Occultation Newsletter

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IOTA NEWS

David W. Dunham

The major bad news is given in the article about Royal Greenwich Observatory's decreased occultation work after next year. There is some good news, in that the magnetic tapes with graze data for 1980 were sent to the graze computors six weeks earlier than in recent years, so that hopefully most observers will receive complete graze predictions for early 1980 before the end of this year.

My work with predictions for asteroid occultations during 1980 is nearly finished; a comprehensive list will be published in *O.N.* in the near future. Other obligations have prevented me from preparing the usual graze and new double star articles in time for publication now; they also will appear in the near future. There are some interesting results, such as the discovery of close duplicity for the 4.8-mag. Hyades star Z.C. 677 at McDonald Observatory last March, and the detection of a possible extended envelope around Aldebaran from observations of September's very favorable graze of the star in California (unfortunately, expeditions for that graze from Colorado to Michigan were all clouded out).

A couple of months ago, I computed an ephemeris for the 205-km asteroid (747) Winchester using orbital elements derived by Paul Herget at Cincinnati. The new ephemeris is in substantial disagreement with the one computed earlier at Leningrad, where relatively old observations and perturbations by only Jupiter and Saturn were used. Comparing my new ephemeris with the SAO catalog, Derek Wallentinsen has found that the asteroid will occult the 8.4-mag. star SAO 117178 (R.A. $8^h\ 47^m\!.3$, Dec. +8° 28', equinox 1950) between $23^h 40^m$ and $23^h 48^m$ U.T. of November 14th in the Arctic. If there is a possible south shift, the occultation might occur in northern Europe, but the AGK3 indicates a ½" north shift. Since Winchester's magnitude will be 11.9, there will be a 3.5-mag. drop in case of an occultation, which is expected to last as long as 19 seconds.

Most of the work for the index to the first volume of *O.N.* has been completed, but I must do a few things to finish the job, and haven't had time to do so. I hope that it will be ready in about three months. In the meantime, more volunteer help is requested for jobs such as preparing finder charts for asteroidal occultations for *O.N.*, and for someone with access to a small computer which can read either IBM cards or magnetic tape, work on preparation of occultation tallies for 1977 and 1978.

The pioneer flyby of Saturn and the discovery of the F-Ring brings back the memory of an occultation of the ringed planet observed near Edmonton, Alberta, under nearly grazing conditions during 1973 October (See *O.N.* *1* (1), 1). One or two seconds before the rings started to reappear, a glow was observed at the point on the moon's limb where they did emerge. The timing is about right for the F-Ring, which, however, is narrow and sharp, not like the diffuse glow reported in 1973. The consensus was that it was the inner part of the D-Ring. A similar glow was reported above the south pole of Jupiter when Harold Brock observed a graze of the planet in 1968 October. Studies of Voyagers' observations of the volcanoes of Io and of meteors in Jupiter's atmosphere might show that there is enough material near the planet to cause the phenomenon reported by Brock. The Saturn results might be checked with earth-based observations when the earth and the sun are on opposite sides of Saturn's rings from 1979 October 27 to 1980 July. Plans to observe the rings edge-on were discussed by Harold Reitsema, Lunar and Planetary

FROM THE PUBLISHER

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

At least for subscribers receiving the original mailing of this issue, coupons for reporting counts of total occultations made in both 1978 and 1979 are enclosed.

O.N.'s price is $1/issue, or $4/year (4 issues) including first class surface mailing, and air mail to Mexico. Air mail is extra outside the U.S.A., Canada, and Mexico: $1.20/year in the Americas as far south as Colombia; $1.60/year elsewhere. Back issues also are priced at $1/issue. Please see the masthead for the correct ordering address.

IOTA membership, subscription included, is $7/year for residents of North America (including Mexico) and $9/year for others, to cover costs of overseas air mail. European (excluding Spain and Portugal) and U. K. observers should join IOTA/ES, sending DM 12.-- to Hans J. Bode, Bartold-Knaust Str. 6, 3000 Hannover 91, German Federal Republic. Spanish, Portuguese, and Latin American occultation observers may have free membership in IOTA/LAS, including *Occultation Newsletter en Español*; contact Sr. Francisco Diego Q., Ixpantenco 26-bis, Real de los Reyes, Coyoacán, Mexico, D.F., Mexico.

Laboratory, Tucson, AZ, at the I.A.U. meeting in Montreal. He will coordinate detailed photoelectric and photographic observations. The ring phenomena are described in *Icarus 34*, 194. The same article lists predictions of mutual occultations and eclipses of Saturn's satellites. Photoelectric monitoring of these events will be valuable for refining the satellite ephemerides, which are currently so poor that most of the mutual phenomena can not be predicted with certainty. The authors point out that a six-hour total eclipse of Hyperion by Titan, centered at about 6^h U.T. of 1979 December 6 might afford a chance to record brightness and color changes caused by Titan's atmosphere. Predictions of mutual phenomena observable locally can be obtained from Fred A. Franklin, Smithsonian Astrophysical Observatory, Cambridge, MA 02138. Photoelectric observations should be sent to Robert Millis, Lowell Observatory, Flagstaff, AZ 86002.

During late August and early September, enough computer time became available at USNO to compute extended-coverage K-catalog predictions for many observers for 1980. These were enclosed with the regular XZ predictions for 1980 which were mailed from USNO early in October.

Graze observers are reminded that HMNAO much prefers reports sent to them to be recorded on their occultation forms. Sending them graze reports on IOTA's, or other, forms will delay reduction of the observations, in some cases, beyond 1980, after which they plan to drop the work, as explained in another article in this issue.

ROYAL GREENWICH OBSERVATORY TO DISCONTINUE MOST OF LUNAR OCCULTATION WORK AT END OF 1980

David W. Dunham

George Wilkins, director of H. M. Nautical Almanac Office, Royal Greenwich Observatory, stated that H.M.N.A.O. planned to terminate most of its work with lunar occultations at the end of 1980. About 1½ people have been performing this work since HMNAO assumed the responsibility in 1943; a larger effort probably would be needed temporarily by another organization to develop (or convert HMNAO's) computer programs and methods to do the job. The stunning announcement was made during a special meeting, attended mainly by workers from organizations which prepare national almanacs, held August 20th during the 17th General Assembly of the International Astronomical Union in Montreal, Quebec. The cutback is necessitated by severe staffing limitations and the need to switch some personnel to projects with higher priority at R.G.O.

Some of the analysis and prediction work which can be accomplished with little effort using operational computer programs will continue to be supported. But the following important tasks, which involve relatively time-consuming manual work and correspondence, will be dropped: Collection and keypunching of all lunar occultation observations; calculation and distribution of residuals to observers; and predictions of grazing occultations, including preparation of graze maps for publication (such as those in the annual handbooks of the B.A.A. and R.A.S.C.). Gordon Taylor's work with planetary occultations is not affected and will continue to be supported at current levels.

