

# Occultation Newsletter

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## FROM THE PUBLISHER

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Graze, limit and profile prediction (each graze)	1.50
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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. Full membership in IOTA/ES includes the supplement for European observers (total and grazing occultations) and minor planet occultation data, including last-minute predictions, when available.

<sup>1</sup> Single issue at 1/4 of price shown  
<sup>2</sup> Price includes any supplements for North American observers.  
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<sup>5</sup> Area "B" includes the rest of South America, Mediterranean Africa, and Europe (except Estonia, Latvia, Lithuania, and U.S.S.R.).

## IOTA NEWS

David W. Dunham

The next meeting of IOTA will be held on Saturday, November 12th, at the Lunar and Planetary Institute; 3303 NASA Road 1; Houston, Texas (just east of the Johnson Spaceflight Center and about 35 miles south-east of downtown Houston). The meeting will start at 9 a.m. and is expected to last all day, as previous meetings have. More information can be obtained from Paul Maley; 15807 Brookville; Houston, TX 77059; phone 713,488-6871. The agenda will include business (including tax-deductibility of occultation and eclipse trips)(see p. 201 of the last issue); status reports of IOTA's many observational, analysis, and software projects; and predictions and plans for future occultations and eclipses. On Sunday evening, November 13th, those staying in the area are invited to join an expedition for a spectacular graze of 3rd-magnitude Tau Sagittarii near Houston; Maley will lead this effort.

We no longer live in Silver Spring; stop sending mail to our post office box there. We are now at:

Longitude 76° 52' 09" west  
 Latitude +38° 59' 10" N  
 Height 175 feet

These coordinates, for the center of our new driveway, are accurate to about ±0.5 on the 1927 North American Datum, scaled from the Lanham, Maryland 1:24,000-scale map photorevised in 1979. Although these coordinates are needed for accurate predictions and reporting observations, they will be of little use to the postal service. Mail for both Joan and me should now be sent to:

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

Our telephone is now 301,474-4722 (with answering machine), and the IOTA occultation line is at 301, 474-4945. Send large packages, and anything sent by parcel post, express mail, or commercial couriers such as Federal Express, to my office address (except for magnetic tapes used for transmitting occultation data, which should be sent to Marie Lukac at the U. S. Naval Observatory), which is still Computer Sciences Corp.; GreenTec II Building; 10110 Aerospace Road; Lanham-Seabrook, MD 20706, telephone 301,794-1392. We also have a fax machine there, number 301,794-4377. Telex messages for me should be sent to Wayne Warren at 89675 NASCOM GBLT. Wayne has helped me a great deal with star catalog and

other information (SIMBAD is a great online resource), and we have worked together on grazes for many years. He is now a neighbor, his house being less than 200 meters from ours.

I also now have an electronic mail address, DDUNHAM on NASAMAIL. There are ways to access this from SPAN and BITNET, but I have not yet learned a reliable way of doing this.

The first occultation that I observed from the above coordinates was a lunar reappearance of 8.7-mag. SAO 77777 on 88-8-8. We were fortunate to have unusually clear skies that morning, so I was able to record the emersion with my image-intensified video system (see p. 201 of the last issue), in spite of an altitude of 13°. The event was a graze at Rockville, about 25 miles to the northwest, but I did not go there, not knowing whether I would succeed. With those numbers, I should have realized that I couldn't miss, but some important sessions of the International Astronomical Union were to be held later that morning, and trying the graze would have been too tiring. However, I did record the reappearance of 7.0-mag. SAO 77818 an hour later. The star appeared very bright with the intensifier, and made a pleasing view with Mare Crisium and other earthshine-lit features of the 16%-sunlit Moon nearby. Image intensifiers and telescope connectors similar to the ones I use are sold by Astro Link, which has an advertisement on p. 212 of the August issue of *Sky and Telescope*.

Charles Herold, IOTA's executive secretary, moved from Houston to Venezuela for about two years, starting in July. Gary Nealis; 616 Cole Ave.; Webster, TX 77598, will be acting executive secretary until the next election. We will look forward to Gary's report of the November IOTA meeting.

Some of the spacecraft calculations performed by me and my co-workers at C.S.C. for Robert Farquhar are illustrated in our article on pages 134 and 135 of the August issue of *Sky and Telescope*. Most of my recent business trips have been related to comet mission design, and that will be true for my next trips, to the Institute of Space and Astronautical Science near Tokyo in mid-October, and to a Giotto science working team meeting in Darmstadt, German Federal Republic, in late November or early December (I hope that it will not interfere with my plans to observe the November 30th Regulus graze).

We plan to distribute the next issue in November or early December, to include my predictions for planetary and asteroidal occultations for 1989. The grazing occultation supplements for 1989 are being distributed with this issue.

CHINESE ECLIPSE DATA REDUCED; MEETING ON 1983 PALLAS OCCULTATION HELD; LUNAR OCCULTATION AND STAR CATALOG IMPROVEMENTS; AND OTHER NEWS FROM THE I.A.U. GENERAL ASSEMBLY IN AUGUST

David W. Dunham

Astronomers from around the world converged on Baltimore, Maryland, from August 1st to 11th to attend the 20th General Assembly. It provided a good opportunity to meet IOTA members and other astronomers with whom I had only corresponded by mail, as well as get up-to-date with several whom I had met at

previous meetings.

*Chinese Eclipse Data Analyzed.* Astronomers Wan Lai and Junliang Zhao, from Shanghai Observatory, arrived 10 days early, to work with Alan Fiala and me at the U. S. Naval Observatory to reduce their video observations of last September's annular eclipse. During this time, they stayed at the guest house at USNO, and some of their expenses were supported by IOTA. The first thing we did when they arrived was to take their videotape to a special video store which made and American-format copy.

They got the idea to videotape the eclipse from an article by Paul Maley in *MNASSA*. Three months before the eclipse, they realized that they might obtain observations at both limits, using two 20-cm telescopes that they had acquired for observing Halley's Comet and video equipment which they had also recently obtained for other purposes. They set up a projection system for each telescope, and a large shed to shade the projection screen and camera. They completed the equipment and tests only one day before the two 6-man expeditions had to leave Shanghai, to travel to Tenchang and Funing near the edges of the path of annularity. Besides the excellent observations, their videotape also showed views of setting up the equipment at their sites, on the grounds of government guest houses in both cities.

At USNO, we played back their tape many times to obtain times of all the Baily's bead events. We then computed and printed the lunar profile for each of these times, and were able to correlate nearly 120 timings with features from Watts' charts. We analyzed the residuals to determine the solar diameter and lunar center corrections using different combinations of the data. Later, we will combine their results with IOTA's results for a formal publication. I have obtained bead event timings from IOTA's videotapes, but have not yet produced the profiles needed to identify the beads with features from Watts' charts. I hope to do this before I go to Japan next month, since Isao Sato also photographed the eclipse near the southern limit near Okinawa, and we want to include these results, also.

Zhao also gave me a copy of the report of their photoelectric observation of last December's occultation by (324) Bamberga. This event sparked their interest in asteroidal occultations, and with Shanghai Observatory's emphasis on positional astronomy, they can make significant contributions. Their 155-cm astrometric reflector is similar to the 61-inch USNO telescope at Flagstaff, which has given the most accurate astrometry for occultations.

Occultations of Maia, Electra, and Taygeta were recorded photoelectrically at Shanghai on 1987 December 31. Fringes were recorded, and those for Electra seem to be distorted by the star's duplicity. Duplicity is not obvious in their record for Taygeta, which is also the case for my less-accurate video recording of the star's reappearance on September 2nd.

I expect to attend the International Astronomical Federation's meeting in Beijing in October, 1989, and plan on a side trip to Shanghai Observatory after that meeting.

*Pluto Occultation Observed.* Although the June 9th

occultation of a 12.3-magnitude star was not discussed extensively at the I.A.U. meeting, Graham Blow, Carter Observatory, gave a detailed presentation about it at the meeting of the Astronomical Society of Australia in Narrabri at the end of August. The event was recorded photoelectrically at 6 observatories in Australia and New Zealand, and also from the Kuiper Airborne Observatory and by Robert Millis with one of Lowell Observatory's portable systems in Queensland. In addition, the star was brighter than originally predicted, so that four visual observers were also able to time the occultation. Since the original magnitude was 13.2, I thought that the event would be beyond the reach of most *O.N.* readers' equipment, so I mentioned the event only briefly; see *O.N.* 4 (6), p. 152. A good series of photographs of Pluto approaching the star was obtained with USNO's 61-inch astrometric reflector at Flagstaff. Conditions were so good that the motion of the center of light due to Charon's motion was evident in the measurements, which predicted the center of the occultation path to an accuracy of less than 0.005! This telescope also gave the best last-minute prediction for the occultation of 1 Vulpeculae by Pallas in 1983, where the error was less than 0.02; with slower-moving Pluto and smaller magnitude difference between the objects, one could expect even better accuracies for Pluto events. The occultation observations seem to indicate a diameter of about 2200 km, with an extensive atmosphere, apparently composed mostly of methane. The photoelectric records show some structure in the atmosphere, and the three southernmost observatories were south of the solid-Pluto southern limit, but had substantial partial occultations by the atmosphere. So now multiple-chord occultations have been timed for all the planets except Mercury. Many interesting results are sure to come from the Pluto occultation data as they are analyzed more extensively.

*Eclipse Meetings.* Two meetings on solar eclipses were held, mainly to plan for the total eclipses in 1990 and 1991. Although weather prospects are not very good for 1990, Soviet astronomers are making some plans for this eclipse, to obtain movies near the edges of the path for solar radius determination, and to make some radio observations. Sites in eastern Siberia are being considered for slightly better cloud cover statistics.

For 1991, Hawaii and western Mexico are favored. Mexican astronomers expressed an interest in solar radius determination from path-edge observations. At a meeting on amateur-professional cooperation held on July 31st, Steve Edberg proposed a joint meeting, like the one held last year in Paris, just before or after the 1991 eclipse in Baja California. Before the 1990 eclipse, the British Astronomical Association will celebrate its 100th anniversary with a meeting in England, allowing enough time to go to Finland for the eclipse.

