OCCULTATIONS OF STARS BY SOLAR SYSTEM OBJECTS. IV. OCCULTATIONS OF CATALOG STARS BY ASTEROIDS IN 1984 AND 1985

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ABSTRACT

Results of a computer search for occultations of stars in the AGK3, SAO, and Perth 70 catalogs by 210 asteroids are presented. Sixty-nine events occurring in 1984 and 72 occurring in 1985 are described.

I. INTRODUCTION

In a series of papers, we have presented predictions for upcoming stellar occultations by asteroids (Bowell and Wasserman 1979; Wasserman, Bowell, and Millis 1981; Millis *et al.* 1983). It has been our intent in this work to select the asteroids to be included in the searches according to objective and clearly stated criteria and to provide the reader with sufficient information to permit identification of the most promising opportunities for observations.

This paper contains predictions for the years 1984 and 1985 resulting from a search of the AGK3, SAO, and Perth 70 catalogs. Except for a few asteroids whose orbits are too poorly known to permit meaningful predictions, the search is complete for all numbered asteroids having angular diameters $\geqslant 0.08$ arcsec anytime during the search interval. A few additional minor planets of particular interest because of suspected duplicity, unusual shape, high albedo, or other novel characteristics were also included in the search.

II. SEARCH PROCEDURE

Asteroids meeting the 0.08-arcsec angular diameter requirement are listed in Table I, along with asteroids 44, 170, 171, 433, 617, 624, and 2060, which have smaller angular diameters but were included for the reasons enumerated above. Assuming an uncertainty of 0.1 arcsec in the final predicted separation of the star and asteroid at closest approach, an asteroid with an angular diameter $\geqslant 0.08$ arcsec can produce occultations having values of the Q parameter (Millis and Elliot 1979) $\leqslant 2.5$. Occultations for which Q is significantly greater than 2.5 in general will require a prohibitive number of observing sites to ensure adequate coverage of the ground track.

One factor affecting the quality of occultation predictions of this type is the accuracy of the available orbital elements for the target asteroids. A measure of the quality of the orbits adopted for the objects in Table I has been determined by comparing astrometric measurements made since mid-1979 with positions predicted on the basis of the orbits. The results are given under the "Orb" column headings in Table I. "G" (good) means the observed right ascension and declination agreed with those predicted to within 4 arcsec or better. If the difference between the observed and predicted positions was between 4 and 10 arcsec, a "D" (doubtful) has been entered in Table I. "P" indicates a poor orbit with the observations differing from the predicted positions by more than 10 arcsec. The eight objects in this class were deleted from the search because predictions based on such poor orbits would be meaningless. If no modern observations could be found, a "U" has been listed in the table.

In many instances an asteroid satisfied our angular diameter criterion in one of the search years, but not the other. For such cases the year in which the asteroid was excluded from the search is listed in the columns labelled "Q." An asterisk in this column indicates one of the special objects which was included in the search even though it did not satisfy the angular diameter criterion in either year. Finally, a reference to the source of the orbital elements used is given under the "Ref" headings. Entries beginning with M are *Minor Planet Circular* numbers, while entries commencing with L refer to the *Leningrad Ephemerides of Minor Planets* for the year indicated.

To increase the completeness and efficiency of the search, a composite master catalog consisting of the AGK3 stars plus those SAO stars not in the AGK3 catalog plus those Perth 70 stars not in either the AGK3 or the SAO catalog was compiled. The compilation of this catalog was accomplished by a computerized comparison of star coordinates in those regions of the sky where the catalogs overlap. Stars whose positions in two different catalogs fell within the same 10×10-arcsec box were assumed to be the same star. While this procedure is not perfect, a more complicated algorithm did not seem justified. A total of 1024 SAO stars which are not in the AGK catalog were found north of 0° declination. There are 1526 Perth 70 stars south of the celestial equator which are not in the SAO catalog.

The method of identifying occultations of stars in the composite catalog by the asteroids in Table I is the same as that used in our earlier catalog search (Wasserman,

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TABLE I. Search asteroids.