In response to this announcement, the following resolution was drafted by members of Commission 4 (Ephemerides) and adopted by the I.A.U.:

Commission 4 Resolution

Recognizing

(a) that timings of occultations of stars by the moon will continue to be of value in studies of the lunar motion and figure, the rotation of the earth, and the stellar reference frame, and

(b) that it is desirable that the observations should continue to be collected and processed by one organization,

Considering

that beginning with January, 1981, H. M. Nautical Almanac Office, R. G. O., will no longer be able to act as the international centre for the receipt and processing of timings of occultations,

Recommends

that an organization with the appropriate experience and commitment to the occultation programme be requested to take over this important work.

During the August 20th meeting, the future of the occultation work was not resolved. Ken Seidelmann, director of U.S.N.O.'s Nautical Almanac Office, said that his office did not have the manpower available for the job. Akira Sinzi said that his department of the Japanese Maritime Safety Agency had recently obtained funding for grazing occultation expeditions, and that this support perhaps could be increased to cover most of the tasks being discontinued by HMNAO. I said that IOTA could continue distribution of detailed graze predictions, and could handle the requests generated by graze maps published in journals outside of North America as well as those published in North America. Production of the published graze maps is another question. HMNAO will produce the maps for 1981 (which must be produced early in 1980), but how, or if, graze maps will be published for 1982 is unknown. IOTA probably can develop computer software to produce computer-generated plots in time for 1982, but these require substantial editing and drafting before they are in a form suitable for publication. IOTA probably could not do the latter work, which instead might be done by those who edit and produce the various publications. O.N. readers who might be able to do some of this work, or who have other ideas about how the job might be accomplished, should contact me at P.O. Box 488, Silver Spring, MD 20907, U.S.A.

The biggest job is the collection of the observations, putting them into machine-readable form, and tracing errors by correspondence. This effort needs to be centralized, but it occurs to me that national or regional coordinators could do some of this work, including correspondence with observers, to lessen the manpower needed at the worldwide center. The regional coordinators would receive observation reports, checking them to make sure that all information is given (corresponding with observers when this is not the case), and making sure that the data are written legibly on the forms for direct keypunching (transcription might be needed in some cases, especially for new observers without detailed forms, who send in reports in response to published predictions). There are already national coordinators doing most of this work in Czechoslovakia, Japan, New Zealand, and the U.S.S.R. The national (or regional) coordinators might also help by receiving computed residuals from the worldwide center, distributing them to the observers, and corresponding about further errors revealed by the residuals. Under present circumstances, I don't think that IOTA could serve as the worldwide center, but individual members could make valuable contributions as regional or national coordinators. Those who might be interested in doing this work should write to me, only to assess the possibilities, for the present.

OCCULTATIONS OF ASTROGRAPHIC CATALOG STARS BY (24) THEMIS

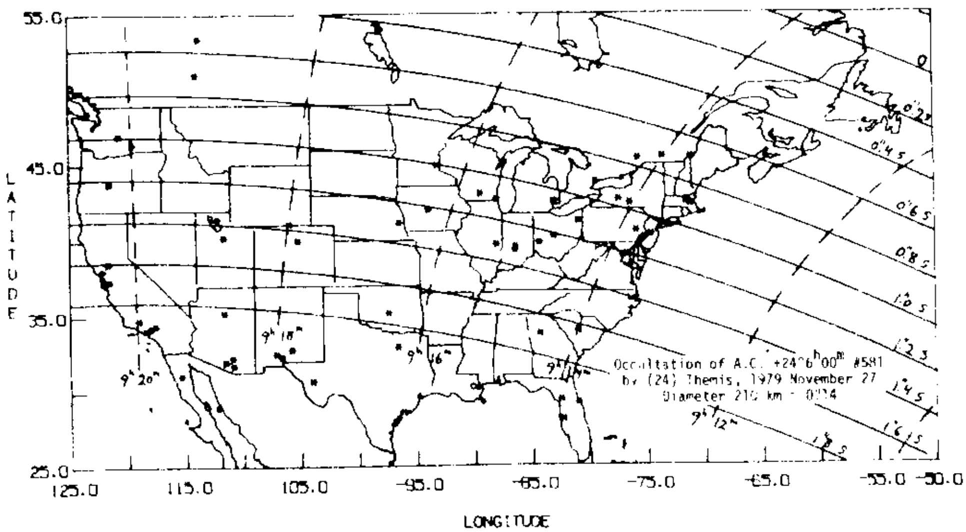
David W. Dunham

In *Tonight's Asteroids* Bulletin No. 50, Dr. J. Gunter shows the path of (24) Themis during its late 1979 opposition on tracking chart no. 505, prepared from Vehrenberg's photographic *Star Atlas* plates. The asteroid crosses a rich Milky Way field near the Gemini-Taurus border, maintaining a nearly constant declination, and passing over the southern part of the dense open cluster M35 in late November. These circumstances seemed especially promising for making a special comparison of Themis' ephemeris against Astrographic Catalog data, as I have done for some other cluster passages, and for (2060) Chiron, in the past. I had been asked to prepare asteroid finder charts for special observing runs at Mt. Lemmon and Palomar Observatories in early November, so little extra effort was involved in doing the computer comparison and extending the finder charts for Themis to the end of the year. Wayne Warren, at the National Space Science Data Center, helped with the computer-selection of the appropriate stellar data from the Paris zone of the Astrographic Catalog.

1979 Date	Universal Time	P L A N E T Name	m_v	Δ,AU	S T A R A.C. No. +24°	m_{pg}	Occultation Δm	Dur	df	F	Possible Area
Nov 26	14^h14^m-24^m	Themis	11.6	2.00	6^h00^m 667	12.0	0.6	24^s	32	14	Siberia?s; Alaska?s
Nov 27	9 13 21	Themis	11.6	2.00	6 00 581	12.5	0.4	23	31	14	Newfoundland; n.Canada; n.USA?s
Dec 2	21 56 60	Themis	11.5	1.96	6 00 187	12.5	0.4	21	27	14	South Africa?n
Dec 20	5 2 19	Themis	11.3	1.90	5 44 162	12.2	0.4	17	22	13	Canary Is.?n;n.S.America;cen.America;Hawaii?n
Dec 27	14 20 30	Themis	11.3	1.90	5 36 180	12.0	0.5	18	23	13	Japan?s; Siberia?s
Dec 29	3 46 62	Themis	11.3	1.90	5 36 146	11.5	0.7	18	23	13	s.w.Europe?n; Canary Is.; n.USA; Hawaii?s

1979 Date	MINOR PLANET No.	Name	km-diam-"	RSOT	MOTION "/Day	P.A.	STAR A.C.	Number	R.A. (1950)	Dec.	Apparent R. A.	(+)Dec.	El Sun	MOON El	%Snl	Up
Nov 26	24	Themis	210 0.14	1142	0.144	273°	+24° 6^h00^m	667	$6^h06^m.6$	+24°14'	$6^h08^m.4$	24°14'	152°	122°	47+	w. 90°E.
Nov 27	24	Themis	210 0.14	1141	0.148	273	+24 6 00	581	6 06.1	+24 15	6 07.9	24 14	153	111	56+	none
Dec 2	24	Themis	210 0.15	1139	0.173	272	+24 6 00	187	6 02.2	+24 17	6 04.0	24 17	159	32	99+	all
Dec 20	24	Themis	210 0.15	1131	0.212	269	+24 5 44	162	5 47.1	+24 19	5 49.0	24 20	179	168	1+	none
Dec 22	24	Themis	210 0.15	1130	0.212	269	+24 5 44	85	5 45.0	+24 19	5 46.8	24 19	177	136	12+	w.135°E.
Dec 27	24	Themis	210 0.15	1128	0.206	268	+24 5 36	180	5 40.3	+24 17	5 42.2	24 18	171	63	65+	w.110°E.
Dec 29	24	Themis	210 0.15	1127	0.203	268	+24 5 36	146	5 38.9	+24 17	5 40.8	24 18	169	41	81+	w. 10°W.

