

# Occultation Newsletter

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## FROM THE PUBLISHER

For subscription purposes, this is the first issue of 1979.

O.N.'s price is \$1/issue, or \$4/year (4 issues) including first class surface mailing, and air mail to 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 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 (excluding Spain and Portugal) and U. K. observers should join IOTA/ES, sending DM 10.-- to Hans J. Bode, Bartold-Knaust Str. 6, 3000 Hannover 91, German Federal Republic. Spanish, Portuguese, and Latin American occultation observers may have free membership in IOTA/LAS, including Occultation Newsletter en Español; contact Sr. Francisco Diego Q., Ixpantenco 26-bis, Real de los Reyes, Coyoacan, Mexico, D.F., Mexico.

## PRELIMINARY REPORT OF OBSERVATIONS MADE NEAR THE EDGES OF THE 1979 FEBRUARY 26 TOTAL SOLAR ECLIPSE

David W. Dunham

Plans to make observations near the edges of the path of totality were described on pp. 102 and 103 of the January issue of *Sky and Telescope* and in O.N. 2 (1), p. 5, and (2), p. 11. A detailed 9-page bulletin was prepared by IOTA and sent to about 3 dozen observers who had responded to the above articles, as well as to over 200 high schools, newspapers, and television stations in cities and towns near the edges of the eclipse path.

Overcast skies foiled the attempts of some observers west of the Continental Divide, but many in Washington and Oregon were fortunate, and observed totality through breaks in the clouds. Thanks to the promotional efforts of Richard Linkletter, President of the Olympic Astronomical Society, most of the edge observations were made in those areas. A few observations also were made from Montana, North Dakota, and Saskatchewan, where thin cirrus hardly affected edge phenomena. A very preliminary assessment indicates that the eclipse path was about two miles narrower than expected, as if the solar radius were larger relative to the lunar radius by about 0.3% from the predicted values. However, a careful review of the observations, perhaps including an assessment of the photospheric level sampled by each observer, is needed before any firm conclusions can be drawn.

This is probably especially true at the northern limit, since the smaller-scale features at the moon's northern limb produced less abrupt limb phenomena than those seen at the southern limit.

Perhaps the most successful expedition was led by Robert Hall, Physics Dept., Oregon State University, Corvallis. Nineteen people observed from eight stations spread over a four-mile range at the south edge near Madras, Oregon. The southernmost observer had only a fraction of a second of totality, thus defining the actual southern limit very accurately. He was one mile north of our predicted south edge or 5 miles north of the USNO Circular 157 limit, which does not include refinements such as the effects of deep lunar valleys. Several 35-mm slides and a 16-mm movie recorded the bead phenomena well. Shadow bands and the flash spectrum also were studied.

Another large successful effort was organized by Robert Mitchell, Physics Dept., Central Washington University, Ellensburg, Washington. Eleven stations were spread over a distance of ten miles; the observed totality ranged from 41.5 to 85.4 seconds. In addition, a group of amateur astronomers set up four stations near Cle Elum, 20 miles northwest of Ellensburg, and two stations at nearby Roslyn saw shadow bands but had no totality. The northern station at Cle Elum had only "an instant" of totality, while the southernmost had 46 seconds.

Also in Washington, observations were obtained successfully from four stations near Odessa. The expedition was comprised of students from the Hawthorne High School, Ritzville. Donald Calbick timed 21s of totality at Moses Lake, while Walter Morgan (from Las Vegas, NV) photographed a very close miss from his brother's farm at Quincy. Farther east along the northern limit, John Howell (from Calgary, Alta.) reported an eclipse temperature of -2° F. at Lang, Saskatchewan. Totality lasted about 35 seconds, but absolute times were lost when the sound track failed on the movie camera mounted to an 8-inch Celestron. James Bruton (West Chester, PA) observed from Zenta, Sask., near the Manitoba border.

At the southern limit, totality was timed by students at Wheeler High School in Fossil, Oregon, and also by students in Worden, Montana. Harold Poverwire (Daytona Beach, FL) observed from Sawyer, ND, 15 miles southeast of Minot.

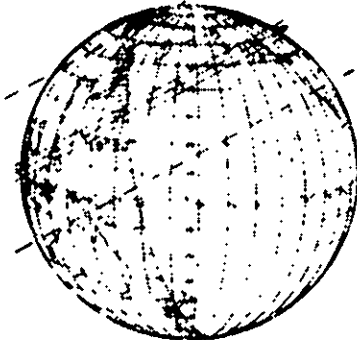
Based on Sunday weather forecasts, Joan and I changed our original plans and flew into Minot, ND, late that evening. In the meantime, my brother, Douglas, had driven from Duluth, with three friends from the University of Minnesota at Duluth, to Rugby, ND, where there is a monument marking the geographical

center of North America. Douglas and Joan took timed photographs from a motel parking lot in Rugby, while I projected the sun's image using a 60-mm refractor at a site 5 miles east of town. I timed dozens of Baily's beads events visually during the few minutes around totality, but within about thirty seconds of totality, the bead events were too complex and rapidly changing to describe; it was the ultimate grazing occultation! One timed photograph of the projected image shortly before totality shows detailed bead structures. Totality lasted 14 seconds, showing that I was only half a mile from the southern limit. Shadow bands were faintly seen, but were stronger in Rugby, where the cirrus clouds were a little thinner and where totality lasted about 40 seconds. We were sorry that we did not have movie cameras or other

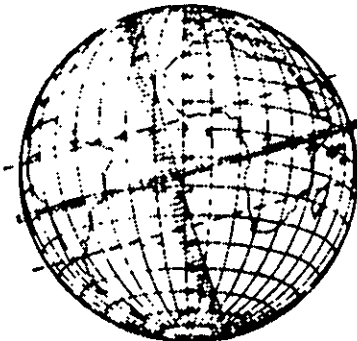
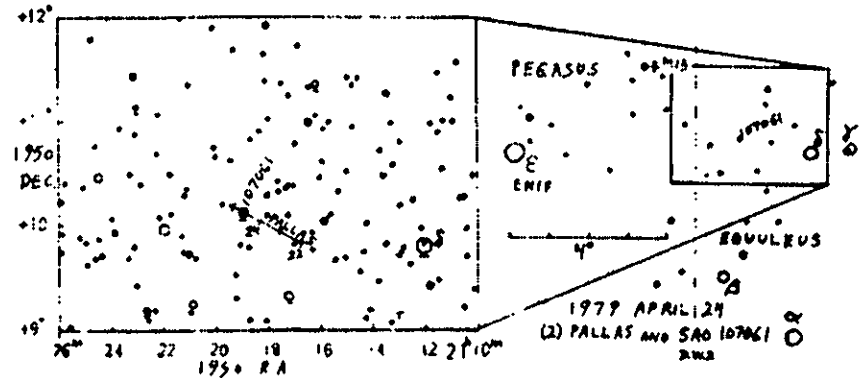
equipment to properly record the fantastic detail which we saw. We had not made extensive arrangements to observe "the eclipse which probably would be clouded out," but which turned out to be one of the best of the four total solar eclipses we have seen.

Many observations were made from locations, such as Minot and Winnipeg, which were far from the center line but more than 15 miles from the path edges. Although limb effects were enhanced only slightly at these places, bead observations and contact timings made there, and from central sites, will be useful for an overall analysis planned by IOTA and USNO. Reports of Baily's beads and contact timings should be sent to: Nautical Almanac Office, U. S. Naval Observatory, Washington, DC 20390, U.S.A.

