Occultation Newsletter

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FROM THE PUBLISHER

This is the third issue of 1985.

When renewing, please give your name and address exactly as they appear on your mailing label, so that we can locate your file; if the label should be revised, tell us how it should be changed.

If you wish, you may use your VISA or MasterCard for payments to IOTA; include the account number, the expiration date, and your signature. Card users must pay the full prices, which are shown below, FOLLOWED BY THE DISCOUNT PRICES IN BRACKETS FOR THE USE OF THOSE PAYING BY CASH, CHECK, OR MONEY ORDER.

O.N.'s price is $1.46[1.40]/issue, or $5.73[5.50]/year (4 issues) including first class surface mailing. Back issues through *Vol. 2*, No. 13 still are priced at only $1.04[1.00]/issue; later issues at $1.46[1.40]. Air mail shipment of *O.N.* back issues and subscriptions, if desired, is 47¢[45¢]/issue ($1.88[1.80]/year) extra, outside the U.S.A., Canada, and Mexico. IOTA membership, subscription included, is $11.46[11.00]/year for residents of North america (including Mexico) and $16.67[16.00] for others, to cover costs of overseas air mail. For IOTA members, the following items are available without extra charge; non-members pay $1.04[1.00] for local circumstance (asteroidal occultation) predictions, and $1.56[1.50] per graze limit prediction.

Observers from Europe and the British Isles should join IOTA/ES, sending DM 50.-- to Hans-J. Bode, Bartold-Knaust Str. 8, 3000 Hannover 91, German Federal Republic.

IOTA NEWS

David W. Dunham

The third annual meeting of the International Occultation Timing Association will be held on Saturday, November 16 from 10 am until 5 pm Central Standard Time at the Armand Bayou Nature Center, 8600 Bay Area Blvd., Clear Lake City, Texas, U.S.A. Besides a short business session, there will be scientific presentations and discussions about grazing occultations observed during 1985 (especially the Zubenelgenubi grazes in Texas in January and in Africa in May, and the Delta Scorpii graze in Arizona in July), attempts to observe occultations by comets (especially the September 4th appulse by Comet Giacobini-Zinner), and predictions for asteroidal, cometary, and lunar grazing occultations in 1986, when events involving Antares and the Pleiades begin. Directions and other local information can be obtained from Charles H. Herold, 9207 Kirkmont, Houston, TX 77089, phone 713,484-2152 (home) or 928-2628 (work, often evenings). During 1986 (during which elections will be held for IOTA offices for the following three years), the annual IOTA meeting might be held in conjunction with the Texas Star Party, and an IOTA session will be held during the Astronomical League convention in Baltimore, Maryland, early in August.

Edwin Goffin recently sent me a letter describing some of the activity at the fourth European Symposium on Occultation Projects (E.S.O.P. IV; see p. 244 of the last issue), and saying that Dr. Eberhard Bredner, Hamm, German Federal Republic, planned to send a report about E.S.O.P. IV for publication in *O.N.* We hope to receive it in time to include in the next issue of *O.N.*, planned for December.

Berton Stevens has maintained IOTA's computerized files diligently since the organization was established in 1975. He updates these files from information supplied by IOTA's treasurer (H. F. DaBoll) and corresponding secretary (Mark Allman). The computer files contain addresses, station data (geographical coordinates and travel radii for grazes), and bookkeeping information (whether *O.N.* subscriber only or IOTA member, subscription or membership expiration date, etc.). They are used to generate address labels for *O.N.* and other IOTA informational mailings, and both labels and station data on IBM cards, which are sent to the graze computors for computation and distribution of grazing occultation predictions, and to the vice president for planetary occultation services (Joseph Carroll) for computation and distribution of planetary and asteroidal appulse and local circumstance predictions. For the past few years, Bert has wanted someone to take over this work, but this has not yet been possible, partly because his programs for updating the records, and generating the address labels and station cards, are written in IBM assembler language for an IBM 360 or 4341 computer. Although the transportability of this system is difficult, the proliferation of personal computers makes other options possible. Someone who owns (or has access to) a p.c., a printer capable of printing labels, and a modem probably could write some simple programs (or modify some existing address-label software) to do this important job. He or she could then generate the address labels, and send station data via the modem and telephone to those who needed it. For those who need the data and don't have a telephone data-transfer capability, the data could be transmitted to our Apple, and I could then upload the data to standard magnetic tape for mailing. Similarly, the current IOTA records could be written to a standard magnetic tape, and the contents transferred to disk here for transmittal by telephone (or perhaps mailed on floppy disks) to your p.c. Mailing and telephone expenses of this work would be reimbursed by IOTA. If you are interested in trying this, please contact me at P.O. Box 7488; Silver Spring, MD 20907; U.S.A.; telephone 301,585-0989. Berton Stevens will be very grateful if a suitable system can be set up elsewhere.

Generating predictions and articles for 1986 occultations is keeping me busy, and will continue to do so until we produce the next issue of *o.n.*, which will include predictions of planetary occultations for 1986. We continue to make progress with the occultation manual (see p. 243 of the last issue), and will show what we have so far at the IOTA meeting on Nov. 16th. After the prediction work is out of the way, top priority will go towards the manual, so that we can distribute a preliminary version (we hope) about a month after the next issue of *o.n.* Then I will turn my attention to completing and distributing copies of the videotape of the 1984 May 30th solar eclipse, and complete analysis of the occultations by (2) Pallas and (51) Nemausa in 1983, and the Zubenelgenubi grazes during the lunar eclipse last May. I also need to create the merged star catalog tape for asteroidal occultation predictions.

The Astronomy Bulletin Board System (ASTBBS), maintained by Joan Bixby Dunham on our Apple II+ computer in Silver Spring, MD, (phone 301,495-9062) was described on p. 244 of the last issue. The system has been upgraded and some errors fixed. Also, we have put a surge protector on the phone line and now leave the system on all the time when we are not using the computer for other purposes, which is a little less than half the time during evenings and weekends. Those of you with computers or terminals with modems are encouraged to use the system, since we can provide more information with it than we can put in the recorded telephone message. We may get a separate phone line for the IOTA spoken message service which we maintain with our telephone answering machine (now on 301,585-0989), so that would become a full-time service; many callers are surprised when they call our number and we answer, rather than let the message play.

Tony Murray, Georgetown, GA, has designed an IOTA membership card. We will discuss this at the IOTA meeting, where we probably will recommend some changes. When these are agreed upon, Tony will generate the cards for distribution by DaBoll, perhaps with the next issue of *o.n.*

Dr. Paul A. Simon, Observatory of Paris-Meudon and president of the Societe Astronomique de France (S.A.F.), has proposed a 5-day meeting, "Contribution of Amateur Astronomers to the Discovery of the Universe," to be cosponsored by the International Astronomical Union and the International Union of Amateur Astronomers, to celebrate the hundredth anniversary of the S.A.F. The meeting would be held in June or the last week of August, 1987. Perhaps a day of that meeting (or half a day) could be combined with E.S.O.P. VI.

Some have been uncertain of the meaning of "O-C" (called the residual) in the residual sheets distributed by the International Lunar Occultation Centre (ILOC). The observed quantity (O) is the angular separation from the center of the moon to the star, as seen from the observer's location and computed using the best-available catalog data for the star and the standard j=2 lunar ephemeris, all evaluated at the time of observation. The calculated quantity (C) is the angular semi-diameter of the moon as seen from the observer's location plus the limb correction computed from Watts' charts of the edge of the moon. The value given in the O-C column is simply the difference, O minus C, in seconds of arc ("), and is therefore the residual error, or just the residual. Errors in the lunar ephemeris, star position, and limb correction all contribute to the residual, usually more than the uncertainty of the observer's timing. If a value of 9.99 or -9.99 is given, the actual residual is probably much larger, probably due to an error in the date, hour, minute, or star number, and the observer should check all of these data, on ILOC's listing, on a copy of his report, and in the predictions, and send any revisions to ILOC for reprocessing. Residuals with absolute values greater than 2".0 are rare, so data for observations whose O-C's have larger absolute values also should be checked. ILOC recently distributed residual lists for 1983 timings.

The U.S. Internal Revenue Service recently announced that effective January 1, 1985, the tax deductible standard mileage rate for use of a personal car in connection with charitable activities is 12¢ per mile, up 3¢ over the 1984 rate. Use the new rate for calculating your deductible mileage expenses for 1985 occultation trips.

DIVISION OF PLANETARY SCIENCES NEWS

David W. Dunham

The 17th annual meeting of the American Astronomical Society's Division of Planetary Sciences met in Baltimore, MD, from 1985 October 28 - November 1. I attended sessions on comets, asteroids, and Jovian satellites. Abstracts (except for a few late papers) were published in *Bull. Amer. Astron. Soc.* 17 (3). Just a few of the highlights can be given here. Comet Giacobini-Zinner was studied extensively in early September, around the time of the ICE spacecraft flyby. H. Campins and others report that infrared measurements indicated significantly more dust than ICE encountered; the discrepancy has not been resolved.

W. Sinton and others located several volcanoes on Io to ±20 km from timings of infrared photoelectric data when Io was occulted by one of the other Galilean satellites. Approximate temperatures could be derived from simultaneous measurements at different wavelengths, and the radiating area (diameter 8 ±3 km) of one volcano was determined.

R. Millis and 23 other authors gave a paper on the diameter of (1) Ceres determined from twelve photoelectric measurements of the 1984 November 13th occultation of B.D. +8° 471. The diameter was found to be 946 ±5 km, in good agreement with recent infrared determinations. When combined with Ceres' mass, the density was found to be 2.6 ±0.1 gm/cm³; the visual geometric albedo was 0.069.

R. Terrile and B. Smith used a coronagraphic device to search for faint satellites or material near (29) Amphitrite, a flyby target of the Galileo spacecraft, as reported in a late paper. Light from Amphitrite was blocked out to 5" or 7500 km. The search ruled out the existence of kilometer-sized satellites beyond the edge of the coronagraph. A similar search was reported by J. Gradie and C. Pilcher, with similar results. S. Weidenschilling did a stability analysis of asteroidal binary models used to explain lightcurves, and found that only the models for (63), (216), and (624) were stable. Weidenschilling said that most of the lightcurves could not be easily distinguished from those of single ellipsoidal models. P. Hut and P. Weissman made some estimates of the sizes and separation of the pair of asteroids or comets that apparently created Clearwater Lakes in Canada, and noted that a further study of the statistics of double craters may allow estimation of the fraction of these objects that are binary.

In separate late papers, F. Vilas and W. Hubbard, and B. Sicardy *et al.*, reported on observations of the 1985 Aug. 20 occultation of a bright (K = 6.4) infrared star by Neptune. Neptune occulted the star centrally, and a central flash was recorded at both ESO and CTIO in Chile, but not in Hawaii. 1-second drops of about 16% were simultaneously recorded at 3:44 UT at ESO and CTIO, at a distance of just over three Neptune radii.

GRAZING OCCULTATIONS

Don Stockbauer

Reports of successful lunar grazing occultations should be sent to me at 2846 Mayflower Landing; Webster, TX 77598; U.S.A. Also sending a copy to ILOC is greatly appreciated; their address is: International Lunar Occultation Centre; Geodesy and Geophysics Division; Hydrographic Department; Tsukiji-5; Chuo-Ku; Tokyo, 104 Japan.

Included in this article is a table of graze reports received since the last newsletter. Here is an explanation of its format:

Mo = month
Dy = day. A "V" following the date indicates that a videorecording was obtained; "P" indicates a photoelectric observation.
Star Number = ZC (Robertson) if 4 digits, or SAO if 6 digits.
Mag = magnitude
% Snl = percent sunlit ("+" is waxing, "-" is waning.)
CA = cusp angle
Location = settlement or prominent feature closest to the expedition
# Sta = number of stations reporting data, possibly including one station reporting a miss
#Tm = total number of timings for whole expedition
SS = best Sky Stability reported by any station
Ap cm = smallest aperture (centimeters) reporting the best stability
Organizer = expedition leader
St = shift observed, in tenths of seconds (N = north S = south)
WA = Watts angle of the average of all events
b = latitude libration in tenths of a degree

It is becoming apparent that northern-limit waning-phase (and possibly waxing-phase) grazes are showing consistent north shifts of several tenths of a second; see p. 276.

Expedition leaders should be aware that an occasional large shift can occur due to a poorly determined star position. This happened to several expeditions for the graze of SAO 128661 on 1985 June 11, reported in the last issue; the positional data for this star were from the old Albany General Catalog (whose positions at current epochs are often in error by large amounts) and there had been no previous occultation observations. While most observers dislike a long occultation as much as a miss, these deep stations are quite important in situations like this.

I believe that there is some confusion about the definition of the shift value, especially its units. It is the number of seconds of arc that the moon's shadow shifted on the ground as subtended at the moon's distance. This is the scale running down the left side of the profiles; the VPS given on the profile converts seconds of arc to miles (or kilometers). A minor shift would be about 0".1, and a major one would be about 1".0, to provide two examples. Some observers may have reported geodetic seconds of latitude or longitude on the ground. This easily could produce a 100" shift, which would be impossibly large (At least, I hope I never get a 100" shift!). I'm still waiting for clarification of a situation like this for the graze of ZC 1290 near Hoernerstown, PA, on 1985 April 28.

The profile plotting program cannot display the predicted limit if it is scaled off the top or bottom of the profile display area. The top and bottom borders look very much like the predicted limit, and it is especially easy to be fooled if the limit is scaled off by only one printer line.

Please use the ILOC reporting forms even if you have a supply of the old "University of Texas" forms on hand. The problem is that if the old forms are used, they have to be transcribed to the new ones so that ILOC can process the data, and I am the person who will wind up having to do the task! I volunteered to do this for a 4-inch stack of reports several years ago; it took months, and bordered on being the most boring job of my life, but I sure got familiar with the new format! Some have complained about the new forms, but once their format is learned, they have quite a few advantages over the old ones.

The project to put the graze lists into machine-readable form has made little progress, due mostly to the magnitude of the effort. I figure that there are about 1,500 past grazes to do, at 80 characters each, and the project must continue as new lists appear. David Dunham devised a format which expedites the project, in that it is virtually identical to the published format, i.e., the lists need not be put on keypunch forms, and can be used directly. Please contact David if you could help with this project. The data can be punched on IBM cards or punched at a terminal to a disk file and copied to a standard 9-track computer tape. A personal computer also might be used for this project; the chances for successful transmission would be greatest if the p.c. has a modem for telephone transmittal of ASCII files. Let David know what hardware you could use for this work, to see whether the data actually can be transmitted.

If more than one person organizes a graze, who should be listed as the expedition leader? David Dunham's rule of thumb was always "whoever scales the coordinates." However, compared to other aspects of a large expedition, this can be relatively minor, especially if one doesn't mind doing it. The person who assigns stations at the graze site is also a logical choice. Perhaps mutual consent would just be best. I'd like to see some suggestions discussed in this column.

In Houston, we have been experimenting with how to assign observers to sites for large efforts. The method must be fair, must not cause last-minute confusion, must not leave large gaps in the fence due to "no-shows," etc. So far, we have found no really good solution, and again, I'm open to Suggestions. [Ed: Suggestion: 1) lay out numbered station markers for the maximum number of observers expected; 2) at assembly time, use as many cards of an ordinary deck as there are observers present; 3) decide which stations will be manned by that number of observers; 4) using a pre-decided card-ranking system (does the trey of hearts precede the four of spades or follow the deuce of hearts; is the ace high or low?), let the observers draw cards to determine their order among the stations to be manned; 5) if some observers are inexperienced, hold two drawings, so that experienced observers alternate with inexperienced ones. If there are more than 52 observers, that's the sort of difficult situation we'd like to have!]

Mo	Dy	Star Number	Mag	% Snl	CA	Location	# Sta	# Tm	S S	Ap cm	Organizer	St WA b
1983												
2	23	0946	3.2	75+	-1S	Tisvildeleje,Denmk	2	9	1	17	N. P. Wieth-Knudsen	179 7
1984												
1	13	0404	5.2	67+	11S	San Martin, CA	4	16	2	15	James H Van Nuland	0166 39
1	22	1702	4.2	80-	4S	Cupertino, CA	1	5	3	20	James H Van Nuland	5S181-64
2	6	0106	6.8	21+		Franksville, WI	4	12	1	25	Gerry Samolyk	
3	8	0505	7.0	29+	8S	Tisvildeleje,Denmk	3	15	1	6	N. P. Wieth-Knudsen	172 24
10	28	185637	8.9	18+	5S	Judgeford, NZ	5	18		10	Tony Dodson	9S178
11	16	1484	3.6	47-	6S	Diamond Bar, CA	2	4	1	13	Donald S. Lynn	4S186-67
1985												
1	14	1973	6.5	49-	S	V.enFagnes,Belgium	1	9			Jean Bourgeois	3S194-22
2	11	2053	4.6	64-	S	Drehance, Belgium	6	12			Jean Schwaenen	2N194-12
2	12	2233	5.5	47-	11S	Upper Hutt, NZ	15	44		10	Tony Dodson	0193
3	1	0842	6.3	62+	4N	New Berlin, WI	10	32	2	15	Gerry Samolyk	3-32
3	11V	2192	6.2	74-	13S	Upper Hutt, NZ	9	27		11	Tony Dodson	4N195
4	28	1290	6.8	48+	15N	Hoernerstown, PA	4	6	2	15	Robert Young	9-63
5	8	2740	6.5	80-	9N	Hikurangi, NZ	1	2		15	G. Hudson	
5	22	0852	5.0	4+	-12S	McMillan Mine, AZ	1	4	2	15	Richard Nolthenius	7S184-37
6	27	139377	8.1	66+	11N	Klein, TX	3	17	1	20	Donald L. Oliver	1N 12-18
7	7	3428	5.2	74-	19N	Santiago Resv.,CA	5	40	1	8	Donald S. Lynn	0343 64
7	12	093185	7.8	28-	16N	Flat Lick, KY	1	11	2	15	Jim Stamm	343 6
7	23	1891	4.4	39+	13N	Westford, CT	3	8	1	10	Philip Dombrowski	15-22
7	25	2014	7.8	51+	11N	Royersford, PA	1	0	2	10	Clifford Bader	S 13 -5
7	27	2290	2.5	74+	17N	Gale, CA	1	11	1	20	David Werner	18 27
7	27V	2290	2.5	75+	17N	Asher, AZ	9	113	1	9	Gerry Rattley	0 17 27
8	12	0869	7.2	21-	N	Crowthorn,England	6	62	1		J. Trott	
8	12	077927	8.9	17-	17N	Borden, TX	2	8	1	32	Logan Rimes	0345-45
8	12	077927	8.9	17-	17N	Cat Spring, TX	2	16	1	20	Don Stockbauer	0345-45
8	13	078957	7.8	10-	17N	Shanksville, PA	1	6		15	Francis Graham	
9	5	093288	8.7	70-	20N	Crabb, TX	1	2	1	20	Donald L. Oliver	1S338 -6
9	12	1408	7.4	7-	13N	Washington, DC	1	1		20	Jay Miller	
9	12	1408	7.4	7-	13N	Greenbelt, MD	12	58	1	15	David Dunham	2N355-64
9	12	080898	7.7	7-	13N	Franklinville, IL	1	4	2	20	Homer DaBoll	1N355-63
10	7V	1093	6.4	48-	10N	Somerset, PA	2	10	1	20	David Dunham	4N350-60
10	7	1093	6.4	48-	9N	East Hartland, CT	1	4		15	Philip Dombrowski	
10	9	1363	5.2	27-	8N	Buckhorn, TX	1	0	1	20	Don Stockbauer	<3N355-67
10	9V	1363	5.2	27-	8N	Hempstead, TX	1	10	1	36	Paul Maley	2N355-67
10	9	1365	6.1	27-	7N	Buckhorn, TX	1	10	1	20	Don Stockbauer	2N356-67
10	9	1365	6.1	27-	7N	Lewisville, TX	2	16	1	15	Donald L. Oliver	2N356-67
10	9V	1365	6.1	27-	7N	Hempstead, TX	1	0	1	36	Paul Maley	356-67

