Occultation Newsletter

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FROM THE PUBLISHER

For subscription purposes, this is the second issue of 1991. It is the third issue of Volume 5. Annual IOTA membership dues may be paid by check drawn on an American bank, money order, cash, or by charge to Visa or MasterCard. If you use Visa or MasterCard, include your account number, the expiration date, and your signature.

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Back issues of ON	
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ON 4 (2) through ON 4 (16), each	5.00

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Although they are available to IOTA members without charge, nonmembers must pay for these items:

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

Asteroidal occultation supplements will be available at extra cost: for South America through Ignacio Ferrin (Apartado 700; Merida 5101-A; Venezuela), for Europe through Roland Boninsegna (Rue de Mariembourg, 33; B-6381 DOURBES; Belgium) or IOTA/ES (see below), 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), and 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 (117891 N. Joi Drive; Tucson, AZ 85737; U.S.A.) for 2.50

Observers from Europe and the British isles should join IOTA/ES, sending DM 40.-- to the account IOTA/ES; Bartold-Knaust Strasse 8; 3000 Hannover 91; Postgiro Hannover 555 829 - 303; bank-code-number (Bankleitzahl) 250 100 30.

IOTA NEWS

David W. Dunham

The highlight of this issue is the information, given in a separate article, about the passage of the waning crescent Moon across the compact M35 star cluster visible from most of North America on the morning of September 3, 1991.

IOTA Meetings. As announced on p. 61 of the last issue, a special IOTA meeting was held on July 9th in conjunction with The Eclipse Edge expedition, at the Buganvilias Sheraton Resort in Puerto Vallarta, Mexico. We had lectures in the morning and a session on video observations in the afternoon.

Also as announced last time, the 9th annual meeting of IOTA was held on Saturday, July 13th, at the Lunar and Planetary Institute; a report of the meeting is given on the next page.

The tenth European Symposium on Occultation Projects (ESOP-X), sponsored by IOTA/ES, was held in Hannover, Germany, on Aug. 16 - 19, as this issue goes to press. A list of the titles of papers given at that meeting, and a discussion of highlights of the meeting, will appear in the next issue. The next meeting, ESOP-XI, will be held in Castel Gondolpho, Rome, Italy during August 1992.

Derald Nye, from Tucson, AZ, gave a paper on IOTA at the Astronomical League's convention in Springfield, MA, on August 9. He discussed results of the three asteroidal occultations observed in January, showing a videotape of each of them, and also described IOTA's efforts for the July 11th total lunar eclipse, among other things.

IOTA/ES Distribution. When ON is prepared and taken to the printer in the USA, a good-quality copy is made and sent to Hannover by express mail. The copies for IOTA/ES members are then printed quickly in Germany and mailed from Hannover at about the same time that it is put into the mail in the USA for IOTA members. This means that IOTA/ES members will not have the delay of waiting for their copies to be produced in the USA and mailed to Germany for much later distribution. Henceforth, Europeans should find little, if any, advantage in joining the USA-based IOTA, and are encouraged to join IOTA/ES instead.

Next issue. My work on the 1992 total lunar occultation predictions, and efforts related to documentation and migration of the occultation software at the U. S. Naval Observatory, not to mention the interruption caused by my attendance at the asteroid meetings and efforts for the July 11th eclipse, have left little time to prepare articles for this issue. So most of my contributions intended for the last issue, such as descriptions of the new 80L version of the XZ star catalog and planetary occultation table formats (not covered last time), plus notes about special events, will again have to wait until the next issue, which is planned for October or early November. The North American Asteroidal Occultation Supplement and hemispheric grazing occultation supplements for 1992, and probably also David Herald's table of zodiacal variable stars, will be distributed with that issue. Try to have your contributions for it to us by Oct. 15.

IOTA ANNUAL MEETING

Joan Bixby Dunham

The 9th annual meeting of IOTA was held on Saturday, July 13th, at the Lunar and Planetary Institute in Houston, Texas.

The meeting began with a discussion of the upcoming eclipses and their observing potential for the solar diameter experiment. The next eclipse, the annular of January 4-5, 1992, will be observable from Truk. There are possible locations for the northern limit, but the southern limit is a problem.

The total eclipse in June 1992 will have landfall in Uruguay at sunrise, but the center line and the southern limit never cross land. The next opportunities are two eclipses in 1994.

Under business, the US Naval Observatory is withdrawing support for the occultation predictions, and will no longer support mailing the predictions. The programs can be run at GSFC, but only to do updates, not the bulk of the predictions. ILOC will do the work in the future, but cannot do the predictions for 1992. The USNO gave IOTA $1000 to pay for distribution of the 1992 predictions. IOTA/ES is trying to get the prediction software to run on 386-type PC's.

Next year is an election year. The predictions for next year were not available, so we did not know when might be a good time for the next IOTA annual meeting.

IOTA will generate the maps for the RASC Handbook. Charles Baker and Steve Chien converted a data set of the Canadian political boundaries data to the format the graze mapping software expects. Steve is now working on the Australian boundary data.

There was a discussion of tax deductions for work done in support of IOTA. The expenses of trips to observe occultations or eclipses are deductible. How to determine what is allowable when a trip to make an observation is combined with a vacation or a tour can be a problem.

Discussions were held on the observations made in the first half of 1991: the Pleiades passages, the eclipses, and the asteroid occultations observed in January. On the Pleiades passages, the Moon is moving to the South, so this series of passages is ending. The passage on July 8 was probably not observed on the Mexican mainland because of clouds. It was clear in Baja California and three people (David Dunham, Don Stockbauer, and Pincas Jawetz) flew to Baja from Puerto Vallarta to observer there. Don used a Celestron-8 with a Phillips CCTV; David used a Celestron-5 with a Panasonic camera and an image intensifier.

Six people from IOTA/ES observed the eclipse of July 11 very near the southern limit on the Mexican western coast, 300 observed from a location not quite as close to the limit in Salulita, and four observers tried to observe at the northern limit, but had to go a location about 10 km in because of the weather.

Discussions continued after the meeting ended, mostly on the different experiences people had observing the eclipse. Those who had made video tapes showed them. One that was particularly interesting was made by Larry Woods and Jared Zitwer at the Pyramids of the Sun and Moon using an all-sky recorder, which is a camera suspended above a polished hubcap. Unfortunately, it rained there. Their recording has impressive large drops of water dripping from the tarp protecting the camera; the drops appear to be aiming straight into the lens.

1992 TOTAL OCCULTATION PREDICTIONS

David W. Dunham

Detailed total occultation predictions for 1992 are being computed by me at the US Naval Observatory and written to magnetic tape for printing with a laser printer at the Goddard Space Flight Center. As explained in "USNO Ends Occultation Prediction Service" on p. 63 ON 5(3), they will not be distributed from USNO. Instead, they are being distributed by IOTA with postage costs paid by a one-time grant from USNO.

Marie Lukac has been instructing me on the procedures for running the occultation prediction service. She helped me perform the bookkeeping work in preparation for the 1992 prediction runs. I have concentrated on transporting two large programs used in computing the predictions to the IBM 3081 computer at GSFC, and preparing minimal documentation to help with efforts to transport these programs to ILOC and to members of IOTA/ES in Germany. Since the long-term future of any detailed occultation prediction service depends on the success of those efforts, it was done before processing several delayed prediction requests. It is hoped that, sometime during 1992, ILOC will be able to take over this work; they want to do so. In the meantime, it will depend on IOTA's (and mainly my) voluntary efforts, and with so many other obligations that I have, there are bound to be delays. The first line of the predictions no longer says "U. S. Naval Observatory Total Occultation Predictions . .", but instead lists the organization distributing the predictions (I.O.T.A.) followed by the location where the predictions were actually computed (U.S.N.O. or G.S.F.C.).

It is not necessary to join IOTA in order to receive the detailed total lunar occultation predictions. However, it is necessary to join IOTA in order to receive IOTA's other services, such as comprehensive predictions of lunar grazing occultations in your region, and planetary and asteroidal occultation local circumstance predictions. For all of these IOTA services, don't write to me, but instead contact the McManuses at the Topeka address given in the masthead, or IOTA/European Section described in the lower-left of p. 85 (first page of this issue, in the "From the Publisher" section).

Detailed Pleiades (P-catalog) predictions have been computed and will be distributed to Southern-Hemisphere observers who have passages under favorable conditions during the tail end of the series early in 1992. Northern-Hemisphere observers will have to wait until about 2004 for more Pleiades passages.

If we are to generate extended predictions for lunar occultations during the lunar eclipses of 1992, we need a special catalog for the eclipse fields, which we call the L-catalog. I would like to see a catalog created for the 1992 lunar eclipses on June 15 and December 9-10. We need someone to volunteer to prepare this catalog. If it is created, it will be announced in a future issue of ON, and predictions would become available upon request.

Total lunar occultation predictions for 1992 for European observers (excluding the USSR) were computed in early August and taken to the ESOP meeting in Hannover for distribution, saving mailing costs. Contact Hans Bode for any questions; the mailing costs from Hannover (for those not at ESOP) will also be paid from the USNO grant to IOTA. Predictions for 1992 for other parts of the world will be computed, and most distributed, during September.

Predictions for 1993 will be computed either by ILOC, or by IOTA at USNO as done for 1992. They will probably be mailed by ILOC, although, if the predictions are computed at USNO and funds remain from the USNO grant, the data for North Americans for 1993 may be distributed by IOTA. In any case, until told to do otherwise, you should return the verification forms enclosed with your 1992 predictions, needed for 1993 predictions, to my address below.

All forms and correspondence should NO LONGER BE SENT TO USNO, but should instead be sent to me at the address below. If you have not returned the verification form sent with your 1991 total lunar occultation predictions, you need to send it to me in order to receive 1992 predictions. When ILOC develops an operational capability to generate and distribute similar predictions, most correspondence about predictions will be shifted to them.

7006 Megan Lane
Greenbelt, MD 20770-3012
U.S.A.

1991 JULY 8 PLEIADES PASSAGE

David W. Dunham and Don Stockbauer

Our plans had been to combine observing the July 8 Pleiades passage with the July 11 eclipse. We had intended to travel to one of several graze paths on the western coast of Mexico, depending on where the weather looked best. The weather forecast was bad for all of them, but it was clear in Baja California. We, along with Pincas Jawetz, were able to get the only three standby seats available on the only scheduled flight, an Aeromexico flight, from Puerto Vallarta to La Paz, Baja California, on July 7th. Perhaps even more remarkable was that we were able to rent a car at the La Paz airport with no reservation, although this was only possible because we assured the rental agent that we would return it by 9 AM when it was reserved for another customer. It was the last rental car at the airport. We managed to find Richard Nolthenius, who gave us detailed maps for the Atlas graze 93 km north of La Paz, and 7 km south of the small town of El Cien. He and other observers in La Paz covered the graze of 7th-mag. ZC 551 that passed over parts of that city, but none of them planned to try the Atlas graze. So we made the only timings of any of the bright, named Pleiades star grazes during the July 8th passage. Don describes the Atlas graze, but we were also able to videorecord many total occultation reappearances of fainter stars.

An interesting sequence was the reappearance of the line of mostly 8th-magnitude stars southeast of Merope. First came 6.8-mag. ZC 550. Then 8.0-mag. SAO 76189 reappeared, and remarkably, it is distinctly brighter than ZC 550 on David's videorecording. Although the camera is red-sensitive, this difference is hard to explain, since the respective spectral types are not that different, being A0 and F5. Maybe SAO 76189 is variable? David will try to image the same area the next time he uses the same camera. Also, although the telescope he was using was only a 5-inch Schmidt-Cassegrain, a 12th-magnitude P-catalog star is faintly visible, apparently a late spectral-type star that appears to the camera at least 2 magnitudes brighter than the photographic magnitude of the P-catalog.

ECLIPSE NEWS

David W. Dunham, Joan Bixby Dunham,
Don N. Stockbauer, Jay H. Miller,
Wayne H. Warren, Jr.

David, Joan, Jay, and Wayne observed this with the Eclipse Edge expedition from a schoolyard at Sayulita, a coastal town about 40 km northwest of Puerto Vallarta and 4 km north of the southern limit. Don Stockbauer traveled to the northern limit. Hans Bode and the Ruperts, from Germany and representing IOTA/ES, videorecorded the eclipse from sites only 1 km north of the southern limit, just east of the town of Patzcuaro and 3 km south of Sayulita. Totality lasted about 30 seconds there.

Southern Limit (David) I used a 5-inch Schmidt-Cassegrain as a lens for a video camera and recorded the eclipse from a location next to a well in the schoolyard. Threatening clouds and some occultations of sunspots are seen during the partial phases. The telescope had to be adjusted in right ascension manually (not a smooth motion) since it had to be mounted backwards in order to give clearance for the camera when pointing within several degrees of the zenith (the Sun and Moon were within a degree of the zenith during totality). In this position, the clock drive moved the telescope in the wrong direction. Many Bailey's beads were recorded as the diminishing solar crescent was "eaten up". A Solarskreen filter and a piece of cardboard with a hole only about 1.5 inches in diameter were used to cut down the light to the right level. When the cardboard was removed just before 2nd contact, the last beads were out of focus. With the 1.5-inch aperture, the focus was much less sensitive than with the full aperture. I didn't realize this at the time, so I left it out of focus, fearing that, if I focused then, the beads would be out of focus when I put the cardboard back on. In the excitement of totality, which lasted just over 100 seconds, I missed 3rd contact, but did eventually record some reappearing beads. As I put the filter back on, details of a prominence can be seen briefly (the light level is right to see it on only one video frame). Some lessons were learned for the next eclipse, such as, when using cardboard to decrease the light, two or more smaller holes should be cut on opposite sides of the full aperture to allow good, consistent focusing throughout the eclipse.

(Jay) I timed second contact beads visually using a 8-inch Schmidt-Cassegrain. I have a total of 7 timings of bead disappearances at the southern edge of the Sun. These timings will be used to compare with the timings of the same beads from David's videorecording.

(Joan) We and the 300 other Eclipse Edge observers saw a beautiful eclipse from Salulita. Tom Van Flandern organized and ran this expedition, with the help of family members, a travel agent, Gabriele Mallen-Ornelas, and us. The purpose of this expedition was to provide observers for the southern limit of the eclipse path for our continuing series of observations to monitor changes in the diameter of the Sun from total and annular eclipse observations. A number of the observers had video equipment, and we showed each other our tapes that evening. David's equipment was set up to maximize the Bailey's beads, and so does not have a good scale for showing the whole eclipse. He did get nice (black and white) images of the inner corona during totality. We did not try to take photographs of the totality because we had so much luggage with did not want to add a large telephoto and tripod to our baggage. We have observed 7 total eclipses (out of 9 tries) and this was by far the most beautiful.

