Occultation Newsletter

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FROM THE PUBLISHER

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Local circumstance (asteroidal appulse) predictions (entire current list for your area)	1.04	1.00
Graze limit and profile prediction (each graze)	1.56	1.50
Papers explaining the use of the predictions	2.60	2.50

Supplements for South America will be available at extra cost through Ignacio Ferrin (Apartado 700; Merida 5101-A; Venezuela), for Europe through Roland Boninsegna (Rue de Mariembourg, 33; B-6381 DOURBES; Belgium), for southern Africa, through M. D. Overbeek (Box 212; Edenvale 1610; Republic of South Africa), for Australia and New Zealand, through Graham Blow (P. O. Box 2241; Wellington, New Zealand), for Japan, through Toshio Hirose (1-13 Shimomaruko 1-chome; Ota-ku, Tokyo 146, Japan). Supplements for all other areas will be available from Jim Stamm (Route 13, Box 109; London, KY 40741; U.S.A.) by surface mail at the low price of 1.23 1.18
or by air (AO) mail at 2.04 1.96

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. Full membership in IOTA/ES includes the supplement for European observers.

[1] Single issue available at ¼ of price shown.
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[5] Area "B" includes the rest of South America, Mediterranean Africa, and Europe (except Estonia, Latvia, Lithuania, and U.S.S.R.).

IOTA NEWS

David W. Dunham

The fourth annual meeting of IOTA was held at the Prude Ranch, Fort Davis, Texas, on Saturday morning, May 10th, the last day of the Texas Star Party. The agenda of the meeting was primarily scientific, covering eclipses, occultations by comets and asteroids, and video recordings of lunar grazing occultations, especially one of Sigma Scorpii in Mexico on March 30th. These topics are covered in separate articles in this issue. The only other presentation was by Eugene Lucas, who described his and Peter Manly's excellent video work with the Saguaro Astronomy Club in Phoenix, AZ. He also showed Gerald Rattley's observed profile from the graze of Delta Scorpii observed at Asher, AZ, last July; the vertical separation of the two components was fortuitously almost exactly three times the separation between the planned stations. Gene also showed how their club uses a bicycle wheel with a counter, that can be purchased from surveying supply stores for about $100, for measuring distances of graze stations along straight Arizona roads.

Although over 300 came to this year's Star Party, we were disappointed that less than 20 came to the IOTA meeting. Most of those at the Star Party came to observe primarily deep sky objects, and stayed up most of the previous night, when the sky was very clear. It is an excellent observing site, offering memorable views of the zodiacal light, Milky Way, and Halley's Comet, which was still an easy naked-eye object there. The next time we meet at the Texas Star Party, we need to insist on an afternoon for our main session, when most of those present will not be asleep from observing the night before (a later date would also be preferred, to allow participation by students and others from academia; weather and financial considerations make it advantageous to hold the Texas Star Party around the new moon in May). Lucas had planned to give a presentation about their club's outstanding video efforts with Halley's Comet in conjunction with the local P.B.S. television station on the afternoon of the 8th, but for various reasons was not able to do so. He used his own equipment to show this material to a few of us the afternoon of the 10th.

In other developments, Derald Nye, Tucson, AZ, described his efforts to develop software to use his IBM PC to keep IOTA's computerized records, so that he can (we hope) soon take over this important work, now performed by Berton Stevens. David Clark, Dallas, TX, demonstrated the "PC Almanac" software that he, Paul Newman, and Keith Shank have developed for distribution by the Astronomical League soon. It includes an occultation simulator that shows the moon's disk, terminator, and path of a specified star relative to the moon for a specified location. At the star party, I input the coordinates in the southern limit of an Antares graze as a test. The test failed because their position for Antares was wrong. When I entered the correct stellar data recently on our PC at home, the PC Almanac correctly computed that the star was 0" from the moon's limb at the time of central graze. The graphics part does not yet work on our PC. It would be interesting (and useful, especially for reappearances) to include the brighter craters, rays, and maria outlines on the lunar disk (this would also be useful for estimating crater umbra entrance and exit times with the lunar eclipse simulator that is included in PC Almanac). Librations would need to be calculated to do this properly. But the extensive calculations involved would unacceptably slow down the graphics display.

ASTROCON '86. The next IOTA sessions, covering almost only scientific topics, will be held in conjunction with the Astronomical League's ASTROCON '86 convention at Notre Dame College in Baltimore, MD, on August 5-10. I do not know on which day, or days, the IOTA sessions will take place. Considering Baltimore's dismal skies, especially in August, attendance will likely be better than at Fort Davis. Those interested in attending can use the registration form in the May issue of *The Reflector*, newsletter of the Astronomical League, or can obtain a copy by sending me a self-addressed (stamped, if in the U.S.A.) envelope at P.O. Box 7488; Silver Spring, MD 20907; U.S.A. The registration fee is $22, or $27 for families. On-campus dormitories are available for $17.50 per person per night, double occupancy; on-campus meals can also be purchased. There will be field trips to Goddard Space Flight Center, U. S. Naval Observatory, National Air and Space Museum, and the Space Telescope Science Institute. The banquet at 7:30 pm on the 9th costs $16. The registration form is to be sent to: ASTROCON '86; 642 Kingston Road; Baltimore, MD 21220, with checks payable to ASTROCON '86. If you plan to give a presentation during the IOTA session, please send me the title of your presentation, and if possible, a copy of your abstract. I have some extra abstract forms, but they need to be postmarked before July 1, after which most of you will receive this issue.

ESOP V. A member of the IOTA board of directors may be attending the E.S.O.P. V meeting in Poland at the end of August; see p. 342.

ILOC reductions for 1983. Many observers recently received the International Lunar Occultation Centre's *Report of Lunar Occultation Observations – The Observation and Reduction in 1983*, issued this March. Included are 10,995 timings by 532 observers in 32 nations – that averages 20.67 timings per observer. The timings are listed chronologically, with station and telescope codes providing the only information about who made the observation, and where. A "G" in the second position of the phenomenon column indicates a graze; unfortunately, the information about whether the event is on the bright or dark limb is then lost, especially important for grazes near the cusps. The formulae used for computation of residuals are published in the report.

Graze computors. Two individuals in Houston, TX, have succeeded in running the IOTA graze and profile prediction programs on local computers. Stephen Preston used a VAX, and has computed predictions for the rest of the year for the E-region (south central U.S.A.). IOTA member Don Oliver used his IBM PC-XT clone, and has sent me copies on diskettes. I have not yet succeeded in running his programs on our PC. When we get them to work, we can distribute copies to other IOTA members who own or have access to these machines, including one in Hong Kong who recently asked for such a copy.

Asteroid speckle interferometry. Richard Nolthenius sent me an article, "Mathematical technique lets astronomers 'see' details of asteroids," from an unspecified University of Arizona (UA) magazine. It describes speckle interferometric work on asteroids done at the university and led by Jack Drummond. Using 2.3- and 4-meter telescopes at Kitt Peak since 1981, the UA team has collected data on about a dozen asteroids. Analyses have been completed for (2) Pallas, (433) Eros, (511) Davida, and (532) Herculina. Only results for Herculina were quoted, including triaxial ellipsoidal dimensions of 215, 218, and 263 km. Of most interest was the strong indication of a 115-km-wide bright spot on Herculina's southern hemisphere, possibly the result of a collision that knocked Herculina upside down. Herculina now spins in the opposite direction to that of the major planets. Drummond speculated that asteroid light curves might be caused more by such albedo variations than by shape.

Star catalog errors. On May 19th, Harold Povenmire, Indian Harbour Beach, FL, easily timed a disappearance of 7.8-magnitude X17501 (SAO 118978, spectral type K0) by the 71% sunlit waxing moon, but he could hardly see Z.C. 1693 (SAO 118983), sp. F5), also listed as mag. 7.8, under similar conditions less than an hour later. He estimated that the second star was at least 0.7 mag. fainter than the first one. The Z.C. is the source for 1693's mag., which is given as 7.5 in the SAO. According to Wayne Warren, Astronomical Data Center, Goddard Space Flight Center, the first star's mag. is given as 7.8 in both the SAO and in the Centre de Donnees Astronomique de Strasbourg's updated SIMBAD stellar database. SIMBAD is an abbreviation of "Set of Identification, Measurements, and Bibliography for Astronomical Data." However, SIMBAD gives 8.4 for the mag. of Z.C. 1693, in good agreement with Povenmire's estimate. Don Stockbauer spotted another discrepancy; he noticed that the positions for the non-double stars X16468 (SAO 99368) and X16469 were identical in his USNO total occultation predictions. The Bonner Durchmusterung (B.D.) number of the second star is +10° 2225, its correct number as given in the AGK3 catalog. However, the B.D. number for the same star is given incorrectly as +10° 2325 in the SAO catalog. When the two catalogs were merged to form the XZ catalog used for the USNO predictions, the stars were matched by B.D. number; hence, the erroneous SAO B.D. number caused the match to fail and the star ended up with separate entries from the two catalogs. Wayne Warren says that the star's correct B.D. number is given in the Astronomical Data Center's version of the SAO catalog, his workers having found the error a few years ago. David Herald; P.O. Box 254; Woden, A.C.T. 2606; Australia;

normally tracks down catalog errors, especially those that produce actual occultations more than two accuracy ranges (AC in USNO predictions) from the predicted time. But some obvious catalog errors can be traced down faster by Warren. I do want to correct errors in the XZ, and the catalog work that I will be doing during the next month or two will provide a good opportunity for this.

IOTA manual delayed. Since returning from the Halley occultation effort in Australia and from the IOTA meeting in Texas, I have not had time to work more on the IOTA manual. I must devote the next couple of months primarily to software projects, upon which IOTA depends to continue to produce the lunar graze and planetary occultation predictions that are our lifeblood; see "USNO News" on p. 343. After these projects are completed, it will be time for me to concentrate on predictions for 1987, to write the articles for *Sky and Telescope* and *O.N.* needed before the end of this year. Unfortunately, it may be January before I can complete the unfinished sections of the manual, and resume other important analysis tasks, especially the 1983 May 29th Pallas occultation reduction, and 1984 solar eclipse videotapes and analysis information. In the meantime, IOTA members can obtain a preliminary version of the manual upon request to H. DaBoll.

We will probably aim to distribute the next issue of *O.N.*, the first issue of Volume 4, late in September.

IOTA REMAINS TAX-EXEMPT

Paul D. Maley

In *O.N. 3* (14), 295, Dunham noted that we had ninety days from the end of 1985 to submit materials to the U.S. Internal Revenue Service for the support test to continue our tax-exempt status. The necessary questions were answered and supporting material was sent on time to the I.R.S. office in Chicago, IL. I recently telephoned our contact there, and found out that we did pass the support test. So IOTA retains its tax-exempt status under section 509(a)(2) of the Internal Revenue Code of the U.S.A. The board of directors thanks all members who sent newspaper clippings and other articles that helped demonstrate that IOTA is a public organization. Since our status will be reviewed periodically by the I.R.S., especially U.S. members are encouraged to save published articles mentioning IOTA, and send a copy to me at: 15807 Brookvilla; Houston, TX 77059.

