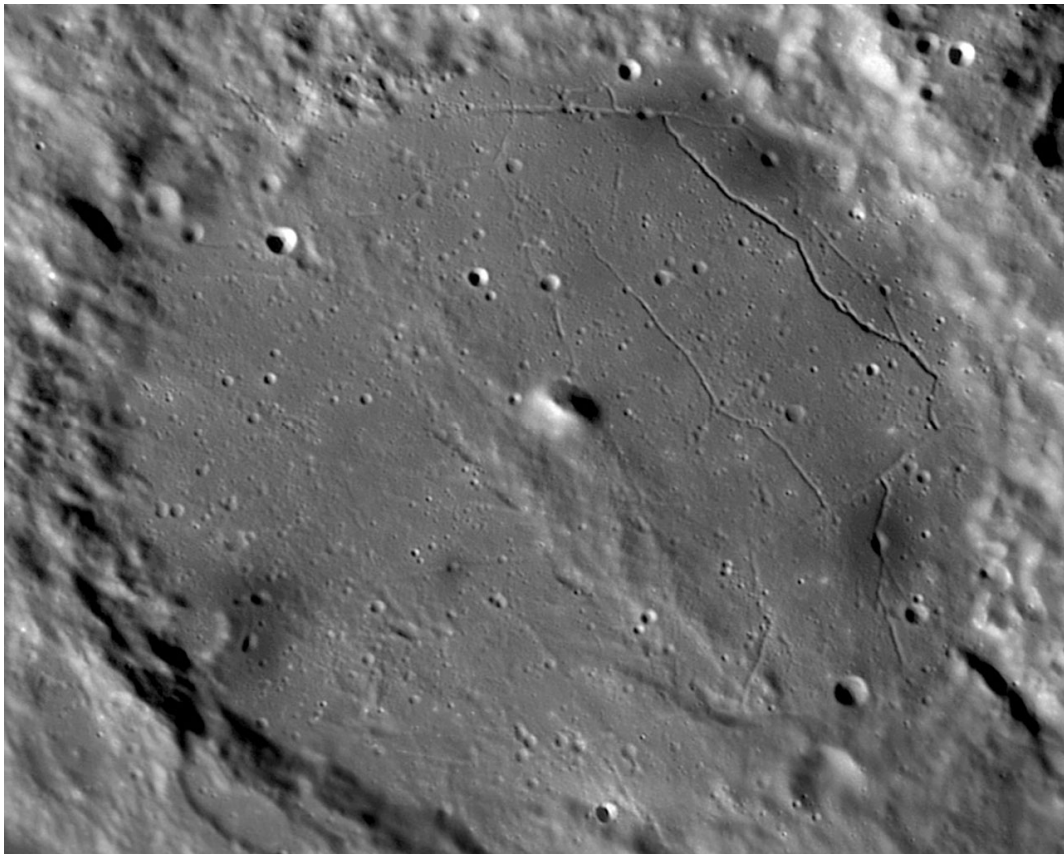


Figure 1: Crater Alphonsus

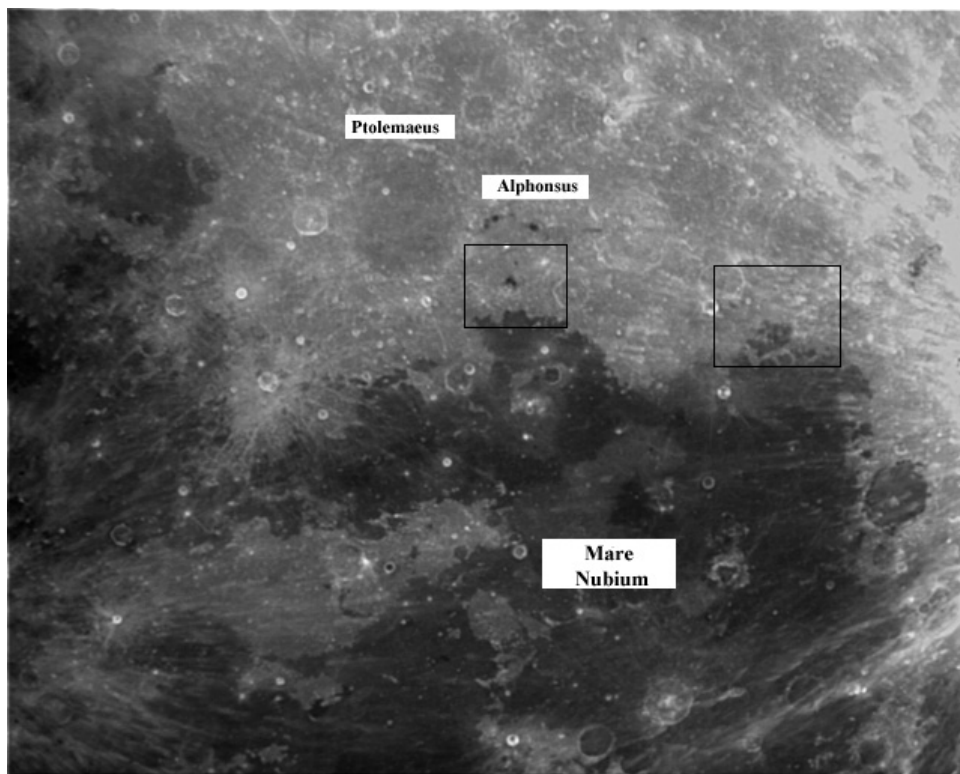


Figure 2: Mare Nubium and crater Alphonsus

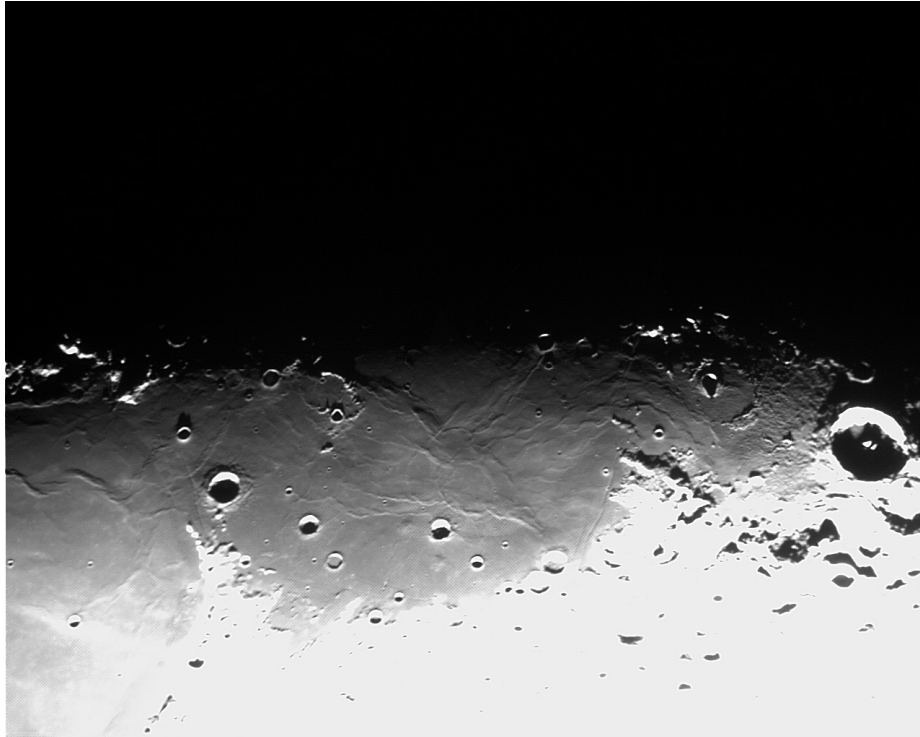


Figure 3: Local evening in Mare Tranquillitatis ("Dream valley", the photo is taken by the author). It is