(Wayne) Since most other observers were in the schoolyard, I went to the beach, which is several hundred meters away. I had planned to mount my 8-mm Sony camcorder behind a 3.5-inch Questar, discovering too late that at the particular angle of the Sun during the eclipse and the places available to set up, the camera was inaccessible from the from the back end (a similar experience to David's discovery that the C-5 mounting had to be reversed). However, I had a special telephoto lens for the camcorder, so it was decided to use the hand-held camcorder without optical aid. This worked out quite well except that the combination of the high sensitivity of the CCD and the brightness of totality (The sky never became very dark during totality due to a combination of being near the eclipse edge and the brightness of the corona as a result of the high solar activity.) produced considerable blooming of the video images. An acceptable video of the entire sequence of events was obtained, however, and prominences are visible near second and third contact, except that it will not be possible to obtain bead timings from the film. It was also discovered that, although shadow bands were seen visually, they did not record on the video images, another lesson learned for future eclipses.

We hope to compare the results of several different techniques used during this eclipse. We want to compare data taken by visual observers with no aid other than a filter, by those using image projection or visual observing with a filter, and by those using video equipment all from the same site. We are still collecting data from the observers.

Northern Limit. The northern edge of the path of totality passed through three locations that seemed, from weather prospects, to be good places to observe, Hawaii, Baja California, and the west coast of Mexico. Alan Fiala, observing the northern limit from Maui, was rained on. The observers who had planned to go to the northern limit in Baja did not, for a variety of reasons -- family, health, and visa problems. The only successful observations reported near the northern limit are described by Don Stockbauer in the next paragraph. On his way back home, Derald Nye stopped in Villa Insurgentes, the city in Baja just inside the northern limit, and talked to someone there who said that totality lasted 23 seconds. But they did not tell Derald just where in the sizeable town they were located.

(Don) The main Eclipse Edge group was slated to observe the July 11th solar eclipse near the southern limit at the town Sayulita, on the coast NW of Puerto Vallarta. David decided that the northern limit needed to be covered on the mainland (in case Hawaii and Baja both failed), so Wolfgang Beisker, Reinhold Buechner, and I drove to Mazatlan on July 10th and met Jim Vail. (Jim Stamm was also present in Mazatlan, but unfortunately our vehicle was not big enough to take him too.) The four of us drove to the town of Dimas (some 80 km NW of Mazatlan) to record Bailey's beads near the northern limit. Two hours before totality at Dimas it was overcast and raining. We travelled back to the south to approximately 10 km inside the northern limit, at which point the clouds were a little thinner. It was still so bad, however, that I did not think that my equipment (which needs fairly good conditions) would have any chance of getting a successful video. Wolfgang and Reinhold were more optimistic and did record data with a smaller, more easily deployed system. At this point we are waiting to reduce the tape and determine the quality of the data; it is the only record of any sort at the northern limit as the efforts at Hawaii and Baja were both unsuccessful.

High quality data were obtained by David Dunham and others at Sayulita, but without a corresponding set of high quality bead timings at the northern limit the solar radius cannot be determined accurately. It seems that those who travel large distances to get special observations often wind up with less than those who stay behind. But those are the chances that one takes in the name of Science, right?

1992 January 4th annular eclipse. The northern limit passes over the Truk atoll in Micronesia. Paul Maley has done some research about this area, and wants to know who might be interested in joining an expedition to observe and record the eclipse there. If interested, contact him at 11815 Lone Hickory Ct.; Houston, TX 77059; phone 713,488-6871. The total cost would be about $2100 round trip from California. Morning skies in January are mostly clear there. As a bonus, the Truk lagoon has some of the best snorkeling in the world. Maley is also looking into the possibility of going to one of the Kiribati Islands near the southern limit, but access will be more difficult and expensive. Efforts will also be made to observe the eclipse near sunset in the Los Angeles, CA, area, and Richard Nolthenius hopes to lead a small expedition to Catalina Island, relatively close to the centerline. The northern limit crosses Santa Cruz, an island with limited access. Unfortunately, bad seeing at the very low altitude above the horizon in all of these Californian locations will probably preclude recording meaningful Bailey's bead events, even if the usually bad winter weather cooperates.

Future Eclipses The next total is on June 30, 1992, with its only landfall in Uruguay at sunrise. The next eclipse we plan to observe is the annular crossing the USA in May 1994. This will occur during the Texas Star Party, and 200+ observers are expected to travel from the Davis Ranch to the Texas panhandle. The next total we want to observe will be in November 1994, crossing Peru, Chile, Bolivia, Paraguay, and Brazil. The eclipses in 1993 are all partial.

GRAZING OCCULTATIONS

Don Stockbauer

Please send copies of grazing occultation reports to me at 2846 Mayflower Landing; Webster, TX 77598; USA. If a copy can be sent to the International Lunar Occultation Centre (ILOC), this is greatly appreciated; their address is Geodesy and Geophysics Division; Hydrographic Department; Tsukiji-5, Chuo-ku; Tokyo, 104 Japan. For graze reports on diskette, please send me a printed copy of the data file only and send the actual diskette to ILOC. Total occultation reports on any medium need only be sent to ILOC. Due to the use of an inaccurate ephemeris for the 1990 graze predictions (see ON 5 (2), p. 34), 1990 shifts are not directly comparable to those of 1991 and should not be used to upgrade your current version 80K (or equivalent 80L) predictions. Reductions of some well-observed events can be performed to determine the 80K shifts.

Northern limit grazes during crescent phases (less than 50% sunlit waxing or waning) are shifting to the south from the present USNO predictions, on the average; see David's separate article about this [page 92]. However, David and I did not experience a shift of this magnitude when we did the Atlas graze in Baja California on July 8, 1991; we both obtained video records of long shallow total occultations (no multiple events). Apparently, the correction is weaker for waning phases than for waxing phases. David thinks that the south shifts may be occurring in a particular section of the sky, mainly in Pisces, Aries, Taurus, Gemini, and Cancer, rather than being tied to the Moon's phase. More observations over a period of several months are needed to resolve this. Unlike previous shifts of this nature, these are occurring at low latitude librations, so that a simple scaling of the shift with the latitude libration will not work. Analyses planned by Mitsuru Sôma at the Tokyo National Observatory should resolve this problem, after which we may be able to use his software to give the final corrections for the predicted profiles, rather than the USNO 80L OCC software.

Bert Carpenter writes that "their success rate has been abysmally low since July of 1990, so I think it is time to report on our nonexistent successes". Henk Bulder also writes that bad weather prevented viewing most of the planned grazes in the Netherlands and Belgium for the first quarter of 1991. At least the skies cleared on May 16th, allowing a new European graze record to be set (5.9 magnitude ZC 936, 140 timings collected from two locations). A combined plot submitted by Henk is included in this issue.

Jean Schwaenen reported a shift of 0.2" south for the graze of ZC 287 observed on 2/19/91 in the last issue. He warned that he generated his own prediction and that the shift was not calculated using an ACLPPP profile. Henk Bulder recalculated the shift in the USNO system and reports that the 0.2" figure is indeed correct.

Correction: Dietmar Buettner reports that the >0.8" south shift of ZC 562 on 21 Feb 1991 observed from Germany (reported in ON 5 (3) p. 65) should be changed to >0.1" south. This is more in line with the near-zero shift that Harold Povenmire found during a graze of the same star near Columbia, SC, a month after Buettner's observation.

Having become a recent convert to video occultations (I now have the Philips low-light level CCD camera and a Sony Handycam as a recorder), it is interesting to compare the two modes of operation (visual versus video). Video has one great advantage in that you do not have to be as worried about being interrupted during the observing window. If everything is operating properly, taking your eye off the star in the camera's viewfinder really doesn't matter (unless, of course, you're also calling out the events for a reaction time study). Of course, a long interruption might prove disastrous if there are any tracking problems. The Philips camera gives a field of view of only 6 X 9 arc minutes when used with my 8" Schmidt-Cassegrain. Pointing to the correct location to do lunar reappearances requires a very accurate finder. One must also get accustomed to a much longer setup time; this can prove difficult if you are the graze expedition leader and are always running late by the multitude of problems that always seem to arise.

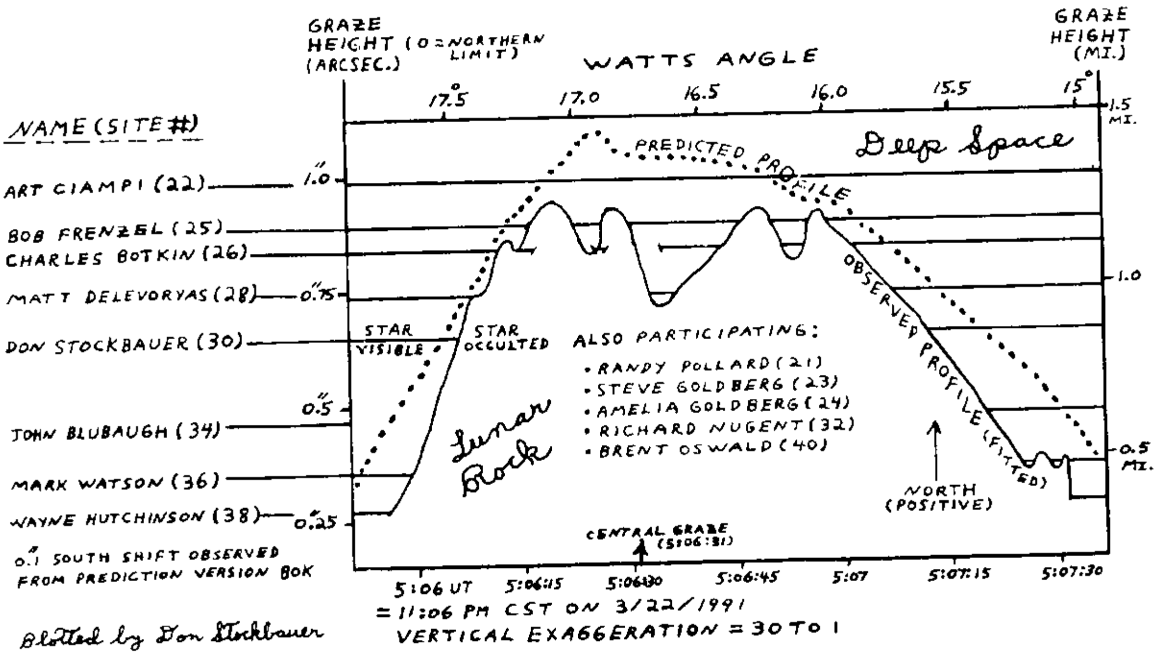
The July 11th solar eclipse was the first for which I travelled a large distance (Puerto Vallarta, Mexico). The highlight of the trip for me was not the eclipse (I was mostly clouded-out near Mazatlan), but a quick trip that David and I made to La Paz, Baja California to videotape the Pleiades passage on July 8th. We went to Baja to escape the mainland clouds near Puerto Vallarta, which did ruin the passage for those who stayed. The total reappearances were quite spectacular, as was the graze of Atlas (we were approximately 90 km NW of La Paz on the main highway). My flashlight failed partway into the event; the worst part was not being able to read the predictions. Looking around in desperation for any source of light at all, I finally thought of projecting light from the viewfinder of the Handycam onto the predictions (this gave me a 12mm by 12mm reading area). We flew back from Baja the same day, leaving behind beautifully clear skies and reentering the cloudy skies of the mainland.

Thanks for the reports; Jim Stamm is the winner this quarter. See you next issue.

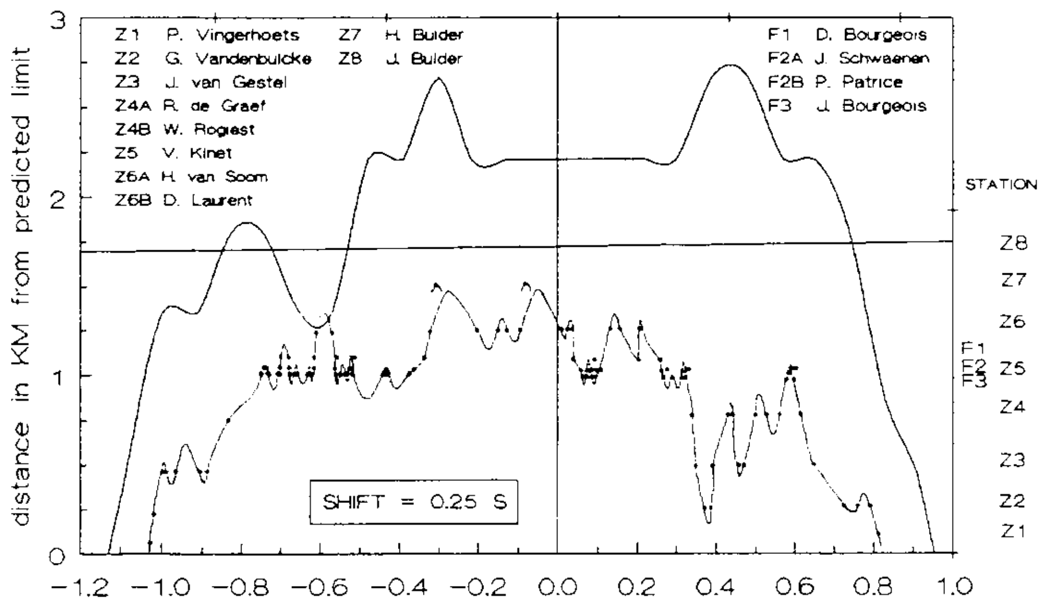
Graze List as of 7/29/1991

Date YrMoDy	P	V	Star #	Mag	% Snl	CA	Location	# Sta	# Tm	S S	Ap Cm	Organizer	N ShS	WA	B
890124			1487	1.3	95-	-6N	De Lachigan, Que.	6	39	2	13	Marc Jobin			
900309			1396	7.1			Uitdam, Holland	1	1	2	20	Henk Bulder			
910219			092712	9.1	27+	7N	Uitdam, Holland	1	1	2	20	Henk Bulder	1S	5	-62
910321			076249	7.3	25+	13N	Cary, NC	4	18	1	15	Mark Lang		11	-51
910321		V	076259	7.3	26+	14N	Parrish, FL	2	4	1	20	Tom Campbell	0	12	-53
910323			0918	7.0	49+	15N	Stoneham, TX	8	32	2	10	Don Stockbauer	1S	17	-24
910408			2987	5.2	36-	4N	Elliott,Australia	2	7	1	20	Phillip Kearney	7S	355	-12
910420			1143	6.8	42+	13N	Schloditz,Germany	3	8	1	6	Viertel/Buettner	6S	14	6
910421			079710	8.2	45+	18N	Oracle, AZ	2	2	1	20	Jim Stamm	6S	19	6
910421			079815	8.2	47+	13N	Mammoth, AZ	1	2	2	20	Jim Stamm	0	14	12
910516			0936	5.9	10+	12N	Fromiees, Belgium	4	67	1	5	Jean Schwaenen	3S	12	-12
910602			2981	5.2	80-	15N	Rocky River, OH	2	12	1	15	Robert Modic	4S	343	10
910610			075715	7.4	7-	10N	Bay Village, OH	1	2	2	20	Robert Modic	1S	358	-51
910615			1217	6.1	9+	8N	Montville, OH	3	22	2	9	Robert Modic	5S	13	20
910615			1217	6.1	9+	8N	Slate Lick, PA	2	3	1	20	John Holtz	5S	12	20
910615			1217	6.1	9+	8N	Daniel, MD	1	0	1	10	Bolster/Dunham	>6S	12	20
910616			098395	8.1	19+	7N	Sonoita, AZ	1	9	2	20	Jim Stamm	3S	11	38
910627			2672	2.9	100-	-55S	Tucson, AZ	2	13	3	20	Jim Stamm		181	23
910708			0550	6.8	15-	10N	OracleJunction,AZ	1	7	1	20	Jim Stamm	2S	355	-47