Seven probable occultations were found, listed in the table, which is similar to ones published in earlier issues of o.v. The stars are identified by specifying the 1900 R.A. and Dec. of the A.C. plate center, and the star's A.C. number on the plate. Only this last number is shown for the occulted star in the three finder charts. The two stars occulted in late November are in M35; the expanded plot of the cluster is needed to find them. Except for 5.0-mag. 132 Tauri, which is actually just outside the northern boundary of the late December chart, the brightest stars shown on the charts are 7th magnitude, while the faintest are about 13½ mag. The magnitude scale is the same on each of the plots. Stars in the AGK2 catalog are underlined; most of them are also in the SAO and plotted on *Atlas Eclipticalis*.

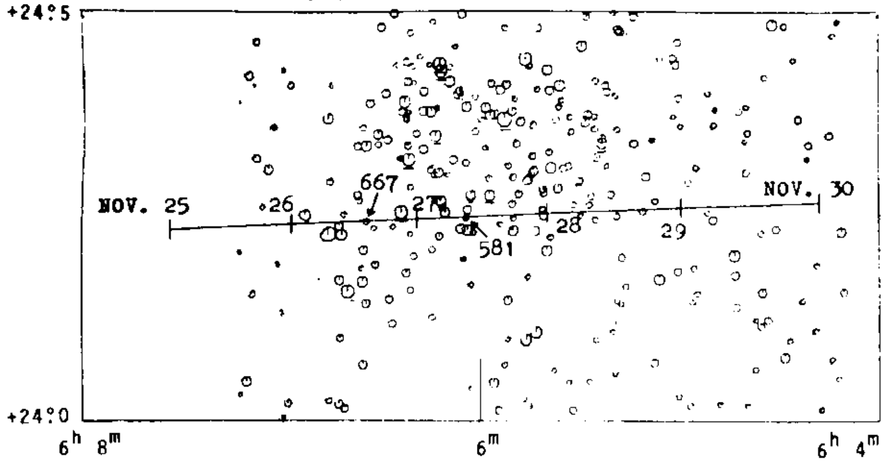


Good conditions and relatively large telescopes will be needed to observe most of these events. The actual occultation Δm's probably will be larger than given in the table, since the V-mag. of Themis was used, while the A.C. magnitudes are photographic. It would be more correct to use Themis' fainter B-mag., which results in Δm's about 0.4 greater than given in the table. Nevertheless, photoelectric observations will be required to obtain reliable data for most of the events. The A.C. photographic magnitudes are not very reliable; it would be useful to obtain V-magnitudes for these stars.

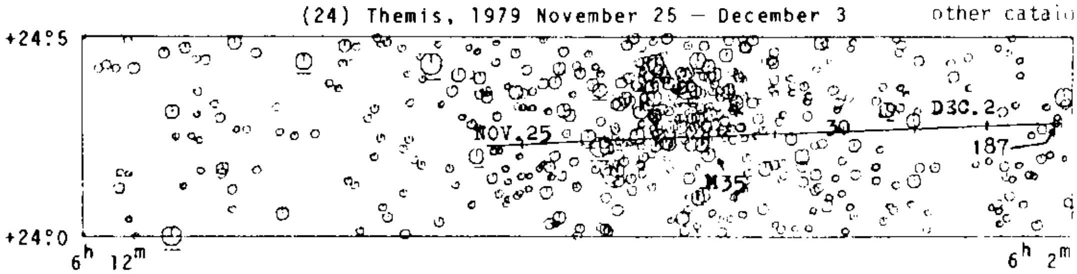
The A.C. plates of this region were taken in 1895. Measurements of modern astrographic plates would be valuable for obtaining current star positions to improve the occultation predictions. Since the stars are faint, they are probably distant, with small proper motions. Most of their positions probably will be accurate to about 1", but errors of 2", and even larger, are possible.

This work shows that computer comparison of AC data with asteroid ephemerides can be quite fruitful in finding many more probable occultations than are being found by the AGK3 - SAO searches. Wayne Warren and I plan to organize the AC data, and correct many known errors, and cross-reference the AC with other catalogs so that searches against asteroid ephemerides can be performed efficiently. But progress on this project is slow, due to the many other pressing obligations on our time.

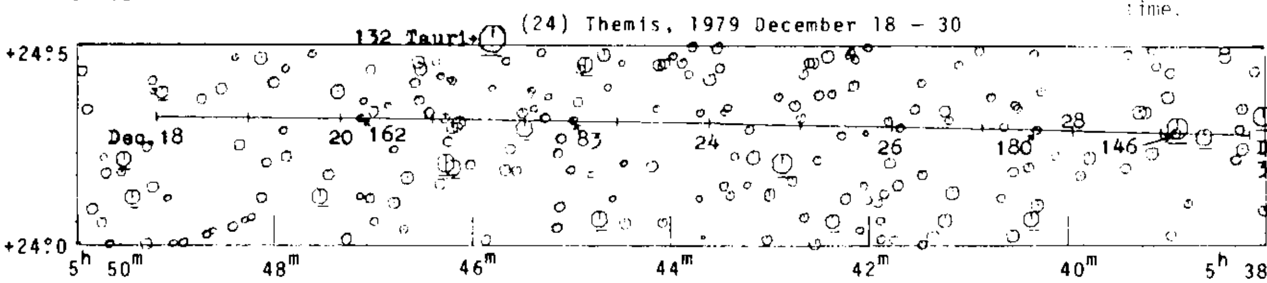
Expanded Plot of (24) Themis' Track Across M35, 1979 Late November



