Occultation Newsletter

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NOTICE TO LUNAR OCCULTATION OBSERVERS

L. V. Morrison

On 1981 January 1 the international centre for the receipt of timings of occultations of stars by the Moon will be transferred from HM Nautical Almanac Office, Royal Greenwich Observatory, England to Astronomical Division, Hydrographic Department, Japan. From that date observers should send their lunar occultation reports and any correspondence connected with lunar occultations to the following address:

Astronomical Division
Hydrographic Department
Tsukiji-5
Chuo-ku, Tokyo
104 JAPAN

The layout of the report form may be changed a little and observers should write to the Hydrographic Department for new forms. During this change-over period it is important that observers should give their full postal address, positions and descriptions of their telescopes on the report forms, otherwise there may be considerable delay in reducing their observations.

Observations of occultations of stars by planets, satellites or minor planets should continue to be sent to HM Nautical Almanac Office.

FROM THE PUBLISHER

For subscription purposes, this is the fourth and final issue of 1980.

O.N.'s price is $1/issue, or $4/year (4 issues) including first class surface mailing, and air mail Mexico. Air mail is extra outside the U.S.A., Canada, and Mexico: $1.20/year in the Americas as far south as Colombia; $1.68/year elsewhere. Back issues also are priced at $1/issue. Please see the masthead for the correct ordering address.

IOTA membership, subscription included, is $7/year for residents of North America (including Mexico) and $9/year for others, to cover costs of overseas air mail. European (ordinarily excluding Spain and Portugal) and U. K. observers should join IOTA/ES, sending DM 12.-- to Hans J. Bode, Bartold-Knaust Str. 8, 3000 Hannover 91, German Federal Republic. Spanish, Portuguese, and Latin American occultation observers ordinarily may have free membership in IOTA/LAS, including *Occultation Newsletter en Español*, by contacting Sr. Francisco Diego Q., Ixpantenco 26-bis, Real de los Reyes, Coyoacán, Mexico, D.F., Mexico. Currently, however, the Latin American Section is experiencing problems with funding, and for the time being, it may be necessary for would-be IOTA/LAS members to subscribe to the English-language edition of *O.N.*, or to join the parent IOTA.

IOTA NEWS

David W. Dunham

As of 1981 January 1, H. M. Nautical Almanac Office, at the Royal Greenwich Observatory, England, will discontinue collecting observations of lunar occultations. After that date, observers should send their reports to the new International Occultation Centre in Japan, as described in this issue's lead article. This poses a problem for 1980 reports, since most observers have been filling out their HMNAO occultation report forms as they make their observations, and new report forms have been designed by the I.O.C. Any reports sent to HMNAO will simply be sent on to Japan. Since the I.O.C. report forms are rather similar to HMNAO's, the I.O.C. might accept reports, for 1980 only, on HMNAO's forms. I have written to the I.O.C. asking if this is all right, and hope to publish their reply in the next issue, which we hope to distribute early in February. In the meantime, you might hold onto your 1980 data until we publish the decision. Also, the new I.O.C. report forms should be available by then, so that if you have not already filled out an HMNAO form, you could use the new forms instead. In any case, start using I.O.C. forms as soon as possible.

Guillermo Mallén reports continued difficulties with high demand for use of the computer at the Universidad Nacional Autonoma de Mexico, so that graze predictions for Latin American section members are still available only through membership in the main I.O.T.A. Mallén is applying for resumed support of IOTA/LAS operations in Mexico City, hoping for computer access perhaps in April, hopefully in time to compute graze predictions for the second half of 1981. If you need the *total* occultation predictions for 1981 which were originally supplied by Mállen, write to me at P. O. Box 488, Silver Spring, Maryland 20907, U.S.A. If there is a large demand for such predictions, I will send magnetic tape data for Latin America to Walter Morgan so that he can supply them.

The American Ephemeris and Nautical Almanac has been substantially revised for 1981, and renamed *The*

Astronomical Almanac, published jointly by the Royal Greenwich and U. S. Naval Observatories. There is an error in the 1981 edition: The ephemerides given for the four main minor planets are labelled as "astrometric, 1950" when in fact they are apparent of date. Starting with the 1982 edition, these ephemerides actually will be astrometric, 1950.

The errors in USNO's X7 catalog, described in *o.N. 2* (6) 58-60, have still not been corrected. Hence, the magnitude of X05404 is still given as 5.8 in the USNO total occultation predictions for 1981, although the star's magnitude is actually 11.3. Thomas Van Flandern has recently programmed a method for updating information about non-SAO stars in the X7 catalog. Sometime during the next few months, I plan to write a program to read my magnetic tape of K - XZ matched data and generate input data to correct the bad magnitudes and spectral types in the current version of the XZ. So if X05404 is occulted during 1982, its magnitude should be listed correctly as 11.3 in the USNO predictions for that year.

Our first publication on Solar variations from eclipses, "Observations of a Probable Change in the Solar Radius Between 1715 and 1979," has appeared in *Science 210* (4475) 1243-1245, issue of 1980 December 12. We have not yet received reprints, but a large supply should be available soon, hopefully to be announced in the next issue of *o.N.* Copies will be sent to all observers who reported observations, or otherwise were involved in the effort, near the edges of the 1976 and 1979 total eclipse paths. More recent analyses were mentioned on p. 102 of the last issue, but further more refined calculations have shown no significant variation between the total eclipses of 1979 and 1980, but perhaps a small expansion from 1976 to 1979. J.H Parkinson, L.V. Morrison, and F.R. Stephenson have published an analysis of central eclipse timings in a paper, "The Constancy of the Solar Diameter over the Last 250 Years," in a recent issue of *Nature*. They found no significant variation, but their observational errors are greater than ours since their method does not have the advantage of the grazing geometry and is much more strongly affected by random and libration-dependent systematic errors in Watts' Lunar limb correction data. They point out that our result depends largely on the rather uncertain location of the observer at the northern limit of the 1715 eclipse. However, we have recently found well-documented observations at both edges of the path of the 1925 January 24th total eclipse, analysis of which reveals a Solar radius over 0.″6 larger than that derived from the recent eclipses, and slightly larger than the value we derived for 1715. The 1979 eclipse occurred three Saros cycles after the 1925 eclipse, so the geometry and librations were similar. In 1979, two contacts and one bead event were produced by three Lunar valleys which produced three of the four defining contacts in 1925. An analysis of just these three 1979 events confirms our earlier analysis of a correction near zero to ·0.″2 accuracy, and we have a similar less accurate result from three 1980 eclipse bead timings. It appears that we have strong evidence for a substantial decrease of the Solar radius from 1925 to the present. The variations do not seem to be secular, but rather may be irregular or partly periodic, perhaps with time scales of tens of years, perhaps related to the sunspot cycle.

The inclusion of K-catalog stars in the regular USNO total occultation predictions for 1981 was mentioned in the last issue. The calculation of J-catalog predictions for 1981 will be delayed until February, to allow time to create a new catalog with Praesepe-cluster stars, more southern stars from the Southern Astrographic Catalog project, and more northerly stars in the northern Milky Way from the Astrographic Catalog. These stars are not in the current J-catalog, but begin to be occulted during 1982 as the Lunar node regresses. The delays in doing this work have resulted from the usual new-year prediction crunch, greater this time due to the much larger number of planetary occultations during 1981, and my involvement with favorable but time-consuming asteroidal occultation observations late in 1980.

John Phelps produced and distributed the very useful IOTA membership list of 1980 September. I found only a few errors, such as "Chris Aikhan" (should be "Chris Aikman"). Dr. A. A. Nefedjev, who computed graze predictions for Soviet observers, died a few years ago. Just after the list was produced, Richard Nolthenius moved to 1137 N. Clark, Apt. 5, still in West Hollywood, CA, and Derald Nye moved to Route 7, Box 511, Tucson, AZ 85706. The geographical listing in Part II should be most useful for contacting other observers in your area.

Byron D. Groves, 601 N. Parkcenter Dr., Suite 101, Santa Ana, CA 92705, wrote to me in September asking again if I.O.T.A. would like to meet with the Western Amateur Astronomers in Orange, CA, from 1981 July 23 to 26, and assumed that we would not if he had no reply by Thanksgiving. I had hoped that this issue would have been distributed before then, to see if there was any interest in at least a regional IOTA meeting. I did not reply, since the dates conflict with a possible trip to observe the 1981 July 31 Solar eclipse, and the distance is too great for the other IOTA officers. If there is some local interest, an at least informal regional IOTA session might still be arranged.

Last August 12th, Russ Genet, M. D. Overbeek, Wayne Warren, Mark Trueblood, and I met in Silver Spring, MD, to discuss photometry of occultations. Russ Genet, 1247 Folk Rd., Fairborn, OH 45324, phone 513, 879-4583, is co-editor of the *I.A.P.P.P.C.* (*International Amateur-Professional Photoelectric Photometry Communication*), the 2nd issue (1980 Sept.) of which contained a summary of their first annual symposium held in Dayton and Fairborn just before the 1980 Apollo Rendezvous in June, short sketches of the backgrounds of the first 51 members of I.A.P.P.P., and articles with titles such as "A Solid State Photometer," "A Photoelectric Data Reduction Program in BASIC for Microcomputers," and "High Speed Spectroscopy of Algol Systems."