Asteroid	Orb	Q	Ref	Asteroid	Orb	Q	Ref	Asteroid	Orb	Q	Ref	Asteroid	Orb	Q	Ref
1 Ceres	G		L75	63 Ausonia	G	85	M4364	163 Erigone	U	84	L82	387 Aquitania	U	84	M4373
2 Pallas	G		M6464	65 Cybele	G		M4365	164 Eva	U		M4369	388 Charybdis	G		M4737
3 Juno	G		L75	66 Maja	G		L74	165 Loreley	G		M4369	404 Arsinoe	G	84	L74
4 Vesta	G		L75	68 Leto	G		M4365	168 Sibylla	D		M6190	405 Thia	U	84	M4373
5 Astraea	G		L73	69 Hesperia	G	85	M4365	170 Maria	G	*	L77	407 Arachne	G		L80
6 Hebe	D		M4360	70 Panopaea	G		M4365	171 Ophelia	G	*	L82	409 Aspasia	G		M6190
7 Iris	G		M4360	71 Niobe	G	85	M4365	173 Ino	U		M4369	410 Chloris	P		M2102
8 Flora	G		M4360	74 Galatea	G	85	M4365	184 Dejopeja	G		L82	415 Palatia	G	85	M4373
9 Metis	G		M4361	75 Eurydike	G	85	L77	185 Eunike	G		M4369	416 Vaticana	P	84	M4373
10 Hygiea	G		M6630	78 Diana	G		M4365	187 Lamberta	G		M4369	423 Diotima	G		L79
11 Parthenope	G		M4361	79 Eurynome	G	84	M4365	192 Nausikaa	G	84	M4369	426 Hippo	G		M4374
12 Victoria	G		M4361	80 Sappho	D	85	L76	194 Prokne	P		L79	433 Eros	G	*	L80
13 Egeria	G		M4361	81 Terpsichore	G		M4366	196 Philomela	G		M4369	444 Gyptis	D		M4374
14 Irene	G		M4361	83 Beatrix	G		M4366	200 Dynamene	G		M4370	451 Patientia	G		M4374
15 Eunomia	G		M4824	84 Klio	G	84	M4366	201 Penelope	G		L79	454 Mathesis	D	84	L73
16 Psyche	G		M4824	85 Io	G		M4366	203 Pompeja	D		L73	455 Bruchsalia	D	85	M3650
17 Thetis	G		L79	86 Semele	D	84	L73	206 Hersilia	D		L77	471 Papagena	G	84	L75
18 Melpomene	G		L75	87 Sylvia	G		L81	209 Dido	G		L79	476 Hedwig	G		L83
19 Fortuna	G		L79	88 Thisbe	G		M4366	211 Isolda	G		M6190	481 Emita	D	85	M4375
20 Massalia	G		M4361	89 Julia	G		L76	212 Medea	P	85	M4370	488 Kreusa	D		M6190
21 Lutetia	G		L77	90 Antiope	G	85	L81	216 Kleopatra	G		M4370	489 Comacina	P		L67
22 Kaliope	G		L75	91 Aegina	D		L79	230 Athamantis	G		L80	503 Evelyn	G	85	L81
23 Thalia	G		L83	92 Undina	G		M4366	238 Hypatia	G		L74	508 Princetonia	P		L66
24 Themis	G		M4362	93 Minerva	G		M4366	240 Vanadis	G		L77	511 Davida	G		L75
27 Euterpe	G		M4362	94 Aurora	D		L81	241 Germania	D		M2761	521 Brixia	G		L80
28 Bellona	G	85	M4362	95 Arethusa	G		L80	247 Eukrate	G		L81	532 Herculina	G		M4375
29 Amphitrite	G		M4362	96 Aegle	G		L82	250 Bettina	G		M6190	536 Merapi	G		M6191
30 Urania	G	84	M4362	97 Klotho	G		M4367	259 Aletheia	G		M6190	537 Pauly	G	84	M3651
31 Euphrosyne	G		L78	98 Ianthe	G	84	L77	261 Prymno	G	85	L78	554 Peraga	G		M4376
32 Pomona	G	84	M4362	101 Helena	P	85	M2090	275 Sapientia	G	84	L78	566 Stereoskopia	G	85	L66
33 Polyhymnia	D	84	M4362	102 Miriam	G	84	L79	276 Adelheid	U	84	L77	584 Semiramis	G	84	M4376
34 Circe	G		M4363	104 Klymene	G	84	L82	308 Polyxo	G		L79	596 Scheila	P	84	L67
36 Atalante	G	85	M4363	105 Artemis	D		M4367	313 Chaldaea	G		M4371	602 Marianna	G		M4376
37 Fides	G	85	M4363	107 Camilla	G		M4367	324 Bamberga	G		M4371	617 Patroclus	U	*	M6191
38 Leda	G	85	L80	109 Felicitas	G	85	L73	326 Tamara	U	85	L80	618 Elfriede	G		L80
39 Laetitia	G		L75	110 Lydia	G		M3650	334 Chicago	D		M4371	624 Hektor	U	*	L75
40 Harmonia	G		M4363	111 Ate	G		L79	335 Roberta	U	84	L77	626 Notburga	G		L78
41 Daphne	G		M4363	114 Kassandra	G		M4367	337 Devosa	G	85	L78	654 Zelinda	G	84	M4377
42 Isis	G	85	M4363	115 Thyra	G	84	M4772	344 Desiderata	G		M4372	674 Rachele	G	84	M4377
43 Ariadne	G	84	M4363	117 Lomia	G		L81	345 Tercidina	G		L80	690 Wratislavia	G		L80
44 Nysa	G	*	M4363	120 Lachesis	G		L80	346 Hermentaria	G	84	L83	702 Alauda	U		M4378
45 Eugenia	G		M4363	121 Hermione	G		L81	349 Dembowska	G		L75	704 Interamnia	G		L77
46 Hestia	G		M4363	125 Liberatrix	U	84	M4367	350 Ornamenta	U	84	L83	705 Ermina	U		L73
47 Aglaja	G		M4363	128 Nemesis	G		M4368	354 Elonora	G		M4372	712 Boliviana	D		L76
48 Doris	G		M4364	129 Antigone	U	84	L75	356 Liguria	D		M4372	735 Marghanna	U	85	L81
49 Pales	G		M4364	134 Sophrosyne	G		L79	359 Georgia	G	84	L77	739 Mandeville	G		L79
51 Nemausa	D		L79	135 Hertha	G	84	M4368	360 Carlova	G		L83	747 Winchester	G		M4378
52 Europa	G		L75	137 Meliboea	G		L82	362 Havnia	D		M4737	751 Faina	D		L73
53 Kalypso	G		M4364	139 Juewa	G		M4368	365 Corduba	P		M2044	776 Berbericia	D		M4379
54 Alexandra	U		M4364	144 Vibilia	G		M4368	369 Aeria	G		L73	790 Pretoria	U		M4737
55 Pandora	G		M4364	145 Adeona	G		M4368	372 Palma	U		M4372	804 Hispania	G		M4379
56 Melete	G		M4364	146 Lucina	G		L74	375 Ursula	G		L79	1036 Ganymed	G	84	M4381
57 Mnemosyne	U	85	M4364	150 Nuwa	G		L80	377 Campania	D	84	L73	2060 Chiron	G	*	M7449
58 Concordia	G		M4364	159 Aemilia	G		L82	385 Ilmatar	U	84	M4373				
59 Elpis	G		M4364	161 Athor	G		L80	386 Siegena	G		M4373				

