Occultation Newsletter

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LUNAR OCCULTATIONS OF MINOR PLANETS IN 1978

David W. Dunham

Leslie Morrison, HMNAO, has sent me a list of approximate Besselian elements for lunar occultations of about 40 minor planets which will occur during 1978. Calculations of apparent ephemerides for the minor planets listed at the bottom of p. 135 of the last issue are now in progress. When these ephemerides are completed and properly merged with the ones for the objects listed on p. 125 of *O.N.* #12, computed several months ago, predictions for all of the events listed by Morrison will be computed at USNO and distributed to at least known active photoelectric observers. This will not be done until after this issue is distributed, so I have listed some of HMNAO's data below, after eliminating several events which occur very close to new or full moon, or which I believe will be visible only from polar or oceanic areas with no observers. I have done an approximate mental calculation of the possible area of visibility of each event, using the time, lunar phase, the Besselian elements, and a world map. Updated information for some of the events probably will be published in a future issue after detailed predictions are computed. In the meantime, I have listed HMNAO's approximate Besselian elements, in case you might want to check the visibility at your station more closely, or at least have some warning of events in which you might be interested. In the table, Elong. is the moon's mean elongation from the sun, being the fundamental argument D of the lunar theory and is the moon's mean ecliptic longitude minus that of the sun. The moon's true elongation from the sun can differ from it by as much as several degrees, but in general, new moon occurs at 0°, first quarter at 90°, full moon at 180°, and last quarter at 270°. Dec. is the object's apparent declination, or the latitude of the point where the minor planet will be in the zenith. The Besselian elements are discussed on p. 281-284 of the ***Explanatory Supplement to the Astronomical Ephemeris and the A. E. N. A.*** The Besselian plane, onto which the earth's surface and the occulting body can be projected, passes through the earth's center and is perpendicular to a line connecting the earth's center and the occulted object. Therefore, the occulted object is in the zenith for an observer who is projected to the origin, the earth's center, of the Besselian plane. The maps of occultations by minor planets prepared by Soma, like those on p. 144, are projections onto the Besselian plane. An x-y rectangular coordinate system can be established on the Besselian plane, with the y-axis being the projection of the earth's rotation axis on the plane (north being positive) and the x-axis perpendicular to it pointing to where the equator intersects the plane, with east positive. Y_o is the value of y of the center of the moon on the Besselian plane at the time of conjunction in R.A., when it crosses the y-axis (x = 0); units are earth radii (specifically, earth equatorial radii). The hourly motion of the moon's center in y is given under Y'. X', the hourly motion in x, averages +0.58; the deviation of the actual value is less than 10% from this average value. Detailed predictions for the occultation of (15) Eunomia on March 19, one of the most favorable events in the list, were computed by me at USNO and are presented in a separate article, below. In this case, my estimate of the area was correct.

Date	UT	Minor Planet	Mag.	Elong.	Dec.	Y_o	Y'	Poss. Visibility Area
Mar 19	3^h	15 Eunomia	9.8	116°	+16.°2	+.25	-.07	eastern U.S.A., Mexico
Apr 15	19	15 Eunomia	10.1	94	+15.1	+.94	-.08	eastern U.S.S.R.
Jun 29	19	65 Cybele	13.3	297	+11.0	-.62	+.15	Australia
Jul 14	22	16 Psyche	11.3	107	-11.3	-.34	-.15	Argentina, s. Africa
Jul 29	14	14 Irene	11.8	300	+16.6	+.19	+.07	Hawaii
Aug 11	11	16 Psyche	11.6	83	-12.8	+.61	-.14	Japan
Aug 24	2	65 Cybele	12.9	251	+13.0	-.70	+.13	southern Africa
Aug 25	18	11 Parthenope	11.2	270	+16.1	+.15	+.08	Philippines
Aug 26	15	14 Irene	11.6	280	+17.8	-.35	+.05	Polynesia
Oct 6	16	45 Eugenia	12.4	51	-16.5	+.01	-.07	southern Africa
Oct 13	4	19 Fortuna	10.5	137	-7.0	+.14	+.18	northern South America
Nov 3	19	45 Eugenia	12.5	36	-18.8	+.89	-.04	Iberia
Nov 9	13	19 Fortuna	11.0	111	-6.9	+.47	+.18	eastern Asia, Japan
Dec 7	6	19 Fortuna	11.5	91	-6.8	+.4	+.18	Hawaii
Dec 7	11	48 Doris	12.7	94	-3.5	+.6	+.19	eastern Siberia
Dec 8	11	24 Themis	13.0	106	+1.2	-.76	+.18	Tasmania, New Zealand
Dec 22	19	5 Astraea	11.0	269	+0.8	-.43	-.17	Tasmania

[Ed: More detailed predictions received from HMNAO on 1 March have allowed Dr. Dunham to make some last-minute changes in the above list, rendering areas of visibility more accurate, eliminating some events, and adding several others.]

LUNAR OCCULTATION OF (15) EUNOMIA

David W. Dunham

On March 19th (UT), the 72% sunlit waxing moon will occult the 9.8-mag. minor planet (15) Eunomia as seen from most of the United States and Mexico east of the Rocky Mountains. The northern limit of the occultation crosses southern Saskatchewan, northern Minnesota, northern Michigan, southern Ontario, New York, and southwestern Connecticut; IOTA members will be sent predictions for the partial occultation path if it passes within their travel radii for marginal grazes. If the diameter of Eunomia is 272 km, it will subtend 0".180. The altitude above the horizon will be greater than 45° for all locations in the table below, while the sun will be at least 12° below the horizon except for Boulder (sun alt. -9°) and Ft. Davis (-11°). The time of disappearance could possibly be timed by visual observers with large well-baffled telescopes, but photoelectric data are needed in order to determine the diameter of Eunomia. The diameter is too large to produce diffraction fringes from which the local lunar slope can be determined, and it is too small for Watts' charts to help in this regard. Knowledge of the local lunar slope is important since it modifies the time scale of the event, which is needed to determine the diameter from the duration. The local lunar slope can be determined from careful photoelectric timings of the occultation made from two telescopes separated from each other in a north-south direction by 100 to 400 meters, as was done by James Elliot at Mauna Kea for the lunar occultation of Saturn's satellites in 1974. If this is not done, but photoelectric records of the disappearance are obtained at several observatories, the effects of local lunar slopes can be largely removed statistically. Due to the duration of the disappearance, photoelectric integration times of 0ˢ01 to 0ˢ02 are sufficient, and perhaps preferred in order to increase the signal-to-noise ratio. Pen chart recorders could be used to record photoelectric data in this case. During the occultation, the apparent position of Eunomia will be R.A. $7^h39^m00^s$, Decl. +16°09!1. In the table, the predicted quantities are the UT of disappearance (of central graze for two stations), the duration of the fade expected at disappearance due to the size of the minor planet, the Position angle of disappearance (or central graze), and the Cusp angle measured around the moon's limb from the Northern or Southern cusp. In the case of a graze, d can not be calculated.

Location	UT		d	P	C
Sommers-Bausch Observatory, Boulder, Colorado	1^h	55.0	0.62	73°	66°N
McDonald Observatory, Fort Davis, Texas	1	53.7	0.60	106	81 S
Cerro Virgem Observatorio, Zacatecas, Mexico	2	09.6	0.76	136	51 S
Universidad Nacional Autonoma Obs., Mexico City, Mexico	2	30.0	0.90	149	38 S
Observatorio Astrofisico Nacional, Tonantzintla, Mexico	2	33.3	0.90	149	38 S
Johnson Space Center Observatory, Houston, Texas	2	18.7	0.61	105	82 S
Fick Observatory, Ames, Iowa	2	26.0	0.77	59	52 N
Macalester Observatory, St. Paul, Minnesota	2	35.2	1.07	43	36 N
Prairie Observatory, Oakland, Illinois	2	38.6	0.74	62	55 N
Modine-Benstead Observatory, Racine Wisconsin	2	43.7	0.95	48	41 N
Perkins Observatory, Delaware, Ohio	2	53.2	0.86	53	46 N
Rosemary Hill Observatory, Bronson, Florida	2	51.9	0.59	93	86 N
T. Campbell Observatory, Tampa, Florida	2	53.6	0.58	97	90 S
Melton Observatory, Columbia, South Carolina	2	54.3	0.64	76	69 N
R. Pike Observatory, Mississauga, Ontario	3	20.9	(graze)	15	8 N
U. S. Naval Observatory, Washington, D. C.	3	08.2	0.93	49	42 N
Temple University Observatory, Ambler, Pennsylvania	3	16.9	1.34	38	31 N
Sperry Observatory, Cranford, New Jersey	3	22.4	1.93	31	24 N
Stamford Observatory, Stamford, Connecticut	3	32.9	(graze)	16	9 N

PREDICTIONS OF PLANETARY OCCULTATIONS

David W. Dunham

The table below gives information about more occultations by minor planets which will occur during 1978; it complements the table on p. 134 of the last issue (#13). The format is the same as that of the earlier table except that the D,km column has been removed. Most events were found by Gordon Taylor, HMNAO, who listed approximate data for them in his Bulletin 3 (see p. 136). Events during early 1978, as well as 3 events which occur in areas with no known observers, are not included. Data for the February events were sent directly to IOTA members in the areas involved. Derek Wallentinsen found the events of April 1 and July 19 using accurate astrometric ephemerides supplied by me.

