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1.

MINOR PLANETS AT UNUSUALLY FAVORABLE APPARITIONS IN 1987

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A list is presented of minor planets which are much brighter than usual at their 1987 apparitions. Included are three numbered Earth-approachers, 1566 Icarus, 1981 Midas, and 2202 Pele.

The minor planets in the lists which follow will be much brighter at their 1987 apparitions than at their average opposition distances. Many years may pass before these planets will be again as bright as in 1987. Observers are encouraged to give special attention to those which lie near the limit of their equipment.

This list has been compiled on the basis of a comparison of the actual B magnitude at 1987 opposition with B(a,0) at a mean opposition, both as given in the 1987 *Ephemerides of Minor Planets*. Tables I and II list all planets 1.0 magnitudes brighter at 1987 opposition than B(a,0). Some planets which come to opposition at large distances from the ecliptic, and therefore at large phase angles, will be fainter than listed in the 1987 ephemeris volume because phase coefficients are not included in the calculation of opposition magnitudes in this source. No systematic effort has been made by the writer to revise the published magnitudes for phase effects. Observers are cautioned that such planets may be slightly fainter than predicted.

Minor planet 1566 Icarus will be making its first moderately close approach to Earth in 19 years. The 1987 apparition will not be nearly as close as that in 1968, but closer than any other before 1996. Observers with larger telescopes should take advantage as Icarus reaches 16th B magnitude at closest approach. The included ephemeris (Table III) has been computed by the author from elements by W. Landgraf published in *MPC* 8665. The agreement with that in *EMP* 1987 is good on dates of overlap.

Minor planet 1981 Midas will pass the Earth very rapidly in late September, 1987, and briefly become as bright as 14th B magnitude, the brightest since the discovery apparition. Every effort should be expended to obtain physical data on this occasion. The ephemeris published here (Table IV) is from *EMP* 1987.

Minor planet 2202 Pele will be in opposition in late January, 1987. At the 19th magnitude this may not seem very favorable, requiring a large telescope for astrometric positions. However, this is still much brighter than at average opposition, and E. Goffin has shown that Pele will not make another approach to Earth within 0.3 AU until the year 2024. Accurate photographic positions in 1987 will aid in the availability of an accurate ephemeris at this far future year.

Separate lists arranged in numerical order (Table I) and in order of opposition date (Table II) are provided. For Earth-approaching asteroids 1566 Icarus and 1981 Midas, the date given is that of brightest magnitude rather than opposition and these exceptions are noted by asterisks. All magnitudes given in this paper are in the photoelectric B system. Visually most minor planets are 0.7 to 0.9 magnitudes brighter.

Table I
Numerical Order of Favorable Oppositions

Planet	Opposition	
	Date	B Mag
5 Astraea	Jan 31	10.0
20 Massalia	Dec 2	9.6
25 Phocaea	May 25	10.9
36 Atalante	Sep 1	12.2
62 Erato	Oct 10	12.9
74 Galatea	Aug 20	12.2
98 Ianthe	Mar 26	12.1
106 Dione	Nov 23	12.0
157 Dejanira	Dec 22	14.3
175 Andromache	Sep 17	12.4
181 Eucharis	Dec 3	12.2
204 Kallisto	May 18	12.3
217 Eudora	Sep 4	12.6
227 Philosophia	Apr 20	13.0
239 Adrastea	Nov 25	14.3
245 Vera	Dec 3	12.3
266 Aline	Nov 2	12.1
284 Amalia	Jun 22	12.3
285 Regina	Sep 4	14.7
313 Chaldaea	Dec 23	11.8

Table I Continued

324 Bamberga	Dec 26	10.3
325 Heidelberga	Nov 22	13.0
432 Pythia	Jul 4	11.9
455 Bruchsalia	Jul 11	11.8
457 Alleghenia	Sep 22	15.4
474 Prudentia	Oct 6	13.4
517 Edith	Nov 6	13.4
532 Herculina	Apr 8	9.4
547 Praxedis	Oct 4	12.8
572 Rebekka	Nov 8	13.5
594 Mireille	Apr 9	15.1
603 Timandra	Jan 19	15.6
610 Valeska	Aug 31	16.1
648 Pippa	Dec 17	14.0
654 Zelinda	Dec 24	10.6
664 Judith	Jul 12	14.0
675 Ludmilla	Dec 27	11.7
682 Hagar	Jul 31	15.6
690 Wratislavia	Sep 1	12.0
694 Ekard	Jun 19	12.2
749 Malzovia	Apr 30	14.0
763 Cupido	Nov 20	15.1
800 Kressmannia	Jun 15	13.6
849 Ara	Aug 5	12.6
883 Matterania	Jun 27	15.2
896 Sphinx	Jul 13	14.3
902 Probitas	Oct 18	15.2
923 Herluga	Dec 6	14.8
931 Whittemora	Jan 10	13.5
967 Helionape	Sep 21	14.9
982 Franklina	Jul 9	14.1
989 Schwassmannia	Oct 20	15.1
990 Yerkes	Sep 17	14.7
995 Sternberga	Sep 17	13.6
1058 Grubba	Aug 16	13.7
1081 Reseda	Oct 18	15.3
1093 Freda	Oct 9	13.1
1096 Reunerta	Sep 20	13.3
1122 Neith	Oct 16	14.5
1125 China	Feb 25	16.4
1147 Stavropolis	Apr 27	14.5
1166 Sakuntala	Sep 1	14.5
1168 Brandia	Aug 7	14.7
1169 Alwine	Dec 10	15.7
1247 Memoria	Jun 28	15.0
1277 Dolores	Sep 19	14.7
1298 Nocturna	Sep 12	15.3
1322 Copernicus	Jul 26	15.6
1325 Inanda	Nov 9	15.0
1342 Brabantia	Mar 2	14.6
1345 Potomac	Jan 28	15.2
1346 Gotha	Dec 14	14.7
1357 Khama	Oct 9	15.4
1384 Kniertje	Dec 10	15.1
1426 Riviera	Jun 7	14.1
1459 Magnya	Sep 9	14.3
1468 Zomba	Oct 7	15.2
1477 Bonsdorffia	Oct 7	15.5
1493 Sigrid	Jul 12	14.0
1498 Lahti	Aug 15	15.9
1501 Baade	Dec 10	15.4
1566 Icarus	*Jun 21	16.1
1576 Fabiola	Nov 18	14.9
1608 Muñoz	Jun 30	14.9
1610 Mirnaya	Nov 14	15.7
1662 Hoffmann	Nov 26	15.5
1693 Hertzsprung	Sep 2	14.0
1695 Walbeck	Jul 16	15.4
1699 Honkasalo	Sep 5	15.4
1702 Kalahari	Sep 1	15.0
1719 Jens	Sep 30	14.4
1730 Marceline	Oct 20	14.8
1736 Floirac	Oct 11	14.6
1746 Brouwer	Oct 4	15.2
1752 Van Herk	Aug 20	15.5
1795 Woltjer	May 22	15.4
1819 Laputa	Jul 31	15.0
1883 Rimito	Nov 25	15.2
1925 Franklin-Adams	Oct 4	15.5
1941 Wild	Oct 16	16.3
1946 1931 PH	Nov 9	15.2
1954 Kukarkin	Jul 12	15.7
1981 Midas	*Sep 22	14.0
1994 Shane	Aug 11	15.6
2064 Thomsen	Sep 21	15.1
2133 Franceswright	Oct 10	15.9
2167 Erin	Apr 20	14.9
2174 Asmodeus	Sep 19	15.5
2175 Andrea Doria	Nov 16	16.0
2202 Pele	Jan 24	19.2
2213 Meeus	Aug 26	14.9
2215 Sichuan	Oct 3	14.8
2256 4519 P-L	Aug 19	16.2
2287 Kalmykia	Aug 28	15.6
2301 Whitford	Oct 27	15.7
2324 Janice	Jul 7	15.3
2346 Lillio	Sep 14	15.0
2379 Heiskanen	Oct 2	14.7
2485 1932 BH	Nov 9	16.1
2515 Gansu	Dec 14	17.1
2533 A905 VA	Dec 19	15.6
2551 Decabrina	Dec 6	16.1
2568 Maksutov	Aug 13	16.0
2585 Irpedina	Nov 30	15.2
2623 A919 SA	Dec 9	15.8
2633 Bishop	Aug 19	15.2
2648 Owa	Dec 20	15.2
2660 Wasserman	Jul 8	15.6
2693 Yan'an	Oct 7	15.7
2772 Dugan	Jan 15	15.7
2775 1953 TX ₂	Oct 28	16.5
2848 1959 VF	Oct 6	15.5
2880 Nihondaira	Jun 21	15.0
2882 Tedesco	Sep 11	16.0
2887 Krinov	Jul 7	15.2
2892 Filipenko	Oct 30	14.5
2896 1931 RN	Jul 30	14.8
2937 Gibbs	Jun 30	14.9
2964 1974 OA ₁	Sep 17	15.4
2993 1970 PA	Oct 7	15.4
3027 Shavarsh	Oct 23	16.6
3061 Cook	Sep 8	15.8
3079 Schiller	Dec 25	16.6
3173 1981 WY	Jul 17	14.5
3221 1981 XF ₂	Aug 26	15.6
3244 4008 P-L	Oct 28	16.6
3267 1981 AA	Dec 19	14.4
3285 Ruth Wolfe	Nov 15	15.0
3321 1975 TZ ₂	Sep 4	16.2