The next issue will be published a few weeks after this issue, and will contain mainly several reduction profiles of grazing occultations, finder charts and maps for some of the early 1981 planetary occultations, and probably less text than this issue. Articles on new double stars and on grazes reported to IOTA may be delayed until the following issue #12 scheduled for early April, with a mid-March deadline for receipt of material by DaBoll. Joseph Carroll, Minnetonka, MN, hopes to have occultation tallies for two or more recent years ready for that issue. He notes that his tally work is considerably facilitated if observers put their HMNAO station/observer/telescope codes on their annual occultation count coupon.

GRAZING OCCULTATIONS

David W. Dunham

Reports of observations of grazing occultations should be sent to me at P. O. Box 488, Silver Spring, Maryland 20907, U.S.A. If possible, a copy of the report should be sent to the International Occultation Centre (I.O.C.), Astronomical Division, Hydrographic Department, Tsukiji-5, Chuo-ku, Tokyo, 104 Japan, and it should be stated on the report whether or not a copy was sent to the I.O.C. If no such indication is given, it will be assumed that no copy was sent, and I will make and send a copy to I.O.C. Graze reports should no longer be sent to H. M. Nautical Almanac Office at the Royal Greenwich Observatory, England. I have quite a few reports of 1980 grazes which need to be sent to the I.O.C., and am looking for a volunteer to transcribe these reports onto the new I.O.C. forms.

In late October, the I.O.C. sent copies of their proposed report forms to H.M.N.A.O. and to U.S.N.O asking for comments. I got a copy of USNO's copy and wrote a letter to I.O.C. enclosing a copy of IOTA's form, and suggested several relatively mino modifications that could be made to include all of the information now requested on IOTA's form. Even if they do not change their form, a large are is provided for comments, and part of this can be blocked into specific columns for any of the additional information which IOTA may want. In any case, IOTA will soon abandon its current forms for grazes and use the finally-adopted I.O.C. form, pe haps adding some columns in the comments section a noted above. When the new forms become available, they will be distributed first to active graze observers and later to all IOTA members.

The corrections to the USNO graze predictions described on pages 95 and 96 of the last issue should no longer be applied; they have been taken care of with changes to the ACLPPP profile printing progra sent to all computors for the 1981 predictions.

PLANETARY OCCULTATION PREDICTIONS

David W. Dunham

Predictions of occultations of stars by major and minor planets, all but one during 1981, are given in two tables. They are like the tables described in *o.n.* 2 (2) 16-18, except that in the second table, the geocentric angular velocity of the object in degrees/day is listed with the position angle of motion under the common heading "Motion," and the taxonomic type of asteroids is given in a new column between the columns for the radius of sphere of influence (RSOI) and motion.

The taxonomic types are those given in the Tucson Revised Index of Asteroid Data (TRIAD) as published in the book *Asteroids* (see p. 104 of the last issue) and are described on pages 783-806 of that book. Based on new comprehensive observations, the type of (216) Kleopatra has been revised to "M." The types are determined mainly from observations of albedo (reflectance) and spectral characteristics (color), and are named from meteorites with similar properties. Hence, specific mineralogies are implied, which may not be completely correct. But most asteroids of a given type probably do have similar compositions. The six types are described below:

C low albedo, carbonaceous
S moderate albedo, silicate
M moderate albedo, metallic
E high albedo, enstatite achondrites
R moderate to high albedo, red (iron silicates)
U unusual, not in the other five categories

Composite types, such as "CMEU," only mean that the observations exclude the other types.

A complete description of the S-column in the second table (source of star's position) was given in *o.n.* 2 (7) 62-63.

Most of the events in the table were found by Gordon Taylor at the Royal Greenwich Observatory and published in his Bulletin 20 of I.A.U. Commission 20's Working Group on Predictions of Occultations by Satellites and Minor Planets. Derek Wallentinsen, comparing the SAO catalog manually with astrometric ephemerides supplied by me, found the events on the following 1981 dates and published predictions of them in *Contribution* No. 2 of the James-Mims Observatory (see p. 104 of the last issue): Jan. 23, March 6 (216 Kleopatra), March 19, June 26, July 2, July 15, Nov. 28 (624 Hektor), and Dec. 14. He also independently found many of the events listed by Taylor, and also found ten events which miss the Earth by less than one arc second, so that, due to star position or ephemeris error, an occultation may be visible from the Earth's surface, most likely in the polar regions. Taylor found two of his events, those on Jan. 26 and on Sept. 19, after he had issued Bulletin 20, so he sent predictions for those events to observers later. The occultation by Venus on Nov. 17 was first publicized by Jean Meeus; Steve Albers found the occultation by Mercury.

About half of the asteroidal ephemerides I use are computed from osculating orbital elements computed by Paul Herget at Cincinnati Observatory and published in the *Minor Planet Circulars* in 1978 (Nos. 4361-4390) and in 1979 (Nos. 4824-4825). Most of the others were calculated at the Leningrad Institute of Theoretical Astronomy (I.T.A.) and published in the *Ephemerides of Minor Planets* (E.M.P.) for 1980 or 1981. For many events, elements from both sources are available, so that I can make two separate predictions. For events on the following dates, the ephemerides differ by less than 0".4 and less than 2.5 minutes in time, smaller than the expected errors relative to the occulted stars: Jan. 23, Feb. 1 (18 Melpomene), March 6 (54 Alexandra), March 19, April 2 (36 Atalante), April 4 (83 Beatrix), April 15, April 20, April 26 (13 Egeria), April 29, May 11, May 14, May 17, May 20, May 21, May 26, May 30, Aug. 9 (354 Eleonora), Aug. 26 (70 Panopaea), Sept. 6, Oct. 7, Nov. 2, Nov. 18, Nov. 28 (16 Psyche), and Dec. 14. Larger ephemeris differences are given in Table 3, in the sense I.T.A. minus Herget, except for one noted case. The value in the shift column gives the path differences in arc seconds measured perpendicular to the asteroid's geocentric motion; the letter following it tells which direction the occultation path will be displaced on the Earth's surface from the nominal (usually Herget) prediction. The value in the Δt column tells whether the geocentric time of closest approach will be early (negative) or late (positive) in minutes relative to the nominal prediction. Some of the differences were so large that comparisons were made with mid-1970's observations published in recent numbers of *Minor Planets and Comets*, in particular, for minor planets 409, 476, 617, and 790.

For (409) Aspasia, the observations clearly favor Herget's orbit over the I.T.A. orbit, which was used by Taylor for his consequently incorrect prediction. The computed positions for (476) Hedwig using both available I.T.A. orbits (Herget did not compute one) disagree with the observations by over one arc minute, hopelessly inadequate for asteroid occultation