*Pallas Occultation Meeting.* On August 10th, Joan and I held a special meeting for observers of the 1983 May 29th occultation of 1 Vulpeculae by Pallas. Analysis of this event is virtually complete, and we distributed a rough draft of a paper about the occultation at the meeting, where we discussed additional material, and some changes, that were needed. These changes were documented in a letter sent to coauthors a few days later. We will work on revising the draft after my October 1st deadline for 1989

occultation articles for *Sky and Telescope*, and hope to complete it before I depart for Japan in mid-October.

*Lunar Occultation News.* Dr. Kubo presented ILOC's results from lunar occultations, showing monthly corrections to the lunar ecliptic longitude and latitude at monthly intervals for the previous three years. After the presentation, Dr. Myles Standish, Jet Propulsion Laboratory, asked why they were solving for corrections to the lunar ephemeris, when it is known to much better accuracy from lunar laser ranging observations. Kubo acknowledged that the corrections were really mainly due to systematic and random errors in stellar positions and proper motions, and the limb correction data, and was open to discussing other ways of analyzing the data.

Victor Abalakin, Institute of Theoretical Astronomy, Leningrad, discussed lunar occultation observations in the U.S.S.R., saying that they had submitted a proposal to equip ten observatories with equipment to record occultations photoelectrically. To support lunar occultation work, they are working on a new catalog of the zodiacal zone that should be complete to 11th magnitude. They have made photographic observations for the catalog, but were having some trouble with securing accurate results. I suggested that USNO's Zodiacal Zone catalog may be able to help.

*Star Catalog News.* Conversion from equinox B1950 to J2000 dominated many discussions of catalogs. Agreement has been reached for this conversion to a few tenths of an arc second, and conversion to J2000 was recommended for most applications during the next few years.

Workers at the Astronomische Rechen Institut at Heidelberg, German Federal Republic, reported on a new version of the AGK catalogs called PPM. A preliminary version, including Astrographic Catalog, AGK2, and AGK3 data, is now available. But better improvement is expected for the final version due at the end of 1989, which will include thousands of new observations, especially those made with a photoelectric meridian telescope at La Palma, Canary Islands.

Although less precise, the Guide Star catalog being prepared for the Space Telescope promises even greater benefits, since it will include millions of stars complete to 13th magnitude, with stars as faint as 15th mag. far from the Milky Way. The AGK3 and SAO catalogs were used to reduce the scans of large Schmidt plates for this gargantuan project, which is expected to be complete by the end of the year. That's too late for 1989 asteroidal occultation predictions, but from 1990 on, we should be able to compute comprehensive predictions of these events.

*Commission 20 Meeting on Minor Planets.* Elizabeth Roemer made some introductory remarks for a session on asteroidal occultations, unfortunately stating that only two observatories (Lick and Lowell) were properly equipped for performing last-minute astrometry. Perhaps reflecting this feeling, Millis' report of priority occultations during the past three years showed a shocking decline in the number of these events for which astrometric improvement had been accomplished, and after leading in this field for many years, the large majority of this work is

now done outside of the U.S.A. Less can be accomplished at Lick with the retirement of G. Harlan, and Lowell's 18-inch telescope has been plagued with focusing problems during warm weather. Due to these problems and other commitments, Lowell can now improve only about 3 events per year, and more observatories must get involved if enough astrometric improvements are to be made for more observers to justify the cost of acquiring portable photoelectric or video systems. Fortunately, this is starting to happen, and with catalogs such as the Zodiacal Zone and (future) PPM giving relatively dense coverage at the quarter-arc-second accuracy level, astrometric telescopes with smaller fields of view will become more effective. Preliminary astrometry (obtained 4 to 6 weeks before the occultation) will have greater meaning, since a quarter of an arc second is enough to tell whether a path will cross areas with numerous observers that would justify further last-minute improvements.

At the occultation session, Bob Millis said that he would no longer be able to chair the working group on occultations. There was some discussion about the need for the working group, but a vote showed that nearly everyone was in favor of continuing it. Although some European members suggested that IOTA run the working group, other American members (not those in Flagstaff) stated that it would be best run from Lowell. Larry Wasserman was selected as the new chairman. One of his first jobs was to update a list of proposed stars for the Hipparcos astrometric satellite which Gordon Taylor had assembled, of stars occulted by planets, asteroids, and natural satellites other than the Moon, in 1984. I helped Wasserman with this, since I am principal investigator for a list of thousands of stars whose lunar occultations have been observed. The rule was that a star added to the Hipparcos observation catalog (called INput Catalogue, or INCA) had to be accompanied by another one in INCA that was removed, to keep the total number constant. So I selected low-priority stars to be removed from the lunar proposal to make room for the less-than 50 stars, mainly involved with asteroidal occultations, that we wanted to add. The extremely accurate positions for these stars that Hipparcos can provide can greatly improve values for the orbital elements of the asteroids involved. Also, with help from Paul Maley and others, I had assembled an up-to-date list of observed asteroidal occultations, part of which will be published in a chapter on occultations, of which I am a coauthor with Bob Millis, in the Asteroids II book that grew out of last March's conference.

*HST Asteroid Proposal Meeting.* On August 11th, I attended a special meeting held at the Space Telescope Science Institute to formulate a joint General Observer proposal for the Hubble telescope. Clark Chapman, Planetary Science Institute, is leading the effort to complete the proposal before the October 1st deadline. My main interest is to image certain asteroids to check on claims that they have satellites, from occultation observations, and part of the proposal is devoted to this idea.

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#### XZ CATALOG AND PREDICTIONS FOR 1989 AND 1990

David W. Dunham

I have completed merging the Perth 70 and Zodiacal Zone catalogs with the XZ. The printouts generated

by the computer runs give the differences between the current catalog positions and the new catalogs, facilitating the calculation of shifts for grazes and asteroidal occultations. In October, I plan to also merge Lick Voyager data into the XZ, after which it will be ready to generate the data for 1989 grazes, and for distribution to several who have requested it. So I expect to distribute the 1989 graze data to computers at the end of October, or very early in November.

At the moment, we can not generate accurate predictions for 1990 and beyond, since the current ephemeris tape used by the main OCC program at USNO ends early in January, 1990. Fortunately, Al Fiala recently found three of Tom Van Flandern's programs, along with some notes and an input ephemeris tape from J.P.L., that together should permit creation of an OCC ephemeris tape through at least the end of the century. We hope to sort out any problems with running these programs on the current CMS system long before the 1990 prediction runs need to start.

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#### THE OCCULTATION OF 136 TAURI BY VENUS ON 1988 MAY 11

Jean Meeus

We received several observations of this occultation. They are mentioned in the accompanying table. The German observations were communicated to me by Roland Boninsegna, while A. A. Gerritsen sent me the Dutch observations.

The star's reappearance took place at the bright limb of Venus, and hence the instant of this event was almost impossible to measure. Moreover, at many places the seeing was bad.

In the table, column 'Phen.' mentions the type of the phenomenon: 1 = disappearance, 2 = reappearance.

The last column gives the distance of the star to the center of the planet's disk, in units of the planet's radius. This distance has been calculated by me. The star's position has been taken from the XZ catalogue; for Venus, use has been made of the accurate ephemeris published in the Soviet almanac *Astronomicheskii Ezhegodnik* for 1988.

For the difference ET-UT, a value of +56 seconds has been used. For the radius of Venus, I used the value  $k = 0.95632$  (Earth = 1), which corresponds to the "classical" value of 8.41 arcseconds for Venus' semidiameter at unit distance. No allowance has been made for any atmospheric effect.

#### Remarks

- a Very bad seeing
- b Bad seeing
- c First observed decrease of light
- d Disappearance of last speck of light
- e First possible detection of star
- f Only from now on is the star well visible
- g Star disappears suddenly
- h Brightness decrease of star is approximately 0.5 magnitude
- i Brightness of star approximately magnitude 9.0
- j Star stands away from bright limb
- k "Central" disappearance. Blinks during about 5 seconds from 19:31:43 UT. Bad seeing and cloudy.

l The star then flashes during 11 seconds after a decrease during a few seconds, the star  
 m Brightness of star decreases during 5 seconds disappears definitely  
 n Noise from a nearby meeting r Brightness of star decreases during 6 minutes (??)  
 o Brightness of star decreases during 1 to 1½ sec. s Star disappears during 1 or 2 seconds. Then, af-  
 p Noise from enthusiastic viewers ter a decrease during 0.5 to 1 second, it disap-  
 q Star disappears completely during 1 second. Then, pears definitely