STATION COORDINATES NEEDED FOR MANY IOTA MEMBERS

Homer F. DaBoll and David W. Dunham

Station data are still not included in the IOTA computer records for a rather large fraction of IOTA members. If you have received computer-generated graze or appulse predictions from Jim Carroll, Joe Senne, or one of the other graze computors, we have your station data, and you do not have to read the rest of this article. But if we don't have station data for you, you are not receiving local circumstance predictions for asteroidal and planetary appulses, nor grazing occultation predictions for your region, both of which you paid to receive. In order to prepare the predictions, we need to know where you are, that is, your geographical longitude, latitude, and preferably also your height above sea level. For graze predictions, we also need to know the distance that you are willing to travel for marginal, favorable, and spectacular events. For reporting observations, the coordinates need to be accurate to 1 arc second (") or better, with height to 30 meters. We prefer to have data to this accuracy, which can be achieved by carefully measuring a detailed topographic map of scale 1:100,000 or larger scale. But for prediction purposes, positions accurate to 1 arc minute (') of longitude and latitude, with no height above sea level, are sufficient and might be easier for you to obtain quickly. You should send the information to DaBoll, address in the masthead, to arrive before August 15, if we do try to generate graze predictions for 1987 before the end of September (see USNO NEWS on p. 343). If we find that we do not need to compute the 1987 predictions early, the August 15th deadline will be extended to October 1st. After the deadline, if data have not been received, DaBoll will obtain coordinates for your town center (most, but not all, towns are listed) from one of the detailed atlases (which are given to 1' or 0°01 and will be in error by the distance of your site from your town center) to enter in our records, and will use distances of 3, 50, and 100 miles for marginal, favorable, and spectacular grazes, respectively. If your telescope is not transportable and you observe only from a fixed site, state this, and we will use distances of 3 miles for all categories to generate those rare grazes which might be visible from your site. If you rely on another IOTA member in your city who leads expeditions that you join, and don't need graze predictions yourself, we will assign distances of -4, -4, and 1 miles, which means that you will get the local-circumstance appulse list, but virtually never get any graze predictions.

Atlas maps, detailed road maps with latitude and longitude lines, or aeronautical charts available at any airport can be used to measure coordinates to 1' accuracy. Detailed topographic maps are needed for 1" accuracy. You might obtain access to these for your area at a local college or university library (perhaps in the geology department), or at a large public library. Or you might be able to purchase them from a local sporting goods (hiking), engineering supply, or government map store. In the U.S.A., an index for ordering detailed topographic maps of your state can be obtained free upon request from: U.S. Geological Survey; 1200 S. Eads St.; Arlington, VA 22202 (for states east of the Mississippi River), or from U.S. Geological Survey; Denver Federal Center, Bldg. 41; Denver, CO 80225 (for western states, including all of LA and MN). For Canada, the address is: Canada Map Office; 615 Booth St.; Ottawa, Ont. K1A 0E9.

If you live in a new subdivision that is not shown on the latest map of your area, you should send us approximate coordinates right away. A recent road atlas of your county might show at least the approximate positions of the streets in front of your house relative to old roads shown on the topographic map. For accurate coordinates, you might obtain help from your county survey office, or the developer who designed your subdivision, to obtain either grid coordinates or the precise relation of your lot to older roads shown on the topographic map. A recent aerial photograph might help.

E.S.O.P. V

Marek Zawilski

The Fifth European Symposium on Occultation Predictions will be held in Poland from August 29 to September 3. Sessions will be held in Warsaw on August 29-30 and in Łódź on August 31. The facultative part of the symposium will take place in Warsaw on September 1-3. Those interested in attending should write me at: ul. Julianowska 5 7 m.369; 91-473 Łódź; Poland.

GRAZING OCCULTATION CORRECTION REMINDER

David W. Dunham

Graze observers are reminded that corrections should be applied to IOTA's predictions, as described in *O.N. 3* (13), 276. The corrections described there have not been applied to the predictions for 1986; they may be applied for 1987. Most important during the next few months is the 0.″3 northward shift that should be applied to all northern-limit grazes of northern-declination stars (generally those with Z.C. numbers less than 1600). The correction for southern-limit Cassini-region grazes normally affects only a few grazes that occur from November through March.

GRAZING OCCULTATIONS

Don Stockbauer

Yr Mo Dy	Vp	Star Number	Mag	% Snl	CA	Location	# Sta	# Tm	S S	Ap Cm	Organizer	C St	WA	b
840407		077772	8.5	33+	N	Poltava, Ukraine	1	5		20	B. F. Sincheskul			
840505		1030	3.2	21+	-S	Kiev, Ukraine	8	26		8	Alexander Osipov			
851219		128607	7.3	53+	21S	Welcome Cr,Austrl	3	10	1	20	Dennis Lowe	5?	158	36
851221		109850	8.6	69+	18S	Lissie, TX	3	21	1	20	Donald L. Oliver	2S	160	20
851221		109871	8.5	69+	14S	Glen Flora, TX	2	19	1	20	Donald L. Oliver	2S	165	19
860115		146794	8.8	23+	16S	Worth, IL	1	6	1	15	Robert H.Hays,Jr.	3S	166	50
860219		0844	5.7	71+	10S	Reynolds, NE	1	1	3	15	Richard P. Wilds	0	173	-51
860315		0407	7.8	18+	4S	Rugeley, TX	1	1	1	32	Don Stockbauer		174	-16
860317		0649	7.2	34+	-2S	Jellico, TN	1	10	1	20	Jim Stamm		179	-40
860317		0780	6.8	43+	2S	W.Springfield, MA	1	6	2	20	Phil Dombrowski		176	
860321		079920	8.8	73+	9N	Point Barrow, TX	1	4	1	20	Don Stockbauer	1N	12	-66
860330	V	2349	3.1	76-	15S	S.Jos D.Cabo, Mex	2	27	1	9	David Dunham	0	199	47
860401		2677	6.8	54-	6S	Aberdeen, MD	1	1	1	20	Jay Miller	S	187	71
860414		076945	7.7	20+	9N	Valyermo, CA	1	8	1	20	David Paul Werner	6N	5	-48
860415		077639	8.3	27+	9N	Bull Run, VA	1	1	2	20	David Dunham	N	7	-55
860418		1290	6.8	57+	12N	Nashville, TN	3	10	2	8	Michael Crist	5N	13	-64
860424		158378	8.3	0E	26U	Malabar Jnc., NSW	1	4	1	20	Greg Hayward		20	0
860513		078506	9.0	15+	13N	Alief, TX	1	2	1	20	Donald L. Oliver	5S	8	-59
860519		118987	8.2	72+	14N	Columbia, MD	1	1	3	25	Terry Losonsky		17	-33
860524		2366	1.2	100-	-37S	Spring Mtn., OH	2	8	1	13	David Dunham		182	53
860524		2366	1.2	100-	-35S	Lyndon, KS	1	2	3	15	Richard P. Wilds	0	186	53

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.

Several items on the graze report form are in need of clarification; papers describing the use of the forms in detail are available from me upon request. The "PLACE NAME" is the village or other prominent landmark closest to the point of observation. Give the name of the city in which you live only if you observed from home, or if it is closer than any other village. For "ADDRESS" put your complete mailing address; include your name if you are not the only observer listed on the back of the form, or if you are not the graze expedition leader specified on the back of the form. Please report the year a USGS map was photorevised, not its original year. Percent sunlit (% Snl) must have a + or - following the numeric value; + means waxing, and - means waning. Cusp angle (C.A.) needs an N or S following the value, for north or south (rarely an E or W is needed for east or west). However, the most important direction of all is the direction that the moon's shadow shifted. Please indicate its size in arc seconds, plus an N for north or an S for south. I'd like to state again that the shift is the most important number derived from a graze expedition, so please measure and report it as part of your data. I'll send a worked example to anyone who is unsure about measuring it. The shift of SAO 128607 on 1985 Dec. 19 at Welcome Creek needs further elaboration; a note giving the direction of the 0.5-second observed shift would be appreciated. Perhaps the next edition of the form could have symbols to circle for these values, similar to the present longitude and latitude fields.

SAO 128607, observed at Welcome Creek, was reported on an IOTA/ILOC form slightly modified by the Royal Astronomical Society of New Zealand. It only lists the RASNZ as recipient; are copies always forwarded to both IOTA and ILOC?

In my opinion, it is much better to continue observations during a time-signal fadeout than to stop, deal with the problem, and chance missing events. Most tape recorders run quite uniformly while recording, and thus interpolation can be performed for the fadeout period. The tape can be analyzed for linearity during reduction; even if it is not linear, data fitting will establish the maximum error. In such a situation, a long period of time signals should be recorded after the graze to aid in the analysis. Fresh batteries and protecting the recorder from cold helps to ensure a uniform recording. See "On Digital Quartz Wristwatches as Time Sources," in *O.N. 3* (3), 59-60 for added details.

David Dunham reports that the Yale Catalog predicted a 2.″9 north shift from the General Catalog for Z.C. 2677 observed near Aberdeen, MD, on 1986 April 1; the star position given by the G.C. was much closer to the truth.

Recent grazes continue to show that a 0.″3 north shift should be applied to 1986 predictions for northern-limit grazes of stars north of BD zone +05 (see "Grazing Occultation Correction Reminder" on

p. 342). The rare exceptions appear to be stars with poorly determined positions.

The project to put all the graze lists into machine-readable form has made excellent progress, almost entirely due to the perseverance of Don Oliver, who has already entered all of *Volume 3*; his devotion to this effort is greatly appreciated.

Also appreciated are the reports which keep flowing in; please keep up the good work.

REPORTS OF ASTEROIDAL APPULSES AND OCCULTATIONS

Jim Stamm

I will have a summary of all observations reported for the first half of 1986 ready for the next issue of *O.N.* [Ed: Sorry, make that *O.N. 4* (2)]. Please send all reports of observations made through June, to me, at Rt 13 Box 109; London, KY 40741; U.S.A.

(219) Thusnelda and SAO 111948, Dec 9, 1985: Negative reports were received from French observers R. Heidmann at Vernon, E. Nezry at Pic du Midi, and J. Vialle at La Rochelle.

(18) Melpomene and AGK3 +08° 0871, Dec 30, 1985: Y. Thirionet observed a miss at Brussels, Belgium.

(259) Aletheia and SAO 160139, May 10,1986: R. H. McNaught recorded a 15.46-second fade from Siding Spring Observatory in Australia. He used a 32-cm reflector at 308 power under very clear skies.

(338) Lacadiera and SAO 185428, May 12, 1986: Arvind Paranjpye and Gsd. Babu recorded a 1-mag. drop from 19:15:32 to 19:15:57 UT. They used a 20" reflector at Leh, India.