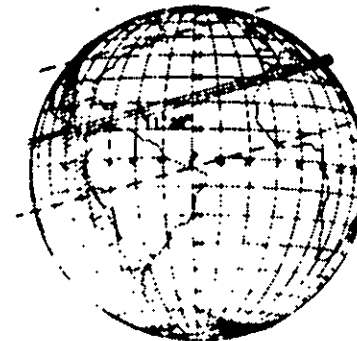
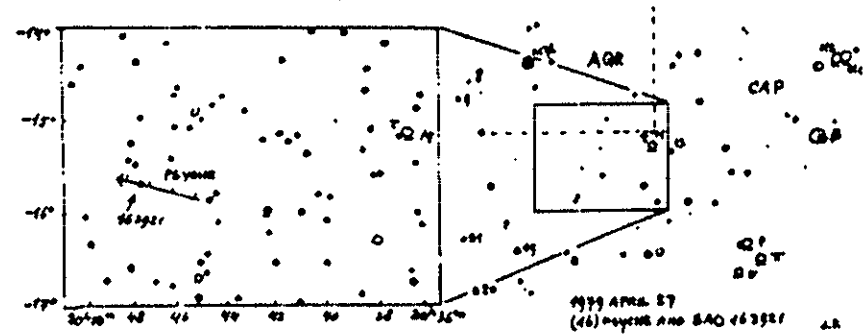
The figures below and on the next page are a continuation of the article PLANETARY OCCULTATIONS DURING 1979, which appears on pages 16-23 of the last issue.



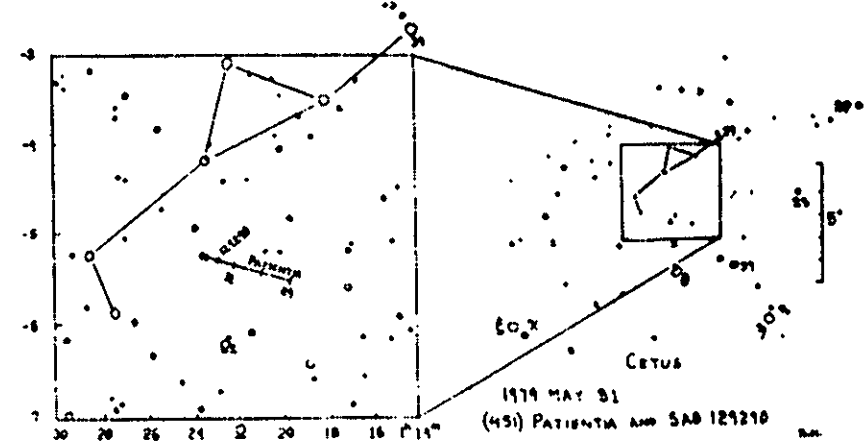
SAO 107741 by Pallas, 1979 Apr 24



SAO 163921 by Psyche, 1979 Apr 27



SAO 129290 by Patientia, 1979 May 31



THE ACCURACY OF COORDINATES OF OBSERVERS OF GRAZING OCCULTATIONS

David W. Dunham

Glen Rowe, a surveyor in Gisborne, New Zealand, published an article about the determination of geographical coordinates for occultation work in Circular C78/5 of the Occultation Section of the Royal Astronomical Society of New Zealand (inquiries about

this publication should be addressed to Graham Clow; R.A.S.N.Z. Occultation Section; P.O. Box 2241; Wellington; New Zealand). He describes a standard procedure for measuring coordinates from a large-scale topographic map, and notes that this is sufficient for stations from which total occultations are observed. But for grazing occultations, he feels that it is necessary to have the observation sites surveyed, and gives comprehensive formulae for the calculation of longitude and latitude from the surveyed measurements. Although the information he uses is for New Zealand, the procedures and formulae are applicable to other geodetic datums. My thoughts about these matters are given below.

Glen Rowe's article, "Co-ordinating Telescope Sites," is certainly interesting and informative, but I am afraid that some of his statements, and the complexity of the formulae for calculating precise coordinates, might discourage observations of grazing occultations in New Zealand. The fact is, an accuracy of one second of arc ( $1''$ ) in latitude and longitude is currently adequate for nearly all grazing observations, so that the map scaling method he describes for total occultation observation sites is sufficient. Since the moon is about 60 earth radii away, a geographical uncertainty of  $1''$  corresponds to an error of less than  $0.02$  on the celestial sphere (that is, this is the size of a geographical uncertainty of  $1''$  subtended at the moon's distance).

Even the best available star positions have uncertainties greater than  $0.05$ , and most are uncertain by more than  $0.1$ . The uncertainties in star positions likely will be reduced by future sophisticated observations, such as those planned with the Large Space Telescope. An even more serious error source is the specification of individual points, and large areas, of the moon's limb with respect to its center of mass. This exceeds  $0.2$ , and I know of no future projects, except the ultimate analysis of graze data, to reduce this error. Consequently, an accuracy of  $1''$  in geographical position is sufficient for making studies to improve our current knowledge of star positions (and associated stellar reference frames) and of the moon's limb by nearly an order of magnitude. Improvements in the mathematical specification of the moon's motion, and fitting these improved theories to lunar laser ranging and occultation observations, have considerably reduced the lunar ephemeris error relative to the other two error sources described above.

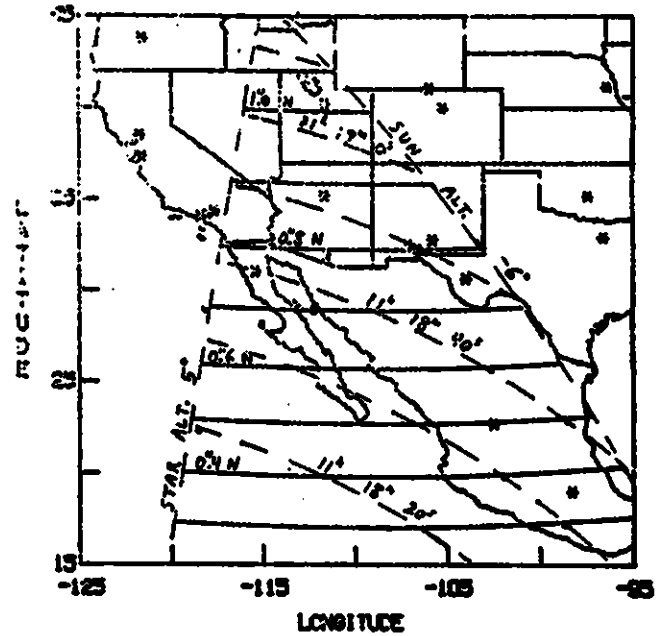
Geographical accuracies better than  $1''$  are sometimes useful, and are needed to specify the observations as accurately as the timings can imply. In the case of favorable circumstances, when events occur at relatively flat areas of the moon during a graze, two observers only 5 meters (about  $0.2$  in geographical position) apart can notice differ-

ences in their timings of a few tenths of a second, enough to be resolved by the usual methods of visual observation. At present, there is no use for such fine-scale information about the moon's limb (except for future occultation events which may occur in that lunar area), but knowledge of observers' relative locations to 5-meter accuracy can be useful for obtaining very accurate information about close double stars. In such a case, the height above sea level should also be known to this accuracy. A survey, as Rowe recommends, would normally be needed to achieve this accuracy, but as only the relative positions are needed this accurately, the coordinates of one station could be scaled from a topographic map, and the coordinates of the other stations specified with respect to that position to  $0.2$  (5-meter) accuracy. There is a case in which similar absolute accuracy would be worthwhile, which is alluded to above: Grazes of the same star might be observed in the same lunar limb area during different months. This effectively eliminates absolute star position and limb errors, so that precise observations could be used for refining the star's proper motion (in an absolute sense) and would also be an extremely accurate test of the lunar motion. Observers might keep this in mind when observing grazes of bright stars, future observations of which would be likely. In such cases, observers should keep careful records of where they were, to at least 5-meter accuracy, so that Glen Rowe's procedures could be used to establish precise geographical positions if future observations make this worthwhile. When possible, observers can position themselves close to geodetic horizontal control stations, whose precise latitudes and longitudes already have been established; then, the procedures for ob-

Occultation of SAO 129290 by (451) Patencia

1975 May 31

Diameter 327 km =  $0.713$



SAO 164174 by Interamnia, 19 May 1979



SAO 78148 by Parthenope, 23 May 1979

taining accurate coordinates described by Rowe could be avoided.

**INSIGHTS INTO THE NATURE OF COMETS  
FROM THE DISCOVERY OF MINOR PLANET SATELLITES**

T. C. Van Flandern

[This is an abstract of a paper presented at a post-session of the 153rd meeting of the American Astronomical Society held 1979 Jan. 7-10 in Mexico City. It is reprinted here with permission of the author from *Bull. Am. Astron. Soc.* 10, 660 (1978).]