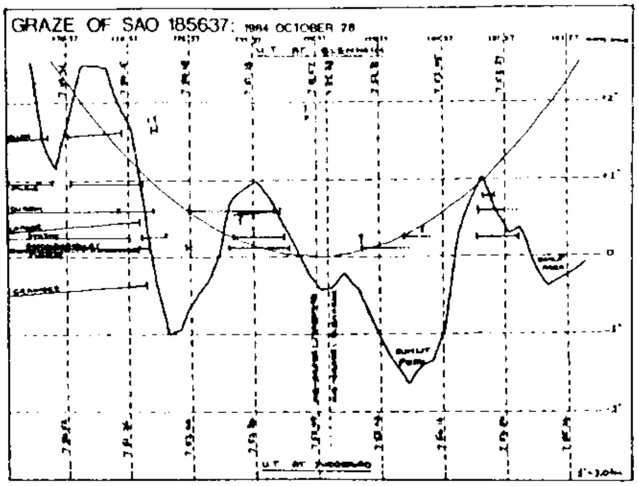
One of the more memorable expeditions for co-organizer Don Oliver and me will be the double graze of ξ and 79 Cancri (ZC 1363 and 1365, respectively) on 1985 October 9. The paths of these two favorable grazes crossed 50 miles northwest of Houston, near the tiny settlement of Lewisville, and 35 stations were planned for it. With only 30 minutes between grazes, we did not want to move sites after the first one. Luckily, the roads provided coverage up to the tops of the highest mountains for both, and also quite deep into the shadows. A pessimistic weather forecast kept all but 5 of the 35 grazers at home, and a warning of a north shift prompted me to leave the main expedition and travel west to cover ξ Cancri more to the north. I had good weather there and got a miss on ξ and 10 events on 79 Cancri; the main expedition was clouded out for ξ but got 16 events for 79 Cancri. Since we were forced to set up directly adjacent to farm houses in Lewisville, Don Oliver and I made friends with the residents on the preliminary reconnaissance trips; this seems to work much better than merely notifying the authorities the night of the graze. One of the farmers, 78-year-old John Jackson, says that his long life is due to eating the aloe vera plant. Don Oliver had a huge one in a pot that he offered to bring Mr. Jackson the night of the graze. While setting up his equipment, Don cut himself several times on the plant's thorns, but unfortunately, in the rush, did not think to rub some of the plant's famed juices on the wounds to promote the healing process. Don has dubbed the expedition the "aloe vera extravaganza."

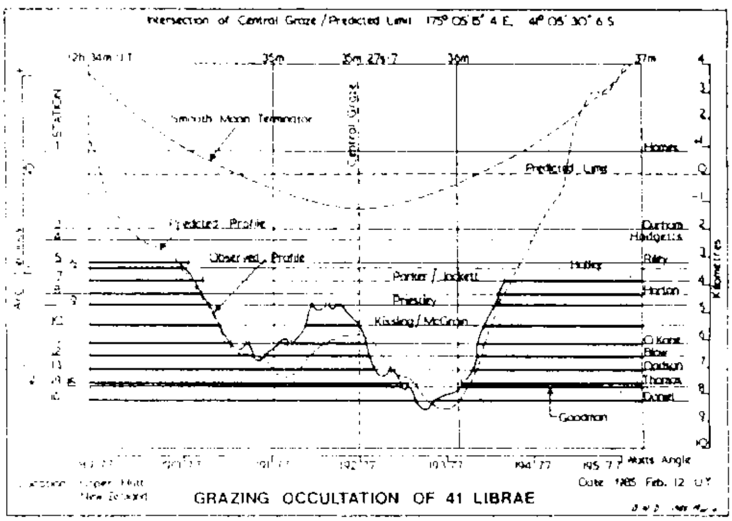
David Dunham has not had time to unravel the data obtained during the graze of α 2 Librae at Hag Abdullah, Sudan, last May. Also, he recently received a large package of reports of the southern-limit graze from M. D. Overbeek. We hope he will be able to provide summary information for these important events for the graze table in the next issue. He hopes to have a preliminary analysis of some of the data, to obtain the lunar polar diameter, completed in time for presentation at the IOTA meeting on November 16th.

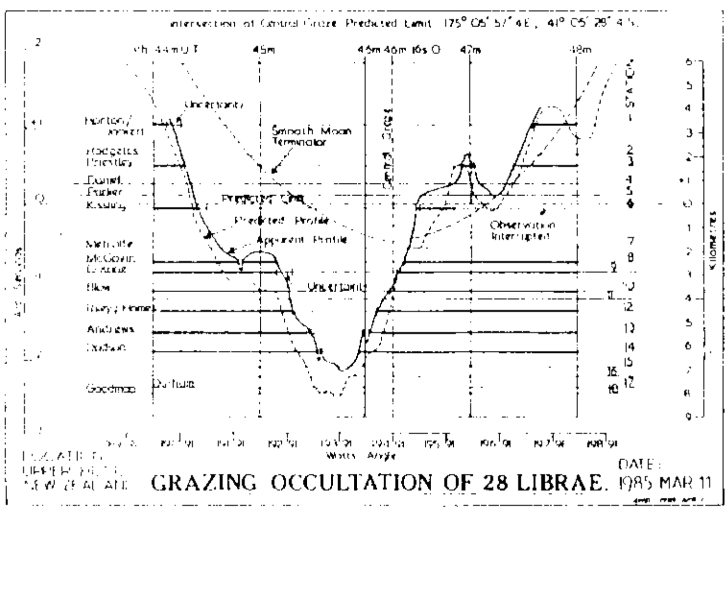
Gerry Rattley notes that 48 events involved the primary and 65 the secondary star during the July 27th graze of δ Scorpii (ZC 2290 = Dschubba) at Asher, AZ. A record four videorecordings were made of this graze; three of them will be shown at the IOTA meeting. Unexpectedly, the secondary was about 0".3 north of the primary, making it easy to see events of both components, in spite of the fact that the sun was just setting at central graze time. Rattley will submit a plot of the observed profiles for the stars for publication in a future issue, showing how they can be moved to determine accurately the separation and position angle of the components. This information has special value since this star was used by Voyager II when it made the photopolarimeter measurements of the rings during the Saturn flyby. Speckle interferometric measurements show that the components' separation remained less than 0".2 from 1973 to 1981.

Thanks for all the reports received.

[Ed: Shown here are pictorial representations of the three grazes shown in the accompanying table as having been led by Tony Dodson. At least two of the drawings also were prepared by Dodson and are reproduced from the circular of the Royal Astronomical Society of New Zealand. The source of the other drawing is unknown to us.]



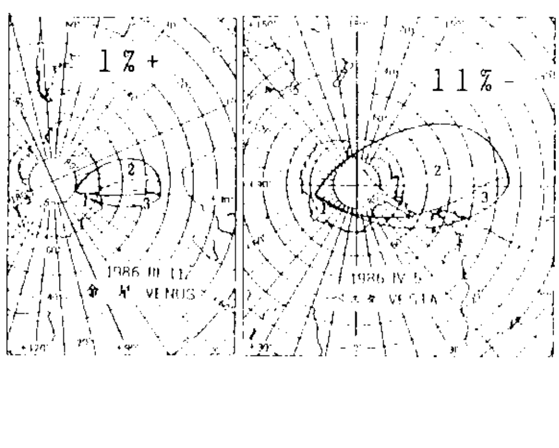


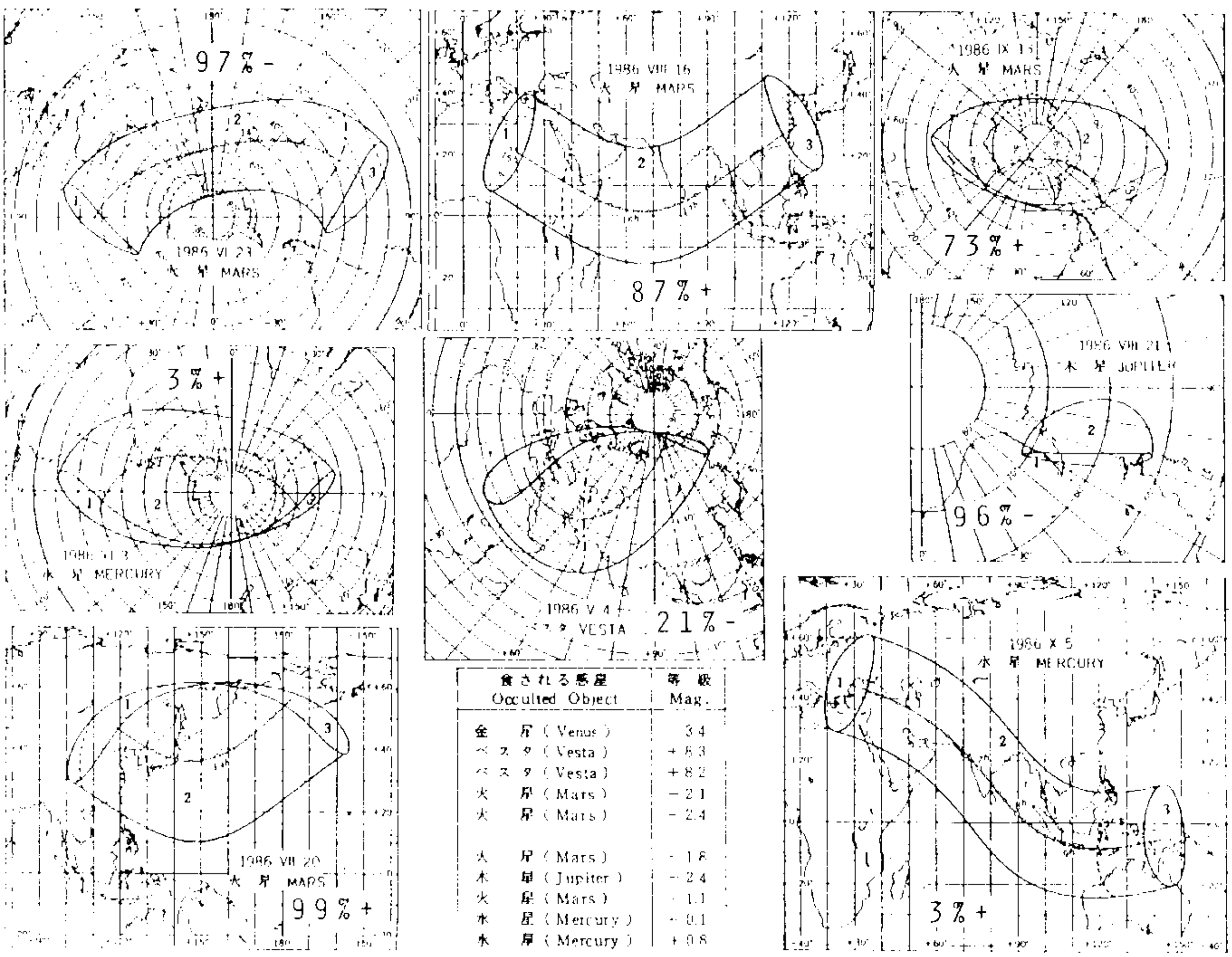


LUNAR OCCULTATIONS OF PLANETS

The maps showing the regions of visibility of lunar occultations of planets are reprinted by permission, from the Japanese ephemeris for 1986, published by the Hydrographic Department of the Maritime Safety Agency of Japan. In region 1, only the reappearance is visible; in region 3, only disappearance may be seen. Reappearance occurs at sunset along a dashed curve, while disappearance is at sunrise along a curve of alternating dots and dashes. We have added a legend to each map indicating the phase of the moon at the time of the event.

Those interested in observing partial occultations should request predictions at least three months in advance, from Joseph Senne; P.O. Box 643; Rolla, MO 65401; U.S.A.; telephone 314,363-6233.





食される惑星 Occulted Object	等級 Mag.
金星 (Venus)	3.4
ベスタ (Vesta)	+6.3
ベスタ (Vesta)	+8.2
火星 (Mars)	−2.1
火星 (Mars)	−2.4
火星 (Mars)	−1.8
木星 (Jupiter)	−2.4
火星 (Mars)	−1.1
水星 (Mercury)	−0.1
水星 (Mercury)	+0.8

GRAZING OCCULTATION PREDICTIONS

David W. Dunham

Corrections to Southern-limit Graze Predictions. Observations during the last couple of years have shown that southern-limit waning-phase Cassini-region grazes generally are shifting about 0".5 south. Consequently, you should shift the observing range 0".5 south of that predicted by the version 78A profile for these cases, which can be recognized on the ACLPPP profiles as consisting of predominantly 3's and 4's (previously observed graze data). The Watts angle range is 180° to about 188°, for latitude librations less than -1° and for all longitude librations. Only the observed-graze points (3's and 4's) should be shifted south; if there are also *'s and other points, they should not be shifted. Unless the star is bright enough to observe against the moon's sunlit limb, these grazes always occur during the waning phases between full and new moon, and usually occur from November through March.

Corrections to Northern-limit Graze Predictions. Don Stockbauer and I have noticed that most northern-limit grazes of northern-declination stars during the last couple of years have shifted a small amount north from the 78A profile prediction, on the average. The actual averages are 0".30 north from 14 waxing-phase grazes and 0".25 north from 16 waning-phase grazes. Consequently, we recommend shifting the ACLPPP version 78A profile 0".3 north when planning to observe all northern-limit grazes with R.D. declination zones greater than +05 (generally stars with Z.C. numbers less than 1600 or USNO X numbers less than 16500). These grazes generally occur on the dark limb from April through September. Since individual star position errors can have larger effects, it is recommended that you scan the observed-graze lists published in last November's, and later, issues to see whether a graze of the same star has been observed. If you find one, shift your profile by the amount given in the Shift column (if there is an entry) rather than the average value of 0".3, to obtain a more accurate prediction. There is some evidence for a corresponding southward trend for northern-limit southern-declination stars, but there are not enough recent observations of these events to form useful statistics.

Error in ACLPPP Profiles for Some Multiple Stars. For stars with double star codes of K, L, I, V, X, Y, Z, and $, the close components should both be offset from a mean position (the center of light) between the two stars, rather than both offset from the primary star, as has been done in the past. I discovered this error only recently, because most close components for these double star codes are separated by less than 0".3, causing a negligible error. The error affects all predictions for 1985 and earlier, and for 1986 only for the A-region (northeastern U.S.A. and southern Quebec). The program should be fixed for all other regions for 1986 predictions. The values for the primary component's vertical and horizontal shifts given at the bottom of the profile will both be 0.0 if the error has been committed for these codes (note that these values should be 0.0 for the common codes A and C, and some others) and will have non-zero values (as is the case for code M and O doubles, and a few others, already) if the error has been corrected. If the error has been committed, there is no significant error if the secondary is 1 or more magnitudes fainter than the primary. If the stars are of comparable brightness and the absolute value for the vertical shift for the secondary is greater than 0".2, you should shift the profiles for both components by half of the secondary's vertical shift towards the primary (north if the secondary's vertical shift is negative, and south if it is positive). This should be done only for the codes K, L, T, V, X, Y, 7, and $, although it is also recommended for code A and C stars if the secondary and primary are of comparable brightness, the secondary's separation is 2".0 or less, and the secondary's vertical shift absolute value is greater than 0".3. As an example, for a graze of ZC 1093 on October 7, the double star code was Z, the primary and secondary magnitudes were 7.18 and 7.23, and their vertical shifts were 0.0 and -1.29 miles (or -1".03), respectively. Since the stars were nearly the same brightness, the profiles for both components should be shifted north by 0".5 or 0.65 mile.

More Graze Computers Needed. William Stein recently changed jobs, and no longer has access to a large computer in his new location. So now only four computors are generating and distributing all of IOTA's grazing occultation predictions: Walter Morgan, Livermore, CA; Joseph Senne, Rolla, MO; Tom Webber, Auburn, WA; and I. Hans-Joachim Bode, Hannover, German Federal Republic, continues this work for the European Section of IOTA. Two or three more computors with access to mainframe computers would lighten the burden on the rest of us, permitting earlier distribution of predictions. The programs are written in FORTRAN. The longest program has about 2700 lines, requires over 100K bytes CPU to run, uses ten I/O files [most temporary disk files, an optional tape input file, two card or standard 9-track (EBCDIC or ASCII) tape output files, and three print files]. Current versions of the program are run on IBM 360, 370, 4341, or equivalent, and CDC 6600 or equivalent, computers. The programs once were run on a PDP computer, and they also probably could be run on a VAX. There will be several months for conversion, since the predictions for most of 1986 already have been, or soon will be, completed (see below). If you are interested in trying this work, and if it looks as though you will have access to a suitable computer for 3 or more years, write to me at P.O. Box 7488, Silver Spring, MD 20907, U.S.A.

MVT – CMS Conversion at USNO. The phasing out of the MVT operating system on the IBM 4341 computer at USNO, and the problems that this might cause for IOTA, were described in IOTA NEWS of the last issue. Regular use of MVT ended on October 1; the MVT system will be set up now only sporadically for special use. The MVT system uses 8 CalComp disk drives, for which the maintenance contract was allowed to lapse on October 1. If one of those drives malfunctions, we will no longer be able to run the 78A version of OCC, which has been the basis for IOTA's graze predictions (through the ACLPPP profiles) for several years. If one drive fails, we still could run the less accurate 80F OCC program until a second drive fails. Van Flandern is working with Marie Lukac and me to fix the 80G version on CMS, but progress is slow. Graze data for 1986 were distributed to the computors in mid September, along with a notice encouraging them to compute the predictions for all of 1986 as soon as possible. I hope it will be possible to make the OCC runs needed for generating the 78A version profiles before one of the disk drives fails. As of late October, OCC input data for most of 1986 had been received at USNO from most of the computors, and was run successfully with the 78A OCC after MVT was reinstalled temporarily. The CalComp disk drives probably will not be removed until October 1986, so with luck, we may be able to continue to use the 78A OCC program until then.