After an absence of several years, I plan to return to Stellafane. I would be pleased to meet some more IOTA members or *O.N.* subscribers this year. My silver Ford van with Kentucky tags should be the only one in the camping area. I also plan to meet some future members and subscribers.

I would like to see many more astronomy clubs join IOTA, and set up occultation divisions. I had the pleasure of meeting the Saguaro Astronomy Club's division during a graze, and was very impressed with their accomplishments. I know there are others that do well, but I also know that with some recruitment from you, there can be many others.

USNO NEWS

David W. Dunham

Total Occultation Predictions. Marie Lukac has generated "Besselian elements" tapes that can be used for computing detailed U. S. Naval Observatory total occultation predictions for 1987, 1988, and 1989. The generation of these tapes is done in several steps, a couple of which have depended on the MVT OCC programs, whose imminent termination is discussed below; hence, she produced the tapes for the later years early. If you have special applications that require early predictions, you can request them from Mrs. Lukac.

During the next couple of weeks, I plan to create a machine-readable subset of the USNO total occultation predictions for Washington (and perhaps later some other stations) and download them to diskette. Joan then plans to use them with the ASTBBS computer bulletin board that she developed, so that anyone with a terminal (or personal computer) and modem can call 301,495-9062, supply their coordinates, and obtain a list of total occultation times predicted for his location using *a* and *b* factors.

Pleiades. We have recreated (from cards used a saros ago) the Pleiades P-catalog, which includes accurate positions and proper motions of many faint Pleiads determined by Eichhorn and referred to the FK4. Lukac has created Besselian elements tapes for the P-catalog for 1987, 1988, and 1989. She plans to distribute P-catalog predictions (including a chronological listing of the events) for 1987 along with the ordinary detailed USNO predictions for 1987.

Toshio Hirose, Tokyo, Japan, has sent me computer-generated plots of all AGK3 stars in the Pleiades, showing the moon's outline (with terminator) and topocentric tracks of the moon's center for 12 cities (4 each in western Europe, Japan, and eastern North America) for each of the Pleiades passages through 1991.

Grazing Occultation Predictions. The dependence of IOTA's accurate graze predictions, specifically the data needed to generate the predicted profiles, has been described in my "IOTA News" articles in *O.N. 3*, issues #12, 13, and 15. Only those with some knowledge of IBM mainframe computer systems will understand everything in the rest of this section, but I have tried to stress the important results for IOTA and how they will affect our future graze predictions. Accurate profile data can be generated only with Tom Van Flandern's 78A version of his OCC program, which exists only in load-module form on CalComp disk drives used by the MVT operating system on the U. S. Naval Observatory's IBM 4341 computer. As described in the previous articles, we have been able to limp along, in spite of termination of the maintenance contract on the CalComp drives last October. However, all other USNO applications have now been converted to run under the CMS operating system, so USNO recently decided to terminate MVT and remove the CalComp disk drives this October 1st. It is possible that another CalComp drive, or another critical MVT component, could fail at any time before October. For instance, unrecoverable permanent read errors were recently encountered while trying to read "hasp" instructions from the SPOOL1 disk during an MVT IPL attempt. Fortunately, another special version of the SPOOL1 disk was found that worked, so as of mid-June, we can still generate profile data with 78A OCC.

After September, we will have to use the 80G version of OCC that runs under CMS. Alan Fiala and I spent a few evenings late in May and early in June trying to debug 80G OCC, which previously bombed whenever we tried to use it to compute profile data. We located a problem in a calling sequence that the CMS Fortran G compiler treated differently from the MVT Fortran G compiler. We were able to correct this so that 80G OCC now computes profile data. There are differences from the supposedly equivalent 80F OCC that runs under MVT, most attributable to differences in Delta-T and UT1 corrections that have essentially no practical consequence. But disturbingly, the longitude librations computed by 80G and 80F differ by about 0°1 (which causes small differences in the limb corrections used to construct the predicted lunar profile), whereas there should be agreement to 0°001 or better. The practical consequence for grazes, where latitude is the dominant libration, should be negligible. But it could be a symptom of a more serious problem that could lead to systematic errors, possibly even divergence, later on. I am starting to track the libration difference down by printing out intermediate quantities, but this is difficult with the MVT versions where the exact Fortran source no longer exists. I have compiled the 80G source with MVT Fortran X, and got a different, divergent calculation. I hope that further investigation will uncover instabilities in the code that can be corrected.

Even if 80G works perfectly (it may be "good enough" for prediction calculations now), we are still left with large differences (profile shifts of 1" and more) between the 80G (or 80F) and older 78A versions of OCC. I believe that these are primarily due to bad Perth 70 catalog data for the relatively bright (generally brighter than 7th-mag.) northern stars in the XZ catalog that affect the newer, but not the 78A, version. By combining the northern half of the 78A XZ with the southern half (which includes good Perth 70 data) of the 80G XZ, I will create a new XZ that may give usable predictions with 80G OCC. Empirical corrections, that we can build into ACLPPP, will probably be needed, since observational corrections are embedded in 80G that were determined using the corrupted current XZ catalog. If it is not possible to devise a simple set of empirical corrections, it will be necessary to perform a complete new analysis of all the observations using 80G OCC and the corrected XZ in order to determine new observational corrections for the OCC program. This should be done in any case (it would be a publishable result), but would need a lot of advice and help from Van Flandern. If I am not completely satisfied with 80G OCC by mid-August, I will press the graze computors to quickly process all IOTA predictions for 1987, so that profile data can be generated with 78A.

New XZ Star Catalog. When I create the new XZ, I also plan to replace the positional information for Pleiades stars with the more accurate data from the P catalog, as well as correct a couple of other errors mentioned elsewhere in this issue. At the same time, I plan to create a subset of the brighter XZ stars, to copy to an IBM PC diskette for use with the PC Almanac program (see p. 340), and possibly other applications.

Watts' limb correction data on diskette. With help from Tim Carroll at USNO, I am transferring a subset of the Watts lunar limb correction data to IBM PC diskettes. Each limb correction is written in the form of a 3-digit number. 1800 data points (for each 0°2 of Watts angle) are specified for a grid of longitude and latitude librations covering all possible values at 0°5 intervals. Twenty diskettes will hold all of these data. They are being sent to David Herald in Australia, where he plans to use the data for his analyses of total lunar eclipse occultation timings, as well as other applications. He will transfer the data to his Commodore 64 computer for this work.

DOUBLE STAR NEWS

David W. Dunham

In the British Astronomical Association's *Lunar Section Circular 21* (3), p. 20 (1986 March), Alan E. Wells reports in his "Project Fade" section that Mr. Elliott observed several non-instantaneous lunar occultation events last year, listed below:

SAO	mag.	1985	dur.	remark
76835	8.5	Jan21	0^{s}3	gradual fade
78579	8.9	Apr25	0.2	gradual fade
93094	8.1	Feb25	0.1	fade
93424	8.3	Jan 4	0.25	step event; Z.C. 495
93476	8.1	Feb26	0.1	fade
93507	7.6	Sep 5	0.2	gradual R; Z.C. 520
119243	8.6	May 1	0.2	suspect gradual

The date is given under "1985" and "dur." is the duration of the phenomenon reported under "remarks," where the Zodiacal Catalog number is given for those stars in the Z.C. The reported phenomena indicate that these stars may be double. This is buttressed by the fact that gradual occultations have previously been reported for two of these stars: SAO 76835, observed in South Africa on 1929 April 13; and SAO 93424 (the only definite step event noted above), observed by G. Hewick at Leicester, England, on 1976 Feb. 8, and reported in *O.N. 1* (11), p. 120.

The first spectroscopic orbit for 6th-mag. 29 Arietis (Z.C. 374 = SAO 92998) was published by Wenxian Lu in *Publ. Astron. Soc. Pacific 98* (602), p. 468 (1968 April issue). Lu was able to measure the spectra of both components on most of the spectrograms that he obtained at Victoria, B.C. The derived period is 19.3787 days and the projected separation is 13.6 million kilometers. SKYMAP gives 30 parsecs for 29 Arietis' distance, implying a projected separation of only 0"0030, which would be hard to resolve even for high-speed photoelectric occultation observers. Hence, the double star code should be U, not V, as given in the XZ. The XZ double code was derived from the star's being listed as a spectroscopic binary in Wilson's radial velocity catalog.

The bright double stars Antares and Sigma Scorpii are discussed in separate articles. There are several other reports of gradual events that I have received since the last "New Double Stars" article that I published in *O.N.* many issues ago, and I apologize to the observers concerned for not having had time to properly document them here. I will do so eventually, and will try to make double star code updates for at least some of them when I work on the XZ catalog during the next few weeks. This article is not to be considered a resumption of the "New Double Stars" series. Unfortunately, the IOTA double star records are not in good order, with many errors that need to be corrected. I try to keep track of at least the brighter stars that are currently being occulted, but it will be at least a year before I can turn my attention to really getting our double star records in order. At that time, I may ask for some help with the job; perhaps someone with a PC could help. In the meantime, the ILOC has asked me for a copy of the computerized records, which I hope to provide with a lot of words of caution within a couple of months.

ECLIPSE NEWS

David W. Dunham

1986 April 24, total lunar: Halley's Comet apparently distracted most observers during this eclipse, since David Herald says that he has received only a few reports of occultation timings made during the eclipse, including only 3 reappearances. He is anxious to receive the 11 timings that I made at Yorke Island (see p. 353) since 8 of them were reappearances. One star that I did not time, and never even saw, was SAO 158394 = E01442 = X20056, listed as mag. 9.1 in the detailed E-catalog predictions. This was remarkable, since I was able to see eleventh-magnitude stars; Steven Hutcheon also noticed that this star was missing. Checking the XZ predictions later revealed that the star's spectral type is M5e and that it is a (apparently Mira) variable, Mag. 15 at minimum. It was clearly far from maximum during this eclipse. As expected, the northern edge of the moon, being deeper in the shadow, was much darker than the southern edge, against which it was very difficult to time any occultations. We haven't heard of any grazes observed during this eclipse; one favorable northern limit of an 8.3-mag. star passed over downtown Sydney, Australia, during totality.

1986 October 3, total-annular solar: Joe Rao; Compu-Weather, Inc.; P.O. Box 1122; Flushing, NY 11354, asked me if I knew anyone who planned to attempt this eclipse, which is only visible at low altitude in a small part of the Atlantic near Iceland. Neither Fiala at USNO nor I know of anyone, but if you do, you might inform Mr. Rao. Perhaps an Icelandic Airways flight could be arranged to cross the path at the right time.

1986 October17, total lunar: It is very rare to have a total lunar and total solar eclipse during the same month; perhaps Jean Meeus can inform us how frequently this occurs. Lunar and solar eclipses often occur during the same month, but almost invariably one is partial. This eclipse will be visible throughout the Eastern Hemisphere. Star field charts and extended USNO total occultation predictions including stars to 12th mag. can be obtained for this eclipse, if you don't already have them, by requesting them from me at P.O. Box 7488; Silver Spring, MD 20907; U.S.A. Detailed predictions of specified grazes are also available upon request. I have received only two special requests for occultations during this eclipse so far, both from observers in South Australia (S.A.), one wanting predictions for a graze of 7.2-mag. Z.C. 209, whose path crosses northern S.A. at fairly low altitude in the west.