The photoelectric confirmation of the existence of a satellite of the minor planet (532) Herculina on 7 June 1978 has been followed by the discovery, from other occultations of stars by minor planets, that such satellites are both numerous and commonplace. All 7 minor planets which have been observed to occult stars have shown evidence of having satellites; and there are now 22 known or suspected companions of these 7. If comets are thought of as systems of orbiting bodies like minor planets, differing only in that their gas and dust-sized "satellites" have not yet been expelled by solar radiation pressure, then many puzzling features of comets are simultaneously explained. Comet comas contract as they approach the sun and expand as they recede because the comet's gravitational sphere of influence does likewise. Splitting of comets represents gentle escapes of satellites. The gas and dust of comas is orbiting material, and therefore accompanies a comet even at aphelion; hence no solar heating is required to produce them. New comets lose much more material than old ones because of the first-time shrinking of their spheres of influence. The same process spreads meteors into the comet's orbit. This model therefore explains away the principal criticisms of both the "dirty snowball" and "particle swarm" comet models.

**OTHER LATE 1978 ASTEROIDAL OCCULTATIONS**

David W. Dunham

(12) *Victoria* and SAO 161878, October 25. An observation of this occultation from Battelle Observatory, Richland, WA, was reported on p. 7 of *O.N.* 2 (1). James McMahon reports that he observed a blink using a 10-inch reflector at China Lake, CA. Although there were some cirrus clouds in the area, he feels that the sudden event was probably not atmospheric. An observer using the guide telescope in the same observatory, and another observer a few miles away, claimed that no blink occurred. But McMahon asked each observer to point out the star he was watching, and in each case it was the wrong star. McMahon is confident that he had the correct star in view, as he saw the faint asteroid approaching it before the images merged.

(10) *Hygiea* and SAO 187163, November 4. Jan Hers and other South African observers reported that large patches of clouds prevented observation.

(10) *Hygiea* and SAO 187576, November 17. Richard Nolthenius reports that cloudy skies prevented observation of this event from California. As far as I know, no astrometric updates were made for the two November *Hygiea* occultations. The southern declination and relatively small elongation from the sun virtually ruled out astrometric observations from England or from the U.S.A.

(511) *Davidia* and SAO 190782, November 21. Astromet-

ric plates obtained at Lowell Observatory during the several days preceding the event continued to indicate a considerable north shift, as noted on p. 7 of *O.N.* 2 (1), but with a considerable scatter due to the southern declination. An approaching storm prevented observation from the West Coast of the U.S.A. The asteroid was observed to merge with the northern side of the star's image at Lowell Observatory, AZ, and Tortugas Observatory near Las Cruces, NM, confirming that the path did go well to the north. Jack Drummond, New Mexico State University, reported measurements of plates of the appulse taken at their Tortugas station. My calculations from these data indicated that the path was far to the north, probably off the earth's surface. The *Davidia* event clearly illustrates the need for good astrometric observations from the Southern Hemisphere. Such a capability also would be useful for refining predictions of asteroidal occultations expected to occur in the Southern Hemisphere.

(29) *Amphitrite* and SAO 146788, December 6. Maps and updates to the prediction for this event were published on p. 6 and 7 of *O.N.* 2 (1). Later in November, William Penhallow obtained a plate of the star. This measurement, combined with his earlier update on *Amphitrite*'s ephemeris indicated that the center of the occultation path would be 0°18 south of the nominal prediction (crossing the English Channel, Belgium, northern Germany, Poland) with the event 1½ minutes late. We estimated that the prediction could be 0°5 in error. I prepared IOTA Special Bulletin No. 6 about the event and this astrometric result, noting that a last-minute update might be obtained from Gordon Taylor, and distributed the bulletin to many groups of observers in western Europe. Taylor obtained a plate with the two objects about a degree apart. His prediction based on this plate put the path near the Canary Islands and across northern Africa, apparently near 2° south.

Observing conditions at the time of the event were very favorable in the northeastern U.S.A. In the Washington, DC, area, the sun was only 7° below the horizon at the time. Due to a lack of bright stars near the asteroid readily visible in the twilight, I was unable to locate the objects until nearly twenty minutes after the conjunction, although I had familiarized myself with the star field the previous evening. I recommend two approaches for future events of this type in bright evening twilight: 1) Use an equatorial mount, aligned well with the celestial pole, and good setting circles to offset from first magnitude stars to the desired star field, or 2) Use the technique that has been used successfully for making some daytime lunar occultation observations at small elongations from the sun (when the moon could not be seen without optical aid): Observe a star which has approximately the same declination as the star to be occulted, at a time during a previous evening when it will be at the same hour angle as that predicted for the event to be observed. Mark the orientation of the telescope axes with masking tape, and the tripod legs with stakes driven in the ground. The masking tape can be cut to disassemble the telescope, and the cut ends matched to reassemble it in the correct orientation just before the possible occultation.

Needless to say, the telescopes at the U.S. Naval Observatory do have good setting circles, so that T. Van Flandern and R. Schmidt were able to locate the star and minor planet several minutes beforehand and monitor the appulse photoelectrically. No drops occurred in the light curve, and the objects were

clearly separated at closest approach. Charles Morley obtained plates of the approach with the double star camera on the 26-inch refractor. Measurements of these plates showed that closest approach was 1:75, about 4 minutes later than the nominal prediction. Since the 0:9 north path went through Washington, the occultation path must have been at 0:85 south, so that the following cities should have been in, or very near, the path: Lisbon, Portugal; Madrid and Barcelona, Spain; and Rome, Italy. I have not heard from observers in those areas; perhaps it was cloudy (they were sent copies of IOTA Special Bulletin No. 6). No occultation was reported by observers in Massachusetts and in Belgium (where the seeing was poor).

(41) *Daphne* and SAO 111443, December 11. Penhallow made astrometric observations of the star and *Daphne* in late November. My calculations using these data indicated a 1:6 north shift, indicating that the path might cross southern India and the Philippines. Penhallow obtained more exposures on December 7, when the star and *Daphne* were about a degree apart. Although there was some scatter, the mean result indicated a 1:5 north shift with the event 44 minutes early. When I telephoned Gordon Taylor a day in advance to discuss astrometry for the *Melpomene* occultation, I gave him Penhallow's measurements for the *Daphne* event, suggesting that it might be worthwhile to notify observers in southern India and the Philippines. A long run of poor weather had prevented Taylor from making astrometric observations for the event.

#### NEW DOUBLE STARS

David W. Dunham

The table lists additions and revisions to the special double star list of 1974 May 9 not listed in previous issues. The columns and general format were described on p. 3 of *O.N.* 2 (1).

The most interesting double star discovery since the last list was published is SAO 114159, whose duplicity was discovered during the occultation by *Melpomene* as described on p. 13 of the last issue. The values given in the table were determined largely by the visual observations of the occultation which indicate sizeable limb irregularities, the existence of which is supported by photoelectric rotational light-curve data on *Melpomene*. The irregularities introduce an uncertainty of about 0:005 in the relative positions of the stellar components. If some of the visual occultation observations are ignored, producing a more regular shape for *Melpomene*, the separation of the stellar components decreases. The accurate relative positions of the stars is important for proper interpretation of the secondary occultation events reported outside the main occultation path, indicating possible satellites of the asteroid. The relatively large stellar separation poses some problems for the satellite model of some of the secondary occultation events, in the sense that with such a separation, some of the secondary events should have been confirmed at other stations, but were not. An accurate relative position of the two stars independently determined would be very useful. Unfortunately, the star is in Monoceros, far from the ecliptic, where it can not be occulted by the moon. Another star in this category is SAO 120836, which was occulted by (2) Pallas on 1973 February 6 as seen from parts of western North America (*J.R.A.S.C.* 67, 198 (1973)). No conclusions were drawn from the conflicting observations. Van Flandern feels

that the data can be explained by stellar duplicity (approximate parameters given in the table) and a satellite of Pallas, as described in his and Binzel's article, "Minor Planets: The Discovery of Minor Satellites" in *Science* 203, 904 (1979 March 2). Independent observations of the stellar duplicity would be valuable for checking Van Flandern's hypothesis. Speckle and spectroscopic observations of both of these stars for duplicity would be useful.