possible to distinguish some ring ridges that can be craters filled in with lava when the mare was formed. They are not similar to the circular features, which are best seen at the local noon.

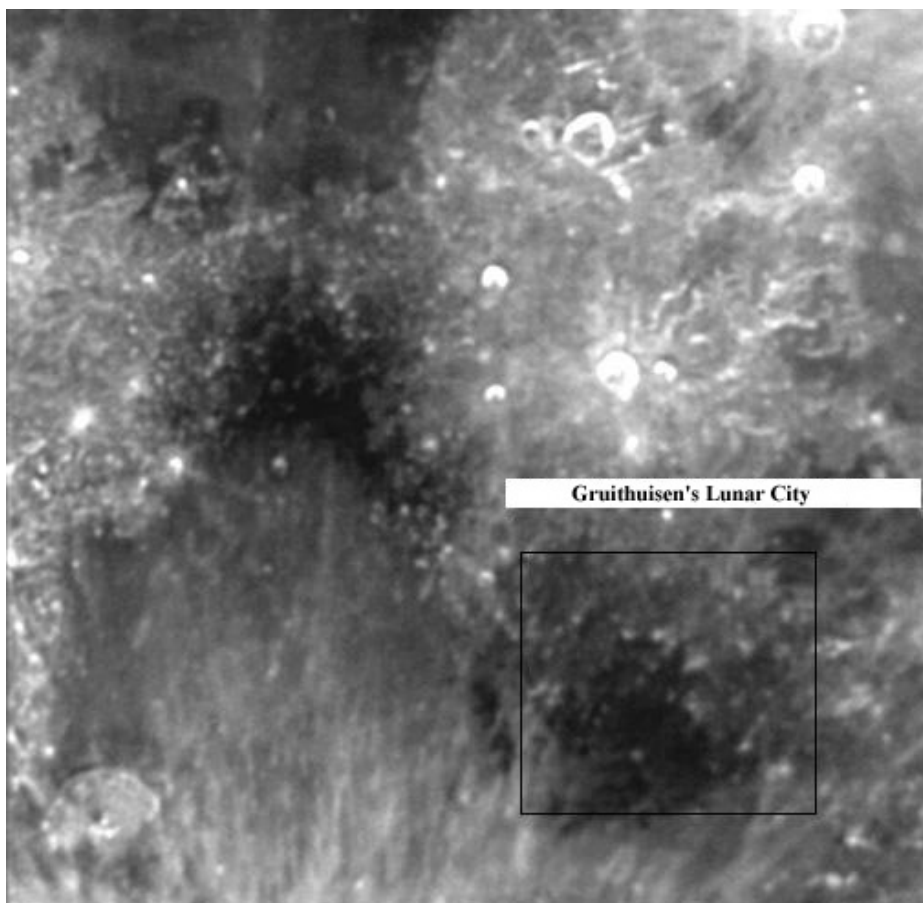


Figure 4: A ring feature against the Gruithuisen's Lunar City background.