1987 March 29, broken annular solar: This eclipse will be total over parts of the Atlantic Ocean. The best land view will be obtained from Gabon, on the Atlantic coast of central Africa, where the eclipse will be broken annular. The beads phenomena should be even better than during the 1984 May 30 eclipse, since the moon's apparent radius will be about 1" larger relative to that of the sun. Since phenomena take place all the way around the moon as seen from the same site, precise coordinates of the observing site are not needed for determining the solar radius from the timings. Paul Maley says that examination of last year's satellite photoes taken around the date and time of the eclipse show about 50% cloud cover. He is organizing a one-week expedition to observe the eclipse near Port Gentil, Gabon. The estimated total cost, from Houston, TX, to Amsterdam to Gabon and return, is $2700, which is tax-deductible for U.S. IOTA members. Contact Paul at 15807 Brookvilla; Houston, TX 77059; phone 713,483-5378 if you are interested in joining this effort. Wolfgang Beisker informed Maley that IOTA/ES also plans to attempt observation of this eclipse, possibly from another site in Gabon, perhaps east of Libreville. Contact Hans Bode for more information about IOTA/ES plans.

1987 September 23, annular solar: Paul Maley is working with Wang Sichao at Purple Mountain Observatory to try to set up an expedition to observe this eclipse from China. Tentative plans are to leave California on Sept. 18 and return on Oct. 4, with total cost about $3500. While in China, they hope to visit Beijing, Nanjing, Shanghai, Xian, and Chunking, as well as sites at both limits in two separate groups on eclipse day. The southern limit site would probably be about 100 km n.e. of Nanjing, while the northern limit crosses directly over Taiyuan. Paul has inquired about weather and other logistic questions; weather satellite photoes for previous years can probably be obtained from my Japanese source, that supplied good data for northern Australia for our recent trip; see p. 354. Contact Paul for future information about this IOTA eclipse expedition. David Herald says that he, and possibly some other Australian observers, are interested in joining this effort.

1991 July 11, total solar: While in Baja California on March 31 (see p. 349), we took pictures at the centerline of this path, which crosses a paved highway in open desert near the town of Santiago. A tropic of cancer monument is nearby, and there is a resort on the shore of the Gulf of California (Sea of Cortez) about 12 km north of the centerline. We did not visit the limits of the very wide path, since the southern limit passes some 50 km south of Cabo San Lucas, the southernmost tip of Baja, and the northern limit crosses the highway over 100 road kilometers north of La Paz.

2004 May 4, total lunar: Zubenelgenubi (Alpha 2 Librae = Z.C. 2118, mag. 2.9) will be occulted during totality, as it was on the same date in 1985. The successful observations at both limits of the 1985 event have been reported in previous issues. However, it will be difficult to repeat this experiment in 2004. The northern limit crosses southern Namibia and southwestern South Africa, passing near Port Elizabeth. The southern limit crosses a small part of Antarctica where the moon's altitude will reach a maximum of 9°.

IOTA ELECTION RESULTS

Charles Herold

By the time of the IOTA meeting on May 10th, I had received ballots from 116 IOTA members. I was designated proxy on 51 of the ballots. The nominated slate of candidates was selected by 56 members. Nine members both voted for the nominated slate and designated me as proxy. There were no write-in votes. Since I cast my vote for the nominated slate, the nominated slate was unanimously elected.

We exceeded the required 30% (74 members) by a wide margin. The 116 ballots represent 47% of the membership, so the 1986 election is valid, and the nominated officers will hold their offices until the 1989 election.

SIGMA SCORPII, A BRIGHT CLOSE BINARY

David W. Dunham

I will first describe some of the interesting history behind this double star, then the value of observations of grazes of close binaries, then our trip to Baja California to successfully videorecord a graze of the star on Easter morning, and finally an appeal for more timings of both components (or grazes of any star at similar librations and Watts angle), including maps showing the limits of Sigma Scorpii occultations during the rest of 1986.

History. I recently listed all timings of occultations of 3.1-mag. σ Sco. (Z.C. 2349 = Al Niyat = SAO 184336) that are in the U. S. Naval Observatory's tape of occultation observations that was used by T. Van Flandern for his various analyses. The earliest timing was of a reappearance timed on 1843 January 25 in Cambridge, MA.

A good article, "Occultation Resolution of Sigma Scorpii," was published by R. Edward Nather, Joseph Churms, and P. A. T. Wild in *Publ. Astron. Soc. Pacific 86*, p. 116 (1974 February), reporting photoelectric observations made of a disappearance of the star recorded at the South African astronomical observatories at Sutherland and at Cape Town on 1972 July 21. They clearly resolved two components, and scanned the literature to find previous visual observations of step disappearances or reappearances. The earliest record they found, which apparently constituted the discovery of the star's close duplicity, was published in *Annals of the Cape Observatory 1*, p. 17, listing a timing of an occultation on 1860 March 12. A footnote for the event said: "Not instantaneous. The time recorded is that of the first appearance of light, which was followed at an interval of about 0.5^s by the full blaze of the star." Curiously, this observation is not on the USNO tape. Nather *et al*. found four other step-event observations, made in 1917 at USNO, Washington, DC (R); 1931 at La Plata, Argentina (D); 1953 at Union Obs., Johannesburg (D); and 1968 at Royal Obs., Cape (R, on bright limb).

Nather *et al*. describe some of the photometric history of σ Sco., which is a Beta Canis Majoris variable of small amplitude with a basic period of about 4.5 hours. In addition, beat phenomena have been resolved in spectroscopic radial velocity measurements, with periods as long as 33 days. There were suggestions that the longer period might be caused by a close companion, that could perhaps be resolved with high-speed photoelectric observations of an occultation. The authors go on to note that, at σ's expected distance of almost 300 parsecs, with reasonable assumptions for the stellar masses, the radius of an orbit for a companion with a 33-day period would subtend at most 0".002. This is clearly not the companion seen visually, which must have had separations of at least a few tenths of an arc second. Combining the two 1972 S.A.A.O. timing differences of the two components yielded a separation of 0".49 in position angle 268°. There is a fair amount of uncertainty in this result, due to unknown lunar limb height differences for the two components at the two stations and the fact that the event p.a.s differed by only 9°. The mag. difference was found to be 2.2.

The authors used their data and the earlier visual timings to estimate the orbit of the pair. They found that minimum separation occurred in the early 1950s, and that the pair is now separating. The period is probably much longer than 112 years; they adopt an orbit with a period of about 300 years that seems to fit the data. Measuring the orbit shown in their Fig. 7 indicates that the separation would now be about 0".6 in p.a. 273°.

A more detailed analysis of the excellent Sutherland photoelectric data by the authors revealed no other companions down to 0".002 vector separation. There could be a companion with slightly greater separation that would be missed if it and the primary happened to be nearly in line with the lunar limb, so the 1972 observations neither show any evidence for a very close companion with a 33-day period, nor rule out the possibility for such a star.

Another event brought σ to prominence early in 1984. The 187-km asteroid (241) Germania was predicted to occult σ in eastern Asia on March 4, as described in *O.N. 3* (6), p. 132. The nominal path crossed China. Since there was no interference from moonlight, the occultation of the primary star could be seen without optical aid. Wang Sichao, Purple Mountain Observatory, Nanjing, publicized the event extensively in Chinese newspapers, resulting in probably the largest (in number of observers) organized effort to record any astronomical event to date (dwarfing even the 1983 May 29th Pallas occultation effort). Clouds prevented complete coverage of the event, but over 3000 Chinese monitored the star, and none of them reported any occultation. A few other observations made in Japan (where the event occurred shortly after sunrise), the Philippines, and India were also negative. The little astrometry that was obtained before the event was conflicting and inconclusive. The uncertainty zone included nearly all of eastern Asia, and there were many gaps in the coverage outside of the cloud-free areas of China where the occultation path could have been located. An opportunity to obtain unprecedented resolution of σ was missed.

Measurements of σ Sco. made by speckle interferometry between 1976 and 1981 have been published by Harold A. McAlister and William I. Hartkopf in "Catalog of Interferometric Measurements of Binary Stars," *Contribution* No. 1 of the Center for High Angular Resolution Astronomy, Georgia State University, 1984. The 1976.47 sep. and p.a. were 0".326 and 111°.8, which I used for IOTA's special double star list (having obtained the result from Morgan *et al*., *M.N.R.A.S. 183*, p. 701, 1978), after adding 180° to the p.a. The latter is justified because the speckle results have a 180° ambiguity in p.a., and the 1972 occultation clearly showed the companion to be west of the primary. Unfortunately, the errors in Morgan *et al*.'s measurements proved to be larger than they estimated, and a better early observation of σ to use was made by McAlister *et al*. on 1977.49 (sep. 0".353, p.a. 105°.4). In 1981.47, the measured separation was 0".369 and p.a. 95°.6 (should be 275°.6). Differencing the 1981 and 1977 observations gives annual rates of +0″0043 for sep. and -2°45 for p.a., with values of 0″390 and 263°9 on 1986 March 30.

Value of Observations of Grazing Occultations of Close Doubles. Carefully observed grazing occultations, where the lunar profile is resolved in considerable detail, several timings of the secondary component are obtained, and the separation between at least one pair of stations is similar to the actual component separation projected onto the position angle of central graze (so that one observer times virtually the same series of events for the primary that the other times for the secondary), can yield the separation and position angle of the two stars to an accuracy of 0″02 or better.

Similar information can be obtained by combining two or more photoelectric occultation timings (or video timings, or even accurate visual estimates), but the accuracy is much poorer due to errors introduced by the unobserved lunar profile, especially when the difference in p.a. of occultation between stations is small. For example, the speckle data clearly show that the separation derived by Nather *et al.* from the 1972 occultation was too large, by as much as 0″2. The speckle data indicate a smaller orbit with a shorter period than the one postulated by Nather *et al.* Either graze or total occultation data can quickly resolve the 180° ambiguity of the speckle observations. Good graze data of close binaries supplement the speckle data, which require expensive large telescope time and extensive processing and computer analysis to obtain results. Video records of grazes of close doubles can be important for reducing timing errors, resulting in more accurate determination of that component of a binary's relative position which is parallel to the lunar motion (or perpendicular to the p.a. of graze).

When I printed out all observations of occultations of σ from the USNO tape, there was only one graze, when 22 timings were made from about 9 stations in northern New Zealand on 1968 May 13. Unfortunately, the moon was nearly full, so events involving the companion were probably not timed. The printout also revealed that the most extensively observed total occultation was observed throughout the U.S.A. on 1967 August 14. Stan Warkoczewski photographed the star and moon shortly before the disappearance, and just after the reappearance, with his 16-inch reflector in Kansas City, MO, using film much slower than is available today. For many years, I used copies of his slides of that event to illustrate total occultations during lectures on grazes (he also took a series of slides during a graze of a 6th-mag. star that happened to be visible from the site of his non-transportable telescope).