The brightest new double is SAO 110408 = Z.C. 327 =  $\epsilon^1$  Ceti, which is now being occulted. Roger Griffin writes that his analysis of spectroscopic data indicates a period of 1640 days and an amplitude of about 6 km/s, so that "the secondary should have non-negligible mass," and possibly be detectable during an occultation. A couple of grazes of the star have been observed visually, with no reports of possible duplicity, but the separation may be too small to resolve without a high-speed photoelectric record.

All of the new non-SAO doubles were reported in the I.A.U.'s Commission of Double Stars Information Circular No. 76 (1978 October) and No. 77 (1979 March). BD +15:269 = K 1015 = AGK: N15:155, BD +15:340 = K 1348 = N15:211, and BD +15:409 = K 1593 = N16:260 are in USNO's XZ catalog; the others are in neither the AGK3, XZ, or K catalogs. The anonymous star is at 1950 R.A. 7<sup>h</sup>45<sup>m</sup>2, Decl. +15°34', 1' south of SAO 97258. Newly determined orbits are given for four of the stars in our list, mostly from Circular No. 74.

C. L. Morby, J. M. Fletcher, and G. Edwards have published some notes about known or suspected doubles based on photoelectric occultations recorded at the Dominion Astrophysical Observatory, Victoria, British Columbia, in the *Journal of the R.A.S.C.*, 72, 305-309 (1978 December). They resolved the spectroscopic binary SAO 158489 = Z.C. 2053 =  $\lambda$  Virginis on 1977 July 24, obtaining a separation of 0:006 and a magnitude difference of 1.4 in blue. Since the separation is more than an order of magnitude larger than the spectroscopic nominal angular separation, I think there is a possibility that the star is triple. SAO 94865 was observed on 1978 April 15. There was evidence for a 0:015 separation for this spectrum double. An observation of SAO 158489 = Z.C. 2826 =  $\rho$  Sagittarii on 1977 July 29 showed no evidence for duplicity. This, combined with a good photoelectric record by R. Radick at the University of Illinois, also showing no duplicity, casts considerable doubt on the possible duplicity of the star reported in previous issues. Repeated frustrations with Murphy's laws led one of the authors to write an ode entitled "O Occultation", which was included in the *JRASC* article. 162512

SAO 92996 is the only new double reported by W. Beavers and J. Eitter in a recently received preprint of a long article giving results of their photoelectric occultation observations made from 1974 to 1977. No evidence for duplicity was found for several stars reported as double by other occultation observers, usually at McDonald Observatory, TX, including the following stars: SAO 78666, SAO 93835, SAO 97120 = ZC 1158, SAO 97843 = ZC 1271 (a high-quality record; the star's originally claimed duplicity has been questioned according to other observations reported in recent *O.N.'s*), SAO 109262 = ZC 69 (1975 Nov. 15, p.a. 39:7; good record with strong fringes showing no evidence of second or third member"), SAO 146239 = Z.C. 3326 ("geometry apparently unfavorable"; the star is a known close visual double, Kuiper 114, probably very close to periastron

in 1974-1975), SAO 146307 = ZC 3340, and SAO 164213. SAO 162512 = Z.C. 2826 =  $\rho$  Sagittarii is noted as a "possible double" according to data obtained at p.a. 49°4 on 1976 Sept. 4, but other observations noted above indicate no duplicity. Improved component magnitudes are given for the following known doubles: SAO 77313 = Z.C. 843 + ADS 4200, mags. 7.8 and 8.1; SAO 77423 = ADS 4277AB, 9.3 and 10.0; SAO 159090 = Z.C. 2172 = ADS 9532Aa, 5.0 and 6.2; and SAO 163645 = Z.C. 2995, 6.8 and 7.2 (the components as listed in the Lick IDS need to be reversed, so that at 1975, the p.a. is 347°4, not 167°4).

The two errors which I have corrected in the list were discovered when the graze computers requested double star data for stars which are not in their 1977 lists, and I tried to supply the information. Joe Senne recently pointed out a variable star error, for 8.2-mag. SAO 161257 = WZ Sagittarii. The magnitude at minimum light was given as 0.9 in the USNO data, when it should have been 10.9. Don Stockbauer noticed that the same data are given in our lists for SAO 98614 and 98615. SAO 98615 is the 7.7-

mag. primary; 98614 is the 8.0-mag. secondary 14°2 from 98615 in p.a. 242°.

Jim Van Nuland writes, "In studying your new Double Stars Article in *o.n.* 2, 4 (1), col. 1, under other stars, I noticed the same SAO number, 184336, given for ZC 2609 (line 2) and for ZC 2349 (line 12). Other issues of *o.n.* list 184336 = ZC 2349, so I conclude that the SAO number in line 2 is wrong. Presumably the correct number for AC 2609 is 186237, as given in the table at the head of the page." His presumption is correct.

[Note added Apr. 9] Van Flandern has retracted his published interpretation of the 1973 Feb. 6 occultation of SAO 120836 by Pallas, since astrometric observations show that the main occultation path crossed part of western Canada, not Colorado. The short occultation recorded in Alberta involved a light drop 85% of that expected, indicating that the star is probably double, but the separation and p.a. are unknown, since no occultation of the secondary star seems to have been recorded.