(24) Themis, 1979 November 25 — December 3



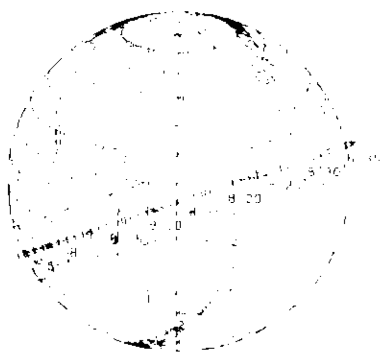
(24) Themis, 1979 December 18 — 30



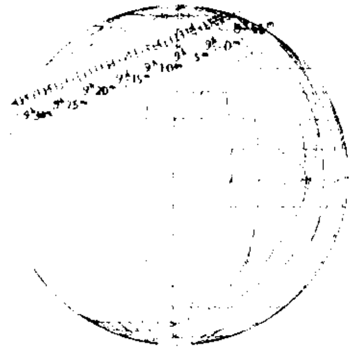
PLANS TO OBSERVE OCCULTATIONS BY (3) JUNO AND (9) METIS IN DECEMBER

David W. Dunham

Exactly one year after last December's successful observations of the occultation of SAO 114159 by (18) Melpomene, during Tuesday morning, 1979 December 11th, there are good opportunities to observe two occultations by asteroids from the Western Hemisphere. Basic information about the occultations is given in *O.N.* 2, (2) 17 (tables) and p. 20 (notes). Sôma's world maps and Espenak's regional maps for these two occultations, similar to the maps described in *O.N.* 2 (2), are presented here. Jorge Polman's finder chart locates the 6.8-mag. star to be occulted by Metis, SAO 80950, within the northern part of the "sickle" of Leo. Richard Nolthenius' finder chart locates the 9.0-mag. star to be occulted by Juno, SAO 115946, near the southern boundary of Canis Minor. The slow motion of both asteroids prolongs the duration of the occultations (expected central durations are 28^s for Metis and 75^s for Juno) and means that each object will be within 1° of the star to be occulted for about ten days. Consequently, a good "last-minute" astrometric prediction should be available one to two weeks in advance.