Bowell, and Millis 1981); the reader is referred to that paper for details.

III. RESULTS

The occultations predicted to occur in 1984 and 1985 are listed in Tables II and III, respectively. With one exception, only occultations having a predicted maximum duration $\geqslant 5$ s, a $Q \leqslant 2.5$, and occurring when the asteroid is at a solar elongation $\geqslant 45°$ are listed. Several additional events meeting these criteria have been excluded simply because their ground tracks appear certain to lie within the oceans or other regions devoid of interested observers. The one listed event which does not meet the constraint on Q is the 2 June 1984 occultation by Hektor. We have included it because of the wide interest in this possibly binary Trojan asteroid (see Hartmann 1979). A few occultations involving the other six "special case" asteroids were found, but all were extremely unfavorable and have not been included in Tables II and III.

The first two columns of Tables II and III are self-explanatory. Columns 3–6 give the asteroid's geocentric distance, apparent magnitude, expected diameter, and solar elongation, respectively. Except for the cases of Pallas and Juno, for which accurate occultation results are available (Wasserman *et al.* 1979; Millis *et al.* 1981), the listed diameters are taken from the TRIAD file (Bowell, Gehrels, and Zellner 1979). The AGK or SAO number of the star to be occulted is given in column 7, followed by the star's apparent magnitude in column 8. No occultations of stars unique to the Perth 70 catalog were found. The fractional change in brightness of the merged star-asteroid image expected at immersion is given in column 9. Asterisks in columns 4, 8, and 9 indicate that the listed values are for a blue passband. Otherwise, these values pertain to the visual spectral region. The expected maximum duration of the occultation, assuming the asteroid diameter given in column 5, is listed in column 10. The value of Q for an uncertainty in the predicted separation of star and asteroid at closest approach of 0.1 arcsec is given in column 11.

Nominal predicted ground tracks for several of the more promising occultations found in this search are plotted in Figs. 1–4. It must be emphasized that the lateral placement of these tracks is quite uncertain. Actual observations of a particular occultation should be attempted only after refined predictions based on photographic astrometry become available. The events whose tracks are shown in Figs. 1–4 are those on which, in the

TABLE II. Predicted occultations in 1984.

