

17. COMMISSION DU MOUVEMENT ET DE LA FIGURE  
DE LA LUNE

PRÉSIDENT: Professor Dr K. Koziel, Professor of Astronomy, Jagellonian University, Kopernika 27/3, Cracow, Poland.

MEMBRES: Atkinson, Boneff, Botelhoiro, Brouwer, Eckert, Guth, Hirose, Jeffreys, Markowitz, Meyer, Nefediev, O'Keefe, Mme McBain Sadler, Ueta, Watts, Weimer, A. A. Yakovkin.

PROGRESS OF RESEARCH

In the U.S.S.R. investigations of the rotational elements and of the figure of the Moon have been continued.

At Engelhardt Observatory, Kazan, A. A. Nefediev continued his heliometer measures and obtained 420 observations of Mösting A since 1938, of which he is now reducing the series 1946-58. S. T. Habibulin with K. S. Shakirov developed a method for the determination of libration constants  $I$  and  $f$  based upon the measurements of the distances between two craters, one near the lunar disk's centre, the other near the limb.

At the Central Astronomical Observatory of the Ukrainian Academy of Sciences, Kiev, I. V. Gavrilov has completed the study of the libration effect in the Moon's radius (*Astr. Circ. U.S.S.R.* no. 206, 1960) and the following formulae were obtained to pass from the centre of the Moon's figure to the centre of mass:

$$\begin{aligned} \xi &= -0''\cdot27 - 0''\cdot025 \beta_0, \quad \eta = +0''\cdot21 + 0''\cdot021 \beta_0 \\ &\text{for the western limb and} \\ \xi &= -0''\cdot54 + 0''\cdot009 \beta_0, \quad \eta = -0''\cdot96 + 0''\cdot096 \beta_0 \\ &\text{for the eastern limb,} \end{aligned}$$

where  $\xi$  and  $\eta$  denote the co-ordinates of the centre of the figure referred to the mass centre and  $\beta_0$  the optical libration in latitude.

A. A. Gorynia has re-reduced a part of the Bamberg series of Hartwig (1890-1915) and has obtained two sets of solutions, (*Astr. Circ. U.S.S.R.* no. 211, 1960) of which the second corresponds to the hypothesis of an asymmetry of the Moon's figure with respect to the rotation axis:

$$\begin{aligned} \lambda &= -5^\circ11'10'' \pm 18'', & -5^\circ11'32'' \pm 13'' \\ \beta &= -3^\circ12'56'' \pm 13'', & -3^\circ12'43'' \pm 10'' \\ h &= 15'32''\cdot0 \pm 0''\cdot73, & 15'34'' \pm 0''\cdot52 \\ I &= 1^\circ32'36'' \pm 22'', & 1^\circ32'40''\cdot1 \pm 15'' \\ f &= 0\cdot82 \pm 0\cdot041, & 0\cdot82 \pm 0\cdot029 \end{aligned}$$

A. A. Yakovkin developed a method for the determination of libration constants consisting in measurements of position angles of the directions from Mösting A to the craters near the limb.

At the Institute for Theoretical Astronomy, Leningrad, M. V. Freedland tried to determine the free libration constants in longitude (*Bull. Inst. astr. Leningr.* 7, no. 4, 1959) on the basis of the Dorpat series of Hartwig (1884-85), treated first by K. Koziel and of the Kazan series of Nefediev (1938-45).

N. G. Rizvanov at the Engelhardt Observatory obtained 200 photographs with a Markowitz camera. On the basis of these photographs corrections to the Moon's co-ordinates have been determined for 4 dates in 1959.

Similarly at Kiev 100 photographs were obtained with the Markowitz camera and 120 plates with a 400 mm astrograph for the study of the figure and surface of the Moon.

I. N. Demenko seems to confirm the libration effect in the Moon's radius (*Astr. Circ. U.S.S.R.* No. 203, 1959; No. 209, 1960) on the basis of the Greenwich and Washington meridian observations of the Moon (1923-52).

During the reported period 408 observations of lunar occultations were made at Soviet Observatories.