DATE 1980	UNIVERSAL TIME	PLANET NAME	PLANET m_v	PLANET Δ,AU	STAR SAO No	STAR m_v	STAR Sp	STAR R.A.(1950)	STAR Dec.	OCCULTATION Δm	OCCULTATION Dur	OCCULTATION df	OCCULTATION P	Possible Area	El SUN	MOON El	MOON %Snl	MOON Up
Dec 11	10^h49^m-106^m	Jupiter	-1.2	5.66	138920	8.6	A0	$12^h27^m.8$	-1°40'	0.0	110^m	22	2	North America	72°	117°	15+	none
1981																		
Jan 5	10 42	Semele	13.3	2.17	109752	9.2	F8	1 12.1	3 31	4.1	6^s	16	28	s.e. Australia; New Zealand?s	93	104	1-	none
Jan 8	2 08-20	Nysa	10.4	1.59	119165	9.0	G0	11 58.4	2 09	1.7	7	27	34	s. Europe, Mideast	108	130	4+	none
Jan 23	19 20	Daphne	12.1	2.80	160962	9.2	K5	17 56.4	-12 08	3.0	4	7	20	Aleutian Islands	36	103	87-	all
Jan 26	7 05-14	Corduba	13.3	1.89	111635	8.9	K2	4 07.2	4 15	4.4	14	34	26	Hawaii, w. U.S.A.	114	134	67-	e125°W
Jan 28	7 43	Mercury	-0.8	1.08	164713	5.1	F0	21 50.6	-13 47	0.0	103	4	1	e. Siberia, Hokkaido	18	106	49-	none
Feb 1	3 01	Melpomene	11.3	3.14	161626	9.2	A0	18 31.9	-16 10	2.2	3^s	8	31	Caspian Sea area; Mideast?s	35	13	15-	all
Feb 1	17 40	Neptune-R?	8.0	30.92		13.4		17 32.6	-21 59	.16	33^m	43	1	e. Australia	49	10	11-	e140°E
Feb 5	3 33	Minerva	12.5	3.07	187067	9.2	G0	18 34.8	-29 43	3.4	4^s	8	26	e. equatorial Africa	39	41	0+	all
Feb 12	1 12	Metis	11.6	2.75	184474	9.0	K0	16 32.0	-20 02	2.7	7	13	24	S. Africa	73	167	54+	none
Feb 18	12 31	Julia	11.2	2.96		10.2	F8	23 12.9	4 29	1.4	3	7	26	e. Tibet	23	151	100+	all
Feb 24	5 35	Pandora	13.1	3.14	185534	9.1	K5	17 32.7	-28 55	4.1	7	13	25	southern S. America	71	51	75-	all
Feb 26	10 50	Arethusa	12.8	2.56	94045	8.3	K2	4 35.5	15 25	4.5	10	20	22	e.China. s Japan, Hawaii (low)	92	171	56-	e162°W
Mar 6	1 37-76	Alexandra	13.0	2.65	79033	8.7	K0	7 01.2	26 14	4.3	40	73	22	n.w.Africa, e.Brazil, Iberia?n	119	123	0-	none
Mar 6	8 18	Kleopatra	11.5	2.62	110447	8.8	G0	2 14.2	9 33	2.8	3	8	29	New Zealand (North Island)	49	50	0+	none
Mar 9	1 56	Hesperia	13.4	3.82	162369	9.4	F5	19 12.5	-14 38	4.0	4	13	51	S. Africa?n	61	97	10+	none
Mar 13	14 14	Parthenope	11.4	2.44	161895	9.4	B9	18 47.7	-19 43	2.2	5	11	23	New Zealand (South Island)	71	168	56+	none
Mar 19	11 41	Doris	11.4	2.10	118832	9.0	K2	11 21.9	2 12	2.5	12	22	20	n. central U.S.A., w. Canada	172	7	99+	all
Mar 25	21 21	Laetitia	10.9	2.17	139976	9.1	K0	14 28.1	-2 53	2.9	15	28	20	S. Africa	147	27	77-	e 6°E
Apr 2	0 39-47	Winchester	13.2	2.83	100625	7.4	K0	13 31.9	14 22	5.8	12	19	20	cen.USSR;eEurope,Scandinavia?s	158	134	11-	e 55 E
Apr 2	19 42-56	Atalante	13.9	2.74	205907	9.3	F8	14 42.4	-32 36	4.6	9	24	32	n. Australia, S. Africa	141	114	6-	e125 E
Apr 4	10 03-10	Aegina	12.9	1.84	158864	8.6	F8	14 49.3	-17 37	4.3	12	31	25	n. U.S.A. and s. Canada	149	143	0-	none
Apr 4	18 14	Beatrix	13.8	3.45	92925	9.0	F8	2 21.8	15 28	4.8	3	8	43	s. central Europe	24	26	0+	none
Apr 7	16 20	Pallas	9.1	2.82	130921	8.3	K0	4 02.2	-6 54	0.9	13	8	8	cen. U.S.S.R.?s	47	22	12+	all
Apr 8	18 50	Semele	13.9	3.26	93474	8.4	K2	3 28.6	17 39	5.5	3	8	42	n. Africa, Mediterranean	36	20	22+	all
Apr 11	3 33	Aurora	13.2	3.26	58389	8.1	G5	5 41.5	30 36	5.1	7	12	25	s.e. Pacific	66	23	47+	all
Apr 15	1 44	Psyche	11.5	3.20	77370	9.1	A5	5 37.2	21 19	2.5	6	11	19	n.w. South America	60	73	84+	all
Apr 20	3 09-15	Atalante	13.7	2.63	205617	8.7	K2	14 27.1	-32 57	5.1	6	19	31	Iberia?s; maritime Canada(low)	157	23	99-	all
Apr 21	6 48-52	Ceres	8.5	2.52	60300	8.8	G5	7 40.2	30 25	0.6	48^s	15	4	w. central Pacific; Hawaii?n	81	119	96-	e165°W
Apr 26	19 45-55	Uranus	5.4	17.88		10.2		15 45.5	-19 37	.17	42^m	41	1	Australia, Asia, Africa	158	60	56-	e 55 E
Apr 26	22 30	Egeria	11.2	1.96	209303	8.9	B9	17 46.1	-34 05	2.4	30^s	34	12	China, India	128	35	55-	e 20 W
Apr 29	20 01	Vibilia	13.3	3.04	79051	8.3	K2	7 03.0	25 54	4.9	5	12	33	n. Africa; Mediterranean?n	65	125	25-	none
May 4	23 19	Minerva	12.0	2.15	190234	9.4	G5	21 16.7	-25 28	2.6	9	15	18	e. equatorial Africa	90	101	1+	none
May 9	8 12	Melete	14.0	3.13	97880	8.9	F0	8 28.7	12 55	5.1	7^s	18	32	Pacific Ocean; Hawaii?n	78	9	33+	all
May 10	12 18-27	Neptune	7.9	29.44		13.9		17 33.8	-21 57	.49	45^m	58	1	Pacific Ocean, Australia	145	129	46+	w170°E
May 10	22 39	Pallas	9.0	2.94	131847	6.2	G5	5 08.4	-2 19	2.8	11^s	7	8	Brazil; n.Chile, n.Argentina?s	36	67	50+	all
May 11	18 15	Daphne	12.2	2.02		10.6	F5	20 56.8	0 18	1.8	14	19	14	s.e. Australia?n; New Zealand	94	157	59+	none
May 13	7 08	Arethusa	13.4	3.56	95447	5.3	B9	6 12.5	16 10	8.1	4	9	31	central Pacific; Hawaii?n(low)	42	77	73+	all
May 14	7 51	Alexandra	13.6	3.60		11.3	K5	7 42.9	22 02	2.5	6	13	29	Alaska, n.w. Canada?n	61	68	81+	all
May 17	11 02	Bellona	12.9	3.30	146428	8.9	A2	22 56.9	-6 53	4.1	5	15	44	s.e. Pacific; s. Chile?s	73	124	98+	w 85°W
May 20	0 20	Patientia	12.5	3.20		10.3	A2	8 55.6	29 58	2.3	11	13	17	Newfoundland; Canary Islands?n	70	120	99-	all
May 21	7 38	Bellona	12.9	3.25	146472	9.2	K0	23 00.4	-6 38	3.7	5	16	43	n. South America	76	79	95-	all
May 22	15 33	Irene	11.8	2.86	165440	7.4	K0	22 58.8	-14 32	4.4	8^s	16	27	Papua,Queensland?s;s.w.Pacific	81	60	88-	all
May 24	8 17-23	Neptune-R?	7.9	29.33		14.8		17 32.4	-21 55	.09	38^m	49	1	Western Hemisphere	159	39	75-	e115°W
May 26	0 32-41	Hesperia	12.7	2.79	163084	8.9	F5	19 50.8	-10 14	3.8	23^s	71	37	southern Africa	126	29	59-	e 15 W
May 29	12 48-56	Parthenope	10.2	1.50	163352	8.6	K0	20 10.4	-17 2	1.9	65	101	14	s. Pacific	126	71	22-	e145 W
May 30	20 07-25	Hestia	11.7	1.58	159945	9.0	A0	16 26.8	-18 08	2.8	12	22	17	Indonesia, equatorial Africa	176	144	10-	
Jun 5	3 02-22	Antigone	10.2	1.39	142674	6.7	NB	18 47.6	-7 58	3.6	20	41	18	U.K.?s;s.e.Canada;s.e.U.S.A.?s	148	164	10+	w 80 W
Jun 5	23 43	Patroclus	16.5	6.29	61509	9.3	K0	9 25.6	36 29	7.2	6	17	57	Chile; n. South America?n	60	22	16+	3 35 W
Jun 7	5 48	Ate	12.8	2.67	98622	8.9	K0	9 28.4	12 05	3.9	5	10	25	south central Pacific Ocean	65	4	28+	all

searches, so that Taylor's event involving Hedwig on Nov. 1 probably will not be visible from the earth's surface (his prediction is consistent with one using the earlier I.T.A. orbit, where perturbations by only Jupiter and Saturn were computed). A similar situation exists for (790) Pretoria, which Taylor predicts will occult SAO 136602 on Jan. 18, consistent with an early I.T.A. orbit. Improved orbits published in E.M.P. for 1981 and also published by Herget, unlike the early orbit, agree with recent observations and show that the Jan. 18 shadow will miss the earth's surface by 7" or 15,000 km. The situation for (617) Patroclus is not so clear, since orbits by Herget and two by I.T.A. all satisfy late 1977 observations; the earlier I.T.A. orbit, used by Taylor and by me, gives residuals in declination of