Results from the March 30th Graze in Baja. While most observers were making plans to travel south to observe Halley's Comet, we instead made not one but two international trips south to observe occultations instead (see p. 353 for an account of the other trip). Incidentally, we also had some good views of the comet, although both trips maximized interference from moonlight. But this unfortunately discouraged others from joining us; we certainly could have used some more observers, especially for the graze of σ.

The logistics of the trip will be discussed in a separate section. The moon was 76% sunlit, waning. The southern limit is shown in the Pacific in the southwest corner of my map published with my lunar occultation highlights article in the January issue of *Sky and Telescope*. Just off the map, the path crossed the southern end of Baja California, where central graze occurred on the dark limb 15° from the south cusp with the moon 30° above the southeastern horizon. The path also grazed a short section of mainland Mexico's Pacific coast near Manzanillo. It then arced down across open ocean, finally bending east and crossing Colombia. The path passed only a few kilometers from downtown Bogota with central graze in morning twilight. I sent predictions to the Asociacion de Astronomos Autodidactos de Colombia in Bogota; according to the 1984 edition of the International Directory of Amateur Astronomical Societies, "occultations" is one of their activities. So far, I have received no reply. A total occultation was visible throughout most of North America, and I hope that numerous timings of it were obtained; I believe that the reappearance was recorded photoelectrically at McDonald Observatory, TX.

There were three of us in the graze path in Baja, Joan Dunham, Jared Zitwer (from Damascus, MD), and I. Unfortunately, we had only two telescopes with us, since Continental Airlines failed to transfer a third scope (a 5-inch Schmidt-Cass) to our flight from Denver to Tucson. We observed the graze through very thin cirrus, which seemed to have no adverse effect; events involving the 5th-mag. companion were seen very clearly. Joan and I attached our RCA TC-2055 Ultricon video camera to an 8-inch Schmidt-Cass, and recorded 8 events of the primary and 6 events of the secondary over a period of about two minutes. The individual occultations of the secondary star were much shorter than those of the primary. I feel that it is our best videorecording of a binary star. Jared Zitwer observed visually, using a cassette tape recorder and a 9-cm Schmidt-Cass, from a site 50 meters northeast of our position. He observed virtually the same sequence of events as we did. WWV reception was very good with our Timekubes.

If we had had the third telescope, we would have separated more. For planning purposes, we used Morgan *et al.*'s separation and p.a., which was nearly in line with the moon's motion. This implied that the vertical separation of the two components on the predicted profile would be only 0″03, or 50 meters on the ground, the separation selected for our two stations. But if we had used the values extrapolated from McAlister's catalog discussed above, we would have spread out almost ten times as far, since the predicted vertical profile separation would then have been 0″22, or 490 meters on the ground measured perpendicular to the limit. Our observations seem to confirm this wider separation. But we could not measure it very accurately due to the small separation between our sites.

At our site, the Watts angle of central graze was 199°3, while the longitude and latitude librations were +2°26 and +4°68, respectively. Another well-observed multi-station graze in the same Watts angle range with similar librations could be analyzed to determine the actual lunar profile for our graze; then, accurate values for the sep. and p.a. could be calculated from our timings. Unfortunately, the observations of the 1968 May graze are of no help, since their Watts angle range was 15° away. I made a computer scan of the USNO observation tape, printing out all observations in the range of interest. A graze of 3.8-mag. Z.C. 1428 observed in Japan on 1973 January 20 differs from our graze by only 0°.21 in latitude libration, and is otherwise just in the right range, but the five timings are not enough to construct a profile. A better job might be done with 18 timings that were made during a graze of 6.0-mag. Z.C. 2134 on 1969 January 13 in Florida and Missouri. But although this was in just the right W.A. range, the librations differ by 0°.44 in latitude and 7° in longitude. When time permits, I will check to see whether these events might help our analysis, but there are clearly problems with them for this purpose.

Planning and Logistics for the Trip to Baja. Since the occultation occurred on Easter morning, a popular time to travel, we purchased our discount airline tickets over two months in advance (we got a partial refund because the price was decreased after the purchase). We felt that the desert climate of Baja meant that there would be little chance that we would have to pay a substantial cancellation penalty. Consulting with IOTA member Guillermo Mallén in Mexico City, we learned that southern Baja was a free trade zone, which meant that there would be no customs hassles like those that have been encountered previously by U.S.A. citizens with telescopes who cross the border by automobile. Mallén also noted that the area had been recently mapped at 1:50,000 scale by the Mexican Comision de Estudios del Territorio Nacional (CETENAL), and he could get copies of the maps that we needed. Fortunately, I already had a CETENAL index map that Harold Povenmire had given to me several years ago. We are deeply indebted to Guillermo Mallén for sending us the maps that we needed for this trip, as well as some new maps covering areas of Mexico where we had previously made occultation observations. Southern Baja is very sparsely populated, so there are no planetariums or known astronomical or scientific groups, or even individual amateur astronomers, with whom we could work. Because of the free trade status, commerce is the dominant occupation, and preoccupation, of the populace. The lack of direct local support was discouraging, but this was balanced by the fact that the Mexican government has targeted Baja for major development of resources for foreign tourists, who are traveling there in increasing numbers. The people are friendly and like to help tourists.

We were booked on Continental flights to Tucson, AZ, and an Aeromexico flight to La Paz, scheduled to arrive late the afternoon of the 29th. We were scheduled to return on the 31st. We reserved a rental car through Avis. But we were dismayed to learn that all the hotels in La Paz that make reservations were filled up. We wanted to stay in La Paz, and travel south about 80 km to just north of Todos Santos on the Pacific side to observe the graze. Mallén said that La Paz had many small motels where we could surely find a room.

Looking at weather satellite photoes the week before, we nervously watched a band of clouds that moved up and down the Baja peninsula. A few hours before departure, the band was moving rapidly down the southern end of Baja, being pushed by a high-pressure area centered over California; the forecaster thought that the clouds would be pushed mostly south of the southern tip, so that we would have only some ligering cirrus. We decided that we would check the more recent forecast that we could get when we arrived in Tucson. But a jammed cargo door delayed our receipt of luggage (minus the 5-inch telescope) in Tucson, so that we barely had time to make the Aeromexico flight, and no time to call back for the updated weather forecast. When we arrived at La Paz, we found that Avis had no record of our reservation. Most of their cars were already rented, since the president of Mexico was due to arrive the next day (that explained the filled hotels). Of the two available cars, we rented a well-used VW Rabbit. Some of the supporting bolts for the muffler pipe were missing, so the pipe would hit the ground whenever we went over a bump, of which there were many. We solved the problem by using duct tape to suspend the tail pipe from the rear bumper. Although the car ran roughly, we had no problems in driving where we needed to go. We ate dinner, bought some soft drinks at a supermarket, and drove south.

Unfortunately, the sky was virtually overcast, with only a few breaks. About 40 km south of La Paz, we came to a fork in the road, with the newly paved eastern fork crossing to the east side of the peninsula and extending to Cabo San Lucas at the southern tip. The sky looked a little better in that direction, and we had time to drive about 140 km to where the limit crossed the highway about 10 km north of San Jose del Cabo. The 1983 map showed an intersecting road at just the place we wanted to be, with no buildings within 200 meters.

When we got there, the sky had improved considerably, but we were dismayed to find several buildings at the desired intersection. Loud music emanated from one of them, obviously a tavern; it was late Saturday night. We did not want to try to explain why we were setting up telescopes in the area, to the patrons of the tavern, with our very limited knowledge of Spanish. The maps showed a dirt road that extended east from San Jose del Cabo near the southern coast; it intersected the graze path about 8 km east of town. We passed a lighthouse shown on the map, and traveled the distance to the limit that we measured from the map. But we found that the road was not the one on the map that we expected, because we were too close to the beach. The road we were on had apparently been graded after the map was made, but even so, was very washboardy (or corrugated, as they say in Australia). Nevertheless, we traveled the estimated distance, stopped, and found three high hills that were shown on the map. We used the beach and the eastern hill (which we dubbed "Sigma Scorpii Mountain") as positional references, since that hill was crossed by the isoskiatic line that gave promise of the most events, judging from the predicted profile.

After the highly successful observations described above, we drove to Cabo San Lucas. We learned from the clerk at the first hotel we stopped at, that all of the hotel rooms in town were taken; the president was coming there, too, and it was Easter. But he phoned a beachside resort hotel 6 km to the northeast, and found that they had rooms available. We found that the air conditioning was not working, but the nights were cool enough that we did not need it. After getting some much-needed sleep, we enjoyed

Easter afternoon sightseeing in Cabo San Lucas, climbing the rocks north of the famous arch, and lounging in the hotel pool and on the beach.

We got up early the morning of the 31st, showed some of the hotel guests Halley's Comet and Omega Centauri with the 9-cm telescope, ate an early breakfast, and drove back to La Paz. On the way, we stopped at the central line of the 1991 July 11 total solar eclipse; see p. 345. Our flight out of La Paz was delayed over two hours, causing us to miss our Continental flight, which would have returned us home with about four hours to drive to Aberdeen, MD, for a graze of 6.8-mag. Z.C. 2677. We retrieved our 5-inch telescope from Continental, and Aeromexico put us on the next-available flight, a United red-eye that would depart in seven hours, getting us to Dulles airport by 9:30 am. After straightening things out, I remembered that I had promised Peter Manly, Phoenix, AZ, that I would call him from Tucson. By then it was four hours after I had told him that our flight would arrive in Tucson. He was very relieved to hear from me, because we first learned from him about the Mexicana crash earlier that day. Not knowing our exact itinerary, he was afraid that we might have been on the Mexicana flight. Although we missed the Aberdeen graze, Jay Miller managed to observe it; see p. 342.

Call for Observations. Since σ will be occulted during the next few years, you should watch for future opportunities to observe grazes of this important double. Judging from the current sep. and p.a. calculated from McAlister's data given above, the secondary will always be easier to see, grazing a higher part of the lunar profile than the primary, during southern-limit grazes. Although the reverse occurs at northern limits, the secondary will likely be seen occasionally there, too, when it reappears before the primary from relatively steep lunar slopes. The graze must occur on the dark limb at night in order to see the 5th-mag. companion. Pairs of observers should set up on isoskiatic lines separated by the predicted vertical separation (shift difference) on the profile. If there are more than one pair of stations, they should not be set up at the same vertical separation differences, but should be offset by small increments (perhaps 0″.02 or 0″.03) in order to obtain observed results more accurate than the predicted result. The vertical shifts for the two components are given at the bottom of the profile, but since the predictions for the second half of 1986 have already been mostly computed, Morgan's incorrect values (0″.33 in p.a. 292°) were probably used. The correct values can be computed from:

sep. = 0″.390 + 0″.0043(year - 1986.24)

p.a. = 263°.9 - 2°.45(year - 1986.24),

where "year" is the date expressed in Gregorian years and fractions of a year. The vertical profile shift difference is then:

shift diff. = sep. × cos(p.a.g. - p.a.).

where p.a.g. is the p.a. of central graze at the intended place of observation. The shift difference, now in arc seconds, can be converted to miles or km by dividing it by the VPS (vertical profile scale) given on the predicted profile.