Table II

Temporal Order of Favorable Oppositions

Opposition Date (1987)	Planet	
Jan 10	931 Whittemora	13.5
Jan 15	2772 Dugan	15.7
Jan 19	603 Timandra	15.6
Jan 24	2202 Pele	19.2
Jan 28	1345 Potomac	15.2
Jan 31	5 Astraea	10.0
Feb 25	1125 China	16.4
Mar 2	1342 Brabantia	14.6
Mar 26	98 Ianthe	12.1
Apr 8	532 Herculina	9.4
Apr 9	594 Mireille	15.1
Apr 20	227 Philosophia	13.0
Apr 20	2167 Erin	14.9
Apr 27	1147 Stavropolis	14.5
Apr 30	749 Malzovia	14.0
May 18	204 Kallisto	12.3
May 22	1795 Woltjer	15.4
May 25	25 Phocaea	10.9
Jun 7	1426 Riviera	14.1
Jun 15	800 Kressmannia	13.6
Jun 19	694 Ekard	12.2
Jun 21	2880 Nihondaira	15.0
Jun 21*	1566 Icarus	16.1
Jun 22	284 Amalia	12.3
Jun 27	883 Matterania	15.2
Jun 28	1247 Memoria	15.0
Jun 30	1608 Muñoz	14.9
Jun 30	2937 Gibbs	14.9
Jul 4	432 Pythia	11.9
Jul 7	2324 Janice	15.3
Jul 7	2887 Krinov	15.2
Jul 8	2660 Wasserman	15.6
Jul 9	982 Franklina	14.1
Jul 11	455 Bruchsalia	11.8
Jul 12	664 Judith	14.0
Jul 12	1493 Sigrid	14.0
Jul 12	1954 Kukarkin	15.7
Jul 13	896 Sphinx	14.3
Jul 16	1695 Walbeck	15.4
Jul 17	3173 1981 WY	14.5
Jul 26	1322 Copernicus	15.6
Jul 30	2896 1931 RN	14.8
Jul 31	682 Hagar	15.6
Jul 31	1819 Laputa	15.0
Aug 5	849 Ara	12.6
Aug 7	1168 Brandia	14.7
Aug 11	1994 Shane	15.6
Aug 13	2568 Maksutov	16.0
Aug 15	1498 Lahti	15.9
Aug 16	1058 Grubba	13.7
Aug 19	2256 4519 P-L	16.2
Aug 19	2633 Bishop	15.2
Aug 20	74 Galatea	12.2
Aug 20	1752 Van Herk	15.5
Aug 26	2213 Meeus	14.9
Aug 26	3221 1981 XF ₂	15.6
Aug 28	2287 Kalmykia	15.6
Aug 31	610 Valeska	16.1
Sep 1	36 Atalante	12.2
Sep 1	690 Wratislavia	12.0
Sep 1	1166 Sakuntala	14.5
Sep 1	1702 Kalahari	15.0
Sep 2	1693 Hertzsprung	14.0
Sep 4	217 Eudora	12.6
Sep 4	285 Regina	14.7

Table II Continued

Sep 4	3321 1975 TZ ₂	16.2	Oct 7	1468 Zomba	15.2	Nov 18	1576 Fabiola	14.9
Sep 5	1699 Honkasalo	15.4	Oct 7	1477 Bonsdorffia	15.5	Nov 20	763 Cupido	15.1
Sep 8	3061 Cook	15.8	Oct 7	2693 Yan'an	15.7	Nov 22	325 Heidelberga	13.0
Sep 9	1459 Magnya	14.3	Oct 7	2993 1970 PA	15.4	Nov 23	106 Dione	12.0
Sep 11	2882 Tedesco	16.0	Oct 9	1093 Freda	13.1	Nov 25	239 Adrastea	14.3
Sep 12	1298 Nocturna	15.3	Oct 9	1357 Khama	15.4	Nov 25	1883 Rimito	15.2
Sep 14	2346 Lilio	15.0	Oct 10	62 Erato	12.9	Nov 26	1662 Hoffmann	15.5
Sep 17	175 Andromache	12.4	Oct 10	2133 Franceswright	15.9	Nov 30	2585 Irpedina	15.2
Sep 17	990 Yerkes	14.7	Oct 11	1736 Floirac	14.6	Dec 2	20 Massalia	9.6
Sep 17	995 Sternberga	13.6	Oct 16	1122 Neith	14.5	Dec 3	181 Eucharis	12.2
Sep 17	2964 1974 OA ₁	15.4	Oct 16	1941 Wild	16.3	Dec 3	245 Vera	12.3
Sep 19	1277 Dolores	14.7	Oct 18	902 Probitas	15.2	Dec 6	923 Herluga	14.8
Sep 19	2174 Asmodeus	15.5	Oct 18	1081 Reseda	15.3	Dec 6	2551 Decabrina	16.1
Sep 20	1096 Reunerta	13.3	Oct 20	989 Schwassmannia	15.1	Dec 9	2623 A919 SA	15.8
Sep 21	967 Helionape	14.9	Oct 20	1730 Marceline	14.8	Dec 10	1169 Alwine	15.7
Sep 21	2064 Thomsen	15.1	Oct 23	3027 Shavarsh	16.6	Dec 10	1384 Kniertje	15.1
Sep 22	457 Alleghenia	15.4	Oct 27	2301 Whitford	15.7	Dec 10	1501 Baade	15.4
Sep 22*	1981 Midas	14.0	Oct 28	2775 1953 TX ₂	16.5	Dec 14	1346 Gotha	14.7
Sep 30	1719 Jens	14.4	Oct 28	3244 4008 P-L	16.6	Dec 14	2515 Gansu	17.1
Oct 2	2379 Heiskanen	14.7	Oct 30	2892 Filipenko	14.5	Dec 17	648 Pippa	14.0
Oct 3	2215 Sichuan	14.8	Nov 2	266 Aline	12.1	Dec 19	2533 A905 VA	15.6
Oct 4	547 Praxedis	12.8	Nov 6	517 Edith	13.4	Dec 19	3267 1981 AA	14.4
Oct 4	1746 Brouwer	15.2	Nov 8	572 Rebekka	13.5	Dec 20	2648 Owa	15.2
Oct 4	1925 Franklin-Adams	15.5	Nov 9	1325 Inanda	15.0	Dec 22	157 Dejanira	14.3
Oct 6	474 Prudentia	13.4	Nov 9	1946 1931 PH	15.2	Dec 23	313 Chaldaea	11.8
Oct 6	2848 1959 VF	15.5	Nov 9	2485 1932 BH	16.1	Dec 24	654 Zelinda	10.6
			Nov 14	1610 Mirnaya	15.7	Dec 25	3079 Schiller	16.6
			Nov 15	3285 Ruth Wolfe	15.0	Dec 26	324 Bamberg	10.3
			Nov 16	2175 Andrea Doria	16.0	Dec 27	675 Ludmilla	11.7

EPHEMERIDES

Table III

1566 Icarus

1987 0 ^h	RA (1950)	Dec	r	Δ	B Mag	Phase
Jun 20	10 ^h 16 ^m 2	+31°15'	0.942	0.162	16 ^m 4	112.0 ⁷
21	10 43.2	+27 37	0.958	0.161	16.2	106.8
22	11 08.3	+23 42	0.973	0.162	16.1	100.9
23	11 31.2	+19 39	0.988	0.165	16.0	95.2
24	11 51.9	+15 39	1.003	0.171	15.9	89.7
25	12 10.3	+11 50	1.017	0.178	15.9	84.7
26	12 26.7	+ 8 18	1.032	0.187	16.0	80.1
27	12 41.2	+ 5 04	1.046	0.197	16.0	76.0
28	12 54.2	+ 2 10	1.060	0.209	16.1	72.4
29	13 05.6	- 0 26	1.074	0.222	16.2	69.2
30	13 15.8	- 2 45	1.088	0.235	16.3	66.4
Jul 1	13 25.0	- 4 48	1.101	0.249	16.4	64.0
2	13 33.2	- 6 38	1.114	0.264	16.5	61.8
3	13 40.7	- 8 16	1.127	0.280	16.6	59.9
4	13 47.5	- 9 43	1.140	0.295	16.7	58.3
5	13 53.7	-11 01	1.153	0.311	16.8	56.8