DATE	MINOR PLANET No.	Name	km-diam.	"	RSOI	Type	MOTION "/Day	PA	STAR SAO No	DM No.	D	STELLAR DIAMETER M"	M	Time	df	S	COMPARISON DATA AGK3 No	Shift	Time	APPARENT R.A.	Dec.
1980																					
Dec 11		Jupiter	140904	34.79			0.125	112°	136820	-01°2677		0.07	294	14	0.6	X	S 1°1673	-0".37	$-0^m.4$	$12^h29^m.3$	-1°50'
1981																					
Jan 5	86	Semele	113	0.07	377	C	0.273	59	109752	+03 174		0.11	173	10	0.6	P	N 3 143	0.28	-0.1	1 13.7	3 41
Jan 8	44	Nysa	68	0.06	152	E	0.191	102	119165	+02 2505		0.15	169	18	0.7	X	N 2 1540	-0.23	0.5	12 00.0	1 59
Jan 23	41	Daphne	204	0.10	783	C	0.551	86	160962	-12 4884		0.50	1017	22	3.1	S				17 58.1	-12 08
Jan 26	365	Corduba	107	0.08	350	C	0.139	42	111635	+04 644		0.35	484	61	1.8	S	N 4 422	-0.35	-0.6	4 08.9	4 20
Jan 28		Mercury	4880	6.20	4308		1.440	63	164713	-14 6149		0.55	434	9	2.1	P				21 52.2	-13 39
Feb 1	18	Melpomene	148	0.06	556	S	0.463	87	161626	-16 4936		0.05	106	2	0.3	S				18 33.7	-16 09
Feb 1		Neptune	50184	2.24			0.027	92		KMN 27		0.12	2777	108	2.5	H				17 34.5	-22 00
Feb 5	93	Minerva	170	0.08	680	C	0.474	89	187067	-2915159		0.12	258	6	0.7	X				18 36.7	-29 41
Feb 12	9	Metis	168	0.08	742	S	0.296	101	184474	-19 4382		0.26	522	21	1.6	X				16 33.8	-20 05
Feb 18	89	Julia	168	0.08	586	S	0.554	63		+03 4842		0.07	144	3	0.4	A	N 4 3129			23 14.5	4 39
Feb 24	55	Pandora	185	0.08	962	CMEU	0.281	100	185534	-2813325		0.53	1213	46	3.5	X				17 34.6	-28 56
Feb 26	95	Arethusa	168	0.09	780	C	0.207	85	94045	+15 663		0.46	854	53	2.7	X	N15 394	0.15	-0.2	4 37.2	15 29
Mar 6	54	Alexandra	177	0.09	985	C	0.055	197	79033	+26 1447		0.38	725	165	2.3	X	N26 759	0.03	5.1	7 03.1	26 12
Mar 6	216	Kleopatra	130	0.07	404	M	0.513	76	110447	+09 296		0.16	307	8	1.0	Z	N 9 218	-0.45	-0.0	2 15.8	9 42
Mar 9	69	Hesperia	108	0.04	498	M	0.254	77	162369	-14 5349		0.09	252	9	0.7	S				19 14.3	-14 35
Mar 13	11	Parthenope	155	0.09	577	S	0.393	85	161895	-19 5192		0.04	72	2	0.2	X				18 49.6	-19 41
Mar 19	48	Doris	149	0.10	724	U	0.203	302	118832	+02 2420	A	0.33	505	39	1.8	X	N 2 1488	0.15	0.3	11 23.5	2 01
Mar 25	39	Laetitia	158	0.10	782	S	0.159	314	139976	-02 3855		0.51	796	77	2.7	P		0.15	-1.3	14 29.7	-3 02
Apr 2	747	Winchester	208	0.10	1457	C	0.200	301	100625	+14 2636		0.69	1419	83	4.3	S	N14 1386	-0.83	0.2	13 33.4	14 12
Apr 2	36	Atalante	124	0.06	636	C	0.163	255	205907	-3210347		0.10	207	15	0.6	S				14 44.3	-32 44
Apr 4	91	Aegina	106	0.08	386	C	0.154	281	158864	-17 4202		0.15	195	23	0.7	X				14 51.1	-17 45
Apr 4	83	Beatrix	118	0.05	429	C	0.423	69	92925	+15 335		0.12	305	7	0.8	X	N15 207	-0.01	0.6	2 23.5	15 36
Apr 7	2	Pallas	538	0.26	3620	U	0.492	71	130921	-07 734		0.36	743	18	2.2	S				4 03.7	-6 49
Apr 8	86	Semele	113	0.05	390	C	0.447	73	93474	+17 565		0.43	1029	23	2.9	X	N17 305	0.51	-0.0	3 30.3	17 45
Apr 11	94	Aurora	191	0.08	1017	C	0.297	94	58389	+30 994		0.59	1400	48	3.9	S	N30 582	-0.35	0.5	5 43.5	30 37
Apr 15	16	Psyche	249	0.11	1438	M	0.331	85	77370	+21 922		0.07	153	5	0.4	X	N21 548	0.78	0.3	5 39.0	21 20
Apr 20	36	Atalante	124	0.06	637	C	0.207	271	205617	-3210154		0.39	752	46	2.3	S				14 29.0	-33 06
Apr 21	1	Ceres	1025	0.56	10532	C	0.283	103	60300	+30 1557		0.22	398	18	1.3	S	N30 836	-0.06	0.1	7 42.2	30 20
Apr 26		Uranus	50300	3.88			0.037	283		-19 4222		0.21	2693	134	3.2	H				15 47.3	-19 43
Apr 26	13	Egeria	245	0.17	1335	C	0.136	197	209308	-3412108		0.05	73	9	0.3	S				17 48.2	-34 05
Apr 29	144	Vibilia	132	0.06	543	C	0.319	97	79051	+26 1453		0.82	1802	61	5.2	Z	N25 808	0.23	0.9	7 04.9	25 51
May 4	93	Minerva	170	0.11	679	C	0.291	80	190234	-2515360		0.17	259	14	0.9	S				21 18.5	-25 20
May 9	56	Melete	142	0.06	674	C	0.208	92	97880	+13 1935		0.10	218	11	0.6	X	N12 1043	0.43	-0.0	8 30.4	12 49
May 10		Neptune	50184	2.35			0.021	273		KMN 28		0.29	6291	339	5.9	H				17 35.7	-21 58
May 10	2	Pallas	538	0.25	3536	U	0.535	78	131847	-02 1161		0.92	1958	41	5.8	A	S 2 118	-1.24	-0.5	5 10.0	-2 17
May 11	41	Daphne	204	0.14	870	C	0.245	59		-00 4138		0.05	75	5	0.3	A	N 0 2613			20 58.4	0 25
May 13	95	Arethusa	168	0.07	809	C	0.368	93	95447	+16 1060		0.21	538	14	1.4	P	N16 586	1.19	0.2	6 14.3	16 09
May 14	54	Alexandra	177	0.07	979	C	0.258	107		+22 1766		0.18	464	17	1.2	X	N22 920	0.01	0.0	7 44.7	21 57
May 17	28	Bellona	109	0.05	464	S	0.239	74	146428	-07 5902		0.06	149	6	0.4	P		-0.07	-0.2	22 58.5	-6 43
May 20	451	Patientia	281	0.12	1827	C	0.273	111		+30 1798		0.03	75	3	0.2	A	N29 1008			8 57.4	29 51
May 21	28	Bellona	109	0.05	463	S	0.229	74	146472	-07 5918		0.24	563	25	1.6	X				23 02.0	-6 28
May 22	14	Irene	155	0.07	715	S	0.235	80	165440	-15 6325		0.70	1448	71	4.3	S				23 00.4	-14 22
May 24		Neptune	50184	2.36			0.025	273		KMN 29		0.62	13146	601	12.3	H				17 34.3	-21 57
May 26	69	Hesperia	108	0.05	503	M	0.055	306	163084	-10 5210		0.12	233	50	0.7	S				19 52.5	-10 09
May 29	11	Parthenope	155	0.14	560	S	0.053	93	163352	-17 5901		0.40	433	181	1.8	X				20 12.2	-16 56
May 30	46	Hestia	133	0.12	512	C	0.239	281	159945	-17 4585		0.05	59	5	0.2	P		0.12	0.5	16 28.6	-18 12
Jun 5	129	Antigone	113	0.11	358	U	0.134	257	142674	-08 4726		19.36	19496	3476	83.9	P		-0.65	0.9	18 49.3	-7 56
Jun 5	617	Patroclus	159	0.03	1508	U	0.150	127	61509	+36 1964		0.23	1040	36	2.1	S	N36 923	-0.35	0.2	9 27.5	36 21
Jun 7	111	Ate	156	0.08	606	C	0.386	109	98622	+12 2049	X	0.35	668	21	2.1	X	N12 1148	0.17	0.6	9 30.1	11 56

0".4, five times smaller than those given by the other orbits, which say that the June 5th shadow of Patroclus will miss the earth's surface by 4".5 or 21,000 km. Some recent astrometry is needed to clarify the situation for Patroclus, as well as for some of the other large ephemeris disagreements in Table 3 (p. 120). The differences in (18) Melpomene's orbits become apparent only when the asteroid is closest to the earth near opposition in mid-1981.