Place	Longitude East	Latitude North	Height (m)	Observer	Instrument	Magni- fication	Phen.	UT	Remarks	Distance			
Heist-op- den-Berg (Belgium)	4° 44' "	51° 05' "	-	L. Aerts	Celestron- Schmidt-Cass. 280 mm	250	1	19 <sup>h</sup> 31 <sup>m</sup> 28 <sup>s</sup>	a, g	1.0224			
							2	19 58 40	e	1.0698			
							2	20 02 58	f, j	1.2058			
Zoetermeer (NL)	4 28 46	52 04 12	5	H. Bulder	Newton, 300 mm	253	1	19 30 52.0	a, c	1.0232			
							1	19 31 02.4	a, d	1.0185			
							2	19 58 59.6	a, e	1.0840			
							2	20 00 10.0	a, f	1.1202			
Stuttgart (D)	9 11 51	48 47 00	350	A. Epple	Schmidt- Cassegrain 200 mm	170	1	19 32 09	b, c	1.0239			
							1	19 32 24	b, d	1.0171			
				H. Marx	Refr. 175 mm	144	1	19 32 10.3	b, c, h	1.0233			
							1	19 32 24.9	b, d, i	1.0167			
							2	20 02 04	b, j	1.1496			
				O. Farago	Celestron 8 200 mm	129	1	19 32 09.1	b, c	1.0239			
1	19 32 27.0	b, d	1.0158										
E.-J. Beneke	Refr. 220 mm	150	1	19 32 19.2	b	1.0193							
Klein- Wintersheim (Mainz) (D)	8 13 37	49 56 55	202	T. Presper	Newton 200 mm	88	1	19 31 43	k	1.0207			
Wiesbaden (D)	8 15 47	50 04 58	198	W. Palzer	Maksutov 300 mm	282	1	19 31 39.3	c, l	1.0201			
							1	19 31 51	d	1.0147			
							A. Schott	Refr. 120 mm	180	1	19 31 47.5	d	1.0163
Roden (NL)	6 24 35	53 08 23	0	G. Comello	Schmidt- Cassegrain 200 mm	230	1	19 30 04.5	m	1.0208			
Amsterdam (NL)	4 55 10	52 23 04	10	W. Nobel	Refr. 75 mm	96	1	19 30 34.5	n	1.0245			
Wassenaar (NL)	4 22 41	52 07 08	5	P. Louwman	Celestron C 11		1	19 30 52.4	o	1.0225			
Almen (NL)	6 19 05	52 09 52	10	R. Boschloo	Newton 300 mm		1	19 30 39.3	p	1.0210			
Geleen (NL)	5 49 51	50 59 04	65	H. J. Brill	Newton 140 mm	60	1	19 31 24	q	1.0217			
Weert (NL)	5 43 03	51 14 30	35	J. Geenen	Refr. 100 mm	60	1	19 29 30	r	1.0716			
Zaandam (NL)	4 44 19	52 26 01	0	A. A. Ger- ritsen	Newton 153 mm	105	1	19 30 37	s	1.0231			
Bennebroek (NL)	4 36 22	52 19 17	0	Roos	Refr. 102 mm	145	1	19 30 42.8	t	1.0228			
Baexem (NL)	5 52 44	51 13 39	60	Scheenen	Schmidt-Cass. 200 mm	133	1	19 31 12		1.0230			
Roden (NL)	6 26 37	53 07 44	12	A. A. Schoenmaker	Cassegrain 600 mm	200	1	19 29 58.7	u	1.0236			
Amersfoort (NL)	5 23 10	52 10 47	5	Jansen	Refr. 90 mm	150	1	19 30 43		1.0223			
							Slooten	Newton 200 mm	200	1	19 30 42		1.0228
Thesinge (NL)	6 39 09	53 16 01	0	W. A. Zijlema	Refr. 102 mm	167	1	19 29 52		1.0238			
Appingedam (NL)	6 50 44	53 19 08	0	W. T. Zanstra	Newton 150 mm	70	1	19 29 58		1.0194			
Oosterhout (NL)	4 52 54	51 39 16		E. K. Wubbena	Kutter 200 mm	200	1	19 31 03.6	v	1.0234			
Emmen (NL)	6 53 44	52 47 48		B. Boelens	Cassegrain 255 mm	300	1	19 30 17	w	1.0189			
							Mink	Newton 200 mm	150	1	19 30 13	x	1.0208
							Westen- broek	Newton 200 mm	167	1	19 30 30	y	1.0128

- t Brightness decreases during 0.75 second
- u Excellent conditions
- v Brightness decreases during  $\frac{1}{2}$  to 1 second
- w Brightness decreases during 15 to 20 seconds.  
Just before the actual occultation, the star dis-  
appears completely during about 1 second
- x Bad optics. Brightness decreases during 10 sec.
- y Brightness decreases during 20 seconds

This same report will be published, with minor changes, in the Belgian journal *Heelal* (in Dutch).

#### ASTRONOMY AND PERSONAL COMPUTERS

JOAN BIXBY DUNHAM

*Maps for Spectacular Events.* A map of the November 30 Regulus occultation for the continental U.S. will appear in the November issue of *Sky and Telescope*, based in part on software written by Dan Falla. In response to my request for software to generate the data, Dan wrote a BASIC program to provide data for plotting the occultation time curves. He was not able to finish his program before David needed the data, so he sent it to us with instructions on what further modifications it needed. We completed those, ran the software, generated the maps, and faxed them to *Sky and Telescope* only an hour before their deadline. We found the computations very slow in standard GW BASIC, so we compiled the program with Borland's Turbo Basic, and gained a fourfold increase in execution speed.

*MOCCULT.* Jim Van Nuland sent a copy of MOCCULT, a program to calculate local circumstances for grazing occultations of a star or a planet, using algorithms and data given in Meeus' *Astronomical Tables of the Sun, Moon, and Planets*, Willman-Bell, 1983. This is a BASIC program for MS DOS machines. Jim writes that the program accurately reproduces the test cases in the book, down to 4 decimals of latitude and 1 second of time. However, comparison with stellar grazes as calculated by USNO/IOTA shows a consistent difference of about 0.3 minutes of latitude. MOCCULT reads a file to obtain its input data, then writes the results onto the screen. It gives the local circumstances, then calculates the nearest graze line, for the longitudes specified in the input file.

Jim's diskette arrived folded completely double, so that the diskette jacket was permanently creased. Once creased, the jackets do not allow the diskette to turn, so I cut away (carefully!) the crimped part, and was able to read Jim's disk and copy it to another diskette. I have since been told that some people keep an empty jacket, created by slitting a jacket and discarding the diskette, for just such eventualities.

*Backing up Hard Disks.* How often should a hard disk be backed up? We know some very cautious people who back up virtually every week, if not every day. We owned our hard-disk-equipped computer more than two years before we backed it up once. We follow a policy of software on the hard disk, data on floppies, so that, if the hard disk should fail, we have everything on floppies. Somewhere. We admit that we could find ourselves digging among stacks of floppies, trying to remember what we had where, but, so far, we have had no trouble. We felt comfortable with this non-backup procedure, since our experience

with PCs has been that, once past the initial start-up failures, disk failures are not that common. Also, we really do have copies of everything on our hard disk somewhere. (For very large data sets, that may be on a mainframe data set.)

We backed up the hard disk before we moved the computer to our new house. Since we didn't make a practice of frequent backup, we did not purchase any of the backup packages, but used the MS DOS Backup. This requires that the process start with formatted floppies. We were not sure how many we needed, so we formatted 50 floppies (we needed 38). The whole process took most of an afternoon and evening, during which we packed up the office. Fortunately, the computer works just fine after moving, so we did not have to investigate the MD DOS Restore.

How frequently hard disk backups should be performed depends on who uses them, how they are used, and what plans there are for recovery should the hard disk fail. Our plans are, basically, to use other computers which either do not have hard disks, or have hard disks that we do not control until repairs are complete. This could mean that we spend some time after the hard disk repairs are complete trying to remember how the software was configured. We are assuming that disk failures are so infrequent that the time spent would be less than the time we would have taken doing the backups. These plans would not suit everyone, but we think they make sense for us.

*Multi-Year Floppy Almanac.* The USNO is preparing a new version of the floppy almanac, one that would have data for more than one year. The software was discussed and demonstrated at meetings this summer. It is not yet ready for general distribution, but is expected soon. Floppy Almanac gives information from much of the *Astronomical Almanac* to full precision. Anyone familiar with using the *aa* will find this easy enough not to need the Users Guide for basic operations. There are no fancy graphics, no flashy sounds, just a nice solid program that does the job.

*Editorial.* Recently, I received two announcements of commercial software for astronomical computations, one being sold by a publisher, one being sold by the author. Both of them made me feel slightly uncomfortable, since they are similar to software I have written for myself in the past. One of them in particular, the simulation of  $n$  bodies interacting gravitationally, I find both amusing and slightly appalling. I used such a program for my dissertation research, and I could not then (and still cannot) imagine any reason to expect large numbers of people to pay \$39.95 for a copy of the software. On the other hand, I was happy to provide a copy to anyone who was interested, and spent more than a few hours helping others get it to run on their computers. (This software no longer exists.) Many researchers give each other software, considering it no different than exchanging ideas through papers and lectures, and many, myself included, use software in our research which has passed through many hands in the course of its development. Charging each other for this software, beyond perhaps a nominal charge for the media and for mailing expenses, would not seem advisable. There are not enough potential buyers of such specialized software to pay for the work of producing it if the charge is low (and I consider \$39.95 to be low), and no one would

pay the price if all the development costs were to be paid by a few buyers. The n-body program is being marketed as educational software, but I consider its educational value as marginal. I would think it a far more educational experience for the student to program the equations, rather than to run somebody else's package. I think the author of this package would have provided a much better service by preparing a package to assist students in writing their own programs.

*Shells.* Shells are programs that sit between the user and the operating system, helping the user with use of the machine. A shell can display a menu of programs to choose from, instead of requiring the user to remember the program name and the operating system command to activate it. Shells also can be set up to handle some of the system maintenance details, such as formatting diskettes, deleting files, parking the hard disk. Many users, especially those who use their systems infrequently, like shells very much. Versions of shells are often used in businesses, so that users do not have to learn the details of the operating system. Shells, however, are memory-resident software, which may conflict with other programs. Also, experienced users may find menu systems more cumbersome than just directly calling the programs. Also, there is some question as to the wisdom of a user being isolated from the operating system. This may be fine for a business, where presumably there are personnel charged with maintenance of the computer systems. But for the independent users who must maintain their own systems, isolation may also mean lack of knowledge about the operating system, and possible difficulties when something out of the ordinary is required. DOS shell programs are available as commercial products, as well as shareware and user-supported products. They are relatively inexpensive software, selling for \$30 to \$100, depending on the features.

*Mathematics Packages.* Recently, I have been using two math-processing software packages, one of them moderately expensive (MathCAD, for \$350) and the other expensive (PC MATLAB, for \$900 and more, depending on the options purchased). These packages were a type of software I had seen, but had never used. They allow the immediate, interactive, evaluation of mathematical equations. Both of them allow variables to be defined as vectors or matrices, which then can be used in equations almost as easily as we would write them. PC MATLAB also allows building what are called scripts, programs that are evaluated by typing in the name of the script. We were using these programs to test mainframe software, and we found them invaluable. PC MATLAB, in particular, is a very nice tool to use for prototyping software. Anyone who frequently writes small pieces of software for single-purpose use would find a mathematics-solver package similar to these very useful.

PC MATLAB is built following the LINPACK and EISPACK projects, which were FORTRAN software packages for mainframe computers. It includes the curious unreal numbers inf and NaN, where inf is positive infinity, and NaN stands for not a number. They can be considered as the result of attempts to compute, for inf, a divide by zero, and, for NaN, zero divided by zero. These are constructs defined by the IEEE standards on mathematical computations, to provide standard representations so that software can be de-

signed to handle the accidental (or deliberate) attempt to divide by zero instead of a "crash and burn" response. Many mathematical packages, as well as well as computer language implementations, are providing the inf and NaN "numbers."