In general, these events have larger predicted magnitude drops (Δm) than the ones in the list in the last issue. But the inverse probabilities of seeing the events (P) are usually not as good in this list, which is intended only as an approximate guide to alert observers. Using uncorrected star catalog and ephemeris data, we can't do much better than specify the continent(s) from which the events will be visible. You are cautioned not to make a large effort to set up observing fences at distant sites unless Taylor or I inform you of an improvement in the predicted path based on a relatively recent accurate astrometric position of the star and/or minor planet. Unfortunately, bad weather and the rather large number of events, coupled with the effort to derive accurate astrometric positions, make it impossible to improve the prediction in many cases.

1978 Date	Universal Time	PLANET Name	m_V	Δ,AU	STAR SAO No	m_V	Sp	R.A. (1950)	Dec.	Occultation Δm	Dur	df	P	Possible Area	El Sun	MOON El	%Snl	Up
Mar 11	9^h54^m68	Papagena	11.5	2.30	82129	9.1	G0	$12^h\ 3^m.1$	+23° 2'	2.5	10^s	20	23	neS.Amer.s&wUSA?n,Japan	159°	146°	6+	w155°E
Apr 1	10 49	Leto	12.1	2.74	189790	8.7	K2	20 49.4	-24 21	3.4	4	10	32	Mexico, central USA?n	63	20	41-	all
Apr 17	2 55	Melpomene	10.5	2.70	-1°12	10.9	G5	0 9.2	-1 22	0.6	3	6	26	se Africa	25	131	65+	none
Jun 7	11 37-46	Herculina	9.3	1.56	120774	6.2	M0	14 56.9	+4 46	3.2	24	28	11	Samoa,N.Z.?s,seAustral.	139	125	3+	none
Jul 12	17 08-30	Metis	10.3	1.65	165132	8.7	K2	22 27.9	-18 1	1.8	34	57	16	Japan,Phil.I.,Indonesia	137	141	42+	none
Jul 17	6 48	Melpomene	10.3	2.14	93624	8.7	K5	3 47.0	+12 27	1.8	4	8	21	Quebec?s	57	164	88+	w 75 W
Jul 19	1 36-42	Eugenia	11.7	2.02	140167	8.6	K5	14 47.6	-7 40	3.1	21	26	13	cen.S.America(w. to e.)	106	58	98+	all
Aug 1	6 56	Cybele	13.1	3.48	93064	8.1	F5	2 39.6	+12 38	5.0	20	23	16	Midwest?s,e Canada?s	87	57	7-	e 65 W
Aug 22	23 25	Herculina	10.6	2.47	140552	7.8	K0	15 25.5	-9 11	2.9	9	13	17	Chile, Argentina	82	157	75-	none
Oct 25	3 40	Victoria	10.9	1.89	161878	9.0	K5	18 46.9	-15 6	2.1	4	9	22	west USA, sw Canada?n	71	148	39-	none
Nov 4	19 20	Hygeia	11.1	3.31	187163	9.1	A0	18 39.5	-22 23	2.2	13	10	11	Congo, north S.Africa?s	58	7	19+	all
Nov 17	3 25	Hygeia	11.2	3.45	187576	9.5	F5	18 58.1	-21 55	1.9	12	10	11	Alaska?n,Calif.?s(low)	49	157	94-	w130 W
Nov 21	3 00	Davida	11.9	3.18	190782	9.4	G5	21 55.5	-26 23	2.6	18	20	14	Mexico,USA,sw Canada?n	84	159	66-	none
Dec 6	22 17-24	Amphitrite	10.4	2.04	146788	9.0	F5	23 32.6	-0 5	1.7	15	22	15	eCarib.,neUSA?n,wEurope	100	11	49+	w 15 E
Dec 11	9 15-24	Melpomene	8.8	1.11	114159	8.6	K0	6 35.2	+6 44	0.8	19	26	11	USA(e to w),s Canada?n	154	57	90+	w 78 W
Dec 11	17 45-58	Daphne	12.6	2.56	111443	9.0	G5	3 47.2	+0 11	3.7	14	22	18	nAustralia?s,s. Africa	149	17	92+	w145 E

The numbers (in parentheses) and expected diameters of the minor planets in the table are as follows: (9) Metis, 151 km; (10) Hygeia, 450 km; (12) Victoria, 126 km; (18) Melpomene, 150 km; (29) Amphitrite, 195 km; (41) Daphne, 204 km; (45) Eugenia, 226 km; (65) Cybele, 309 km; (68) Leto, 126 km; (471) Papagena, 143 km; (511) Davida, 323 km; and (532) Herculina, 215 km. The star occulted on April 17 is not in the SAO catalog; the number given under SAO is the star's number in the AGK3 catalog, from which all data about it were obtained. SAO stellar data have been used for all other events except for the one on June 7 discussed below; also note August 22. AGK3 data are available for many of the stars, but we have found from lunar graze observations that SAO data tend to be somewhat more reliable than those obtained from AGK3.

Notes about some events in the table:

Feb 15: The nominal path is predicted to miss the earth's surface by 470 km, which subtends 0".38 at Eunomia's distance.

Feb 16: Possible area also includes Philippine Is.?n, Indonesia?s, s.e. Asia, Pakistan.

Mar 11: Possible area also includes Mexico and the Siberian Maritime Provinces. A south shift is needed for Japan.

June 7: Possible area includes FIji. A 1".0 north shift is needed for Tasmania and the southeast coast of Australia. The star position and proper motion were derived from the positions of the star as given in the SAO (which used GC) and the AGK3 at the very different observation epochs of the catalogs.

Jul 12: A north shift could cause the path to cross the Siberian Maritime Provinces and eastern China.

Jul 17: The nominal path is predicted to miss the earth by 360 km above the Arctic, equivalent to 0".24 at Melpomene's distance. A shift of slightly more than 1".0 to the south is needed for the event to occur in the populated southern part of Quebec.

Aug 1: The nominal path is predicted to miss the earth by 560 km above the Arctic, equivalent to 0".22 at Cybele's distance.

Aug 22: The SAO catalog source is the Albany General Catalog (GC), whose positions are usually unreliable at current epochs. The Yale catalog, which tends to be a little more reliable, predicts a 1".59 south shift with respect to the nominal prediction, which would move the path to Antarctica. The truth is likely to be somewhere between SAO and Yale;

the star position is in special need of recent astrometric improvement. Wayne Warren, Jr. computed the Yale shift.

Oct 25: The nominal path, about 180 km wide, passes near San Francisco and ends at low altitude in South Dakota. A south shift could move the path into nw Mexico and Texas.

Nov 21: The nominal path, about 360 km wide, crosses the soutgern tip of Baja California and ends at low altitude (7°) in Lake Michigan. The altitude will be 7° along a line joining Lake Superior and South Carolina; Davida's altitude will be higher at locations in the USA west and south of this line.

Dec 11, Melpomene: The nominal path, about 190 km wide, crossed Virginia, northern Missouri, and Oregon. If Melpomene passes 1."0 south of its predicted path with respect to the star, the path will pass near Jacksonville, FL; Dallas, TX; and Bakersfield, CA.

Dec 11, Daphne: Possible area also includes Indonesia?n.

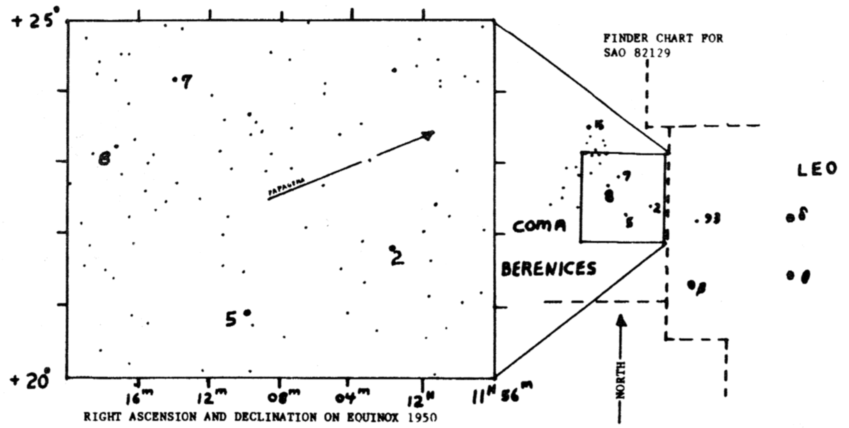
Jean Meeus has used my astrometric ephemerides of minor planets limited to V-magnitudes greater than 11.0 to check for possible occultations of bright stars during 1979. He found none, the closest approach being by (29) Amphitrite to 5.7-mag. 51 Piscium. Closest geocentric approach, 5."6 north of the star, will occur at 15^h 23^m U.T. of 1979 January 26. Since Amphitrite's horizontal parallax will be 3."3, there will be no occultation visible from the earth.