Besides σ itself, we are very interested in observations of any grazes that might define the March 30th profile in more detail. These would have to occur within Watts angle range of 196°.4 to 201°.4, with the latitude libration between +4°.18 and +5°.18, and with the longitude libration any value, but the closer to +2°.26, the better. What is wanted is as much detail of the profile as possible, which can be obtained with as many observers as possible.

Future Occultations. The maps show the northern and southern limits of occultations of σ Sco. during the rest of 1986. They are drawn in virtually the same way as the maps for the Antares grazes were produced for p. 320 of the last issue. The main difference is that σ is not bright enough to be seen in the daytime when the moon is a thin crescent, or when the sun is higher in the sky than the moon when near first or last quarter, or when the moon's daytime altitude above the horizon is less than about 15°, regardless of the phase. Hence, I have added tests that eliminate the unobservable daytime parts of the paths. During the moon's waxing phases, a daylight condition terminates the path at the west end, whereas the 4° altitude limit stops it at the east end, and vice versa during the waning phases. The table below gives the percent of the moon sunlit for the events shown:

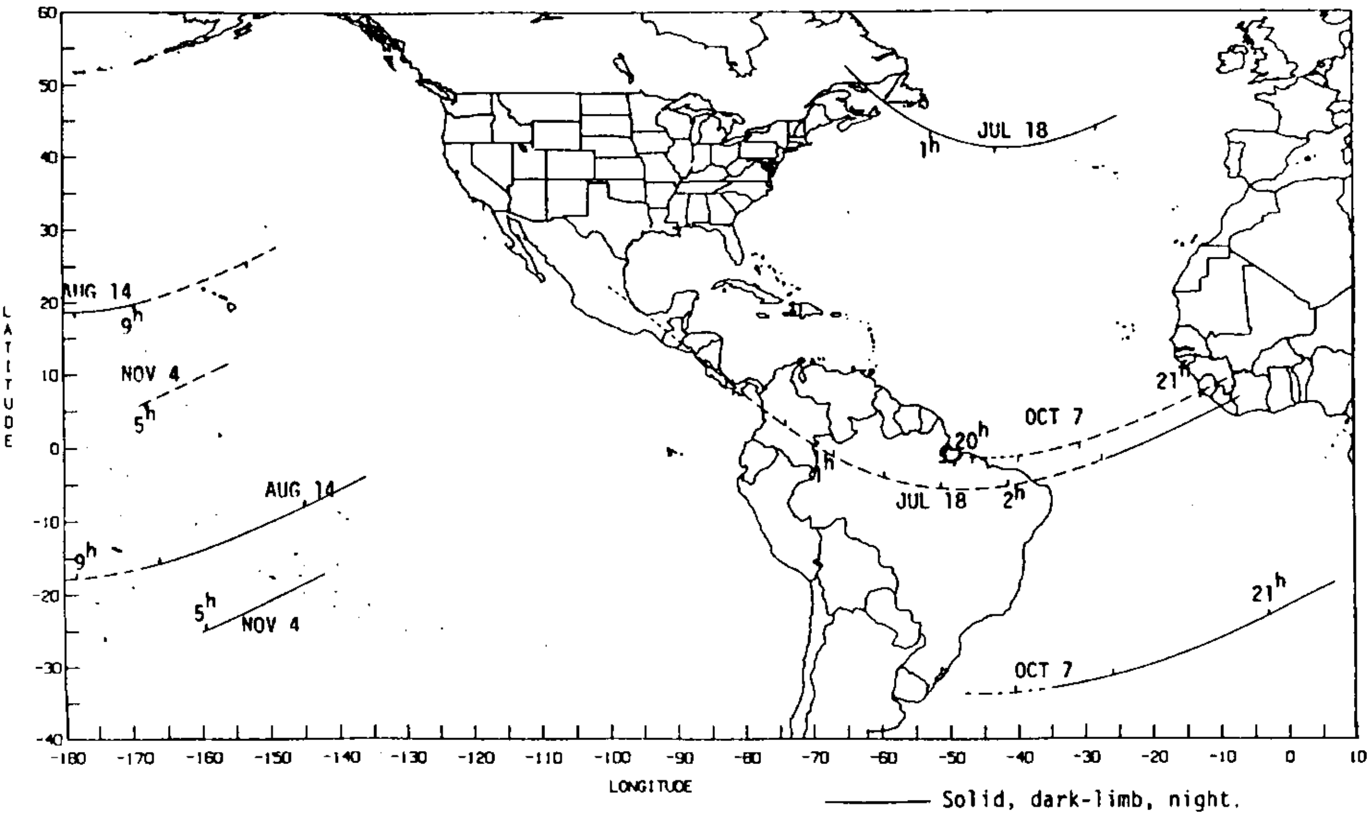
1986 Date	% Sunlit
June 20	96+
July 18	84+
Aug. 14	64+
Sept. 10	41+
Oct. 7	20+
Nov. 4	5+
Dec. 29	7-

Only the June 20th occultation has no northern limit, but this bright-limb event is of little interest since it has already happened. Upon request, I will supply detailed predictions for any of the occultations shown on the map. But most of the good paths are over ocean. We may have already observed the best graze of σ this year. Next year, the paths will migrate farther south, leaving fewer opportunities for the Northern Hemisphere.

The last graze of σ in North America this year occurs early the evening of July 17th, local time. The northern limit crosses a desolate stretch of eastern Quebec, passing several km east of the village of Baie Johan Beetz on the north shore of the Gulf of St. Lawrence. At the shoreline, the moon will be 12° high, the sun 4° down, and cusp angle +15°N. The path extends southeast across the Gulf, missing both Anticosti Island and Cape Ray at the southwestern tip of Newfoundland, apparently by only a few km. The southern limit is in daylight in Mexico, with the sun setting in western Nicaragua. A total occultation will be visible from the eastern U.S.A., but under rather difficult conditions. At Silver Spring, the disappearance occurs at 23^h44^m U.T. at C.A. 82°N, with the sun 8° up and the moon 19° up in the opposite azimuth. The reappearance will be at 0^h51^m U.T. of the 18th at C.A. -47°N, with the sun 4° down and the moon 24° up.

Observers may be distracted from Sigma, because five hours after the moon passes in front of it, Antares is occulted. The areas of visibility of the σ events generally lie a few thousand km southeast of those for Antares, which is also a close double star.

GRAZES OF SIGMA SCORPII DURING 1986



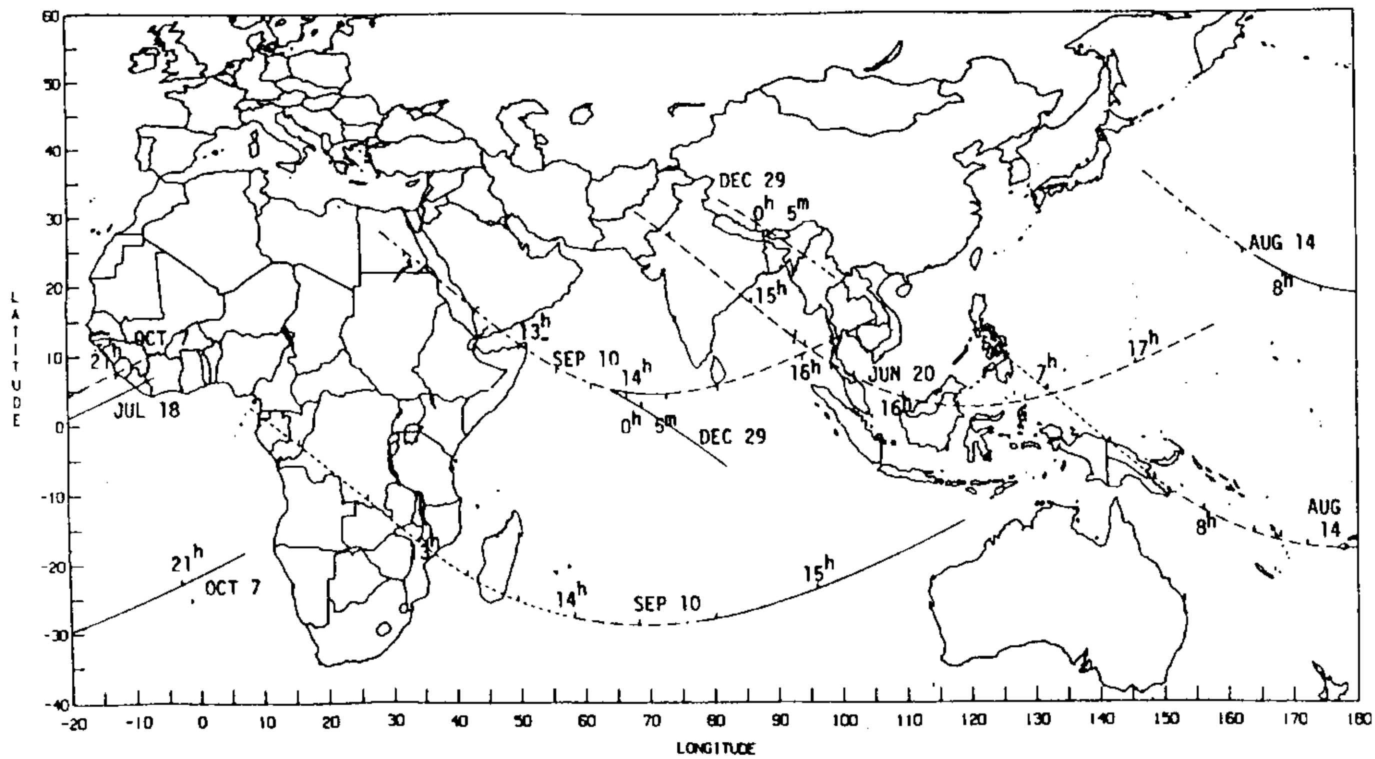
——— Solid, dark-limb, night.

– – – – Long dashes, bright-limb, night.

.... Short dashes, bright-limb, day.

–·–·–· Alternating long and short dashes, dark-limb, day.

GRAZES OF SIGMA SCORPII DURING 1986



MINOR PLANET (3123) DUNHAM

M.P.C. 10847, 1986 June 22, reads as follows:

(3123) Dunham = 1981 QF2.

Discovered 1981 Aug. 30 by E. Bowell at the Anderson Mesa station of the Lowell Observatory.

Named in honor of David W. Dunham, American astronomer and organizer of the International Occultation Timing Association. Dunham has played a cardinal role in collecting and analyzing occultation observations, particularly those involving asteroids and grazing occultations by the moon. In addition, he has stimulated many observers to make accurate and useful timings of occultation phenomena. Name proposed by the discoverer following suggestions by E. Goffin and P. L. Dombrowski.