PREDICTIONS OF ASTEROIDAL OCCULTATIONS

Edwin Goffin and David W. Dunham

Goffin has combined the AGK3 and SAO star catalogs, and compared them against ephemerides of all asteroids with diameters expected to be 40 km or larger, to generate predictions of asteroidal occultations during 1986. This will supplement the predictions recently published by L. H. Wasserman, E. Bowell, and R. Millis in "Occultations of Stars by Solar System Objects. VI. Occultations of Catalog Stars by Asteroids in 1986 and 1987" in *Astronomical Journal 90* (10), p. 2124. Goffin has sent Dunham his predictions for events outside of Europe, and Dunham will send them on to Jim Stamm to select the ones which might be visible from North America for possible publication in *o.n.*, and to distribute the others to IOTA regional coordinators elsewhere. Goffin's searches overlapped into 1985, so some late December events are included. Three of these events predicted for North America are enclosed for *o.n.* subscribers who live there. One on Dec. 23 involves (9) Metis, unfortunately at an elongation from the sun of 37°, too small to obtain an astrometric update of the prediction. Roland Boninsegna; rue de Mariembourg, 33; 6381 Dourbes, Belgium, will distribute Goffin's predictions of European events to IOTA/ES members. Larry Wassermann has also computed and sent Dunham predictions of occultations of stars by the planets Mercury through Saturn; they supplement the list published by D. Mink and A. Klemola in "Predicted Occultations by Uranus, Neptune, and Pluto: 1985-1990" in *Astron. J. 90* (9), p. 1894. Observable planetary occultations from these lists during 1986 will be published in the next issue.

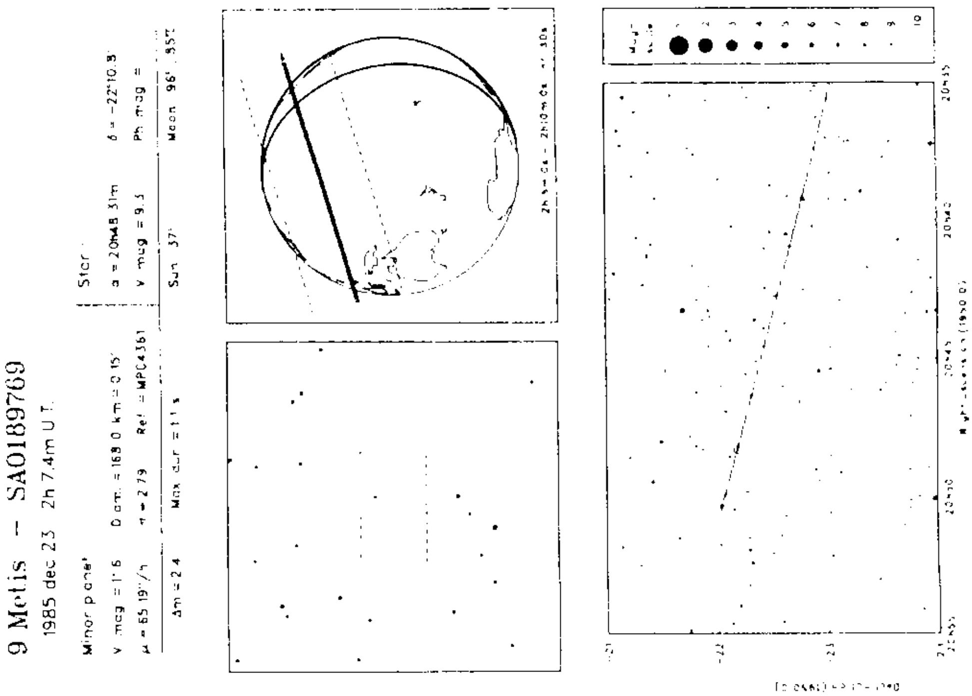
Goffin says (and Dunham confirms) that the value given to the right of km in the diam. line is actually *twice* the angular diameter; the km value is the actual value in kilometers.

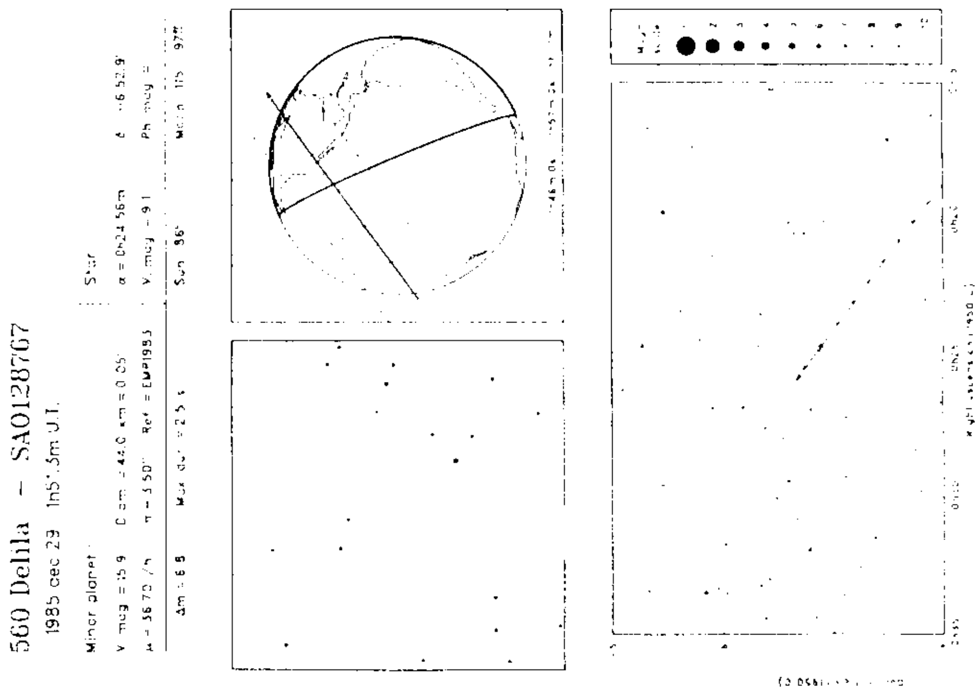
Unfortunately, the maximum durations (Max. dur.) given in Goffin's predictions are wrong due to a program error. For large asteroids, the values are usually much smaller than the true maximum durations. Roland Boninsegna discovered the error, which affects all of the 1986, and the late December 1985, predictions. The true maximum duration in seconds can be computed from the formula:

$$\text{Max. dur.} = \frac{\pi}{\mu} \times \frac{\text{Diam. in km}}{1.771}$$

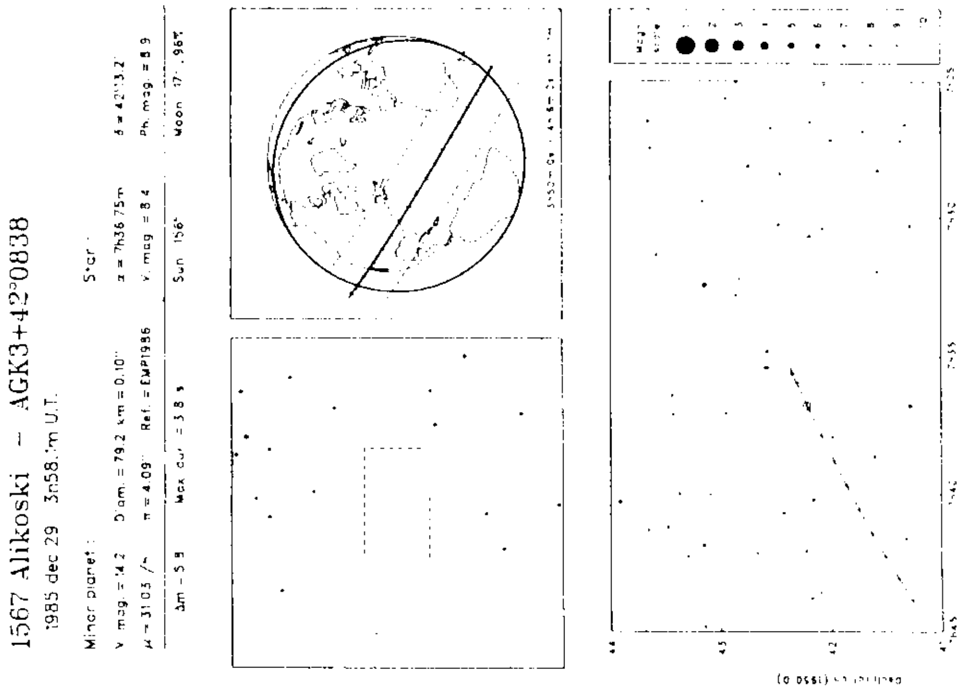
where π is the horizontal parallax in arc seconds, μ is the apparent motion of the asteroid in arc seconds per hour, and Diam. is the diameter of the asteroid in kilometers, all obtained from the heading information for each event. A simpler expression could be used if the angular diameter of the asteroid were used, but that would give much less accuracy due to the fact that only one or two digits are given for it. The constant 1.771 is the earth's equatorial radius in kilometers divided by 3600, the number of seconds per hour. As an example, consider the occultation of AGK3 +06° 1234 by (1456) Salhanha on 1986 January 12. μ is 21.94 arc seconds per hour, Diam. is 40.0 km, and π is 3.00 arc seconds, so that Max. dur. is 3.09 seconds, not the given value of 3.8. In this case, the given value is much closer to the true value than is usually the case. Goffin apologizes for the inconvenience that this causes, and the error will be corrected for future predictions.

Goffin also has computed prediction of possible occultations (or transits) of asteroids, and published his list in *Sky and Telescope 70* (5), 464. Observations of such events could have astrometric value. One such event already may have been observed by chance, by Richard Binzel at McDonald Observatory, TX. We will not give any information about it in *o.n.* until Binzel's account is published in the *Astronomical Journal*, probably in the 1986 February issue. A world map and finder chart for the best event, expected to be visible from southern and western Africa and the northern U.S.A. from 0^h 24^m to 56^m U.T. on 1985 Dec. 18, are given in the *S&T* article. 12.3-mag. (317) Roxane will pass in front of 13.5-mag. (790) Pretoria at 1950 R.A. 4^h $54^m\!.12$, Dec. +19° 40'.1. The elongation from the sun will be 168° and will be 91° from the 40%-sunlit moon. An astrometric update might be obtained for this event, in which case an updated prediction will be available by telephoning the usual IOTA recorded messages for asteroidal occultation updates. Another event, involving 16th-mag. (1137) Raissa and 15th-mag. (760) Massinga, occurred on 1985 Oct. 28, possibly visible from Japan and eastern Siberia. Unfortunately, the time was 8^h 55^m U.T., several hours before a total lunar eclipse, so moonlight would have hindered observation of the asteroids and their possible 0.25-mag. drop. Details of the 1986





possibilities will be published in the next issue of *Occultation Newsletter* for events possibly visible from North America and Europe, and will be distributed to regional coordinators by Jim Stamm (as for Goffin's predictions of asteroidal occultations of stars) for events visible elsewhere.



ASTEROIDAL APPULSE AND OCCULTATION OBSERVATIONS

Jim Stamm

I have received several reports that were too late to include in this article. They were sent to someone else, and although most were forwarded to me immediately, some did not make it in time. They will be be included in my next article. Another reason for delays is that observation reports are not on familiar forms. Although reports in the form of letters or notes will suffice, it helps me if they are on any of the usual forms. These forms are available from me, IOTA, and most of the coordinators. My address is Rt. 13 Box 109; London, KY 40741; U.S.A.

(1) Ceres and B.D. +8° 471, Nov 13, 1984: (*O.N.* 3 (12) 250). Barbara Jones, not Smith was the partner of Ted Dunham (Grand Turk chord). At the time of the observation, Barbara was only to be a 'Smith', after she married J. Allyn Smith, the Melbourne chord observer.

(97) Klotho and SAO 130198, Jan 10, 1985: (*O.N.* 3 (12) 251). A. Manna at Minusio, Switzerland saw no event, nor did 5 Italian observers: P. Baruffetti and G. Pacifico at Massa, R. Di Luca at Bologna, and two Gr. Astr. Savonesi observers at Savona.

(206) Hersilia and SAO 94422, Jan 18: (*O.N.* 3 (11) 230). P. Baruffetti saw no event at Massa, Italy.

(488) Kreusa and SAO 60442, Jan 19: No occultation was seen by R. De Bosscher at Evergem, Belgium, nor by P. Baruffetti at Massa, Italy.

(747) Winchester and SAO 95375, Jan 22: (*O.N.* 3 (12) 251). H. Bulder saw no event at Zoetermeer, Netherlands, nor did Belgian observers C. Baetens at Boechout, and R. De Bosscher at Evergem.

(402) Chloe and anonymous star, Feb 16: Six Belgian observers all recorded no events: C. Baetens and H. Riemig at Boechout, R. Boninsegna at Dourbes, L. Louys at Charneux, and Y. Thirionet and L. Zimmermann at Brussels.

(7) Iris and SAO 94467, Feb 16: (*O.N.* 3 (12) 251). Roland Boninsegna reports that a record 28 stations participated in this European event. All but one recorded misses: Belgium - Boninsegna, P. Matagne, and Z. Przbylo at Dourbes; F. Ciette, A. Jorissen, and L. Zimmermann at Brussels; W. Coenen and J. Van Camp at Waarloos; J-P. Heylen at Gozee; L. Louys at Charneux; B. Thooris at Wervik; C. Baetens at Boechout; J. Bourgeois at Reux; R. De Bosscher at Evergem; P. De Nayer at Sterrebeek; J. Fruru at Merksem; J. Schwaenen at Marcinelle; and W. Verhaegen at Wetteren. France – Halbwachs at Molsheim; R. Heidmann at St. Maurice/Vernon; J. Lecacheux at Caen; S. Maksymowicz at Chapet; P. Mazalrey at Vernon; Bradel, M. Dumont, and A. Figer at Paris; and the Meudon Observatory. The Netherlands H. Bulder at Zoetermeer; and six observers led by J. Warmerdam at Emmen. Spain – P. Coleron, M. March, J. Ilia and J. Marti at Mataro; and C. E. Torres at San Sebastian. J. Barthes at Castres, France, reported an event under unstable skies, and his observation was inconsistent with actual conditions.

(564) Dudu and SAO 76544, Feb 18: (*O.N.* 3 (12) 251). None of the following European observers detected any events: Belgium - C. Baetens and H. Riemig at Boechout; R. Boninsegna at Dourbes; L. Louys at Charneux; Y. Thirionet and L. Zimmermann at Brussels; B. Thooris at Wervik; R. De Bosscher at Evergem; F. Van Loo at Itegem; and W. Verhaegen at Wetteren. France – S. Maksymowicz at Chapet; P. Rousselot at Besancon; A. Figer at Paris; R. Mailler at Pontailler; J. Vialle at La Rochelle; and the Meudon Observatory. The Netherlands – H. Bulder at Zoetermeer. Italy F. Tulipani at Bologna.

(51) Nemausa and 10.6-mag. star, Feb 19: (*O.N.* 3 (12) 251). No occultation was seen by H. Bulder at Zoetermeer, Netherlands, the Meudon Observatory, nor by Belgian observers A. Lheureux and Y. Thirionet at Brussels, and B. Thooris at Wervik.

(454) Mathesis and AGK3 +13° 1117, Mar 12: (*O.N.* 3 (12) 252). No events were observed by C. Baetens at Boshoek, Belgium, S. Maksymowicz at Moisson, France; the Meudon Observatory; nor by Spanish observers J. Ripero, A. Gomez, and D. Rodriguez at Madrid.

(198) Ampella and SAO 77087, Mar 12: (*O.N.* 3 (12) 252). Misses were reported by the Meudon Observatory, and French observers S. Maksymowicz at Moisson and R. Mailler at Pontailler, as well as by C. Baetens at Boshoek, Belgium; and A. Gomez and D. Rodriguez at Madrid, Spain.

Mars and SAO 92739, Mar 17: S. Maksymowicz recorded an occultation at Moisson, France, but did not supply any details.

P/Halley and anonymous star, Mar 17: French observers S. Maksymowicz at Moisson, and R. Heidmann and P. Mazalrey at Vernon recorded misses. P. Morel reported an event at Saint Saulve, France, but it was at the limit of visibility, and inconsistent with the latest path determination, which placed the event over Africa.

(1022) Olympiada and anonymous star, Apr 8: M. March and J. Marti both report no event at Matero, Spain.

(275) Sapientia and SAO 139564, Apr 15: (*O.N.* 3 (12) 252). Italian observers P. Baruffetti at Massa, and R. Di Luca and F. Tulipani at Bologna saw no occultation, and none were detected from the Meudon Observatory (France). We know from the previously reported American observations that the actual path crossed northern Africa.

(12) Victoria and SAO 183095, Apr 21: (*O.N.* 3 (12) 253). P. Hernando and J. Soldevilla saw no event at Vilanova, Spain.

(746) Marlu and SAO 138569, May 1: (*O.N.* 3 (12) 253). Andrea Manna saw a 1.8-second occultation around 23:32.

(2771) Makover and SAO 81369, May 2: (*O.N.* 3 (12) 253). Negative observations were recorded by T. Tobal at Vilanova, Spain, R. Heidmann and P. Mazelrey at Vernon, France, and S. Maksymowicz at Moisson, France.

(625) Xenia and SAO 99935, May 8: (*O.N.* 3 (12) 253). P. Hernando, P. Soler and J. Soldevilla saw no occultation at Vilanova, Spain.

(578) Happelia and SAO 98974, May 20: (*O.N.* 3 (12) 253). Y. Thirionet saw no event at Brussels, belgium, nor did T. Tobal at Vilanova, Spain.

Saturn and 34 Librae, May 23-24: Misses for this close appulse predicted by J. Meeus were reported by French observers P. Mazelrey at St. Sauveur, F. Texier at Marcilly, the Meudon Observatory, and the Pic du Midi Observatory.

(145) Adeona and SAO 190822 = η Piscis Austrini A, Jul 20: French observers F. Vaissiere and J. Royer saw a miss from St-Etienne. J. Lecacheux recorded a 7.5-second extinction at Montpellier, but has determined that it was due to clouds because the above-mentioned observers were exactly at the same place perpendicular to Adeona's motion. P. Mazalrey also recorded a miss at Vernon, France. Other misses were reported by Aloy Domenech at Sampsor, Spain, C. Gualdoni at Mt. Penice, Italy, P. Rousselot at Jungfraujoch, Switzerland, and the Jungfraujoch Observatory. An occultation was observed from La Paz, Bolivia; this and several South American miss observations will be reported in my next article.