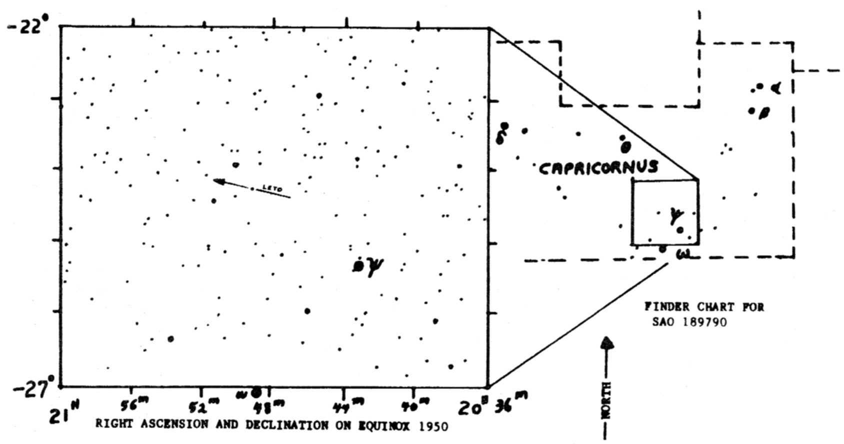
Shifts of the occultation paths from those indicated above (which are based on SAO data, except as noted), calculated from AGK3 data for the stars, are tabulated below. As noted above, the actual paths will likely be closer to the SAO predictions than to the AGK3 predictions, but the truth often lies in between, so that the table indicates the probable direction of shift based upon star position errors. But keep in mind that this argument ignores errors in minor planet ephemerides, which are usually larger than the star position errors. Especially for the events on March 11, April 1, August 1, November 21, and December 6, ephemeris errors could exceed 2". The need for improvement based on modern observations can not be overemphasized. The path shift based on AGK3 data is given under Shift, which is expressed in seconds of arc, "n" or "s" indicating whether the shift is to the north or south, respectively. For instance, 1."00s would mean that the path would be at the southern edge of the possible area described above, according to the AGK3. The unusually large shift for the December 6 event is mainly due to a difference in proper motion of 4."0 per century in declination. If the AGK3 and ephemeris are correct, the path will cross Brazil and northwestern Africa. In each case, the along-track component of the difference in star positions implied an event time difference of less than one minute.

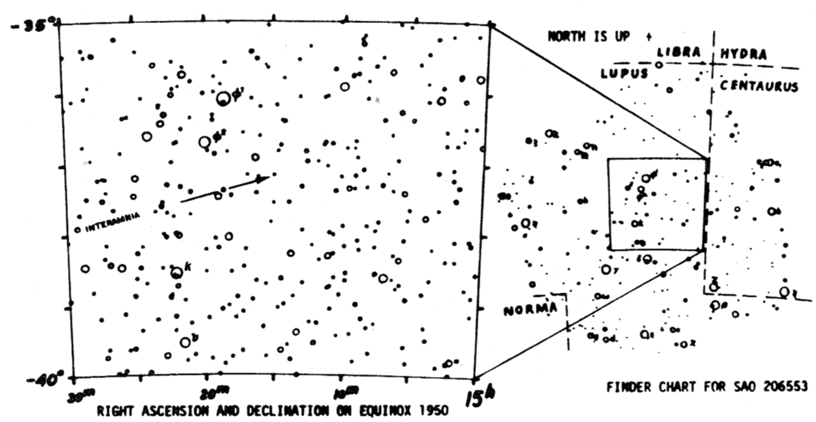
Date	Name	SAO#	AGK3#	Shift
Mar 11	Papagena	82129	+23°1206	0."70s
Jul 17	Melpomene	93624	+12 513	1.10s
Aug 1	Cybele	93064	+12 377	0.44s
Dec 6	Amphitrite	146788	-0 2972	2.25s
Dec 11	Melpomene	114159	+6 778	1.08n
Dec 11	Daphne	111443	+0 330	0.06n

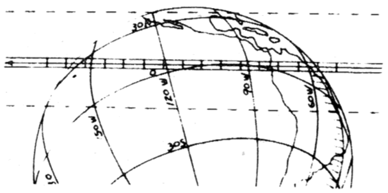
Ben Hudgens, Clinton, MS, prepared the finder charts for SAO 82129 and SAO 189790. [The finder charts for SAO 144070 and SAO 206553 were prepared by Jorge Polman, Recife, Brazil, and the editor, respectively.]

An error was made in the heading for the maps of occultations by minor planets prepared by Mitsuru Soma, Japan, reproduced at the top of p.135 of the last issue; it should have said "Hatched side of terminator is dark (night)." The line with the arrow indicates the center of the predicted path of the occultation shadow, with vertical marks at one-minute intervals. The two adjacent parallel lines indicate the width of the path based on our best knowledge of the minor plamet's diameter. The two dashed parallel lines show the path of the occultation shadow in case the minor planet passes 1."0 north or south (measured perpendicularly) of its predicted path with respect to the star. The "possible area" given in my tables is generally between these two lines, but in fact, prediction errors which have not been corrected with recent observations can exceed 1."0, and sometimes can exceed 2."0.

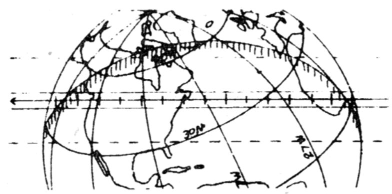






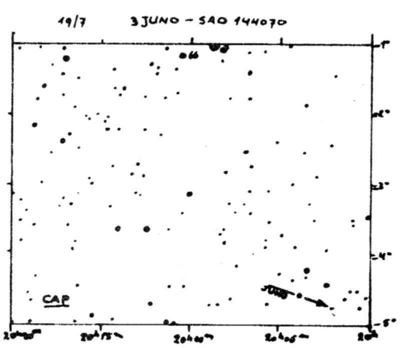


SAO 206553 by Interamnia, 1978 Apr 28



SAO 85009 by Pallas, 1978 May 29

SAO 144070 by Juno, 1978 Jul 19



OBSERVATIONS OF CLUSTER PASSAGES

Brad Timerson

The table below summarizes cluster passage occultation timings reported to *O. N.* since the last article (see #11, p.117). The format is unchanged.

Several observers failed to report complete data, with many observers leaving out telescope used, address, and % sunlit. All observers are urged to be as complete as possible.

The report from T. Hirose included observations by 16 individuals. Twenty events (11 D's, 9 R's) were reported for ZC 648 and twenty-four (14 D's, 10 R's) were reported for ZC 653.

Most observers reporting weather conditions had to contend with varying degrees of bad seeing and cloudiness. Only one observer, D. P. Scott, reported excellent seeing. On Aug. 24, Richard Nolthenius had fair but hazy conditions. Widespread, generally bad weather seems to have kept the number of observations down. Hopefully, the extended USNO predictions for the clusters will start to increase the number of observations that can be made when weather permits.

Date	% Sunlit	Observer	Total	Non SAO	Non BD
Hyades					
1977 Mar. 25	27+	T. Hirose, Shimada City, Japan	44	0	0
1977 Apr. 21	6+	J. Osorio, Portugal	4	1	0
1977 Apr. 21	6+	N. Rego, Portugal	3	1	0
1977 Jul. 12	14-	Robert Wood, Cocoa, FL	11	5	5
1977 Jul. 12	14-	Michael Hutton, Cocoa, FL	3	0	0
1977 Jul. 12	14-	Seymour Salkind, Cocoa, FL	4	0	0
1977 Jul. 12	14-	Jane Geoghegan, Cocoa, FL	4	0	0
1977 Jul. 12	14-	Paul Newman, Garland, TX	3	0	0
1977 Jul. 12	14-	Walt Morgan, Las Vegas, NV	4	0	0
1977 Jul. 12	14-	Richard Binzel, Washington Court House, OH	2	0	0
1977 Jul. 12	14-	D. P. Scott, Panama City, FL	2	0	0
1977 Jul. 12	14-	Robert Sandy, Kansas City, MO	2	0	0
1977 Sep. 5	56-	Richard Nolthenius, Lake Gregory, CA	5	1	0
1977 Oct. 2	80-	Richard Nolthenius, San Diego, CA	1	0	0
M23					
1977 Aug. 24	75+	Richard Nolthenius, Alpine, CA	15	7	0
M24					
1977 Mar. 13	44-	J. A. B. Araujo, Brazil	8	3	0
M67					
1977 May 24	29+	M. J. Morrow	2	1	0

SOME ECLIPSE PUBLICATIONS

Fred Espenak

Anyone who has been bitten by the eclipse chasing bug will be interested in several recent circulars I have prepared. The circulars contain predictions for future total solar eclipses which were generated on an IBM 360/91 computer, using algorithms found in the Explanatory Supplement to the ***American Ephemeris and Nautical Almanac***.

Eclipse Chaser Atlas is a 25-year survey which contains information on every total solar eclipse occurring between 1976 and 2000. Seven computer-generated maps are featured, which cover most of the earth's surface. The northern and southern limits of the path of totality for 19 total eclipses are plotted on these maps, as are two annular eclipse paths which pass thru the United States. A table details the local circumstances at the instant of maximum eclipse for each event, and the duration of totality as a function of longitude is plotted. The astrophotographer will find a useful exposure guide for planning his eclipse program. Also included is a table listing all total, annular, and partial eclipses, and the text describes the mechanics of eclipses and the solar corona.