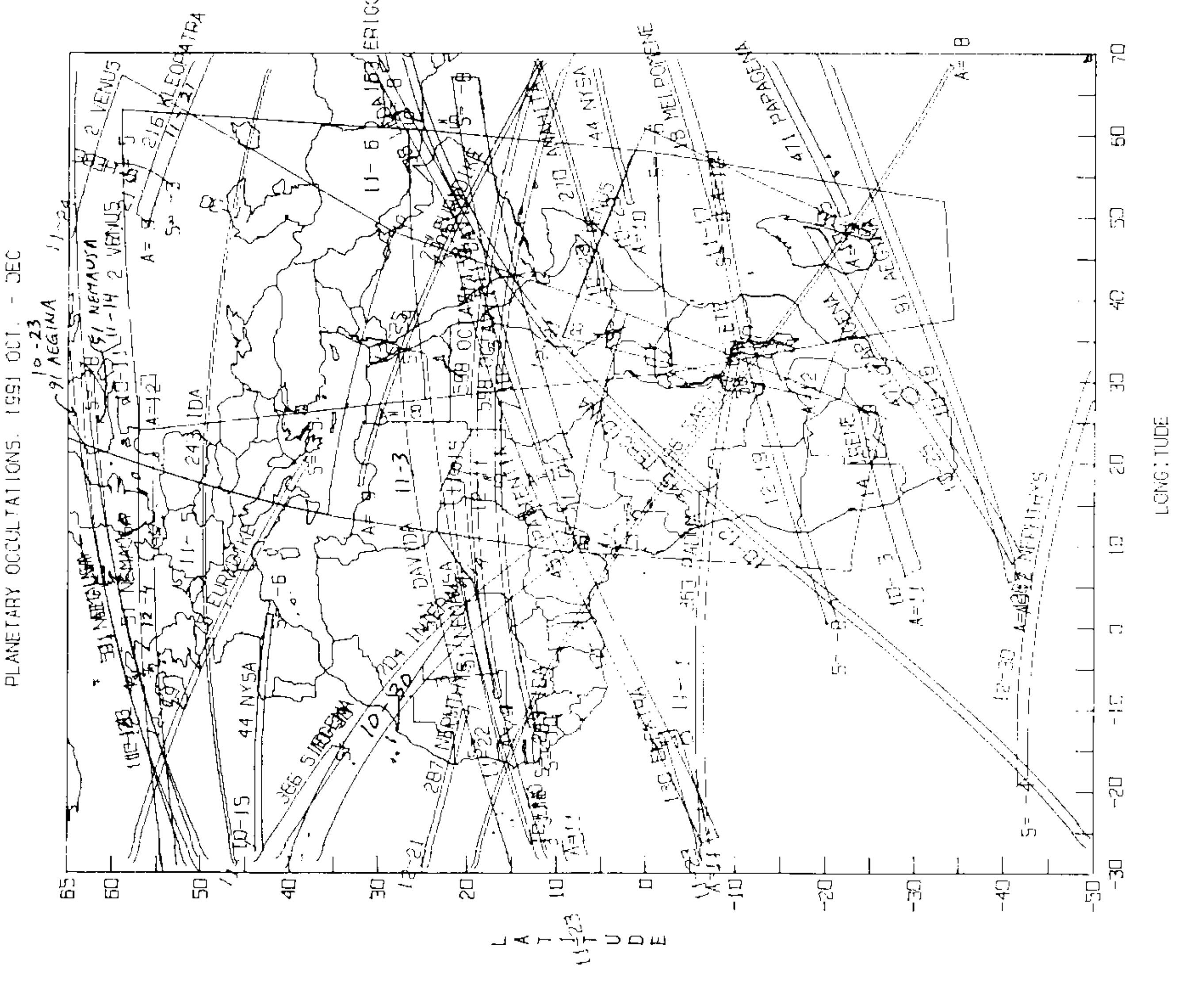
Lunar Grazing Occultation of SAO 77918 on 23 March 1991 (UT) near Plantersville, Texas



ZEVEREN / FROMIEES (BELGIUM)
16 MAY 1991 / ZC 936 (MAG 5.9)



RECORD BREAKING EUROPEAN GRAZE (140 EVENTS)



WARNING FOR NORTHERN-LIMIT GRAZES

David W. Dunham

Observers of northern-limit crescent-moon grazes that have occurred in April, May, and June have reported substantial south shifts of the actual shadow from our nominal predictions, causing many to see no occultation (a miss). The south shifts have been averaging about 0.4 arc seconds. Consequently, I suggest that you shift the recommended range for northern-limit grazes, as determined from your version 80K or 80L ACLPPP profile, south by 0.4 arc seconds when the Moon is less than 30% sunlit, and south by 0.2 arc seconds when it is from 31% to 50% sunlit, and not at all for other conditions. For this, you need to use the arc seconds scale on the left side of the profile; for some current grazes, there are more than 2 miles per arc second, so the shifts can be very large. The problem is probably caused by errors in our empirical corrections to the Watts profile data relative to the new lunar ephemeris that we are using. Star positions have additional errors, so in general, you should try to cover down to 1.0 arc second below the highest mountain, and someone should be 0.7 arc seconds south of the most interesting multiple events zone inferred from the nominal profile. However, also see the later information in Don Stockbauer's grazing occultation article.

BOUNDARIES WITHIN CANADA AND AUSTRALIA

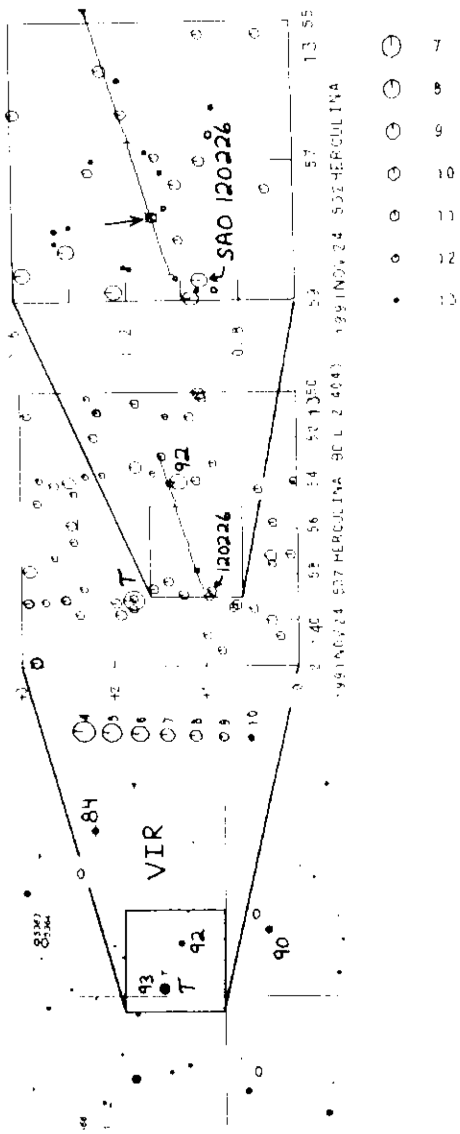
David W. Dunham, Steve Chien, Stephen Hutcheon, and Charles Baker

A few years ago, Dunham asked for coordinates of the boundaries of Canadian provinces, Australian states, and the Soviet republics so that they might be added to the world data set that Dunham uses, SYS2.WRLDATA2, for computer-generated maps of graze and asteroid occultation paths. Baker, in Rockville, MD, had access to the Canadian province boundaries, and sent them to Dunham. Stephen Hutcheon, Sheldon, Queensland, Australia, examined 1:1,000,000-scale maps of Australia to manually create a data set of the Australian state boundaries to about 1-km accuracy, which is at least as accurate as the other data in the world data set. Then for about 3 years, nothing was done because Dunham did not have time to convert these data to the format of SYS2.WRLDATA2. Fortunately, Dunham learned that Chien, a local high school student, was looking for a computer-related project to work on this summer, and he agreed to transform the data provided by Baker and Hutcheon to the form needed by SYS2.WRLDATA2. Dunham appended these data to SYS2.WRLDATA2, with the result that Canadian province boundaries and Australian state boundaries now appear on <u>ON</u> maps, including the asteroidal and planetary occultation path maps for October - December in this issue. The Canadian data were also important for they were needed for the grazing occultation maps of North America for the 1992 issue of the RASC <u>Observer's Handbook</u>, which Dunham sent to the editor, Roy Bishop, in late July. Dunham is still looking for the Soviet republic boundaries, and could also use data for Slovenia, and perhaps later for Croatia.

SOLAR SYSTEM OCCULTATIONS DURING 1991

David W. Dunham

The figures appearing on this and the following pages continue to illustrate the article with the same title starting in <u>ON 5</u> (2), giving charts and maps for events that <u>will</u> occur during the next few months. The finder charts have been annotated by David Werner, and the world maps were provided by Mitsuru Sôma. The regional maps on pages 67, 79, and 80 of the last issue are mislabelled; the date ranges were actually 1991 July - September. Also, the event involving (48) Doris on November 4, given in the tables on pages 70 and 71 of the last issue, and also in the local circumstance predictions for many North American observers, will not happen; the FAC data for all stars south of declination +3.8 degrees are erroneous.



IOTA FINANCIAL REPORT

Craig and Terri McManus

The following is the IOTA financial report as of the end of July 1991.

Debits	91-1-1 to 91-7-31		90-6-30 to 91-7-31	
ON Printing	$2003.67	50.4%	$3806.30	46.5%
Supp. Printing	251.87	6.3	377.76	4.6
Office Supplies	69.05	1.7	137.02	1.7
Postage	1622.02	40.8	3014.54	36.9
Bank Card Costs	30.87	0.8	71.51	0.9
Miscellaneous	0.00	0.0	771.15	9.4
Total Debits	3977.48		8178.28	
Credits				
Member Renewal	$3674.50	68.7	$7012.38	70.0
Predictions	16.50	0.3	19.50	0.2
Subscriptions	577.64	10.8	867.27	8.6
Back Issues	8.50	0.2	60.75	0.6
P.O.M.	10.00	0.2	12.50	0.1
Interest	38.90	0.7	70.58	0.7
Contributions	25.00	0.5	206.75	2.1
Miscellaneous	1000.00*	18.7	1771.59	17.7
Total Credits	5351.04		10021.32	

*USNO check for total occultation postage

Balance, as of 1991 July 31: $2549.61

ASTEROID NEWS

David W. Dunham

Conferences. On June 24 - 28, I attended the Asteroids, Comets, and Meteorites (ACM) conference at the Northern Arizona University campus in Flagstaff. Two previous meetings of this series were held in Europe, and many of the Europeans (including several from the Soviet Union) who had attended the previous ACM's came to this one, as well as a large number of Americans. About 300 attended, nearly twice the number that had been expected two weeks beforehand. It was a very interesting meeting, with many new results presented, such as the latest radar observations of main-belt objects. My talk on the January Vesta, Myrrha, and Kleopatra occultations was the only one, of nearly 300 papers, on occultations, and was well-received. Some of the results are given in the Vesta and Kleopatra sections below. After talking with others there, I decided against publishing our results in the ACM conference proceedings, preferring instead the wider audience of a journal publication. I need to save publication of figures and most results for the journal article first, and therefore will not publish them in ON. On June 30 to July 3, I also attended the Near Earth Asteroids conference held in San Juan Capistrano, CA, of interest to me for my professional spacecraft studies, not for occultations.

Vesta. A good elliptical fit can be made to the 22 chords obtained during the January 4th occultation. My preliminary analysis shows that the major axis of the ellipse was 545 km, while the minor axis was 460 km. If the unobserved axis is assumed to be the 561 km length obtained during the 1989 August occultation, which took place approximately 90 degrees away in the sky, the mean diameter of Vesta becomes 520 km. This is less than the 533 km that we derived for Pallas in our paper about the 1983 occultation by that asteroid. Consequently, Vesta is the 3rd-largest asteroid, not the 2nd-largest. (The values for the Vesta minor axis and mean diameter given here differ from the values given in my ACM abstract. These values are the correct ones.)

Kleopatra. I learned about a 9th chord for the January 19th occultation, by Gary Kiser in Delaware, shortly after the last issue went to press. His timed duration was at least 8.5 seconds, much longer than any of the other chords, indicating a strange projection, or steep mountain, jutting out of Kleopatra's side. Kiser's tape clearly has WWV recorded and the projection is on his disappearance side, so it can't be blamed on reaction time. In any case, Kleopatra overall still looks cigar-shaped, like a long brick about 60 by 120 by 230 kilometers. We will look for future occultations by Kleopatra with much interest. In the meantime, combining the shapes from the 1980 October occultation with this one presents a real challenge.