Table IV

1981 Midas

1987 0 ^h	RA (1950)	Dec	r	Δ	B Mag	Phase
Sep 19	14 ^h 32 ^m .5	-69°45'	0.990	0.080	14 ^m 9	98.0 ³
20	16 39.0	-67 37	1.001	0.073	14.5	90.6
21	18 16.6	-59 36	1.012	0.070	14.2	81.5
22	19 14.0	-48 25	1.023	0.070	14.0	72.2
23	19 47.7	-36 57	1.034	0.074	14.0	63.9
24	20 09.2	-26 50	1.045	0.082	14.1	57.5
25	20 23.8	-18 34	1.056	0.092	14.3	52.8
26	20 34.4	-12 02	1.067	0.104	14.5	49.7
27	20 42.4	- 6 53	1.078	0.118	14.7	47.5
28	20 48.7	- 2 47	1.089	0.132	14.9	46.1
29	20 53.8	+ 0 30	1.100	0.147	15.2	45.0
30	20 58.0	+ 3 10	1.111	0.162	15.4	44.3
Oct 1	21 01.6	+ 5 23	1.122	0.177	15.6	43.7
2	21 04.7	+ 7 14	1.133	0.193	15.8	43.3

ASTEROID WORKING GROUP MEETS IN PARIS

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An informal working group on Asteroid Shapes and Pole Positions met during the Division of Planetary Sciences (DPS) conference in Paris, France November 4-7. Participants noted that when performing shape and pole solutions for an asteroid, all of the available lightcurve data for an asteroid should be utilized. In many cases, however, researchers are unaware that colleagues have additional lightcurve data which are unpublished.

To help keep all researchers informed of the available data base, the meeting participants agreed that an "Index to Unpublished Lightcurve Data" would be very useful. Such an index will be published periodically in the *Minor Planet Bulletin*. The index will probably have a very simple format indicating the minor planet, the month/year of the observations, the observer, and a code letter giving some information on the data set. The purpose of the index is not to give highly specific information on unpublished observations, but rather to note that some lightcurve data exist. Researchers interested in a data set would contact the observer directly.

Observers should now begin preparing their lists of unpublished lightcurve data. Observers with extensive listings should prepare them in machine readable form. Suggestions for the final format of the index are now being solicited. The format for the index will be announced in the next issue of the *Minor Planet Bulletin* and the deadline for receipt of listings for the first index will be May 1, 1987.

CLOSE APPROACHES OF MINOR PLANETS TO NAKED EYE STARS IN 1987

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(Received: October 30)

A list is presented of approaches of minor planets brighter than magnitude 14 to naked eye stars. This may be helpful in finding some faint minor planets.

The accompanying table lists close approaches of minor planets to stars during 1987 where:

- The event takes place more than 30° from the Sun.
- The minor planet is brighter than visual magnitude 14.
- The star is brighter than magnitude 6.
- The minimum angular separation is smaller than 120".

This list can be helpful in locating some otherwise faint minor planets. By carefully drawing the star field around the predicted position down to the magnitude of the minor planet and comparing it to the situation some time later, one can detect the intruder by its apparent motion.

The information contained in the list is divided into 5 groups:

1. Date: gives the date and time in U.T. of the closest geocentric approach. All subsequent data pertain to this instant.
2. Closest approach: the two columns give the position of the minor planet with respect to the star:
 - the minimum geocentric distance in seconds of arc
 - the position angle in degrees, measured from north over east
3. Minor planet: gives information about the minor planet:
 - number and name
 - visual magnitude
 - apparent motion in seconds of arc per hour
 - parallax in seconds of arc.
4. Star: the following data of the star are given:
 - AGK3 or SAO number
 - visual magnitude
 - right ascension for the equinox 1950.0
 - declination (1950.0)
5. Sun and Moon:
 - elongation of the Sun in degrees
 - elongation of the Moon (degrees)
 - illuminated fraction of the Moon in %

The *observed* minimum distance depends on the location of the observer on the Earth's surface but is always comprised between the minimum *geocentric* distance plus and minus the parallax. An occultation will be visible somewhere on the Earth when the parallax is greater than the geocentric separation.

It is my pleasant duty to thank Dr. Joseph De Kerf, General Manager of the Scientific Computer Centre of Agfa-Gevaert N.V., Mortsels, Belgium, for allowing me to use the computing facilities.

Close approaches of minor planets to stars

" 0
(Dist. < 120 ; El. Sun > 30
Star < 6.0 ; Min. Pl. < 14.0)