(21) Lutetia and SAO 93083 = 38 Arietis, Aug 9: I observed no events from 07:00 to 07:15 at London, KY. The star remained fairly steady, although fog permitted only first-magnitude stars to be seen with the naked eye. Benny Roberts also recorded no event from 06:55 to 07:15 at Jackson, MS, as did David Dunham from 07:08 to 07:14 at Silver Spring, MD.

(28) Bellona and SAO 74620, Aug 15: Luigi Baldinelli and Stefano Trentini detected no photoelectric event from 23:30 to 24:00 at Bologna, Italy.

(28) Bellona and SAO 162924, Aug 17: Ferruccio Ginelli saw no occultation from 21:25 to 21:59 at Fortaleza, Brazil. He saw the asteroid pass south of the star, with the images joined between 21:40 and 21:50, at 500 power. Luigi Baldinelli, Muzzi, and Norelli detected no photoelectric event from 21:21 to 21:40 at Bologna, Italy.

(1036) Ganymed and SAO 38952, Aug 22: Greg Lyzenga saw no occultation from 07:36 to 08:06 at La Verne, CA. The two images were fused together for about 4 minutes, centered on about 07:50, and the asteroid appeared to pass slightly south of the star. Thomas Langhans observed photoelectrically from 07:47:05 to 08:00:16 at San Bruno, CA. He recorded a larger-than-normal drop in count at 07:51:18 (1-second integration period). Benny Roberts saw no occultation from 07:55 to 08:10 at Jackson, MS, and Paul Maley and others in the Houston, TX, area also had a miss.

(230) Athamantis and SAO 108412, Aug 25: Three exposures obtained with the 18-inch astrograph at Lowell Observatory were measured and the results given to David Dunham, who computed a path shift of 1".13 south with time 2.5 min. early. Since the implied path crossed Glacier National Park at 11:53 UT and Vancouver, BC, at 11:54, Dunham phoned Richard Linkletter, who notified several observers in the area. The only report is from Howard Louth, Sedro Valley, WA, who saw a miss, thinking that Athamantis passed north of the star. That would be in agreement with measurements of four Lick exposures, which implied a path of 0".48 S ±0".10, which passed just north of Edmonton, Alberta, and crossed central British Columbia, and just south of Japan and over southeastern China on the other side of the Pacific Ocean.

(230) Athamantis and SAO 108346, Sep 1: Larry Wasserman computed a path equivalent to 0".41 south from the Aug 19 Lowell exposures. This was updated to 0".20 south ±0".25 based on additional plates taken Aug 24 and 25. Using these predictions, Dunham distributed a special notice to over 130 groups and individual observers, most of whom were not already subscribing to *O.N.* Unfortunately, even more Lowell plates taken up to about Aug 28 gave very different

paths, leading the Lowell astronomers to conclude that the new filter/plateholder combination for their telescope was giving slightly comatic images which could not be measured accurately. As this issue goes to press, these problems had not been fixed and Lowell remained astrometrically out of commission.

Fortunately, Arnold Klemola's measurements of the Lick Aug 23rd plate (see Aug 25 above) came to the rescue. They gave a path of 0".28 north ±0".12 (with time 1.7 min. early), passing just north of San Francisco and Sacramento, CA, and north of everyone to whom Dunham had distributed the special notice. Unfortunately, it was mostly cloudy in the estimated path in northern California, where Dunham had telephoned many observers during the 24 hours preceding the event. Using a 36-cm Schmidt-Cass. 2 km southeast of Loyalton, CA, at path 0".32 north, John Westfall observed the only actual disappearance, at 04:57:10.4. At 04:57:23 patchy clouds covered the field for about a minute, and the star had reappeared when the field cleared. Duration was at least 12.5 seconds. Richard Bochonko saw no event at the University of Manitoba (0".26 north), from 04:51 to 04:57, so Dunham believes the path center was probably a little north of Loyalton (ca. 0".35 N). At Boone, CO, Walter Russell observed from 04:50 to 05:01, and saw much dimming due to clouds. A disappearance at 04:54:15, lasting 1 to 1.5 second seemed to be abrupt, and he feels that there was a possibility of having observed a grazing occultation, but rates the "the reliability of the observation as low." Robert Lorenzo observed at Santa Monica, CA, from 04:48 to 05:01, and saw a dimming of 0.2 magnitude begin at 04:58:11.2. It lasted for 20 to 30 seconds, and there was no sudden increase in brightness. Brent Sorenson at Cedar City, UT, reported a slight dimming ("..probably clouds") for 1 to 2 seconds that began at 04:55:26. Clouds dimmed Pat Wiggins' observation at Tooele, UT, at 04:58 and 05:01. He began observing at 04:50, and saw the images merge just after 04:52, and remain fused until just before 05:03, when he finished. Greg Lyzenga estimated closest approach at La Verne, CA, to be approximately 04:57. He could not determine side of closest approach because the images remained coalesced for about 8 minutes. Six other California observers reported misses: Jim Young at Red Mountain (04:56 - 05:01), Robert Moss at East Palo Alto, Jim Van Nuland at San Jose, Gene Harlan at the Lick Observatory, Bill Owen at Altadena, and Don Macholz at Grand Ranch Park.

(230) Athamantis and SAO 108226, Sep 7: This star was also on the Lick plate, and Dunham's calculation gave a path of 0".45 north with time 4.1 min. early. Activities relating to G-Z (see p. 291) delayed this calculation, so that Dunham was unable to notify observers in Asia about the shift before the event.

(70) Panopaea and SAO 76770, Nov 5: Measurement of three Lick Observatory exposures shows that the path is at 0".28 south ±0".20 with time correction 4.4 ±0.4 minutes early. This path crosses the southern Bahamas at 03:28 UT, Cuba at 03:29, and the Yucatan Peninsula and Mexico a short distance south of Mexico City at 03:30. Dunham telephoned observers in Mexico City and southernmost Florida, where the occultation could occur.

UPCOMING OCCULTATIONS BY COMETS

David W. Dunham

Predictions of numerous occultations of stars by comets Halley and Giacobini-Zinner (G-Z) were given in an article starting on p. 253 of the last issue. The predicted paths of both comets are now a few to several arc seconds south of the ephemerides used to calculate those predictions. I have generated new occultation lists using International Halley Watch (IHW) orbits #31 for G-Z and #28 for Halley, both computed at the end of September by D. Yeomans at J.P.L. I have redone the A.C. search for Halley, finding some new events and showing that some previously listed events now miss the earth's surface to the south. I also have included occultations of SAO stars in 1986 originally identified by E. Bowell and L. Wasserman at Lowell. "Postdictions" are included for some of the better events during October. In that month, many observers were looking for Halley, and it's possible that someone noticed one of the appulses by chance.

The tables are similar to the ones in the last issue, using "diameters" of 50 and 100 km for G-Z and Halley, respectively. See the article about observations of G-Z appulses (p. 291) for a discussion of the probable smaller size of observable dimming. When Halley is at its brightest, it probably will have a dust production about ten times larger than G-Z in early September, according to N. Divine. The magnitudes given are considerably brighter than nuclear magnitudes, to try to represent approximately the total brightness in the near-nucleus region which would contribute to the observability of the expected magnitude drop. In late October, Paul Maley estimated that Halley's nucleus is already nearly 11th mag., rather brighter than my calculated values. So the occultations of stars fainter than tenth magnitude may be very difficult to observe.

Differences between Yeomans' and my ephemerides of G-Z were discussed on p. 257 of the last issue. The same problem exists with Halley, but it is generally smaller; during 1985, the maximum difference amounts to 0".23. The correct path is indicated by "YEOMANS" on the regional maps. The updated (IHW28) paths are drawn in on Sôma's world maps, which are not available for the new events not listed last time. Sôma's maps were prepared with IHW 24 ephemeris data for Halley used for the predictions in the last issue. The times given on Sôma's maps are a few minutes in error; use the times given in the table, since the predicted time of the occultation using orbit IHW 28 always will be within 2 minutes of the tabular time. In the titles for the regional maps, ignore the "(2)" preceding the name "P/HALLEY." Maps for the 1986 events will be published in the next issue. Finder charts have not been prepared for the new Halley events since other charts published in *Sky and Telescope* and elsewhere should be adequate for finding the comet. Once you find the comet, you should be able to find the target star before the occultation a short distance east of the nucleus. The distance between the target star and the nucleus can be calculated from the motion in the second table; multiply the value there by 2.5 to get the rate in arc seconds per minute of time. SAO 203904, occulted on 1986 April 16, is a double star. The occultation of SAO 179904 on April 24 occurs deep in

(Text continues on page 283)

In the tables, name G means Comet Giacobini-Zinner; name H means Comet Halley. Ephemeris source is omitted from Table 1 to save space (see the first paragraph of the text). Assumed diameters: G = 50 km; H = 100 km.

Table 1

	COMET				STAR					OCCULTATION						MOON		
DATE	UT	NAME	m_v	Δ,AU	SAO No	m_v	Sp	R.A.(1950)	Dec.	Δm	Dur	df	P	Possible Area	El SUN	El	%Snl	Up
October, 1985																		
9	7^h49^m	G	13.7	0.59	152379	8.0	B95	$7^h03^m.8$	-10°05'	5.8	3^s	9	34	Labrador, Newfoundland	87°	43°	29-	all
19	6 22	H	13.2	1.46		11.6		5 55.2	20 53	1.8	6	14	21	s. Brazil,Bolivia,n.Chile	116	171	33+	none
20	1 04	H	13.2	1.43		12.0		5 53.9	20 56	1.5	6	13	21	Europe, U.K.	117	161	41+	none
20	14 15	H	13.1	1.41		12.8		5 52.9	20 58	0.9	5	13	21	n.e. Pacific, Taiwan	118	154	47+	w130°E
21	10 28	H	13.1	1.39		12.0		5 51.3	21 01	1.4	5	12	20	Tahiti, Fiji	119	142	56+	w140W
28	6 27	H	12.6	1.18		10.5		5 34.9	21 31	2.2	4	9	17	s.e. Canada, n.w. U.S.A.	130	55	100+	all
29	20 19	H	12.4	1.14		12.1		5 29.9	21 38	0.9	4	8	16	Japan,China,Mideast,Libya	133	35	99-	all
30	0 07	H	12.4	1.13		11.6		5 29.4	21 39	1.2	4	8	16	w.India, Arabia, n.Africa	133	33	99-	all
30	9 58	H	12.4	1.12		10.2		5 28.0	21 41	2.3	4	8	16	n. Canada, Alaska?s	134	28	97-	all
November, 1985																		
4	3 59	H	12.0	0.99		12.1		5 09.0	22 01	0.7	3	6	14	Argentina, Chile	143	34	67-	e 55W
4	23 29	H	11.9	0.97		12.1		5 05.1	22 04	0.7	3	6	14	n.w.U.S.S.R., Scandinavia	145	45	59-	all
6	6 38	H	11.8	0.93		11.3		4 58.5	22 08	1.0	3	5	14	Cuba, Mexico	147	63	45-	e100W
7	19 23	H	11.6	0.89		11.0		4 49.9	22 12	1.1	3	5	13	Malaya,SriLanka,c.Africa	151	85	29-	e 95E
7	23 19	H	11.6	0.89		12.0		4 49.0	22 12	0.6	3	5	13	w.U.S.S.R.,n.Europe,U.K.	151	88	28-	e 20E
10	3 59	H	11.4	0.84		11.6		4 35.1	22 14	0.6	3	5	12	Algeria,Iberia,seUSA,nMex	157	122	9-	e 5W
12	23 20	H	11.1	0.78	76535	9.0	A3	4 14.6	22 08	2.2	2	4	11	southern Africa	164	169	0+	none
13	0 24	H	11.1	0.78		12.5		4 14.3	22 08	0.3	2	4	11	central Africa, Amazon	164	170	0+	none
14	19 38	H	10.9	0.74		11.6		3 59.4	21 57	0.4	2	4	11	Malaya,sIndia,centAfrica	170	159	7+	w 5E
15	10 45	H	10.8	0.73		11.2		3 53.8	21 52	0.6	2	4	11	centralPacific,Queensland	171	149	12+	w150E
15	19 50	H	10.8	0.72		10.9		3 50.4	21 48	0.7	2	4	10	Japan,China,sUSSR,Mediter	172	142	15+	w 0
16	1 38	H	10.7	0.72		12.0		3 48.2	21 46	0.3	2	4	10	centAfrica,Brazil,Bolivia	173	138	17+	w 50W
16	18 49	G	14.5	0.82	197937	9.2		7 21.6	-33 28	5.3	5	20	72	w. Pacific, e. Austalia	103	120	23+	none
16	22 19	H	10.6	0.70		10.4		3 40.1	21 36	0.9	2	3	10	South Africa	176	124	25+	w 15E
19	14 27	H	10.7	0.67		8.2	A0	3 13.1	20 51	2.6	2	3	19	New Zealand, Tasmania?n	174	82	52+	w155E
19	15 51	H	10.5	0.67		10.7		3 12.5	20 50	0.7	2	3	10	sPh'lpnIs,seAsia,nIndOc'n	174	81	53+	w125E
21	15 11	H	10.5	0.64		10.5		2 51.1	20 02	0.7	2	3	9	Hokkaido,neChina,Tibet,Pakistan	167	52	72+	w150E
22	5 18	H	10.5	0.64		11.3		2 44.5	19 45	0.4	2	3	9	CanaryIs,FL,Mex	165	43	77+	w 45W
22	8 32	H	10.5	0.64		10.9		2 43.0	19 41	0.6	2	3	9	southern USA	164	41	78+	w 95W
23	3 54	H	10.5	0.63		11.9		2 33.8	19 16	0.3	2	3	9	Brazil, Peru	161	30	84+	all
25	17 14	H	10.5	0.62		11.1		2 04.4	17 42	0.5	2	3	9	southwestern Australia	152	9	97+	all
27	20 41	H	10.6	0.62		9.7	G5	1 39.8	16 09	1.3	2	3	9	wChina,Kazakhstan,sEurope	144	40	100-	all
29	21 39	H	10.6	0.62		9.0		1 28.1	15 21	1.9	2	3	9	nUSSR, Greenland, nCanada	140	55	98-	all
December, 1985																		
1	9 48	H	10.8	0.63		10.6		1 01.2	13 19	0.8	2	3	9	nwCanada,Alaska,eSiberia	130	92	86-	e120E
2	2 10	H	10.8	0.64		9.3	G5	0 54.2	12 46	1.7	2	3	9	Amazon, Colombia	128	102	81-	e 76W
4	1 45	H	10.9	0.66		11.7		0 34.9	11 08	0.4	2	3	10	Greenland, northernCanada	121	132	64-	e 85W
4	8 45	H	10.9	0.66		11.9		0 32.1	10 53	0.4	2	3	10	Alaska,Kamchatka,Hokkaido	120	136	61-	e170W
7	6 56	H	11.1	0.69		11.6		0 06.8	8 36	0.5	2	4	10	swMexico?n;centralPacific	110	170	29-	none
7	11 28	H	11.1	0.70		11.2		0 05.3	8 28	0.7	2	4	10	Japan?n; southern China	110	168	27-	none
9	4 55	H	11.2	0.72		11.5		23 52.1	7 12	0.6	2	4	10	USA(SCtoAZ), BajaCal, HI	104	143	11-	none
9	20 10	H	11.2	0.73	128409	8.6	G0	23 47.6	6 46	2.4	2	4	11	southern Africa	103	133	7-	none
11	16 36	H	11.3	0.76		10.5		23 35.2	5 33	1.2	3	4	11	Seychelles, Tanzania	97	103	0-	none
14	10 14	G	12.0	0.99	197296	10.1	F0	6 50.3	-38 02	2.1	6	23	29	New Zealand, Queensland?s	116	114	8+	w170E
15	20 29	H	11.5	0.84	128050	9.1	G5	23 11.4	3 10	2.5	3	5	24	Lapland, Newfoundland	87	38	19+	w 30W
26	9 42	H	11.8	1.05	146146	8.9	MB	22 30.1	-1 02	2.9	4	8	30	n. Europe?s (1".4 miss)	65	104	99+	all
January, 1986																		
11	9 49	G	12.6	1.22	196652	9.8	F8	6 15.3	-33 22	2.9	4	18	71	e. Australia, W. Irian?w	122	115	1+	all
March, 1986																		
3	11 25	G	14.0	1.89	151324	8.5	K2	6 15.6	-16 44	5.5	3	14	110	Antarctic,NZ;MarshallIs?w	107	131	51-	s 35S
28	14 59	H	10.8	0.60	210769	8.9	B9	18 54.9	-34 20	2.1	3	4	17	Antarctica, New Zealand?n	86	61	92-	all
April, 1986																		
6	7 29	H	10.0	0.44	227471	9.6		16 53.0	-45 40	1.0	2	2	13	Antarctica; Tierra del Fuego?n	116	83	9-	none
7	7 52	H	9.9	0.43	226884	8.5	B9	16 29.9	-46 34	1.7	2	2	13	Amazon, Peru	120	99	4-	none
12	3 29	H	9.6	0.42	224955	9.0	F5	14 25.8	-46 06	1.1	2	2	12	Antarctica?n (2".3 miss)	140	152	8+	none
13	5 59	H	9.6	0.42	224622	9.5	A3	13 58.8	-44 48	0.8	2	2	12	Tierra del Fuego?n; Tahiti	143	146	14+	w145W
14	17 30	H	9.6	0.44	224173	9.6	A2	13 26.0	-42 32	0.8	2	2	13	Antarctica;South Africa?n	147	129	25+	w 40E
16	14 19	H	9.8	0.46	203912	9.2	G0	12 51.0	-39 11	1.1	2	3	13	cent & w Pacific, e China	149	103	42+	w140E
16	15 05	H	9.8	0.46	203904	6.8	K2	12 50.5	-39 07	3.0	2	3	13	Guam,Japan,Korea,ne China	149	103	42+	w140E
16	16 53	H	9.8	0.46	203882	9.1	G5	12 49.2	-38 58	1.1	2	3	13	nAustralia,India,Pakistan	149	102	43+	w100E
18	19 51	H	10.0	0.50	203363	9.2	G5	12 18.0	-34 57	1.2	2	3	14	s.e. Australia, S. Africa	149	72	64+	w 60E
24	12 02	H	10.7	0.62	179904	6.8	K0	11 25.1	-25 35	3.9	3	4	18	N.Z.,Queensland,Indonesia	140	39	10E	all

the partial phases just before totality begins during the lunar eclipse on April 24.