REPORTS OF ASTEROIDAL APPULSES AND OCCULTATIONS

Jim Stamm

If you do not have a regional coordinator who forwards your reports, they should be sent to me at: 11781 N. Joi Dr., Tucson, AZ 85737 USA. Names and addresses of regional coordinators are given in "From the Publisher" on ON's front page. All times in this report are UTC.

I have received six positive reports for 1990 events:

(444) Gyptis and ACK3 +11 0739, March 11. A photoelectric observation from Del Teide Observatory at La Orotava, Spain produced a disappearance at 22:03:38.0 and a reappearance 2.4 seconds later. A blink was also recorded at 22:03:34.3.

(83) Beatrix and AGK3 +01 1465, March 13. R. Di Luca at Bologna, Italy reported a disappearance at 23:22:56.3 and a reappearance 4.5 seconds later.

(3) Juno and AGK3 -01 1862, June 15. Danie Overbeek at East Rand, South Africa observed a definite disappearance at 16:12:15.9 ±0.8 second, and a reappearance at 16:12:51.9 ±0.2 second.

(679) Pax and SAO 186343, August 9. A new record 56 European observers saw this event. Some reports were received of gradual events and of possible secondary events, but subsequent analysis by Roland Boninsegna

of 22 observers' positions and timings concluded that the fog was probably responsible for all of the anomalous observed events.

(19) Fortuna and AGK3 +22 0623, September 19. R Dusser at Kalaa Sghira, Tunisia reported a disappearance at 00:23:21.6 that lasted 2.8 seconds, and a possible blink around 00:23:15.2.

(704) Interamnia and FAC 900107, December 9. Francis Graham at East Pittsburgh, Pennsylvania, USA reported a disappearance at 03:20:30.9 and a reappearance at 03:20:57.9.

I have not received all of the first half of 1990 reports from other coordinators yet, so that summary will have to wait until the next issue.

I have seen a copy of Danie Overbeek's preliminary annual reports on occultation work to the Council of the ASSA, and will share the whole thing with you:

The stars blinked out
To many a shout
The stars flashed back
But alas, alak
Our poor old ZUO
Is still no go

M35 PASSAGES

David W. Dunham

Several passages of the Moon through M35 are listed in a table of occultations of nebulae during 1991 in ON 5 (2), p. 32. Most of these have past, but one of the best, involving a 32% sunlit waning Moon, will be visible from nearly all of North America around 9 hours UT of Tuesday, September 3. Reappearances of cluster members will occur on the Moon's dark side for about an hour and a half. The passage will occur at very low altitude above the horizon for those near the west coast of North America, while Newfoundland will be in daylight, and those in the Canadian Maritime Provinces will have their view spoiled by strong dawn twilight.

M35 consists of some 8th-mag. stars, about 20 9th-mag. stars, and several dozen 10th-mag. stars spread over an area only a little larger than the Moon. I have used the Fresneau Astrographic Catalog (FAC) data to plot the chart on page 93 . David Werner has compared the chart with the True Visual Magnitude Atlas (TVMA), and has entered (using solid dots) several TVMA stars not in FAC, which used photographic magnitudes. Some stars are marked NS (Not Shown on TVMA) and VF (Very Faint on TVMA). SAO 78051, at magnitude 7.4, is the brightest star on the chart. NSV 02852 is a suspected variable with a possible magnitude range of 12.0 - 12.5. Its variable catalog position is marked with a small +, but the catalog position is only approximate, and the star may be the FAC star to the right of the +. Two figures of the Moon, produced by Bob Bolster, are shown, one for the September 3rd passage, and the other for the September 30th passage visible from Japan at low altitude.

In late 1981, I prepared a special catalog, called the C-catalog, from Astrographic Catalog data for detailed USNO total occultation predictions of certain interesting parts of the sky. One of the areas covered is M35, as described in ON 2 (14), p. 188 (1982). The C-catalog is well-referenced to the XZ and ZC catalogs. Unfortunately, I have not had time to distribute C-catalog predictions for the September 3rd passage, so most observers, if they get this in time, should note the approximate cusp or position angles of events that they time. The stars can then be identified by "post"dictions. I may be able to generate predictions for some observers, such as those with access to telescopes of 17 inches aperture or greater. If you want to receive such predictions, call me at 301,474-4722 (or 474-4945), and leave a message on the answering machine specifying the telescope you plan to use, its USNO station code, or the accurate longitude, latitude, and height above sea level, if your site does not have a USNO code, and either a phone number where you can receive FAX messages or an E-mail address.

VIDEO NEWS

Henk Bulder

I purchased an MXII CCD camera with image intensifier from HCS Vision Technology. With this camera I'm able to record magnitude 13.5 stars with my 30-cm Newtonian, although it gives a noisy picture at maximum gain.

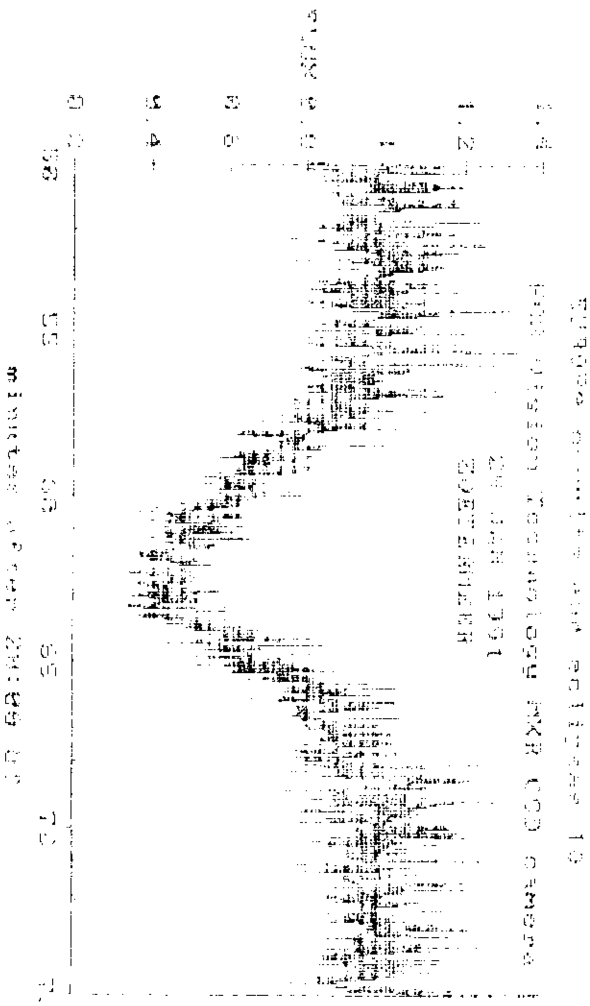
I have been looking for a cheap time inserter for some time now and found an interesting item. It concerns the JVC character generator CG-P50E. Besides generating all kinds of titles, which can be of use when you are preparing a talk with some video examples, it has an option to put an elapsed time in the upper right corner of the frame. This works more or less like a stopwatch. It is quartz generated and runs for a maximum of 9 hours 59 minutes 59.99 seconds. I found the crystal to be fast by 0.6 seconds/hour. I have been told this is done on purpose. The crystal is made slightly bigger than necessary and will reach its final accuracy (at a slower pace) after using it for about a month or so. I will just have to wait and see. The module is normally connected to the viewfinder of specific JVC cameras. A standard modified module can be placed between any camera and a VCR, though. This modified module costs 440 Dutch guilders, which would be in the vicinity of $220 or less in the USA.

So far, I have succeeded in recording several mutual phenomena of Galilean satellites for project PHEMU91. The plot shows the mutual phenomenon of Europa and Io I recorded with an MXR camera of HCS Vision Technology (comparable with the Philips module). This was reduced using a Data Translation (DT2851) frame-grabber resulting in 4 points/second. Relatively large windows were used to compensate for tracking errors which led to poor signal-to-noise ratios. I'm still trying to improve processing techniques to get better signal-to-noise ratios.

Besides these events, I recorded several eclipses of Galilean satellites (for which reduction is even more difficult) and tried an asteroid occultation (9th magnitude star by Princetonia) but did not record an occultation. I tried to record two grazes, but failed because of simple technical failures (like short-circuiting one of the connectors).

[Ed note - JVC has several character generators - CG V60U as well as P50E - for $200 or less. Other manufacturers make similar devices. These devices are manually triggered, so that although the elapsed time can be accurate, the absolute time (UTC) cannot be recovered to the video frame rate accuracy of 0.03 second. For that, a display that triggers electronically from a radio time signal is needed, and the only device that does that, as far as we know, is the time inserter designed by Peter Manly discussed in previous issues. Manly says that he has added a variable gain to his trigger electronics in his latest design, to facilitate triggering for weak or unusually strong time signal minute pulses.]

[As this went to press, we received word that Henk has a group of 10 people preparing to make a group purchase of the Philips camera in PAL format. If you want to join the purchase, contact him at his address of Mendelssohnrode 72, 2717 CS Zoetermeer, Netherlands, or phone him at 31 795 17083.]



ASTRONOMY AND PERSONAL COMPUTERS

Joan Bixby Dunham

<u>Computing the Location of CRRES Releases</u> The CRRES (Combined Release and Radiation Effects Satellite) releases chemicals, barium, strontium, and lithium, at various points in its orbit to map the magnetic field near the Earth. The times and locations for the planned releases are given by Marshall Space Flight Center on at answering machine at (205) 544-5356. They give the time (in CST) and the spacecraft location as the latitude and longitude of the point on the Earth underneath the satellite and the height of the spacecraft above the Earth's surface.

David wanted to observe the lithium release scheduled for Friday night, Feb. 8, and derived the equations to convert the information to right ascension and declination. He computed the values with a hand calculator. Since the time of release was changed several times, it occurred to me that it would be easier to prepare a program to compute this. I tried to do it with a spreadsheet, and found that it is very easy, as long as the spreadsheet program can compute trigonometric functions (sines, cosines, arcsines, and arccosines. Tangents are not needed.) and square roots. High precision is not necessary for these computations, so the single precision computations from a spreadsheet on a computer without a math coprocessor are sufficient. Also, since this was a quick and dirty computation, elaborate input/output routines are not necessary.

The equations are from spherical and plane trigonometry. First, the azimuth of CRRES from the observer's location is computed from a spherical triangle, then the elevation of the spacecraft above the horizon is computed from a plane triangle, and the right ascension and declination of CRRES at the time of the release is computed from a spherical triangle. The information needed is the following:

(l, p) - the observer's longitude and latitude (longitude measured west)
(L, P) - the CRRES longitude and latitude
H - the height of the CRRES above the Earth's surface
R - the Earth's radius in kilometers (6378.16)
T - the time of the release (in CST)
pi - the constant 3.14159... (my spreadsheet and my calculator both have this as a constant)

My spreadsheet program does trigonometric functions only as radians, so the first step is to convert the latitudes from degrees and minutes to degrees and decimals of a degree, and then to multiply that by pi/180 to get radians. Then, to make later computations easier, compute the sine and cosine of p and P, and refer to the cells where those are stored instead of recomputing the trigonometric functions each time. Compute the difference in longitude (L-l) in radians, and the sine and cosine of that difference, and compute the longitude in hours and fractions of an hour (degrees divided by 15) for later use.

The first spherical triangle is one with apexes at the observer, the sub-satellite point on the Earth, and the North pole. The side between the observer and the North pole is of length 90 deg - p; the side between the sub-satellite point and the North pole is of length 90 deg - P, the angle between those two sides at the North pole is L - l. The side between the observer and the sub-satellite point is d, the arc distance on the Earth's surface between the observer and the sub-satellite point. The angle between the two sides at the observer is A, the azimuth of the satellite as seen by the observer. The distance d is computed from the law of cosines; the angle A from the law of sines.

The law of cosines gives d as

cos(d) = sin(p)*sin(P) + cos(p)*cos(P)*cos(L-l)

To compute this in a spreadsheet, compute the quantity to the right of the equals sign, and then take the arccos. Many spreadsheet programs (mine included) compute the trigonometric functions in radians. Since d is only used as an intermediate quantity to compute A, it is not necessary to convert from radians to degrees.

The azimuth, A, is computed from

sin(A) = sin(L-l)*cos(P)/sin(d)

If L-l is negative (CRRES is east of the observer), and CRRES is south of the observer (P less than p), then A is between 90 and 180 degrees. If L-l is positive, A is between 180 and 270 degrees. Since CRRES is an equatorial satellite, it is always south of observers in North America. You may need to add pi to the result from computing A to get the correct quadrant.

The CRRES elevation above the horizon is computed from a plane triangle with one apex at the center of the Earth, one at the observer, and one at the spacecraft. The side of the triangle between the center of the Earth and the observer has the length of the radius of the Earth, R. The side between the center of the Earth and CRRES has the length of the radius vector of the orbit, or H + R. The third side has the length of the slant range, S. The apex angle at the center of the Earth is d; the apex angle at the observer is 90 + h, where h is the elevation above the horizon. The slant range, S, is computed from the law of cosines for plane trigonometry, and the elevation, h, from the law of sines.

The slant range is

S = sqrt[(R*R + (R+H)*(R+H) + 2*R*(R+H)*cos(d)]

where sqrt stands for square root. The S is in kilometers, since R and H are both given in kilometers.

Then the elevation is

cos(h) = (R+H)*sin(d)/S

If h is negative, then CRRES is below your horizon (or, more likely, you have made an error somewhere).

Then h and A are used to compute the hour angle and declination (HA and DEC) of CRRES at the time of the release, from a spherical triangle with one apex at the zenith, one at the north pole, and one at CRRES. This is known as the astronomical triangle. The side between the zenith and the north pole has length 90 - p; between the north pole and CRRES has length 90 - DEC, and between the zenith and CRRES has length 90 - h, the zenith distance. The angle at the zenith is A, the angle at the north pole is HA, the hour angle.

The declination is computed from the law of cosines, as

sin(DEC) = sin(p)*sin(h) + cos(p)*cos(h)*cos(A)

and then the hour angle is

sin(HA) = sin(A)*cos(h)/cos(DEC)

The HA is positive if A is less than 180 deg, negative if A is greater than 180 degrees.

