SYSTEM OF ABSOLUTE ELEVATIONS IN THE MARGINAL ZONE OF THE MOON DERIVED FROM STELLAR OCCULTATIONS

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Abstract. The present paper contains an outline of the method for a determination of the altitudes in the lunar marginal zone from occultations of the stars by the Moon; and the limb charts of this zone were constructed from such altitudes.

At the present time, several systems of the altitudes in the lunar marginal zone are in existence; closely tied up with the geometrical centre of the Moon. A correct solution of several significant problems – such as the reduction of positional observations of the Moon, a transfer of selenodetic control from the near side of the Moon to the far side, a solution of morphological problems, etc. – is impossible without establishment of an adequate barycentric system of absolute altitudes in the limb zone of the Moon.

In principle, the problem of the barycentric altitudes in the marginal zone can be solved with the aid of a known position of the Moon's limb relative to the stars, furnished by the theory of the Moon's motion in the sky. For the solution of the above-mentioned problem we can utilize the observations of stellar occultation by the Moon, photographic positional measurements, meridian observations of the lunar limb, and positional heliometric observations. The most important of these appear to us to be the observations of lunar occultations; since these are practically independent of such influences of such uncertain factors as atmospheric refraction anomalies, irradiation, etc.

The reductions of observations of the occultations are based on an equation for the differential corrections, of the form

$$\Delta\sigma = f(\mathrm{d}\varphi, \mathrm{d}\lambda, \mathrm{d}\rho, \mathrm{d}\alpha_1, \mathrm{d}\delta_1, \mathrm{d}\pi_1, \mathrm{d}R_1, \mathrm{d}\alpha_*, \mathrm{d}\delta_*, \mathrm{d}T), \tag{1}$$

where $\Delta\sigma$ is the absolute term of the foregoing equation for the errors; and $\mathrm{d}\varphi$, $\mathrm{d}\lambda$, ... $\mathrm{d}T$ are differential corrections to the latitude, longitude and altitude of the observer above the mean terrestrial spheroid; to the right ascension, declination, and horizontal parallax of the Moon; its mean radius R; the right ascension and declination of the occulted star, and the time T of its disappearance; respectively.

In the course of the reductions based on the foregoing Equation (1) it was necessary to include only the differential corrections to the equatorial coordinates of the Moon ($\mathrm{d}\alpha_1$, $\mathrm{d}\delta$), to reduce the coordinates $\mathrm{d}\alpha_*$, $\mathrm{d}\delta_*$ of the star to the system of the FK-4 catalogue, to apply personal corrections of the observer, and to harmonize the FK-4 system with the lunar ephemeris. Whenever the observer did not apply his personal correction to the observations, in the course of reductions the following corrections were applied:

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$$\Delta T = -0.5 \text{ s (egress)} = -0.30 \text{ s (ingress)}.$$

Therefore, in accordance with the foregoing discussion, Equation (1) can be rewritten as

$$\Delta\sigma_K = \Delta\sigma - L\,, \tag{2}$$

where $\Delta\sigma_K$ stands for the correction which refers to the actual (deformed) limb; and L, for the sum of the above-mentioned systematic corrections.

On the basis of the reductions of 8600 observations of stellar occultations by the Moon we constructed a catalogue of barycentric altitudes in the marginal zones of the Moon. Of these 8600 occultations, 5000 referred to disappearance of the star, 2700 to its appearance from behind the Moon's disc, and 28 grazing occulations (about 900 points). About 500 of these were observed photoelectrically, and the balance visually. On the basis of the 8600 observations giving barycentric altitudes we constructed the charts of the marginal zone of the Moon, in the coordinates R and D, shown on the accompanying figures. The isohypes were drawn at $0''.2$ intervals, and constant elevations above the mean Moon level are represented by isohypses drawn as solid curves; while isohypses representing depressions are drawn as broken lines.