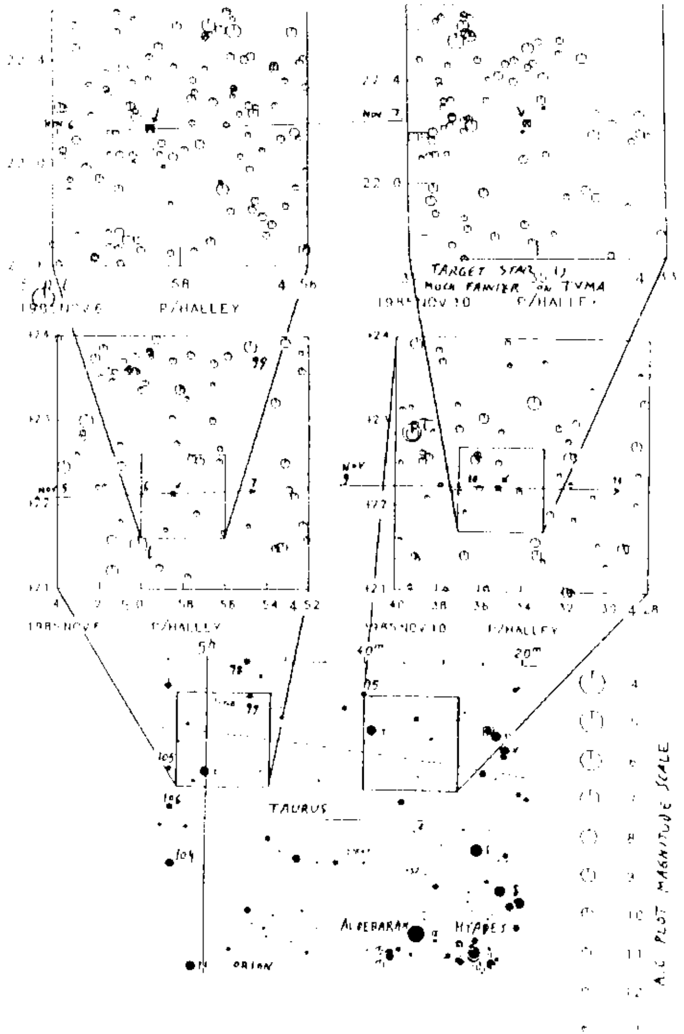
The remainder of this article consists of figures relating not only to the occultations listed here, but also relating to asteroidal occultations. No finder chart is published for 5.3-mag. SAO 190559

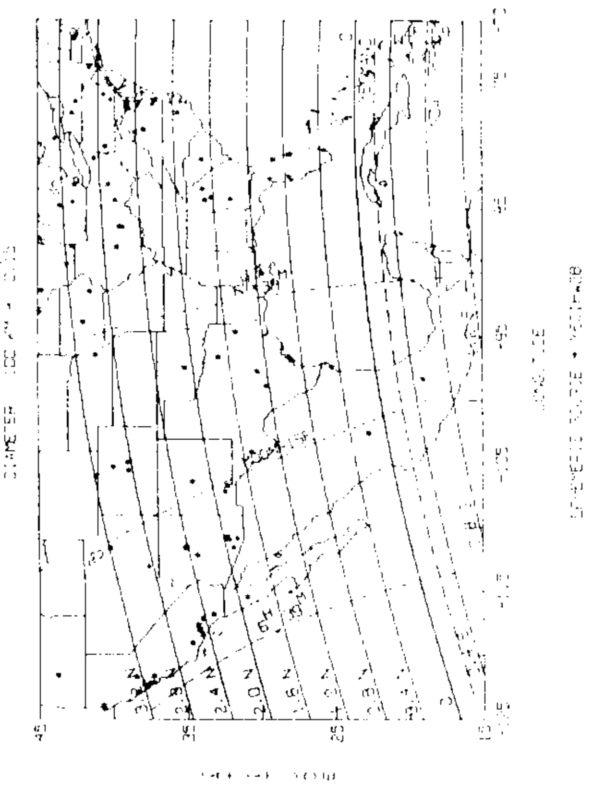
(Text continues overleaf)

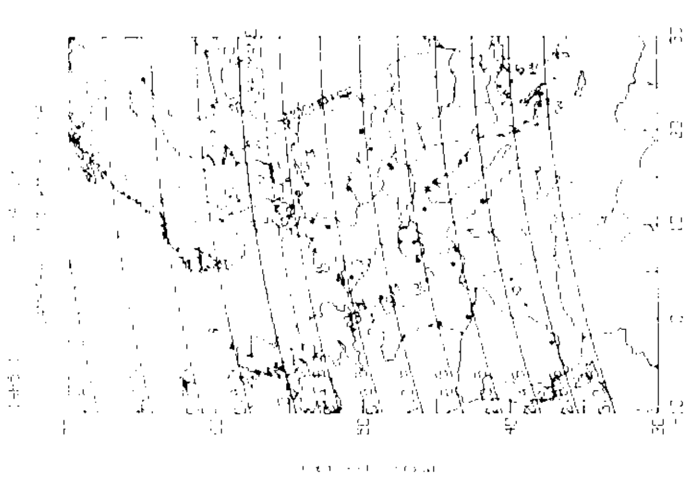
Table 2

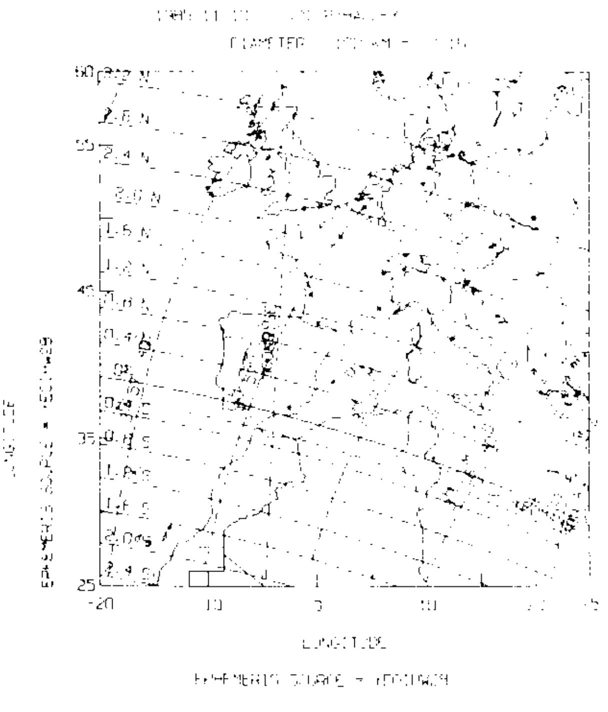
	COMET DATA			MOTION		S T A R			STELLAR DIAMETER					COMPARISON DATA			APPARENT	
DATE	NAME	DIAM	RSOI	°/Day	PA	SAO No	DM No.	D	m"	m	Time	df	S	AGK3 No	Shift	Time	R.A.	Dec.
October, 1985																		
9	G	0".12	52	0.994	157°	152379	-09°1844		0.08	35	2	0.2	S				$7^h05^m.5$	-10°08'
19	H	0.09	270	0.390	279								C				5 57.3	20 53
20	H	0.10	269	0.410	279								C				5 56.0	20 56
20	H	0.10	268	0.426	279								C				5 55.0	20 58
21	H	0.10	266	0.450	279								C				5 53.5	21 02
28	H	0.12	254	0.698	276								C				5 37.0	21 32
29	H	0.12	251	0.772	276								C				5 32.1	21 40
30	H	0.12	251	0.780	276								C				5 31.6	21 41
30	H	0.12	250	0.800	275								C				5 30.2	21 43
November, 1985																		
4	H	0.14	242	1.079	273								C				5 11.1	22 04
4	H	0.14	240	1.135	273								C				5 07.2	22 07
6	H	0.15	238	1.230	272								C				5 00.6	22 11
7	H	0.15	235	1.351	271								C				4 52.1	22 16
7	H	0.16	235	1.365	271								C				4 51.1	22 16
10	H	0.16	231	1.557	270								C				4 37.3	22 18
12	H	0.18	225	1.828	268	76535	+21 616						XA	N22° 405	0".24	$0^m.0$	4 16.8	22 14
13	H	0.18	225	1.832	268								C				4 16.4	22 13
14	H	0.19	222	2.016	266								C				4 01.5	22 03
15	H	0.19	221	2.082	266								C				3 55.9	21 58
15	H	0.19	220	2.121	265								C				3 52.5	21 55
16	H	0.19	220	2.146	265								C				3 50.3	21 53
16	G	0.08	65	0.367	200	197937							S				7 23.0	-33 31
16	H	0.20	218	2.234	264								C				3 42.2	21 43
19	H	0.21	213	2.492	262		+20 531						XA	N20 295			3 15.2	20 59
19	H	0.21	213	2.497	262								C				3 14.6	20 58
21	H	0.21	209	2.656	260								C				2 53.1	20 11
22	H	0.22	208	2.695	259								C				2 46.5	19 54
22	H	0.22	208	2.704	259								C				2 45.0	19 50
23	H	0.22	206	2.749	259								C				2 35.8	19 25
25	H	0.22	201	2.832	256		KLH 1511						H				2 06.3	17 52
27	H	0.22	197	2.822	254		+15° 252						XA	N16 160			1 41.7	16 20
28	H	0.22	195	2.791	254		+14 228						A	N15 1			1 30.1	15 32
December, 1985																		
1	H	0.22	190	2.654	252								C				1 03.1	13 31
2	H	0.22	189	2.604	252		+12 114						XA	N12 105			0 56.1	12 57
4	H	0.21	185	2.437	251								C				0 36.7	11 19
4	H	0.21	184	2.410	250								C				0 34.0	11 05
7	H	0.20	179	2.128	249								C				0 08.7	8 48
7	H	0.20	178	2.109	249								C				0 07.2	8 40
9	H	0.19	175	1.940	249								C				23 54.0	7 24
9	H	0.19	174	1.879	249	128409	+06 5207		0.18	95	2	0.6	A	N06 3236	-0.11	-0.0	23 49.4	6 58
11	H	0.18	170	1.707	248								C				23 37.0	5 45
14	G	0.07	76	0.286	273	197296	-37 3133						S				6 51.5	-38 05
15	H	0.16	162	1.368	248	128050	+02 4634	N	0.20	120	3	0.7	A	N03 2986	-0.24	0.1	23 13.3	3 22
26	H	0.13	141	0.813	248	146146	-01 4309						AS	S01 2752	0.35	0.2	22 31.9	0 51
January, 1986																		
11	G	0.06	88	0.338	328	196652	-33 2858						S				6 16.6	-33 23
March, 1986																		
3	G	0.04	108	0.334	30	151324	-16 1427						S				6 17.2	-16 45
28	H	0.23	145	2.083	234	210769	-3413269						S				18 57.3	-34 17
April, 1986																		
6	H	0.31	162	3.936	255	227471	-45 8209						S				16 55.7	-45 43
7	H	0.32	164	4.140	260	226884	-46 8059						S				16 32.6	-46 39
12	H	0.33	174	4.493	283	224955	-45 6861						S				14 28.2	-46 16
13	H	0.32	176	4.392	288	224622	-44 6616						S				14 01.1	-44 58
14	H	0.32	179	4.164	294	224173	-42 6280						S				13 28.2	-42 43
16	H	0.30	183	3.770	300	203912	-38 8069						S				12 53.0	-39 23
16	H	0.30	183	3.762	300	203904	-38 8062	A					G				12 52.5	-39 19
16	H	0.30	183	3.745	300	203882	-38 8043						S				12 51.2	-39 10
18	H	0.28	187	3.235	305	203363	-34 8087						S				12 19.9	-35 10
24	H	0.22	198	2.028	313	179904	-25 8682						G				11 26.9	-25 47

(41 Capricorni), to be occulted on Nov. 27 by (651) Antikleia, since it already appears on the large-field view at the top of p. 259 of the last issue. 41 Capricorni is the star near the left edge of the circled "+" marking the globular cluster M30. Paul Maley points out that on the same page, the small rectangle for the occultation by (1036) Ganymed on Aug. 22 should be 10° of declination north of its plotted position.

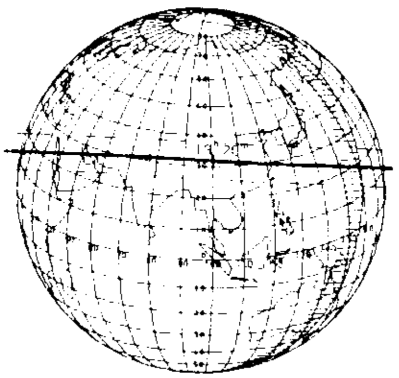








In the legends below and on page 289, P/H means Comet Halley, and P/G means Comet Giacobini-Zinner



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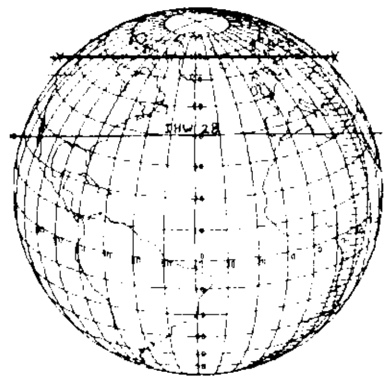

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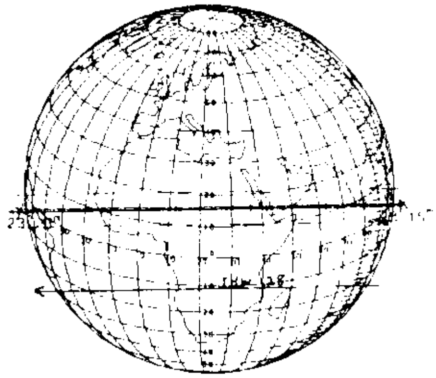

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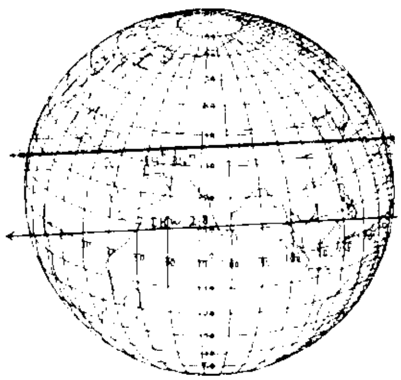

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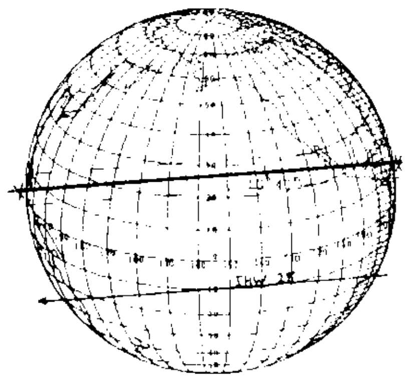

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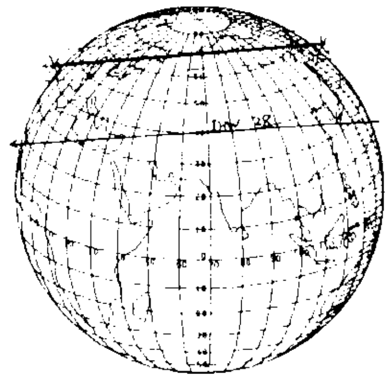

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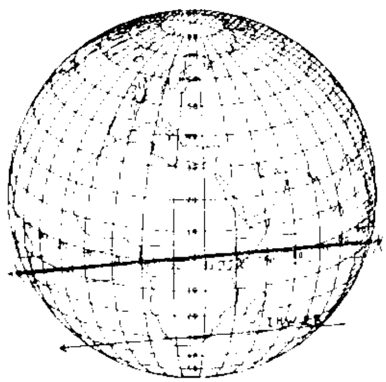

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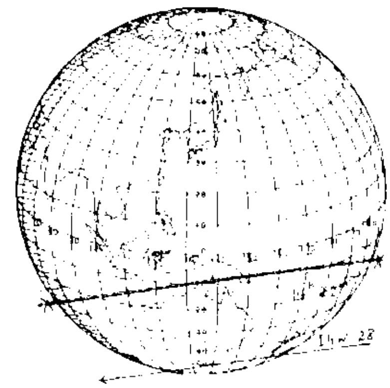
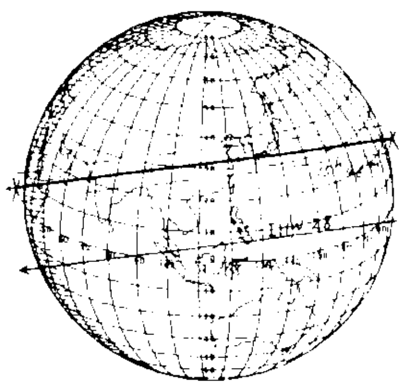


+20° 531 by P/H 1985 Nov 19, 14:27



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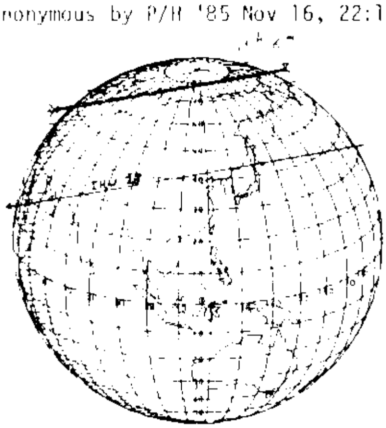

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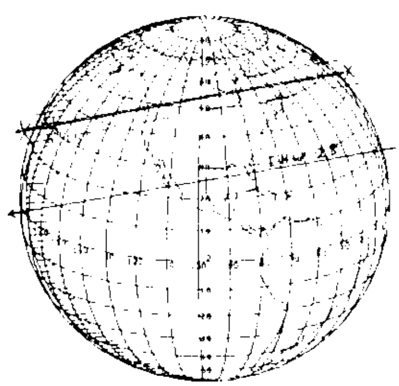

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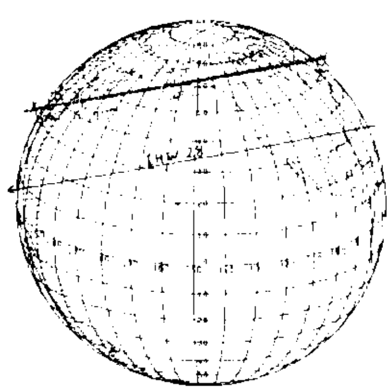