The hour angle is the difference between the right ascension, RA, and the local sidereal time, LST. The LST is computed for the time of the event, and then the RA is found. The easiest way to compute the LST is using the equations for 1991 given on page 30 of the 1991 "Observer's Handbook". For dates in February, this is to first compute the Greenwich mean sidereal time, and then subtract the observer's longitude, l, as follows:

GMST = 8.6476 + 0.06572*(day of month) +
1.002738*(time in UT)

This equation basically computes the Greenwich mean sidereal time at 0 hour UT for the date, and adds to it the number of sidereal hours that have elapsed since. Another equation is given in The Astronomical Almanac, but easier method is to use the Greenwich sidereal time at 0 hr UT given in the AA and add to it 1.002738*(time in UT).

LST = GMST - l

where l, the observer's longitude, has been converted to hours (by dividing the longitude west in degrees by 15).

Then the RA is

RA = HA + LST

For computations done for Friday, February 8,

l = 38 deg 59 min
p = 76 deg 52 min west
L = 66.1 deg west
P = 1.3 deg
H = 33,387 km
Time of release = 10:30 PM CST = 4:30 UT on Feb. 9

RA = 9 hr 26.8 min, DEC = -5.1 deg

Intermediate quantities:
d = 38.95 deg; S = 35,035 km; A = 162.7 deg;
h = 44.5 deg; GMST = 13.7513 hours

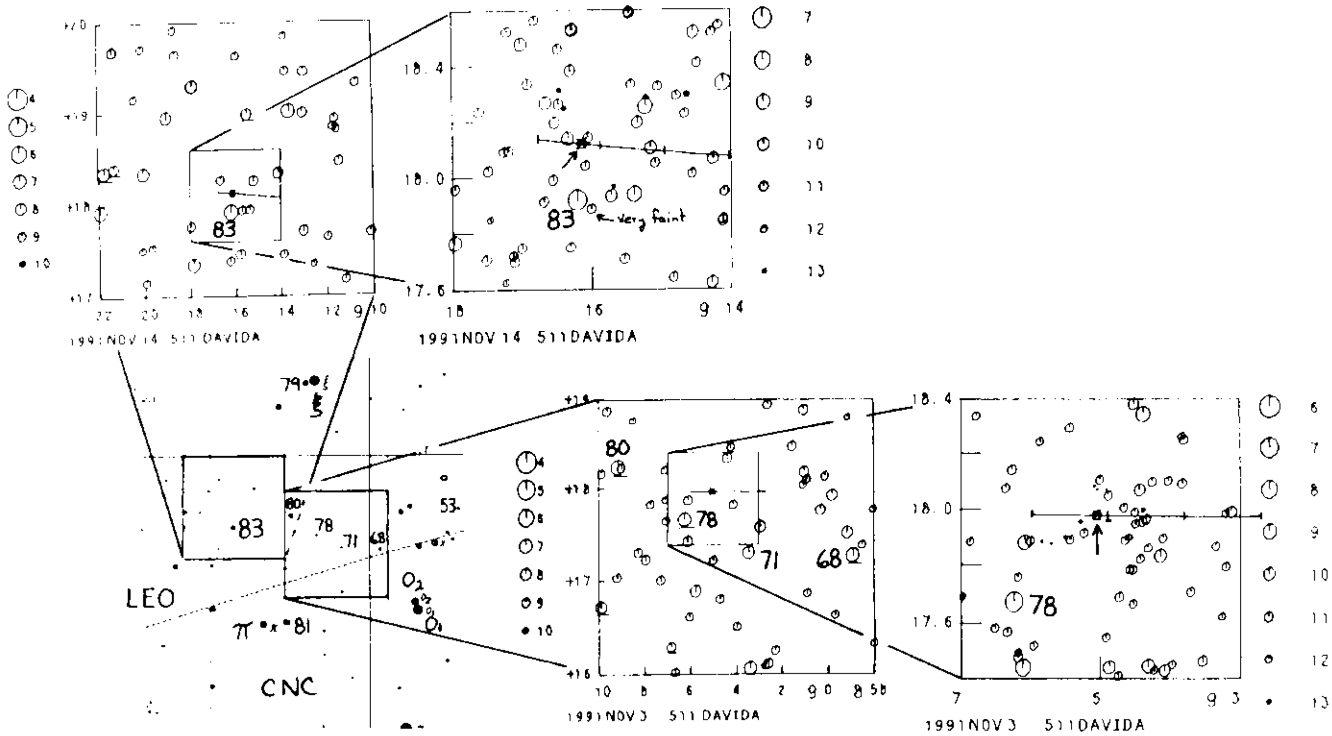
The CRRES release was not done Friday night. It was delayed until Monday. It was a brilliant red flash, visible in binoculars but not naked eye, that was detectable for only a few minutes.

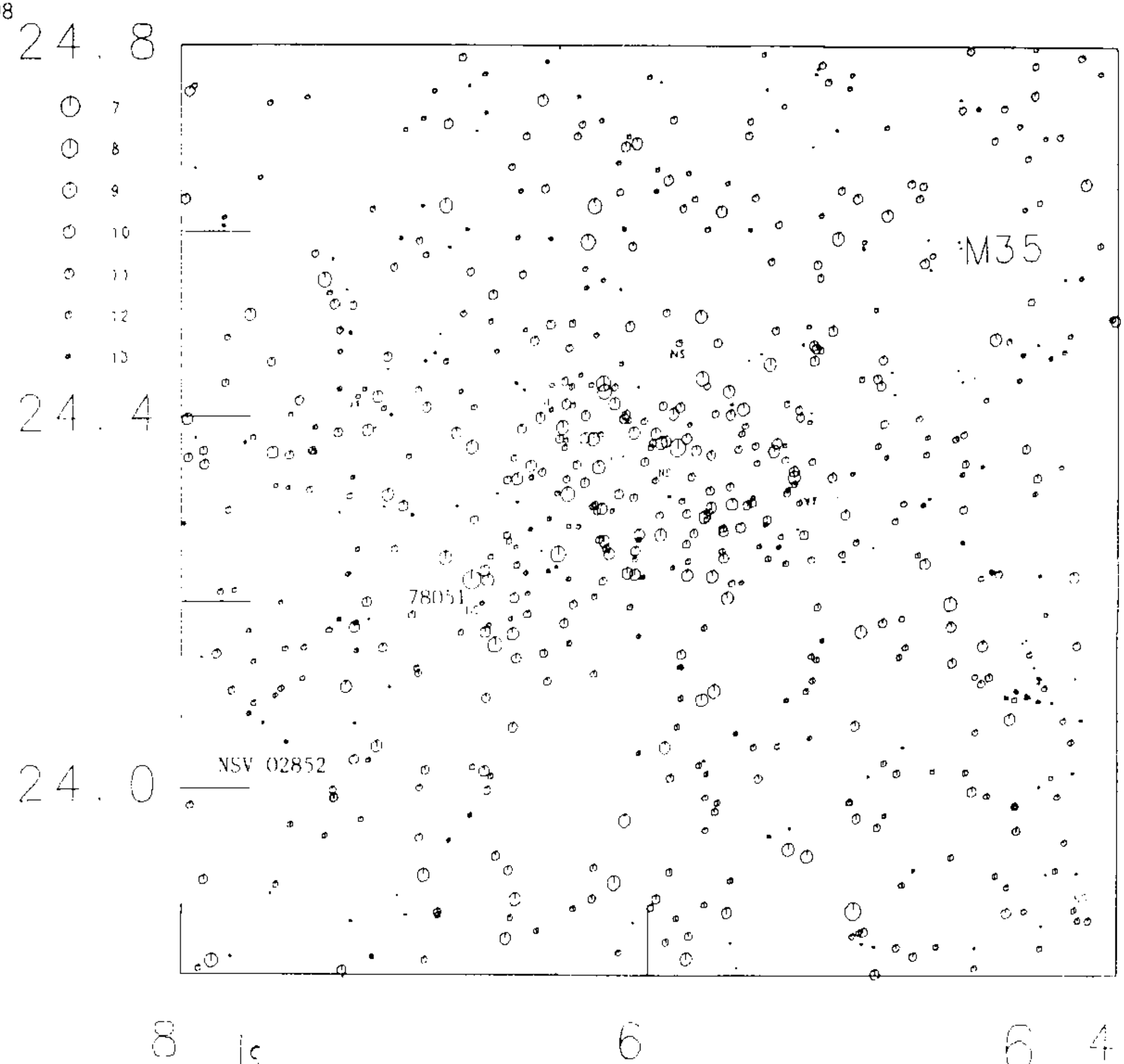
Is the universe a computer? The May 1991 issue of Physics Today has an entertaining article by an IBM Fellow, Rolf Landauer, titled "Information is Physical" (pg 23-29). This article surveys the current ideas on the limits of the communications channel, a field of study that combines computer science, physics, and philosophy. He argues that there are no unavoidable energy consumption requirements per computer operation, and shows how consideration of this topic raises questions about the nature of the laws of physics.

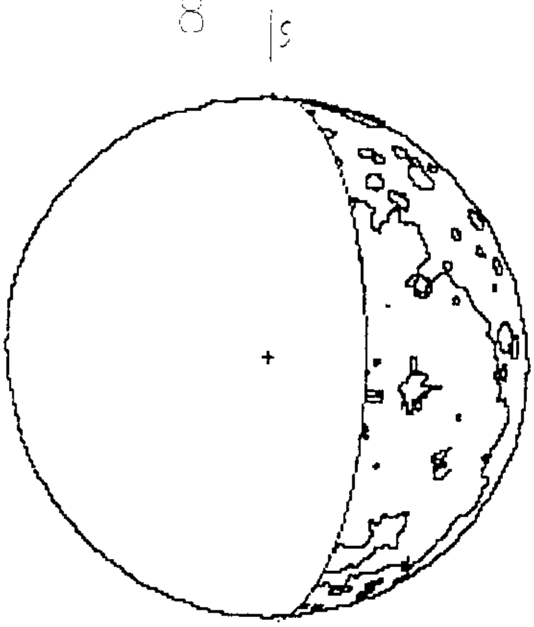
The minimal energy computations Landauer presents are those in which no information is thrown away, known as reversible computations. This is not just computation in which the initial conditions are saved: this is computation in which everything is saved. This avoids the energy used in erasing data. Minimal energy computation is only for the purpose of minimizing energy use, and says nothing about speed of computation or size of the computer components. Computers designed for minimal energy computation would be very different from the machines with which we are familiar, since the usual logic functions cannot be used. No such computer has ever been built. There has been a lot of discussion of the subject and considerable controversy over how minimal the energy consumption really is, and whether or not information can be discarded and still have minimal energy use.

A consequence of the discussion of minimal energy computation are the following questions: Is the universe a minimal energy computer for the laws of physics or are the laws independent of the universe? If the universe is finite, then are there limits on the precision of the laws of physics? If numbers such as pi cannot be computed exactly with a minimal energy computer without requiring an infinite memory, then are the laws of physics implementable? Most people believe that the laws of physics exist separately from the universe, but Landauer presents the case for believing that the laws and the universe are linked.

This field of study is one of much controversy. There is an extensive literature on the subject. If you are interested, I recommend starting with the Landauer article and his list of references.







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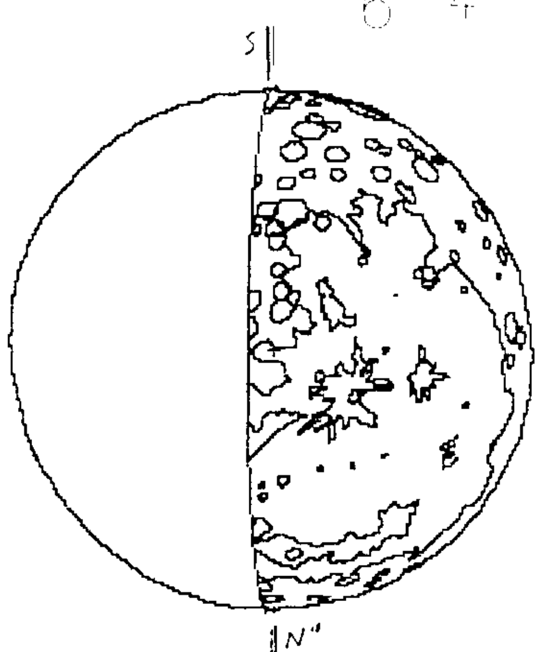