Date (U.T.)	Minim. dist.	Pos. ang.	Minor planet			Star			Elon- gation Sun	Ill. frac Moon		
			Name	Vis. mag.	App. mot.	Hor. par.	Designation	Vis. mag.			Right ascens. (1950.0)	Declination (1950.0)
					"/h "			h m	° ' "	° ' "	%	
1986 dec 22	7 49.0	0.29	188	877 Walkure	13.6	26.85	7.08	AGK3+16 0364	5.7	4 20.55	16 39.7	156 90 70
dec 23	8 30.3	12.95	154	55 Pandora	12.7	62.33	3.24	SA0164974	5.5	22 14.13	-13 4.9	60 162 60
dec 24	1 29.8	45.64	182	1212 Francette	12.9	23.11	3.39	AGK3+12 0461	5.4	4 37.27	12 6.0	156 108 53
dec 25	0 10.9	93.66	173	205 Martha	13.1	33.86	4.96	AGK3+09 0592	5.5	5 44.12	9 30.3	164 104 43
dec 25	0 37.0	100.41	173	205 Martha	13.1	33.85	4.96	AGK3+09 0591	5.9	5 44.10	9 30.4	164 104 43
dec 29	9 15.3	112.16	2	335 Roberta	13.3	26.91	4.55	AGK3+14 0414	4.8	4 31.01	14 44.4	150 168 5
dec 29	20 2.4	30.34	192	868 Lova	13.3	35.32	6.08	AGK3+19 0526	5.2	6 0.49	19 41.5	171 166 3
1987 jan 6	21 6.5	89.69	151	194 Prokne	12.4	52.66	3.97	SA0147519	5.5	0 53.52	-11 32.2	82 17 49
jan 10	2 58.8	116.01	7	86 Semele	12.6	23.35	4.93	AGK3+24 0510	5.3	5 32.40	24 0.5	154 29 79
jan 12	2 43.3	48.08	358	38 Leda	13.2	29.31	4.31	SA092680	4.8	1 50.78	19 3.0	101 46 92
jan 12	2 43.4	56.02	358	38 Leda	13.2	29.31	4.31	SA092681	4.8	1 50.78	19 2.9	101 46 92
jan 13	2 7.9	1.12	204	54 Alexandra	13.1	57.06	3.05	SA0183058	5.7	14 55.69	-27 27.5	62 140 96
jan 13	21 22.3	1.87	152	137 Meliboea	13.6	10.86	3.22	AGK3+06 0296	5.3	2 50.01	6 16.2	109 59 98
jan 23	3 59.2	82.82	342	80 Sappho	12.3	92.46	3.48	SA0146210	5.3	22 35.16	-4 29.3	36 124 48
jan 23	21 7.6	41.72	191	432 Pythia	13.7	75.49	3.56	SA0159948	5.8	16 26.95	-14 26.5	55 25 40
jan 30	5 43.4	105.85	211	5 Astraea	8.9	36.35	7.98	AGK3+15 0997	5.2	8 54.47	15 31.0	176 171 1
jan 31	0 12.9	79.74	153	55 Pandora	12.7	70.60	2.87	SA0146639	5.7	23 16.81	-5 23.9	37 18 3
feb 2	17 16.8	101.28	160	141 Lumen	13.4	73.09	3.65	AGK3+14 0047	5.9	0 34.18	14 57.4	61 12 21
feb 6	17 30.0	49.37	194	24 Themis	12.9	36.30	2.97	SA0159442	5.0	15 39.06	-19 31.2	79 175 60
feb 7	21 52.2	76.21	5	359 Georgia	13.6	31.17	4.20	AGK3+28 0906	5.8	8 23.42	28 3.5	161 49 71
feb 9	6 12.1	60.07	357	584 Semiramis	13.1	25.65	4.35	SA0156658	5.1	11 22.08	-10 35.1	141 88 81
feb 16	14 17.9	18.79	158	64 Angelina	13.1	55.69	2.75	SA0109627	4.5	1 0.34	7 37.3	49 161 93
feb 19	23 19.2	117.69	105	117 Lomia	13.0	17.50	3.85	AGK3+39 0789	5.7	6 35.19	39 26.1	125 125 65
feb 20	22 41.3	31.39	351	476 Hedwig	13.9	63.67	2.94	SA0187448	2.1	18 52.17	-26 21.7	49 46 55
feb 22	20 33.6	25.81	239	369 Aeria	13.2	20.44	4.20	AGK3+11 1488	5.8	13 12.03	11 35.8	137 73 33
feb 23	7 11.8	35.64	165	261 Prymno	13.8	39.70	4.45	AGK3+21 0404	5.4	4 16.48	21 1.3	92 156 29
feb 24	8 16.6	35.20	207	102 Miriam	14.0	16.77	4.08	AGK3+14 0831	5.8	7 39.24	14 19.6	139 164 18
feb 25	1 17.7	116.90	348	471 Papagena	11.2	16.64	4.36	AGK3+31 0570	5.8	5 51.73	31 41.6	112. 154 12
feb 26	4 56.8	67.11	167	25 Phocaea	12.3	45.07	4.61	SA0183895	5.1	15 50.43	-20 1.2	96 72 5
feb 26	5 14.6	100.23	358	83 Beatrix	13.7	64.12	3.18	SA0187448	2.1	18 52.17	-26 21.7	54 30 5
feb 28	6 46.1	61.49	186	704 Interamnia	11.4	16.13	3.64	AGK3+08 1060	5.8	7 52.81	8 59.7	138 134 0
mar 1	23 44.3	31.96	185	68 Leto	12.4	50.80	2.98	SA0186612	4.7	18 14.92	-27 3.7	67 93 5
mar 2	13 54.3	18.66	347	261 Prymno	13.9	44.80	4.28	AGK3+21 0421	5.7	4 25.05	21 30.6	87 54 8
mar 13	17 31.5	82.06	36	71 Niobe	12.8	31.97	3.17	AGK3+37 0588	5.2	5 21.25	37 20.4	89 69 97
mar 14	9 32.7	5.85	175	104 Klymene	13.7	40.17	3.28	AGK3+24 0441	5.6	4 55.10	24 58.4	82 84 99
mar 16	1 10.6	23.04	351	19 Fortuna	11.9	58.97	3.92	AGK3+20 0422	5.7	4 35.31	20 35.1	75 110 100
mar 17	6 46.1	51.27	340	250 Bettina	13.1	54.23	2.60	AGK3+21 0244	5.4	2 35.97	21 44.8	48 153 97
mar 19	4 55.2	11.40	24	584 Semiramis	12.8	36.08	4.54	SA0137823	5.8	10 47.79	-8 38.0	161 56 85
mar 30	17 7.2	105.13	196	451 Patientia	11.3	29.00	4.02	AGK3+21 1293	5.7	12 27.21	21 10.3	155 145 2
apr 3	9 29.8	23.63	6	361 Bononia	13.4	23.91	3.14	AGK3+08 1511	5.1	11 42.71	8 32.1	159 102 23
apr 7	4 22.8	33.73	345	141 Lumen	13.5	78.05	2.94	AGK3+24 0241	5.9	2 45.85	24 58.8	31 69 58
apr 7	7 25.3	87.00	197	702 Alauda	13.4	30.87	2.63	AGK3+22 0693	3.2	6 19.94	22 32.4	78 24 59
apr 7	15 13.7	0.74	329	849 Ara	13.4	56.20	3.17	SA0144495	5.1	20 27.04	-3 3.2	69 158 62
apr 12	17 57.9	72.35	176	19 Fortuna	12.1	65.50	3.39	AGK3+21 0519	4.8	5 24.63	21 53.8	60 103 98
apr 15	21 15.6	98.37	223	595 Polyxena	13.6	25.22	3.35	SA0229285	5.3	18 44.25	-40 27.7	105 52 96
apr 19	13 46.1	88.51	187	404 Arsinoe	13.4	41.26	4.61	SA0162964	5.1	19 43.44	-19 53.0	94 16 65
apr 25	13 51.3	65.32	174	187 Lamberta	13.0	46.02	3.85	SA0190129	5.5	21 10.33	-27 49.5	82 53 7
apr 27	14 17.0	110.57	203	317 Roxane	12.8	32.44	6.07	SA0139086	5.9	12 57.08	-3 32.6	158 163 0
apr 30	14 27.0	11.26	202	18 Melpomene	10.4	34.91	4.83	AGK3+03 1731	5.6	13 40.53	3 47.4	158 130 7
may 1	17 39.5	27.81	162	287 Nephthys	13.3	69.47	2.81	AGK3-00 0065	5.9	0 32.99	-0 46.8	33 76 13
may 4	7 13.8	45.38	9	65 Cybele	13.1	25.53	2.41	AGK3+18 0857	5.9	8 20.50	18 29.6	80 12 33
may 5	14 29.9	79.73	357	38 Leda	13.7	71.39	2.80	AGK3+24 0441	5.6	4 55.10	24 58.4	31 53 45
may 15	4 46.7	37.17	116	292 Ludovica	13.9	24.99	5.31	SA0210061	5.4	18 19.50	-36 41.7	137 19 96
may 17	1 45.0	49.50	19	94 Aurora	13.6	43.11	2.57	AGK3+25 0954	5.8	8 7.44	25 39.4	63 165 83
may 17	18 21.3	34.70	166	925 Alphonsina	13.2	23.61	4.26	SA0155980	4.1	10 23.66	-16 34.9	106 122 76
may 18	23 36.6	22.15	280	344 Desiderata	12.3	28.16	5.10	AGK3+15 1269	5.5	11 53.10	15 55.5	114 139 63
may 19	11 4.8	30.44	23	2 Pallas	8.8	31.45	4.17	AGK3+26 1536	2.0	15 57.41	26 3.7	134 92 58
may 19	17 13.6	36.17	354	195 Eurykleia	13.4	27.49	4.44	SA0208324	5.1	16 58.64	-32 4.3	158 65 55
may 23	6 57.1	96.89	12	346 Hermentaria	13.1	48.47	2.66	AGK3+25 0954	5.8	8 7.44	25 39.4	57 108 18
may 25	15 14.5	77.06	348	247 Eukrate	13.5	32.49	3.41	SA0191524	1.3	22 54.91	-29 53.4	90 70 4
may 31	1 19.4	51.18	338	175 Andromache	13.4	48.59	3.62	SA0146612	5.1	23 14.26	-7 60.0	82 120 11
jun 3	0 9.2	71.36	226	694 Ekard	12.0	38.52	6.87	SA0142083	5.8	18 3.40	-8 19.8	155 126 33
jun 9	13 21.6	37.13	19	71 Niobe	12.9	56.72	2.43	AGK3+27 0803	5.7	7 21.45	27 44.2	30 118 92
jun 13	2 45.0	107.21	154	324 Bambergia	11.2	95.41	3.77	AGK3+19 0168	5.9	2 7.86	19 15.9	45 118 97
jun 13	16 33.0	2.83	16	702 Alauda	13.5	48.53	2.14	AGK3+17 0801	5.2	7 36.59	17 47.4	31 169 95
jun 16	2 28.7	23.72	197	419 Aurelia	13.2	43.09	4.10	AGK3+02 1476	5.4	11 14.72	2 17.0	84 154 75
jun 16	3 14.4	29.90	203	21 Lutetia	13.0	43.55	2.89	AGK3+13 1028	5.7	10 14.00	13 58.7	66 173 75
jun 18	17 16.2	95.73	66	709 Fringilla	13.9	19.32	4.08	SA0205453	4.2	14 17.50	-37 39.4	133 130 47
jun 27	19 35.6	6.14	173	758 Mancunia	13.1	28.48	3.41	SA0186509	5.7	18 11.26	-21 43.7	176 159 2
jun 30	9 51.8	114.31	187	386 Siegena	13.4	51.19	2.31	AGK3+10 1179	5.1	9 5.04	10 52.2	38 12 15