Northwest '79 is a set of detailed predictions for the total solar eclipse of February 26, 1979. This is the last total solar eclipse passing thru the continental U.S.A. until 2017. Two maps illustrate the path which the umbral shadow will follow, plotted at one-minute intervals. The predictions consist of the coordinates of the northern, southern, and center line positions of the path, the altitude and azimuth of the sun, the dimensions of the shadow, and the duration of totality for every minute of Universal Time. In addition, local circumstances are presented for 70 cities in the U.S. and Canada, which include times for all four contacts, the duration of totality, and the altitude of the sun during totality. A lunar limb profile and a planetary ephemeris for February 26.70 are also included.

Africa 1980 contains predictions for the February 16, 1980 total solar eclipse visible in southern Africa and India. This eclipse will have a maximum duration of totality of $4^m\ 08^s$. The format of ***Africa 1980*** is identical to that of ***Northwest '79***, and it contains the same type of information.

Eclipse Chaser Atlas ($5.00), ***Northwest '79*** ($2.50), and ***Africa 1980*** ($2.50) can be ordered separately, or pay $8.50 for all three and receive an 11"X14" world map containing the paths for all total eclipses, 1976-2000. Make checks payable to me.

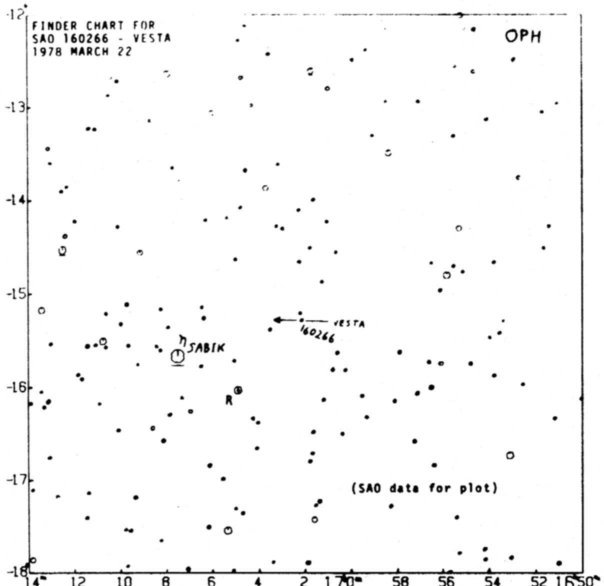
8523 Greenbelt Rd., #103
Greenbelt, MD 20770

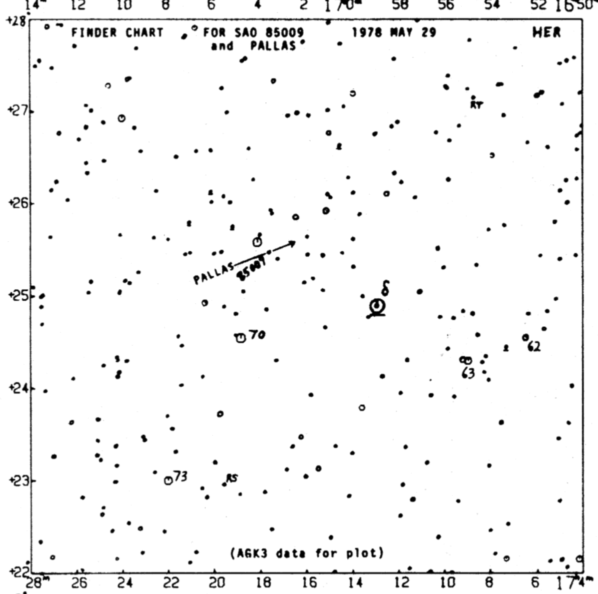
[DWD: It should be mentioned that one of IOTA's services is the provision of local eclipse circumstances to members. For the 1979 eclipse, IOTA plans to rigorously compute and plot the northern and southern edges of the path of totality, taking into account lunar limb features and known corrections to the lunar and solar ephemerides. We hope to encourage amateurs to observe from locations a few kilometers inside the edges, in order to greatly magnify limb effects (Bailey's beads, chromosphere, shadow bands) to obtain more accurate observations. Also, we plan to contact schools and planetaria near the path edges, so that students and other local citizens might be organized to straddle the predicted edges and accurately determine their actual positions.]

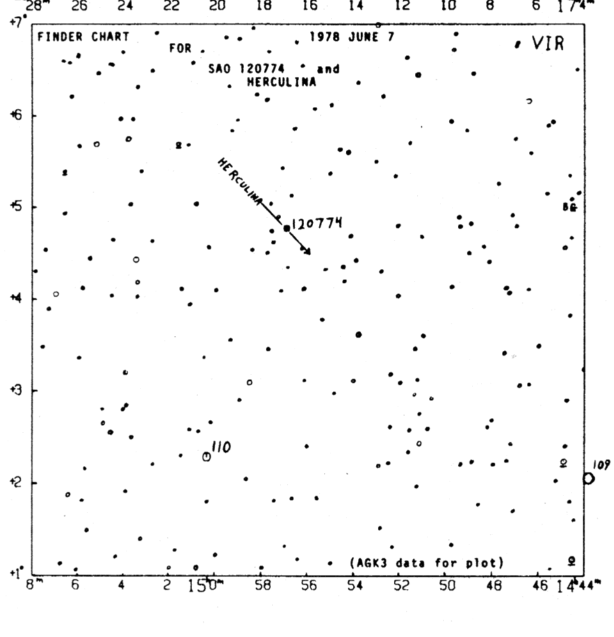
IDENTIFICATION OF UNPREDICTED STARS

Wayne H. Warren, Jr.

Requests for identification of unpredicted stars (see *O.N. 1*, 114) should now be sent to me at Code 601, NASA-Goddard Space Flight Center, Greenbelt, MD 20771.







ERRATA

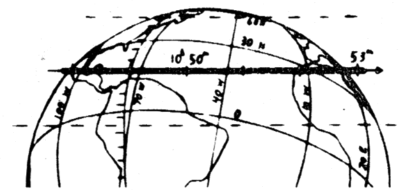
In *O.N., 1*, 133 (#13), a star is listed as SAO 138877 in the table; it should be listed as SAO 133877.

On p. 142 of this issue, February events were deleted from the second table because they preceded the publication date; we neglected to delete them from the notes. This was not detected until the printer had completed that part.

ADDITIONS TO PREDICTIONS OF PLANETARY OCCULTATIONS

David W. Dunham

Time ticks on the minor planet occultation world maps, on the facing page, inadvertently were left unlabeled; for the April 28 event, the easternmost time tick represents 8^h47^m U.T., and the westernmost, 9^h02^m; for May 29, the easternmost tick is 5^h15^m, and the westernmost 5^h28^m; for July 19, the easternmost tick is 22^h57^m, and the westernmost, which coincides with the edge of the disk, is 23^h11^m U.T.



SAO 189790 by Leto, 1978 Apr 1

OCCULTATIONS DURING LUNAR ECLIPSES AND CLUSTER PASSAGES

David W. Dunham

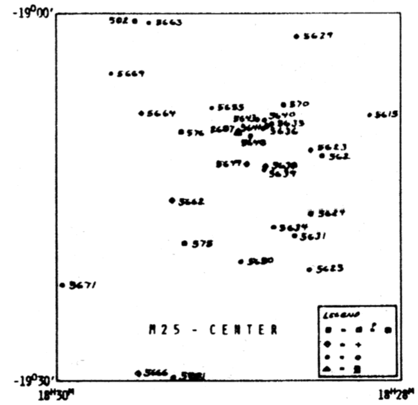
We failed to properly document the March 24th lunar eclipse star field charts in our rush to produce and mail the last issue. The moon's radius is about 15', so its diameter is very nearly equal to the ½° spacing between lines of the grids on all the star field plots. The moon's actual apparent radius varies with its distance. During this year's total lunar eclipses, the apparent radius will be 15.'7 on Mar. 24 and 16.'4 on Sept. 16, ± 0.'1 if the moon's altitude is very high or very low. It probably doesn't need to be explained that the horizontal scale is equinox 1950 R.A. in minutes, the hour being indicated by the large number on the right, and the vertical scale is 1950 dec. in degrees On the p. 133 chart, time increases from right to left along each track (the moon's R.A. is always increasing, except when crossing the 24^h - 0^h discontinuity). The dots along the track mark hours of U.T., from 14^h to 19^h, although some tracks on the right side end earlier than 19^h and some on the left start later than 14^h as no points were plotted when the moon was 10° or more below the horizon. A few points were not plotted because they were just off the chart's edge. The vertical ticks mark the position of the moon's center at times of various eclipse phenomena: Start of umbral eclipse (1st contact), $14^h32^m.8$ U.T.; start of totality, $15^h36^m.7$; mid-eclipse, $16^h22^m.4$; end of totality, $17^h08^m.0$; and last umbral contact, $18^h12^m.0$. Some locations used for path predictions for the March eclipse are observatories near small towns not shown in most world atlases. These include Okayama, s. Japan; Lembang, Java; Khurel-Togoot, Mongolia; Naini Tal, n. India; Kodaikanal, s. India; Abastuman, Georgia, USSR; and Causeway, at Salisbury, Rhodesia.

