

MARS RELATIVE ALTITUDES FROM SHADOWS. D. W. G. Arthur, U. S. Geological Survey, Flagstaff, Arizona 86001.

Relative heights on the Moon have been estimated from shadow lengths since before 1800 when Schröter (1) introduced the technique. The method has been applied to lunar photographs but without real success until used by Arthur (2) and his associates on the long-focus lunar orbiter pictures. Photographs are affected by photographic and other effects which are quite severe for small-scale imagery. To avoid these effects for Viking Orbiter images of martian shadows the shadow estimates are derived directly from the digitized brightness values recorded in the original tapes, or replicas of these. The tapes can be made to provide, via appropriate computers, rectangular arrays of brightness values corresponding element by element with the picture-elements (pixels) of the hard copy on the so-called rectilinear versions (unchanged geometry). A line across the array in the appropriate direction corresponds to the shadow hypotenuse and interpolated brightness values along this line are plotted as a shadow photometric profile. The shadow itself is a depressed section of the profile and its ends are identified as the inflexion points. For shadows longer than 12 pixels there are no real problems in locating these points. The shadow length in pixels is easily converted to a height on Mars using the range, focal length (c.475mm), the pixel dimension (0.0120mm), and the phase angle and viewing angle.

Pixel counting, as above, is useless for extremely short shadows, only a few pixels long, that have to be estimated to a fraction of a pixel. For these a technique has been developed using brightness integration over the shadow and an estimate of the background brightness. The uncertainty of the latter sets a limit of $\pm 20\%$ in the resulting height estimate, generally ± 4 meters in the actual applications to grabens, channels, faults, and other features casting short shadows.

The pixel counting and integration methods have been applied to several hundred features. (Papers in preparation)

Mars impact craters are extremely diverse in form and at present a firm statement of a depth/diameter relation is not possible. The small craters ($D < 0.5$ km) have the same depths as their lunar cousins; the larger craters are appreciably shallower. Considerable classification work must precede the publication of valid depth/diameter correlations.

References:

- (1) Schröter, J.H. (1791 and 1802) Selenotopographische Fragmente, two volumes. Schroter, Lilienthal and Göttingen.
- (2) Arthur, D.W.G. (1974) Lunar crater depths from Orbiter IV long-focus photographs. Icarus, 23 p. 116-133.