Jul 2	4	48.7	9.80	16	346	Hermentaria	13.2	55.13	2.37	AGK3+22 1066	5.2	9	6.49	22	14.9	33	32	29
Jul 3	22	31.0	51.92	203	120	Lachesis	13.7	50.87	2.43	AGK3+12 1188	5.2	9	55.53	12	41.0	45	39	46
Jul 3	22	47.9	87.32	176	570	Kythera	13.4	27.35	3.70	SA0187498	5.1	18	54.37	-20	43.4	177	97	46
Jul 3	23	7.0	69.97	337	628	Christine	12.3	37.20	5.94	SA0161540	5.8	18	27.26	-18	45.8	173	90	46
Jul 5	2	11.8	29.11	208	198	Ampella	11.5	31.26	6.38	SA0184822	5.6	16	53.78	-23	4.4	152	54	58
Jul 5	8	0.3	80.39	232	626	Notburga	13.6	30.48	4.43	SA0243368	5.8	16	5.18	-57	48.1	133	56	60
Jul 5	12	45.0	51.64	227	511	Davida	12.4	28.32	2.68	SA0100384	3.0	12	59.68	11	13.7	86	25	62
Jul 9	3	16.0	100.98	20	211	Isolda	13.9	44.65	2.54	AGK3+02 1459	5.7	11	4.33	2	13.5	60	91	94
Jul 11	0	27.7	43.75	358	130	Elektra	12.5	65.44	2.59	SA0112740	1.7	5	22.45	6	18.4	31	146	100
Jul 12	12	7.9	17.45	173	306	Unitas	13.9	64.11	2.95	SA093868	3.9	4	16.95	15	30.5	44	116	97
Jul 17	13	51.7	11.21	354	306	Unitas	13.9	62.91	2.99	AGK3+15 0370	3.6	4	25.81	15	45.7	46	47	53
Jul 18	10	26.6	94.05	336	796	Sarita	13.6	82.38	3.81	AGK3+21 0376	4.5	4	1.70	21	54.6	52	31	44
Jul 18	11	24.9	14.34	156	796	Sarita	13.6	82.37	3.81	AGK3+21 0377	4.5	4	1.74	21	56.8	52	30	43
Jul 18	16	21.0	63.07	25	186	Celuta	13.8	38.40	3.99	SA0157788	5.1	13	9.40	-15	55.9	87	166	41
Jul 19	7	46.8	32.21	196	478	Tergeste	13.8	59.07	2.44	AGK3+02 1313	5.9	9	49.61	2	41.4	34	106	35
Jul 20	6	18.9	51.01	146	6	Hebe	8.4	42.77	6.95	SA0162792	5.2	19	32.37	-10	40.3	168	120	26
Jul 23	10	32.4	65.65	25	192	Nausikaa	13.2	46.59	2.50	AGK3+01 1372	5.5	11	21.47	1	40.9	50	78	5
Jul 23	13	53.6	20.24	58	200	Dynamene	13.3	10.12	3.84	SA0184369	5.9	16	21.52	-29	35.4	128	154	5
Jul 24	6	43.8	117.57	181	130	Elektra	12.6	63.04	2.64	AGK3+06 0631	5.3	5	45.31	6	26.3	37	28	2
Jul 24	21	1.5	89.27	160	266	Aline	13.2	47.43	3.91	AGK3+23 0175	2.2	2	4.36	23	13.5	84	73	1
Jul 25	12	25.2	64.98	8	66	Maja	13.9	20.68	4.36	SA0185755	4.7	17	44.41	-27	48.8	144	149	0
Jul 26	21	5.5	25.86	337	814	Tauris	13.8	26.50	4.01	SA0209696	3.1	18	2.59	-30	25.7	147	137	1
Jul 28	12	50.7	1.17	358	313	Chaldae	13.9	65.38	3.35	AGK3+13 0342	5.6	4	17.15	13	55.0	59	89	6
Jul 29	16	56.1	104.27	179	313	Chaldae	13.9	65.23	3.37	AGK3+13 0345	5.8	4	19.24	13	57.6	60	102	13
Aug 3	5	19.9	4.65	351	93	Minerva	13.7	46.89	2.42	AGK3+29 0559	5.7	5	18.03	29	31.3	49	144	54
Aug 6	3	23.6	50.15	335	455	Bruchsalia	11.6	21.59	7.73	SA0210781	4.9	10	55.35	-37	10.5	145	17	84
Aug 6	16	11.5	101.60	171	481	Emita	13.9	65.90	3.17	AGK3+22 0518	5.1	5	16.27	22	2.7	53	164	89
Aug 7	13	19.4	99.50	36	344	Desiderata	12.8	68.38	3.74	SA0139086	5.9	12	57.08	-3	32.6	60	93	94
Aug 9	14	55.7	58.91	355	52	Europa	12.1	43.97	2.83	AGK3+14 0398	4.9	4	23.78	14	36.1	69	107	100
Aug 10	11	19.8	80.76	358	42	Isis	12.9	56.62	2.74	AGK3+22 0665	3.7	6	11.86	22	31.4	44	121	98
Aug 11	1	54.7	102.12	5	113	Amalthea	13.7	66.32	2.73	AGK3+20 0786	3.9	7	1.14	20	38.7	33	124	96
Aug 13	3	32.4	39.49	357	675	Ludmilla	13.1	65.81	3.57	AGK3+27 0468	5.9	4	56.78	27	15.1	63	66	82
Aug 13	11	13.9	71.17	158	796	Sarita	13.6	74.01	4.10	AGK3+27 0468	5.9	4	56.78	27	15.1	63	61	79
Aug 13	23	15.4	55.62	11	485	Genua	13.6	75.81	2.92	AGK3+12 0869	5.8	7	11.75	12	12.2	33	87	74
Aug 15	18	9.8	19.43	357	52	Europa	12.1	41.82	2.90	AGK3+14 0414	4.8	4	31.01	14	44.4	73	26	56
Aug 19	14	10.9	100.41	14	24	Themis	13.1	27.43	2.89	SA0159330	5.5	15	29.73	-19	30.1	89	143	21
Aug 22	22	25.3	42.64	183	505	Cava	13.9	78.56	3.23	AGK3+22 0862	3.5	7	17.14	22	4.5	40	24	2
Aug 26	5	29.7	37.06	205	101	Helena	13.7	56.33	2.54	SA0138845	5.4	12	31.19	-9	10.6	39	21	3
Aug 26	19	18.1	15.96	7	28	Bellona	12.4	65.54	2.91	AGK3+16 0741	5.3	7	10.50	16	14.7	45	71	5
Aug 30	0	37.3	4.20	352	200	Dynamene	13.8	23.85	3.22	SA0184481	2.9	16	32.76	-28	6.9	95	32	28
Aug 30	6	38.6	40.72	359	88	Thisbe	12.7	39.45	2.89	AGK3+25 0517	5.0	5	36.64	25	52.2	71	138	30
Sep 1	19	45.8	115.95	348	324	Bamberg	11.1	69.36	4.78	AGK3+34 0571	5.3	5	24.33	34	26.1	76	172	57
Sep 13	8	28.6	94.96	181	42	Isis	12.9	45.55	3.02	AGK3+22 0815	5.9	7	2.30	22	42.8	65	44	66
Sep 15	12	24.5	75.78	12	24	Themis	13.3	38.81	2.55	SA0183972	5.9	15	54.75	-20	50.4	69	153	45
Sep 16	18	35.8	98.43	181	88	Thisbe	12.6	30.54	3.10	AGK3+25 0595	4.9	5	54.89	25	57.0	83	14	33
Sep 19	19	14.5	118.84	7	505	Cava	13.9	72.50	3.48	AGK3+20 0965	5.9	8	17.44	20	54.4	53	17	10
Sep 21	10	39.7	118.78	354	127	Johanna	13.8	44.36	3.33	AGK3+29 0765	5.5	6	41.59	29	1.4	78	59	3
Sep 25	21	21.9	68.99	187	505	Cava	13.9	70.76	3.55	AGK3+20 0983	5.5	8	29.82	20	36.7	57	90	8
Oct 6	0	17.7	43.82	135	266	Aline	11.9	19.44	5.96	AGK3+24 0241	5.9	2	45.85	24	58.8	144	51	98
Oct 8	8	55.8	76.34	22	10	Hygiea	11.6	46.23	2.33	AGK3+12 1170	5.9	9	43.70	12	2.5	49	115	98
Oct 16	0	41.3	101.44	15	186	Celuta	13.9	72.56	2.98	SA0183580	5.2	15	31.58	-27	52.8	36	112	38
Oct 16	4	10.6	9.24	182	29	Amphitrite	10.5	40.51	4.02	AGK3+28 0833	1.2	7	42.22	28	8.9	89	15	37
Oct 16	5	12.4	19.45	12	233	Asterope	13.8	61.02	2.53	SA0159307	5.9	15	27.85	-16	26.4	32	106	36
Oct 17	3	12.0	65.22	194	186	Celuta	13.9	72.80	2.98	SA0183619	3.8	15	33.98	-27	58.3	36	100	28
Oct 19	2	25.7	3.27	138	472	Roma	12.3	27.81	6.11	SA0130628	5.9	3	36.04	-7	33.2	144	111	13
Oct 26	6	12.6	66.52	13	186	Celuta	13.9	74.68	2.94	SA0183957	4.0	15	53.79	-29	4.2	31	14	15
Oct 30	7	25.2	66.05	185	171	Ophelia	13.7	16.90	3.49	AGK3+21 0816	5.3	7	24.77	21	32.9	106	156	57
Oct 31	19	29.5	86.77	6	24	Themis	13.3	49.48	2.19	SA0184822	5.6	16	53.78	-23	4.4	37	80	73
Nov 2	3	53.5	78.89	351	7	Iris	10.1	52.56	4.14	SA0163141	5.0	19	55.12	-15	37.6	79	56	85
Nov 10	11	8.7	95.90	202	426	Hippo	13.6	21.64	3.69	AGK3+28 0943	4.2	8	43.67	28	56.6	101	23	78
Nov 10	11	48.2	66.20	200	107	Camilla	13.1	41.57	2.43	AGK3+02 1459	5.7	11	4.33	2	13.5	60	64	78
Nov 13	18	35.2	84.07	3	519	Sylvania	12.1	37.81	5.87	SA093328	4.5	3	8.77	19	32.3	178	92	48
Nov 22	0	11.5	36.61	349	140	Siva	12.4	24.86	4.95	AGK3+08 0243	5.7	2	8.70	8	20.1	153	143	1
Nov 27	19	45.1	79.73	135	313	Chaldae	11.8	24.02	7.40	AGK3+02 0725	5.8	6	24.72	2	56.4	142	121	48
Dec 3	14	10.7	116.47	175	204	Kallisto	13.9	75.40	2.92	SA0162201	5.9	19	4.00	-16	18.4	35	123	97
Dec 10	3	20.3	27.67	200	110	Lydia	13.5	54.39	2.50	SA0158427	4.3	14	10.22	-10	2.4	43	83	79
Dec 18	4	2.7	97.70	1	44	Nysa	9.4	33.25	7.59	AGK3+16 0384	4.8	4	27.70	16	5.2	161	160	9
Dec 18	10	44.1	41.45	6	866	Fatme	13.7	31.39	4.16	AGK3+20 0473	5.3	5	4.84	20	21.2	171	156	7
Dec 18	11	22.6	41.24	176	379	Huenna	13.0	30.87	4.41	AGK3+20 0473	5.3	5	4.84	20	21.2	171	156	7
Dec 21	4	22.1	11.32	6	306	Unitas	12.2	39.70	5.42	AGK3+13 0485	5.2	5	44.88	13	53.0	170	163	0
Dec 22	6	46.7	79.87	342	675	Ludmilla	10.9	37.89	6.67	AGK3+20 0689	4.1	6	25.99	20	14.7	172	163	4
Dec 23	20	33.1	74.15	252	702	Alaude	13.1	25.04	2.98	SA0156421	5.6	11	0.74	-11	2.0	99	138	13
Dec 29	5	43.5	68.83	21	43	Ariadne	12.8	70.98	3.63	SA0158401	5.1	14	8.11	-16	4.0	61	174	69
1988 Jan 1	8	1.5	92.45	320	338	Budrosa	13.3	15.36	4.30	AGK3+24 0328	5.6	3	42.17	24	41.0	139	10	93
Jan 5	7</																	

