SHORT-PERIOD NUTATION FROM OBSERVATION WITH THE PULKOVO POLAR TUBE

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Since 1953 regular observations have been made with the polar photographic tube at Pulkovo, a fixed astrograph (D = 20 cm, F = 600 cm), which can take photographs of a circumpolar zone of 60' radius (Bakhrakh, 1971). An analysis of measured polar distances of the same 30 stars on each plate gives corrections to the adopted values of the constants of aberration and precession and of the coefficients of nutation. At present the determination of the coefficients of the short-period semi-annual solar and fortnightly nutations is of greatest interest, as they are affected most by the Earth's liquid core.

Several papers have recently appeared (Yokoyama, 1973, 1976; O'Hora, 1973; McCarthy, 1976) in which long series of observations of the ILS and observations with PZT were used for the determination of the nutation coefficients. With modern methods of reduction the authors of these papers obtained results in good agreement with theoretical results for models of the Earth with a liquid core. Melchior (1976) also confirmed the theoretical conclusions of the effects of the liquid core on nutation by an analysis of Earth tides.

In this connection, the results from a 12-year series of observations with the polar tube at Pulkovo are of interest. This is because they differ essentially from those using zenith-telescopes and PZT, where the stars are related to the local plumb line, a cylical change of the observed stars occurs during the year, and the influence of the z-term is felt.

The observations with the polar tube have their own difficulties, as perfect stability of the instrument during the night's observations (from 4 to 14 hours) is needed. For this purpose the pavilion or tower is sealed so that during the night the temperature inside is nearly constant and causes no deformation of the instrument. At present, investigations of the stability of the tube's foundations with a very sensitive Ostrovsky tiltmeter are being conducted. We are

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already sure that the amplitude of inclination change does not exceed 0".1-0".2, i.e., less than 0.006 mm.

During 1953-1964, 361 nights of observations were obtained and 4322 polar distances of stars with a m.e. of ± 0".05 were measured. These were reduced according to two methods. In the first method we determined the corrections to the adopted constant of aberration K(20".496), and to the coefficients of semi-annual $N_{2\odot}$(0".5522) and fortnightly $N_{2☾}$ (0".0884) nutation in obliquity. In the second method no correction to the constant of aberration was sought, as it was considered to be known sufficiently well. Both cases gave concordant results, due to the smallness of ΔK = 0".004.

	I	II
$\Delta N_{2\odot}$ =	−0".024 ± 9	−0".022 ± 9
$\Delta N_{2☾}$ =	+0".013 ± 8	+0".014 ± 8

For comparison with theoretical values we give the following table for different models of the Earth and also the results of observation (Itogy..., 1976).

Model	$\Delta\varepsilon$ (cal.-IAU) in 0".001	
	$2\odot$	$2☾$
J - V I	+21	+9
J - V II	-12	+9
M I	+25	+9
M II	+22	+9
Observation		
Yokoyama	+22	--
Yokoyama	+20	--
McCarthy	--	+8
Melchior	+20	--

The coefficients of nutation in obliquity for models with a liquid core are larger than those adopted by the IAU; the observations also give larger values. Our result for the fortnightly nutation is in good agreement with the theoretical and other observed values. Our semi-annual term (negative correction of ΔN_{20}, corresponding only to the model J - V II) differs from other determinations, which may have been caused by an uneven distribution of observations during the year; we have no observations in summer owing to twilight and few in winter owing to cloudy weather. Evidently a more prolonged series of observations is needed in order to determine the semi-annual nutation with more reliability. The observations at Pulkovo are continuing, and we expect to get more reliable results in the future.

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