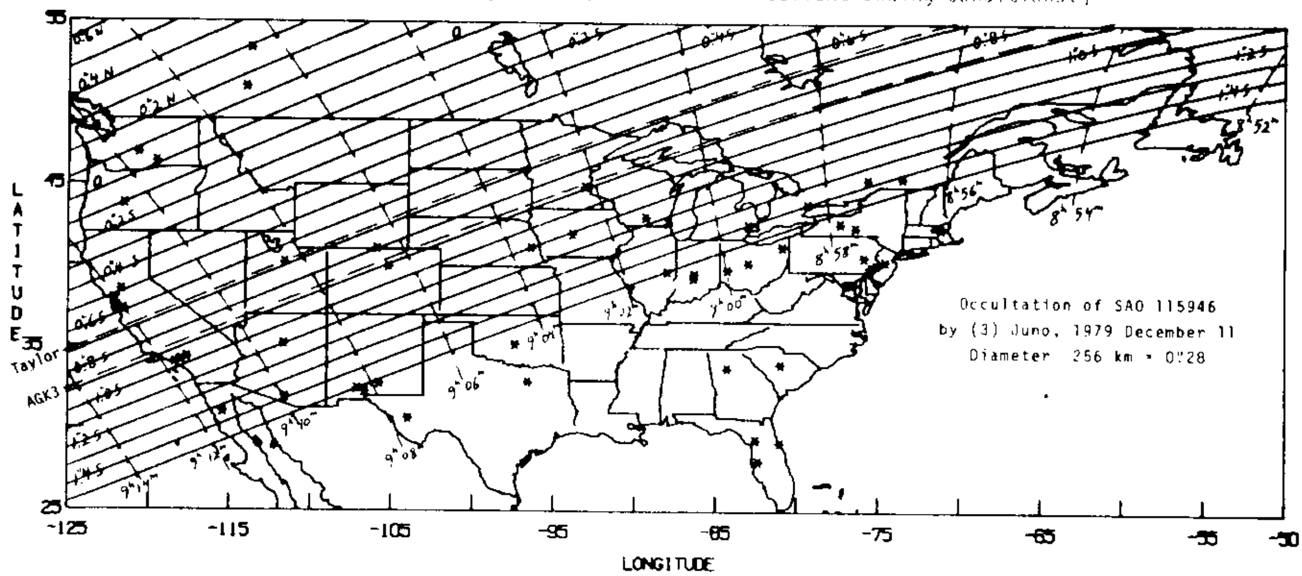


80950 by Metis 1979 Dec 11

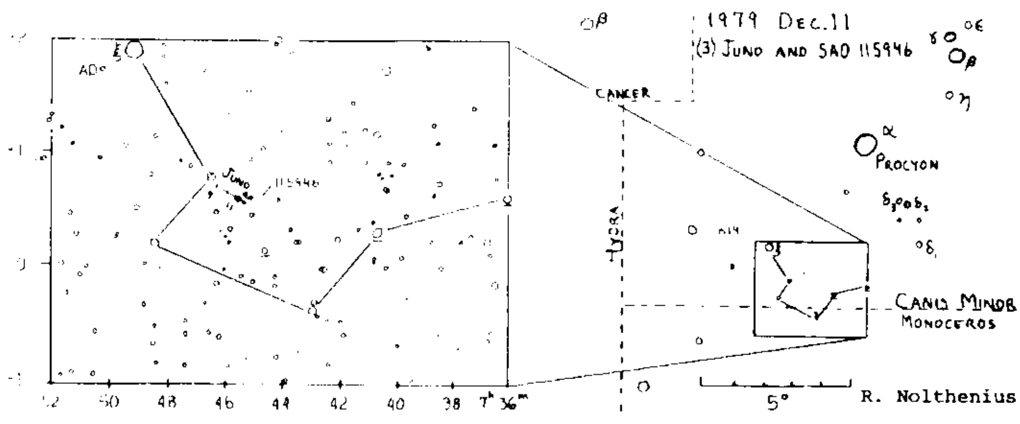


SAO 115946 by Juno 1979 Dec 11

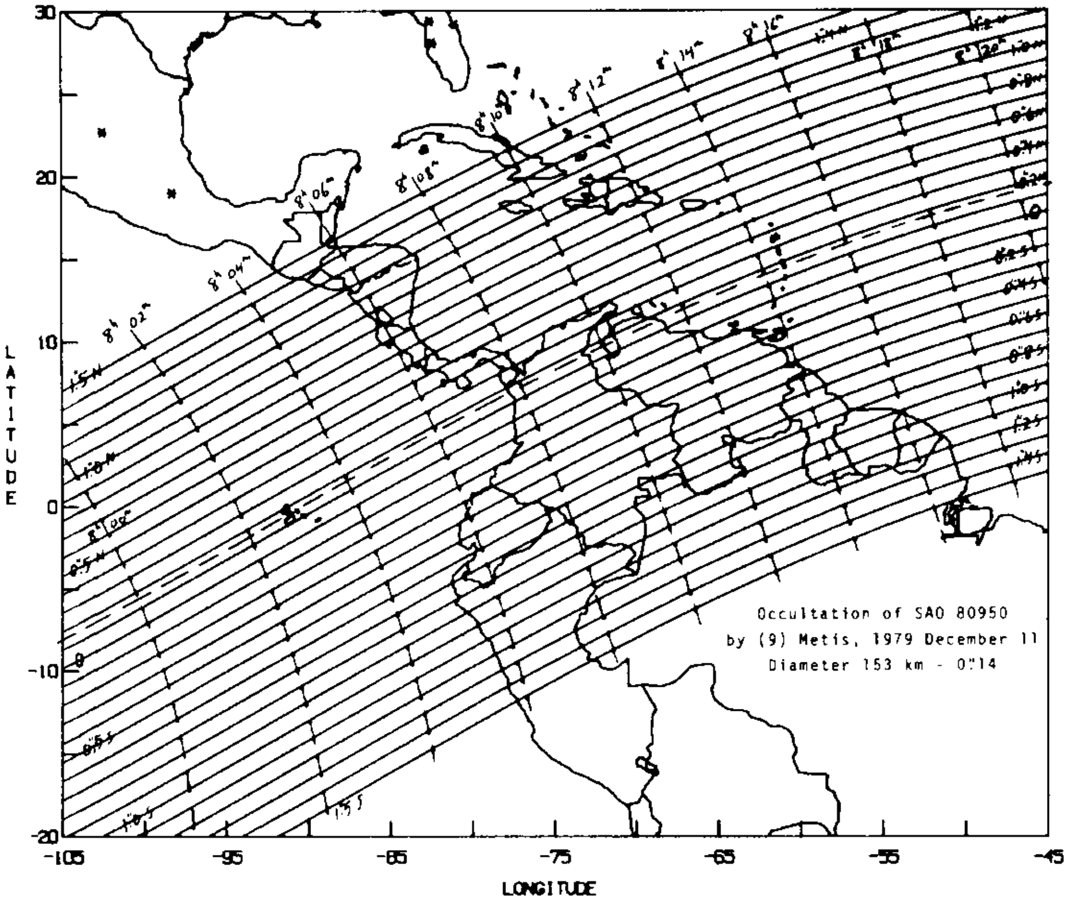
With a predicted magnitude drop of only 0.4, photoelectric equipment will be needed to reliably record the occultation of 9.0-mag. SAO 115946 by brighter Juno. The nominal path computed with the star's SAO data is shown on the maps; it crosses the northwestern U.S.A. and central Canada, areas which often have heavy cloud cover in December. However, if the star's positional data from the AGK3 catalog are correct, there will be a 0".87 southward shift of the path relative to the nominal SAO path, putting the occultation track across southern California, southern Utah, and northern Colorado, where weather prospects are better. For the occultation by Pallas in May last year and for the occultation by Melpomene last December, the AGK3 and SAO declinations of the stars also differed by a large fraction of an arc second. For Pallas, the AGK3 prediction was closest to the truth, while for Melpomene, the SAO data gave a better prediction. Since the uncertainty in the Juno occultation path probably is mainly due to star position error, the prediction probably can be refined soon by measurement of a recent plate and reduction with good reference star data, such as Perth 70. Robert Harrington is undertaking such an effort at USNO. Astrometry a couple of weeks in advance should refine the prediction considerably. Larry Wasserman, Lowell Observatory, Flagstaff, AZ (phone 602,774-3358) plans to coordinate the astrometric prediction improvements and observational plans for the occultation. Photoelectric observers in North America are reminded to also monitor SAO 80950 about an hour before the Juno event in order to record any short occultations of the bright star by possible distant satellites of Metis. [Note added October 19th: Gordon Taylor has issued a revised prediction for the occultation by Juno in Bulletin 19 of the I.A.U. Working Group on Predictions of Occultations by Satellites and Minor Planets. A plate of Juno taken at Herstmonceux on September 17th indicated a correction to the asteroid's path of only about 0".1. The new prediction also includes a correction to the star's position based on another HMNAO plate, and should be accurate to less than ± 0".5. The new central occultation path is shown by the dashed line at 0".68 S on the detailed map; the correction to the time is only + 0.3 minute. Recent photoelectric light curves of Juno by Al Harris show that the Δm for an occultation event on December 11 will be 0.54 magnitude, making visual observation very difficult, but perhaps not impossible for experienced observers with excellent seeing conditions.]



An expedition is being organized by Paul Maley and me to observe the occultation by Metis from Venezuela. The source for the star's position (Perth 70) and Metis' ephemeris are the best available, virtually guaranteeing only a small shift from the nominal predictions. Consequently, chances are very high that the path will pass somewhere over western Venezuela. Infrared weather satellite photos taken at about the time of the occultation on Dec. 10, 11, and 12 of the past three years indicate at least a 70% chance of clear skies in the area. The probability of clouds increases to the west in Colombia where, nevertheless, local observers are encouraged to attempt observations. With an occultation Δm of 3.2 and with the star more than



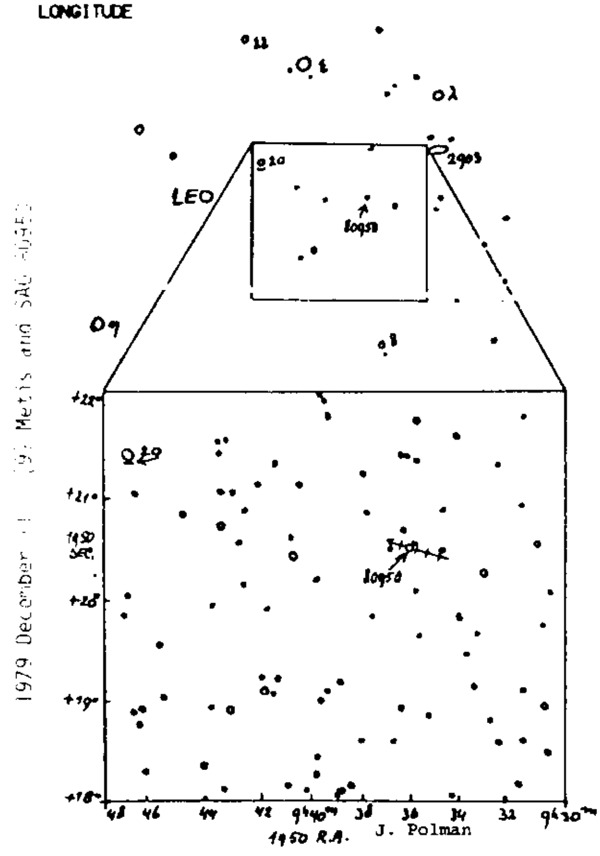
70° above the horizon everywhere in the eastern Caribbean at the time of the event, visual observation should be easy. The favorable conditions also mean that the diffraction pattern can be recorded with high-speed photoelectric equipment to obtain the star's angular diameter. The diffraction pattern has not been resolved during any previous asteroidal occultation (diffraction fringes for a central Metis occultation will be about 0.05 apart in time).



We plan to attempt observation from pairs of stations bracketing the predicted occultation zone, with the observers in a pair about a mile apart to obtain independent confirmation of any secondary occultation events. We are working with Venezuelan astronomers to help with the logistics and to combine forces to provide the best observational coverage.

By Saturday, December 8th, when observers plan to assemble in Venezuela, an accurate "last-minute" astrometric prediction should be available. A fairly good preliminary prediction proobably will be available about two weeks in advance, giving enough time to cancel the effort, or perhaps to switch to Colombia (observing south of Bogota) or to the Puerto Rico area, in case of an unlikely large south or north shift, respectively. Anyone who is interested in joining this expedition should contact Paul Maley, 15807 Brookvilla, Houston, TX 77059, telephone 713,488-6871.

