VARIATIONS OF THE MERCURIAN PHOTOMETRIC RELIEF. V.V.Shevchenko, Sternberg State Astronomical Institute, Universitetsky pr.13, Moscow 119992, Russia, shev@sai.msu.ru

Introduction. Differential photometry of the surface of Mercury can be carried out with result of Mariner 10 imaging the planet. The spacecraft data contain valuable information on regional variations of upper layer photometric properties. Because of trajectory and pointing angle constraints the planet could be observed from Mariner 10 only over a small range of phase angles between about 75^o and 110^o. Therefore the photometric investigations are restricted to measuring the distribution of brightness on the Mercurian disk. Nevertheless it's possible to obtain surface distribution of the photometric relief or roughness characteristics along visible disk of the planet.

Initial data. The relative brightness of areas on the visible disk were measured on two far-encounter low-resolution pictures. Raw versions of real-time processing pictures FDS 0000984 and FDS 0000986 were used (images 196 and 202). The pictures were obtained from distance of 422619 km and 423500 km from center of Mercury accordingly from outgoing part of Mariner 10 trajectory. Position of spacecraft relatively planet was the same for both images: latitude 21.26^o and longitude 175.80^o in the planet coordinate system. Solar coordinates were latitude 0.0^o and longitude 101.10^o, and phase angle was 75.76^o. Both images were taken through the blue filter (effective wavelength about 486 nm). Originals of FDS frames contain a photometric scale (table) which was used in process of measurements for calibration of the film copies. For example original negative image 196 is shown in Figure 1.

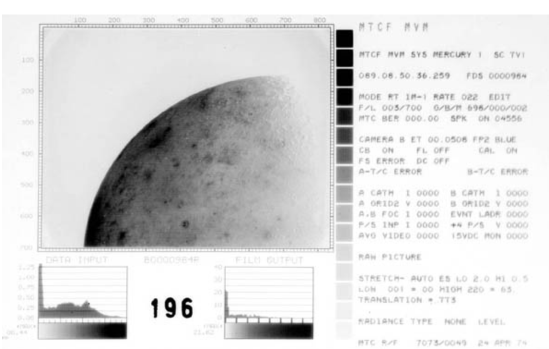

Fig. 1. Raw version of real-time processing image 196 (Mariner 10 outgoing trajectory).

Photomosaic showing the area of photometric measurements is presented in Figure 2. The mosaic

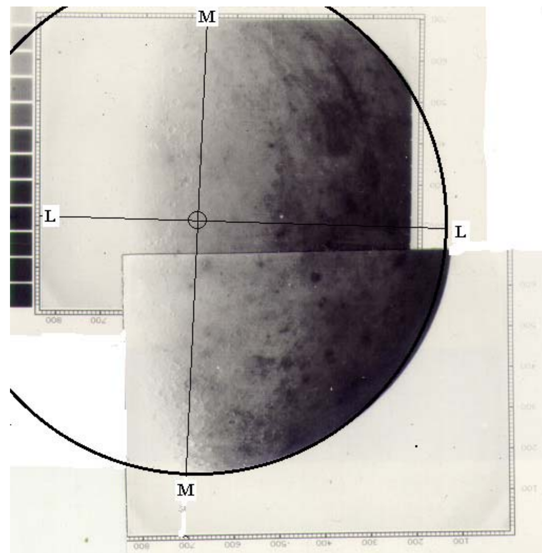

Fig. 2. Photomosaic showing the area under study.

negative image is constructed from the frames 196 (South part) and 202 (North part). This photomosaic is similar to visible disk of Mercury as photographed by the departing spacecraft. In Figure 2 the line MM is projection of central meridian (longitude 175.80^o) on the visible disk. Line LL shows position of the luminous equator. The calibration curves are shown in Figure 3. These two

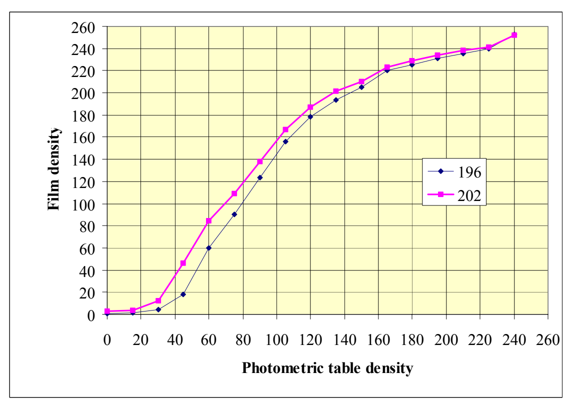

Fig. 3. Calibration curves of images 196 and 202.