[Ed: On behalf of ourselves and our readers, we offer congratulations on this honor, to Dr. Dunham.]

ASTROMETRIC UPDATES FOR ASTEROIDAL OCCULTATIONS IN THE U.S.S.R. DURING 1984

David W. Dunham and I. S. Balinsky

A new series of articles discussing updates for asteroidal occultations was begun on p. 327 of the last issue. IOTA has received no updates for asteroidal occultations since Dunham wrote the last article, other than Balinsky's report included in the Kiev University report of all occultation observations made during 1984, which was recently sent to Dunham by Alexander Osipov. Dunham thanks Robert McCutcheon for translating important parts of the report. By far, the largest number of astrometric positions of Halley's Comet and Comet Giacobini-Zinner have been reported to the International Halley Watch by observers in the U.S.S.R., and it is gratifying to see that some of these resources have already been used to refine predictions for asteroidal occultations. More useful observations of this type are sorely needed worldwide, to update predictions for more events. It would help if asteroid astrometrists would add preliminary observations of occultation-candidate asteroids, that will occur one or two months in the future, to their regular observing schedules. Predictions for the events below were listed in *O.N. 3* (6), 120-128.

May 19, SAO 158099 by (230) Athamantis: Astrometric plates were taken and measured at Dushanbe. The results were relayed to the Institute of Theoretical Astronomy (ITA) in Leningrad, where the data were reduced, showing that the occultation would not be visible from the U.S.S.R.

Sep 14, anonymous by (6) Hebe: Astrometry for this event obtained at Kharkov and Dushanbe was received at ITA too late to refine the prediction before the occultation.

Sep 17, anonymous by (8) Flora: Astrometry from Uzhgorod was reduced at ITA to predict a path that passed near Blagoveshchensk in eastern Siberia, where there were no observers. The path also crossed eastern China, close to the nominal path shown in *O.N. 3* (8), 173. Data for the star were taken from the Astrographic Catalog, and its declination is -0° 47'. Dunham has found problems with other stars in the equatorial zone of the A.C., as noted in *O.N. 3* (8), 161 and (10), 201, so this star might be used to test the equatorial A.C. data.

PAST OBSERVATIONS AND FUTURE PLANS FOR 1986 GRAZING OCCULTATIONS OF ANTARES

David W. Dunham

See p. 319 of the last issue for an article giving predictions of grazes of Antares through the rest of 1986.

March 30: This first graze of the current series was successfully observed by Larry Dunn, Eugene, OR, and Richard Linkletter, Bremerton, WA, from locations north of Klamath Falls, OR. Each got four timings. A good article describing the effort to observe the graze, "Amateur Astronomers Fill Expert Needs," was published on page B1 of the *Oregonian* newspaper of 1986 April 17. IOTA and the graze were highlighted in this article by Robert Goldfield. The activities of the I.H.W., A.A.V.S.O., and I.A.P.P.P. were also discussed. The article did not mention whether the companion star was seen, but that would have been difficult, since there was considerable interference from sunlit features and twilight. Peter Manly planned to videorecord the graze with a Nuvicon color camera. His telescope was put on a plane scheduled to fly to San Francisco, to connect with another flight to Klamath Falls, where he would be met by Dunn and Linkletter. But mechanical problems with the plane delayed the flight for a few critical hours, before the airline decided to cancel the flight entirely and returned all checked luggage. By that time, Manly could not get to San Francisco in time to make the connecting flight to Klamath Falls, so he got a refund for his ticket, aborting the first attempt to videorecord an Antares graze.

May 24: Richard Wilds, Topeka, KS, reported two timings during this full-moon graze, which he observed through breaks in the clouds near Lyndon, KS. Farther east, our expedition was driving west across PA to rendezvous with Pittsburgh-area observers at the Gateway Interchange toll booth, where I-76 crosses the border with OH. We had left the Washington area about an hour early to allow time to go farther west, where fewer clouds were predicted. It turned out that we needed every extra second, and then some! We encountered unpredicted heavy fog in the mountains. We stopped at New Stanton, PA, and telephoned the weather forecaster. He said that Morgantown, WV, was reporting fog, Pittsburgh had scattered clouds, Columbus was clear, and Youngstown, OH, was overcast. That wasn't good, since Youngstown was the closest station to our site. I called Francis Graham in East Pittsburgh, telling him that we were going to head for Dover, OH, south of Akron, to improve our chances. He said that they couldn't go there, and would try it at the Gateway Interchange. The sky was mostly clear as we drove to Wheeling, WV. Then I made a mistake; I decided to take a "shortcut," US 250, to Dover, rather than the interstates. The road was much slower than expected. Two thirds of the way there, the road was on the edge of a reservoir for many miles, and heavy fog obscured the sky. When we got out of the fog 30 km short of Dover, alto-stratus clouds covered the sky. With 90 minutes to graze, I phoned the forecaster, who checked the latest satellite photoes to see whether there was any hope. He said that clouds from the north would definitely continue the overcast at Dover, but that it might stay clear in Columbus. We couldn't get that far, but we headed west on secondary roads. After about 15 minutes, we noticed that it was getting lighter in the west, and then saw clear sky low on the horizon. We drove west as fast as the roads would physically allow, at speeds that can't be printed here. The moon finally appeared, but the next available highway south to the graze path was in a fog-shrouded valley. We left the Canton 1:250,000 map and had to stop to quickly plot the path on the Marion map. It showed a small road going into the hills, 12 km to the graze path. We found a dirt road leading south at about the right place. The others thought it was a driveway, but I spotted a county road number. We hurtled up into the hills on the twisting dirt road. After about 9 km, I realized we were going east instead of south; we had made a wrong turn somewhere. Also only 20 minutes to graze; there wasn't time to correct the mistake. The graze path was wide, so maybe we could get something there. We found a meadow with a view of the moon; no time to drive to separate sites. Pat Trueblood and Joan set up separate telescopes, while Jared Zitwer carried a 5-inch scope to another site over 100 meters to the north. I quickly set up our video equipment, but by the time it was working, the star was too close to the full moon to locate. I removed the camera and visually timed four events. They were easy, in spite of the full moon, bright limb, and 12° altitude. It was interesting seeing the lunar mountains that were causing the occultation events; I heartily recommend observing bright-limb grazes of first-mag. stars. They are also important, since only these stars are bright enough to get reliable data under bright-limb combinations of libration and other parameters, which otherwise couldn't be observed. The observers at Gateway Interchange, PA, said it clouded up there an hour before the graze, and remained that way. Our location was near Spring Mountain, OH, about 110 km northeast of Columbus.

July 18: The southern limit of this occultation is shown on my map in *Sky and Telescope 71* (1), p. 72 (1986 January). The path enters CA near Pebble Beach (where the sun's altitude will be -4°, and the moon will be 23° up in the opposite direction), and passes over Atascadero, Ojai (sun -8°), Camarillo, Newbury Park, Palos Verdes Estates, and a few km north and east of San Diego (sun -11°). I plan to observe this bright-limb event; if you will be in CA and are interested also, contact me at P.O. Box 7488, Silver Spring, MD 20907, phone 301,585-0989 before July 11; afterward, the address will be 3342 Bradbury Rd., #40; Los Alamitos, CA 90720, phone 213,430-2391. Palos Verdes will be my first choice, but if coastal fog might be a problem, I will join separately organized expeditions either near or north of Newbury Park, or near San Diego. Observers should remember the occultation of SAO 189278 by the asteroid (679) Pax, that occurs at 10:03 U.T. July 18, just over six hours after the Antares graze. As shown on the map on p. 337 of the last issue, the northern limit for the nominal path, which will be about 75 km wide, passes near Pebble Beach and Monterey. But sites in the San Joaquin Valley would be preferred to escape coastal fog, which is frequent that late at night. The strong twilight to the north favors more southern sites for the Antares graze, but six hours allows enough time to drive to the nominal Pax path from Antares sites probably as far south as Newbury Park. Of course, the actual Pax path could be much farther south. Astrometry is planned to refine the prediction, and the result will be available from the Antares graze expedition leaders. In any case, the Pax event should be monitored from sites throughout the southwestern U.S.A. to check for secondary events or astrometric error, but I hope that some of the observers, already mobilized for Antares, can be persuaded to travel into the predicted Pax path.

The α Sco. path also crosses North Miami and Hialeah, FL. To join the Florida effort, contact Harold Povenmire; 215 Osage Dr.; Indian Harbour Beach, FL 32937; phone 305, 777-1303. There are some real bargain air fares available now; for example, Presidential Airlines flies from Dulles to Miami one-way for only $69. Many amateurs traveled south to see Halley's Comet; here's a chance to travel south for a dynamic, even brighter, event.

September 10: Dr. N. P. Wieth-Knudsen; "Dorthens Huus"; Margot Nyholmsvej 19; Tisvildelunde pr. 3220 Tisvildeleje; Denmark, has computed the northern limit for this event himself, with rather good agreement with the IOTA predictions. He hopes to observe the graze before sunset at Maria Taferl, Austria, at longitude 15° 9' E. Other Europeans who might also want to attempt this should contact Dr. Wieth-Knudsen.

OBSERVATIONS OF APPULSES BY HALLEY'S COMET

David W. Dunham

This is essentially a continuation (and probably conclusion) of the article about occultations by Halley's Comet that started on p. 321 of the last issue. Predictions for 1986 were given in the last issue, starting on p. 302. In the accounts below, the observer reported good conditions and no dimmings or other variations of the star's light during the appulse, unless otherwise stated. No definite occultations by Halley's nucleus have been observed, and there have been only a few reports of dimmings, implying that the dust extinction models, which indicate that dust extinction would be visually apparent only within less than 20 km of the nucleus, seem to be essentially correct. However, there do seem to be large variations, as indicated by the two Vega spacecraft flybys three days apart. The encountered dust densities differed by a factor of five, although the flyby distances from the nucleus were almost identical (in fact, less dust was encountered during the 2nd, slightly closer flyby). It seems that sporadic outbursts can release large amounts of dust that can cause significant extinction of starlight at large distances from the nucleus for short periods of time. This might explain how P. Anderson and Charles Smith, both near Brisbane, Australia, visually observed significant dimmings for projected distances of hundreds of kilometers from the nucleus, with timings in rough agreement with each other, during the November 19th appulse of B.D. +20° 531, but saw no significant dimming during a similarly close appulse one week later; see p. 322 of the last issue. The very large percentage of "no variation" reports indicates that large dust outbursts are rare. Hence, for future cometary appulses, I don't think that travel by a few observers to remote areas will be very productive. If an outburst does occur, phenomena may be visible over a wide area, so that observers are still encouraged to monitor close appulses from their usual home observing sites. A large mobilization would be justified only if an updated path crossed a heavily populated area where observers could be positioned a 5- or 10-km intervals across the path, so that a couple of chords very close to the nucleus could be ensured.