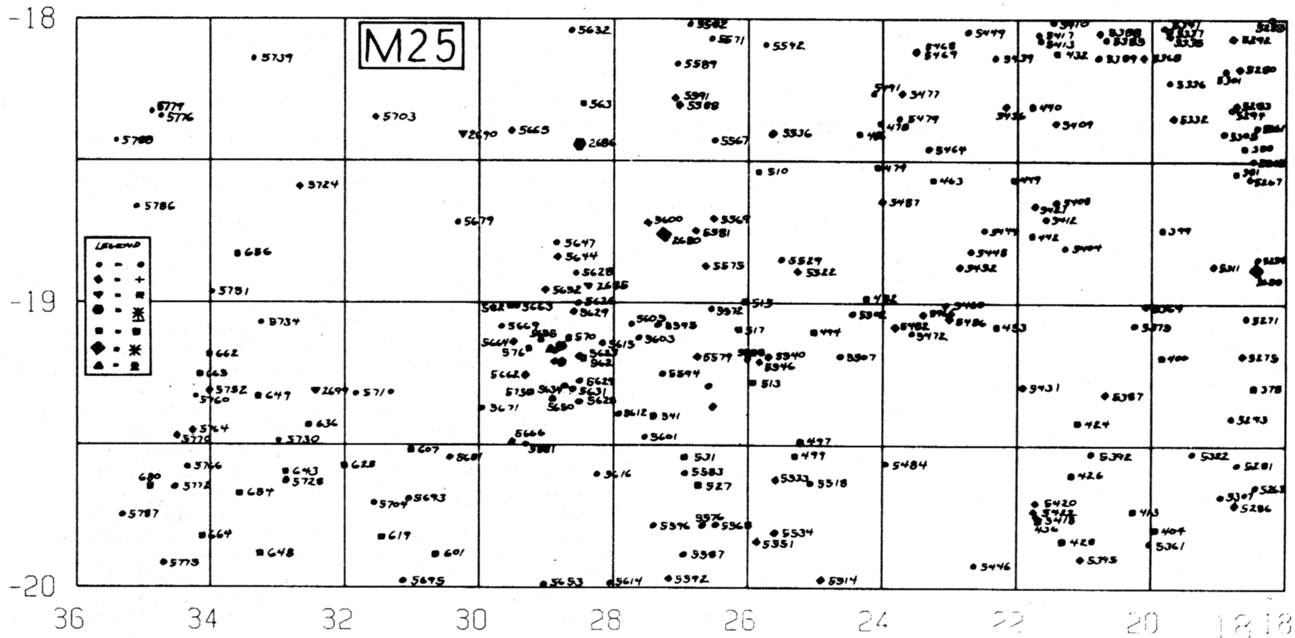
Numbers for the stars on all charts in this issue and the last are given by the same rules as for the stars on the Hyades charts of issue #12; Z.C. numbers for Zodiacal Catalog stars; the last 3 digits of SAO numbers for SAO stars not in the Z.C.; the number in the AGK3 zone for AGK3 stars not in the SAO; and USNO J-catalog numbers for all other stars. AGK3 stars are included only in the plot for NGC 1647. For non-Z.C. SAO stars, add the following numbers to the one from the chart to obtain the full SAO number: 94000 for NGC 1647; 138000 for the March 24th eclipse field; 160000 for M23; 161000 for M25 (186000 for a couple of stars south of declination -20°). A chart for M24 by David Herald was published on p. 82 of *O.N., 1* (#9).

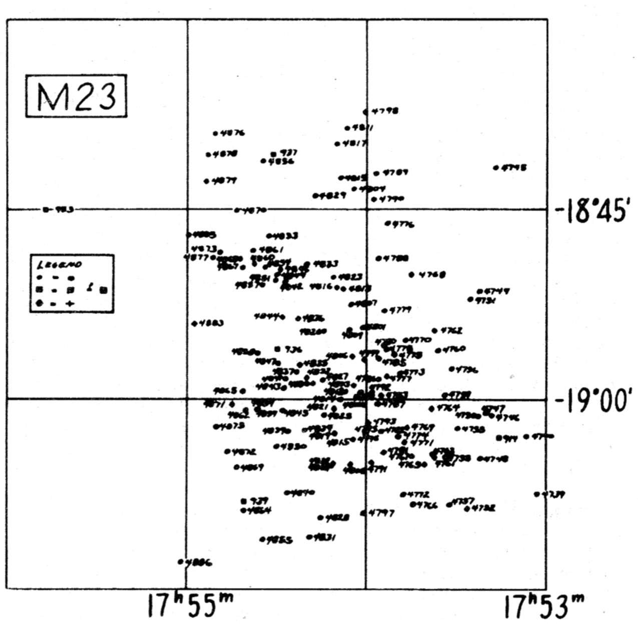
Unfortunately, when creating the eclipse star field data sets for the J-catalog, I forgot to merge their non-SAO stars with the AGK3. As the AGK3 goes down to nearly -3° declination, it turns out that there are 4 K-catalog stars in the Sept. eclipse field and many in the March eclipse field. The K-catalog positions, derived from AGK3 data, are generally much better than the J-catalog positions for the same stars, based mainly on Astrographic Catalog data with little or no provision for proper motion. The J positions should always be used, when available, for reporting observations. Of course, the K-catalog predictions will also be more accurate, and should be used for stars in them. The K-catalog predictions for nearly all observers were computed before the lunar eclipse changes to USNO's prediction program were made. Consequently, some of the events in the K predictions are not in the J predictions since in fact the event will occur on an uneclipsed part of the moon and not be observable. Another problem regarding the observability code calculation and rejection is that the AGK3 (K) magnitudes are about 1.5 fainter than the J-catalog magnitudes. The J and K number cross reference for the March eclipse field is given in a table. In the March eclipse field, K6795 has no J counterpart; it is an 11th-mag. companion 23".5 away from Z11700 = SAO 138626 in p.a. 278°.

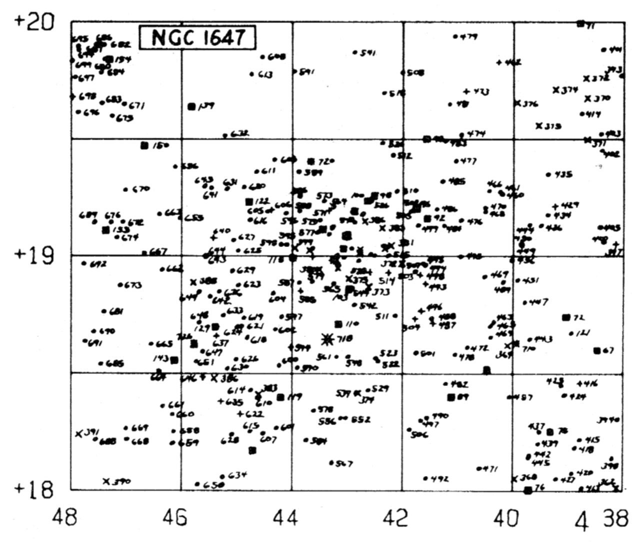
I recently developed a tape-reading version of the standard-coverage prediction program which was used to compute J-catalog predictions using a and b factors for many observers much quicker than USNO's standard "Evans" total occultation prediction program. This new program prints the predictions in chronological order. In my notice, "Extended USNO Occultation Predictions for 1978 for Eastern-Hemi-

(Continued, p. 147, column 1)









General Key. M23 and M25 have referred keys. Scale varies.

✱	Z.C. mag. 6.5 - 7.5	ʘ	B.D. mag. ∿ 9 - 10
⊞	SAO mag. 4 - 6.4	+	A.C. mag. 8.5 - 10.5
■	SAO mag. 6.5 - ∿ 9	•	A.C. mag. 10.6 +
×	AGK3 mag. ∿ 8.5 - 10.5		If underlined, star is double.

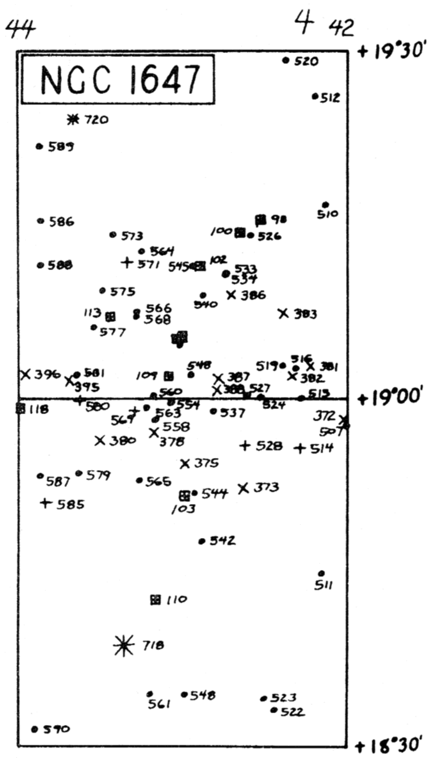
sphere Observers," which I distributed to many observers there with J-catalog predictions, I gave 1977 as the date of the notice; it should be 1978.

David Herald prepared the cross reference lists of B.D. numbers and double star data for the March eclipse field. John Phelps, Jr. added star numbers, drew curves through the computed points for the lunar tracks, and otherwise prepared most of my computer-generated charts in this issue and the last issue of *O.N.* in a form suitable for publication. He also did this for most of Soma's minor planet occultation world maps.