D. Brouwer, Yale University Observatory, calls attention to the radar-distance determination of the Moon, carried out at the U.S. Naval Research Laboratory in Washington. The mean centre-to-centre distance between the Earth and the Moon has been found (*A.J.* 64, 325, 1959) to be 384 402 km with a probable error not exceeding 2 km. The observations are being continued.

At the U.S. Naval Observatory, Washington, the survey of the marginal zone of the Moon by C. B. Watts has progressed as follows: The 1800 libration frame charts, in which the elevations are referred to an adjusted datum surface, have been completed. The charts are being prepared for publication by the Aeronautical Chart and Information Center of the Air Force. A map of the zone in the  $P, D$  system of co-ordinates, based on normal apparent gradients transferred from these charts, has also been constructed. A few checking operations remain to be carried out and the work will be published in 1961.

Mrs F. M. McBain Sadler reports that the British Nautical Almanac Office has continued its routine programme of prediction of lunar occultations; the number of stations has increased to 80. It also provides approximate predictions of occultations of about 40 bright radio sources for 17 stations.

The discussions of reduced observations have been published for the years 1953 to 1955 in *A.J.* 63, 244, 1958 and for 1956 and 1957 in *A.J.* 65, 102, 1960. These observations have been reduced without limb corrections. The observations for 1958 have already been reduced; but C. B. Watts has now supplied values of the necessary limb corrections prior to the publication of his charts, and they will be re-reduced. The publication of the combined list of all observations included in the discussions for 1948 to 1953 has been delayed. It is hoped to publish it soon, and a start has been made in preparing a similar list for the years 1954 to 1957.

H. Jeffreys, Cambridge, has rediscussed the libration of the Moon's axis, taking into account terms in  $e^2$  and  $i^2$ , and also two solar effects not taken into account by Hayn. The observational data are discussed, and it appears that

$$\beta = 0.00006284 \pm 0.00000015.$$

At the Paris Observatory photographs were taken with a Markowitz camera and 213 plates were measured, including plates obtained at San Fernando, Helsinki and Uppsala.

Besides, Th. Weimer dealt with the problem of the Moon's figure and found no libration effect in the Moon's radius. He also established a preliminary list of 135 'fundamental' craters, measurable on Markowitz's plates.

At the Tokyo Observatory H. Hirose has made photo-electric occultation observations (*Tokyo astr. Bull.* II, no. 111) and in their reduction he has used the unpublished lunar profiles

of Watts as well as the atlas of Weimer. On the basis of 220 points on the Moon's limb he obtained a relation between these two profile maps expressed by the formula:

$$\text{Watts} - \text{Weimer} = +0''.49 \sin (\Pi + 282^\circ)$$

where  $\Pi$  is the selenographic co-latitude of the limb point.

Also the Moon's positions have been traced at the Tokyo Observatory with a transit circle and a Markowitz camera (*Tokyo astr. Bull.* II, nos. 108, 117, 131).

J. Ueta, Kyoto, deals with the problem of the  $Q$  factor in the theory of the Moon's orbital motion.

At Sofia, N. Boneff dealt with the problem of meteoric danger in astronautics in connection with the problem of the origin and distribution of lunar craters. He investigated, moreover, the probable influence of the Moon on the formation of contours of terrestrial continents (*A.N.* 284, 155).

A. Botelho, of the Lisbon Observatory, reports that the Observatory is continuing as routine work the observation of occultations. Since 1938, when the programme was begun at Lisbon, 1171 occultations had been observed up to the end of 1959.

At the University Observatory, Vienna, G. Schrutka-Rechtenstamm intends to determine from measurements of 12 lunar photographs from the Lick Observatory precise co-ordinates and absolute altitudes of over 150 points on the Moon's surface, taking into account the list of Weimer.

At the Cracow University K. Koziel has worked out a new variant of the method of adjusting libration observations, given previously in *Acta. astr. Cracoviae*, a, 4, 153, 1949. This variant may be successfully applied when using fast-working electronic calculators. The re-reduction of the Kazan series of heliometric measures of Banachiewicz (1910-15) is being continued by J. Mietelski, as that of the Bamberg series of Hartwig (1890-1922) by J. Maslowski and Mrs H. Jaško. The Cracow University Observatory continues as routine work the observation of occultations.

K. KOZIEL

*President of the Commission*