respectively. At a distance of 1.919 AU, the sun subtends 1000 arcsec (diameter), and at a distance of 0.914 AU, the earth subtends 19.2 arcsec (diameter). The area ratio earth/sun is therefore 1/2700, which converts to 0.0004 mag, about four times larger than the number derived last time, but the conclusion remains unchanged: the loss of light is unmeasurable. Theoretically, one could collect enough photons to measure the brightness of an object to 0.0004 mag precision; in practice, the fluctuations produced by the atmosphere and the rotation of the object would mask such a small variation by many times over.

TABLE I

	Asteroid	Phase Angle	Mag B	UT Date	Time
673	Edda	0.15	14.56	1984 Nov 4	2 hr UT
1909	Alekhin	0.09	16.97	1984 Nov 4	10
24	Themis	0.04	11.94	1984 Nov 4	14
1340	Yvette	0.13	17.22	1984 Nov 4	16
735	Marghanna	0.02	11.91	1984 Nov 5	17
1486	Marilyn	0.07	16.20	1984 Nov 8	9
1841	Masaryk	0.07	16.27	1984 Nov 11	21
2286	Fesenkov	0.09	16.19	1984 Nov 17	4
1752	van Herk	0.01	16.15	1984 Nov 19	9
90	Antiope	0.05	13.43	1984 Nov 30	3
1185	Nikko	0.03	14.49	1984 Dec 3	16
1109	Tata	0.02	15.51	1984 Dec 20	2
637	Chrysothemis	0.14	15.53	1984 Dec 21	15
514	Armida	0.13	13.59	1984 Dec 24	21
2264	Sabrina	0.03	16.46	1984 Dec 25	19
677	Aaltje	0.13	14.40	1984 Dec 26	14
2039	Payne-Gaposchkin	0.11	17.28	1985 Jan 1	0
2324	Janice	0.10	16.77	1985 Jan 1	12
2593	Buryatia	0.13	16.39	1985 Jan 2	1
2403	Sumava	0.03	16.73	1985 Jan 10	4
2800	4585 P-L	0.14	18.10	1985 Jan 10	3
1778	Alfven	0.11	17.09	1985 Jan 13	10
2066	Palala	0.04	16.66	1985 Jan 16	13
2217	Eltigen	0.14	16.89	1985 Jan 18	17
2237	1938 TB	0.06	16.29	1985 Jan 21	10
1383	Limburgia	0.02	17.01	1985 Jan 23	2
2123	Vltava	0.08	16.54	1985 Jan 23	21
1966	Tristan	0.12	17.31	1985 Jan 29	9
1748	Mauderli	0.07	17.75	1985 Jan 30	21

LETTER TO THE EDITOR

Dear Editor,

I enjoyed reading "William Herschel and the First Two Asteroids" (MPB v. 11 p. 3), but author Cunningham failed to tell you an interesting fact about the meeting of Herschel and Piazzi. According to Isaac Asimov, (Asimov's Biographical Encyclopedia of Science and Technology) when Piazzi visited England ". . . he had the doubtful privilege of falling off the ladder at the side of Herschel's great reflector and breaking his arm."

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COMPUTER TRACKING CHARTS

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To aid in photographing asteroids, a computer program is used to generate finding charts for the selection of guide stars. The data base contains all asteroids with a given minimum magnitude and the stars from the Yale catalogue down to 7th magnitude. Parameters may be set that allow the charts to be plotted in many different formats. The charts will be sent to interested readers for a small charge to cover costs for copies and postage.

It's very time consuming work to find guide stars for photographing asteroids, especially if they are invisible in the telescope itself. The normal procedure is to take the ephemerides from the EMP (Ephemerides of Minor Planets by the Institute of Theoretical Astronomy in Leningrad) or ephemerides from the Minor Planet Center and plot the positions by hand on a star chart with a good scale so that finding guide stars for long focus exposures is possible.

Because this is too much work for all asteroids, I decided to do this with a computer. At first I typed all the elements of the EMP in to my computer files, which was very hard work, but there is no computer readable version available to my knowledge. Then I took star positions from the Yale catalogue which contains about 9000 stars down to 7th magnitude. This is the limiting magnitude for guide stars for most amateurs, I think.

Now the problem was to bring both data sets together in a form which was best for quickly planning the exposures. At first I wrote a program to calculate ephemerides with errors under 20". An example of this is presented in Table I. In addition to the normal data like date (day.month.year), right ascension (hh.mmmm), declination (ddd.mmm), and magnitude, the radius (asteroid-sun distance) and earth-asteroid distance (both in AU) are given. (For example, the first entry is for 27 August 1984 and the coordinates are R.A. 4 hours 21.42 minutes and declination -8 degrees 28.2 minutes.) The table also gives the time (in minutes) for the asteroid to move 5 arc seconds (5"), the motion of the asteroid (in arc seconds) in 15 minutes (15 m), the elongation from the sun, the phase angle, and the daily motion in right ascension and declination (M-A and M-D are in minutes and arc minutes, respectively). The top of the table lists the number and name of the asteroid, the interval (in days) covered by the ephemeris, and the date of the printing.