#### NEW DOUBLE STARS, 1979 APRIL 9

SAO/BD	ZC	M	N	M1	MAG2	SEP	PA	MAG3	SEP3	PA3	DATE, DISCOVERER, NOTES
78135*0946	V	Q		3.4	5.4	0°03		8.8	1°08		1978, 3rd* orbit by Baize, IAU Circular 76 (ADS 4841)
78349*0983	I	V		6.5	6.9	.055	160°				1976.860, H. McAlister, Kitt Peak Observatory, AZ
92996	P	X		9.3	9.3	.041	37				1976 Mar 6, J. Eitter and M. Beavers, Ames, IA
93076	V	C		8.4	10.7	0.9	339				1978.9, W. Heintz, Swarthmore, PA
93433	V	O		8.7	10.2	0.30					1979, orbit by Baize, IAU Circular 77
93524	0523	T	K	7.3	7.3	0.1	90				1977 Nov 25, A. Osipov, Kiev, Ukraine
93731	V	C		9.8	9.8	0.2	22				1978.9, W. Heintz, Swarthmore, PA
93803	0618	P	V	7.3	10.0	.037	80				1978 Oct 19, B. Smith, McDonald Observatory, TX
94288	T	X		9.6	9.6	0.3	91				1979 Apr 2, J. Van Nuland, San Jose, CA
94922	T	K		9.3	9.3	0.1	270				1978 Oct 21, P. McBride, Green Forest, AR
95728	P	V		9.6	9.7	.041	138				1978 Nov 18, D. Evans, McDonald Observatory, TX
96267	T	K		9.4	9.4	0.1	270				1977 Sep 8, A. Zhitetski, Kiev, Ukraine
96343*	C	T		9.1	9.1	0.6	270	9.1	40.8	48°	Correct error
97222	T	K		8.6	8.6	0.36	90				1978 Dec 17, P. McBride, Green Forest, AR
97782	T	X		8.8	9.3	0.2	93				1979 Apr 6, D. Dunham, Silver Spring, MD
109039	T	V		8.6	8.6	0.2	90				1977 Nov 20, A. Zhitetski, Kiev, Ukraine
109355	T	X		9.1	9.1	0.1	90				1977 Dec 18, B. Sincheskul, Poltava, Ukraine
110183	T	V		9.7	9.3	0.3	270				1977 Sep 1, A. Zhitetski, Kiev, Ukraine
110295	0300	P	V	8.2	9.2	.028	228				1978 Nov 13, D. Evans, McDonald Observatory, TX
110359	0315	T	X	8.3	8.8	0.3	221				1979 Feb 3, R. Nolthenius, Mountain View, CA
110398	T	K		9.1	10.1	0.2	277				1979 Feb 3, R. Nolthenius, Mountain View, CA
110408	0327	S	J	4.7	6.7	.012					1979, R. Griffin, Cambridge, U. K.
114159	X	V		8.6	10.1	.051	27				1978 Dec 11, T. Van Flandern, U.S.N.O., Washington, DC
118443*1564	V	O		6.7	8.0	.378					1978, orbit by Heintz, IAU Dbl. Star Circ. 74 (ADS 8887)
120836	X	X		9.4	10.3	0.2	320				1973 Feb 6, T. Clark and E. Milona, Priddis, Alberta
139175	1886	T	K	6.5	6.5	0.1	90				1977 May 1, A. Zhitetski, Kiev, Ukraine
145537*3166	I	V		5.0	8.0	.033	123				1977.4819, H. McAlister, Kitt Peak Observatory, AZ
146047	T	K		10.1	10.1	0.5	90				1978 Nov 9, P. McBride, Green Forest, AR
146088	3296	T	X	9.5	9.5	0.3	90				1978 Nov 9, P. McBride, Green Forest, AR
146289	P	V		8.9	9.4	.017	259				1978 Oct 13, L. Coleman, McDonald Observatory, TX
161107	T	V		9.4	11	1.0	10				1978 Oct 8, R. Giller, Engadine, N.S.W., Australia
161426*	C	A		8.1	11.4	8.0	46				Correct error
162777	2856	G	X	6.8	8.5	0.2	347				1978 Dec 3, D. Staicks, Murray Bridge, South Australia
163666*2997	V	O		7.9	7.9	.231					1978, orbit by Heintz, IAU Dbl. Star Circ. 74 (ADS 13961)
164233	T	K		9.7	9.7	0.1	90				1977 Dec 14, A. Zhitetski, Kiev, Ukraine
164482	P	X		9.3	10.9	.042	236				1978 Nov 8, B. Smith, McDonald Observatory, TX
187251*	V	O		8.7	9.2	.398					1978, orbit by Heintz, IAU Dbl. Star Circ. 74 (ADS 11643)
+17*1043b	T	V		9.8	10.0	0.8	155				1979 Apr 3, J. Van Nuland, San Jose, CA
+15 269	V	C		9.4	11.5	0.8	120				1978.9, W. Heintz, Swarthmore, PA
+15 340	V	C		9.8	11.0	2.5	53				1978.8, W. Heintz, Swarthmore, PA
+15 409	V	C		9.9	11.1	4.1	197				1978.9, W. Heintz, Swarthmore, PA
+15 1612	V	C		10.6	10.6	0.7	4				1978.2, W. Heintz, Swarthmore, PA
+15 1640	V	C		9.5	10.6	2.8	102				1978.2, W. Heintz, Swarthmore, PA
+15 1682	V	C		10.5	10.5	0.2	54				1978.2, W. Heintz, Swarthmore, PA
+15 1692	V	C		10.3	10.4	0.4	116				1978.2, W. Heintz, Swarthmore, PA
+15 1746	V	C		10.2	10.7	1.5	65				1978.2, W. Heintz, Swarthmore, PA
Anonymous	V	C		10.5	11.2	3.4	42				1978.2, W. Heintz, Swarthmore, PA

## POSSIBLE OCCULTATION BY PLUTO ON 1980 APRIL 6

Gordon E. Taylor

The star concerned is about 12th magnitude and its 1950.0 position is R.A.  $13^h40^m45^s.1$ , Dec  $+8^{\circ}34'48''$ . The occultation, if it occurs, will be seen from a track about 6000(?) km wide, between longitudes E  $90^{\circ}$  and W  $60^{\circ}$ . Note that it cannot be seen from observatories in North America, Australasia or east Asia. The present indication is that the chances are lower in Europe and higher in S Africa (where an occultation would be seen in a dark sky at a high altitude above the horizon).

I propose the following schedule:

- January 1979 Pluto within 1 $\frac{1}{3}$  of the star. I intend to take plates at Herstmonceux.
- February I will issue preliminary predictions in a Bulletin.
- March-May I hope that U.S. astronomers will determine spectrum and magnitudes of the star - if it is still likely to be occulted.
- August IAU meeting in Montreal. We could discuss planning of observations and any necessary expeditions.
- December Pluto within 1 $^{\circ}$  of star. I intend to take plates at Herstmonceux.
- January 1980 I will issue revised predictions in a Bulletin.
- end of March Pluto 0 $\frac{1}{3}$  from star. I intend to take plates at Herstmonceux.
- April 1-3 I will issue final predictions by telex or telephone.
- April 6 Occultation.

[D.W.D.: T. Van Flandern has supplied the following additional information, largely based on ephemeris data for Charon supplied by R. Harrington at USNO. The occultation is expected to occur about 23 $^h$  U.T. of April 6. At that time, Charon, the satellite of Pluto, is expected to have a separation of 0 $\frac{1}{6}$  from Pluto in position angle  $355^{\circ}$ . Consequently, an occultation by Charon is more likely in Europe and less likely in southern Africa. Since Pluto's horizontal parallax will be 0 $\frac{1}{3}$ , it is possible that Charon's shadow could narrowly miss the north polar regions while Pluto's shadow could miss the south polar regions, but hopefully, we won't be that unlucky. Although the star is faint, Pluto will be about two magnitudes fainter, so that an occultation could be observed visually with a large telescope.]

## MORE ON JUNO

Yaron Sheffer

Since the article by Dunham and myself (o.n. 2 (2), 12) was written, I have learned of two more attempts to observe last July's occultation of SAO 144070 by (3) Juno from Israel. A. Lerrer used a 6-cm refractor to observe the occultation from Ramat Hasharon, 9 km southwest of my location and only 2 km south of a line parallel to the motion of Juno's shadow pas-

sing through my site. Since he had only one stopwatch, he only timed the disappearance, at 23 $^h$ 01m-1995 U.T., 1 $\frac{1}{2}$ 0 earlier than my timing. However, the disappearance should have been 0 $\frac{1}{7}$  later at his site. I believe that the discrepancy can be explained by different personal equations, and stopwatches with different mechanisms perhaps running at slightly different rates and with different zero-settings (stopwatch jumping at start, and/or different personal equations when stopping watch to time signals). Lerrer did not see the secondary occultation which I observed, either because he was not observing at the time (he had difficulties in finding the star in strong moonlight) or because the satellite occultation shadow passed north of him (the event was grazing at my site; this would imply that the star was occulted by the southern edge of the object).

I. Shlosman observed the appulse visually with the 102-cm telescope of Wise Observatory. The objects merged, but no fading was detected. If Juno's diameter is 256 km, as implied by my observed chord, and if the occultation was central at my location, Wise observatory would have been about 30 km south of the actual southern limit of the occultation.

## MWV IN ERROR

According to the National Bureau of Standards Time and Frequency Bulletin No. 253 (1978 December), there was an approximately 1.2-millisecond time error in MWV's transmissions at all frequencies on 1978 November 29 between 13 $^h$ 10 $^m$  and 15 $^h$ 05 $^m$  UTC. Inquiries about the Bulletin should be addressed to: Sandra L. Howe, Editor; Time and Frequency Division; National Bureau of Standards; Boulder, CO 80303.

## GRAZES REPORTED TO IOTA

David W. Dunham and Robert A. McCutcheon

Report forms for grazing occultation observations are available from either the IOTA Secretary-Treasurer or from me. Completed reports should be sent to me at: P.O. Box 488; Silver Spring, MD 20907; USA. If possible, a copy of the report should also be sent to: H.M. Nautical Almanac Office; Royal Greenwich Observatory; Herstmonceux Castle; Hailsham; Sussex BN27 1RP; England, the world center for reporting all occultation observations, as designated by the International Astronomical Union. Please indicate on your report whether copies have been supplied to IOTA and/or IMAAO. If this is not done, we will assume that no copy has been sent to the other.