A close examination of the March eclipse field charts on pp. 132 and 133 of the last issue shows that the stars are not plotted in exactly the same positions, DaBoll has noted. The stars on p. 132 are plotted about 1' south of their true positions, apparently due to slippage when the chart was automatically drawn. This happens occasionally, but is usually large enough to be immediately noticeable, so that the plot tape can be rewound and the chart redrawn.

J and K Number Cross Reference
for the March Eclipse Field

J#	K#	J#	K#	J#	K#
4144	6784	4236	6810	4299	6833
4181	4239	4239	6811	4304	6839
4186	6790	4241	6814	4309	6841
4188	6791	4255	6820	4322	6849
4193	6794	4258	6821	4323	6850
4210	6801	4263	6822	4349	6864
4219	6803	4275	6824	4358	6871
4223	6804	4284	6826	4361	6877
4226	6805	4287	6828	4365	6880



Herald and B.D. Cross Reference
for the March Eclipse Field

Herald	BD	Herald	BD	Herald	BD
5	-0°2539	73	-0°2547	152	-1°2644
15	-1 2623	74	-0 2548	155	-0 2559
17	-1 2624	77	-1 2636	156	-2 3493
20	-1 2625	91	-0 2552	170	-0 2560
22	-1 2626	96	-0 2553	173	-1 2647
27	+0 2904	108	+0 2915	178	-1 2649
40 or 41	-1 2629	117	-0 2555	180	-1 2650
		122	-1 2638	183	-1 2651
		129	-2 3486	185	-1 2652
45	-1 2631	132	-0 2556	188	-0 2561
50	-0 2541	137	-0 2557	189	-2 3502
54	+0 2908	138	+0 2917	190	-0 2562
58	-1 2633	139	-1 2640	191	-1 2653
61	-0 2543	142	-0 2558	195	+0 2930
67	-1 2635	149	-1 2642		
70	-0 2545	150	-1 2643		

The above list does not include SAO stars, but AGK3 stars have not been deleted. Note: The magnitude of -1°2635 is given in BD as 7.0, much brighter than in the A.C.

Lick I.D.S. Double Stars
for the March Eclipse Field

30 & 33	9.2	9.4	278°	23".5	
100 & 101	10.8	11.3	356	6.3	
103 & 105	7.7	10.9	56	35.7	
115 & 116	9.3	9.6	273	3.3	
166	12	13	300	7	(Only one old observation listed)

Variable stars: None listed in Kukarkin, et al., 3rd edition + supplements

GRAZING OCCULTATIONS

David W. Dunham

Graze reports should be sent to my current address: P.O. Box 488, Silver Spring, MD 20907, U.S.A. See also p. 137 of the last issue. The table of observed grazes is in the same format as used in previous issues.

In order to conserve many hours of computer time, the computer graze searches at USNO, upon which all IOTA graze predictions are based, no longer include daytime grazes (and have not done so starting with the predictions for 1977). Actually, due to the liberal selection limits of the search process, Grazes will be predicted for nearly an hour after sunrise during the waning phases and for a similar time before sunset during the waxing phases. With the occultations of Aldebaran, observers will notice the lack of daytime predictions during 1978. These will be computed specially for observers in the United States and southern Canada, since we know about them from the map on p. 149. Fred Espenak is working on a program to read a special "EVANS" Besselian elements tape of all first-magnitude occultations during 1978 - 1981 to produce worldwide maps of the northern and southern limits of these events. Before this is done, the only way we can know about daytime events outside of North America is by having observers request data for them based upon the regional graze maps produced by HMNAO and published in various periodicals, or "GRAZE NEARBY" me-sages in USNO's total occultation predictions. Rick Binzel produced a large stack of computer listings of all Aldebaran and Regulus graze tracks during the next few years as preparation for making the map on p. 124 of issue #12. Unfortunately, nobody locally has the time to go through the lists to see which daytime predictions should be computed. But daytime grazes of third-magnitude stars would still pose a problem.

Four grazes should have been included on the map on p. 124, but were not. The map is reproduced on p. 149 with these events included, along with an addendum to the table of conditions at the ends of the graze paths. The 1980 Aug. 11 graze of Regulus was included in the table on p. 124, but not on the map. It will not be observable because the sun will be only about 12° away, and higher than the moon for everyone.

Perhaps the most spectacular grazing occultation of Aldebaran visible from North America during the current four-year series will be the one by the 4% sunlit waxing crescent moon on May 9. Graze will be on the dark limb after sundown as seen from near the southern limit across Montana; see the map on p. 149. An IOTA expedition is planned to observe this rare event, probably near Billings, Montana, where the moon will be about 7° above the horizon and the sun a similar distance below it. More information can be obtained from the expedition coordinator, Paul Asmus, 1141 Ironton, Aurora, CO 80016, phone 303,341-2444. If the expedition is not canceled due to bad weather, at least one other IOTA officer and I plan to be there. A larger-scale map and other data will be in the May issue of ***Sky and Telescope***. The night after the Aldebaran graze, some of us may try to observe a very favorable graze of 5.1-mag. 111 Tauri (Z.C. 806) at the dark southern limb of the 8% sunlit moon from eastern South Dakota. The southern limit for that graze also crosses the Chicago area, where DaBoll plans to lead an expedition. The following night, we might try another good graze of the 5.7-mag. double star Z.C. 944 at the dark northern limb of the 14% sunlit moon northeast of Duluth, MN, or from upper Michigan (the path also crosses southern Ontario, near Toronto). The components are each mag. 6.2, separated by 0".27 in p.a. 137°. So if weather permits, we may be able to observe grazes of four bright stars under very good conditions on three consecutive evenings. The paths are shown on my map on p. 87 of the Jan. issue of ***Sky and Telescope***.

A volunteer is sought to help with the measurement of accurate geographical coordinates from large-scale topographic maps for some successful large graze expeditions, reports of which are being held up for lack of time of the expedition leader to do the job.

Unfortunately, many observers received their early 1978 graze predictions after the beginning of the new year; this was especially the case for profiles. The delay was caused not so much by the graze computors as by my delay in sending magnetic tapes with the graze data for 1978 from USNO to the computors; I apologize for any events which you might have missed on this account. Our computer situation is now better than it has ever been before, with the volunteers involved doing a very conscientious job; future delays should be rare or nonexistent. Calculation of the basic graze data for 1979 is now in progress at USNO.

Substantial south shifts, resulting in some observers seeing no occultation, occurred during recent northern-limit grazes of Z.C. 310 and Z.C. 437 in Texas. Detailed reductions have not been calculated, so this warning is given in case a graze of one of these stars occurs in your area soon. The shift for Z.C. 437 was the larger, amounting to several tenths of a mile.

The large shift for the graze of Z03744 on February 16 would have been predicted by data from the AGK3 or Yale catalog. This emphasizes the low quality of positions from the G.C., which was used for the prediction of this graze.

Several observers tried to observe a graze of a 4th-magnitude star last year. They set up their observing fence using predictions supplied by HMNAO and similar data which they computed themselves from the star's Z.C. position, the Astronomical Ephemeris for the moon, and Watts' limb correction charts. Unfortunately, each source contained substantial errors, producing a 0".95 north shift from their and HMNAO's prediction and causing most observers to see only two events, missing the interesting northern relatively flat part of the profile. If USNO-IOTA graze predictions had been used instead, the observed shift would have been near zero, since we used an improved N30 catalog position for the star, corrections to the lunar ephemeris based on thousands of occultation observations made during the past 20 years and analyzed by Van Flandern, and corrections to Watts data based on previous graze observations which have been incorporated into ACLPPP. We have had trouble in getting our predictions to all graze observers, but more computors are operational now, so we should have less trouble in computing and distributing predictions on time in the future.

A new catalog of accurate, up-to-date star positions and proper motions, compiled from observations made with automated photoelectric equipment at Perth Observatory, Western Australia, and coordinated from Hamburg Observatory, German Federal Republic, is now available. This Perth 70 catalog was produced as part of the Southern Reference Star program, and includes stars at a density of about one per square degree (i.e., about one of every sixth SZ star) from the south celestial pole to +35° declination, which includes all zodiacal regions. The Perth 70 data will be especially valuable for stars whose position source in the SZ is either the Z.C. or G.C., even in the southern sky, and should be a considerable improvement also over AGK3 and Yale positions. Most stars whose <u>only</u> position source is AGK3 or Yale are not in Perth 70, due to its lower density. I successfully predicted the observed shift for the graze of Z.C. 3294 on 1977 Dec. 15 using Perth 70 data. In the near future, I will compute position differences in current epochs in the sense Perth 70 - SZ, as I have done for AGK3 - SZ, and will then be able to supply Perth 70 shifts on the same basis that I now use for supplying AGK3 shifts. Richard Schmidt, USNO, has done some preliminary work with the magnetic tape version of the catalog.

A number of Cassini-region grazes have been rather well observed during the past several months. I have not had time to complete the reduction (in which I am being helped by Robert Sandy) and incorporation of these data into ACLPPP, but will eventually finish the job and distribute the information to the graze computors, along with program changes which can be used for eventually plotting regional graze maps automatically (although, as usual, such plots need to have some manual work done to make them suitable for publication). The plot capability will be an extension of the programming done to produce the map on p. 149.