The occultations by Uranus and by Neptune were found by Arnold Klemola, Doug Mink, and Jim Elliot by scanning Lick Observatory plates. Their results for events for 1981 through 1984 will appear soon in the *Astronomical Journal*; I thank the authors for providing me with preprints. The central durations for these events usually are given in minutes rather than seconds, as given for most of the other events. These occultations can only be recorded photoelectrically, in infrared methane absorption bands. Hence, the magnitude drop (Δm) for these events is for the I-magnitude band, not V, as for the other events. The visual (V) magnitudes given for these stars are very approximate; more accurate measurements were made in the I-band. Predicted times for major observatories will appear in the *A.J.* articles. In the case of Neptune on Feb. 1, the planet will not occult the star, with minimum geocentric separation being 2".2; however, the star could be monitored to discover possible close rings. The occultation of May 24, also marked with "R?," is in the same category. The May 10 Neptune event is very favorable, and the one by Uranus on April 26 is the second best by that planet during the four-year interval covered by Klemola, Mink, and Elliot.

DATE 1981	UNIVERSAL TIME	PLANET NAME	PLANET m_v	PLANET Δ,AU	STAR SAO No	STAR m_v	STAR Sp	STAR R.A.(1950)	STAR Dec.	OCCULTATION Δm	OCCULTATION Dur	OCCULTATION df	OCCULTATION P	OCCULTATION Possible Area	El SUN	MOON El	MOON %Snl	MOON Up
Jun 13	7^h44^m-66^m	Thisbe	10.2	1.41	186977	7.8	B9	$18^h30^m.7$	-24°10'	2.5	26^s	29	10	northern S. America, Hawaii	165°	63°	84+	w 75°W
Jun 14	18 51-59	Metis	10.1	1.68	184440	8.0	G5	16 28.6	-22 42	2.2	14	22	15	Mongolia, s. U.S.S.R., Romania	166	18	93+	all
Jun 26	18 31	Nysa	11.4	2.25	119207	7.2	K0	12 02.2	3 51	4.2	3	14	48	southwest Siberia?s	84	154	32-	none
Jul 2	18 18-26	Euphrosyne	12.6	2.98	244226	8.6	G0	16 48.7	-51 3	4.0	19	24	16	New Zealand?n; Antarctica	144	135	1+	none
Jul 11	14 57	Lydia	13.3	3.50		9.9	B8	5 00.0	23 22	3.5	2	9	50	Hawaii	33	150	73+	none
Jul 15	3 38	Juno	11.2	3.13	120105	9.0	K0	13 44.0	0 57	2.3	19	27	18	Chile, Argentina	92	65	96+	all
Aug 7	11 51-81	Melpomene	8.1	0.95	145972	9.4	F8	22 12.5	-8 18	0.3	23	29	9	w. USA, N.Z.?s;s.e.Australia?n	162	111	47+	w176°E
Aug 9	14 13	Vesta	7.9	2.80		10.0	F2	12 16.5	4 19	0.2	14	8	7	Mauritius?n	46	64	67+	all
Aug 9	23 42	Eleonora	11.6	3.36	96278	9.4	F8	6 53.0	11 51	2.3	4	8	31	Sri Lanka; India?n	35	147	70+	none
Aug 12	9 17	Julia	11.6	2.68	58135	8.6	K0	5 27.6	36 12	3.1	5	10	23	western U.S.A.	57	158	89+	w107°W
Aug 20	0 09-20	Aspasia	11.2	1.69	108373	8.8	A3	23 01.7	12 34	2.6	21	28	13	Scandinavia?s; s.e. Canada	150	38	78-	e 47 W
Aug 20	13 26	Lydia	13.3	3.17	78007	8.7	A0	6 05.1	24 55	4.6	3	11	45	Hawaii?n	56	61	73-	all
Aug 26	8 28	Panopaea	13.4	3.03	77350	6.4	K0	5 35.8	26 35	7.0	6	13	29	Alaska; western Canada?s	68	27	12-	e100°W
Aug 26	15 44	Aegina	14.2	3.01	158784	7.4	K5	14 43.1	-17 29	6.8	4	13	41	Malagasy Republic, Mauritius	71	108	10-	none
Aug 27	3 33-48	Artemis	11.2	1.29	126198	8.8	K2	20 44.2	9 41	2.6	11	19	15	UK;Iberia?s;nwS.America;eUSA?n	149	150	7-	e 20°W
Sep 4	15 27-45	Melpomene	7.9	0.90	164747	9.4	A2	21 53.1	-14 24	0.3	21	26	9	western Pacific, Australia	164	95	32+	w115 E
Sep 6	18 07	Beatrix	13.5	2.84		12.0	G0	7 03.9	26 17	1.8	4	10	35	north central Siberia	59	151	52+	none
Sep 17	20 46	Klymene	13.7	3.31		10.7	F5	8 30.7	21 11	3.1	4	10	36	Novaya Zemlya	50	80	82-	all
Sep 19	9 28-50	Diotima	11.9	2.14	190936	9.3	K0	22 07.5	-28 30	2.7	25	34	15	sPacific,Papua;N.Z.?s,Austrl?s	144	102	66-	e158°W
Sep 20	9 48-60	Irene	10.8	2.04	191415	8.7	G5	22 45.4	-21 54	2.2	13	25	19	western U.S.A., Hawaii	154	106	55-	e163 W
Sep 23	6 18	Laetitia	12.0	3.54	140280	6.8	G5	14 59.4	-8 09	5.2	4	10	33	Hawaii?n	46	104	24-	none
Sep 27	23 07	Iris	10.6	3.13	118220	9.3	K0	10 16.9	6 50	1.5	5	8	20	Sinkiang; India?s;s.w.Siberia?n	31	29	0-	none
Sep 28	1 50	Lydia	13.1	2.72	78931	8.6	M0	6 55.8	25 24	4.5	5	16	39	southern Europe	82	81	0+	none
Oct 5	19 58-70	Artemis	12.0	1.63	144809	9.1	A2	20 44.9	-0 35	3.0	10	20	18	Iberia, Africa	120	39	45+	w 63°E
Oct 7	2 01	Thisbe	11.8	2.18	187124	8.9	G0	18 37.9	-20 33	2.9	10	13	15	western North America?s	86	13	57+	all
Oct 12	16 03	Arethusa	13.7	3.66		9.9	G0	9 54.2	1 35	3.8	5	11	32	Hawaii?n (dawn)	50	141	99+	w163°W
Oct 12	23 07-26	Eunomia	9.2	1.62	58448	9.0	F0	5 44.9	35 57	0.9	38	37	9	n. Africa, Turkey, s.cen. USSR	112	77	99+	all
Oct 27	14 17-31	Freia	12.6	2.27	109524	8.7	F5	0 51.0	5 43	3.9	7	25	42	Hawaii?s;Indonesia,s.e. Asia?n	160	162	0-	none
Nov 1	13 14-56	Papagena	9.9	1.51		10.4	M0	5 53.2	17 26	0.5	37	62	15	New Zealand, Japan, n.e. China	130	176	19+	none
Nov 2	6 22	Thisbe	12.0	2.48	162511	6.4	B8	19 18.7	-19 20	5.6	7	10	17	Hawaii?n	69	10	24+	w133°W
Nov 7	6 34	Hebe	11.2	3.15	118858	8.6	K0	11 23.6	7 04	2.6	6	11	25	Greenland; Labrador?s, U.K.?s	55	172	72+	none
Nov 17	15 27-38	Venus	-4.1	0.62	187448	2.1	B3	18 52.2	-26 22	0.0	685	9	0	S.America,Africa,Europe,swAsia	47	149	61-	w 62°W
Nov 18	2 34	Melpomene	9.3	1.38	165156	7.9	G5	22 30.3	-17 46	1.7	9	14	14	south Atlantic; Patagonia?n	97	165	56-	e 30 W
Nov 28	16 08	Psyche	11.7	3.10	118607	8.8	F8	10 57.4	6 22	2.9	14	19	18	New Guinea,w.equatorial Pacific	83	105	4+	none
Nov 28	22 35	Hektor	15.4	5.98	210667	9.4	G5	18 49.7	-36 14	6.0	6	13	37	southeast U.S.A.?s	36	17	5+	all
Nov 30	14 08-27	Papagena	9.4	1.36		9.1	K7	5 37.1	20 26	0.9	14	22	14	Pacific, Japan, China; India?s	163	153	14+	w 82°E
Dec 5	21 23	Harmonia	11.3	2.02	99271	9.3	F8	10 41.7	11 36	2.1	8	20	25	Mauritius?n	96	159	63+	w 58 E
Dec 14	11 38	Undina	12.2	3.61	189428	9.3	G0	20 30.7	-23 49	3.0	5	9	28	Tasmania	42	176	87-	none
Dec 30	17 54-60	Dione	12.2	2.34	109467	9.1	K2	0 45.6	2 16	3.2	7	17	29	s.e.Africa, Sri Lanka, India?n	93	44	17+	w 52°E

A map showing my predicted paths of asteroidal occultations during 1981 in the U.S.A., southern Canada, and northern Mexico will be published in the 1981 January issue of *Sky* *and Telescope* [Ed: Actually, it does not appear in that issue]. A similar map of the U.S.S.R. has been prepared and submitted for publication in a Soviet journal. Maps and finder charts for the early 1981 events will be published in the next issue of *O.N.*

As noted in the last issue, local circumstances of asteroidal and planetary occultations and appulses are being computed by Joseph E. Carroll, 4216 Queen's Way, Minnetonka, MN 55343, telephone 612, 938-4028. I recently supplied him with input data for the 1981 events, and we plan to compute and distribute these predictions to everyone on the IOTA mailing list. If you want predictions for a different station(s), send coordinates to Joe Carroll. The local predictions are planned to supplement the data given in the tables in this article.