The location of the nominal Metis path on the enclosed maps is slightly in error due to a minor computer program error in the calculation of the star's position for the occultation predictions. The corrected path is 0".16 north of the plotted nominal "0" path, with the occultation occurring 2.7 minutes later than indicated on the map. The correction is smaller than the current prediction uncertainty, but just in case the last-minute astrometry indicates a further shift to the north, we are looking into the possibility of diverting some of our observers to the Leeward Islands to provide some coverage north of Venezuela, if that might be needed to ensure catching the occultation.



PLANETARY ASTRONOMY MAGAZINE

IOTA member Wayne Coskrey, who will be Associate Editor of *Planetary Astronomy*, has sent us a pre-publication announcement. According to Coskrey, "three of our four editors are quite avid occultation observers," and "we plan to be covering occultations quite a bit."

January, 1980, will see distribution of the first issue of this magazine, which will be devoted to the study of the solar system, and will be aimed at both amateurs and professionals with a serious interest in the planetary sciences. Articles dealing with such topics as binary asteroids, planetary rings, and possible solar companions, and regular columns covering comets, meteors, asteroids, etc., will be complemented with superb full-color photographs by amateurs, professionals, and space probes. Bi-monthly publication is planned, with yearly subscription rate $5.00 in USA and possessions; subscribe before January and receive a seventh issue free. Address: *Planetary Astronomy*; James-Mims Observatory; 2144 Monaco Drive; Baton Rouge, LA 70815.

A TAPE RECORDER MONITORING CIRCUIT FOR OCCULTATIONS

Wayne H. Warren, Jr., and James L. Shannon

After having several bad experiences of finding blank tapes following occultation observations because a recorder switch inadvertently had been tripped off or batteries had run too low during an observation period, we decided to design and build a circuit to monitor recording. The ideal method of doing this is, of course, to tie the monitor directly into the recording head so that the end of the tape can be detected; however, we preferred to construct a circuit which would require no tape recorder internal modifications, since different recorders use various recording techniques and circuitry. The monitor to be described is therefore a general design which can be connected to any recorder through its earphone jack, thereby allowing quick disconnect and no recorder modifications.

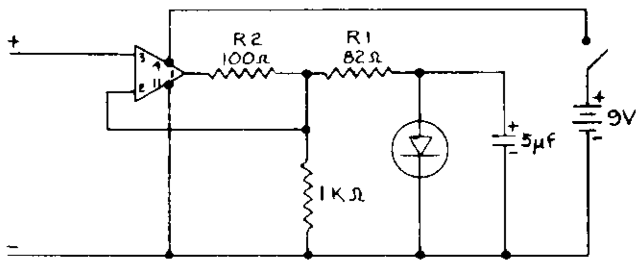
The circuit is designed around a quad operational amplifier LM324 (Signetics or equivalent) having an operating temperature range of 0 to +70°C (for extended ranges use LM224 (-25 to +85°C) or LM124 (-55 to +125°C)), a wide power supply range (3-20VDC), and a very low quiescent current drain (800 μA). The maximum input current is 50 mA and the lead temperature (soldering, 10 seconds) is 300°C. The LED is rated at 60 mA peak forward current with a forward voltage of 2.2, a capacitance of 20 pF, and a peak wavelength of 6350 Å. Its maximum lead soldering temperature at 1.6 mm is 230° for 7 seconds.

When the LED is on, the output of the recorder is amplified by a factor of $A_V = 1 + \frac{R_1}{R_2}$, an increase of about a factor of 2 over the off gain. Since the earphone output may differ among recorders, it is probably safest to build the circuit and substitute an ammeter for the LED to measure forward current (or measure the recorder output directly before specific values of resistors R_1 and R_2 are wired in).

To hold the 9-V transistor radio battery away from other circuit components, we merely cut two pieces of popsicle stick to the length of the box width and inserted them through slots in the vector board to hold the battery at the bottom of the minibox. Our LED is epoxy-mounted in a small bakelite bushing normally used as a chassis wire guide. A nice feature of this design is that the LED lights when the toggle is thrown with the recorder disconnected. When the circuit is connected (make up a BNC to earphone jack adapter cable for this connection) the LED should go out if the monitor is tied in properly. During recording, the LED radiates with an intensity proportional to the input sound level.

Parts List:

1. Minibox 3×3×1¼ and vector board
2. 9-V transistor battery and clip
3. LED HP 5082-4684 hi-efficiency red
4. Resistors 82Ω, 100Ω, 1K
5. Electrolytic capacitor, 5 μF (Ta)
6. Operational amplifier LM324 and 14-pin socket
7. Toggle switch
8. BNC box connector and grounding lug



SAN JOSE'S RAIN PARTY

Penny Pinschmidt

[Reproduced by permission, from the San Jose Astronomical Association bulletin. Another expedition successfully observed the graze (1977 November 5, Z.C. 1465) near Lone Pine, CA.]

Jim Van Nuland, Dave Ambrose, Ed Schell and I were the first to meet at the secondary site on the corner by the "COW" sign at about 4:00 P.M. Jim used John Rhodes' measuring bike to plot stations. The rest of us gabbed away, watching the sun go down in and around the clouds, and wondered in traditional astronomical fashion the big question, "Will it rain?" The only catastrophe so far was that Ed's trusty C.B. died. He spent only about three hours, most of which were after dark, trying to fix the thing. Never did get it to work.

At 9:00 Jim phoned the general meeting. The message: come at your own risk. A 50-50 chance of rain and/or clouds. Excitement over, we congregated at the schoolhouse for a nap. Dave and his sleeping bag found the play yard tanbark almost as comfortable as a good bed!

At midnight nearly all of the 23 people who came crowded into John's motor home. Jim assigned stations, 16 of them, including the one with the skunk smell. When the class was dismissed and the arguments over, the sky was clear and the stars were shining!

Run for your cars! Go to your stations! A graze is coming!

1:30 a.m. -- 16 telescopes out and ready, WWV blaring away. One rain drop, another, and another. 2:00 a.m. -- 16 dripping telescopes still out and ready. 46 still-hopeful eyes watching it pour. 2:15 - 2:30 -- and one by one, telescopes are taken in out of the drenching rain. 3:00 a.m. -- inside John's motor home an electric video game is well under way. People are laughing, joking, and wet as drowned rats

Some went home. Others stayed at their stations, watched the lightning, the rain, the hail, and a very cold, wet telescope, plus worrying about getting stuck.

According to Sam Stoughton, the evening was a total success. Enthusiasm was high, humor was plentiful, and willingness and stick-to-it-iveness were ever present. How can so many people go out in the middle of nowhere, set up telescopes under dark, threatening skies and still stay with it? Even when lightning strikes and rain pours! Crazy? Maybe just a little bit.

The next morning at the school house it was nice, warm, and sunny.

A GRAZE OBSERVED DURING RAIN

Roger Giller

On 1978 October 7, I led an expedition to Wyong, Australia, to observe a graze of mag. 6.1 ZC 2460. This should have been our best effort to date, but the weather let us down. I had a profile from Dave Herald, and eleven sites spaced across it, and hoped to get from 40 to 60 timings. As it turned out, we were lucky to get what we did.