*Debuggers.* The larger and more complex a piece of software, the more likely it is to have bugs, errors which interfere with the planned use of the software and which must be corrected before the program can be used. The best way to handle errors would be not to make them in the first place, but in the real world, that is an unreasonable expectation. Programmers who never make mistakes are programmers who never try anything new. Some mistakes can be found by careful reading of the code, by thinking through the logic, and by adding intermediate output, dumping variables as the computation proceeds. When the program is large and complex, this manual procedure may be too slow to be practical. Debuggers are software packages designed to help find programming errors. BASIC interpreters have the trace capability, a relatively simple debugger which shows the line numbers as execution proceeds. A more sophisticated debugger will stop at preset points in the computations and display the variables, or will step through the program displaying variables as the computations proceed. Some have the capability to show trails of subroutine entries, or to stop when specific conditions are met (a variable changing to a negative number, for example), and displaying the contents of registers, or requested variables.

Debuggers can be purchased as stand-alone packages, as part of a program development system, or as an integral part of a compiler. When purchasing a debugger separately from the language, especially when they are sold by different vendors, it is important to be sure that they are compatible. How much should be invested in a debugger depends on how much is invested in the programming. If your livelihood, or your professional reputation, depends on your programming skills, you probably already have them. For those rest of us who do not have so much depending on our software development skills, it is a matter for some discussion and consideration. In addition to considerations of whether or not we can afford to pay for a debugger, we need to consider how much we would really use it. If we use a package infrequently, it may take more time to understand how to use it each time we try than to search out a bug manually, and we may regret our purchase.

Most of my experience with debuggers has been with relatively unsophisticated debug options of some FORTRAN compilers, and with the BASIC trace statement. I have been considering upgrading a C compiler I bought to the new version, which has internal and debugging packages available. However, these would not work with the FORTRAN compiler we have, so we could find ourselves with two separate, incompatible, debug capabilities.

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## GRAZING OCCULTATIONS

Don Stockbauer

My goals as coordinator of IOTA's lunar grazing occultation section are as follows:

1. To provide a forum for the exchange of information through these articles;
2. To quality check the reports received and to

request any needed clarifications;

3. To publish tabular summaries of each expedition's results; and

4. To maintain an independent repository of the reports.

In order to help IOTA accomplish these goals, please send a copy of your graze report to me at 2846 Mayflower Landing; Webster, TX 77598; U.S.A. (make a copy for yourself, of course). Sending a copy to ILOC in addition is very helpful; their address is: International Lunar Occultation Centre; Geodesy and Geophysics Division; Hydrographic Department; Tsukiji-5, Chuo-ku; Tokyo, 104 Japan. Data on diskette should be sent to ILOC; if you prefer this medium, please send me a printout of your data file only. Total occultation data in any format should only be sent to ILOC, as I do not need it to produce this article.

Many people include copies of their limit and profile predictions with their reports. This is greatly appreciated and helps form a complete history of each graze in my files.

I have found Zodiacaal Zone catalog shifts to be well worth requesting; for the 1989 predictions, they will no longer be needed, as David Dunham plans to fold this catalog into the XZ (which is currently used for graze predictions). Until the end of the year, ZZ shifts of non-FK4 stars are available from Dunham at 7006 Megan Lane; Greenbelt, MD 20770; U.S.A. Please allow a month of lead time, and specify the date, star number (ZC or X preferred), limit, and position angle of graze. As an example, for the graze of SAO 118546 on 1988 July 18, the observed shift from the nominal prediction (80H) was 0.8 north; we set up according to the ZZ catalog update, and our shift from this updated prediction was only 0.2 south, resulting in a much better placement of observers.

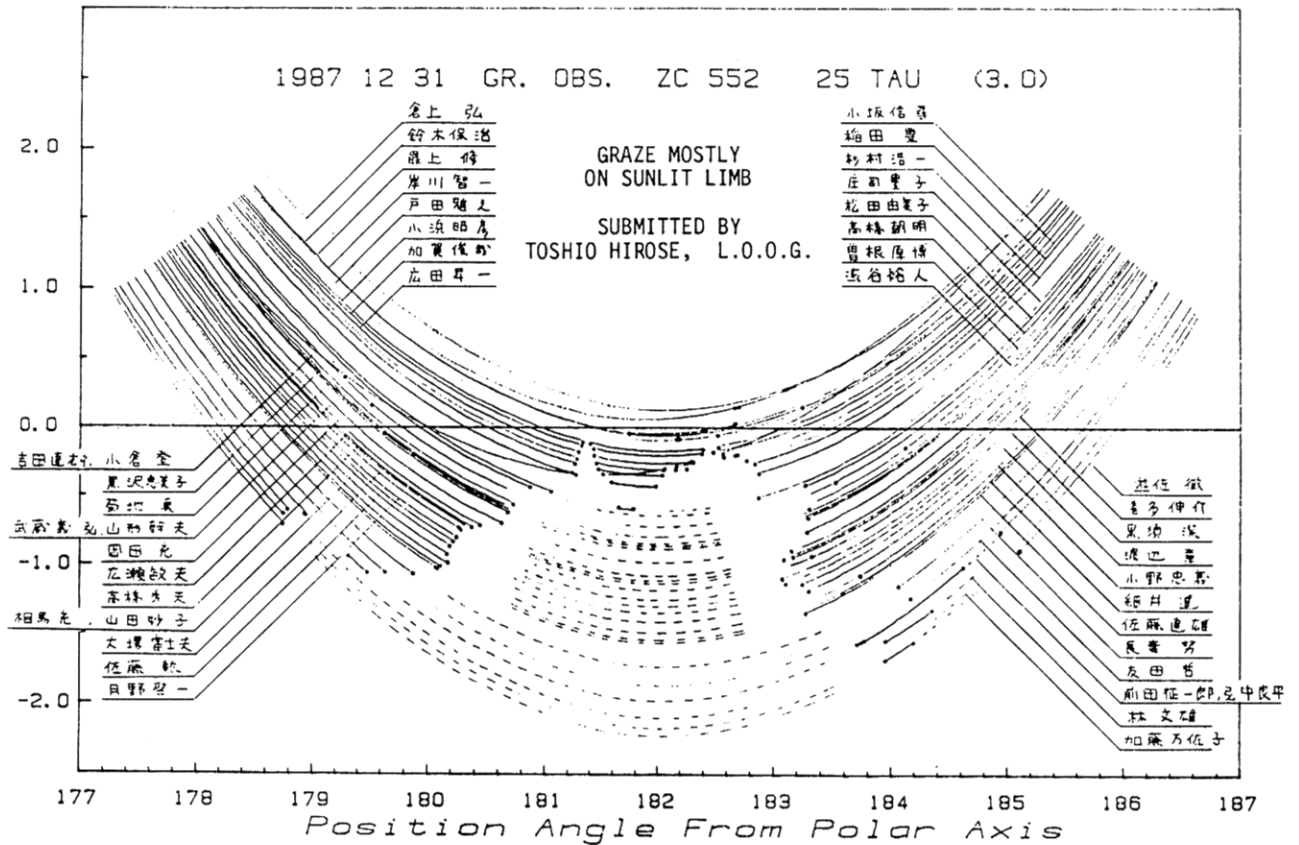
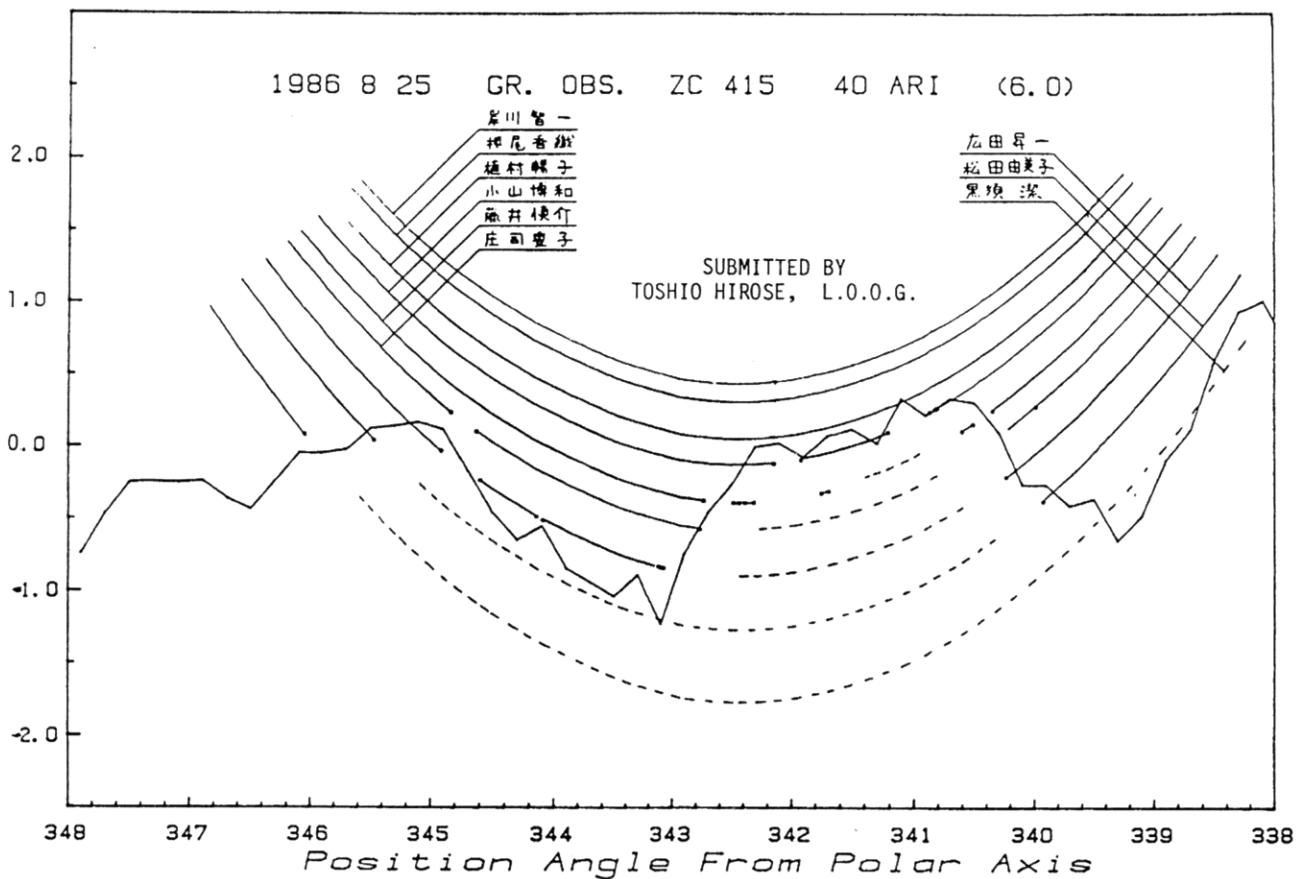
I have two graze papers available: one which tells how to reduce your own graze observations (that is, how to measure the observed shift of the lunar shadow from the predicted shadow); and another which describes how to combine the results of widely separated expeditions of the same graze on a single Automated Computer Lunar Profile Plotting Program