	Asteroid	U.T. date (1984)	Δ (a.u.)	m	Dia. (km)	Elong. (deg)	Star ID	m	ΔI	Dur. (sec)	ʔ	Approximate track location
#	4 Vesta	7.94 Jan	1.68	7.7*	555	148.0	+19°0410	10.5*	0.07*	61.8	0.44	See Track 1, Figure 1.
#	49 Pales	14.46 Jan	1.88	12.5*	175	166.7	+17°0918	10.5*	0.86*	14.5	1.56	South Pacific, Australia
#	165 Loreley	20.54 Jan	2.42	12.9*	228	154.6	+29°0711	9.4*	0.96*	17.9	1.54	Pacific Ocean, S.E. Asia
#	165 Loreley	20.63 Jan	2.42	12.9*	228	154.6	+29°0710	10.2*	0.92*	17.9	1.54	Pacific Ocean, Central Asia
#	41 Daphne	26.76 Jan	2.46	13.4*	204	126.8	+02°0536	8.3*	0.99*	23.4	1.75	See Track 2, Figure 1.
#	46 Hestia	29.19 Jan	2.09	13.8*	133	140.6	+03°1471	9.2*	0.99*	16.8	2.28	See Track 3, Figure 1.
#	349 Dembowska	6.86 Feb	2.21	11.5*	145	151.3	+15°1228	10.8*	0.66*	13.3	2.21	Australia
	704 Interamnia	17.52 Feb	3.65	12.3	338	56.0	186422	7.9	0.98	10.3	1.57	Pacific Ocean
#	9 Metis	19.06 Feb	1.52	10.8*	168	143.6	+06°1540	9.7*	0.73*	25.9	1.31	See Track 4, Figure 1.
	386 Siegena	23.18 Feb	3.28	13.4	203	83.3	141366	9.0	0.98	9.4	2.35	N.W. Africa
	31 Euphrosyne	25.00 Feb	2.80	12.7*	270	62.8	+24°0187	7.9*	0.99*	9.0	1.50	Central South America
	3 Juno	25.52 Feb	2.03	10.2*	267	74.8	+05°0364	9.1*	0.73*	9.1	1.10	Siberia, Laptev Sea
#	241 Germania	4.89 Mar	2.88	13.3	187	96.9	184336	3.1	1.00	14.6	2.25	China
#	27 Euterpe	13.25 Mar	1.21	10.3*	118	173.1	+08°1465	10.8*	0.38*	12.7	1.49	See Track 5, Figure 1.
	114 Kassandra	23.18 Mar	1.96	12.9	131	113.2	159989	8.5	0.98	21.1	2.18	British Isles, Atlantic Ocean
#	10 Hygiea	26.97 Mar	3.13	11.0	443	64.2	163443	8.9	0.87	14.5	1.03	See Track 6, Figure 1.
	201 Penelope	27.39 Mar	2.42	13.1	144	81.5	162170	8.6	0.98	6.0	2.44	USA, Caribbean
#	11 Parthenope	31.81 Mar	1.63	11.0*	155	167.6	+05°1701	11.5*	0.39*	13.1	1.52	See Track 7, Figure 1.
#	137 Meliboea	10.29 Apr	2.36	12.9	153	164.7	138680	8.0	0.99	10.4	2.24	Central South America, Hawaii
	326 Tamara	19.05 Apr	1.08	11.7	90	139.0	207516	8.8	0.93	7.6	1.74	Indian Ocean
#	128 Nemesis	2.07 May	2.13	12.1	191	159.2	139402	7.9	0.98	15.3	1.62	See Track 8, Figure 1.
#	230 Athamantis	11.43 May	1.55	11.1	116	159.1	158162	8.4	0.92	11.0	1.93	South Pacific, New Zealand
	326 Tamara	11.52 May	0.96	11.2	90	154.5	226309	9.5	0.83	7.3	1.55	New Guinea, Indonesia
	326 Tamara	15.99 May	0.95	11.1	90	155.4	226130	9.5	0.82	7.5	1.53	Africa, Atlantic Ocean
#	21 Lutetia	16.41 May	1.47	10.8	114	165.3	158714	9.1	0.82	10.9	1.87	See Track 9, Figure 1.
#	230 Athamantis	19.65 May	1.59	11.2	116	150.0	158099	8.9	0.89	13.0	1.98	China, Pacific Ocean
	47 Aglaja	2.02 Jun	2.35	12.8	156	86.0	146574	8.9	0.97	7.6	2.20	Indian Ocean
	326 Tamara	2.52 Jun	0.96	11.3	90	149.1	225520	9.8	0.79	9.5	1.54	New Guinea, Indonesia
#	602 Marianna	2.74 Jun	2.29	13.2	139	156.7	227909	8.5	0.99	10.6	2.39	New Zealand, Southern Africa
#	624 Hektor	2.81 Jun	5.66	16.2*	234	63.8	+07°0045	10.7*	0.99*	9.0	3.52	Australia
	70 Panopaea	4.04 Jun	1.28	11.1	153	141.5	211413	10.5	0.64	23.8	1.22	Indian Ocean
	326 Tamara	4.25 Jun	0.96	11.3	90	147.8	225478	9.3	0.86	10.0	1.54	See Track 10, Figure 1.
	13 Egeria	8.77 Jun	2.69	12.6*	245	61.7	+27°1026	9.9*	0.92*	7.3	1,59	Central Africa