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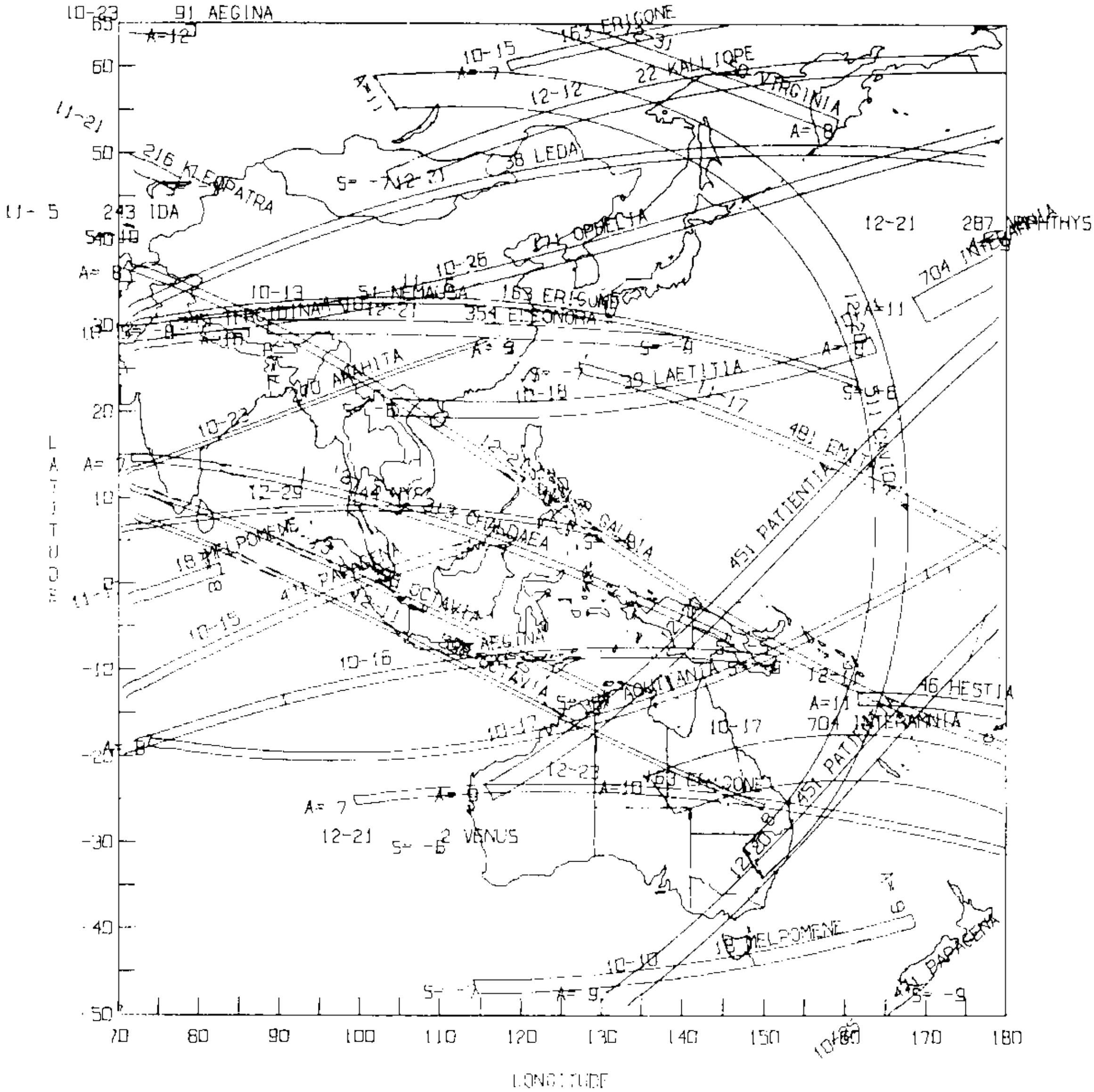
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171 OPHELIA
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51 NEMAUSA
163 ERIGONE
354 ELEONORA
39 LAETITIA
270 ANAHITA
481 EMITA
451 PATIENTIA
444 GYPTIS
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1 CERES
18 MELPOMENE
46 HESTIA
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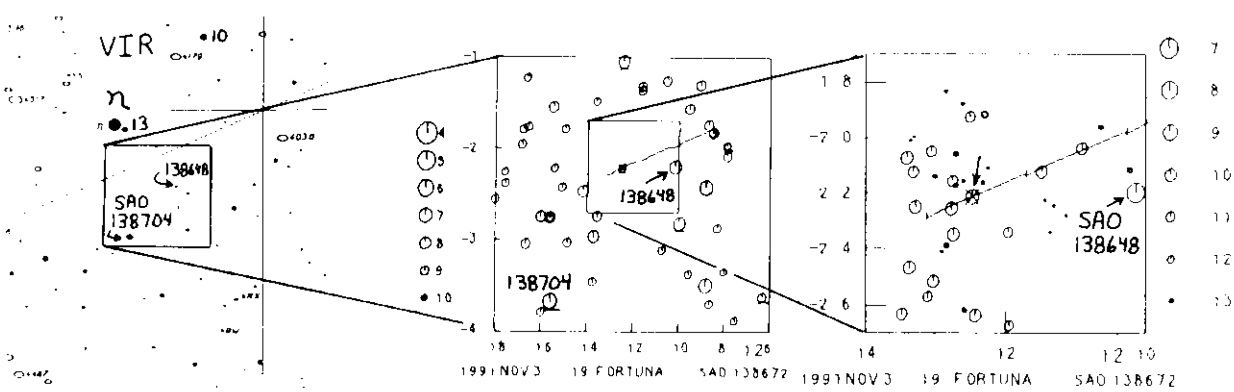
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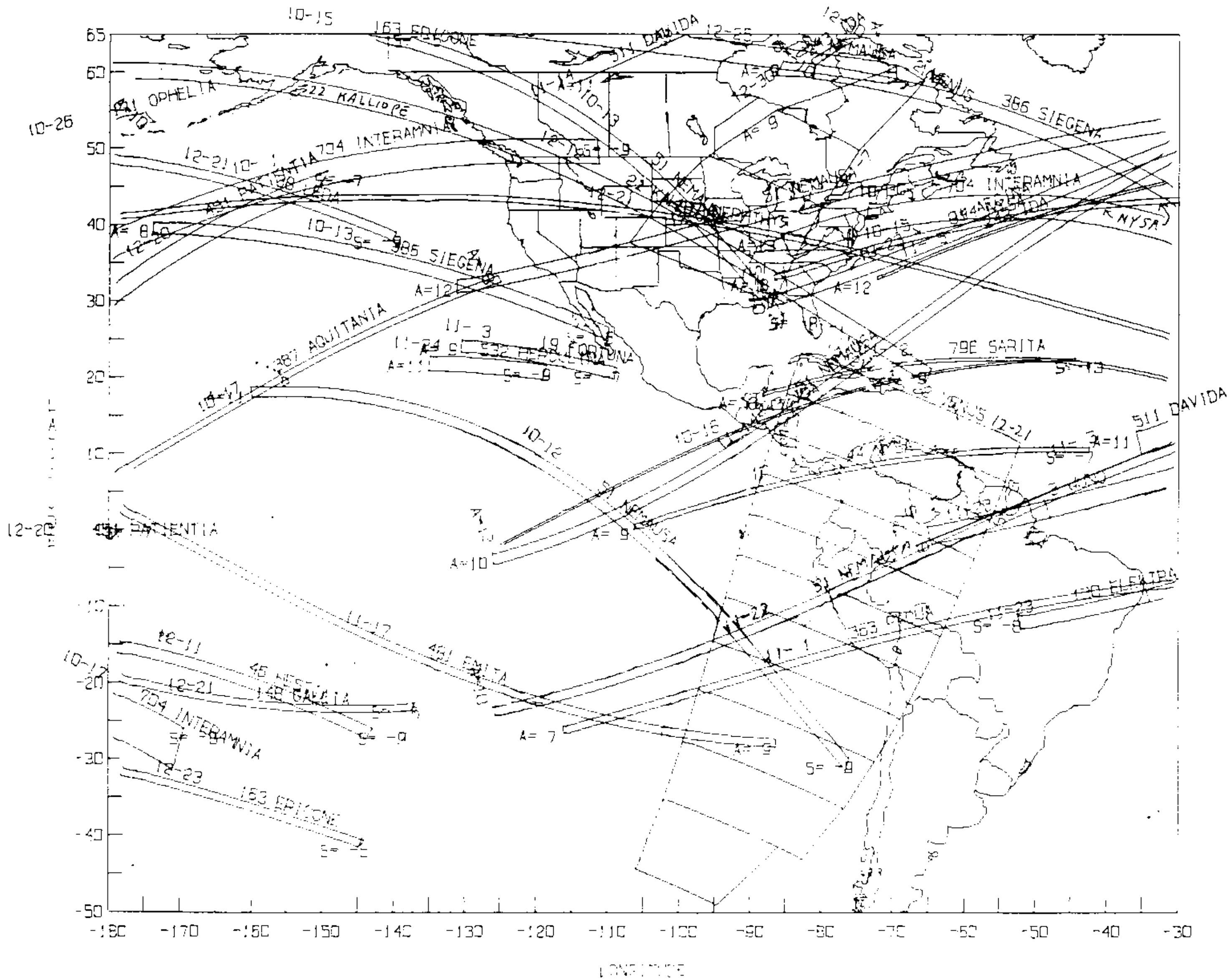
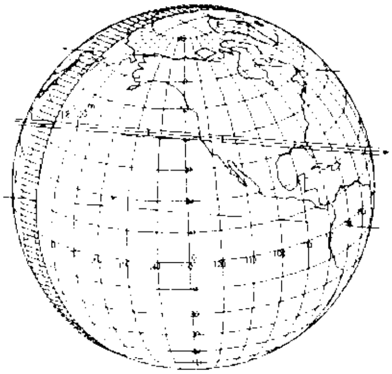
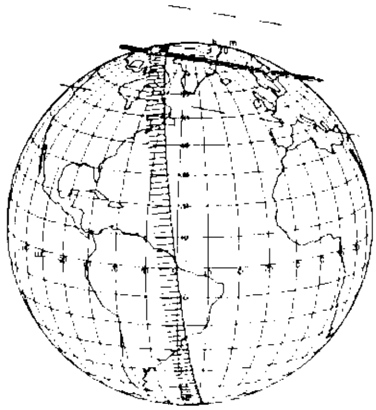
PLANETARY OCCULTATIONS 1991 OCT. - DEC

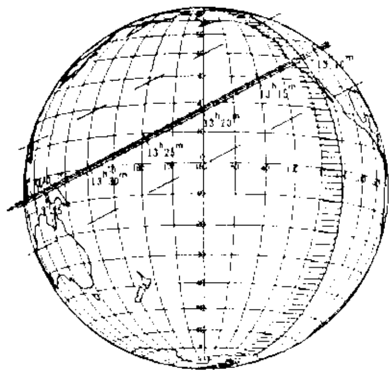




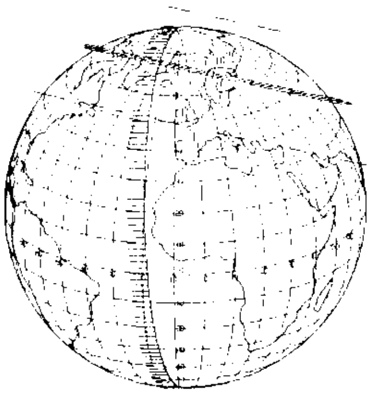
+24° 1976 by Patientia 1991 Sept. 1



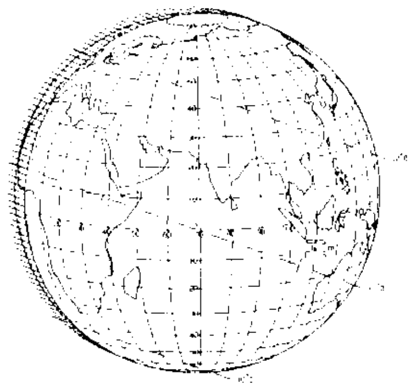
Anon. by Nemausa 1991 Sept. 5



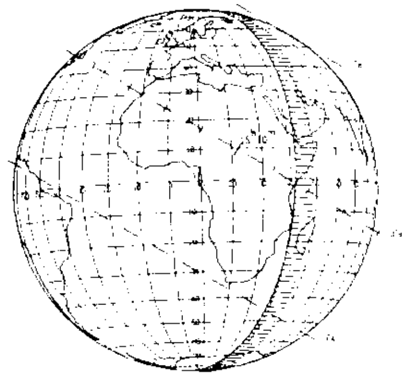
-9° 382 by Merapi 1991 Sept. 10



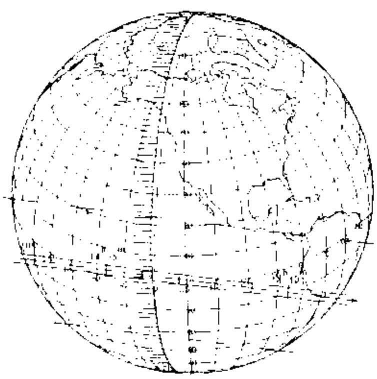
L 1 229 by Arethusa 1991 Sept. 13



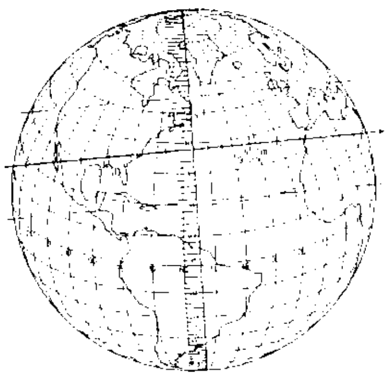
+12° 2162 by Jupiter 1991 Sept. 14



P 14 by Pluto 1991 Sept. 15



Anon. by Interamnia 1991 Sept. 18



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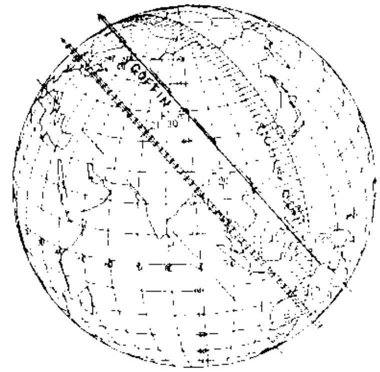

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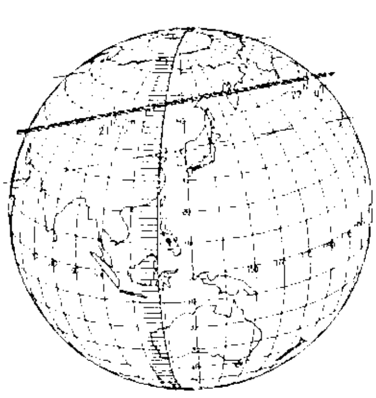
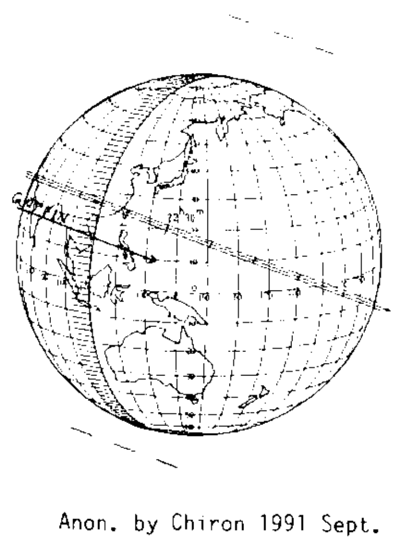
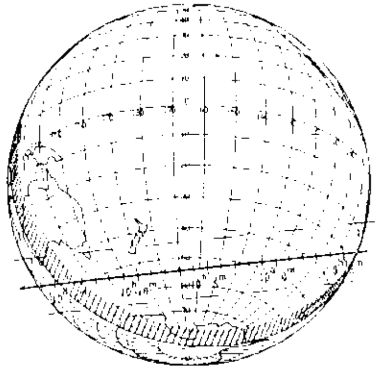