Date <sub>V</sub>	Star #	Mag	% Sn1	CA	Location	# Sta	# Tm	S S	Ap Cm	Organizer	C St	WA	b
1983													
0929	0898	6.0	56-	16N	Brooksville, FL	1	6	1	20	Tom Campbell	3S	343	-8
1210	3158	5.8	27+	15S	Gilchrist, FL	3	30	1	20	Tom Campbell	2S	169	66
1985													
0327	0625	7.0	24+	2S	Reddick, FL	1	4	1	20	Tom Campbell	5N	176	-18
0911	1283	6.8	14-	14N	Bushnell, FL	2	9	1	20	Tom Campbell	3N	352	-65
1008	1233	5.8	38-	10N	Newberg, FL	2	8	1	20	Tom Campbell	5N	351	-66
1118	3052	6.4	36+	16S	Verna, FL	2	14	1	6	Tom Campbell	2S	166	73
1986													
0923	0564	6.1	75-	9N	Bushnell, FL	2	8	2	15	Tom Campbell	3N	348	-43
1987													
0306	0551	7.1	37+	5N	Winston, MO	6	8	2	15	Robert Sandy	2S	3	-48
0504	079944	8.5	37+	17N	Edenvale, R.S.A.	1	2	1	32	D. Overbeek			16-72
0508	1644	4.1	76+	13N	Middenmeer, Nethl.	1	0	1	15	Henk Bulder	1N	16	-21
0508	1644	4.1	76+	13N	Amstelmeer, Nethl.	2	18	1	8	Hans Walrecht	1N	16	-21
0508	1644	4.1	76+	13N	Gietelo, Nethlnds.	2	3	1	14	Jan-Maarten Winkel	1N	16	-21
0620	0162	6.9	33-	13S	Warmbad, R. S. A.	4	18	1	20	B. Fraser	9N	346	-13
0630	098888	8.5	17+		Bulawayo, Zimbabwe	1	23	1	15	A. Morrisby			
0702	1609	4.7	29+	10N	Sycamore, KS	1	5	1	15	R. Dandy	2N	11	-17
0829	158363	7.1	24+	-3S	Edenvale, R.S.A.	1	3	1	32	D. Overbeek			185 36
1002	189879	8.4	76+		Simons Town, RSA	1	2	1	20	P. Van Blommestein			
1125	189244	7.5			Standertown, RSA	2	6	1	20	B. Fraser	9N	165	51
1229	0240	5.6	67+	21S	Cossinade, LA	1	2	1	20	Don Stockbauer			159-29
1229	0240	5.6	67+	20S	Hazlehurst, MS	1	2	1	33	Benny Roberts	8S	160	-29
1988													
0213	185729	8.0	23-	14S	Bernalillo, NM	1	6	1	10	MacPherson Morgan			0190 75
0406	2366	1.2			Campbell Town, Austrl.	3	6	2	15	Martin George	3S		
0419	076345	7.8	8+	14N	Blue Ridge, MO	1	2	1	20	Homer DaBoll	1N	7	-60
0425	1392	7.1	61+	17N	Volo, IL	3	10	1	13	Bert Stevens	1S	19	-34
0528	158014	7.4	88+	24N	Sugar Valley, TX	1	2	1	20	Don Stockbauer	5N	22	44
0617	079868	7.5	7+	14N	Pulaski, WI	1	0	1	15	DaBoll/Parmentier	>3S	11	-43
0619	098674	7.7	20+	18N	Doucette, TX	5	16			John Chauvin			18-24
0621	118664	7.5	37+	15N	Wharton, TX	13	75			Don Stockbauer	1N	16	4
0622	1708	6.2	47+	14N	Independence, KS	1	0	1	15	Robert Sandy	>1S	16	19
0624	1901	6.9	66+	21N	Ganado, TX	7	55			Don Stockbauer	4N	21	43
0627	2263	4.8	91+	15N	Carbondale, MI	1	0	2	20	DaBoll/Burroughs	>2S	7	72
0630	2784	3.4100-	49N	Dwight, IL	1	0	1	20	Homer DaBoll	>3S	352	67	
0630	2784	3.4100-	49N	Monee, IL	1	4	1	13	Robert H. Hays, Jr.	1S	352	67	
0630	2784	3.4100-	48N	Lowell, MI	2	1	2	25	G. M. Ross			351 68	
0704	3379	6.4	74-	12N	Arrendonde, FL	2	16	1	15	Tom Campbell	0347	11	
0705	3520	6.0	63-	15N	Harrodsburg, KY	1	16	2	20	Jim Stamm	2N	344	-7
0718	118546	8.6	15+	10N	Glen Flora, TX	4	17			Don Stockbauer	8N	12	3
0721	139081	7.7	40+	10N	Sheeks, TX	6	45			Don Stockbauer	1S	12	43
0808	0917	8.4	15-	13N	Shirley, IL	1	15	1	20	Homer DaBoll	2N	352	-61
0821	183995	7.1	54+	-0S	Plato Center, IL	4	8	2	13	Homer DaBoll	7N	178	76
0824	2784	3.4	84+	-4N	Old Town, GA	1	6	1	40	Roger J. Venable			348 67

(ACLPPP) plot. While the papers are not written at a novice level, I will be happy to send them to anyone just beginning, and correspond with that person to answer any questions.

Tom Campbell, 5405 98th Ave.; Temple Terrace, FL 33617; phone 813,985-1842 notes that he will lead an expedition for the spectacular graze of El Nath (Beta Tauri) near Fort Myers, Florida on 1988 Oct. 1. Harold Povenmire, 215 Osage Dr.; Indian Harbour Beach, FL 32937; phone 407,777-1303 and Greg Zentz, phone 407,793-9498 will lead an expedition for the same graze near Port Salerno on Florida's east coast. The graze can be predicted very accurately, since the Watts angle of central graze and the latitude libration are virtually identical to what we had at Genoa, Texas a year ago; see O.N. 4 (6), 143. Please let me know about your plans for upcoming favorable expeditions, and I will mention them in this column. Also, if you inform David Dunham, he will put expedition information on IOTA's occultation line at 301,474-4945. (Text continues on page 224)





When asking people to do occultations, don't overlook your club's deep-sky group. Deep-sky observers usually have large-aperture telescopes, are enthusiastic, are looking for challenging observing opportunities, and so on. For instance, on the graze of SAO 118546 on 1988 July 18 that I led near Glen Flora, Texas, the two 8-inch telescopes (including mine) could not hold the 8.6-mag. star steadily, and thus obtained no data. However, a 10-inch, two 13-inch, and a 20-inch telescope had little difficulty and salvaged the whole operation. Try a direct invitation to those you think would normally not be interested.

The summer drought across much of the U.S.A. was unfortunate for farmers, but treated us to a bountiful harvest of observations. Our group in Houston got quite active; we had five major successful expeditions from mid-June to mid-July, certainly the best we have ever done.

Danie Overbeek writes that Arthur Morrisby was murdered in Zimbabwe recently. Arthur was a long-time occultation enthusiast, and we sincerely regret to learn of this unfortunate incident.

Thanks for the reports; I'm looking forward to receiving many more from all of you.

[Late note added by David Dunham:] Although the Moon is now moving too far north to occult most of the members, the northeastern U.S.A. finally had good weather for the September 2nd Pleiades passage, and we successfully observed the graze of 5.6-mag. 18 Tauri (Z.C. 538) only 20 miles from Washington,

#### RADIO TIME SIGNALS

A. G. F. Morrisby\*

[Reprinted from *Mon. Not. Astron. Soc. S. Africa* 47 (5&6), p. 53 (June 1988)]

Observers of all types of occultations require precise time and, in southern Africa, they usually get this from the time signals transmitted 24 hours a day by radio station ZUO at Olifantsfontein near Johannesburg. Invariably, Murphy's Law prevails; at the critical time the signals cannot be picked up and ZUO gets the blame! Perhaps it is worth looking at some of the reasons why the signal cannot be received well.

Is your receiver sufficiently sensitive? The air waves are quite crowded and, although ZUO transmits on a very sharp frequency, if your receiver does not have sufficiently sharp tuning, the signal may well be swamped out by other stations on nearby wavelengths. This does not mean that you need a very expensive set, but it does mean that you need a good band-spread.

At certain times of the day, the air waves are more crowded than at others. This may well vary from place to place, but my experience is that the 4 MHz band is crowded out for a few hours after 3 a.m. and 6 p.m. A tuned aerial may sometimes help.

If you live in the radio shadow of a mountain or large building, then all you can do is to try another

\*Died 16-5-1988

station, about which more later. Road and rail traffic, domestic appliances, and high-voltage power lines all cause interference. There is not much you can do about these, unfortunately.

DC. I also had a good show (10 events in half a minute) for the Mu Arietis graze the night before from a suburb of Pittsburgh; unfortunately, that graze was too close to the cusp to record with my video equipment. In spite of drive problems, I had better luck recording 12 events with my image intensifier during a graze of XZ Piscium (Z.C. 3520) the morning of July 5, working closely with Dan Rothstein of the Chagrin Valley Astronomical Society, which also had a separate successful effort at Chagrin Falls, OH. Andreas Gada reports that the graze was also videorecorded near Toronto, Ont. Details of these efforts will be in future lists, but the shift information is:

1988	ZC	Mag	%	CA	Place	Shift	WA	b
7	5	3520	6.0	63-	15N Aurora, OH	3N	344	-7
9	1	399	5.7	71-	7N Fox Chapel, PA	3N	350	-51
9	2	538	5.6	59-	12N Bristol, MD	5N	347	-61

Phil Dombrowski's 3-station expedition for the 18 Tauri graze at Broad Brook, CT gave a similar shift.