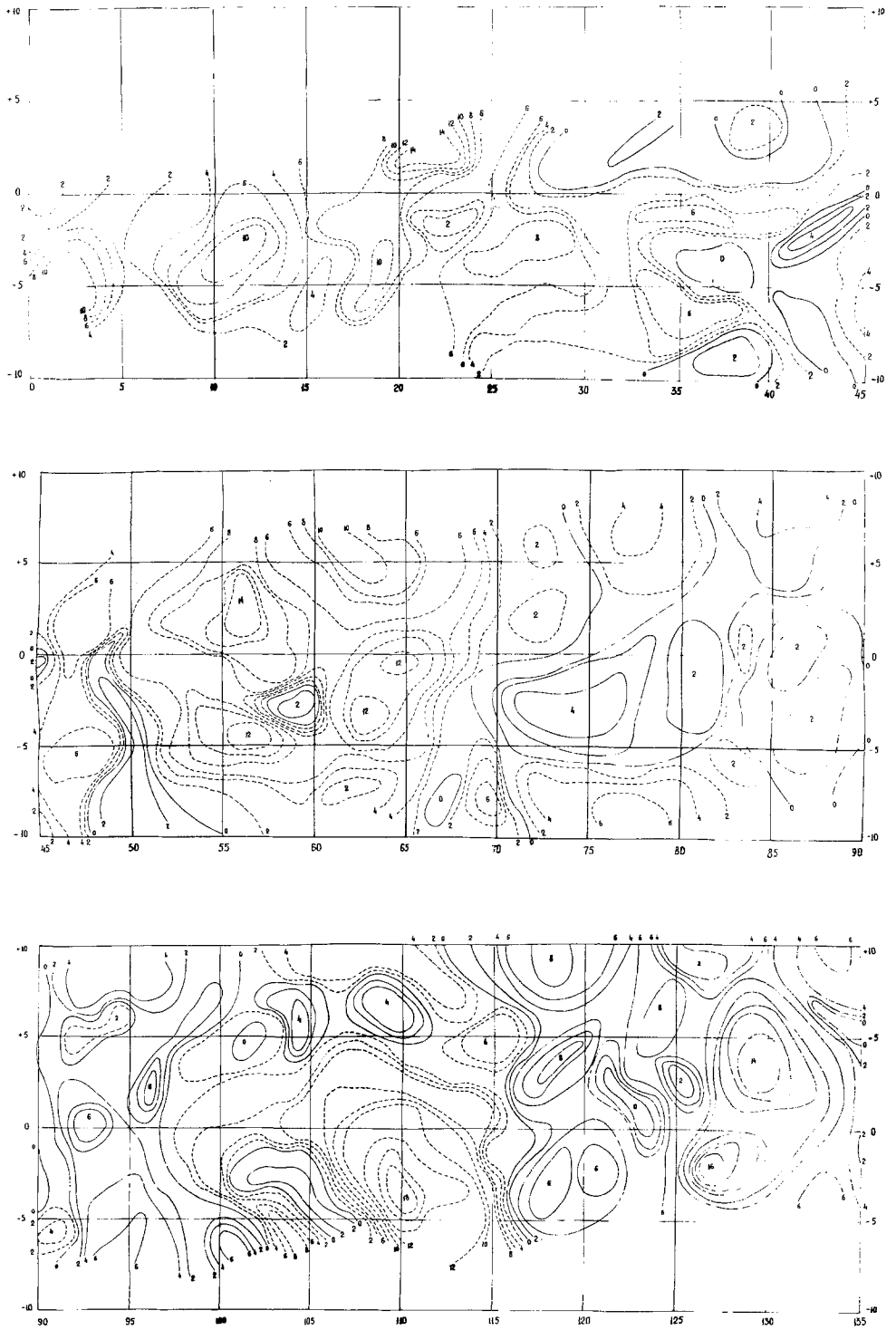
In spite of the fact that, before embarking on the reduction of observations we selected them according to the position angle and libration, the observed points are distributed somewhat unequally in the marginal zone. The largest concentration of observed points is in the near-equatorial zone. Near the poles, the number of grazing occultations available to us was rather small.