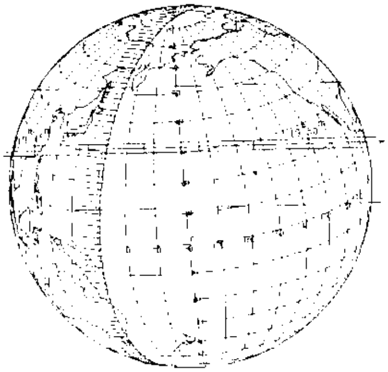
A2151533 Papagena 1991 Sept. 24





C2616626 by Pythia 1991 Sept. 26

Anon. by Chiron 1991 Sept. 24



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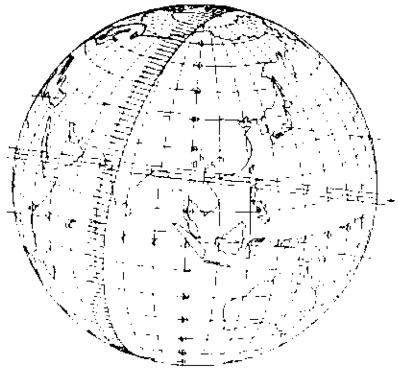
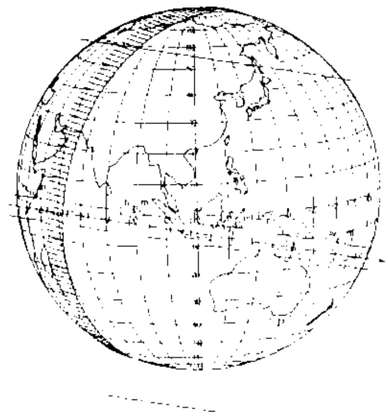
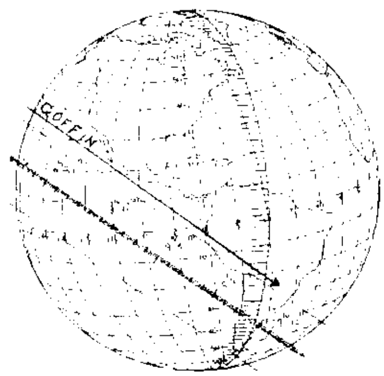


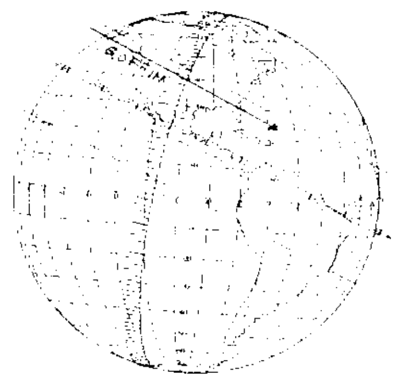
Anon. by Davida 1991 Oct. 3



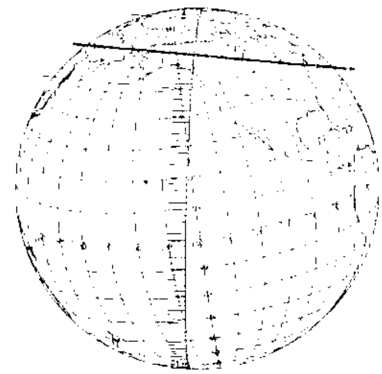
+ 8° 2336 by Venus 1991 Oct. 11



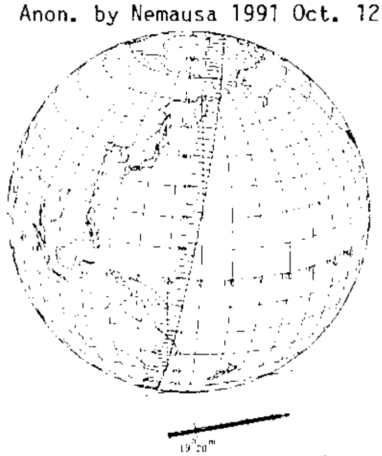
Anon. by Nemausa 1991 Oct. 12



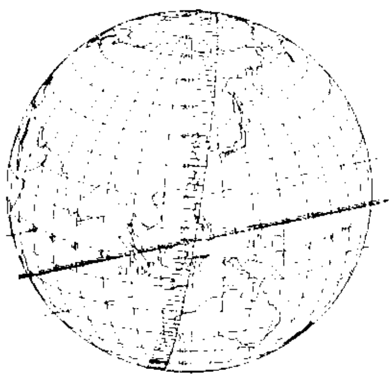
+1° 1994 by Siegena 1991 Oct. 13



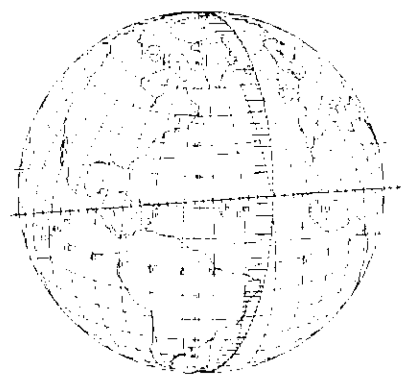
+16° 1549 by Erigone 1991 Oct. 15



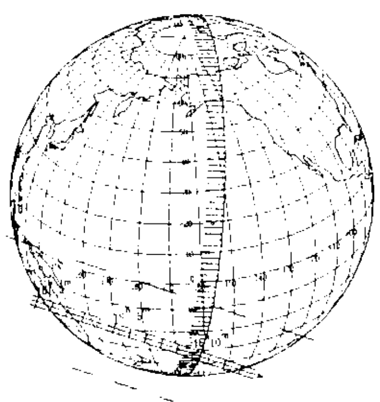
L4 549 by Papagena 1991 Oct. 15



+21° 1560 by Papagena 1991 Oct. 15



Anon. by Ida 1991 Oct. 16



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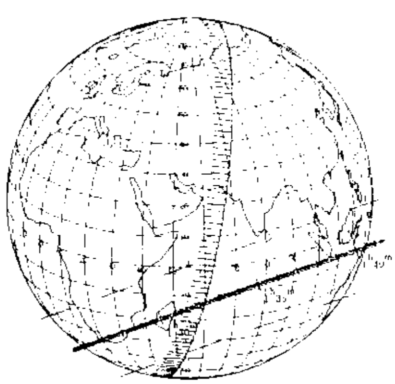
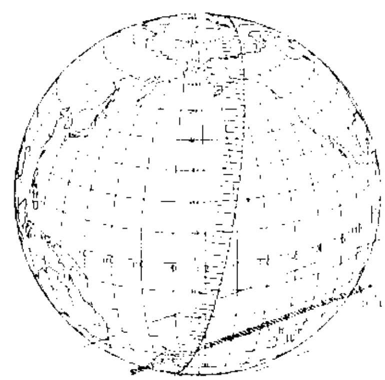
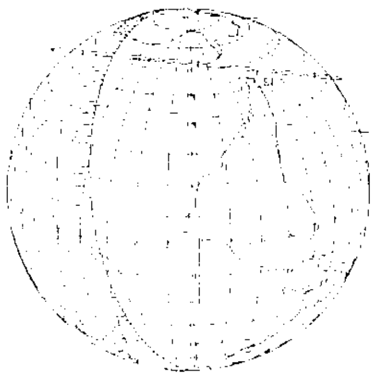


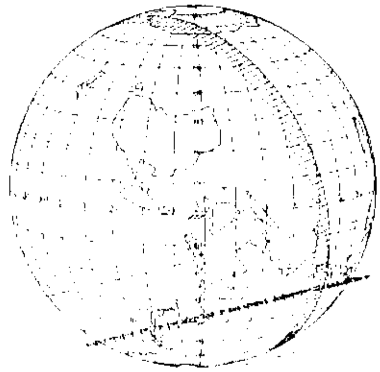
A2256133 by Papagena 1991 Oct. 25



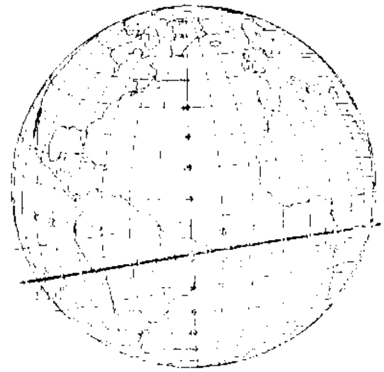
A2256152 by Papagena 1991 Oct. 25



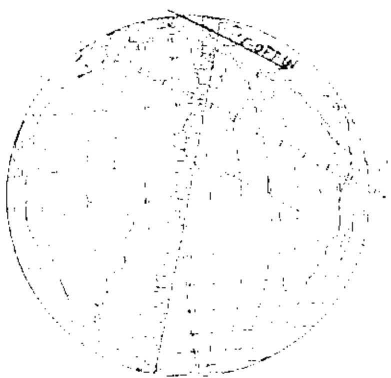
-9° 6134 by Ophelia 1991 Oct. 26



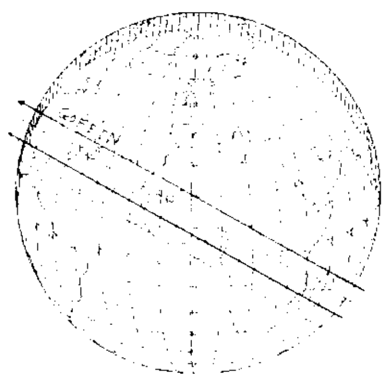
-18° 4858 by Melpomene 1991 Oct. 29



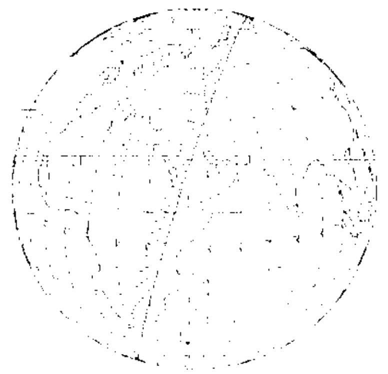
+13° 496 by Padua 1991 Nov. 1



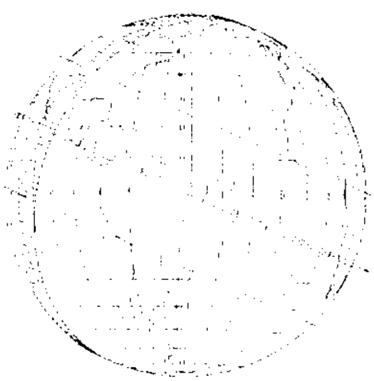
-0° 1973 by Siegena 1991 Nov. 1



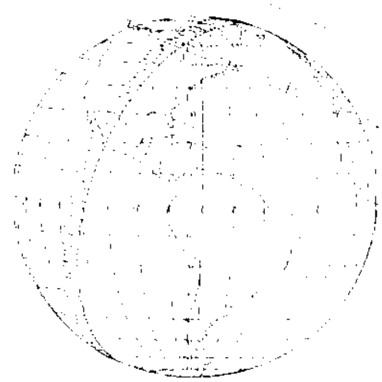
+20° 424 by Sarita 1991 Nov. 2



Anon. by Davida 1991 Nov. 3



-1° 2637 by Fortuna 1991 Nov. 3



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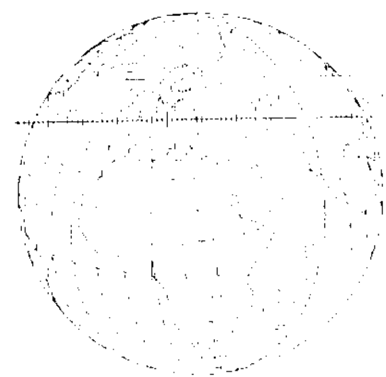

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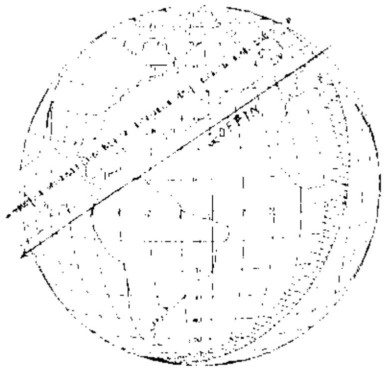

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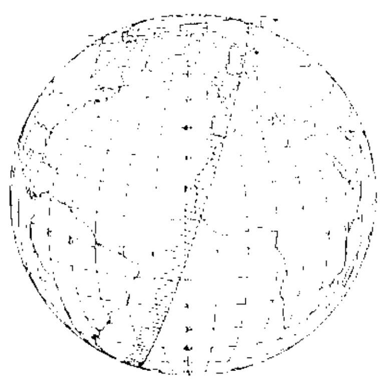

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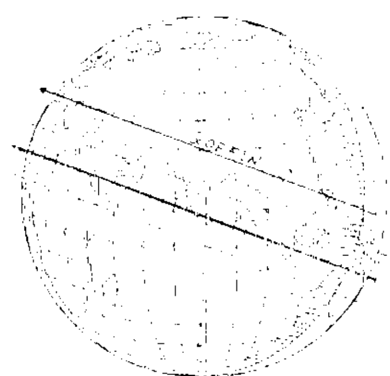
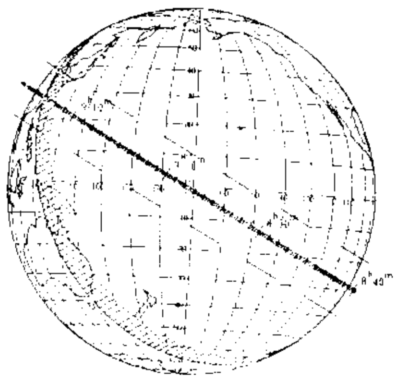
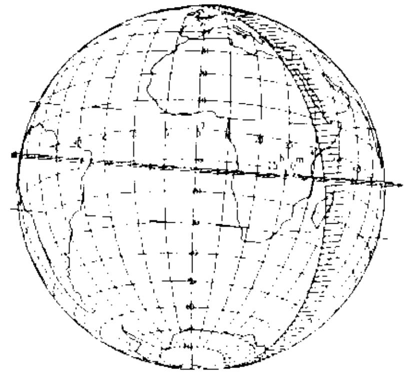


