THE PALOMAR-LEIDEN SURVEY

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The Palomar-Leiden survey (PLS) was set up as an extension to fainter magnitudes of the McDonald survey. The latter is, therefore, the more important survey as far as asteroid statistics are concerned. The main result of the PLS is that no clearcut differences exist between the fainter asteroids found in this survey and the numbered asteroids in the distribution functions of eccentricity, inclination, and semimajor axis and that the statistical relations found in the McDonald survey have a continuous extension in the PLS material. I would, therefore, propose not to summarize the results of the PLS, which would appear to be a tedious job, but to give here some new results that should properly have been included in the publication, but, for reasons of pressures to publish as soon as possible, were not.

AVERAGE DISTANCE TO THE ECLIPTIC PLANE AS A FUNCTION OF SEMIMAJOR AXIS

In the PLS a derivation is given of the density distribution perpendicular to the plane of the ecliptic, under the assumption that this distribution is independent of the distance to the Sun. Whether this was really the case was not checked. This is done here: the average value of $z_0 = a \sin i$ has been determined as a function of a, and this value is assumed to be proportional to the average distance of the asteroids to the plane of the ecliptic at a distance to the Sun equal to a. The results are given in table I and depicted in figure 1. It is seen that the assumption of constancy of $\overline{z_0}$ is wide off the mark; $\overline{z_0}$ varies approximately linearly with a, with the exception of a bulge near $a = 2.6$, which is caused by the new Io family. The value of z_0 at $a = 3.3$ is about four times as large as at $a = 2.2$.

This result shows that the average value of the orbital inclination is a function of the distance to the Sun, the nearby asteroids having, on the average, considerably smaller inclinations than those in the outer parts of the asteroid belt. It was checked that this is also the case for the numbered asteroids, so this result should not be new.

TABLE I.—$\overline{z_0}$ *Values for Various Sizes of the Semimajor Axis*

a	$\overline{z_0}$
2.15	0.14
2.25	.21
2.35	.22
2.45	.24
2.55	.42
2.65	.50
2.75	.38
2.85	.39
2.95	.46
3.05	.50
3.15	.60
3.25	.65

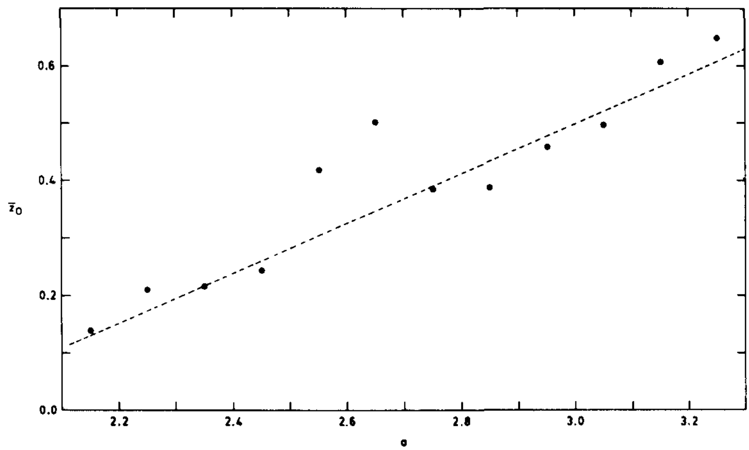

Figure 1.—$\overline{z_0} = \overline{a \sin i}$ as a function of a.

THE PHASE FUNCTION OF THE TROJANS

The average phase function of the PLS asteroids was shown to be of the form

$$F(\alpha) = 1.03T(\alpha) + 0.039|\alpha| - 0.05 \tag{1}$$

in which $T(\alpha)$ is the opposition effect found for the brighter asteroids, α the phase angle, and $F(\alpha)$ is the brightness variation of the asteroid due to phase; it is zero at phase 4°.

In practice, the coefficient of $T(\alpha)$ was determined by only a limited number of asteroids that came close to the opposition point. Of these, the

Trojans played an important part; because of their slow motion and their large distance from the Sun, they were always observed at small phase angles. The maximum phase angle for a Trojan in the PLS is $6\overset{\circ}{.}5$. It follows that the Trojans contribute little to the linear part of the phase function, and heavily to the opposition effect. It is, therefore, surprising that most Trojans yielded negative residuals with respect to expression (1), as may be seen in table II. Here are listed the difference in brightness of the PLS Trojans in September and October 1960, due to phase, the corresponding values based on expression (1), and their difference, $O - C$.

TABLE II.–*Observed and Computed Phase Effect for PLS Trojans*

PLS no.	$(F_O - F_S)_{obs}$, mag	$(F_O - F_S)_{comp}$, mag	$O - C$, mag
2008	-0.02	0.14	-0.16
4139	-.02	.20	-.22
4523	+.20	.34	-.14
4572	+.18	.30	-.12
4596	+.46	.36	+.10
4655	+.20	.39	-.19
6020	+.31	.39	-.08
6540	+.44	.32	+.12
6541	+.43	.33	+.10
6581	+.27	.33	-.06
6591	+.28	.30	-.02
6629	+.44	.35	+.09
6844	-.19	.34	-.53

Apparently the phase function of the Trojans is flatter than that of the normal asteroids, which indicates a different surface structure. On the other hand, omission of the Trojans in the determination of the phase function will fairly certainly result in a larger value of the coefficient of $T(\alpha)$, so that both the opposition effect and the linear part of the phase function should be steeper for the PLS asteroids than for the numbered ones. This redetermination of $F(\alpha)$ for the PLS has not been made as yet.

DISCUSSION

KOWAL: On August 19 and 20, 1969, plates of the following lagrangian point of Saturn were taken at the Palomar 122 cm Schmidt telescope. The plates are 6.6° in diameter and were centered about $1\overset{\circ}{.}5$ north of the L_5 lagrangian point. No "Trojan" asteroids were found. It is estimated that any object brighter than about 19.5 mag would have been detected.

Because Gehrels (1957) has examined the *preceding* lagrangian point of Saturn with negative results, it can be stated with confidence that Saturn does not have any "Trojan" asteroids brighter than 19 mag.

DISCUSSION REFERENCE

Gehrels, T. 1957, Indiana Expedition to South Africa, April-June 1957. Astron. J. **62**, 244.

[*Editorial note: For further information regarding the PLS, see Kiang's paper,* *page 187; Kresák's paper, page 197; the "Discussion" following Dohnanyi's paper, page 292; and Lindblad's paper, page 337.*]

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