Several expeditions have been organized for the spectacular dark-limb southern-limit graze of Regulus on November 30th, from California to Texas. These will be listed, and maps showing details of the path in the San Francisco, CA and Austin, TX areas, will be published in the November issue of *Sky and Telescope* (see also p. 220). We are trying to find members of the R.A.S.C. in Newfoundland who might observe from the northern limit of the same occultation at sunrise there.

er station, about which more later. Road and rail traffic, domestic appliances, and high-voltage power lines all cause interference. There is not much you can do about these, unfortunately.

By the very nature of radio telegraphy, most transmitters have dead zones. The positions of these dead zones depend on the frequency of the signal and on the state of the ionosphere at that moment. If you happen to be in a dead zone, try another frequency or another time of day. Generally speaking, a particular signal does not travel with the same efficiency throughout the day. Happily, there are a number of transmitters, around the world, that transmit on a number of frequencies throughout the 24 hours, or almost so. Do not be afraid to experiment.

Frequency	Wave Length	Stations
2.5 MHz	119.9 m	JJY WWV WWVH ZUO
5.0	60.0	JJY WWV WWVH ZUO
7.5	40.0	VNG
8.0	37.5	JJY
10.0	30.0	JJY WWV WWVH
15.0	20.0	JJY WWV WWVH
20.0	15.0	WWV

JJY comes from Japan                      ZUO comes from RSA  
 WWV comes from U.S.A.                    VNG comes from Australia  
 WWVH comes from Hawaii

In this day and age of quartz crystal clocks and watches, just how important is it to have radio time signals available 24 hours a day?

The modern quartz crystal clock or watch is easily and cheaply available and can safely be relied on to have a rate that is constant to better than 0.1 second per day. This is true if the temperature does not vary by much. This being so, it can be used as an intermediate time standard with complete confidence. Check your clock error against the radio time signal every evening (also every morning, if you are a pessimist), and record it on a graph; the error at any particular instant can then be read off. The clock or watch, with the error applied, may then be used as the observer's source of time.

For checking my clock, I prefer to use ZUO. I make a number of determinations of the error and then use the one I judge to be the best. But in an emergency, the 6 pips, the television clock, or "dial-for-time" will do very well, with this warning: if the 6 pips come via satellite, for example from the BBC Atlantic Relay Station, they will be late by perhaps 0.3 second.

There are, of course, occasions when it is desirable to have an audible signal continuously beating seconds - for instance, in a grazing occultation or for any other occasion when the observations are recorded on tape. From time to time articles appear in *MNASSA* and *Sky and Telescope* describing electronic circuits that beat audible seconds, often with a minute marker. Alternatively, a cheap quartz kitchen clock, particularly if it has a new battery, may have a loud enough tick to come through on the tape recorder.

It must be remembered that the transmission, 24 hours a day, from ZUO is a very expensive exercise. With the ready availability of good time from radio, television, and telephone, and with inflation and otherwise rising costs, there is a real possibility that the service from ZUO may have to be curtailed, as has happened to WWV [Ed: I believe he meant VNG] recently, or even suspended! So it will do no harm to be prepared with other techniques.

If after all this you still don't like the way you receive ZUO, then write to: The Director; Time Standard Section (Attn. Mr R Lake); National Measuring Standards & Metrology Division; C S I R; P O Box 395; PRETORIA 0001, and to The Postmaster General; PRETORIA 0001.

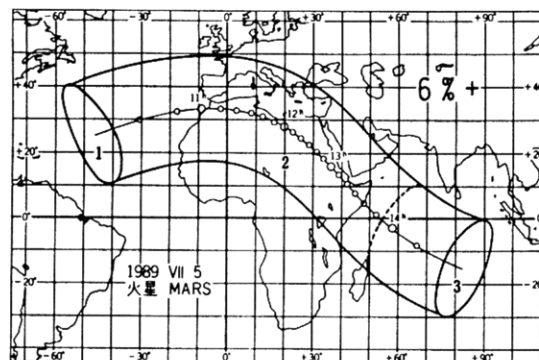
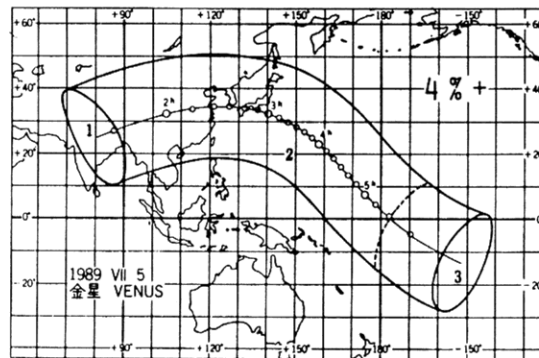
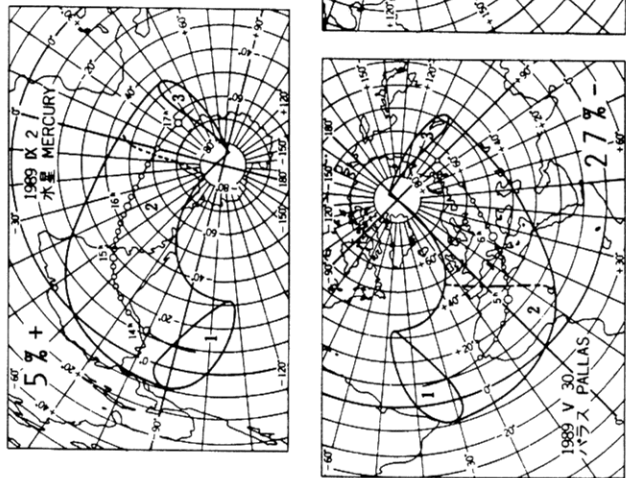
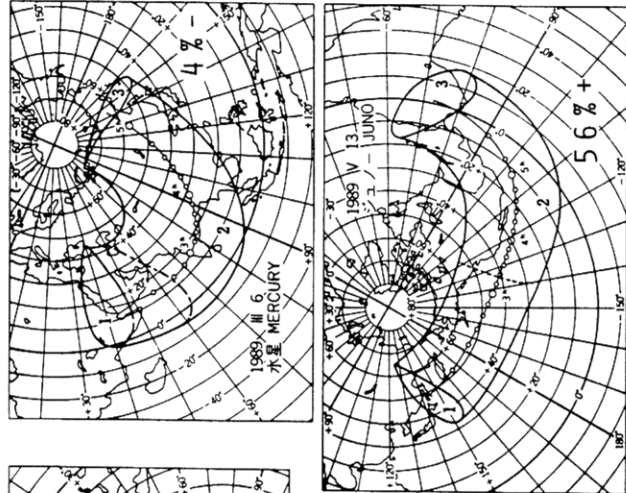
I must thank both the Postmaster General and Mr Lake for reading the draft of this article, particularly Mr Lake who offered very valuable suggestions.

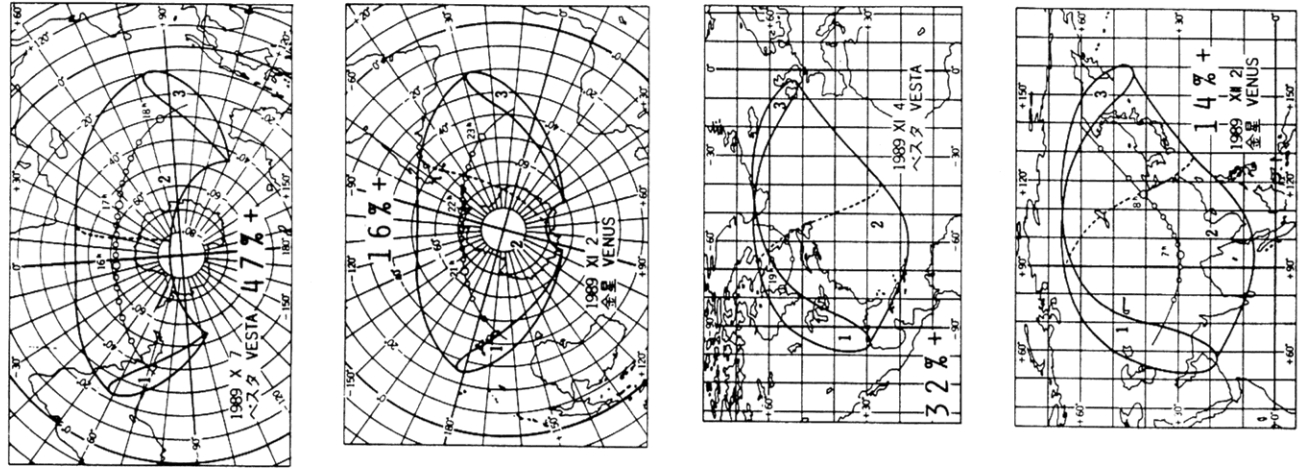
LUNAR OCCULTATIONS OF PLANETS

The maps showing the regions of visibility of lunar occultations of planets are reprinted by permission, from the Japanese ephemeris for 1989, published by the Hydrographic Department of the Maritime Safety Agency of Japan. In region 1, only the reappearance is visible; in region 3, only the disappearance may be seen. Reappearance occurs at sunset along a dashed curve, while disappearance is at sunrise along a curve of alternating dots and dashes. We have added a legend to each map indicating the phase of the Moon at event time.

Those interested in observing partial occultations should request predictions at least three months in advance (if possible) from Joseph Senne; P.O. Box

643; Rolla, MO 65401; U.S.A.; phone 314,363-6233.