curves let us to convert a measured film density into relative brightness. Since there is no evidence indicating that Mercurian photometric function is not similar to that of the Moon, analysis of the brightness distribution can be fulfilled using the mean spatial indicatrix of backscatter for all lunar surface (photometric function) of Shevchenko [1]. Each measurement of brightness corresponds to set of angle parameters: ***i*** – angle of direction of the insident beam (angle of incidence), – angle of scattered beam (angle of emission), and ***A*** – angle between plans of incident beam and of scattered beam (azimuth). Values of the photometric function (relative intensity) can be obtained for each set of angles of incidence, emission, and azimuth, using the mean spatial indicatrix of backscatter. The photometric angles were determined by using the control net established by Davies [2] to locate the frame on the surface of Mercury and by using trajectory data to locate the spacecraft in relation to the planet [3]

Results of the Photometric Measurements. Generalization of the obtained results compared with earlier determinations by Hapke et al. [4] represents in Figure 4. The plot shows relationship between average lunar photometric function (similar to Mercurian one as it was demonstrated above) and relative brightness of the number of the geologic units obtained from Mariner 10 data. The

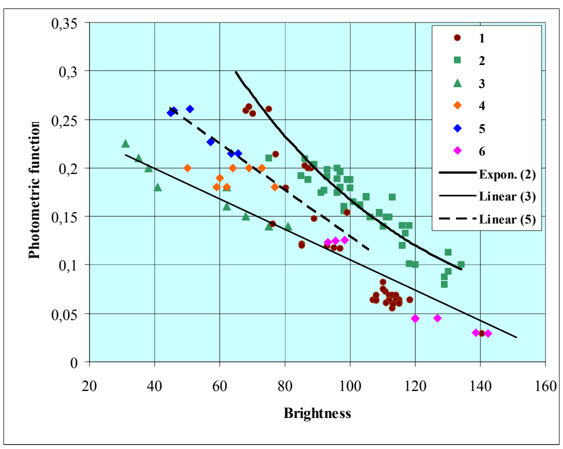

Fig. 4. Differential photometric functions of the local geologic units.

shown values of brightness correspond to the negative image. Measurements of Hapke et al. [4] were converted into photometric system of the given investigation. The marks in Figure 10 are following: 1 – brightness of intercraters plains and smooth plains according to Hapke's measurements, 2 – brightness of plains of different types (given investigation), 3 – brightness of bright craters (given investigation), 4 – brightness of bright rays (given investigation), 5 – brightness of bright rays (Hapke's data), 6 – brightness of secondary crater fields (given investigation). From the data obtained it might be concluded there appear to be at last three main type of the ptotometric relief. The character one of them (exponential regression 2) demonstrates that Mercurian plains are covered by soil with more high level of porosity. In spate of the variations of the local albedo are not considered a good correlation (-0.924) is observed between the values of photometric function and the relative brightness of the investigated formations. Surface of the bright crater areas has a more smooth character of structure in cm-scale of roughness. Linear regression 3 corresponds to this type of the photometric relief. Coefficient of correlation in the case is equal -0.974, that demonstrates a good conformity between surface structure and the type of photometric relief. According to the earlier determinations by Hapke et al. [4] the bright crater surface possesses a combination of relatively bluish color and high albedo that may arise because the crust of Mercury is low in Ti, and metallic Fe. Surface of the secondary crater fields has a similar photometric relief and it is characterized by linear regression 3 too with a good correlation between brightness variations and photometric function (-0.954). Finally, the bright rays surface has an intermediate level of porosity that is characterized by linear regression 5.

Conclusions. It should be noted that given estimations don't consider parameters of the fragment fields because the shape of photometric function in the range of phase angles about 60^{o} - 100^{o} (and more) depends on the surface cm-scale and smaller roughness in the main. The method described and the results of some remote investigations of Mercury show that the similarity of the surface structure of this planet to the Moon's surface can be used to obtain preliminary estimates of the structure and characteristics of the Mercurian regolith. The results presented in this work and their further modification are also of applied significance in planning and implementing the aforementioned space projects planned by NASA and ESA.

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References. [1] V.V. Shevchenko (1980) *Modern Selenography,* Moscow, Nauka, 288 pp. (in Russian). [2] M.E.Davies, R.M. Batson, (1975) *JGR, 80*, No. 17, 2417-2430. [3] M.E. Davies, private communication, (1975). [4] B. Hapke et al. (1975) *JGR, 80*, No. 17, 2431-2443.