1985 Nov 19, mag.-5.2 Z.C. 486 (Tau 1 Arietis = HR 1005): This very distant appulse (over 2') was monitored spectroscopically by George Herbig at Lick Observatory, CA. In his letter noting the appulses that he observed, Herbig does not state whether cometary absorption lines are apparent.

Nov 22, mag.-8.4 Z.C. 414 (SAO 93114 = HD 17435): This is another rather distant appulse, not included in my published predictions, that Herbig monitored spectroscopically at Lick Observatory.

Dec 9, mag.-8.6 SAO 126409: F. Delahaye, Floirac, Bordeaux, France.

1985 Dec 15, mag.-9.1 SAO 128050: A. Grycan, Toulouse; Haute-Provence Observatory, St. Michel; R. Heidmann and P. Mazelrey, Vernon; S. Maksymowicz, Mezieres sur Seine; and E. Nezry, Pic du Midi Observatory; all in France. The closest approach seemed to occur at $20^h\ 21^m$ U.T., several minutes early.

1986 Apr 24, mag.-6.8 SAO 179904: No reports of any of the other predicted 1986 Halley appulses have been received. This was the only post-perihelion star for which any astrometric update was obtained. On April 5, I distributed a notice to many coordinators and several IOTA members, especially in Australia, giving the results of IHW47, which gave a path shift of 0".54 north from IHW31, but no star update was then available. The last orbital update available before the event was IHW48, including astrometric observations that had been made through April 8, but still not explicitly including the March spacecraft flyby data, which remained in good agreement. Berton Jones obtained and measured a Lick Observatory plate of the star, which indicated an additional 1".06 northward shift, giving an overall shift of 1".69 north from the nominal IHW31 prediction. This was quite disturbing, since this path crossed Papua New Guinea (PNG) just south of Port Moresby, and was entirely north of all Australian territory. This path also passed close to New Caledonia. Jones noted that the root-mean-square (r.m.s.) residuals in declination were larger than usual, about 0".4.

Steven Hutcheon, an IOTA member at Sheldon, near Brisbane, found out that a plate of the star had been taken with the 8-inch astrograph at Black Birch Observatory near Blenheim, New Zealand. This was to support an attempt, proposed by astronomers at the Massachusetts Institute of Technology, to monitor the occultation with the Kuiper Airborne Observatory, which was stationed temporarily in New Zealand to make infrared observations of Halley's Comet and other southern objects. Unfortunately, the proposal was denied, but the plate had still been taken. Dennis Robertson, director of Black Birch, gave me the measurements of the star by telephone, saying that the r.m.s. residuals were about ¼". My prediction using this observation, and the IHW48 orbit, gave an overall shift of 1".22 north from the nominal IHW 31, placing the path north of the Cape York Peninsula and passing near Darnell Island in the Torres Strait. This path also passed near Manila in the Philippines. Since the r.m.s. errors were smaller than those for the Lick plate, and considering Black Birch's southern latitude which placed the star higher in the sky (lessening possible problems with refraction), I adopted this as the final prediction, but felt that it could be in error by nearly 0".5. I telegramed this correction to coordinators in China, Hong Kong, the Philippines, and PNG.

Ken Mottram, assisted by George Moylan, photoelectrically monitored the star with a 14-inch Schmidt-Cass at the Webb Observatory of the Darling Downs Institute of Advanced Education in southeastern Queensland, where the updated prediction indicated a miss of just over 2". They used an infrared filter to record the star's light with an Apple computer from $11^h\ 53^m\ 47^s$ almost to $12^h\ 6^m$ U.T. They sent me a chart and floppy disk of their data, but there are no variations that seem any different from the seeing noise throughout the record. Conditions were much better there than near Brisbane, where Peter Anderson watched the star through variable cloudiness. Any variations that he saw seemed to be caused by the clouds. Halley's nucleus seemed to pass north of the star, as expected; the updated minimum separation was just under 2".

Steven Hutcheon, Joan, and I planned to travel to the updated occultation path, as described on p. 323 of the last issue. We observed the appulse under good conditions at Yorke Island in the Torres Strait, only about 40 km southwest of the updated 1".22 north line. Steven observed visually with a 15-cm reflector kindly loaned by Peter Anderson, Joan observed visually with a 5-inch Schmidt-Cass, and I videorecorded the appulse with our Ultricon camera attached to an 8-inch Schmidt-Cass. Joan and I observed in the yard of the Yorke Island Motel, while Steve set up near the center of the landing strip about a kilometer to the west. The star remained steady, with no dimmings obviously caused by cometary material, for all of us. Visually, the comet nucleus merged with the much brighter star for a few minutes around the time of closest approach, during which time the coma could be seen faintly surrounding the star. After the appulse, I visually timed several occultations of stars by the totally eclipsed moon; see p. 345. During the eclipse, we could easily see about 10° of Halley's tail naked eye. I did not see the comet early in April, but I am skeptical of reports of Halley fading rapidly late in the month. Although this was predicted, we could easily see Halley without optical aid in bright moonlight before the eclipse, and I don't think this would have been possible if the comet had been fainter than third magnitude.

Since the comet was within 15° of the zenith at our latitude of 9°7 south during the appulse, we could not use the camera with the usual telescope configuration. We experimented the night before, and solved the problem by removing the base plate of the equatorial wedge and installing it upside down. The telescope tube was then located far from the tripod center, allowing plenty of room for the camera. A bag of sand and some bricks placed at the bottom of the opposite leg of the tripod made the setup reasonably stable.

When I learned of the Lick update noted above, I telephoned Hutcheon to see what our options were. With some trouble, we could get visas to PNG in Brisbane, and get on a flight from Cairns to Port Moresby. We decided against this, primarily due to the poor weather prospects there, as indicated by the Japanese weather satlellite photoes discussed in the last issue. Visas were not needed to travel to New Caledonia, but this would have been a much more expensive option. We were relieved to get the Black Birch update, since weather prospects were very good in the Torres Strait. Hutcheon made reservations for us on Greigs Aviation, which flies a 10-seater Cessna from Cairns to Yorke Island and back, with flights scheduled both on the 24th and 25th. We obtained permission to stay on 3-km-long Yorke Island; the headman, Joe Mosby, gave valuable assistance. It would have been possible to take a helicopter from Yorke Island to Darnell Is. on the 24th, but we would have had to arrange to get back by boat, since there was no helicopter scheduled on the 25th (which also happened to be a holiday, Anzac Day). Since the prediction uncertainty was much greater than the distance between the islands, we decided that going to Darnell was not worth the extra effort.

Steven Hutcheon met us at the airport in Brisbane on April 20th. We spent the rest of the day sightseeing and shopping, and met several other Australian observers at a party at Peter Anderson's home that evening. We spent the night there, and got up early the next morning to monitor an asteroid appulse. The moon had set, so Peter also gave us a tour of the magnificent southern skies with his 16-inch reflector. Steven arrived shortly before sunrise, and the three of us spent the next two days driving north to Cairns, seeing a lot of Queensland along the way.

During the flight to Yorke Island, we had spectacular views of the Great Barrier Reef. On Yorke Island, we found three other guests at the motel, students who were spending several weeks there studying mosquitoes, of which there are quite a few. They were looking for a certain species, and had not been able to find any. Mosquitoes have blue-sensitive eyes, so the students had much red cellophane which they used with their flashlights to observe the mosquitoes without being seen. We were glad to have a source of red cellophane, which turned out to be very helpful during our observations of occultations during the total eclipse. During the day and early evening, there were many cirrus clouds which caused us concern. Cyclone Manu had formed two days earlier and was churning about 500 miles east of us, and moving southward. Fortunately, the cirrus and some scattered low clouds disappeared completely about 15 minutes before the Halley appulse. It remained clear until about an hour after totality ended, when scattered low clouds returned.

During the flight the next day, clouds thickened as we proceeded south along the east coast of the Cape York Peninsula. Finally, we heard the bad news: Manu, now packing winds of 220 km/hour at the maximum, was headed for Cairns, with gale force winds predicted that evening. So much for our plans to go on a boat tour of the Great Barrier Reef the next day. Our plane was ordered to avoid Cairns, and head for Laura, a safe inland location about 200 km to the northwest. Laura is essentially a large ranch with about a dozen buildings on the main Cape York highway. I said on p. 323 of the last issue that the paved highway extends to Coen, which is wrong; it actually stops a short distance north of Cairns, with about 150 km of dirt road between it and Laura.

Fortunately, Manu slowed down and diminished during the night, so we were able to fly to Cairns the next morning, the 26th. It was raining and very windy at Cairns, not very pleasant for seeing the local attractions, so we changed our schedule and got an early flight to Sydney. This gave us a chance to observe a reappearance of Delta Scorpii (ZC 2290) that evening. We got a hotel at Bronte, near the beach where we would have a good view, since the occultation was to occur at 9° altitude in the east. The hotel let us use a 2nd-floor balcony which had a good view. We successfully videorecorded the event, including the close companion, which reappeared $0^s.12$ before the primary.

Late the next evening, we met David Herald, his wife Ann, and their young son Russell, when their delayed flight from Norfolk Is. arrived in Sydney. Unfortunately, they were clouded out during the Halley appulse, but got a few occultation timings during the eclipse. The next morning, we went downtown to the New South Wales government map office, where I purchased detailed maps of Yorke Island and Bronte. After some sightseeing, we all went to the home of David's sister, who lived in a suburb west of Sydney. Her husband owned a Commodore 64, like David Herald's computer. David had his program diskettes with him, so he used them to convert grid coordinates that I measured for our sites from the maps to longitude and latitude. He demonstrated his software, showing how he is virtually independent of the Astronomical Almanac, especially for occultation and eclipse calculations. He reminded me of his recent request for a subset of Watts' limb correction data on diskettes (see p. 344), which would make him even more independent and save him the currently manual job of looking up limb corrections from Watts' charts and keying them in to his computer.

Although we failed in our main reason for going to Australia, to record dimmings of SAO 179904 by material near Halley's nucleus, we learned much, got some useful lunar occultation timings, and thoroughly enjoyed the trip. We thank everyone who gave us so much help in Australia.

The April 24th occultation was the last predicted occultation in the list published by Lowell Observatory in the I.H.W. Newsletters. I asked Larry Wasserman about this. He double checked their calculations, and confirmed that there were indeed no more close appulses with catalog stars through mid-1987. This is understandable, considering Halley's decreasing angular speed in a sparse part of the sky.

May 29, mag.-11 anonymous star: George Herbig spectroscopically observed an unpredicted close appulse at about $6^h\,15^m$ U.T. with the 120-inch reflector at Lick Observatory. Watching the comet nucleus and star merge on a video monitor, he estimates that the minimum separation was 1" or less. At the time, he gave Halley's 1950 coordinates as R.A. $10^h\,23^m\,56^s$, Dec. -6° 56' 57". Berton Jones is measuring an astrometric plate to determine accurate coordinates of the star, which I will use to compute an accurate postdiction for the event.