phase. They have the regular shape of narrow discrete rings, and almost all of them can not be explained within the framework of the current hypotheses of the lunar circular structure formation. Those features are best seen at the local noon. With the oblique incidence of sunlight on that region of the Moon's surface, a streak of smoother surface can be sometimes (but not always) observed in the places of the ring localisation.

It should be noted that the mentioned circular features can not be explained by the ringing artefacts of the image processing as they become apparent on the initial observation records that had not yet been processed (Figs. 3, 4). They can also be traced on the images from various sources (e.g. images taken during the Clementine spacecraft mission or images available at the Astronominsk web-site: <http://www.astronominsk.org>).

The period of visibility of those circular features is about 4-6 days. They do not flare up near the full Moon, and hence, can hardly be explained by the absence of the retro-reflective (cataphot) glass beads. It is obvious that neither they could be old partially erased craters. That is especially true with regard to the sharpest and most contrasty ring located against the background of the crater Alphonsus and adjacent highlands. That ring when it is best seen can be identified even better than Alphonsus, the location of which can be determined only by its inner dark patches.

It should be noted that subsurface circular structures were also discovered in Mars by the Mars Express mission. But it is not clear whether those features are of similar origin with the lunar ones as the history and crustal structure of the Moon and Mars are different a priori.

We discovered six such circular structures. And there is one more interesting feature found on the shore of Mare Humorum. There is a cut across one of the lunar craters from where a straight dark stripe stretches till the Mare Humorum plain. That stripe does not become apparent in the relief features. It does not appear as a tectonic fault or fissure, which are typically brighter at the full Moon. But it is similar to the mentioned peculiar circular features though. It is not resulted from the ringing artefact due to the CCD television camera structure. When rotating the CCD camera that stripe does not disappear.

Besides, it is worth of paying attention to the S-shaped boundary between the dark and bright surface of the Mare Nubium near the crater Gassendi. The origin of that boundary can not be explained. It should be noted that dark patches on the lunar plains often appear like they are result from some self-propagating process kind of the steppe fire. It can be indicative of the fact that the material of the superficial regolith layer is sorted in the course of a certain process (e.g. electrostatic one).

Some images showing those peculiar features are available for downloading and discussing at <http://www.astronomy.ru/forum/index.php/topic,89610.new.html#new>.

While observing the Moon, the crater Alphonsus has been paid our special attention. The obscuration in the centre of that crater, observed by Kozyrev, as well as the obtained spectra have been actively discussed (see "The near-Earth space environment exploratory research", 1961). Although no activity was registered in that region, some interesting suggestions can be retrieved from the archive images, obtained in the Pic du Midi Observatory, France, with the ground resolution of about 100 meters. Several irregularly shaped dark patches can be observed in the mentioned images of the crater Alphonsus. The centres of distribution of those dark patches are peculiar craters that are localised at the fissures of cooling, formed during the solidification of lava that filled up hollows and cavities of the crater billion years ago. Those craters are not circular, they are assignably located exactly on the fissures and evidently are not impact craters or those resulted from volcanic eruptions. One of the craters exhibits a peculiar 'tail' that stretches towards the East and could be the dust tail. That tail can be traced throughout the whole series of our images. The craters look like the material has been ejected from them. When correlating the patch sizes and the possible rate of the material spreading, the latter is supposed to be about 100 meters per second. It should also be taken into consideration that by all indications the ejected material should have spalled from a massive basalt plate, but that is peculiar per se. Such peculiarities of those craters and patches allow of assuming that it is those craters located on the fissures that are the sources of activity in Alphonsus rather than its central peak, which can not be distinguished in our images.

In some cases the dark patches that are visible within the mare regions, in particular within the region of Mare Nubium adjacent to the Alphonsus, have peculiar circular shape, which can be just partially traced along the patch contour. Such a pattern could be explained by the filling of the impact crater with the dark-coloured lava, but no evidences of impact feature presence were detected along the contours of those patches.

The image catalogue of the described peculiar Moon's surface feature images is available at <http://www.astronomy.ru/forum/index.php/topic,89610.new.html#new>.

The following conclusion can be made: at present the Moon as a cosmic object is of great interest for observations with the small-size telescopes.

I would like to express my sincere gratitude to all those who helped me to obtain data for this paper.

## References

The near-Earth space environment exploratory research. The Foreign Literature Publishing House, Moscow, 1961 (in Russian).