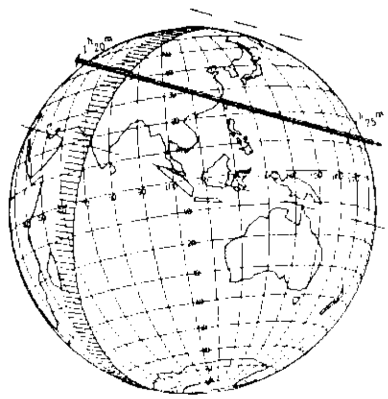
+14° 897 by Octavia 1991 Nov. 15



-2° 191 by Emita 1991 Nov. 17



-19° 5202 by Melpomene 1991 Nov. 17



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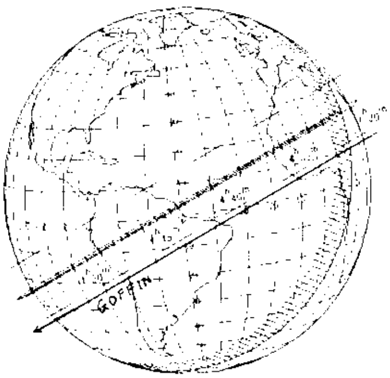

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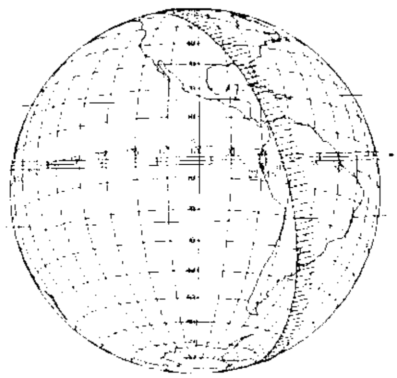
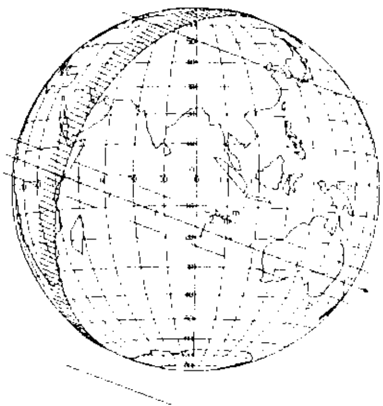
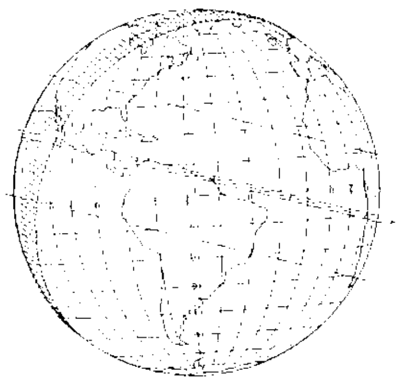


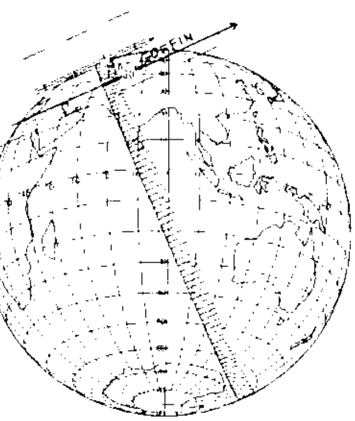
L 5 2674 by Juno 1991 Nov. 23



-3° 3396 by Venus 1991 Nov. 24

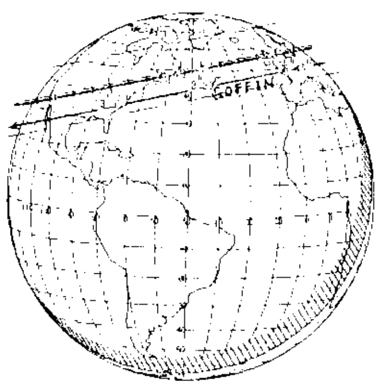


L 2 4043 by Herculina 1991 Nov. 24



-21° 6354 by Hebe 1991 Nov. 30

Anon. by Patientia 1991 Dec. 4



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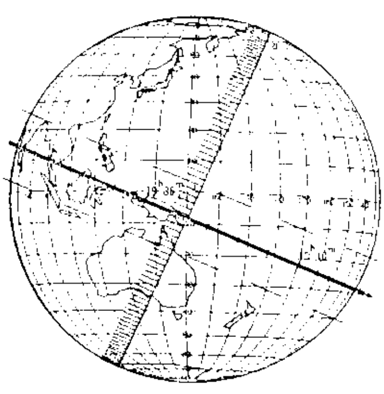

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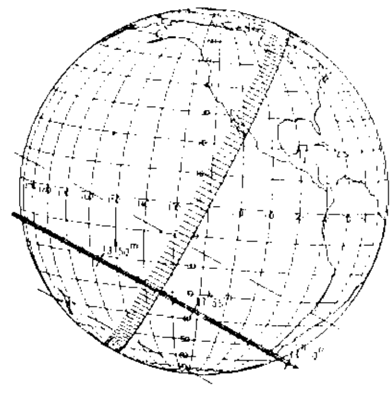

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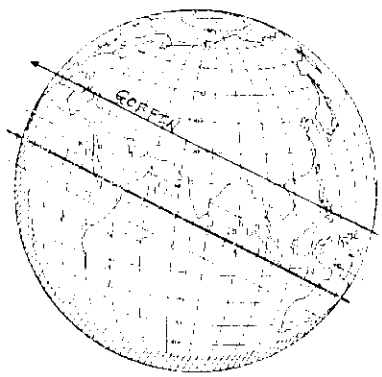

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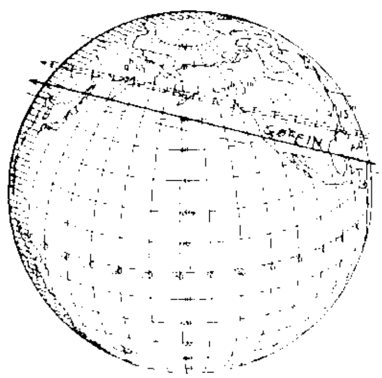

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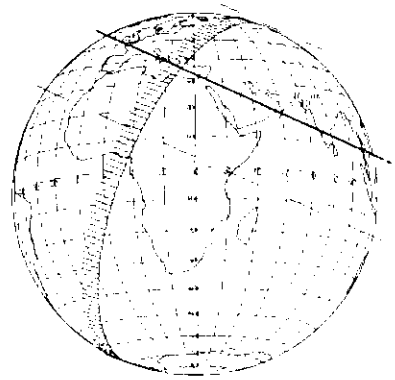
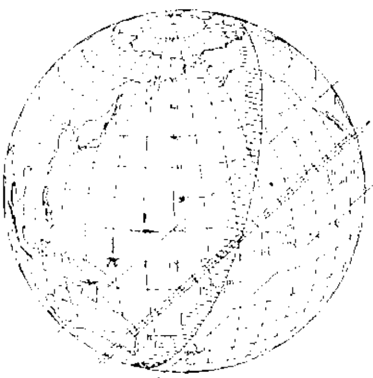


-7° 3582 by Eurydike 1991 Dec. 19



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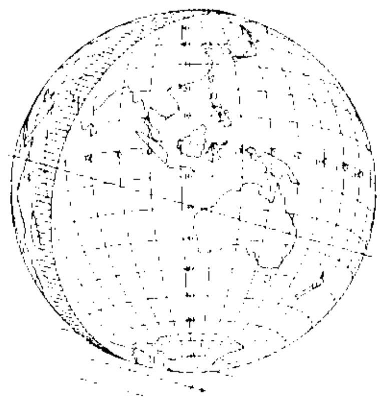
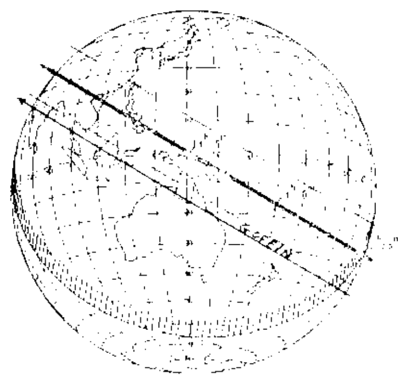


-14° 4095 by Venus 1991 Dec. 21



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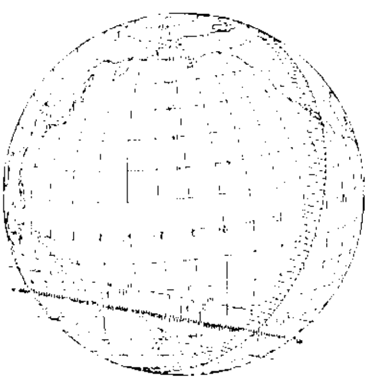

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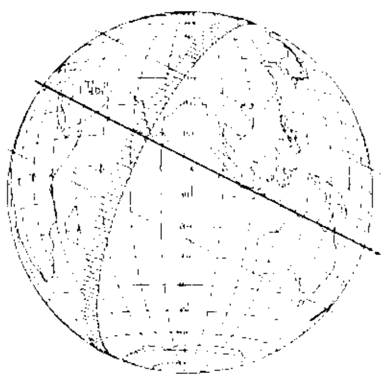

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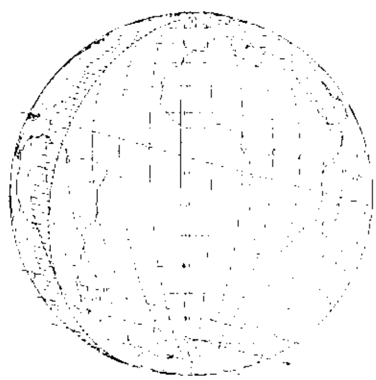

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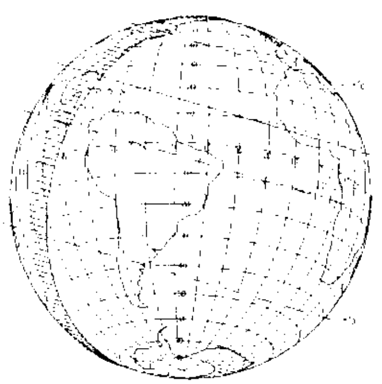

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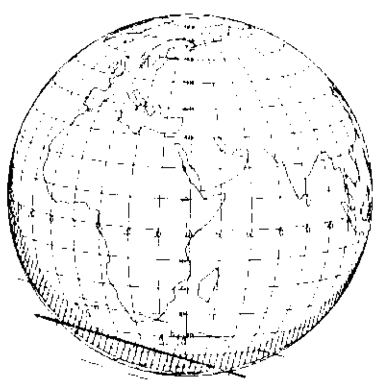
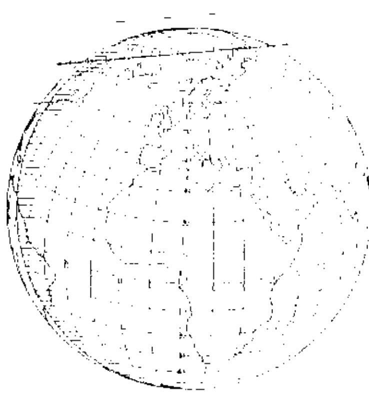


+11° 1159 by Nephthys 1991 Dec. 30



Anon. by Ida 1991 Dec. 30

IOTA

The International Occultation Timing Association was established to encourage and facilitate the observation of occultations and eclipses. It provides predictions for grazing occultations of stars by the Moon and predictions for occultations of stars by asteroids and planets, information on observing equipment and techniques, and reports to the members of observations made. IOTA is a tax-exempt organization under section 509(a)(2) of the (USA) Internal Revenue Code, and is incorporated in the state of Texas.

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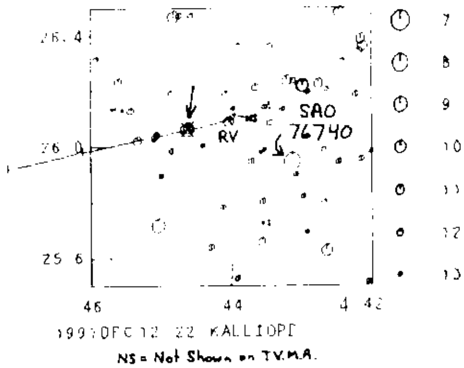
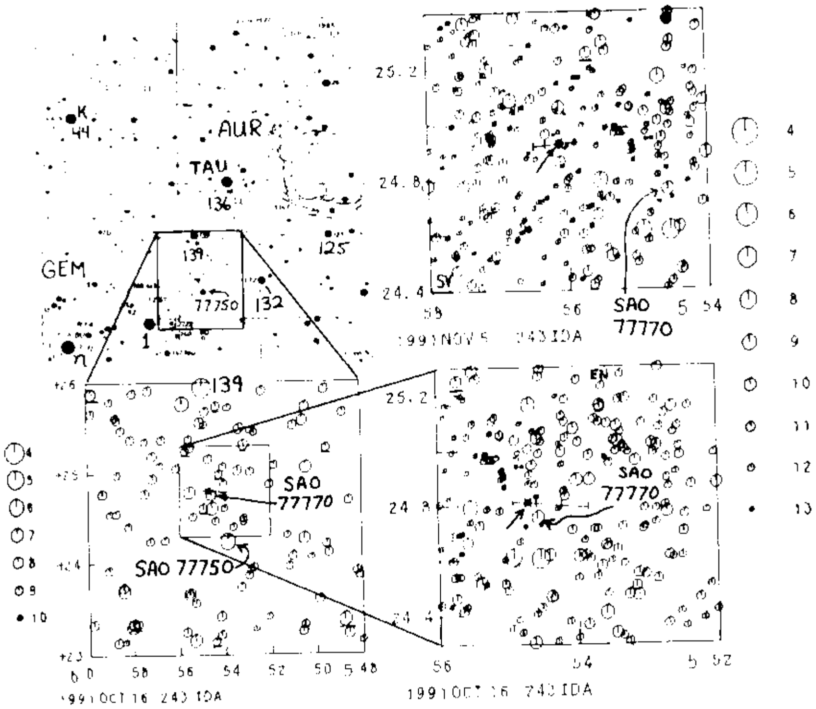
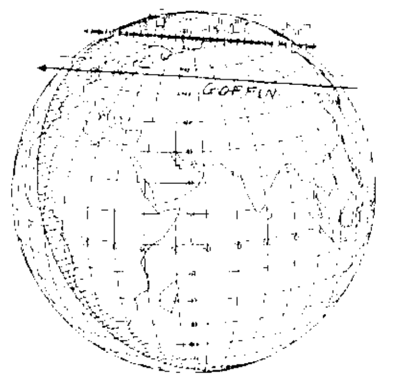
Germany







+16° 598 by Virginia 1991 Dec. 31