the differential magnitudes taking into account the differential atmospheric extinction between asteroid and comparison star. Atmospheric extinction coefficients were estimated at the beginning of each photometric observing session. The obtained photoelectric data could then be displayed on either the computer CRT or the line printer.

60 Echo has been observed on two previous occasions by Gehrels and Owing (1962) and by Harris and Young (1982). Gehrels and Owing estimated a rotational period of greater than or equal to 30 hours based on a single lightcurve of approximately 8 hours duration. Harris and Young gave a tentative value of 52 hours, based on extensive observations, but noted that interpretation was confused by the fact that one of the comparison stars used was later determined to be a variable star with a period very nearly equal to the rotational period of the asteroid.

Observations of 60 Echo made by the authors on 13 nights between January 29 and February 20, 1984 indicate that a synodic rotational period of 25.208 ± 0.048 hours best fit the observed data. The composite lightcurve shown in Figure 1 is based on this rotational period. The lightcurve shows two broad maxima and minima per rotation with an amplitude of 0.22 ± 0.02 magnitudes.

Radar observations of 60 Echo in the 13 cm wavelength conducted by S. Ostro at the Arecibo Radio Observatory returned no detectable echo from the asteroid. This effect may be explained by a greater than expected Doppler broadening caused by the rotational period for Echo being considerably shorter than the anticipated 52 hours. This evidence lends further support to the assertion by the authors that the rotational period of this asteroid is approximately one-half of the previously assumed value.

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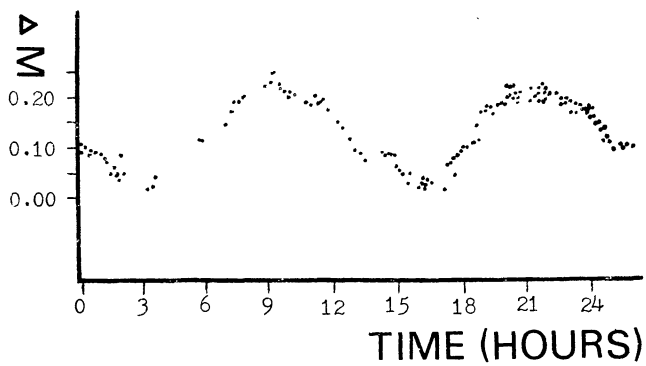

Figure 1. Composite Lightcurve of Asteroid 60 Echo.

THE PHASE COEFFICIENT OF 18 MELPOMENE AS DETERMINED BY VISUAL OBSERVATIONS

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(Received: 15 March Revised: 9 April)

Visual magnitude estimates of 18 Melpomene were made throughout its 1981 apparition. Analysis of the observations made at phase angles > 7 degrees yield a linear phase coefficient of 0.028 ± 0.002 mag/deg, in excellent agreement with the mean value for S-type asteroids. Linear extrapolation to zero degrees phase angle implies a V(1,0) magnitude of 6.88.

The interest generated in this visual observing project was entirely due to Dr. J. U. Gunter's admirable bi-monthly publication Tonight's Asteroids. In the July-August 1981 edition came an appeal by R. P. Binzel encouraging lightcurve observations of asteroid 18 Melpomene during its very favorable opposition in Aquarius.

All observations reported here were made by the first author using a 25 x 105 mm binocular telescope, field 3 degrees, mounted on a portable tripod. Also, a pair of hand-held 15 x 80 mm binoculars, field 4 degrees, was used by the observer comfortably seated in a reclining deck chair with arm rests. Experience has been gained over a number of years in visual magnitude observations of comets and variable stars using various classes of instruments. Particular attention has also been given to monitoring light fluctuations of new and old novae.

The comparison stars were taken from the AAVSO Variable Star Atlas. The magnitude determinations were obtained by the usual variable star techniques by selecting suitable standard comparison stars near the minor planet at the time.

The observations are listed in Table I which gives the UT date, visual magnitude estimate, and the (earth-asteroid-sun) phase angle, α. r and Δ are the sun-asteroid and earth-asteroid distances in AU. $V(1,\alpha)$ is the magnitude of the asteroid corrected to a distance 1 AU from the earth and sun, where

$$V(1,\alpha) = V - 5 \log(r\Delta)$$

Figure 1 shows a "phase curve", a plot of $V(1,\alpha)$ versus phase angle. The data show the typical features of a phase curve: a linear portion for $\alpha > 7$ degrees and a non-linear increase for $\alpha < 7$ degrees called "the opposition effect." The opposition brightening is due to the microscopic