New graze report forms, prepared in a form ready for direct keypunching (as are IMAAO's total occultation forms), are nearly completed and will be distributed to IOTA members within a few months. Since they also will make the job of transcribing previous reports to forms for keypunching much simpler, that project is suspended until the new forms are ready. Don Stockbauer, Victoria, TX, and students at the Bruce Peninsula District School, Lion's Head, Ontario (under the direction of Doug Cunningham) are commended for transcribing a large fraction of the previous reports onto keypunch forms. Completion of the new forms will add impetus to IOTA's long-delayed effort to produce a manual on grazing occultations.

The first 2 columns of the table give the Universal Time month and day numbers. Star numbers are usually Z.C. (4 digits) or SAO numbers (6 digits). The B.D. number is given for non-SAO stars. The B.D. and C.D.



are components of the DM catalog, but the moon will not occult CD stars during the next few years. A number prefixed by a letter is a USNO reference number, but in general, starting with this issue, they will not be used unless there is no B.D., SAO, or Z.C. number available. Solar system objects will be identified by name. The previously used USNO Z numbers are being superseded by X numbers for 1979, and they in turn likely will be replaced within about five years by another catalog when the SRS program is completed. The more widely used ZC, SAO, and DM numbers will remain unchanged. In case of close double stars, the combined magnitude is given. Under the next column, the percent of the moon's apparent disk sunlit, + signifies waxing, - waning phases. Next is the cusp angle in degrees from the north or south cusp. Only the number of stations reporting useful data (including possibly one station reporting no occultation) is given under # Sta. Next is the number of timings, which counts 1/2 for "possibly spurious" events and nothing for "most likely spurious" ones. Only contact timings (extended HNAO codes 1-6 and 15-18) are counted (a "10" event would be counted if the time for the implied event can be inferred to within about 2 seconds). Totals involving halves are rounded up. CC is the best observing condition code (numerically highest) reported by any observer in the expedition. Ap cm gives the aperture, in centimeters, of the smallest telescope in the expedition which achieved the observing code listed under CC (in case more than one observer achieved it). St gives the estimated shift from the USNO prediction (without applying any correction based on latitude libration), in

Mo	Dy	Star Number	% Mag	% Sn1	CA Location	# Sta	# Tm	C C	Ap cm	Organizer	St	WA	b
1976													
7	21	2601	8.4	33-	St.Llorenc,Spain	1	6	20		Raimon Reginaldo			
7	24	095127	7.6	8-	3S Cocoa, FL	1	2	31		Robert Wood			
1977													
3	12	160534	8.4	50-	5S Earthquake, CA	1	1	5	15	Richard Nolthenius	C184-		50
3	15	163504	8.8	19-	-1N Ocean Beach, CA	1	1	4	15	Richard Nolthenius			
8	5	0284	7.4	62-	6N Silverdale, N. Z.	2	6	20		Graham Blow			
9	17	158863	9.1	18+	10S Auckland, N. Z.	1	3	50		Graham Blow			
10	4	095009	8.2	61-	7N Burlington, IL	1	1	3	20	John Phelps	8S356		71
10	18	161482	8.3	34+	7S Descanso, CA	1	1	5	15	Richard Nolthenius	C168-		61
10	19	2826	4.9	44+	3S Walnut, CA	2	9	7	15	Richard Nolthenius	C177-		60
10	20	2969	3.2	56+	-6N Bangor, WI	1	7	7	25	Berton Stevens	3S355-		58
10	22	3362	5.9	83+	S Guntsville, Ont.	1	3	20		Robert Radko			
11	06	118524	8.7	27-	-1N Ocean Beach, CA	1	1	7	15	Richard Nolthenius	C357+		40
1978													
1	29	1795	7.1	71+	7S Lakeside, CA	1	4	8	25	John Hildebrand			
2	17	0829	7.0	70+	7N Sun City, CA	2	8	8	20	Richard Nolthenius	5N		68
3	17	095461	7.8	57+	Cooma, Australia	1	1	32		David Herald			
3	17	095985	7.9	59+	Marinha Gr.,Port.	1	5	4	20	Joaquin Garcia			
3	20	1271	5.9	80+	7N Bondville, IL	3	5	7	13	John Phelps	7S		2 64
3	21	1458	5.9	85+	Agueda, Portugal	1	2	10		Jose Osorio			
4	11	0692	1.1	17+	Fertá-St.Aubin,Fr.	8	56	26		Jean Schwaenen			
4	14	1091	6.7	45+	.Sezimbra,Portugal	1	2	3	16	Joaquin Garcia			
4	14	1096	5.3	45+	N Sonderholm,Denmark	4	5	6		Kyril Fabrin			
5	11	0944	5.7	14+	N Nashville, Ont.	3	7	5	16	Andreas Gada			
5	14	1381	6.3	45+	Malda, Spain	3	18	14		Pedro Manosa			
5	14	1381	6.3	45+	Mollerussa, Spain	1	6	8		Domenech Barbany			
6	7	095715	7.8	3+	4S Johannesburg, RSA	2	3	8	8	Jan Hers			
6	29	0257	4.5	33-	6N Pretoria, R.S.A.	2	7	9	8	Jan Hers	C184-		50
7	2	0692	1.1	7-	3S Orinda, CA	5	49	5	15	James Ferreira	175		
7	2	0692	1.1	7-	3S Concordia, CA	7	25	8	8	Raymond Bryant			
7	9	1474	7.1	14+	Michelago,Austrl.	9	46	8	6	David Herald	C		3 30
7	14	2033	4.3	61+	5S Goulburn,Austrl.	11	26	8	20	David Herald	C175-		40
7	14	2033	4.3	61+	5S Jamberoo, Austrl.	6	23	9	8	Roger Giller			
7	14	2033	4.3	61+	5S Kiama, Australia	4	10	8	8	Andrew Dixon			
7	28	0496	7.9	35-	3N Rochester, IA	1	6	9	20	Frank Olsen			
7	28	0496	7.9	35-	3N La Grange, WI	2	2	8	20	Homer DaBoll	3N356		60
7	29	0618	7.2	27-	1N Hifflinburg, IA	3	8	6	20	David Dunham	357		67
7	29	0627	6.8	26-	2N Berthoud, CO	3	8	5	20	Derald Nye			
7	29	0627	6.8	26-	2N Berthoud, CO	3	15	7	20	Paul Asmus	C354		67
7	31	0862	7.5	13-	4N Lanseria, R.S.A.	2	7	8	8	Jan Hers	351		62
7	31	095487	8.0	9-	S Canberra, Austrl.	2	4	3	20	David Herald	1S172		60
8	7	119009	9.1	12+	Nigel, R.S.Africa	1	0	31		L. Pazzi			
8	8	Venus	-3.8	14+	0N Brownsville, TX	8	16	6	5	Paul Maley			
8	15	161562	8.3	85+	8S Ocean Beach, CA	1	1	7	15	Richard Nolthenius	170-		58
8	26	0692	1.1	45-	N Inverness,Scotland	1	4	5		Graeme Nash			
8	26	0729	7.2	41-	7N Maxwell, TX	1	10	8	15	Don Stockbauer	353		70
8	26	0729	7.2	41-	N Rayville, LA	7	18	5	11	Ben Hudgens	0353		70
8	26	094177	9.0		Collinston, LA	1	1	5	25	Ben Hudgens			
8	26	0764	5.0	38-	5N Kaitaia,N.Zealand	2	5	6		Gordon Herdman			
8	28	095740	8.3	24-	5N Englewood, FL	1	0	15		Harold Povenmire			
8	28	095759	7.7	23-	5N Woodsboro, TX	1	0	6	25	Don Stockbauer	6+S352		71
8	28	095866	8.3	23-	5N Ricardo, TX	1	0	8	25	Don Stockbauer	9+S352		69
8	29	1158	5.2	13-	1N Kaitaia,N.Zealand	1	1	13		Gordon Herdman			
9	8	159095	8.6	28+	4S La Jolla, CA	1	4	6	15	Richard Nolthenius	C174-		45
9	9	2308	7.6	39+	7S Bloomington, TX	1	4	7	25	Don Stockbauer	C172-		55
9	11	2596	7.3	60+	7S Laurel, FL	1	0	15		Harold Povenmire			
9	22	0667	5.3	68-	7N Carr, CO	1	2	6	20	Paul Asmus	356		71
9	22	0667	5.3	68-	7N Henrietta, MN	6	10	8	10	James Fox	3S355		71
9	22	0667	5.3	68-	7N Bayfield, WI	1	5	7	20	Homer DaBoll	10N356		71
9	22	0692	1.1	67-	-5S Riviera, TX	1	4	7	15	Don Stockbauer	178		67
9	22	0692	1.1	67-	-5S Citrus, FL	18	89	9	25	Tom Campbell	2N184		67
9	24	0934	6.4	49-	9 Teatable Key, FL	2	9	15		Harold Povenmire			
9	24	0944	5.7	49-	7N Tranquility, CA	3	22	7	15	Richard Nolthenius	3N352		73
9	24	0944	5.7	48-	8N Kerman, CA	10	47	6	20	James Van Nuland	CS352		73
9	24	0944	5.7	48-	7N Wheatland, WY	2	8	6	25	Paul Asmus	353		73
9	24	0944	5.7	48-	6N Cambridge, MN	9	32	8	10	James Fox	3S354		73
9	24	0944	5.7	48-	6N Hayward, WI	1	3	7	20	Homer DaBoll	3N354		73
9	24	095554	7.8	48-	6N Tranquility, CA	2	0	8	15	Richard Nolthenius	C355		71
9	24	0975	6.8	47-	-1S Devil's Den, CA	2	2	6	15	R. Nolthenius	10N182		70