PHOTOELECTRIC PHOTOMETRY
OPPORTUNITIES
FEBRUARY-APRIL

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The table below lists asteroids which come to opposition during the months of February through April that represent useful targets for photoelectric photometry observations. Observations are needed because the asteroid has either an unknown or ambiguous rotational period or because the asteroid will be observable at a very low phase angle. The table also includes asteroids which are candidates for pole determinations (see the article by Di Martino and Zappalá in issue 12, No. 1) or are targets for radar observations (see the article by Ostro in *MPB* 10, No. 4). The table gives (in order of opposition dates) the asteroid number and name, opposition date, opposition B magnitude (the V magnitude is about 0.8 brighter), the rotational period (in hours), the estimated lightcurve amplitude (in magnitudes), and the designation PER if observations are needed to determine the rotational period. AMB implies that previous period determinations have given ambiguous results and these alternate periods are listed in the table. PHA indicates observations of the phase curve are desired because the asteroid will be at an unusually low phase angle, POL indicates the asteroid is a pole position candidate, and RAD indicates the asteroid is a planned radar target. Question marks are used to denote uncertain or unknown values. An outline of recommended observing procedures is given in *MPB* 11, No. 1, page 7. Also recommended is the book *Solar System Photometry Handbook* (see the review by Tholen in *MPB* 11, No. 4). Ephemerides for all of the asteroids in the table are included in this issue. Some of these may appear on finding charts in *Tonight's Asteroids* prepared by Mr. Joseph F. Flowers, Route 4 Box 446, Wilson, NC 27893, USA. These charts are free for a self-addressed stamped envelope.

Asteroid	Opp'n		Per	Amp	
	Date	B Mag			
5 Astraea	Feb 1	10.5	16.812	0.2	PHA+RAD
16 Psyche	Mar 2	11.5	4.196	0.2	PHA
532 Herculina	Mar 29	10.2	9.408	0.2	RAD
26 Proserpina	Mar 31	12.1	10.60	0.15	AMB
			or 13.13		

Photoelectric Photometry Opportunities

CLOSE MUTUAL APPROACHES OF
MINOR PLANETS IN 1987

Edwin Goffin
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B-2710 Hoboken, Belgium

(Received: 30 October)

The table below lists 48 cases where one minor planet comes to within 120" of another and both are of magnitude 16 or brighter. A challenge for minor planet observers!

Here I present a list of close approaches between numbered minor planets larger than 20 km during 1987 where:

- the elongation of the Sun is more than 30°.
- both minor planets are brighter than visual magnitude 16.
- and the minimum geocentric separation is less than 120".

The table gives the following data:

1. Date: date and time of closest geocentric approach (in U.T.). All other information is given for this instant.
2. Closest approach: gives the minimum geocentric distance (in seconds of arc) and the position angle (in degrees) of the *nearest* minor planet with respect to the *farthest* one.
3. Minor planet 1: contains information about the *nearest* minor planet:
 - number and name
 - visual magnitude
 - parallax in seconds of arc
 - apparent motion in seconds of arc per hour
 - position angle of the direction of motion in degrees
4. Minor planet 2: information about the *farthest* minor planet. The same data as for the nearest one are given. In addition the right ascension and declination (1950.0) are printed.
5. Sun and Moon:
 - elongation of the Sun in degrees
 - elongation of the Moon (degrees)
 - illuminated fraction of the Moon in %

The author is most indebted to Dr. Joseph De Kerf, General Manager of the Scientific Computer Centre of Agfa-Gevaert N.V., Mortsels, Belgium.