DATE 1981	MINOR PLANET No.	Name	km-diam.	"	RSOI	Type	MOTION "/Day	PA	STAR SAC No	DM No.	D	STELLAR DIAMETER M"	M	Time	df	S	COMPARISON DATA AGK3 No	Shift	Time	APPARENT R.A.	Dec.
Jun 13	88	Thisbe	214	0.21	970	C	0.190	279°	186977	-24°14470		0.08	87	11	0.4	X				18h32m.7	-24°08'
Jun 14	9	Metis	168	0.14	752	S	0.230	271	184440	-22 11549		0.48	591	51	2.3	P		0.13	-0.3	16 30.5	-22 46
Jun 26	44	Nysa	68	0.04	171	E	0.317	116	119207	+04°2569		0.76	1237	57	4.2	P	N 3°1579	0.26	0.3	12 03.8	3 41
Jul 2	31	Euphrosyne	270	0.12	2201	C	0.159	283	244226	-50 9716		0.25	531	37	1.6	S				16 51.1	-51 06
Jul 11	110	Lydia	102	0.04	358	U	0.398	81		+23 811		0.03	80	2	0.2	X	N23 466	0.01	-0.0	5 01.8	23 24
Jul 15	3	Juno	256	0.11	1752	S	0.139	123	120105	+01 2848		0.34	763	58	2.2	S	N 0 1683	-1.91	-0.0	13 45.6	0 48
Aug 7	18	Melpomene	148	0.21	450	S	0.229	215	145972	-08 5840		0.10	69	10	0.4	X				22 14.2	-8 09
Aug 9	4	Vesta	555	0.27	3742	U	0.469	116		+04 2598		0.06	119	3	0.4	X	N 4 1605			12 18.1	4 08
Aug 9	354	Eleonora	156	0.06	653	U	0.419	93	96278	+11 1362		0.10	248	6	0.7	S	N11 765	0.27	7.7	6 54.7	11 48
Aug 12	89	Julia	168	0.09	641	S	0.418	83	58135	+36 1165		0.62	1198	35	3.7	S	N36 555	0.60	-0.8	5 29.7	36 13
Aug 20	409	Aspasia	194	0.16	910	C	0.181	259	108373	+12 4932		0.06	80	9	0.3	S	N12 2712	-0.37	3.3	23 03.3	12 44
Aug 20	110	Lydia	102	0.04	363	U	0.343	87	78007	+24 1109		0.07	152	5	0.4	X	N24 610	0.12	1.0	6 07.0	24 55
Aug 26	70	Panopaea	153	0.07	685	C	0.282	78	77350	+26 884	K	0.78	1712	66	5.0	Z	N26 525	-0.04	0.7	5 37.8	26 36
Aug 26	91	Aegina	106	0.05	400	C	0.287	107	158784	-17 4172		1.13	2466	95	7.2	P		0.71	0.6	14 44.8	-17 37
Aug 27	105	Artemis	129	0.14	419	C	0.304	205	126198	+09 4633		0.37	347	29	1.5	S	N 9 2855	0.92	0.6	20 45.7	9 48
Sep 4	18	Melpomene	148	0.23	437	S	0.266	216	164747	-14 6160		0.05	32	4	0.2	X				21 54.8	-14 15
Sep 6	83	Beatrix	118	0.06	410	C	0.381	93				0.03	69	2	0.2	X	N26 761	0.01	-0.0	7 05.8	26 14
Sep 17	104	Klymene	134	0.06	554	C	0.364	102		+21 1864		0.05	116	3	0.3	X	N21 953	0.01	-0.0	8 32.5	21 05
Sep 19	423	Diotima	209	0.13	1173	C	0.130	272	190936	-2817627		0.23	354	42	1.2	S				22 09.3	-28 21
Sep 20	14	Irene	155	0.10	741	S	0.166	255	191415	-2215057		0.30	445	39	1.6	P		-0.18	1.9	22 47.1	-21 44
Sep 23	39	Laetitia	158	0.06	750	S	0.348	110	140280	-07 3943		0.55	1407	38	3.8	P		-0.35	0.1	15 01.1	-8 16
Sep 27	7	Iris	222	0.10	992	S	0.456	113	118220	+07 2278		0.29	649	15	1.9	X	N 6 1299	-0.18	0.1	10 18.5	6 41
Sep 28	110	Lydia	102	0.05	367	U	0.242	88	78931	+25 1520		0.79	1567	79	4.8	X	N25 789	0.34	0.0	6 57.7	25 21
Oct 5	105	Artemis	129	0.11	434	C	0.250	145	144809	-00 4092		0.07	83	7	0.3	S	S 0 2683	-1.37	-0.1	20 46.6	-0 30
Oct 7	88	Thisbe	214	0.14	937	C	0.328	84	187124	-20 5228		0.13	210	10	0.7	X				18 39.8	-20 31
Oct 12	95	Arethusa	168	0.06	871	C	0.318	118		+02 2268		0.08	223	6	0.6	A	N 1 1248			9 55.8	1 26
Oct 12	15	Eunomia	261	0.22	1193	S	0.140	79	58448	+35 1241		0.08	98	14	0.4	S	N35 579	-0.24	-0.4	5 47.0	35 57
Oct 27	76	Freia	79	0.05	292	M	0.171	244	109524	+05 118		0.12	203	17	0.7	X	N 5 105	-0.35	0.8	0 52.7	5 53
Nov 1	471	Papagena	145	0.13	512	S	0.086	347		+17 1058		0.35	379	97	1.6	X	N17 539	0.01	-0.0	5 55.1	17 26
Nov 2	88	Thisbe	214	0.12	936	C	0.405	81	162511	-19 5412	C	0.14	245	8	0.8	Z				19 20.5	-19 16
Nov 7	6	Hebe	186	0.08	887	S	0.334	104	118858	+07 2447		0.39	889	28	2.5	X	N 7 1538	-0.58	-0.1	11 25.3	6 53
Nov 17		Venus	12220	27.29			0.956	84	187448	-2613595	Y	0.85	381	21	2.5	Z				18 54.1	-26 19
Nov 18	18	Melpomene	148	0.15	417	S	0.385	73	165156	-18 6140		0.33	334	21	1.4	Y		1.33	-0.4	22 32.0	-17 36
Nov 28	16	Psyche	249	0.11	1587	M	0.194	110	118607	+06 2381		0.13	293	16	0.8	X	N 6 1379	-0.42	0.4	10 59.1	6 12
Nov 28	624	Hektor	234	0.05	2408	U	0.212	76	210667	-3613091		0.18	797	21	1.7	S				18 51.8	-36 12
Nov 30	471	Papagena	145	0.15	521	S	0.253	298		+20 1035		0.53	524	50	2.3	X	N20 540			5 39.0	20 27
Dec 5	40	Harmonia	118	0.08	385	S	0.231	103	99271	+12 2250		0.11	156	11	0.6	X	N11 1251	-0.32	0.3	10 43.4	11 26
Dec 14	92	Undina	184	0.07	950	U	0.364	78	189428	-2416112		0.11	289	7	0.8	X				20 32.5	-23 43
Dec 30	106	Dione	118	0.07	427	U	0.244	59	109467	+01 141		0.32	542	31	1.8	X	N 2 81	0.29	0.3	0 47.3	2 26

More on Observing Methods: Some notes on observing techniques are given below; these will supplement and amplify some of the procedures described in previous issues of *O.N.* and *Sky and Telescope*.

In some cases, the star will disappear and reappear in steps because it is a previously unknown close double star. The magnitude drop for each step will be less than the total drop listed in the table; events involving a fainter component may be difficult to see. For some events, the disappearance or reappearance will be gradual due to the angular size of the star and/or diffraction of the star's light at the edge of the asteroid. Try to estimate the duration of gradual or step events.

Due to the irregular outline of asteroids, photoelectric observers should try to obtain accurate U.T. for their records, which is not important for most other types of photometry. Event markers on many chart recorders can be synchronized manually with shortwave time signals, but better accuracy can be achieved by tape recording the time signals and the audible beep or click of the event marker. The tape can be developed and measured to obtain 0.ˢ01 accuracy. Those using digital recording systems, if not otherwise synchronized to a clock accurately calibrated with time signals, can do the same if a tone generator can be added to the circuit to beep when the digital data collection is started and stopped. Records of the star and asteroid brightness should be made before the objects merge so that any drops after they merge can be checked for proper level.