Please don't use blue pen or pencil when completing graze report forms; that color, especially when light, does not photocopy well.

Mo	Dy	Star Number	Mag	% Snl	CA	Location	# Sta	# Tm	C C	Ap cm	Organizer	St	WA	b
1977														
10	5	1045	8.1	50-	7N	Victoria, TX	1	3	7	25	Don Stockbauer	C5N	351	-20
10	5	Z06567	8.0	50-	5N	Sun City, FL	1	1		20	Harold Povenmire	N		
10	17	2497	6.6	23+	6S	Maroa, IL	2	5	4	25	John Phelps, Jr.	C0	171	-54
11	20	0104	5.8	84+	3N	Shiroishi, Japan	6	11	4	5	Toshio Hirose	4	4	2
12	14	Z22506	8.0	20+		Canberra, Austrl.	2	16	6	20	David Herald			
12	18	0053	6.9	59+	S	Motu, New Zealand	1	2		20	Glen Rowe			
12	19	0226	6.6	72+	-2N	Schangnau, Switz.	1	1		12	Hans Dubach			
12	19	0226	6.6	72+	-2N	Breitenmatt, Swtz.	2	2		7	Robert Germann			
12	27	1197	6.0	96-	18N	Utsunomiya, Japan	2	3	5	6	Toshio Hirose	C	354	66
1978														
1	2	1814	7.9	51-	-1N	Manhattan, IL	2	2	6	13	John Phelps, Jr.	2S	359	5
1	3	Z12781	8.3	40-	3S	Bethesda, MD	3	2	5	25	David Dunham	7N		
1	4	2114	5.8	25-	2S	Toyohashi, Japan	3	12	6	5	Toshio Hirose	C	354	66
1	11	3233	7.2	11+	1N	Eagle, WI	3	2	8	13	Homer DaBoll	6N	359	-36
1	11	3233	7.2	11+	1N	New Berlin, WI	2	10	8	25	Raymond Zit	5N	359	-36
1	13	Z24817	8.5	24+	N	Canberra, Austrl.	2	4	6	20	David Herald	13N	5	-28
1	17	Z02050	8.5	59+	2S	Verhelle, TX	1	1	6	25	Don Stockbauer		179	34
1	22	1106	3.6	98+	-14S	Solon, OH	1	2		15	Robert Clyde		173	70
2	11	0047	7.7	14+	4N	Estero, FL	1	4		20	Harold Povenmire			
2	11	Z00267	9.0	14+	0S	Peotone, IL	1	3	6	20	John Phelps, Jr.	6S	183	3
2	13	0310	7.7	32+	N	Katy, TX	7	43	8	20	Paul Maley	S		
2	14	0437	7.4	43+	N	Pasadena, TX	5	28	8	20	Paul Maley	S		
2	16	Z03744	7.1	61+	2N	Northfield, MN	2	4	7	20	James Fox	C20N	1	64
3	4	Z19360	7.0	26-	-1N	Stillwater, MN	3	3	7	20	James Fox	2S	4	-58

IOTA NEWS

David W. Dunham

The address list distributed with the last issue should be dated 1977 December. It is actually a listing of all addresses in the IOTA Secretary's file, including some *o.n.* subscribers and some observers who are not IOTA members, but receive graze predictions from institutions which pay for the mailing expenses. Honorary members in socialist countries who can not make payment in western currencies are included; these are limited to one or two in each country who distribute copies of some of our material within their country and who send us observations. Many members of the European and Latin American sections of IOTA are included, but Bode and Daltabuit maintain more comprehensive and up-to-date address lists for their sections. The nation is not indicated for observers in the U.S.A., and also for many in the German Federal Republic and the Republic of South Africa, where graze predictions are computed and distributed locally. Telephone numbers and other astronomical affiliations are often given after the observer's address. If two telephone numbers are given, the first one is generally the home number and the second one an office number. There are many errors in the list (for example, my office phone extension is 358, not 656). If there is an error for your entry, notify Berton Stevens, Jr.; 4032 N. Ashland Ave.; Chicago, IL 60613; U.S.A. I have sent him a list of several corrections; we may publish a list of corrections and new members in a future issue. In any case, the list should be useful for contacting observers listed in the "observers scanned" section of your graze predictions to coordinate observing plans.

The last issue had to be prepared rather hurriedly in order to distribute it in time for the January occultations by minor planets. The same is true for this issue, due to events in March. In the January issue, we failed to describe properly several items which are documented better in various articles, especially "Occultations during Lunar Eclipses and Cluster Passages," in this issue. Several items, mostly about grazes and new double stars, had to be delayed because there was not enough space for them. The star field charts take much space in this issue, so again much material, including some of last issue's carry-over, will have to be delayed until the next issue. We probably will publish the next issue less than 3 months after this one to get caught up on the backlog of unpublished material and to reduce the disparity between our intended and actual publication schedule. I think that we are getting caught up on information about urgent predicted events, although it is possible that some interesting occultation will dictate our next deadline. I hope that we can prepare the total occultation tally for 1976 for the next issue. Short summaries of many published papers about occultations also need to be prepared and published.

Issue #16, which probably will be published 5 to 6 months after this one, will close out Volume I of *O.N.* It should include an index to the entire volume; a volunteer (or volunteers), if possible with some experience with indexing or library science, is sought to do, or help with, creation of the index.

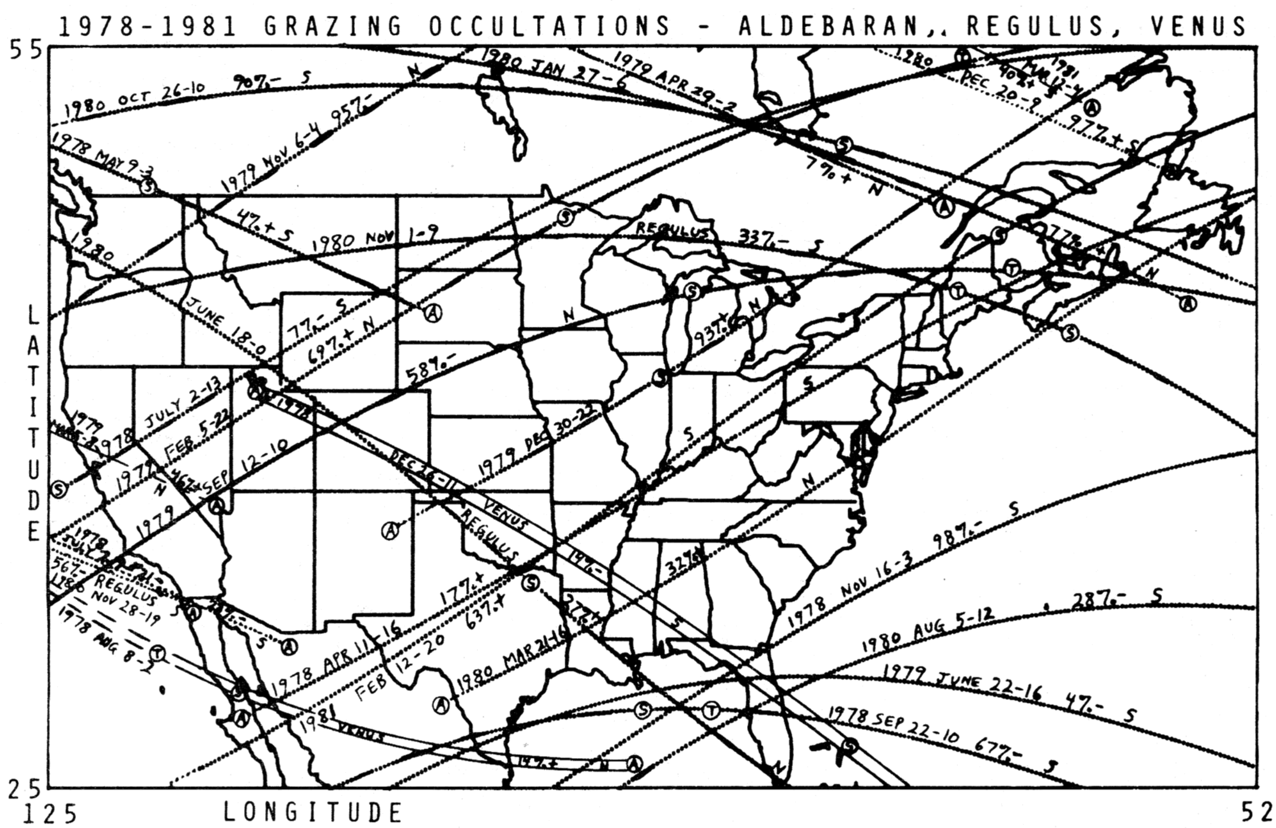
An IOTA regional meeting will be held at the Atlantic Beach Lodge in Cocoa Beach, Florida, in conjunction with the June 15-17 meeting of the Southeast Region of the Astronomical League. More information will appear in *Sky and Telescope* or can be obtained from Michael Reynolds, 610 Florida Blvd., Neptune Beach, FL 32233, telephone 904,249-8968.