Close mutual approaches of minor planets

(Dist. < 120^{''}; El. Sun > 30[°]; Magn. < 16.0)

Date (U.T.)	Min. Pos. Dist. ang.	Minor planet 1				Minor planet 2				Right ascens. (1950.0)	Declination (1950.0)	Elongation Sun Moon	Ill. frac Moon
		Name	Vis. mag.	Hor. par.	Motion per hour	Name	Vis. mag.	Hor. par.	Motion per hour				
1987 jan 6	16 42.0	78.35 28	68 Leto	12.61 2.43	59.28 101	66 Maja	15.37 2.27	52.48 99	16 45.70	-24 22.5	32 119	47	
jan 12	15 55.8	66.78 133	459 Signe	15.88 3.46	20.05 110	380 Fiducia	14.95 3.30	22.74 97	13 1.21	0 46.7	97 108	95	
jan 29	15 9.4	68.91 319	172 Baucis	12.45 5.25	37.70 278	1015 Christa	13.78 3.83	29.66 302	9 42.84	17 59.8	166 168	0	
feb 1	22 40.6	44.63 341	27 Euterpe	10.94 5.33	53.97 70	279 Thule	15.55 2.14	15.14 69	2 48.41	15 32.2	92 47	15	
feb 5	6 1.7	65.43 262	26 Proserpina	11.78 4.64	9.51 104	301 Bavaria	14.82 4.24	9.01 69	13 2.73	-2 43.5	119 154	46	
feb 19	17 21.7	60.00 316	1024 Male	15.73 3.29	65.45 59	171 Ophelia	14.53 2.43	41.00 67	1 53.70	9 40.4	59 170	68	
feb 24	17 45.0	9.74 8	68 Leto	12.48 2.90	52.17 95	162 Laurentia	14.75 2.60	42.33 95	18 6.91	-26 54.5	63 19	15	
feb 25	8 10.5	119.22 348	46 Hestia	13.37 3.76	47.53 75	1269 Rollandia	15.38 2.30	23.23 73	3 46.23	-17 24.9	82 119	10	
mar 9	15 52.9	116.47 221	554 Peraga	14.45 3.01	46.91 85	677 Aaltje	15.58 2.81	44.24 82	18 44.22	-24 36.1	68 175	70	
mar 11	18 51.0	37.38 153	425 Cornelia	13.99 2.98	42.89 91	593 Titania	15.44 2.64	33.79 99	18 29.84	-24 20.8	73 150	86	
mar 28	7 24.2	65.56 279	222 Lucia	15.14 3.03	6.92 107	1118 Hanskya	15.73 3.00	10.69 148	7 52.52	22 56.4	109 125	2	
mar 31	20 15.6	70.83 335	572 Rebekka	15.87 2.96	78.09 70	482 Petrina	14.58 2.41	58.50 72	22 35.03	-2 41.3	31 59	6	
apr 24	8 7.0	25.23 284	936 Kunigunde	15.52 2.66	62.93 67	633 Zellina	15.39 2.56	59.30 72	23 37.57	-4 27.9	40 6	15	
apr 25	6 35.2	47.10 46	404 Arsinoe	13.33 4.76	37.12 100	277 Elvira	15.45 3.45	25.61 77	19 49.69	-20 7.9	98 64	9	
apr 30	23 2.6	47.38 182	433 Eros	13.32 4.78	135.48 89	38 Leda	13.68 2.83	70.87 86	4 45.48	24 52.1	33 3	8	
may 4	21 58.7	83.93 120	347 Pariana	11.87 6.69	36.50 267	890 Waltraut	14.82 4.68	30.73 295	14 46.38	-0 51.7	165 97	39	
may 11	11 43.4	65.34 178	51 Nemausa	12.84 2.76	61.72 71	108 Hecuba	14.58 2.13	45.35 65	0 29.78	3 38.9	41 165	95	
jun 2	15 42.2	67.70 97	577 Rhea	14.72 4.16	14.69 70	92 Undina	11.80 3.62	13.56 112	21 21.21	-19 17.7	114 179	30	
jun 12	4 38.6	37.93 285	162 Laurentia	13.57 3.86	27.50 258	593 Titania	14.21 3.84	31.94 246	18 39.11	-30 28.2	160 14	100	
jun 14	22 31.4	79.00 14	1693 Hertzprung	14.70 6.01	42.36 100	446 Aeternitas	13.26 4.62	25.39 97	22 37.09	-23 30.7	110 27	86	
jul 10	2 57.0	86.39 7	313 Chaldaea	14.02 3.10	67.11 84	52 Europa	12.26 2.53	51.74 80	3 43.76	13 19.5	50 143	98	
aug 2	12 41.4	17.00 115	814 Tauris	13.88 3.95	21.54 245	162 Laurentia	14.04 3.54	14.32 282	17 58.00	-30 50.7	139 54	47	
aug 5	1 7.5	113.99 71	146 Lucina	12.66 4.39	19.01 133	514 Armida	14.42 3.41	9.31 85	16 8.39	-21 32.9	112 8	74	
aug 13	20 51.1	98.44 101	1191 Alfaterna	14.95 4.38	34.44 224	2312 Duboshin	15.53 3.09	23.12 245	22 31.09	-16 52.4	165 48	75	
aug 26	20 46.6	89.30 230	326 Tamara	13.86 3.18	76.48 125	636 Erika	15.90 2.24	48.92 117	12 38.85	-2 32.0	37 11	5	
?	aug 27	5 33.0	111.95 2	163 Erigone	13.74 5.32	31.51 88	140 Siwa	12.96 4.43	16.30 85	2 51.24	12 13.9	108 139	7
?	aug 27	18 36.7	2.62 348	505 Cava	13.88 3.27	77.67 93	158 Koronis	15.14 2.59	56.90 99	7 28.07	21 56.2	43 80	10
?	aug 29	1 8.2	31.23 81	1585 Union	13.88 5.72	48.47 216	214 Aschera	12.84 5.27	34.02 255	22 6.05	-12 47.3	174 123	19
?	sep 1	19 0.4	100.00 166	324 Bamberg	11.13 4.78	69.38 78	762 Pulcova	14.20 2.84	38.00 80	5 24.24	34 29.5	76 172	57
?	sep 2	3 10.7	57.89 128	112 Iphigenia	14.40 4.35	42.59 94	146 Lucina	13.10 3.71	37.11 110	16 28.88	-23 58.7	90 13	61
?	sep 5	14 46.0	16.68 65	282 Clorinde	14.58 5.80	23.67 230	945 Barcelona	14.83 4.11	32.81 291	20 40.75	-17 31.4	145 7	93
?	sep 19	21 2.6	71.82 320	40 Harmonia	10.33 6.65	10.14 228	232 Russia	15.13 4.00	16.64 229	2 34.83	8 6.9	136 101	10
?	sep 26	13 43.0	11.18 214	142 Polana	15.61 2.98	57.54 106	414 Lirioppe	15.81 2.38	43.69 99	8 35.61	18 46.3	55 97	12
?	sep 27	18 18.4	65.62 318	83 Beatrix	13.19 4.42	19.06 58	351 Yrsa	14.56 3.27	7.56 74	19 52.40	-27 2.3	111 56	22
?	sep 29	18 41.9	100.44 259	906 Repsolda	14.12 4.49	14.22 292	1305 Pongola	15.74 3.60	11.85 257	3 13.37	16 36.7	135 143	42
?	oct 2	3 12.8	88.71 207	512 Taurinensis	15.49 3.88	70.83 106	150 Nuwa	14.14 2.64	46.22 100	16 26.69	-20 1.1	60 53	69
?	oct 9	15 4.7	2.99 30	410 Chloris	12.93 3.08	80.68 111	48 Doris	13.27 2.16	49.57 106	15 11.16	-13 17.3	34 171	93
?	oct 20	2 43.1	70.63 257	1416 Renauxa	15.29 4.20	9.37 304	708 Raphaela	15.42 4.11	6.58 272	22 31.08	-9 40.0	130 161	7
?	oct 31	21 15.3	78.39 121	7 Iris	10.10 4.16	51.77 82	664 Judith	15.36 3.31	47.24 89	19 53.25	-15 39.5	79 39	74
?	nov 2	19 35.7	111.20 207	347 Pariana	14.42 2.63	63.55 101	24 Themis	13.34 2.18	49.75 96	16 56.72	-23 7.4	36 107	90
?	nov 6	15 26.3	76.58 256	1585 Union	15.18 4.53	27.37 96	1186 Turnera	14.30 3.74	30.12 45	21 57.46	-23 42.3	99 92	99
?	nov 7	3 30.1	10.93 178	596 Schella	14.36 2.92	59.08 86	593 Titania	15.62 2.37	41.01 85	18 43.88	-32 29.8	56 142	97
?	nov 15	5 51.2	6.38 68	513 Centesima	14.32 4.37	7.77 208	769 Tatjana	14.17 3.82	8.99 297	0 19.81	-1 37.4	132 156	35
?	dec 7	10 3.4	119.90 79	906 Repsolda	14.05 4.49	18.69 273	578 Happella	14.04 4.24	18.11 257	2 18.79	17 3.4	143 60	96
?	dec 9	4 45.1	87.37 237	778 Theobalda	14.64 3.75	31.39 129	431 Nephela	15.39 2.52	15.63 108	10 54.34	8 1.1	94 42	86
?	dec 10	15 22.2	103.93 194	75 Eurydike	14.98 2.35	50.97 112	361 Bononia	15.07 1.79	36.10 115	14 13.98	-15 15.9	41 80	76
?	dec 17	20 41.7	12.90 86	379 Huenna	13.02 4.41	31.06 265	866 Fatme	13.67 4.16	31.52 276	5 5.33	20 21.2	171 148	11
?	dec 22	3 26.0	52.07 186	535 Montague	14.99 2.76	58.72 70	328 Gudrun	15.04 2.28	45.54 62	21 26.18	-20 36.1	48 29	3