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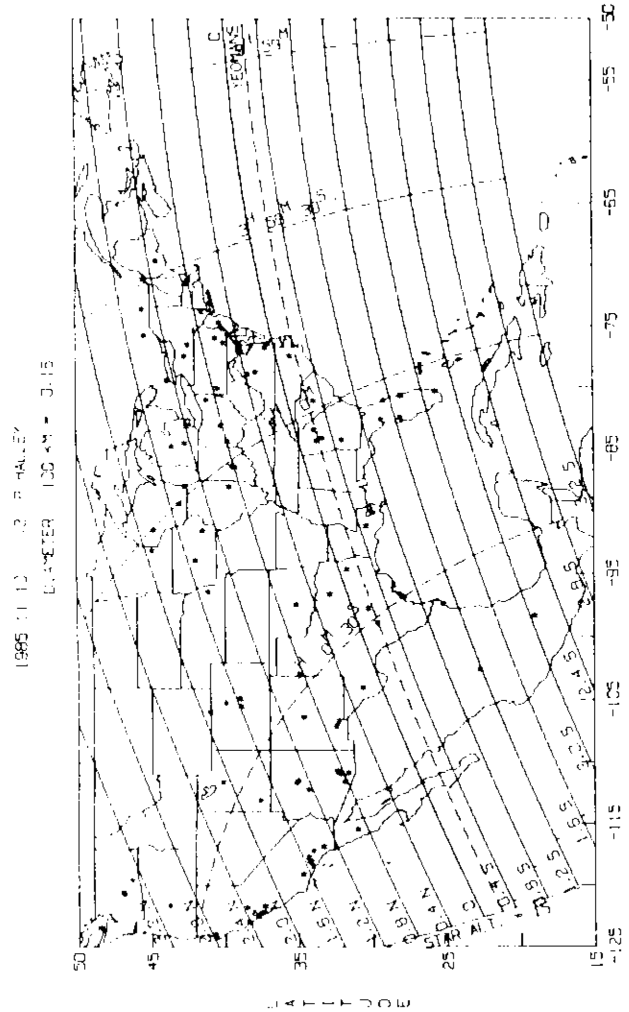

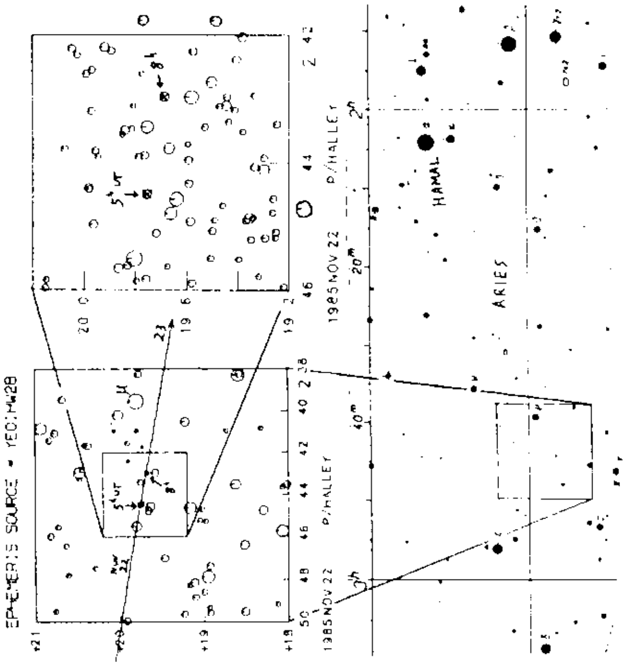

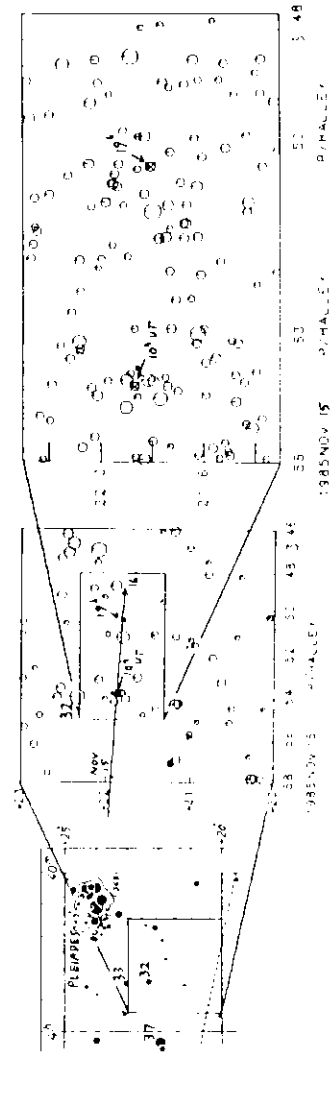

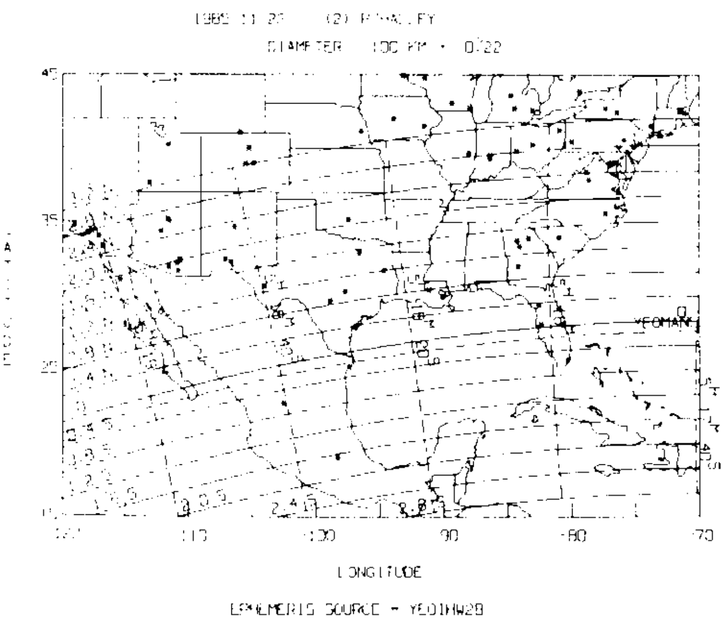
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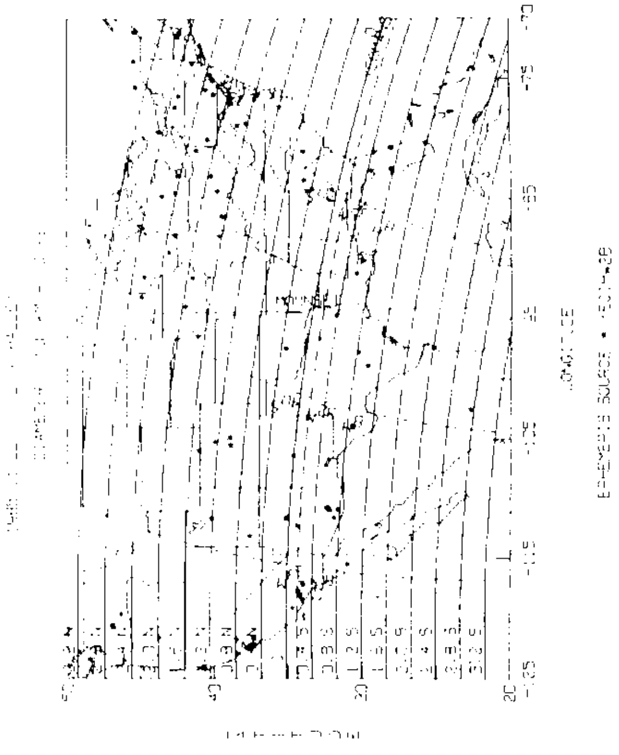
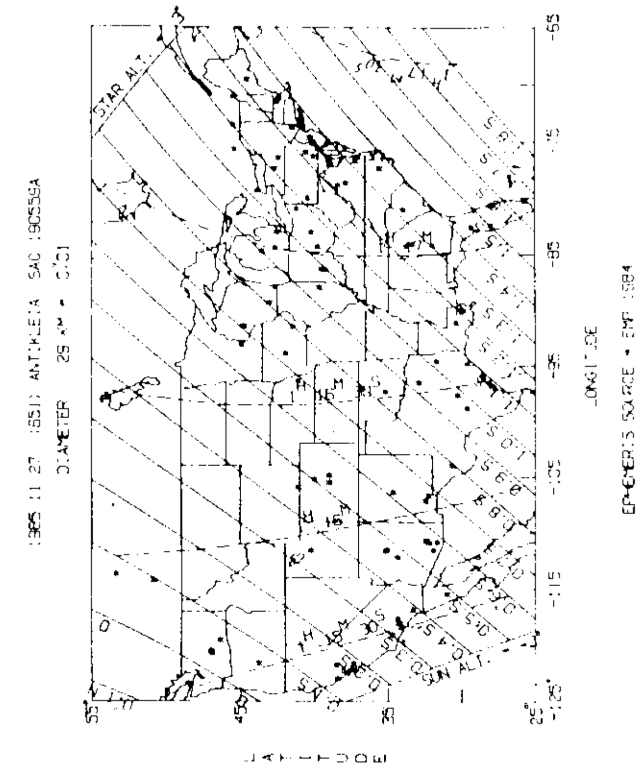
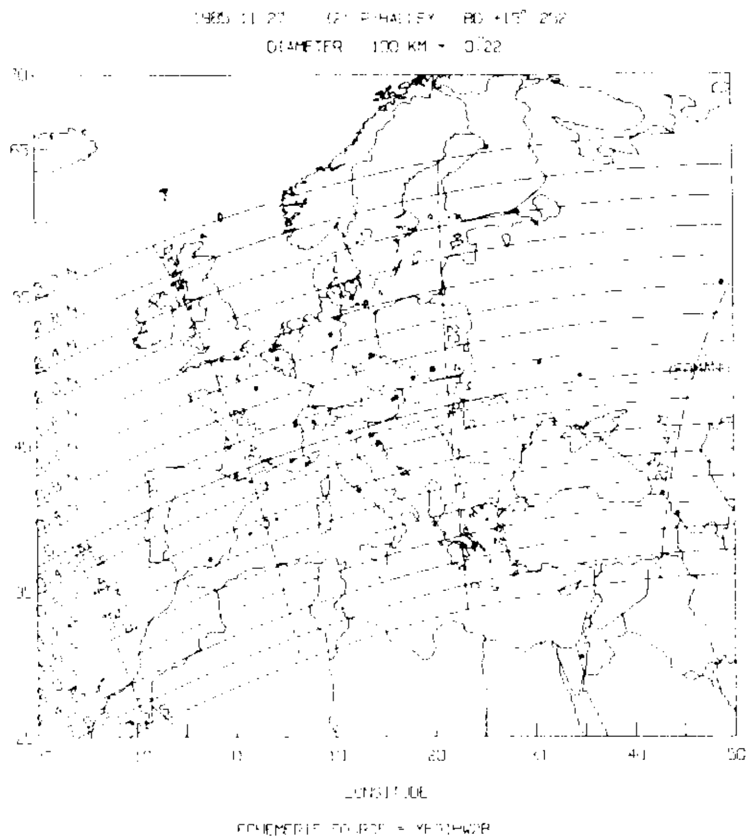
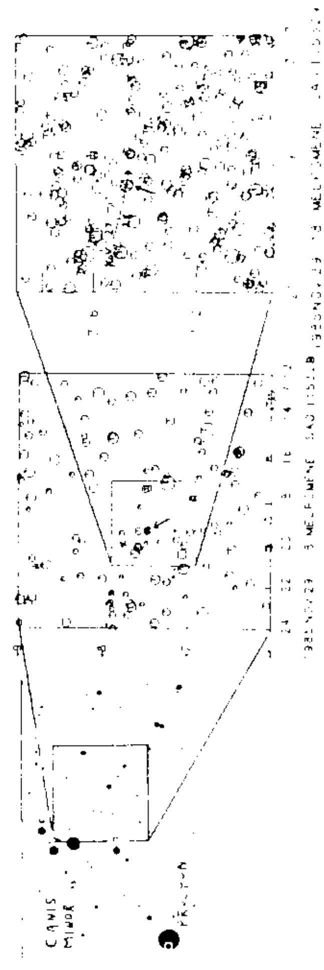
EPHEMERIS SOURCE - YEOIHW28



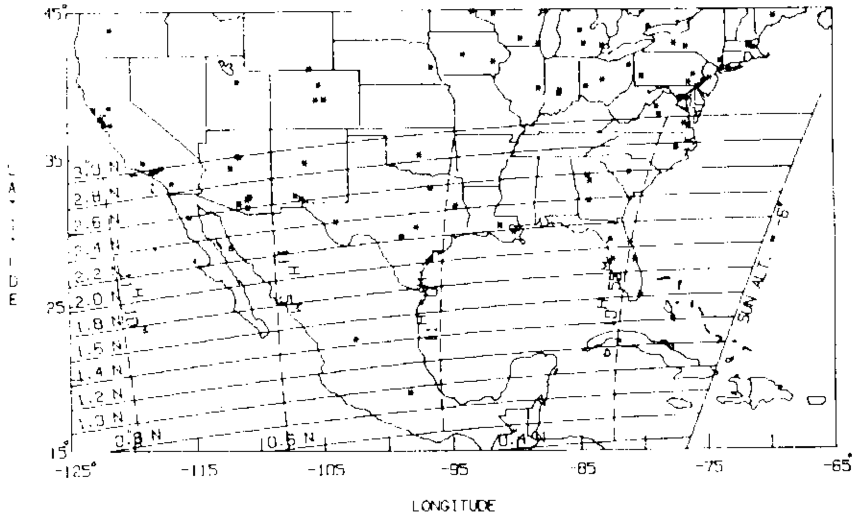

STAR ALT.
SUN ALT.
LONGITUDE


DIAMETER 100 KM = 0.22
LONGITUDE


CANIS MINOR

1985 11 29 (18) MELPOMENE SAO 115329

DIAMETER 148 KM = 0.″16



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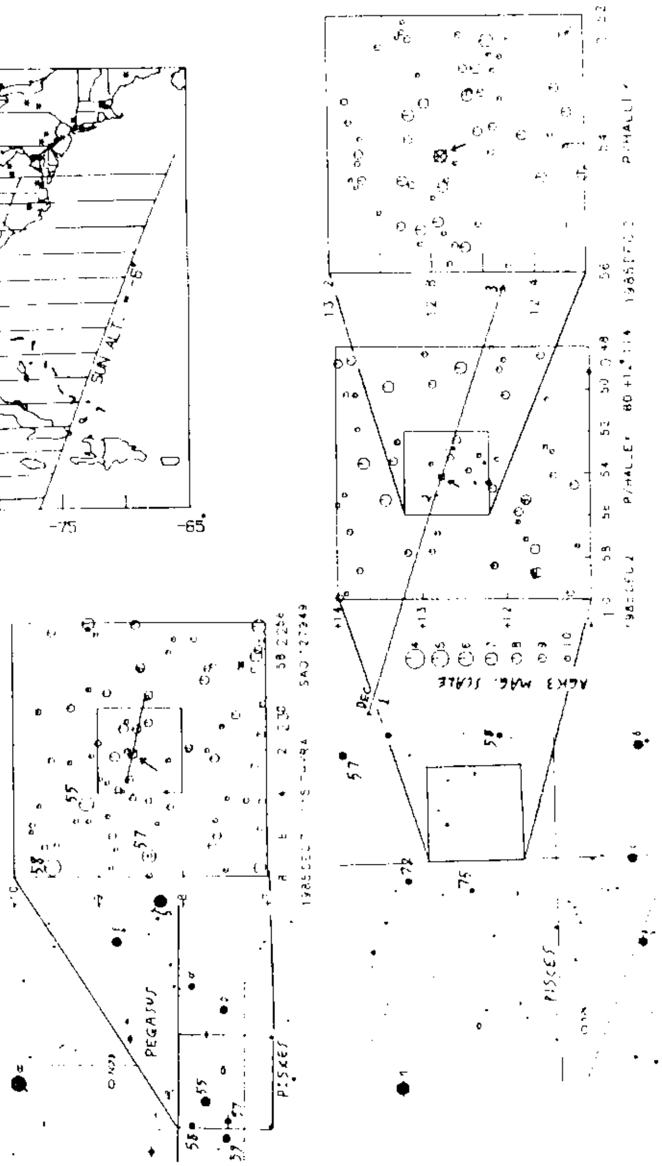
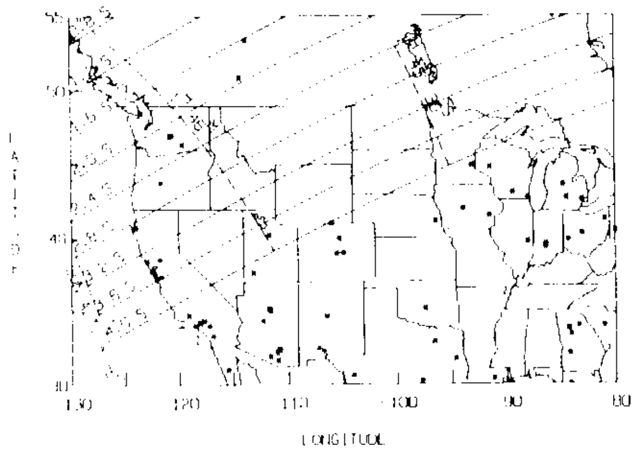


