LETTERS TO THE EDITOR

ASTROPHYSICS

Rotation Period of the Planet Mercury

THE recent radar measurements of Mercury indicate that the period of rotation of the planet is 59 ± 5 days[1]. This result is in complete disagreement with the previously quoted value of 88 days based on the visual observations of the markings on Mercury[2–6]. In this communication we show that the same visual observations can not only be reconciled with the radar-determined rotation period of Mercury but, in addition, can be used to derive an improved value for the period of rotation of the planet, namely, 58·4 ± 0·4 days.

We have examined nearly 50 drawings of Mercury published by Lowell[2], Antoniadi[3], Lyot[4], Dollfus[5], and Baum[6]. Of these, six pairs of drawings show near duplication of markings and phase.

	Time-interval T (days)
(1) Antoniadi (August 11, 1924) and Antoniadi (June 21, 1927)	1,105
(2) Antoniadi (August 23, 1927) and Antoniadi (August 6, 1928)	349
(3) Antoniadi (October 4, 1927) and Antoniadi (August 23, 1929)	689
(4) Antoniadi (August 6, 1928) and Antoniadi (July 20, 1929)	348
(5) Lyot (July 22, 1942) and Dollfus (October 12, 1950)	3,004
(6) Baum (March 15, 1952) and Baum (March 1, 1953)	351

Duplication of markings and phase for any single pair of drawings of Mercury does not necessarily indicate that synchronous rotation of the planet is the only possible solution. A number of other periods of rotation are possible as given by the following equation:

$$P \approx \frac{T}{n + \frac{\theta}{360}}$$

where P is the period of rotation of Mercury in days, T the time-interval between the two observations, n the number of complete rotations of the planet, and θ is the average angular displacement of the earth and Mercury in their orbits, with respect to the stars, in time T. Fig. 1 shows all possible values of P between 50 and 70 days as calculated for each pair of drawings. It is noted that in addition to an 88-day period (not shown in Fig. 1) there are at least three more values of P, namely, 50·1, 58·4 and 70·2 days which will be consistent with all the six pairs of drawings. However, only one of these values is within the allowed limits of radar results (59 ± 5 days). Therefore the rotation period of 58·4 ± 0·4 days is consistent with both the visual and the radar observations of Mercury.

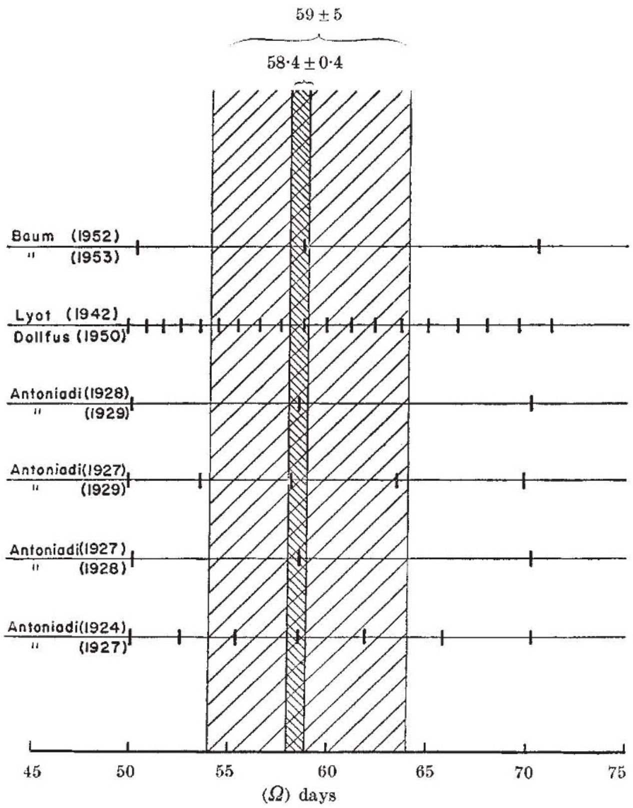

Fig. 1. Rotation periods of the planet Mercury, in days, as derived from six pairs of drawings. The single-hatched area shows the limits in the rotation period allowed by the radar observations of Mercury. Visual observations indicate a value of 58·4 ± 0·4 (double-hatched area)

Peale and Gold[7] have pointed out that because of the large eccentricity of the orbit of Mercury, the tidal torque will be greatest at the perihelion, and the planet will acquire a rotation period lying between 56·6 and 88 days. Our value of 58·4 ± 0·4 days is very close to the lower limit, indicating a significant amplitude dependence of the tidal dissipation on Mercury.

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[6] Baum, R. M., in *The Planet Mercury*, by Sandner, W. (Macmillan Co., New York, 1963); and plate II in *A Guide to the Planets*, by Moore, P. (Norton and Co., Inc., New York, 1960).
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Tidal De-spin of Planets and Satellites

RECENTLY, Peale and Gold[1] have shown that the non-synchronous rotation of Mercury is likely to be a consequence of tidal friction. They point out that in an eccentric orbit the spin of an axially symmetric planet will not relax to the orbital mean motion, but instead will approach a final value which is somewhat larger. The final spin rate will be somewhere between the mean orbital angular velocity and the orbital angular velocity at perihelion. The precise value for the final spin is determined by the condition that the net tidal torque on the planet around each orbit be equal to zero. The spin rate at which this condition is satisfied is determined by the frequency and amplitude dependence of the planet's 'Q' ($1/Q$ is the specific dissipation function[2]). According to Peale and Gold: "The condition discussed here is based on the supposition