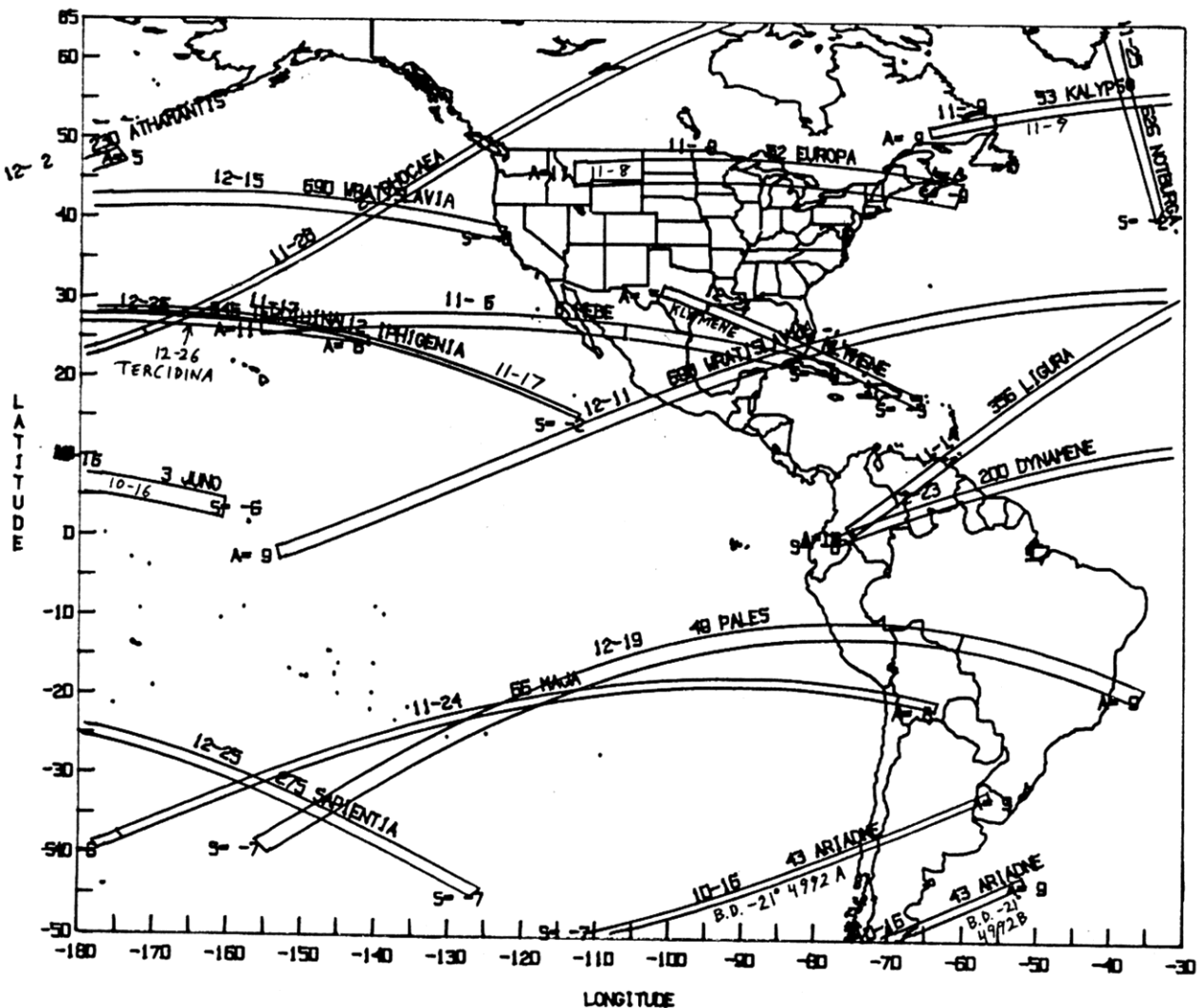




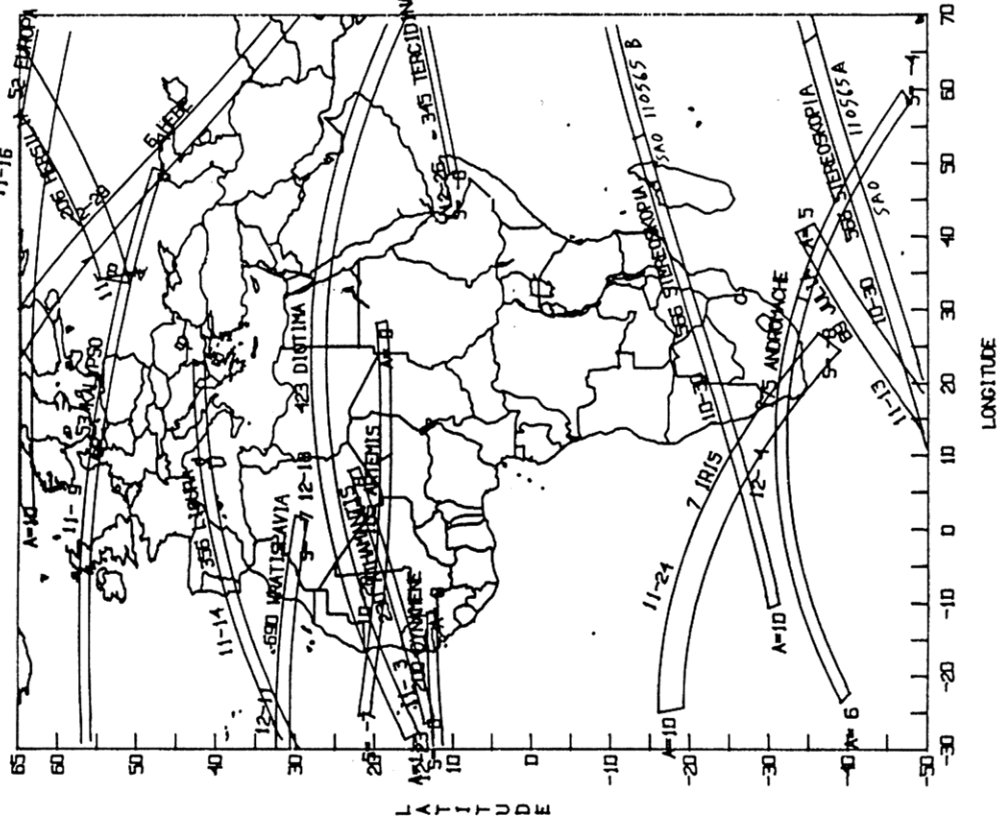
SOLAR SYSTEM OCCULTATIONS DURING 1988

[This is a further continuation of the article started in *o.n.* 4 (6), 148-156 and continued in *o.n.* 4 (7), 171-188 and *o.n.* 4 (8), 205-212. World maps are by Mitsuru Sōma. Hemispheric-coverage maps are by David Dunham. Finder charts are produced by David Dunham, with annotations and faint stars added by David Werner.

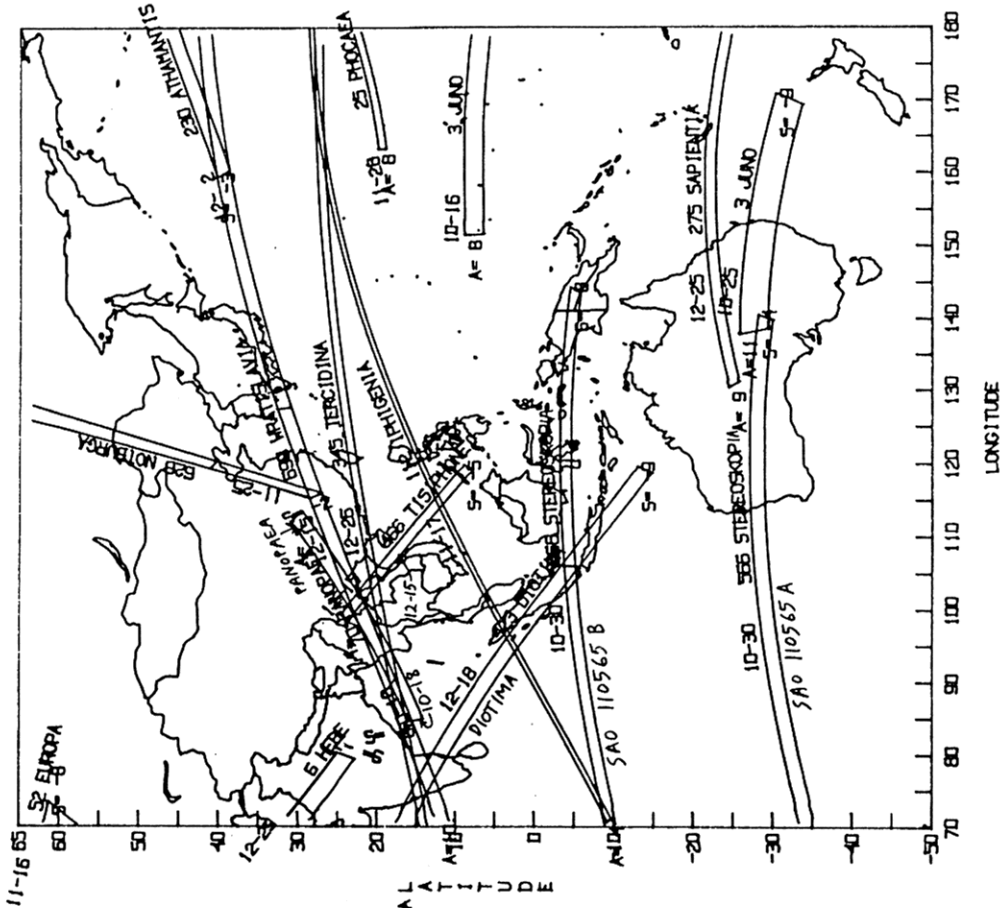
PLANETARY OCCULTATIONS. 1988 10/15 - 12/31