1985 12 4 (2) P/HALLEY

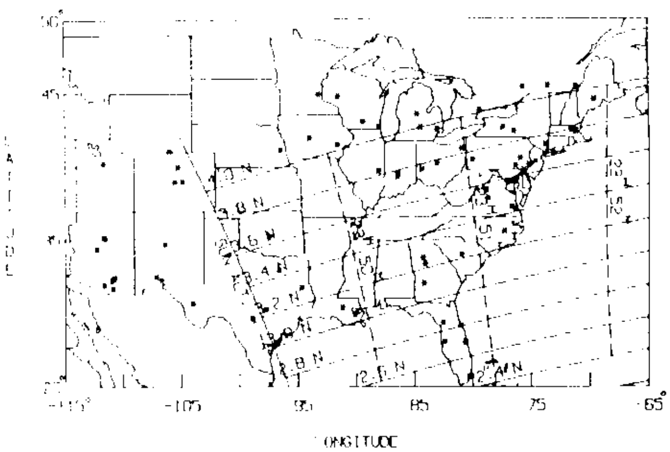
DIAMETER 100 KM = 0.″21



EPHEMERIS SOURCE = YEOMAN28

1985 12 6 (115) THYRA SAO 127949

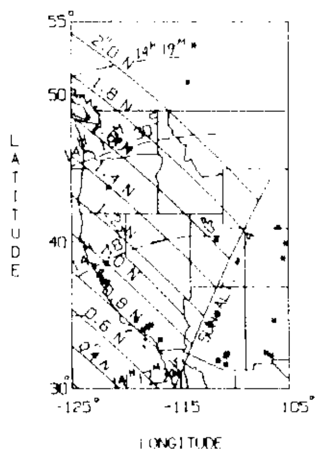
DIAMETER 95 KM = 0.″08



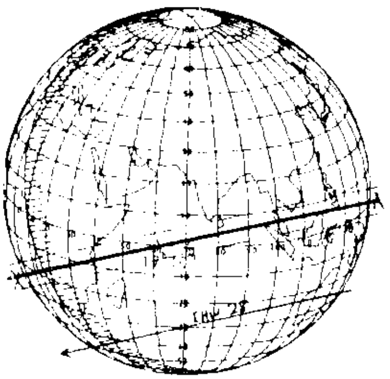
EPHEMERIS SOURCE = LNDGRN79

1985 12 20 (89) JULIA SAO 40825

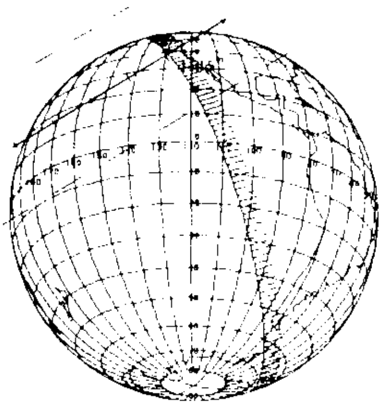
DIAMETER 168 KM = 0.″15



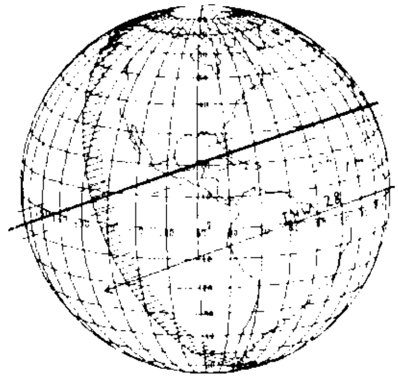
EPHEMERIS SOURCE = EMP 1983



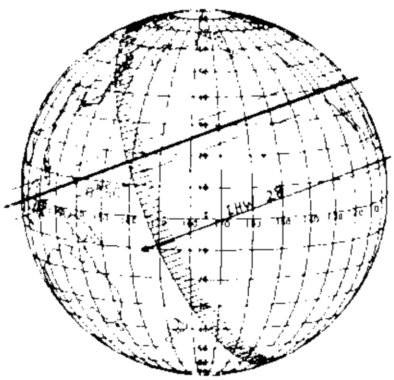
KLH 1511 by P/H 1985 Nov 25, 17:14



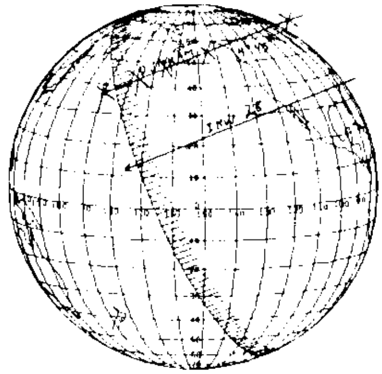
SAO 190559 by Antikleia '85 Nov 27



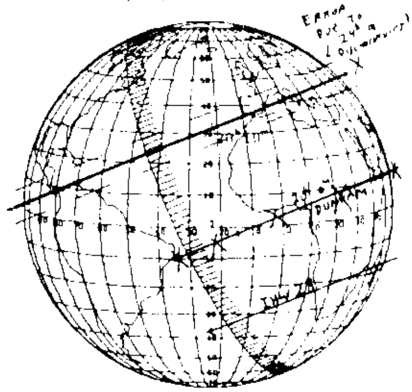
+12° 114 by P/H Dec 2, 2:10



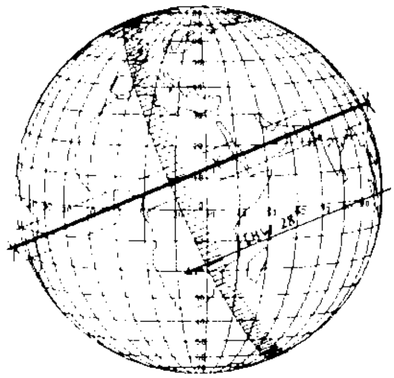
Anonymous by P/H 1985 Dec 7, 6:56



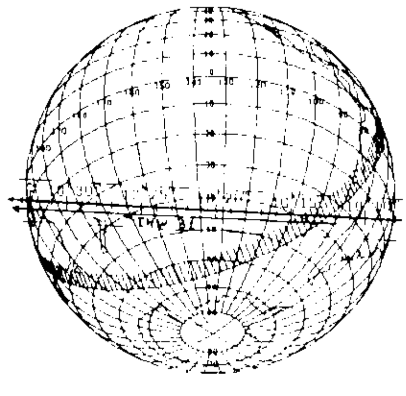
Anonymous by P/H 1985 Dec 9, 4:55



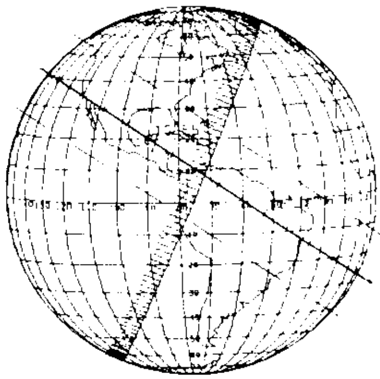
SAO 128409 by P/H '85 Dec 9, 20:10



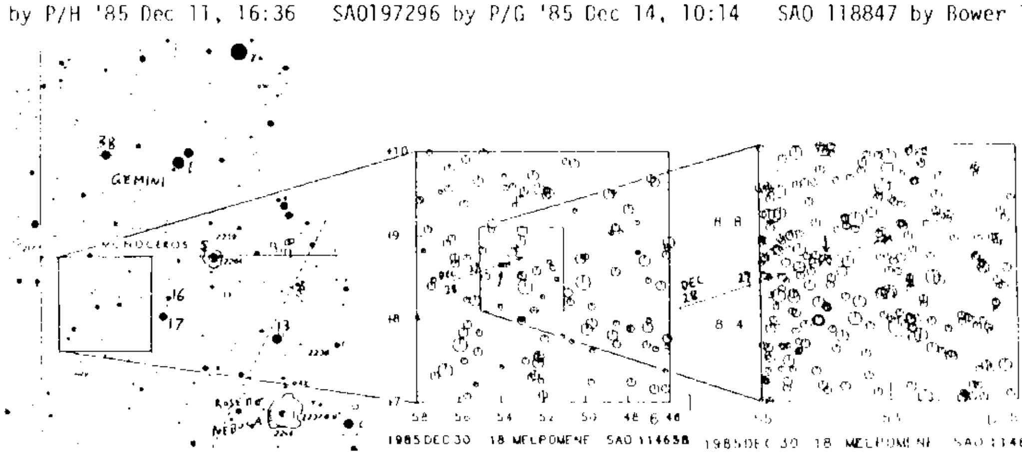
Anonymous by P/H '85 Dec 11, 16:36

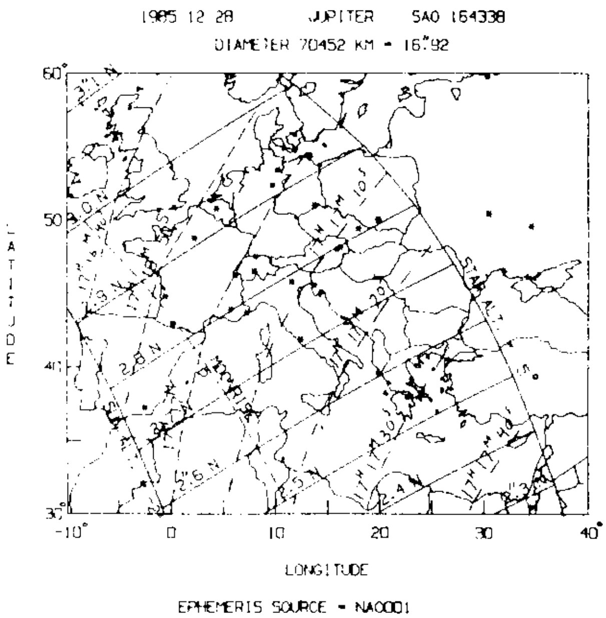


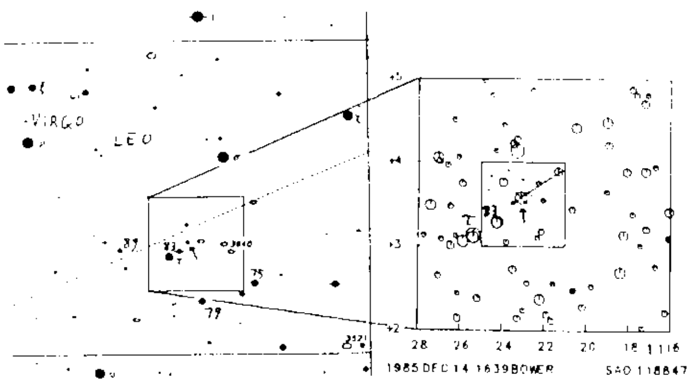
SAO197296 by P/G '85 Dec 14, 10:14

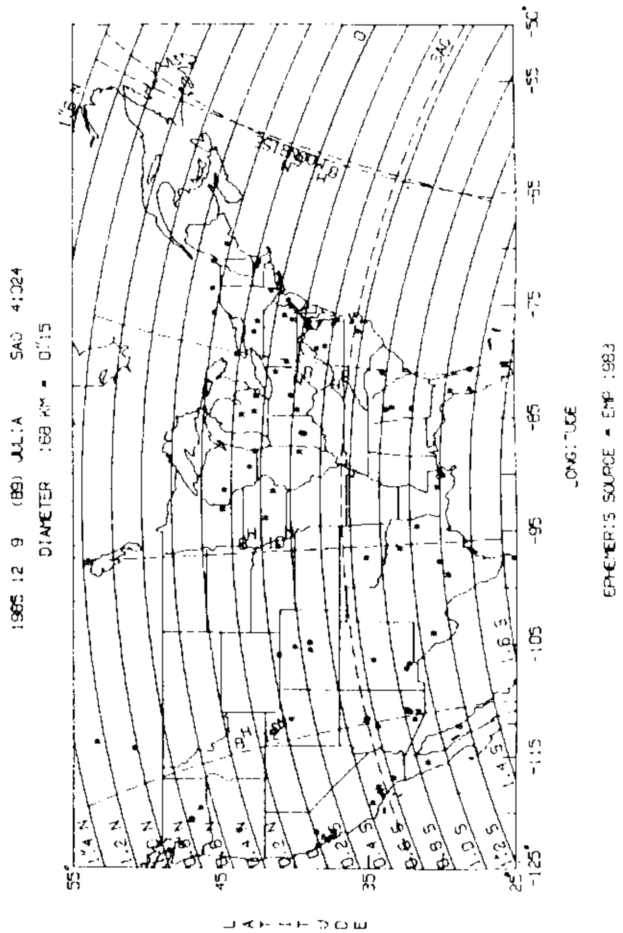


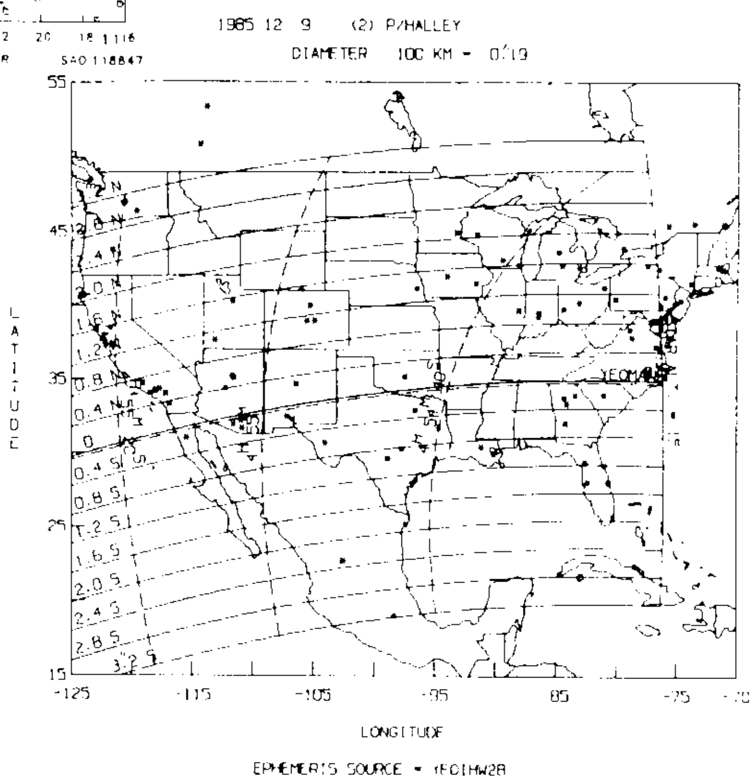
SAO 118847 by Bower 1985 Dec 14

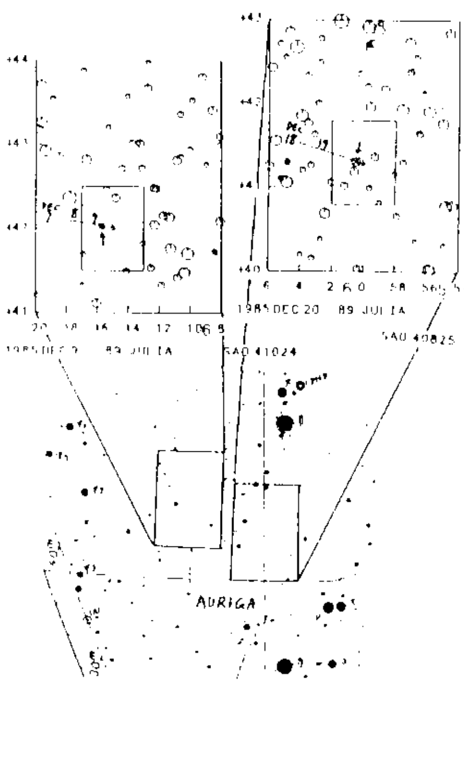


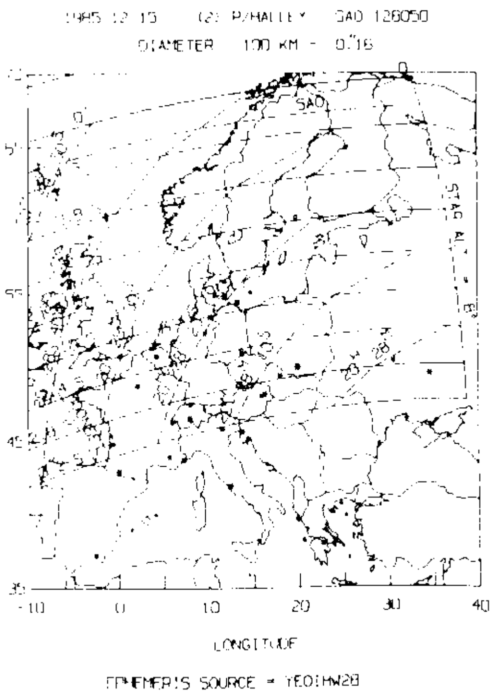

1985 12 28 JUPITER SAO 164338
DIAMETER 70452 KM = 16.92
LATITUDE
LONGITUDE
EPHEMERIS SOURCE = NA0001


VIRGO
LEO
1985 DEC 14 1639 BOWER
SAO 118847


1985 12 9 (89) JULIA SAO 41024
DIAMETER 168 KM = 0.15
LONGITUDE
EPHEMERIS SOURCE = EMP 1983


1985 12 9 (2) P/HALLEY
DIAMETER 100 KM = 0.19
LATITUDE
YEOMANS
LONGITUDE
EPHEMERIS SOURCE = YEOIHW28

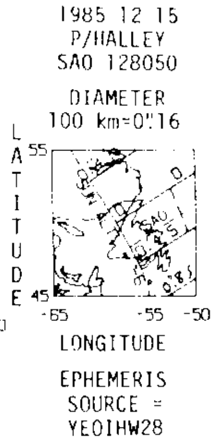

1985 DEC 20 89 JULIA
SAO 40825
1985 DEC 9 89 JULIA
SAO 41024
AURIGA



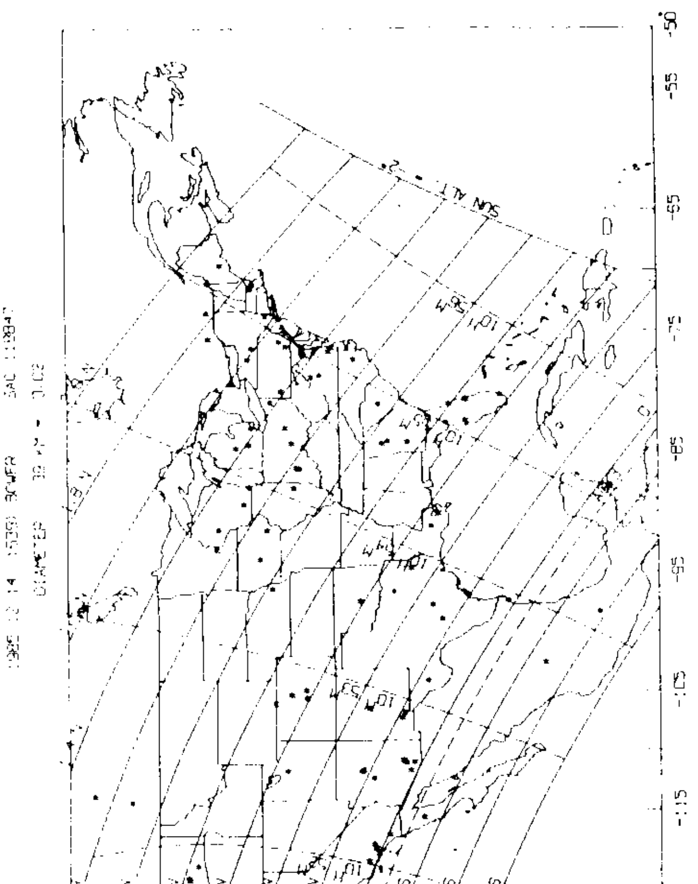
OBSERVATIONS OF APPULSES BY COMET GIACOBINI-ZINNER

David W. Dunham

Predictions of numerous possible occultations by Comet Giacobini-Zinner (G-Z) were published in an article starting on p. 253 of the last issue. Several observers reported substantial dimmings (some photoelectric) or flickerings, but I believe that all such reports might be due to terrestrial atmospheric variations, and none are clearly due to extinction by cometary material. Unfortunately, it is difficult to tell whether a dimming is caused by the atmosphere of the earth or of the comet. Observers of future cometary events should observe from pairs of stations in line with the direction of motion of the occultation shadow, and separated by at least a few kilometers (preferably far enough apart to detect the comet's motion from the difference in timing of corresponding events) for confirmation. Reports of future cometary appulses should be reported to: Jim Stamm; Route 13, Box 109; London, KY 40741; U.S.A.; phone 606-864-7763; he will include summaries of such reports in his regular *O.N.* articles about asteroidal and planetary appulse and occultation observations.