tenths of a second of arc on the predicted profile. N and S indicate whether the observed graze shadow passed north or south of the predicted one. C indicates the Cassini region, where Watts' limb data are not available. WA is the Watts angle of central graze, and b is the latitude libration, in tenths of a degree (e.g., "-50" signifies  $-5^\circ$ ). For a given star, the difference between the WA and PA of graze changes only slightly. For comparison purposes, remember that CC depends on twilight, clouds, and other factors not indicated in the table. When expedition leaders report their observations, it would be helpful if they reported all quantities listed in the table, in addition to the ones on the forms. A copy of the predicted profile sometimes helps. Report SAO or DM numbers for non-Z.C. stars. Observations of grazes of the same star during two or more months can be especially helpful in studies of the moon's shape and motion, since the uncertainty in the star's position can be largely removed. So if you see a graze of a star listed in the table in your upcoming predictions, try to assign the event special priority. There may be opportunities to observe occultations of a particular star for only a few more months, and then not again for many years, so prompt reporting

of observations is encouraged. Also, observers of upcoming grazes of a previously observed star might be alerted to a significant star position shift and thereby improve their prediction. This works better when the WA's of the observed and predicted graze are closer to each other.

More grazing occultations of Aldebaran (ZC 692) have now been observed than of any other star. Observers consequently should be especially careful in determining geographical positions for grazes of this star, as noted in the article on accuracy of positions for grazes on p. 22. Peter Espenschied calls our attention to the fact that the locations of buildings shown on U.S.G.S. maps are not accurate, and are specifically exempted from national map accuracy standards. Hence, buildings should be avoided for positional reference; measurements with respect to road intersections would be preferred when using

Mo	Dy	Star Number	% Mag	% Sml	CA Location	# Sta	# Tm	C C	Ap cm	Organizer	St WA	b
9	25	1045	8.1	43-	N Matadepera, Spain	1	4		20	Joan Genebriera		
9	26	1190	7.1	30-	6N Forbes, MO	2	14	7	15	Robert Sandy	5S351	64
9	26	1190	7.1	30-	5N Lockport, IL	5	26	7	13	John Phelps	3N352	64
9	27	1314	8.1	21-	10 Land O' Lakes, FL	1	3		15	Harold Povenmire		
9	28	1409	5.1	14-	5N Simpson, IL	1	2	7	13	Robert Hays	4N351	43
9	28	1409	5.1	14-	3N Beltsville, MD	16	40	8	15	David Dunham	5N353	43
9	28	1409	5.1	14-	Little Creek, DE	3	8	7	8	Emil Volcheck		
10	5	2253	8.1	15+	0N Coleman, FL	1	1	2	20	Tom Campbell	2N173-52	
10	7	2460	6.1	29+	4S Young, Australia	1	4			R. Price	173-70	
10	7	2460	6.1	29+	S Wyong, Australia	3	21	9	15	Roger Giller		
10	9	161850	7.0	46+	7S Cocoa, FL	1	1		32	Harold Povenmire		
10	10	163051	8.8	59+	6S Aurora, CO	2	4	4	25	Paul Asmus	176-52	
10	11	163851	8.0	69+	6S Lenkerville, PA	1	5		20	Robert Young		
10	12	3188	5.4	79+	S Crandall, TX	1	4	9	20	Paul Newman		
10	12	3188	5.4	80+	5S Albany, NY	1	11		10	M. D. Overbeek		
10	21	0934	6.4	71-	N Toba City, Japan	2	8	6	7	Moto Kawabata	6S352	71
10	21	0934	6.4	71-	N Zushi City, Japan	1	0	7	10	Yoshihiro Musash	352	71
10	21	0934	6.4	71-	N Ohami Town, Japan	8	33	8	7	Toshio Hirose	6S352	71
10	22	096160	8.0	65-	2N Aloe, TX	1	1	7	25	Don Stockbauer	1N359	67
10	23	097083	7.6	56-	8N Green Lake, TX	1	4	8	25	Don Stockbauer	0	352
10	26	1442	5.0	31-	N Reddensburg, RSA	1	8		10	G. N. Walker	12N	
10	28	118879	8.1	15-	Castellbisbal, Sp.	5	0		14	Carles Garcia		
11	2	159919	7.2	6+	Benton, MS	1	6		25	Ben Hudgens		
11	7	163641	7.0	43+	4S Oak Grove, MD	1	2	4	25	David Dunham	2N176-45	
11	16	0692	1.1	98-	-25S Lake City, FL	4	10	8	20	Tom Campbell	6N173	68
11	16	0692	1.1	98-	-25S Callahan, FL	3	14	8	11	Karl Simmons		
11	27	2033	4.3	8-	-1S Cabuyao, Phil.Is.	2	7		8	Oscar de las Alas		
12	2	2787	6.4	10+	Callahan, FL	1	0			Karl Simmons		
12	3	2856	6.6	13+	1N MurrayBdg, Austri.	4	11	6	25	David Steicke	3N357-63	
12	5	3238	7.0	38+	Springfield, MO	2	5	7	15	Robert Sandy	6S178-19	
12	5	3238	7.0	38+	Rolla, MO	2	4	8	20	Joseph Senne		
12	19	1409	5.1	79-	4 Venice, FL	1	3		15	Harold Povenmire		
12	22	118917	7.9	57-	-1S Randburg, R.S.A.	1	2	8	20	Jan Hers		
12	22	1740	7.6	50-	3N Renmark, Australia	1	12	2	15	David Steicke	0	356-17
12	23	138887	8.5	43-	Buena Vista, MD	1	5	7	20	Wayne Warren	2S187-65	
12	23	1808	7.0	43-	2N Baker, CA	1	1	5	15	Richard Nolthenius		
12	26	Venus	-4.3	14-	0S Colorado Spgs., CO	4	5	9	6	Paul Asmus	N	
12	26	Venus	-4.3	14-	3S Benton, AR	8	43	6	15	Paul Maley		
12	26	Venus	-4.3	14-	Lake City, FL	2	14	8	11	Richard Van Etten		
12	26	Venus	-4.3	14-	4S Ormond Beach, FL	1	6		25	Joe Reggin		
1979												
1	6	0327	4.5	66+	Poppenweiler, GFR	2	5	3	7	Gutekunst		
1	9	0692	1.1	88+	Edefors, Sweden	1	5		15	N. P. Wieth-Knudsen		
1	31	3430	5.7	11+	0S Marye, VA	5	22	8	20	William Stein	0	183
2	2	110180	8.4	38+	Hannover, G.F.R.	5	6	9	15	Hans-Joachim Bode		
2	3	0298	7.2	39+	2 Westover, Ontario	2	5	5	20	Andreas Gada		
2	3	110316	7.6	40+	2N Waynesboro, OH	1	1	9	15	Robert Clyde		
2	5	093636	8.9	61+	4S Mountainview, CA	1	5	5	15	Richard Nolthenius		
2	5	0692	1.1	69+	-4N Palcines, CA	1	4	8	15	Richard Nolthenius	N	
2	25	164138	8.3	3-	1S Plettenbg. Bay, RSA	1	2	8	20	Jan Hers		
3	21	160980	7.6	50-	6S Wabasso Beach, FL	1	3		15	Harold Povenmire		

United States Geological Survey maps.