#	209 Dido	14.69 Jun	2.12	13.0	137	138.6	189495	9.1	0.97	26.0	2.25	See Track 11, Figure 1.
#	145 Adeona	24.19 Jun	2.00	12.8	137	139.2	159236	9.0	0.97	18.6	2.11	South America
#	19 Fortuna	24.55 Jun	2.82	13.4*	226	77.8	+03°1496	7.2*	1.00*	10.3	1.81	Indonesia
#	209 Dido	30.27 Jun	2.02	12.7	137	154.4	189347	8.4	0.98	14.6	2.14	See Track 12, Figure 2.
#	139 Juewa	14.04 Jul	1.93	12.1	165	155.8	209985	8.3	0.97	15.0	1.69	North West Africa
#	211 Isolda	16.88 Jul	2.33	12.8	168	158.4	164173	9.1	0.97	14.4	2.02	Indonesia, Southern Africa
#	110 Lydia	18.32 Jul	1.58	11.2	102	167.3	211065	9.3	0.86	10.2	2.24	South America, South Pacific
#	94 Aurora	28.45 Jul	2.26	12.2	191	165.7	211730	9.6	0.91	14.8	1.71	South America, South Pacific
	326 Tamara	4.42 Aug	1.35	12.4	90	104.3	225490	8.5	0.97	8.3	2.17	New Guinea, Australia
#	87 Sylvia	8.74 Aug	2.29	11.7	251	159.2	211985	10.0	0.83	22.3	1.32	See Track 13, Figure 2.
	63 Ausonia	11.32 Aug	1.35	11.0	94	124.5	208918	8.2	0.93	18.9	2.08	South Pacific Ocean
	209 Dido	4.04 Sep	2.24	13.2	137	130.4	188498	9.2	0.97	32.8	2.36	See Track 14, Figure 2.
#	47 Aglaja	16.10 Sep	1.54	11.1	156	173.3	146599	8.7	0.90	15.8	1.43	See Track 15, Figure 2.
#	8 Flora	17.80 Sep	0.96	9.4*	160	147.2	-00°0197	10.2*	0.32*	42.7	0.87	See Track 16, Figure 2.
#	751 Faina	23.83 Sep	1.71	13.4*	113	104.5	+12°0512	11.1*	0.89*	11.4	2.21	S.E. Asia, Sri Lanka
#	7 Iris	25.28 Sep	1.36	9.7*	222	101.3	+26°0486	10.6*	0.31*	16.2	0.87	See Track 17, Figure 2.
#	334 Chicago	2.08 Oct	3.01	13.3	199	136.0	164723	9.0	0.98	33.9	2.19	N.W. Africa, Central South America
	201 Penelope	6.63 Oct	1.82	12.3	144	98.8	162800	8.7	0.97	9.5	1.83	Australia
#	804 Hispania	12.47 Oct	1.66	12.1*	175	157.5	+28°0199	9.4*	0.93*	15.1	1.37	Pacific Ocean, New Guinea
#	159 Aemilia	14.55 Oct	2.14	12.7	141	166.3	128970	9.0	0.97	11.1	2.20	Pacific Ocean, Indonesia
#	747 Winchester	15.64 Oct	1.56	12.1*	208	101.4	+02°0768	9.5*	0.92*	16.9	1.09	Pacific Ocean
	735 Marghanna	16.03 Oct	1.04	12.5*	75	154.0	+13°0253	11.4*	0.74*	8.5	2.01	Central Africa
	201 Penelope	17.62 Oct	1.95	12.4	144	91.2	163019	8.9	0.96	7.6	1.95	USSR
	790 Pretoria	21.62 Oct	2.34	13.7*	178	153.2	+27°0026	10.2*	0.96*	12.7	1.90	USSR
#	712 Boliviana	24.89 Oct	1.30	12.2*	128	142.1	+10°3214	10.7*	0.80*	17.0	1.47	Brazil, Atlantic Ocean
	790 Pretoria	8.23 Nov	2.45	14.0*	178	140.7	+24°0011	10.8*	0.95*	14.4	1.99	See Track 18, Figure 2.
#	238 Hypatia	12.01 Nov	1.79	12.8*	155	149.7	+06°0528	8.2*	0.99*	15.5	1.68	Africa, Middle East, South America
#	751 Faina	24.40 Nov	1.28	12.1*	113	167.8	+17°0426	11.1*	0.71*	10.1	1.64	See Track 19, Figure 2.
#	747 Winchester	28.26 Nov	1.26	11.4*	208	137.2	+01°0783	9.4*	0.86*	49.3	0.88	See Track 20, Figure 2.
#	40 Harmonia	3.93 Dec	1.35	10.8*	118	148.7	+22°0798	9.7*	0.74*	16.9	1.67	Central Africa
	345 Tercidina	15.67 Dec	1.72	13.5*	109	107.2	+03°0083	9.2*	0.98*	11.4	2.28	Indian Ocean, Indonesia
	184 Dejopeja	16.94 Dec	2.22	13.4*	132	178.1	+24°0505	11.8*	0.81*	9.6	2.44	Brazil, North Africa, India
	161 Athor	17.04 Dec	1.65	13.2*	100	162.6	+37°0733	10.5*	0.93*	7.9	2.39	USSR, Canada, USA
#	747 Winchester	26.00 Dec	1.21	11.0*	208	161.0	+04°0801	9.3*	0.83*	19.5	0.84	See Track 21, Figure 2.
#	111 Ate	30.80 Dec	1.36	11.3*	156	176.1	+26°0711	10.2*	0.74*	15.5	1.26	Indonesia, Africa, India
#	150 Nuwa	31.21 Dec	2.04	13.0*	137	175.3	+19°0654	10.0*	0.94*	10.3	2.15	South America