Only appulses during the first half of September have been reported. During this time, G-Z was moving rapidly down rich Milky Way fields. It was at its brightest, having passed through perihelion on the 5th, and was visited by the International Cometary Explorer (ICE), the first spacecraft to fly through a comet, seven days later; see *Sky and Telescope* 70 (5), 426. During most of August, G-Z closely followed International Halley Watch (IHW) orbit #19, used for my predictions in the last issue. But late in August, G-Z veered south, as shown by the astrometric observations (especially an important series measured by Berton Jones at Lick Obs.) that were being rapidly reported to Donald Yeomans at Jet Propulsion Laboratory (JPL). Yeomans had difficulty in obtaining a good fit to the latest observations with his standard orbit model (including observations during two previous apparitions back to 1972). In order to obtain a best prediction for extrapolation of the path in the sky, needed for our occultation prediction improvement, he omitted the non-gravitational parameters and used only the 1985 observations, calling this special solution "Alpha," which I used to update the prediction for the important September 4th occultation. In addition, I calculated residuals myself, comparing the late August Lick observations with orbit Alpha, to determine an additional small correction. Yeomans updated the orbit again on September 6 (using observations, including some made at Lick Observatory, through the 5th), the last update for the ICE final targeting maneuver performed on September 8, and also computed a corresponding "Beta" orbit from the 1985 data alone for the later occultations. Early in October, Yeomans used over 700 observations made from 1972 through 1985 September 28 to obtain a definitive IHW orbit number 31, that represented all of the astrometric observations quite well and could be used



for data analysis. Mean residuals for the G-Z #31 fit were around 1"0 during September. Consequently, I believe that the actual position of G-Z's nucleus at any time in September differed from the position calculated for that time from the IHW #31 orbital elements by 0"5 or less. This corresponds to a linear error of +10 seconds. In mid August, Lick Observatory plates were taken of the star fields to be crossed by G-Z during the first half of September, and Berton Jones measured accurate current positions for most of the stars for which occultation predictions were listed for early September in the last issue. These positions were included in my final updated predictions for the events. Their accuracy was less than +0"2, negligible compared with uncertainty in G-Z's position.

On p. 256 of the last issue, I stated that the scale of Nolthenius' visually observed dimming during an occultation by the nucleus of Comet IRAS-Araki-Alcock was 20 km, and that G-Z was perhaps twice as small. Since this comparison is in linear distance, the visual G-Z target would have been only 10 km, which would be traversed in only half a second. Michael A'Hearn, Univ. of Maryland, estimated a similar scale by extrapolating the results (2-3% dimming) observed photoelectrically by Larson at Kitt Peak when Comet Bowell passed about 600 km from the line of sight to a star of about 15th magnitude. Neil Divine at JPL computed a special dust model for G-Z on Sept. 4, and calculated the resulting optical depths (extinction factors) for a star whose line of sight passes different distances from the nucleus in different directions. The maximum depths he found were even more pessimistic than A'Hearn's and my estimates, as follows: Distance 2 km, max. depth 0.25; 5 km, 0.10; 10 km, 0.05; 20 km, 0.02; 50 km, 0.01; and 100 km, 0.005. These fractions are virtually the same as the magnitude drop that would be seen; keep in mind the time scale from the fact that G-Z was moving about 20 km/second perpendicular to our line of sight in early September. Divine sent these calculations to me by Federal Express on Sept. 3, the afternoon of which I caught a flight to Salt Lake City to observe the occultation on the 4th. Even if I had received Divine's calculations before the event, I wouldn't have changed my plans, since it seemed that there could be errors in the model of even more than an order of magnitude. Fred Scarf's plasma-wave detector on ICE counted a maximum rate of 1 hit per second on the spacecraft by micron-sized dust particles as it flew through the tail of G-Z 7800 km from the nucleus on Sept. 11. Divine hasn't completed a planned detailed comparison of Scarf's data with his model (when he does, we'll publish the results here), but feels that it comes close to confirming it, with the actual dust production rate even slightly below his estimate. So it is not surprising that the attempted occultation observations yielded no clear-cut evidence of dimming by G-Z, although some observers claimed to have seen much larger drops (in depth and time) than could have been due to G-Z.

Observations of the individual events are discussed below. They are listed in chronological order, except for the Sept. 4 event, that I will discuss last since the largest effort was made for it.

September 6, 10.7-mag. Star "A"?: The only information I have about this event is a telex message sent to Don Yeomans from Sutherland Observatory in South Africa. They claimed to have photoelectrically recorded dimming of the light of AGK3 N30° 565 (SAO 58212 = B.D. +30° 944, mag. 8.2, spectral type A3; not in my list, but given in Lowell's prediction list as a fairly wide miss) and wanted to know the predicted time and distance of closest approach. Since I already had the results of the well-observed appulse on the 4th, and other things were demanding my attention as the ICE flyby drew near, I did not pursue this until after the 11th. My calculated closest approach of G-Z to this star was greater than 30" and occurred at 5:30 U.T., several minutes after sunrise at Sutherland. However, there was a close appulse of star "A" that morning, with minimum distance 2"46 (834 km) at $3^h\ 33^m\ 06^s$ U.T., according to Jones' position for the star and the IHW #31 orbit. At the time, the altitudes of G-Z and the sun were 23° and -17°. This is the star that probably was monitored at Sutherland, but G-Z was quite far north at the time, and never got high enough above the horizon for good photometric observations.

September 11, 10.7-mag. Star "F": Using the Beta orbit corrected with the last Lick observations of G-Z, and the Lick position for the star, I calculated final corrections of 1"9 south for the path and 2.2 min. late for the time, relative to the orbit #19 - A.C. data used for the map on p. 262 of the last issue. This resulted in a path passing near Seattle, WA, at 9:12 U.T.; Milwaukee, WI, at 9:13; and Washington, DC, 0.7 min. later. Clouds hampered most observers, and I know of only two who monitored the star. G. Samolyk reports that the star was monitored from 9:09 to 9:20 U.T. at the Milwaukee Astronomical Society's observatory, saying that "A substantial dimming was observed as the comet passed in front of the star, but no sudden drop was seen as would be expected if the nucleus occulted the star." At Silver Spring, MD, skies were partly cloudy that morning, but I was fortunate to have a good break from 9:11.4 U.T. to 9:16 U.T., during which the star's light appeared quite steady as seen with my 20-cm Schmidt-Cass. According to my calculations with orbit #31, the actual path was at about 1"6 south (±0"5), passing near Harrisburg and Lancaster, PA, and Newark, DE. These calculations showed that the closest approach distances were 227 km at 9:12.9 U.T. (alt. 46°) and 132 km at 9:13.5 U.T. (alt. 54°) for Milwaukee and Silver Spring, respectively. Shortly after the observation, I drove to Goddard Space Flight Center, where I watched the activity from the ICE control center as the first comet flyby took place, less than two hours after this appulse.

September 13, 10.2-mag. Star "L": My final prediction for this event was path 2"5 south and time 2.5 min. late, map on p. 263 of the last issue. This path crossed Corpus Christi, TX, at 7:22.5 U.T. (low altitude) and central Florida (passing near Tampa) at 7:23. Dr. Terry Oswalt and S. Panossian monitored the appulse photoelectrically with a 36-cm telescope under clear skies at the Florida Institute of Technology (F.I.T.) in Melbourne, FL. In their report, they incorrectly credit Lowell Observatory with first identifying the event. They state: "The event, observed through a 2.2 arc minute diaphragm and V filter with 60msec sample rate, consists of two broad symmetrical minima: the first centered on 7:26:36 UT of approximately 29-second duration, maximum 25% intensity drop; the second centered on 7:28:26 UT of approximately 72-second duration, maximum 8% intensity drop." They speculate that the first drop might be due to dust in the coma within 300 km of the nucleus, while the second would represent about a 1700-km cut through the dust tail. However, the orbit #31 calculation shows that the closest approach occurred at 7:22.7 U.T., about five minutes earlier than their first dimming, when the star alt. was 28°. The calculation also indicates that the path passed only about 77 km north of Melbourne. If the F.I.T. dimmings were due to G-Z, they should have been observable from most of the Florida peninsula. Unfortunately, nobody else monitored this appulse, as far as I know.

September 4, 6.2-mag. SAO 58030: This occultation was discovered by Ted Bowell and Larry Wasserman, and information about it (and other cometary occultations of SAO and AGK3 stars) was distributed by the IHW in June. Much interest about the occultation was generated by a note in *Sky and Telescope 70* (3), 223; that issue had feature articles about G-Z. Since information gleaned from the occultation might have influenced targeting decisions for ICE, observers were asked to phone in their preliminary results soon after the event.

From the time that this event was first identified until less than ten days before the event, it seemed certain that this occultation could be observed only from southern Canada. Astronomers at the University of Maryland, Lowell Observatory, and the Massachusetts Institute of Technology pondered whether they should chase this event with their portable photoelectric telescopes. Realizing the low probability for any one station of recording a significant drop based on comparison with previous observations mentioned above, they decided that in order to ensure success, they would all have to try it, and adopted an all-or-nothing attitude. They decided on nothing, due to the unbudgeted time and expense of trucking their equipment so far, with possible problems at the border crossing. Unfortunately, there is no mechanism for funding such efforts with less than five months notice, although some rare and potentially valuable occultation events, such as this one, just can not be predicted that far in advance. About a week before the event, it became clear that G-Z was moving south of its earlier path, putting the occultation path in the northern U.S.A. Although this decreased the travel costs, the professional astronomers did not change their minds, primarily because the astrometric uncertainties remained too great to ensure success. Gene Harlan at Lick Observatory planned to expose a large-field plate on Sept. 2, the only date that the two objects would be close enough together and with enough time to develop and measure the plate, and calculate an improved prediction. Such a plate might have enabled a prediction accuracy of ±0"2 or ±70 km, but clouds prevented the observation. Unfortunately, the Lowell 18-inch astrograph, the only other telescope capable of taking astrometrically accurate wide-field plates, could not be used due to plateholder and filter problems; even if those problems had been overcome, the instrument was not capable of obtaining a good image of an object moving as fast as Comet Giacobini-Zinner.

In spite of these setbacks, IOTA decided to mount what effort they could, figuring that the extinction estimates might be in error and that such a rare opportunity should not be passed up. Although chances of success might be small, they were not zero. I prepared a special memo about the occultation and distributed it to over 100 groups and individual observers, most of whom were not *o.n.* subscribers and who lived in the area between 1" north and 2" south on the map on p. 258 of the last issue.

The final prediction was computed using the Alpha orbit and offset by 0"15 north according to an extrapolation of the trend of Lick observations made through August 29. Relative to the IHW #19 prediction used for the map on p. 258 of the last issue, this path was 2"0 south (estimated accuracy was ±0"5) and the time correction 2.0 ±0.4 min. late, which meant that the occultation would occur 7:36 to 7:37 U.T. near San Francisco, CA; north of Salt Lake City, UT; WY; SD; central MN; Upper MI; near Montreal, Que.; central ME; and southern Nova Scotia.

Unfortunately, widespread cloudiness prevented observation anywhere near the path east of WI; many observers in northern CA also were clouded out. Fog blanked much of WI, and high clouds were common in SD, MN, and WI. Prime areas with clear skies were northern UT, WY, and southern ID, where there are few IOTA members. Several other amateurs in these areas were encouraged to observe by telephone, and five IOTA members caught flights to Salt Lake City and Denver to set up four video stations across the path in a pattern to fill in the gaps in expected fixed-site coverage.

According to IHW orbit #31 and the Lick position for the star, the path (still uncertain by ±0"5 or ±180 km) passed north of where we expected it, at 1"77 south relative to the orbit #19 prediction depicted in the map in the last issue, with a time correction of 1.8 minutes late. Unfortunately, few observers were very close to this path, or a short distance north of it (we were expecting coverage for this area mostly by observers in the San Francisco - Sacramento vicinity, but clouds moved in there only an hour beforehand). An observer in Pocatello, ID, close to the orbit #31 path, tried to locate the star, but failed. Accounts of 11 observers within 300 km of the path are listed below, from north to south:

270 km north of line. Bob O'Connell, using a 36-cm telescope, photoelectrically recorded only a gradual increase in the star's brightness from 7:35 to 8:00 UT as it rose higher above his horizon at Kneeland Airport near Eureka, CA. This is the only known photoelectric recording within 300 km of the orbit #31 line.

3 km north of line. Joseph Wallnvand saw no dimmings of the star at Christine, ND.

44 km south of line. I observed visually with a 13-cm telescope at a location 22 km northwest of Malad City, ID. During 7:35 UT, over a minute before predicted closest approach, I timed several flickerings and rapid dimmings of the star's light which I thought might be due to the comet (probably wishful thinking, in retrospect).

60 km south. Joan Dunham and I set up a 20-cm telescope with video camera at a location 6 km northwest of Malad City, ID. and Joan recorded the appulse from 7:31 to 7:40 UT. There were several flickerings at various times, but none at times corresponding to the ones I saw.

100 km south. John McGrath videorecorded some flickering with a 9-cm telescope with image intensifier near Plymouth, UT.

122 km south. Paul Maley videorecorded several brief dimmings with a 20-cm telescope at Edgerton, WY.

128 km south. Peter Manly videorecorded several flickerings with a 9-cm telescope with image intensifier near Corinne, UT. Although very close to Maley's path, there seem to be no coincidental events. But both Maley and McGrath recorded some dimmings near 7:36:30 UT; the durations were different. Manly has built a clever device, including a small box which he can move around his video display to keep it centered on the star, to digitize his record. He thinks that the resulting lightcurve looks like atmospheric seeing variations. He may digitize parts of the other video records to make a more detailed comparison for possible coincidences. Manly and McGrath were assisted by Gary Liptrot of Ogden, UT, whom we thank for letting us use his home as a base for our operations in northern UT and near Malad City, UT.

198 km south. Joseph Carroll, Minnetonka, MN, visually observed a dimming from about 7:35.8 to 7:37.5 UT, with maximum depth estimated at 0.5 to 1.0 mag. G-Z moved nearly 2000 km in this time. Ed Nye at the nearby Univ. of Minnesota decided against making a photoelectric recording, saying that the night was not photometric.

200 km south. A man with first name Jerome at White Lake, WI, left a phone message that "the star blinked out 7:38:00 to 5 seconds later, possibly." Unfortunately, his last name was garbled, and we have not been able to contact him. G-Z moved 120 km in 5 seconds.

217 km south. Jeff Holverson observed visually with a 33-cm Dobsonian at Big Mountain Pass, UT, northeast of Salt Lake City. He said that seeing was 6/10, and said that the star was 1.0 to 1.5 mag. fainter than usual for 10 - 15 seconds. He didn't time when this occurred, and saw the dimming just when he returned to the eyepiece after looking away to get better dark-adapted.

219 km south. Pat Wiggins observed visually with a 36-cm telescope at Tooele, UT, and saw no flickerings, dimmings, or other variations in the star's light. This observation, with its proximity to the three paths above, casts doubt on the dimmings claimed by those observers.

In addition, there were reports from many observers much farther from the expected path, most of whom claimed to have seen no variation in the star's light. Phil Nicholson, Mike Skrutskie, and Tom Herbst obtained a photoelectric recording with Cornell University's 61-cm telescope near Ithaca, NY. The orbit #31 path should have missed them by 1".4 or 480 km. The sky was covered with thin cloud, producing variable extinction of up to 50%. Others who monitored the star include: Larry Baker, TX; Marvin Baldwin, s.e. IN; Garry Beard and Mike Turner, Carthage, MO; Bob Bryant, Phoenix, AZ (video); Bob Cadmus, Grinnell, IA (photoelectric); Lyman Carroll, Pine Mtn. Observatory, OR; Michael Crist, Burns, TN; Robert Elliott, near Eau Claire, WI (less than 300 km s. of path, but thick fog prevented effective observation); John W. Gonzales, Hyattsville, MD; Bill Hathaway, Glendale, MD; Lucien Kembale, Cochrane, Alberta (noted that the star dimmed remarkably, permitting viewing of G-Z's coma, from 7:38 to 7:40); Richard Lines, Mayer, AZ; Craig McDougle, Tampa, FL; Tony Murray, Georgetown, GA; Allan Pierise, Harrisburg, IL; Harold Povenmire, Ed Case, Roy Lee, and Robert Wood, Satellite Beach, FL; Gerry Rattley, south of Phoenix, AZ, at a site to observe a lunar graze the same night; Steve Rismiller, Milford, OH; Basil Rowe, Cincinnati, OH (photoelectric); and Fred West, Royal, MD.

On September 8, I gave Robert Farquhar and Malcomb Niedner a summary of these observations before the last maneuver to target ICE to G-Z was performed. Since no large-scale dimming was confirmed, Niedner felt that we did not have to worry about the dust hazard, and the maneuver was performed with the minimum amount of fuel needed for ICE to intersect G-Z's tail axis according to the latest IHW orbit #29. Farquhar still worried about the dust, but Niedner turned out to be right. I thank all observers who reported their observations of the September G-Z appulses so promptly.

ANNOUNCEMENT OF A NEW JOURNAL

We are in receipt of a letter from Mr Gérard Eggenspieler; "Association Internationale d'Astronomie Amateur"; Residence "le Pré Joly"; 80680 HEBECOURT / FRANCE. He and his associates plan to publish "a technical monthly magazine about solely the making of observation's équipement, used in amateur's set ...This magazine, who will be diffused in the whole world...will be published in English, German, Spanish and French. Like that, a lot of modest amateurs of astronomy will can realize their plans...the magazine will come out, under number 1, the 6th January 1986." Those who wish further information should contact Mr Eggenspieler.

PLUTO-CHARON MUTUAL OCCULTATIONS AND ECLIPSES

Edward F. Tedesco

Photoelectric observers with telescopes of about 1-meter aperture or larger are encouraged to join a Pluto-Charon Mutual Eclipse Season Campaign. We have formed an organizing committee to help spread word of the unique opportunity presented by the mutual eclipse season. Coordination will be needed similar to that provided by the International Halley Watch for Halley's Comet. Many unique experiments will be possible over the next several years, experiments which it will not be possible to repeat for over a century. Because each eclipse event occurs at essentially a unique geometry, and only one event in five will be observable from any given observatory (not counting weather), the benefits of a photometry campaign to define the eclipse light curves are obvious. The eclipse season probably will last through the summer of 1991 or 1992, after which a special Pluto colloquium is proposed. Some of the U.S. members on the organizing committee are: Rick Binzel, Univ. of Texas; Ted Bowell, Lowell Obs., Dale Cruikshank, Univ. of Hawaii; Eleanor Helin, J.P.L.; Brian Marsden, SAO; and Ken Seidelmann, USNO. For more information, please write to me at: MS 183-501; Jet Propulsion Laboratory; 4800 Oak Grove Dr.; Pasadena, CA 91103; U.S.A.