DATE	R.A. (1950) DEC.			MAG B	PHASE ANGLE
	HR	MIN	DEG MIN		
Minor Planet 5 Astraea					
1987 Jan 10	9	8.9	13 20.	10.39	12.4
20	9	2.6	14 18.	10.22	7.1
30	8	54.4	15 28.	9.82	1.5
Feb 9	8	45.8	16 42.	10.04	4.7
19	8	38.3	17 51.	10.28	10.2
Mar 1	8	33.2	18 47.	10.45	15.2
11	8	31.4	19 28.	10.64	19.3
21	8	33.0	19 52.	10.84	22.6
31	8	37.9	19 60.	11.03	25.0
Apr 10	8	45.7	19 52.	11.21	26.7
Minor Planet 16 Psyche					
Jan 20	11	11.2	5 30.	11.72	13.3
30	11	7.8	6 0.	11.57	10.6
Feb 9	11	2.5	6 43.	11.43	7.5
19	10	55.6	7 34.	11.20	4.0
Mar 1	10	48.0	8 29.	10.90	0.3
11	10	40.3	9 23.	11.19	3.5
21	10	33.2	10 11.	11.45	7.0
31	10	27.6	10 49.	11.61	10.1
Apr 10	10	23.7	11 16.	11.78	12.7
20	10	21.9	11 30.	11.94	14.8
Minor Planet 26 Proserpina					
Feb 9	13	3.5	- 2 47.	12.61	19.0
19	13	3.7	- 2 43.	12.40	16.5
Mar 1	13	1.2	- 2 26.	12.19	13.2
11	12	56.1	- 1 55.	11.99	9.5
21	12	48.9	- 1 15.	11.74	5.1
31	12	40.4	- 0 32.	11.44	1.4
Apr 10	12	31.6	0 9.	11.69	4.9
20	12	23.7	0 41.	11.90	9.4
30	12	17.7	0 59.	12.07	13.5
May 10	12	14.0	1 1.	12.25	17.0
20	12	12.9	0 46.	12.43	19.8
30	12	14.4	0 15.	12.60	21.9
Minor Planet 532 Herculina					
Feb 9	13	21.0	14 49.	10.39	21.1
19	13	24.6	16 25.	10.18	18.9
Mar 1	13	25.1	18 13.	9.98	16.4
11	13	22.6	20 2.	9.81	13.9
21	13	17.4	21 41.	9.70	12.2
31	13	10.2	22 59.	9.68	11.9
Apr 10	13	2.2	23 44.	9.75	13.1
20	12	54.7	23 52.	9.90	15.4
30	12	48.6	23 23.	10.09	17.9
May 10	12	44.8	22 22.	10.29	20.3

ASTEROID NEWS NOTES

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Twenty-one New Asteroids

Through the November batch of Minor Planet Circulars, 21 asteroids were newly numbered, bringing the total to 3516. Only two of the new asteroids are non-main-belt objects:

(3496) 1977 RC Mars crosser
(3514) 1971 UJ Hilda

Earth-approaching Asteroid Update

On September 2, the Palomar Sky Survey II yielded yet another earth-approaching asteroid discovery. 1986 RA was discovered by A. Maury on a plate taken by J. Mould. Further observations showed the object to have a peculiar orbit. The perihelion distance is 1.23 AU, which would seem to indicate that the object is of the Amor variety. On the other hand, the aphelion distance is 5.5 AU, making the object a Jupiter crosser as well, joining 944 Hildalgo, 1982 YA, 1983 SA, 1984 BC, and 1984 WE1 in that distinction. Lastly, the semimajor axis is 3.37 AU, which would place it among the asteroids in the Cybele group just beyond the 2:1 resonance with Jupiter. The question is, what are we going to call it? For now, I think I'll call it an Amor.

A trio of objects were found in early October. The first of the three discoveries was reported later than the other two, so it bears the provisional designation 1986 TP, which comes chronologically later than the designations for the other two objects. The object was discovered on October 5 by M. Antal on a plate taken by M. Muciek at Piwnice Observatory. Its fast motion would seem to indicate that it is of the earth-approaching variety, but no further information has become available at the time of this writing. I fear that follow-up observations were either foiled by the weather or not attempted, and the object may now be lost.

The remaining two objects were both found by D. Waldron on plates taken by M. Hawkins with the United Kingdom Schmidt Telescope in Australia. The first was discovered on October 6 and given the designation 1986 TN. No further information has become available, and it may have suffered the same fate as 1986 TP. The second object was discovered on October 10 and given the designation 1986 TO. Follow-up observations were obtained, which permitted C. Bardwell at the Minor Planet Center to link the object with 1983 UH, which was seen on only two nights three years ago. The resulting orbit shows the object to have a semimajor axis of 0.9977, making it a borderline Aten-type object. Further orbit refinement may be necessary to firm up the identification of this object as the seventh known Aten object.

New Asteroid Names

Several people known for their work on comets recently had asteroids named after them: (2954) Delsemme, (2955) Newburn (one of the leaders of the International Halley Watch), (2956) Yeomans, and (3197) Weissman. Joining them are U.S. Naval Observatory astronomers (3216) Harrington and (3217) Seidelmann. The author of one of the most popular introductory astronomy textbooks was honored with the naming of (3449) Abell.

Four individuals who have been active in the asteroid lightcurve field, under the guidance of Tom Gehrels, were also honored. Both the writer and Brian Marsden were on hand in Tucson, Arizona, for a ceremony and surprise party to honor (3291) Dunlap, (3292) Sather, (3293) Rontaylor, and (3294) Carlvesely. I overlapped with the latter three individuals during my graduate student days at the Lunar and Planetary Laboratory. In particular, Carl Vesely was indispensable to me when we ground our way through the monstrous amount of data generated

by the Eight-color Asteroid Survey, and I am most happy to see their work rewarded. Congratulations to all.

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IMPORTANT CHANGES FOR THE MPB

Richard P. Binzel, Editor
Minor Planet Bulletin

Readers will notice a fresh new appearance for the *MPB* with this issue. Publication of the *MPB* has moved from Texas to Iowa where Bob Werner (Route 1 Box 237A, Solon, IA 52333) has taken on the duties as Publisher. Mr. Werner, who has served as the typesetter for the *MPB* for the past year, is utilizing an Apple *Laserwriter* to produce the *MPB*. Comments on the new appearance should be directed to Bob.

This writer still remains the editor of the *Minor Planet Bulletin*, however there is an important (but unrelated change). The editor will have a new address effective January 15, 1987:

Dr. Richard P. Binzel
 Planetary Science Institute
 2030 E. Speedway
 Tucson, AZ 85719

Manuscripts should continue to be submitted to the editor. Prof. Fred Pilcher's role as Recorder for the Minor Planets Section and Derald Nye's role as *MPB* distributor remain unchanged.

THE MINOR PLANET BULLETIN is the quarterly journal of the Minor Planets Section of the Association of Lunar and Planetary Observers. The Minor Planets Section is directed by its Recorder, Prof. Frederick Pilcher, Department of Physics, Illinois College, Jacksonville, IL 62650 USA. The *MPB* is edited by Dr. Richard P. Binzel whose new address effective January 15, 1987 is: Planetary Science Institute, 2030 E. Speedway, Tucson, AZ 85719 USA. The Publisher of the *MPB* is Bob Werner, Route 1 Box 237A, Solon, Iowa 52333 USA. Derald D. Nye, Route 7 Box 511, Tucson, AZ 85747 USA serves as the Distributor. The subscription rate is \$7.00 US a year for surface mail and \$9.00 US a year for overseas air mail. Checks or money orders should be made payable to the "Minor Planet Bulletin". Subscription payments, address changes, or other subscription business should be sent to Mr. Nye. The numbers in the upper-right corner of your mailing label indicate the volume and issue number with which your subscription expires.

Articles for submission to the *MPB* should be sent to the editor who also serves as the Photoelectric Photometry Coordinator. Authors with access to an Apple Macintosh computer are strongly encouraged to submit their manuscripts on diskette. All authors should follow the guidelines given in "Instructions for Authors" in *MPB* 13-3. Visual photometry observations, positional observations, any type of observation not covered above, and general information requests should be sent to the Recorder.

* * * * *

The deadline for the next issue (14-2) is February 1, 1987. The deadline for issue 14-3 is May 1, 1987.