1981 Date (UT)	V	α	r	Δ	V(1,α)
June 29.07	9.6	24.8	2.03	1.28	7.5
July 1.05	9.6	24.3	2.02	1.26	7.5
2.05	9.6	24.1	2.02	1.25	7.6
8.05	9.4	22.5	2.01	1.19	7.5
Aug. 2.12	8.7	12.2	1.95	0.98	7.3
3.01	8.5	11.7	1.95	0.97	7.1
11.13	8.4	7.1	1.93	0.93	7.1
12.05	8.4	6.5	1.93	0.93	7.1
23.00	7.6	0.5	1.91	0.90	6.4
23.91	7.6	1.1	1.91	0.90	6.4
25.95	7.7	2.4	1.90	0.89	6.6
26.93	7.7	3.0	1.90	0.89	6.6
27.91	7.6	3.7	1.90	0.89	6.5
31.90	7.7	6.2	1.89	0.89	6.6
Sep. 5.90	8.1	9.4	1.88	0.90	7.0
18.92	8.6	17.0	1.86	0.94	7.4
22.90	8.7	18.5	1.86	0.95	7.5
Oct. 2.91	9.0	23.0	1.84	1.00	7.7
20.86	9.3	29.1	1.82	1.14	7.7
27.91	9.3	30.6	1.81	1.19	7.6

Table I.
Visual Observations of 18 Melpomene

properties of the surface. The slope of the linear portion is called the "phase coefficient" and its value is related to the asteroid's albedo. The linear least squares best fit slope for the data in Table I with $\alpha > 7$ degrees gives a phase coefficient of 0.028 $\pm$ 0.002 mag/deg. This line is plotted in Figure 1. Bowell et al. (1979) list Melpomene as an S-type asteroid and the mean phase coefficient for S-types is 0.029 mag/deg (Bowell and Lumme 1979). Thus the visual observations reported here yield a phase coefficient which is in excellent agreement with that of a typical S-type asteroid. If the line in Figure 1 is extrapolated to 0 degrees phase angle, a V(1,0) magnitude of 6.88 is obtained. This is in fair agreement with the 6.61 value from Bowell et al. (1979).

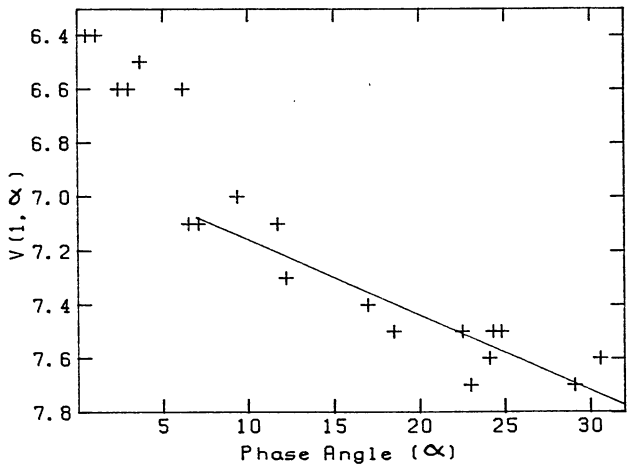

Figure 1.
Phase Curve for 18 Melpomene

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BOOK REVIEW

Solar System Photometry Handbook
Edited by Russell M. Genet
Willmann-Bell, Inc., Richmond, Virginia, 1983
208 pages, $17.95

In the past, photoelectric photometry was an art practiced only by professional astronomers who had access to expensive, custom-made equipment. Recently, however, relatively inexpensive photometers have appeared commercially, thereby providing amateurs the opportunity to obtain photometric observations of various astronomical objects. The professional, however, has a thirty year head-start over the amateur, and many amateurs may wonder if there is anything left for them to do with a photometer on a small telescope. If this is the case for you, then this is the book for you! The book is loaded with discussions of just what opportunities remain for amateur photoelectric photometry of solar system objects.

The book consists of a preface, two forewords, and ten chapters, each written by a different individual covering a different aspect of photoelectric photometry. Eight chapters cover photometry of just about anything in the solar system you can imagine: asteroids, comets, planets, planetary satellites, the sun, and the moon. Two of the chapters are devoted to discussions of the equipment needed to perform the observations covered in the other eight chapters. The foreword by Dunham is practically a chapter by itself, full of information about various kind of occultation observations. Don't skip over this useful portion of the book!

As one might expect from a multiple-author book, the level at which each chapter is written does vary. For example, the chapter by A'Hearn on photometry of comets is clearly aimed at the professional astronomer and only the most advanced amateurs. The chapter by Binzel on photometry of asteroids, on the other hand, describes observations that can be carried out by the beginning amateur photometrist. The readability of the other chapters, especially the ones covering the equipment, depends to large degree on the level of experience the reader has in those subject areas. Another item to watch out for is inconsistent notation from author to author. In chapter one, the Greek letter