Occultations of a 9th-mag. red star by some of the rings of Uranus were observed photoelectrically by R. Millis (Lowell Obs., Flagstaff, AZ) from the Canary Islands the morning of 1977 December 23. The event was noted on p. 131 of the last issue.

Dr. R. Edward Nather, Department of Astronomy, University of Texas, Austin, TX 78712 (phone: 512,471-4484) announces an opening for a post-doctoral position, according to the American Astronomical Society's Employment Opportunities Register, February Supplement. Candidates should have strong backgrounds in electronics and instrument design, with some direct experience in observational astronomy. The selected candidate will be expected to design and build a small, inexpensive high-speed photometer whose basic purpose is the acquisition of lunar occultation observations, and to demonstrate its use on several small- to medium-sized telescopes. He will be expected to provide sufficient, detailed documentation so the system can be duplicated, with only modest effort, by individuals with moderate instrumental skills, and to specify standards so that exchange of digital data is possible between Austin and the diverse cooperating individuals. Nather notes that, to date, the expense and complexity of the necessary high-speed photometer and digital recording equipment have discouraged participation by small colleges and schools which have expressed interest and which have the necessary telescope facilities, but lack the budget and design skills required. Salary is $13,500 per year. The position starts immediately for one year with extension for a second year possible. Those interested in this position should send resumes to Nather. The results of this work would certainly be of interest to many IOTA members.

TABLE OF CONDITIONS AT THE ENDS OF THE GRAZE PATHS
FOR EVENTS NOT GIVEN IN THE TABLE ON PAGE 124

				WEST END OF PATH					EAST END OF PATH				
				U. T.		MOON	SUN	CUSP	U. T.		MOON	SUN	CUSP
YEAR	MO.	DAY	OBJECT	h	m	ALT.	ALT.	ANGLE	h	m	ALT.	ALT.	ANGLE
1978	Jul	29	Aldebaran	21	58	15°	64°	11°S	22	02	1°	52°	11°S
1978	Aug	8	Venus	1	51	25	10	2 N	2	37	0	-35	-6 N
1979	Mar	5	Aldebaran	8	17	8	-55	6 N	8	18	0	-55	6 N
1981	Mar	12	Aldebaran	4	53	5	-50	S	4	53	0	-50	S



FROM THE PUBLISHER

For subscription purposes, this is the fourth and final issue of 1977.

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NEW DOUBLE STARS

David W. Dunham

The table lists additions and corrections to the special double star list of 1974 May 9 not listed in previous issues. The columns and general format are the same as in previous issues.

In the last issue, p. 140, 3rd paragraph of the New Double Stars article, SAO 159683 was incorrectly identified as β Scorpii CR; it is β Scorpii CE.

In September, Frank Fekel, University of Texas, was able to make speckle interferometer observations of several occultation binaries using the 4-m telescope at KPNO. He hopes to analyze his data during the next several months; β Capricorni was one of the observed stars.

A relatively good chart photoelectric observation of last April's occultation of SAO 96746 = Z.C. 1106 = λ Geminorum was obtained by Steve Welch with the 24-inch University of Colorado telescope at Boulder, CO. There was no indication of the close duplicity discovered during the graze that same night and reported in issue #11. He obtained a high-speed digital photoelectric record of the occultation of SAO 162512 = Z.C. 2826 = ρ Sagittarii; this indicates that the star, first claimed to be double by Povenmire and with peculiarities noted earlier by me, is probably double with the parameters given in the table on p. 140 (the p.a. is the value for Boulder + 180° since the fainter star was occulted first). Richard Radick recorded an occultation of the star photoelectrically at the University of Illinois Prairie Observatory near Oakland, IL. He found no evidence for duplicity due either to strong background light from the nearby full moon or to poor geometry, or both.

An occultation of the visual double SAO 96634 = ADS 5885 was recorded photoelectrically last October at McDonald Observatory. The component magnitudes were found to be 9.3 and 10.5, not 9.2 and 11.2, as given in the Lick catalog. The projected separation was not in good agreement with the visual double star data, probably due to differences in lunar limb heights where the components were occulted (the visual separation is 0".6) and the geometry of the event. This can also probably explain the discrepancy between the data for SAO 139033 = ψ Virginis observed at McDonald Observatory and reported in *Astron. J.*, *82*, 828 (Oct. 1977) and the data for the same star recorded photoelectrically in South Africa by Walker, which is superior due to the difference in sequence of component occultations (see p. 109 of issue #10). Orbital motion also may be significant.

J. C. Bhattacharyya obtained a photoelectric record of an occultation of Spica = SAO 157923 at Kavalur Observatory, India, on 1976 March 18, as reported in *Quarterly Journal of the Royal Astronomical Society*, *18*, 397 (Sept. 1977). Since the disappearance was on the bright limb, he observed in the core of the solar calcium K line with a 5 Å bandwidth. The record shows that Spica is clearly double. He probably saw the component discovered by D. Herald in 1975 rather than the very close pair resolved by the Australian intensity interferometer, which would be near or probably smaller than the capability of photoelectric lunar occultation resolution.

Last October 20, Richard Radick obtained a photoelectric record of an occultation of SAO 163471 = Z.C. 2968, β Capricorni's distant 6th-mag. companion. He found that the Strömgren b magnitude was 9.3 ± 0.2, implying a visual magnitude of about 9.0, in exact agreement with the value listed on p. 110 and discussed on p. 108 of *O.N.* #10, based on visual data. Radick, like Fekel, found no evidence for a close third member of the system.

In the table, Richard Nolthenius is credited with the discovery of the duplicity of SAO 161463, but the values given there are based on photoelectric observations made an hour later by B. Smith and J. Africano at McDonald Observatory, TX (hence, the method code is given as P, rather than T, which would have been the case if only Nolthenius' visual observation had been made. Greater accuracy of photoelectric data, and the relatively small difference in position angle, imply that little can be gained from an attempt to combine the two observations.

Jean Bourgeois notes that observing conditions were poor when he saw SAO 161043 disappear in two steps, so there is considerable doubt about its triple nature.

Recently, I uncovered some notes about an occultation of 7.1-mag. Z.C. 2661 = SAO 186717 which I tried to observe in 1975. An occultation of 7.7-mag. SAO was predicted at the same position angle a few seconds earlier; the spectral class of both stars is B8. My curiosity was aroused since it looked like a good double star, but no double star code was given for either star. The occultation was clouded out, so I could not check directly that night. Later searches failed to locate the pair in any of the double star catalogs. The problem was resolved by checking the SAO source catalogs. The source for SAO 186715 was the Yale catalog, which gave CD -22°12893 for the DM number, while the G.C. was the source for SAO 186717, where the DM number was BD -22°4693. In fact, there is only one star; the SAO failed to match the two due to the different DM numbers and large positional errors. So it was another problem caused by the overlap of the BD and CD in the -22° zone. SAO 186715 will be eliminated from USNO's predictions for 1979; it will be many years before the star is occulted again.

The double star code for Z.C. 235 = SAO 110001 is M, "mean position" of a close pair used for predictions. The Lick Observatory IDS, from which most of our Double star data are derived, indicates that the star has an orbit determined and gives no further positional information. However, the orbit was rejected from Finsen and Worley's orbit catalog, so only information for a faint distant component is included in our lists. The problem was uncovered by Walter Nissen while preparing data for recent graze predictions. The double star observation catalogs show that both components are mag. 7.7, and are now separated by about 1".2 in approximately p.a. 55°.

NEW DOUBLE STARS, 1978 FEBRUARY 28

SAO	ZC	M	N	MG1	MAG2	SEP	PA	MAG3	SEP3	PA3	DATE, DISCOVERER, NOTES
93072		P	K	9.7	10.3	".006	328°				1977 Sep 30, J. Africano, McDonald Observatory, TX
94554	0814	T	T	5.6	6.8	0.1	63	10.1	10".1	306°	1978 Feb 17, R. Hays, Palos Hills, IL (2nd *; ADS 4038)
109244		P	K	9.7	9.8	.034	16				1977 Nov 20, B. Smith, McDonald Observatory, TX
109620		T	K	9.1	9.1	0.2	82				1977 Dec 19, R. Sandy, Kansas City, MO
110038		T	K	9.0	9.0	0.1	90				1977 Dec 19, R. Laureys, Diepenbeek, Belgium
161043		T	L	9.9	9.9	0.1	53	9.9	0.2	53	1977 Oct 17, J. Bourgeois, Montigny le Tilleul, Belgium
161399		P	V	9.2	10.5	.090	66				1977 Oct 18, D. Evans, McDonald Observatory, TX
161463		P	X	8.9	11.6	.077	61				1977 Oct 18, R. Nolthenius, San Diego, CA
161479		T	X	9.2	9.8	0.4	214				1977 Oct 18, R. Nolthenius, San Diego, CA
162160		T	X	9.4	9.6	0.12	26				1977 Nov 15, R. Nolthenius, San Diego, CA
162853	2871	T	Y	7.9	7.9	0.05	50	7.6	10.2	236	1977 Dec 13, R. Nolthenius, San Diego, CA (2nd *; ADS 12728)
162877		T	X	9.3	9.9	0.04	252				1977 Sep 22, R. Nolthenius, San Diego, CA