Table 3. Large Ephemeris Differences for 1981.

Date	Aster-oid#	Shift	Δt	Notes
Feb. 5	93	0."50N	-0.ᵐ3	
Mar. 13	11	0.70S	-1.6	
May 4	93	1.02N	-1.0	
May 9	56	0.01S	+4.3	
May 22	14	0.54N	-1.3	
May 29	11	0.26N	-26.9	Motion very slow
June 5	617	6.44N	+7.4	Herget - ITA, see above
June 13	88	0.49S	+0.4	
July 2	31	0.49S	+13.1	
Aug. 7	18	1.40N	-2.3	E.M.P. 1980
Aug. 7	18	2.02S	+3.9	Earlier I.T.A.
Aug. 20	409	3.98S	-68.6	See discussion above
Aug. 27	105	1.47W	-1.7	E.M.P. 1980
Aug. 27	105	0.98E	+0.0	Earlier I.T.A.
Sep. 4	18	1.50N	-2.1	E.M.P. 1980
Sep. 4	18	2.12S	+3.4	Earlier I.T.A.
Sep. 20	14	0.50N	+2.4	
Oct. 5	105	1.54W	+0.7	E.M.P. 1980
Oct. 5	105	0.25E	-1.0	Earlier I.T.A.
Nov. 1	471	2.03E	-1.7	E.M.P. 1980 - early II-
Nov. 28	624	0.12S	+27.8	
Nov. 30	471	4.03N	+6.5	E.M.P. 1980 - early II-
Dec. 5	40	0.07S	-3.3	

Paul Maley describes effective methods for visual observations in his article on p. 396 of the 1980 November issue of *Sky and Telescope*. Most important is learning to find the star several hours, or days, before the event. The records of this year' events emphasized the importance of quick reflexes Reaction times estimated by those who had timed few or no previous occultations were invariably short, by over a second in some cases. Valuable experience can be gained by timing some Lunar events.

We have stressed previously that observations should be made from closely-separated pairs of stations to obtain independently-confirmed timings of secondary occultations. Such observations would be strengthened if the observers in a pair are separated by enough distance along the direction of motion of the shadow on the ground to produce a time difference of two or more seconds. The motion of the occulting object can then be approximately determined to see if it matches that of the asteroid. The direction parallel to the predicted asteroid's shadow path can be estimated from the regional maps, while the minimum desired distance, generally varying from about 5 to 30 or more km, can be calculated from the separation of the equal time lines on the maps. For some events with rapid motion, this becomes impractical; stationing observers within 1 or 2 km of the same path becomes difficult for distances of about 50 km or more along-track.

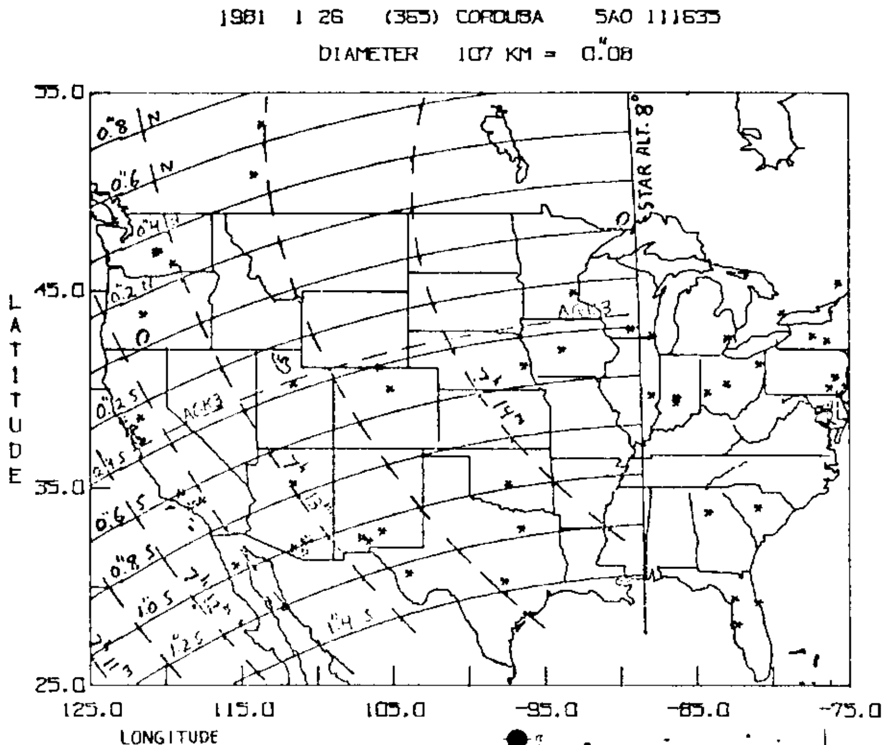
Locating the proper star to be occulted is the most crucial step towards making a successful observation. A good, well-aligned finder scope considerably facilitates this job, but the process of star hopping can still take a considerable amount of time if there is no bright star nearby. Those whose telescopes have setting circles can usually save time by using them after lining the polar axis with the celestial pole to within a fraction of the diameter of the field of view of the finder. The apparent (of date) coordinates of the star are given in the 2nd table for this purpose. The telescope then only needs to be pointed to a bright star in the approximate part of the sky where the asteroid is located, to set the right ascension dial (or to use the difference of the right ascensions of the bright star and the one to be occulted) and to check the declination. The coordinates of some bright stars for this purpose can be obtained from the national almanacs or from sources such as the yearly *Handbook* of the Royal Astronomical Society of Canada. To make it unneccesary for *O.N.* subscribers to go to these other sources, a list of the 1981.0 positions of several bright stars are given in convenient form in Table 4. Most of the stars are first magnitude, but a few far from the ecliptic have not been included, and a few fainter zodiacal stars are included in parts of the Zodiac devoid of first-magnitude stars. Since annual precession amounts to 50", the table can be used for a few years to an accuracy of a few minutes of arc.

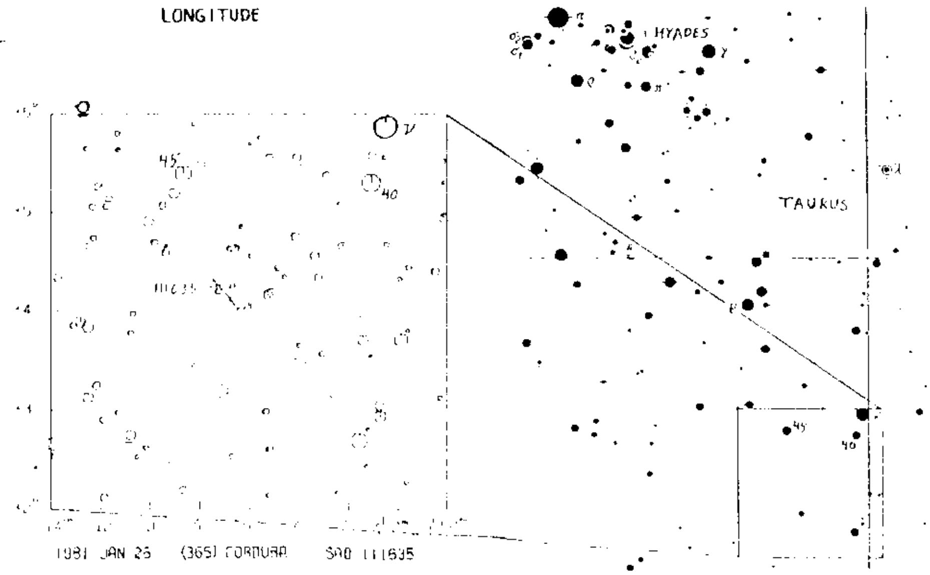
Table 4. Positions of Some Bright Stars for 1981.0

Star	R.A.	Decl.
β Ceti	0ʰ 42.ᵐ6	-18° 05'
Hamal	2 06.1	+23 22
Aldebaran	4 34.8	+16 28
Rigel	5 13.6	-8 13
Capella	5 15.3	+45 59
Betelgeuse	5 54.1	+7 24
Canopus	6 23.5	-52 41
Sirius	6 44.3	-16 41
Castor	7 33.4	+31 56
Procyon	7 38.3	+5 16
Pollux	7 44.2	+28 04
Regulus	10 07.4	+12 03
Spica	13 24.2	-11 04
Arcturus	14 14.8	+19 17
α Centauri	14 38.3	-60 45
Antares	16 28.2	-26 23
Vega	18 36.3	+38 46
Nunki	18 54.1	-26 19
Altair	19 49.9	+8 49
δ Capricorni	21 46.0	-16 13
Fomalhaut	22 56.6	-29 43

Notes about Individual Occultations.