Living near the coast of New South Wales, with the major highways running north and south from Sydney, we consequently have most of our graze expeditions within a few miles of the coast. One of our more common weather patterns is an onshore wind which brings what the weather bureau calls coastal showers. These usually take the form of heavy rain squalls with clear patches in between, and have a cycle time of about 10 to 30 minutes. On the evening of the graze, it was raining heavily while we were waiting for the last of the team to arrive at the meeting place, but by the time I had the convoy formed up, the moon had broken through and was in a clear patch. By the time I arrived at my site after dropping the other observers off, the sky had clouded over again, and it looked as though more rain were approaching from the southeast (the moon was almost due west, at 28° altitude). About seven minutes before central graze time, it started to rain lightly, but the moon was faintly visible as a diffuse white patch through the cloud, so I threw a raincoat over the tape recorder and kept on looking, in hope. Then, with rain still falling, the sky suddenly cleared around the moon, and six seconds later I timed the first disappearance! Such are the rewards of perseverance.

Greg Hayward and Les Dalrymple were the only others who were in this clear patch, but Les' tape recorder drowned and stopped about ten seconds before the first event. Although he had no timings, I reported his position and number of events in case they might be of some use. The other eight observers were rained or clouded out.

This was the first time I had used my new homemade 20-cm, f/5 Newtonian. I built it with a long top end to keep out stray light, but it also works to keep out rain. Incidentally, the rain stopped while I was taking the telescope apart to put it back in the car

[Ed: Here is further justification for habitually wearing your tape recorder suspended from your neck by a rope or strap, inside your jacket (or raincoat) if one is worn.]

ERRONEOUS STAR POSITIONS FROM OCCULTATIONS, by David Herald

Z.C.	S.A.O.	Date	PH	Acc	O-C	Observer	Comments
	92752	77 Jul 9	R	3	+6	Morgan	SAO proper motions bad from poor early epoch position. 1" error in both RA and Dec by 1977.
0464	93327	78 Oct 18	R	2	-4	Van Nuland	Early R. AGK3 & SAO/GC in substantial agreement.
	93430	78 Jul 28	R	4	+5	Sandy	AGK3 and SAO/Yale agree.
0711	94080	78 Feb 16	D	3	-5	Sandy	SAO/Yale position better than ZC.
	94138	78 Aug 26	R	2	+4	Timerson	SAO/Yale & AGK3 positions agree.
	95084	78 Mar 17	D	4	-6	Stockbauer	AGK3 position slightly better than SAO. Star is double, 8.3, 10.8, 10"5, 60°.
	95113	78 Mar 17	D	2	-4	Asmus	SAO RA 1"1 greater than AGK3. AGK3 position satisfies the observations
				2	-3	Stockbauer	
	95158	78 Mar 17	D	5	+13	Asmus	Declination position and proper motion in disagreement with AGK3. Difference at 1978 od 1"0 in Dec. AGK3 satisfies the observation.
0970	95572	78 Feb 18	D	2	-3	Sandy	ZC, SAO/GC, & AGK3 all in substantial agreement.
	95601	78 Feb 18	D	2	+3	Sandy	AGK3 slightly better than SAO/Yale.
0975m	95602	78 Feb 18	D	3	-6	Sandy	Mean position of double star used, 7.2, 8.2, 2"3, 20°. SAO/GC and AGK3 agree. ZC differs by 1"4 in Dec. at 1979.
					-4		
	95740	78 Aug 28	G			Povenmire	Complete miss seen. AGK3 differs from SAO by "8 in PA 107°. PA of graze 354°, observed 1.1 km inside limit.
	95775	78 Apr 14	D	2	+4	Hays	SAO/Yale proper motion in RA erroneous. AGK3 good.
	96138	78 Mar 18	D	2	+3	Sandy	AGK3 position greater in RA.
	96547	78 Feb 19	D	3	-11	Hays	See *O.N.*, *1*, 166. Double star; position is for following star.
					-3		
	97334	75 Oct 27	R	2	+22	Morgan	The 'Tardy Star' of *O.N.*, *1*, 64 and 129.

Z.C.	S.A.O.	Date	PH	Acc	O-C	Observer	Comments
	98614	78 May 15	D	5	+7	Stockbauer	AGK3 position better than SAO/GC. Star has large proper motion in RA. Comparison of the AGK3 position and the GC position at epoch indicates that AGK3 proper motion may be in error.
0109	109507	78 Jul 25	R	3	+4	Sandy	ZC agrees with AGK3.
	117618	75 Jun 14	D	2	-11	Morgan	SAO RA and Dec both differ from AGK3 by 1", but AGK3 position gives worse residual. SAO residual is about 5".
	118241	77 Oct 9	R	3	-6	Morgan	Triple star IDS 10153N0656. GC position for brightest component in error by 1½" in RA.
	118680	78 May 17	D	3	-5	Hays	AGK3 implies considerable error in SAO/Yale proper motion in RA.
				3	-5	DaBoll	
	118972	78 Jun 14	D	5	-8	Hays	AGK3 implies considerable error in SAO/Yale p. m. in RA.
	138659	78 Aug 8	D	4	+8	Giller	SAO/Yale position poor in proper motion. AGK3 good.
				4	+5	Herald	
	138662	78 Jul 12	D	6	+8	Stockbauer	SAO declination bad. Differs from AGK3 by 2½" at 1980.
	146043	77 Sep 25	D	6	-20	Radick	AGK3 and SAO in excellent agreement. Photoelectric observation. Timing error???
3520	146973	77 Sep 26	D	2	-4	Suhonen	ZC and GC positions too great in RA, cf AGK3.
	158482	78 Jun 17	D	3	+7	Van Nuland	No comparison catalogue.
	158835	78 Aug 11	D	5	-8	Giller	SAO/GC proper motion in R.A. too small. Yale and SAO positions good.
	159629	77 Aug 22	D	3	+60?	Morgan	Poor observation due to tree branches, causing intermittent viewing. No comparison catalogues.
	160056	78 Aug 13	D	3	+5	Herald	No comparison catalogue.
	160502	78 Sep 10	D	6	-9	Herald	No comparison catalogue.
	160504	76 Jul 9	D	3	+7	Herald	Reported *O.N.*, *1*, 88. No comparison catalogues. In region covered by SAC project. By comparing the astrographic position at epoch 1917 with the SAO GC source position at epoch 1900, the 1976 position is 4".1 greater than that obtained from SAO alone, giving rise to a satisfactory residual.
	160505	78 Sep 10	D	3	-4	Herald	Comparison with P70 shows SAO/GC RA proper motion to be in error.
	160506	77 Apr 8	R	3	+6	Ashley	No comparison catalogues, but in SAC region. AC/Yale source positions derive a 1977 position 1".1 north of SAO, which makes the residual worse. Cause possibly a bad Yale position which is used in SAO.
	160517	78 Sep 10	D	4	-9	Herald	No comparison catalogue.
	160770	78 Aug 14	D	3	+5	Herald	No comparison catalogue, apart from the Astrographic catalogue, which agrees with the SAO/Yale position.
2596	161004	78 Sep 11	G			Povenmire	Complete miss as seen 2.2 km inside S limit. Yale Dec 1".0 north of both ZC and SAO/GC, which makes for a greater miss.
	161143	77 Aug 24	D	5	-11	Ashley	No comparison cat., but in SAC region. Derived 1977 position 1".6 south of SAO position, which provides for a good residual.
	161217	78 Apr 27	R	3	+5	Hays	No comparison catalogue.
2680	161540	78 Aug 15	D	2	+4	Sandy	Poor ZC position; error of 1".2 in RA and ".6 in Dec at 1979, compared to P70.
	161562	78 Aug 15	D	4	-7	Van Nuland	No comparison catalogue, but possibility of stopwatch error. Reports of other timings desired.
	161570	78 Aug 15	D	4	-9	Van Nuland	
	161850	78 Mar 4	R	3	+5	Hays	SAO/GC proper motion in RA in error. The Yale position is good.
		78 Oct 9	D	3	+5	Sandy	
	162338	77 Aug 25	D	3	+4	Ashley	No comparison catalogues.
	162351	78 Apr 28	R	3	+5	Hays	No comparison catalogue.
	162380	77 Aug 25	D	4	-6	Ashley	No comparison catalogues.
	162468	77 Aug 25	D	3	+4	Ashley	No comparison catalogues.
	163372	77 Sep 24	D	4	-7	Ashley	No comparison catalogues.
	164646	78 Nov 8	D	3	+4	Herald	No comparison catalogue.
	164660	78 Nov 8	D	3	-10	Herald	No comparison catalogue.