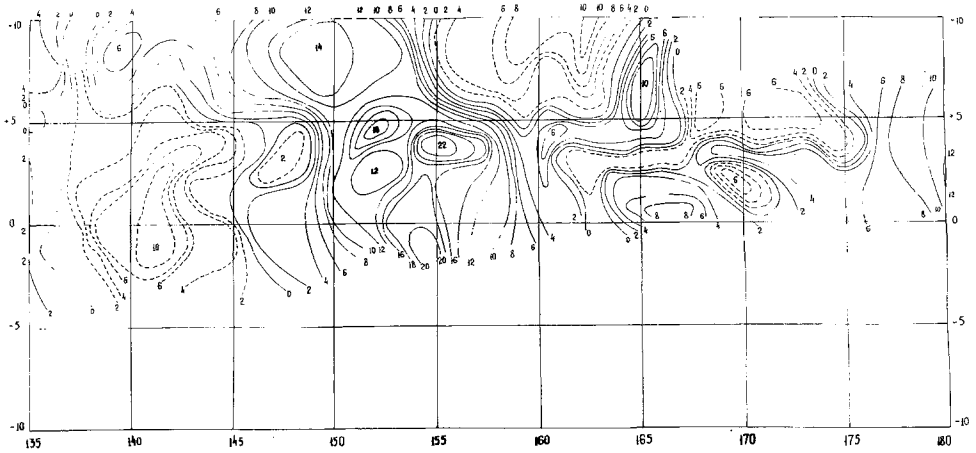
Lastly, these charts of the marginal zone of the lunar globe constructed with the aid of stellar occultations were compared with those based on more direct observations (*cf.* Chugunov, 1976, 1977); and the outcome disclosed that the latter come very close to the system referred to the centre of mass of the Moon.

References

Chugunov, I. G.: 1976, 'Charts of the Marginal Zone of the Moon based on the Observations of Lunar Occultations', Lunar Deposit MS No. 4360–76.

Chugunov, I. G.: 1977, 'Charts of the Relief of the Marginal Zone of the Moon, based on the Observations of Lunar Occultations', *Astron. Zhurnal Letters* **3**, No. 4.