The motion data are very useful for calculating whether or not the asteroid is bright enough to bring enough light to a point on the film. Therefore you must also know your guiding error and the resolution of the film. For example: if the greatest value

Ephemerides of 183 Istria days: 170 printed in 20.03.84

Date	Rektas.	Declin.	Magn.	Radius	Diston	5 "	15m	Sun	Pha	M-A	M-D
27. 8.1984	4.2142	-8.282	14.00	1.840	1.520	4	20	92	33	+2	-9
24. 9.1984	5.1094	-14.091	13.66	1.820	1.320	5	16	102	33	+1	-13
22.10.1984	5.3984	-20.258	13.34	1.820	1.170	8	9	114	30	+1	-11
19.11.1984	5.3996	-24.169	13.08	1.850	1.080	16	5	127	25	+0	-2
17.12.1984	5.1824	-21.426	13.04	1.900	1.070	7	11	135	22	+0	+14
14. 1.1985	5.0298	-12.242	13.38	1.970	1.200	5	15	129	23	+0	+24
11. 2.1985	5.1164	-1.199	13.98	2.050	1.450	5	15	113	26	+1	+22

Table I.

Example ephemeris for 183 Istria. Explanation of the columns is given in the text.

of resolution and guiding error is 2" and the guiding error is 2", your film must be able to reach 13th magnitude in 6 minutes on 1984 Nov. 19 (see table).

I have defined the beginning and end of an asteroid's apparition as when the asteroid's elongation is increasing or decreasing, respectively, above or below a specified value. In addition, the magnitude must also be below a fixed value. For the ephemeris in the table and figure, I set the minimum elongation at 35 degrees and the magnitude limit at 14.0.

The finding charts (see Figure 1) are for the epoch 1950.0, but the epoch is not very interesting because I use the finder chart for the guide stars at the telescope. The area in Figure 1 is a very popular region of the sky (Orion). On the horizontal axis at the bottom is printed the right ascension (labeled every hour) and on the left side is the declination (labeled every 15 degrees). Listed at the top of the chart is the number and name of the asteroid, the dates for the beginning, middle, and end of the opposition where the magnitude on these dates is given in parenthesis. Also given on the top line is the plotting date. On the right vertical axis is the interval in days covered by the chart.

The use of the charts in practice is simple. Note the marks on the asteroid track. The large marks are at 28 day intervals (about one period of the moon) and these marks correspond to the dates in the ephemeris. The smaller marks are in 7 day intervals. An arrow at the end of the track indicates the direction of motion. Suppose you want to photograph 183 Istria on 1985 January 28. You look at the ephemeris and see that the nearest date is 1985 January 14. After a short examination of the chart you find the large mark on the track for this ephemeris date. Moving forward along the track by two smaller marks (14 days) you have located the asteroid's position for January 28. After viewing the field around this position you notice: "Oh, a fine, bright star about two degrees north of the asteroid". (It's Beta Eridani). So, for example, you can photograph the asteroid with about a 400 mm focal length lens on 24 x 36 mm film while guiding on this star. (The diameter of the exposed field for this system is about 4 degrees.)

The charts can also be used for planning over a long time. Because most observers (amateur astronomers) observe on weekends you can step along each small mark on the track (one week). The large marks quickly show the asteroid's position at full (or better new) moons.

For computing I use a SIEMENS 7.882 computer. The language is Fortran 77 and the program may be run with a minimum of 400 KB RAM. In the future I'm planning to take as a base for star positions the SAO catalogue for special asteroids (very bright ones and also fast moving asteroids). Interested observers are requested to send a minimum of DM 16 to cover the cost of copies and postage.

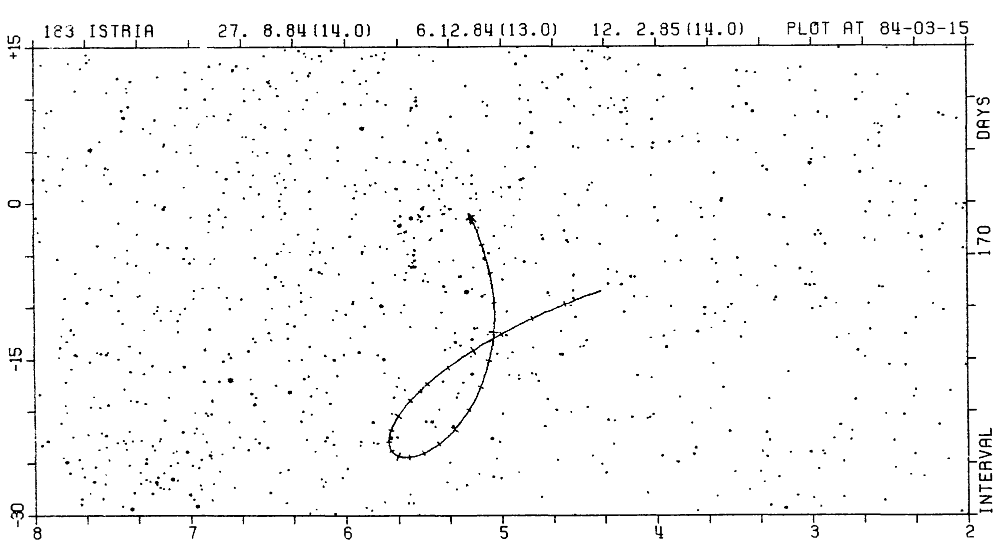

Figure 1.