#Event independently identified by Taylor (1981, 1983).
*Values are for the blue spectral region.

TABLE III. Predicted occultations in 1985.

Asteroid	U.T. date (1985)	Δ (a.u.)	m	Dia. (km)	Elong. (deg)	Star ID	m	ΔI	Dur. (sec)	Q	Approximate track location
40 Harmonia	1.51 Jan	1.29	10.4*	118	175.3	+23°0674	10.1*	0.58*	11.1	1.58	See Track 1, Figure 3.
6 Hebe	3.32 Jan	1.29	9.4*	206	160.3	+06°0699	8.6*	0.67*	18.5	0.91	See Track 2, Figure 3.
144 Vibilia	6.59 Jan	1.62	12.5*	132	113.6	+13°0205	9.7*	0.93*	14.6	1.78	Japan, S.E. Asia, India
97 Klotho	10.81 Jan	1.43	10.9	109	108.6	130148	8.0	0.94	9.3	1.90	See Track 3, Figure 3.
206 Hersilia	18.06 Jan	1.79	13.5*	111	141.2	+18°0426	9.0*	0.98*	19.0	2.33	See Track 4, Figure 3.
488 Kreusa	19.86 Jan	1.70	12.1*	168	169.2	+30°0857	10.9*	0.75*	14.6	1.47	S.E. Asia, Central Asia, Greenland
747 Winchester	22.33 Jan	1.35	11.5*	208	148.1	+10°0705	7.5*	0.98*	20.6	0.94	Pacific Ocean
19 Fortuna	30.46 Jan	3.17	12.8	226	59.0	184542	8.9	0.97	7.1	2.04	Pacific Ocean
8 Flora	31.02 Jan	1.72	11.0*	160	83.8	+08°0252	10.9*	0.52*	6.7	1.56	South America, Atlantic Ocean
488 Kreusa	1.21 Feb	1.72	12.3*	168	157.4	+31°0805	11.4*	0.70*	17.1	1.49	See Track 5, Figure 3.
7 Iris	16.88 Feb	1.45	10.0*	222	112.2	+19°0439	6.5*	0.96*	23.3	0.95	See Track 6, Figure 3.
372 Palma	18.50 Feb	1.70	11.7*	196	172.4	+05°1522	8.4*	0.96*	13.2	1.26	Pacific Ocean, New Guinea
93 Minerva	25.52 Feb	2.15	12.3	170	102.7	183414	9.2	0.95	13.1	1.84	Pacific Ocean, Hawaii
53 Kalypso	27.04 Feb	1.31	12.0*	110	177.6	+10°1352	10.8*	0.74*	11.2	1.73	See Track 7, Figure 3.
454 Mathesis	3.16 Mar	1.41	12.8*	88	171.4	+13°1129	10.3*	0.91*	8.7	2.33	South America
51 Nemausa	4.97 Mar	1.52	12.0*	156	126.1	+11°0848	10.0*	0.86*	28.4	1.41	See Track 8, Figure 3.
29 Amphitrite	4.99 Mar	2.27	10.9	199	106.8	183620	8.8	0.87	23.4	1.66	Middle East, Indian Ocean
375 Ursula	5.97 Mar	2.44	12.5	200	154.9	157187	8.9	0.96	14.9	1.77	S. Atlantic Ocean, Indian Ocean
454 Mathesis	12.88 Mar	1.41	12.9*	88	168.2	+13°1117	9.9*	0.94*	8.8	2.32	Indian Ocean, Africa
24 Themis	27.65 Mar	3.58	13.8*	249	47.2	+19°0266	8.9*	0.99*	6.9	2.08	Central Asia
85 Io	2.79 Apr	1.86	11.8	149	155.2	158545	8.8	0.94	14.0	1.81	Ocean south of Africa
129 Antigone	11.12 Apr	2.00	12.2*	113	121.9	+20°1138	10.5*	0.83*	84.1	2.55	See Track 9, Figure 3.
275 Sapientia	15.09 Apr	1.38	11.7	107	172.1	139564	6.8	0.99	11.7	1.86	See Track 10, Figure 3.
12 Victoria	21.88 Apr	1.19	10.0	135	162.4	183095	9.0	0.71	17.1	1.28	Africa, Indian Ocean
# 4 Vesta	23.15 Apr	1.21	6.5*	555	166.4	+01°1597	9.6*	0.05*	61.9	0.32	Ocean south of S. America, Antarctica
372 Palma	28.21 Apr	2.36	13.2*	196	110.0	+02°1302	9.9*	0.96*	30.0	1.74	Pacific Ocean
# 4 Vesta	16.27 May	1.27	6.9*	555	145.9	+01°1574	10.3*	0.04*	93.5	0.33	Central America, Caribbean
165 Loreley	31.58 May	3.00	13.0	228	91.7	137693	9.0	0.98	16.1	1.90	Indian Ocean
471 Papagena	6.49 Jun	2.19	11.5	145	125.1	189954	9.2	0.89	20.1	2.19	See Track 11, Figure 3.
46 Hestia	21.39 Jun	1.61	12.1	133	151.8	159657	9.1	0.94	15.4	1.76	Pacific Ocean
128 Nemesis	6.74 Jul	1.69	11.1	191	170.4	188456	9.0	0.87	17.4	1.28	See Track 12, Figure 4.
602 Marianna	16.54 Jul	2.00	13.5*	139	98.6	+11°0078	10.9*	0.92*	8.3	2.09	South Pacific Ocean
192 Nausikaa	18.27 Jul	1.24	10.6	99	115.3	128570	8.7	0.86	10.3	1.81	South America
145 Adeona	20.12 Jul	2.12	12.9	137	151.2	190822	5.4	1.00	11.5	2.25	South America, Africa