Unusually cold weather was encountered during the graze of Venus on 1978 December 26. Maley reported  $24^\circ$  F. ( $-4^\circ$  C.), rather cool for the Texas observers in Arkansas. Dunham observed with Paul Asmus' expedition at Colorado Springs, where the wind was blowing and the temperature was  $6^\circ$  F. ( $-14^\circ$  C.). But time signal reception was our most serious problem there; being about 130 miles from the WWV transmitter, we were too far for line-of-sight, but so close that we got very unfavorable reflection from the ionosphere. And WWVH was blocked by the Rocky Mountains to the west. Richard Nolthenius led a small expedition to a site near Vernal, Utah, to attempt the Venus graze from a high-elevation site, with Venus low in the east. They saw an occultation about four minutes long, but obtained no timings, as their tape recorders froze, in spite of being in sleeping

bags with them. The temperature was -11° F. (-24° C.). Dr. Wieth-Knudsen had to take special precautions for observing the graze of Aldebaran near the Arctic Circle in a sparsely populated area of northern Sweden, on January 9. He observed from the house closest to the northern limit, and south of it, which he could find in the area, although this was a few kilometers south of the limit in a low area of the profile, not promising for multiple events. The temperature was -28° C. The method of timing used was "eye-and-ear" by quartz crystal clock, of which the beats of its stepping motor were rendered audible by a microphone, amplifier, and headphones, and which were referred to UTC by time signals.

With solar activity increasing, short-wave time signal reception will become increasingly less reliable in many parts of the world, so that secondary time standards, such as that used by Wieth-Knudsen, will need to be used. Accurate digital watches with seconds display can now be used for this purpose, as long as they are compared with short-wave time signals within a day or so before and after the event. It certainly would be useful for our work if someone would manufacture and sell a digital watch which could be set to emit audible pips at, for example, 10-second intervals, with a double pip at the beginning of each minute. [Ed: For a do-it-yourself version, see *O.N.* 1 (10), 100.]

Twenty-two stations were set up near Dixon, CA, for the graze of Aldebaran on March 4-5. Although occultations of some Hyades stars were timed at some stations earlier in the evening, the graze itself was clouded out. Skies remained clear only 50 miles to the south.

Dunham's generally tight schedule delayed 1979 graze predictions. He prepared the 1979 graze data tapes and sent them to the graze computers at the end of last November. Delays in the mail and at USNO during the Christmas season delayed the profile calculations (data input for which needs to be produced at USNO after the computers have computed the limit predictions), so that most observers didn't receive their first-quarter predictions until early January. The Latin American section suffered the longest delays, since the graze tapes for their regions did not arrive in Mexico City until after January 13. Standard-coverage total occultation predictions for North America also were delayed, as Walter Morgan didn't receive the necessary data tape from USNO until January 5.

DOUBLE AND VARIABLE STARS IN THE J-CATALOG, by David Herald

I have compared a listing of the J-catalog, supplied by D. Dunham for epoch 1900, with Kukarkin's variable star catalog and with the Lick Observatory Index of Variable Stars. Not all SAO stars in Table 1 are identified in the SZ catalog (or XZ) as being variable; only variables with a magnitude range greater than 1.0 generally were identified as variable when the SZ catalog was created.

Table 2 lists double stars in the J-catalog by the "J" cat. No., and the Discoverer's number as listed in the Lick I.D.S. Also included are some stars coded in J as double, but for which the code is apparently erroneous. Dunham hopes to incorporate the variable star data and appropriate double star codes into the J-catalog for the extended predictions for 1980. ( || signifies an SAO or ZC star. )

Table 1

USNO J#	SAO #	ZC #	Variable	Range Max. Min.
85	93876	ZC 640	Y696 Tau	5.20 5.26
336	94027		α Tau	
700	94164		Y480 Tau	5.09 5.11
1087	94604		DE Tau	9.8 10.3
1106	94628		CE Tau	6.1 6.5
1263	94779		DY Tau	10.8 11.5
1382	94837		EU Tau	8.6 9.1
1495			SU Tau	9.5 16.0
3720	96407		NP Gem	5.89 6.02
4898			WX Sag	9.6 11.3
5133	161257		WZ Sag	8.46 10.14
5262	161376		Y Sag	6.00 7.14
5411			Y355 Sag	9.4 10.0
5426	161444		XX Sag	9.5 10.6
5530	161502		Y2349 Sag	8.4 9.0
5620	161562		Y3508 Sag	7.73 7.92
5621	161563		V Sag	Constant
5651	161571		U Sag	6.35 7.08
5867	161870		YZ Sag	7.8 8.9
5929	161972		UX Sag	8.9 9.6
6340			SVS 5772	9.5 10

Table 2

J#	Discoverer	J#	Discoverer
31	HJ 3254	3537	"C" not IDS
34	BUP	3605	A 2460
136	BUP	3614	"E". Is
184	STF 545	3616	a triple
186		3725	J 358
313	OL 107	4372	RST 3061
359	BUP	4380	RST 3063
369	HU 1218	4436	FOX
500	ST 2	4493	HO?
502		4502	"M", but
560	HZG	4505	also E.
700	BUP	4556	HU 171
737	BRT 2323	4575	"A" cf "E"
799	HJ 3269	4643	BRT 624
810	HJ 3270	4649	HLD 138
820	J 1251	4782	FEN 25
821	J 1043	4891	RST 3140
845	J 1817	4898	RST 3144
849	STF 665	4952	HJ 2818
893	J 2729	4980	J 2197
1070	BU 891	4982	S 700 ?
1072	HJ 3275	4984	triple
1143	J 248	4986	
1168	HJ 3276	5041	B
1207	STF 759	5061	RST 3167
1208		5096	FOX
1216	HJ 3277	5107	B 1885
1253	STF 774	5141	HJ 2826
1254	STF 774	5167	HME 42
1257	BU	5176	MWC 16 ?
1335	BRT 2329	5177	J 2206
1336		5253	J 1627
1380	HJ	5275	BRT 1531
1444?	BU	5357?	or} J 2210
1447?	BU 892	5365?	
1493	BAR	5375	I 1365
1495		5399	"E" wrong
1531?	J 944	6403	{or J 2128
1567	J 1910		J 2127
1577	STF 806	6477	FEN 30
1578	J 677	5904	RST 3181
1583	J 1819	5519	RST 3182
1700	STF 813	5622	"K", but SEE
1879	J 958	5645	HU 243
2073	J 1049	5656	RST 3186
2136	"C" Not IDS	5664	RST 5116
2147	BRT 1195	5689	J 2216
2169	J 1260	5822	HLD 146
2295	J 968	5823	HJ 2836
2353	J 19	5846	RST 4020
2368	J 683	5847	HJ 2838
2392	J 684	5864	HJ 2840
2397	J 2740	5873	HME 44
2430	J 1934	5878	HLD 148?
2511	J 973	5891	HU 255
2523	A 2516	5903	HU 257
2578	J 1349	5904	RST 4021
2800?	BRT 2352	5905	RST 4022
2819	STT 141	5931	HJ 2844
2829	HO 340	5939	J 1661
2858	BRT 1203	5944	HJ 2845
2905	{or J 1956	5965	RST 3209
		5978	HU 260
2917	J 1960	6003	DOM 944
2977	BRT 1207	6244	BAL 638
3036	J 1964	6258	HJ 5411
3100	J 2396	6327	
3143	J 989	6328	
3278	BRT 2361	6330	BRT 525
3314	J 992	6331	
3447	J 10567	6403	RST 4728