1980 Dec 11: This event will occur before subscribers receive this issue, but is included here since, as far as I know, it hasn't been published elsewhere. A preprint of this information is being sent to potential photoelectric observers, who have perhaps the only hope for obtaining useful data. Information about this occultation has also been distributed by the Asteroid Intercept Radio Net. The occultation of the star by Jupiter, which is nearly central, will not be observable due to the faintness of the star, but those in North America might see the star's light fluctuate when Jupiter's ring passes in front of it sometime within the 45 minutes preceding the disappearance (the star will be well south of the ring at emersion). Since material seems to be concentrated towards the outer edge of the ring, the star's light should be dimmed rapidly when it first reaches the ring, then slowly brighten as it passes to the thinner inner portions. Variations in the star's light may reveal fine structure within the ring. The star will disappear behind Jupiter at 10:21 U.T. on the West Coast, and a little over two minutes later on the East Coast. The star will be even with the leading tip of the ansa of the ring at 9:36 U.T. on the West Coast, when the separation will be about 14" from Jupiter's limb; an occulting bar in the focal plane would help reduce glare from the planet. The motion is along a line which makes a very shallow angle with the ring, so the time of disappearance at the ring varies considerably with geographical location. At Washington, DC, this time should be about 10:17 U.T., but uncertain by ± 11 minutes if a positional uncertainty of 0".4 (the size of the AGK3 - SAO shift) is assumed. The ring disappearance will occur earlier at more southerly locations. M.I.T. astronomers plan to monitor the event with the Kuiper Airborne Observatory near Panama. Doug Mink called the event to my attention, but said he did not find it himself, and did not know when I asked how they learned of it.





1981 Jan 28: The star is μ Capricorni: Mercury's 6".2-diameter disk will be 72% sunlit; the dark-limb disappearance would be easy to observe except for the small elongation from the sun. The reappearance might also be observable since Mercury's surface brightness is less than the moon's; its light does not appear concentrated in a point like an asteroid's. My predicted southern limit is just south of Hokkaido, where the occultation will occur only a few minutes after sunset.

Mar 19: SAO 118832 is the visual double star A.D.S. 8150. The 12th-magnitude companion, 1".8 away in position angle 75°, may be occulted by (48) Doris in Hawaii. But the nearly full moon only 7° away will hinder observation of even the primary star.

Apr 7: A 1".0 south shift is needed to bring the path for this down to a region northwest of the Caspian Sea, but even there the combination of twilight and low altitude will make observation very difficult. In case of a smaller south shift, putting the path farther north, the twilight-altitude situation would be worse. For events like this with the solar elongation less than 70°, useful last-minute astrometry to make a good prediction is impossible. However, since (2) Pallas is suspected of having a big satellite from speckle interferometer observations, some attempt to record a possible occultation might be made.

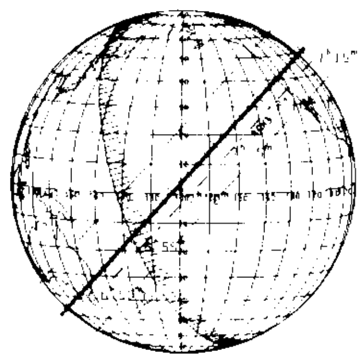
May 10, (2) Pallas: Although the solar elongation is small and the path location quite uncertain due to differences in the star's position, a large effort may be worthwhile since the star is bright and since Pallas may have a large satellite.

May 13: SAO 95447 is 72 Orionis.

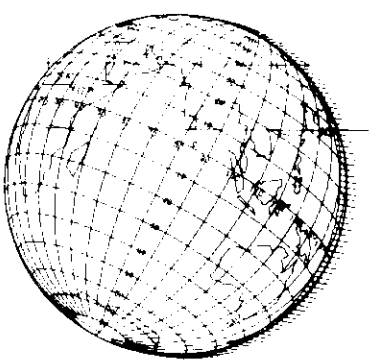
June 5, (129) Antigone: This probably is the most interesting asteroidal occultation of 1981 since SAO 142674 is the irregular red variable star S Scuti. It could be as faint as 8th mag., still bright enough for relatively easy observation. The star's angular diameter may be nearly 0″02, $^1/_6$ that of Antigone, so even a central disappearance will be gradual, lasting over 3^s. At the path edges, there will be partial occultation zones perhaps 35 km wide. Visual observers should note start and end of gradual events; photoelectric observations are encouraged to provide quantitative measurements.

Nov 17: The star is Nunki (σ Sagittarii). Venus will not occult another star this bright until it covers Regulus in 2044. This occultation of Nunki will occur after sunset in eastern Africa, southwestern Asia, and eastern Europe. Venus' 27″-diameter disk will be 46% sunlit. Observers at the center of the occultation path will be able to see a spectacular central flash in the middle of the occultation. Venus' spherical upper atmosphere will focus Nunki's light so that it will appear as a ring of light around the planet, visible on the dark side. This phenomenon was first observed by the Kuiper Airborne Observatory during the occultation of ε Geminorum by Mars in 1976; it should be quite pronounced at this event due to the negligible departure of Venus' shape from a sphere. The central occultation line is expected to cross Ethiopia and Somalia; farther west, for example in northern Brazil and western equatorial Africa, daylight may render the central flash unobservable. Nunki's 9th-mag. companion, 9″0 away in p.a. 244°, will be occulted 3½ minutes before the primary. A gradual disappearance of Nunki reported at a 1919 lunar occultation was more likely due to diffraction than to close duplicity of the primary star. Since this event is a once-in-a-lifetime opportunity, many may want to travel to favorable areas to see it, as for more common total solar eclipses. Gordon Taylor is working with a British travel firm to organize a trip to east Africa to see the occultation under the most favorable conditions, and to combine this with a holiday tour. After observing the occultation it is planned to follow up with optional visits to the Tanzania game parks or a climb of Kilimanjaro. Those interested in joining Gordon on this trip should contact: Explorers Travel Club; 85 Queen St.; Maidenhead; Berks. SL6 1LR; England.

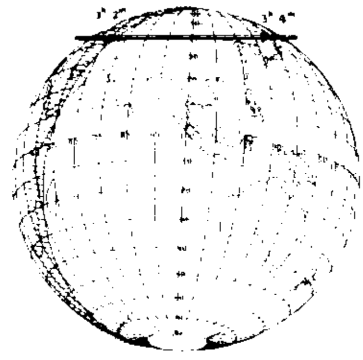
(to be continued, next issue)



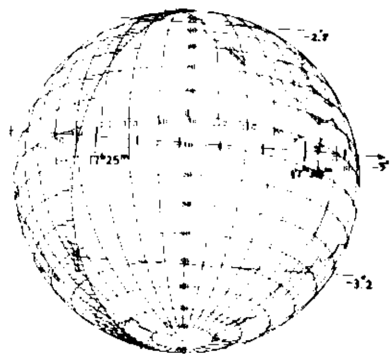
SAO 111635 by Corduba 1981 Jan 26



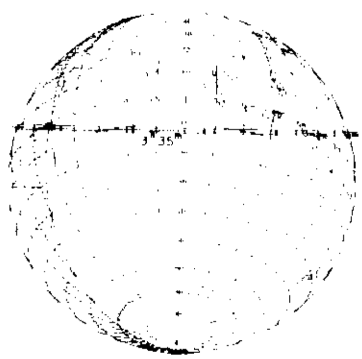
SAO 164713 by Mercury 1981 Jan 28



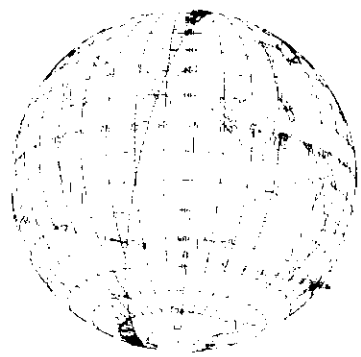
SAO 161626 by Melpomene 1981 Feb



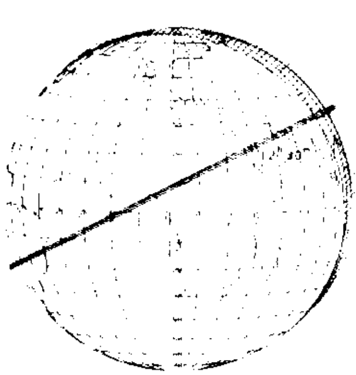
+MN 27 by Neptune 1981 Feb 1



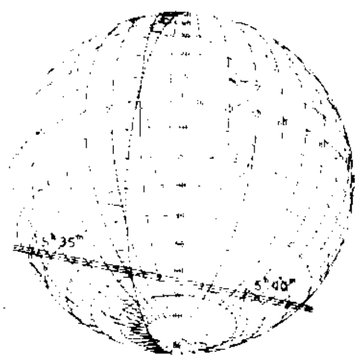
SAO 187067 by Minerva 1981 Feb 5



SAO 184474 by Metis 1981 Feb 12



DM +03 4842 by Julia 1981 Feb 18



SAO 185534 by Pandora 1981 Feb 24