# 10 Hygiea	21.72 Jul	3.21	12.1*	443	89.6	+14°0146	10.2*	0.85*	30.4	1.05	Indonesia, Pacific Ocean
# 4 Vesta	28.28 Jul	1.94	7.3	555	87.5	139767	9.0	0.18	27.4	0.51	See Track 13, Figure 4.
21 Lutetia	9.30 Aug	1.79	12.2*	114	94.2	+12°0295	5.4*	1.00*	7.3	2.28	South America
250 Bettina	12.95 Aug	2.45	12.3	211	161.8	213017	8.2	0.98	15.0	1.68	Antarctica, Indian Ocean
230 Athamantis	25.50 Aug	1.31	11.2*	116	154.4	+11°2891	9.1*	0.88*	15.0	1.63	Pacific Ocean, Japan, China
211 Isolda	25.89 Aug	2.27	13.5*	168	105.4	+20°0262	9.0*	0.99*	16.5	1.96	Africa, India, China
216 Kleopatra	26.77 Aug	1.76	11.8*	236	94.5	+21°0339	10.5*	0.77*	13.3	1.09	Japan, Asia, India
70 Panopaea	27.65 Aug	2.59	14.0*	153	83.2	+22°0441	10.0*	0.98*	8.4	2.45	Pacific Ocean, New Guinea
230 Athamantis	1.20 Sep	1.28	11.1*	116	159.8	+11°2882	10.3*	0.68*	13.4	1.60	See Track 14, Figure 4.
18 Melpomene	7.88 Sep	1.88	11.2*	164	74.3	+13°0527	8.5*	0.92*	6.2	1.67	Western Australia, Indian Ocean
230 Athamantis	7.90 Sep	1.27	11.1*	116	163.4	+10°3151	9.8*	0.76*	12.6	1.59	India, Africa
137 Meliboea	9.44 Sep	1.83	12.3	153	113.6	142583	8.3	0.98	15.5	1.73	Pacific Ocean
386 Siegena	9.85 Sep	1.48	10.3	203	177.9	146494	8.7	0.81	15.8	1.06	Indian Ocean, Indonesia
# 4 Vesta	12.93 Sep	2.44	7.7	555	61.6	159188	7.5	0.55	16.4	0.64	South Atlantic Ocean
185 Eunike	18.23 Sep	2.34	12.4	188	86.2	132709	8.5	0.97	9.0	1.81	Antarctica
81 Terpsichore	21.72 Sep	1.85	13.4*	122	100.5	+30°0481	10.8*	0.92*	8.5	2.21	Asia
70 Panopaea	26.55 Sep	2.25	13.7*	153	107.5	+24°0442	8.4*	0.99*	22.3	2.13	Western USA, Pacific Ocean
105 Artemis	28.36 Sep	1.52	12.1*	129	177.8	+03°0027	9.5*	0.92*	8.8	1.71	Pacific Ocean, Alaska, Canada
196 Philomela	30.88 Sep	2.40	11.8	162	121.3	189888	9.0	0.93	55.7	2.14	See Track 15, Figure 4.
18 Melpomene	5.10 Oct	1.66	10.9*	164	89.4	+11°0746	9.8*	0.74*	9.3	1.47	Africa, Atlantic Ocean
230 Athamantis	9.51 Oct	1.36	11.4*	116	144.1	+05°3290	9.0*	0.90*	17.7	1.69	Asia, Indonesia
33 Polyhymnia	17.55 Oct	1.00	10.9*	62	178.3	+10°0167	8.5*	0.90*	9.8	2.36	Asia, Alaska
2 Pallas	24.68 Oct	1.80	8.3	538	107.2	171571	6.5	0.84	33.8	0.45	Pacific Ocean
471 Papagena	26.64 Oct	2.39	11.6	145	88.1	212168	9.3	0.90	8.3	2.38	Middle East
584 Semiramis	27.62 Oct	0.91	11.3*	57	158.0	+34°0217	9.2*	0.87*	8.9	2.32	Asia
159 Aemilia	31.38 Oct	2.34	13.9*	141	107.3	+16°0769	9.6*	0.98*	16.9	2.41	See Track 16, Figure 4.
70 Panopaea	5.14 Nov	1.90	13.0*	153	148.4	+26°0449	8.5*	0.99*	14.1	1.80	See Track 17, Figure 4.
521 Brixia	10.50 Nov	1.81	13.1*	136	99.3	+20°1039	9.0*	0.98*	10.6	1.93	See Track 18, Figure 4.
107 Camilla	12.41 Nov	2.57	12.9*	252	144.5	-00°0116	11.1*	0.84*	28.1	1.47	Siberia, Sea of Japan, Korea
15 Eunomia	23.62 Nov	1.33	9.3*	261	137.3	+25°0092	11.3*	0.14*	45.7	0.74	New Guinea, Australia, Pacific Ocean
790 Pretoria	25.61 Nov	2.81	14.2*	178	163.8	+21°0499	9.5*	0.99*	10.7	2.29	Pacific Ocean, Indonesia
18 Melpomene	29.47 Nov	1.24	10.1*	164	134.4	+07°0976	9.9*	0.56*	45.7	1.10	See Track 19, Figure 4.
128 Nemesis	1.13 Dec	2.91	12.8	191	56.9	189508	9.3	0.96	5.5	2.20	South America
115 Thyra	7.00 Dec	1.59	12.0*	95	95.6	+08°3182	8.5*	0.96*	5.8	2.43	South America
89 Julia	9.34 Dec	1.54	11.0*	168	155.4	+42°0724	10.3*	0.65*	14.9	1.33	See Track 20, Figure 4.
89 Julia	20.60 Dec	1.53	10.9*	168	162.0	+41°0629	8.9*	0.86*	13.4	1.32	Pacific Ocean, Japan, S.E. Asia
602 Marianna	29.60 Dec	2.05	13.6*	139	97.5	+21°0039	9.0*	0.99*	8.6	2.13	Japan, Asia
18 Melpomene	30.08 Dec	1.17	9.6*	164	164.7	+08°0871	10.2*	0.37*	16.2	1.03	See Track 21, Figure 4.