STARS WITH QUESTIONABLE VISUAL MAGNITUDES

David Herald

SAO 95740: SAO lists 8.3, with spectral type K0. Povenmire, observing at a graze on 78 Aug 28, estimated from the difficulty in seeing the star, a magnitude of 9.0. The star is not listed in the HD (the Henry Draper catalogue of stellar magnitudes and spectral types, published in the Annals to Harvard Observatory). The AGK3 lists an independent *photographic* magnitude of 9.3, and spectral type K0. Correcting this to a visual magnitude, one obtains 8.5, indicating that the SAO magnitude is correct.

SAO 159704 = ZC 2308: ZC gives 7.6; SAO/Yale gives

8.7. Because of this difference, the star is flagged as a variable in the USNO predictions. At a graze, Stockbauer estimated 7.6. He checked with AAVSO, and they had no record of variability. The HD lists 7.58 for this star. Interestingly, the Perth 70 catalogue, which takes its magnitudes from the yet-to-be-published Southern Reference Star (SRS) catalogue, gives 8.7. The astrographic catalogue, in a list of reference stars, also gives 8.7, but a derivation of the magnitude from the image size listed gives 7.1. It would appear that the 7.6 magnitude is the correct figure. The figure of 8.7, as used in various catalogues, can be traced back to the Washington Zone catalogues, where presumably the error was made, and has been carried through to various other catalogues. All sources using independent magnitudes give the 7½ figure.

This second star illustrates one of the problems of listed star magnitudes. In general, the positional catalogues of this century do not make an independent estimate of star magnitudes. Rather, they repeat the magnitudes recorded in the early catalogues which are utilised for determining proper motions. This may mean that several 'different' catalogues, by using the same early epoch catalogue, will list exactly the same magnitude. In the case of the ZC and GC catalogues, the magnitudes were derived from a large number of different catalogues, and thus should be reliable. In the case of other SAO stars, and in particular the Yale catalogue stars, the magnitudes come from only one source, and are thus more prone to error.

I am interested in receiving further reports on magnitudes that do not seem correct. However, it should be emphasised that many factors influence the visibility of a star at an occultation, and some of these factors, notably atmospheric conditions, can change quite rapidly. Therefore, the best reports will be direct comparisons with other stars at about the time of occultation, or even days afterwards (when the moon can't interfere). There is no doubt that errors in the listed star magnitudes do exist, and it is most desirable to locate those in substantial error (more than ½ mag.) since the observability will be considerably affected. Additionally, one may even locate hitherto unknown variable stars, although this would require a considerable number of observations to confirm, and is a less likely alternative. Send reports to me at P.O. Box 254, Woden, A.C.T. 2606, Australia.

MORE ON TIMING SOLAR ECLIPSE CONTACTS

William J. Westbrooke

Earlier, I described Minnaert's method of timing solar eclipse contacts (see *O.N.*, *1* (6), 53). To recapitulate, the method involves making timed measurements of the distance between the cusps of the notch in the solar limb. That distance is a chord of the solar disk. In its original form, the method requires first that timed chord length measurements be made about every thirty seconds for about fifteen minutes after (or before) contact. Next, the measurements are all divided by the maximum chord length (which is attained around mid-eclipse), and the quotients are all squared and plotted against the time of observation. Such a graph will form a straight line, which can be extrapolated to find the time of zero chord length — the time of contact.

My observations of the eclipse of October 12, 1977 involved an extension of that method: the chord measurements were made every two or three minutes throughout the eclipse, which lasted for 2½ hours at my location, the on-campus observatory of San Francisco State University. A 10-cm refractor at 56× was used, projecting a solar image of 116-mm diameter onto a metal screen fastened to the telescope by only one edge. That one-sided support seemed rather inadequate, since the screen vibrated exasperatingly every time my millimeter ruler was laid on it to make measurements. However, serious efforts were made to allow the vibrations to diminish to nothing before actually reading and recording each measurement. The weather was excellent, and WWV was being received in the observatory.

When made with chord measurements obtained during an entire eclipse, a graph of squared chord length ratio versus time of observation forms a dome-like curve instead of a straight line. This is due to a marked change in apparent lunar velocity during an eclipse. The curve is a fourth-degree polynomial in time, and looks like a parabola. In the extension of Minnaert's method, polynomial regression and a computer are used to fit a fourth-degree curve to the observations. The contact times are obtained by solving for the roots of the polynomial when set equal to zero; two of the four roots are the observed contact times. Also, solving for the roots of the first derivative of that polynomial gives the time of maximum eclipse. The solving of polynomials also has to be done on a computer.

It should be mentioned that it was found most convenient to convert all times to hours and decimals, make all the times as small as convenient by subtracting 18^h from all of them (the computer could not handle the problem with the times in their original form, as 18 point something to the fourth power gives rather large residuals), performing the analyses, and then adding 18^h onto the roots.

For my location, and with ΔT equal to $48^s.2$, the times are:

	Predicted	Observed
First contact	$18^h49^m51^s.7$	$18^h48^m54^s.7$
Mid-eclipse (maximum eclipse)	20 01 54.7	20 01 41.8
Last contact	21 14 45.2	21 15 06.4

I wrote my own eclipse prediction program.

It can be seen at once that the times for first contact disagree by some 57 seconds, and some 21 seconds in the case of last contact. These residuals are rather large, and their causes are unknown. Dr. Thomas Van Flandern of the USNO suggests that the problem is caused by irradiation, but the solar image did not seem bright enough to have that effect. My own inclination is to blame the unsteady projection screen; despite all of my care, vibration of the screen may have caused a systematic error, a continuing cause of mismeasurement. Some support for that idea comes from the eclipse of July 10, 1972, which I also observed with the Minnaert method. But the projection screen used then was fastened to the telescope by two opposite edges. That screen did not vibrate, and the results were in good agreement with predictions.