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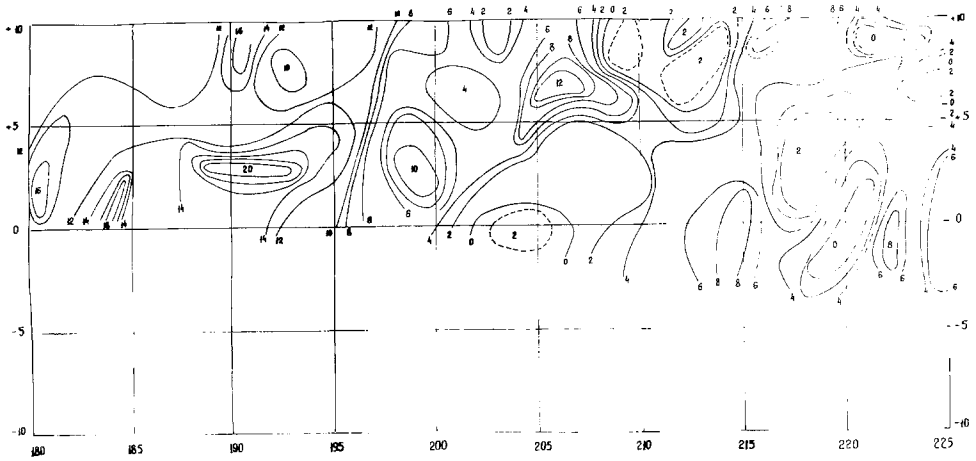
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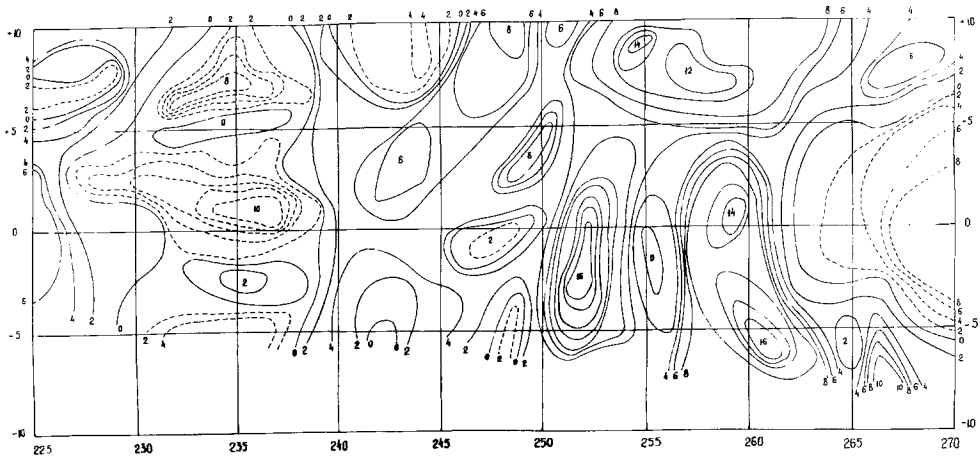
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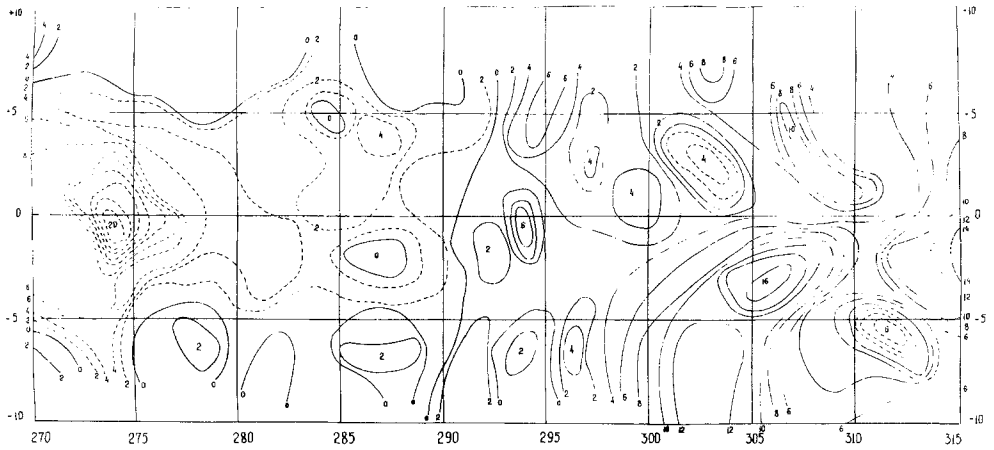
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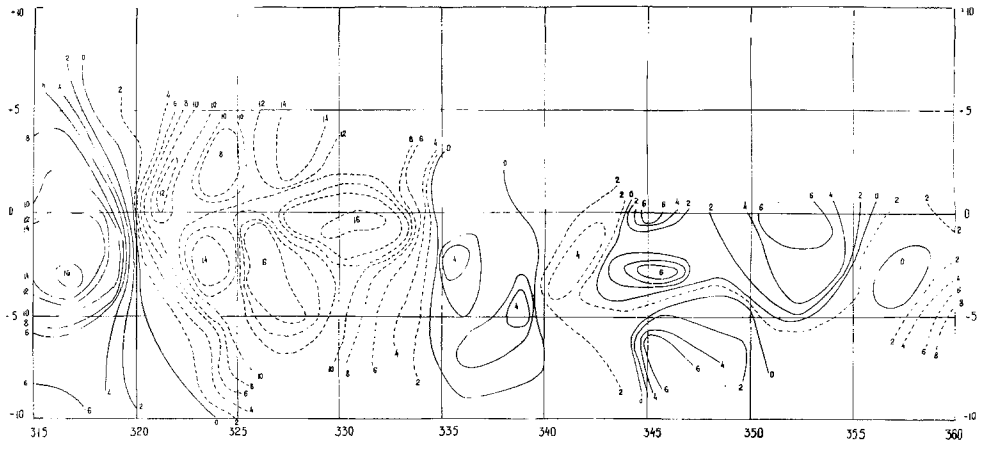
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