#Event independently identified by Taylor (1981, 1983).
*Values are for the blue spectral region.

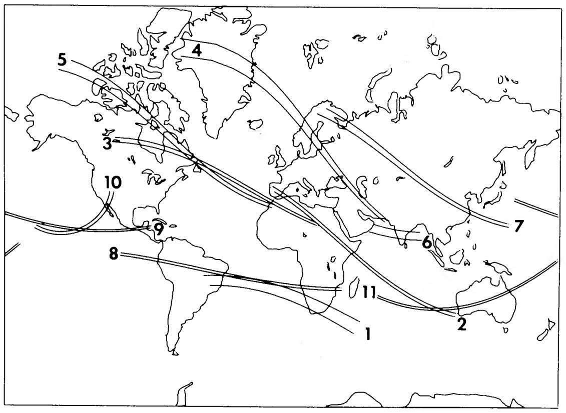

FIG. 1. Nominal ground tracks of selected occultations occurring in 1984. (1) Vesta, 7 January; (2) Daphne, 26 January; (3) Hestia, 29 January; (4) Metis, 19 February; (5) Euterpe, 13 March; (6) Hygiea, 26 March; (7) Parthenope, 31 March; (8) Nemesis, 2 May; (9) Lutetia, 16 May; (10) Tamara, 4 June; (11) Dido, 14 June. See Table II for additional details about the individual events.

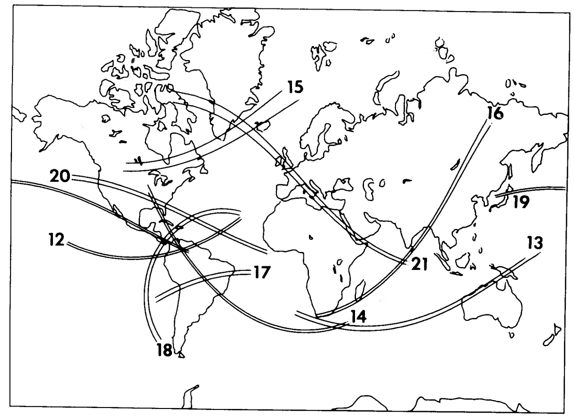

FIG. 2. Nominal ground tracks of selected occultations occurring in 1984. (12) Dido, 30 June; (13) Sylvia, 8 August; (14) Dido, 4 September; (15) Aglaja, 16 September; (16) Flora, 17 September; (17) Iris, 25 September; (18) Pretoria, 8 November; (19) Faina, 24 November; (20) Winchester, 28 November; (21) Winchester, 26 December. See Table II for additional details about the individual events.

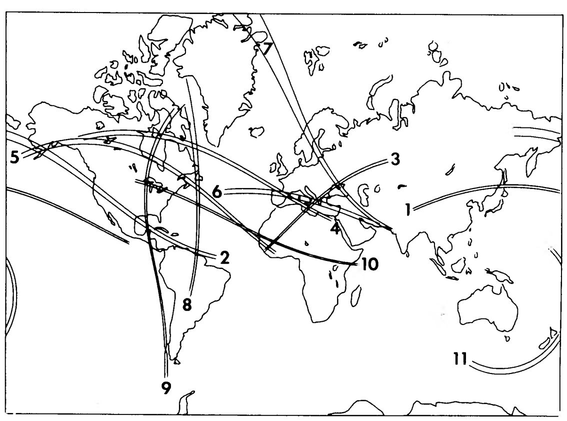

FIG. 3. Nominal ground tracks of selected occultations occurring in 1985. (1) Harmonia, 1 January; (2) Hebe, 3 January; (3) Klotho, 10 January; (4) Hersilia, 18 January; (5) Kreusa, 1 February; (6) Iris, 16 February; (7) Kalypso, 27 February; (8) Nemausa, 4 March; (9) Antigone, 11 April; (10) Sapientia, 15 April; (11) Papagena, 6 June. See Table III for additional details about the individual events.

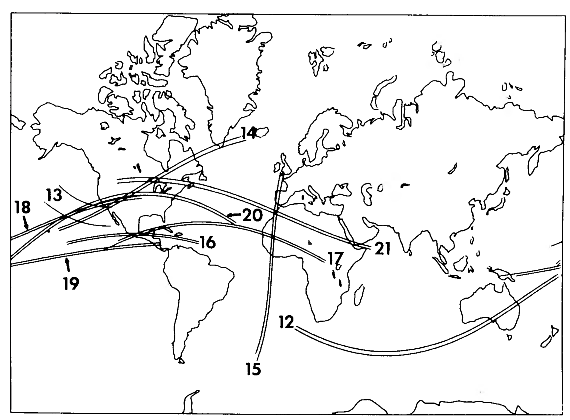

FIG. 4. Nominal ground tracks of selected occultations occurring in 1985. (12) Nemesis, 6 July; (13) Vesta, 28 July; (14) Athamantis, 1 September; (15) Philomela, 30 September; (16) Aemilia, 31 October; (17) Panopaea, 5 November; (18) Brixia, 10 November; (19) Melpomene, 29 November; (20) Julia, 9 December; (21) Melpomene, 30 December. See Table III for additional details about the individual events.

authors' opinion, the refinement efforts should be concentrated.

Many of the events in Table II and a few of those in Table III have been independently identified by Taylor (1981, 1983). These events are marked by the number sign (#). While the overall agreement between the two sets of predictions is good, there are noteworthy differences. Taylor's list contains three occultations missing from the present results because of our more stringent limits on Q. In a few other instances we have apparently used slightly different orbits. Finally, Taylor predicts occultations involving 194 Prokne, 212 Medea, and 365 Corduba—objects excluded from the present search because of the poor quality of their orbits.

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