Example chart for 183 Istria. Explanation of the chart and axis labels are given in the text.

I thank Mr. Grasshoff for making the Yale catalogue available to me, Mr. Klare for communication about star positions on magnetic tapes and Dr. Marsden for communication about asteroids on tapes. I also thank all who made suggestions for improvements in the charts during the development phase of the chart format.

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ASTEROID NEWS NOTES

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Seventy-two New Asteroids

Through the August batch of Minor Planet Circulars (MPCs), 72 new asteroids were numbered, bringing the total to 3104. Most of the new additions are main-belt objects, but there are some notable exceptions. For the first time since (2608) Seneca, an Apollo/Amor has been numbered; in fact, the long dry spell was ended with the numbering of two such objects: Amor asteroid 1981 QA was numbered (3102), and Apollo asteroid 1982 BB was numbered (3103). Other non-main-belt objects include (3040) 1979 BA, a Mars crosser; (3043) San Diego, (3086) 1980 XE, and (3101) 1978 GB, all in the Hungaria region; (3092) 6550 P-L and (3095) 1980 RT2, both in the Cybele region; and (3063) 1983 PV, a Trojan asteroid in the cloud leading Jupiter.

Earth-approaching Asteroid Update

If you think you're going to read about twin discoveries again... you're right! As mentioned in the last issue, 1983 TF2 came along to destroy the pattern. Now, along comes 1983 SN to resurrect it! 1983 SN is presumably an Apollo object discovered by the Infrared Astronomical Satellite (IRAS) last September. Unfortunately, a five-day delay in reporting the object and poor weather at ground-based observatories prevented confirmation of the discovery. Nevertheless, of all the potential earth-approaching objects seen only by IRAS, this one has, by far, the most convincing evidence. Thus the Minor Planet Center gave it the official provisional designation 1983 SN.

Just when you thought 1983 was over, and the twin discoveries along with it, along come two new Apollo asteroid discoveries: 1984 KB and 1984 KD, both discovered at Palomar by the Shoemakers. 1984 KD was a remarkable object, passing only 0.03 AU away from the earth on June 19 (as close as Comet IRAS-Araki-Alcock passed last year), and getting as bright as visual magnitude 11. Several visual observers reported variations in brightness of 0.3 to 0.4 mag in a time span of as little as 20 minutes.

Here's a quick review of the twins "born" during the last 14 months: 1983 LB and LC, 1983 RB and RD, 1983 SA and SN, 1983 TB and TF2, 1983 VA and VB, and 1984 KB and KD. Remarkable, no?

New Names

Once again, the newly named asteroids nearly kept pace with the newly numbered objects during the May to July interval (no new names were reported in August). Fifty-five asteroids received new names. Among the honored are (2227) Otto Struve, named for the famous astronomer, and (3043) San Diego, named for the city in appreciation of its decision to install low pressure sodium vapor lamps, which will help Palomar Mountain retain darker skies. Incidentally, (3043) San Diego is now the highest numbered asteroid with a name. Last but not least, the founder of the Minor Planets Section of the Association of Lunar and Planetary Observers, Richard G. Hodgson, was honored with the naming of (2888) Hodgson. As all MPB readers know, he deserves the honor. Congratulations!

Not In Icarus

Icarus may be the official journal of solar system studies, but papers on asteroid research can also appear in other professional journals. One which may be of interest to MPB readers appeared in the January 22 issue of Science. Using the NASA Infrared Telescope Facility (IRTF) and an infrared photometer equipped with a circularly variable filter (CVF), D. P. Cruikshank and W. K. Hartmann observed two of the five known A-class asteroids over the wavelength range of 0.8 to 2.6 microns. The A-class asteroids had been identified by photometry over the wavelength range of 0.3 to 1.1 microns, and are characterized by extremely steep, reddish spectra between 0.3 and 0.7 microns. Longward of 0.7 microns, a strong absorption feature was present. The fact that the spectrum was not observed to turn back up or even flatten out at 1 micron suggested that olivine was present in abundance. Subsequent JHK photometry located the long-wavelength side of the absorption feature and strengthened the case for olivine. The higher-resolution CVF data confirm the earlier results, but in addition, the data show no sign whatsoever of any absorption feature due to pyroxene. Laboratory experiments have shown that such absorption features will be present if pyroxene exceeds ten percent of a olivine/pyroxene mixture. Therefore we can state that these two objects, (246) Asporina and (289) Nenetta, have relatively pure (less than ten percent pyroxene) olivine surfaces. The significance is that olivine is found in such a nearly pure state only as a result of differentiation processes, so we now have evidence that more asteroids have undergone