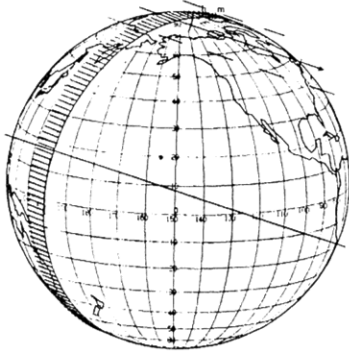


PLANETARY OCCULTATIONS. 1988 10/15 - 12/31



PLANETARY OCCULTATIONS. 1988 10/15 - 12/31





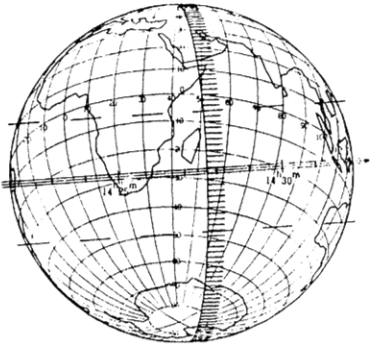
SAO 98982 by Venus 1988 Oct 4



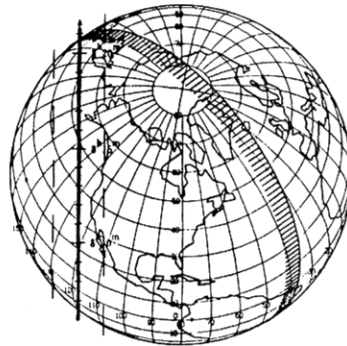
SAO 208693 by Panopaea 1988 Oct 5



+16° 295 by Maja 1988 Oct 8



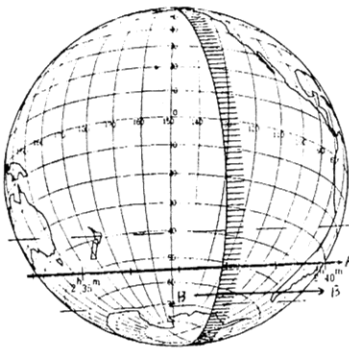
SAO 187125 by Hermione 1988 Oct 10



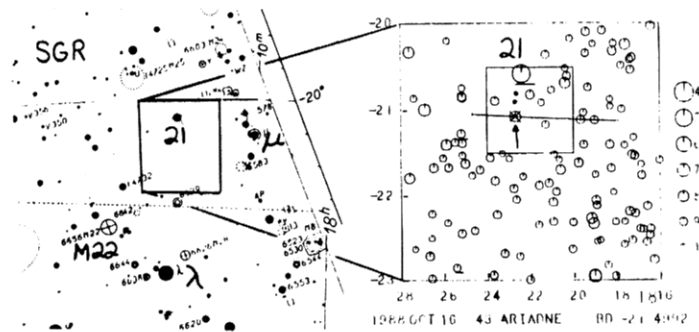
SAO 24519 by Notburga 1988 Oct 13



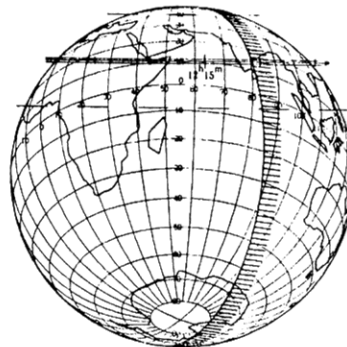
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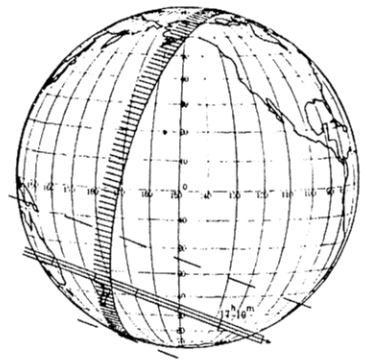
-21°4992 by Ariadne 1988 Oct 16



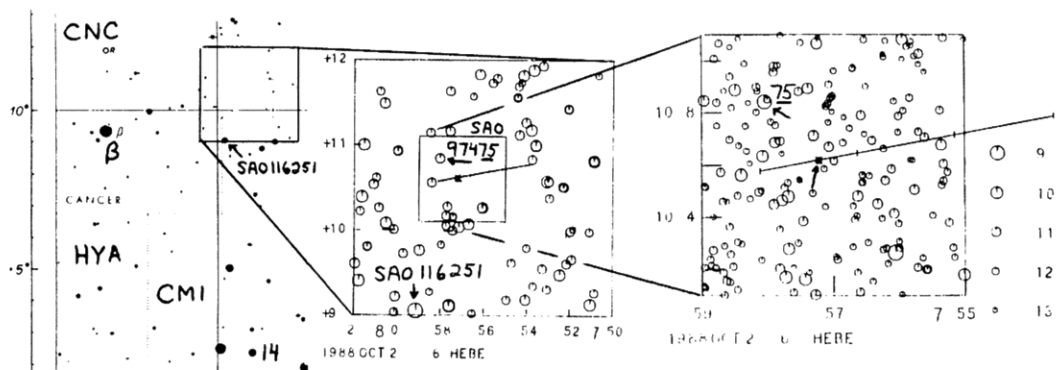
SAO 117639 by Juno 1988 Oct 16



SAO 209277 by Panopaea 1988 Oct 18



Anonymous by Juno 1988 Oct 25



SAO 142597 by Artemis 1988 Oct 28



SAO 110565 / Stereoskopia 88 Oct 30



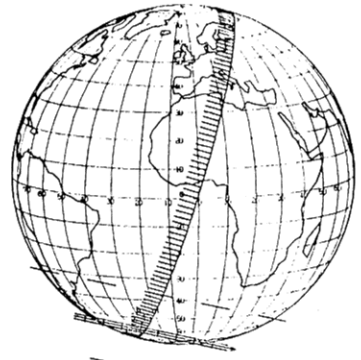
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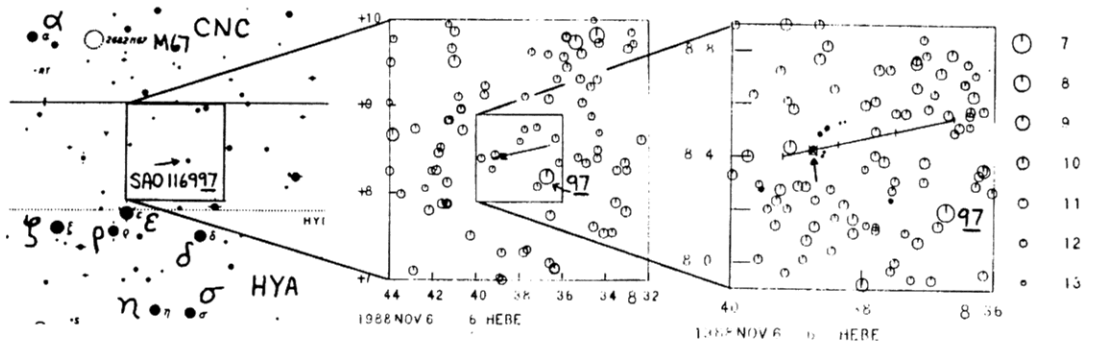
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Anonymous by Hebe 1988 Nov 6

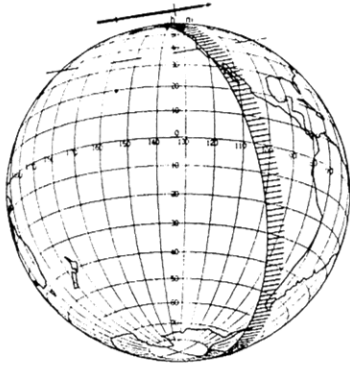


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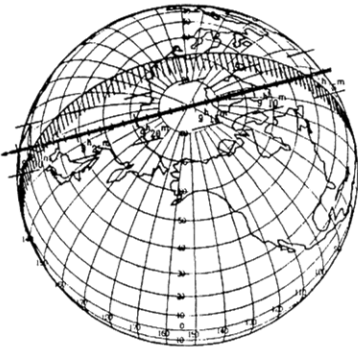




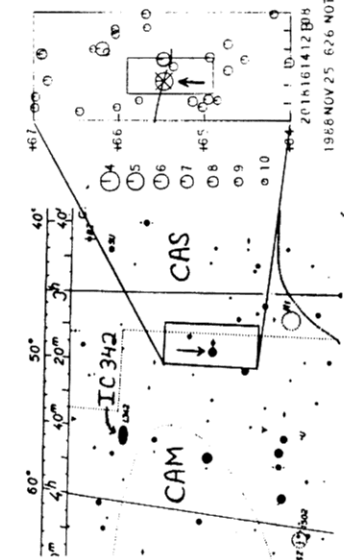
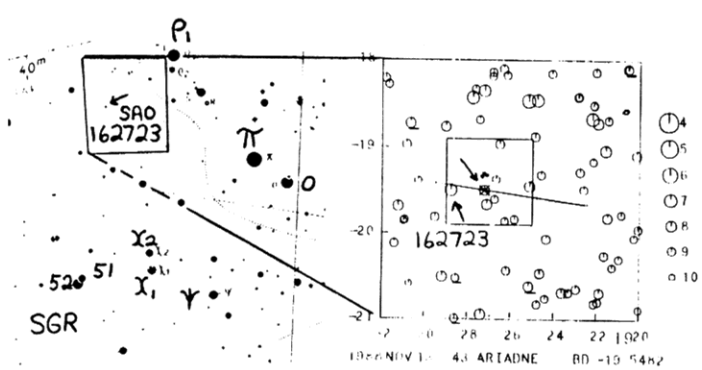
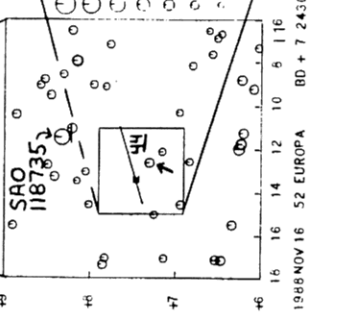
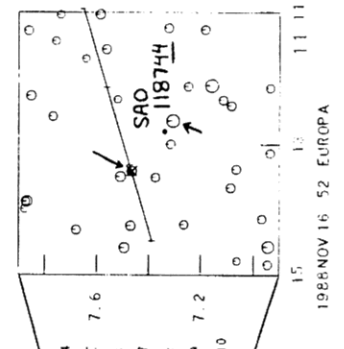
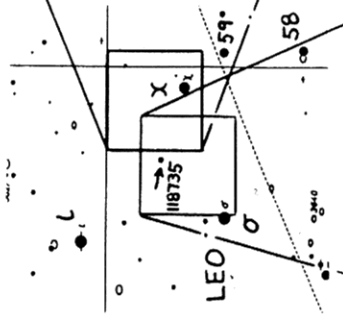
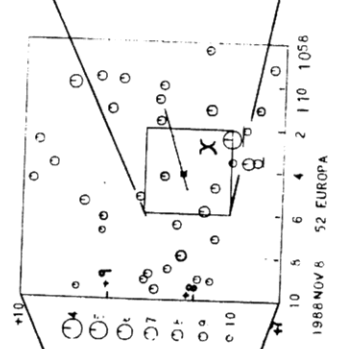
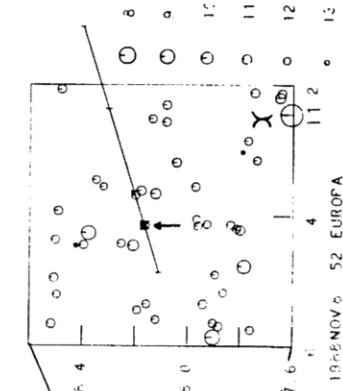
Anonymous by Europa 1988 Nov 8



-19°5482 by Ariadne 1988 Nov 13



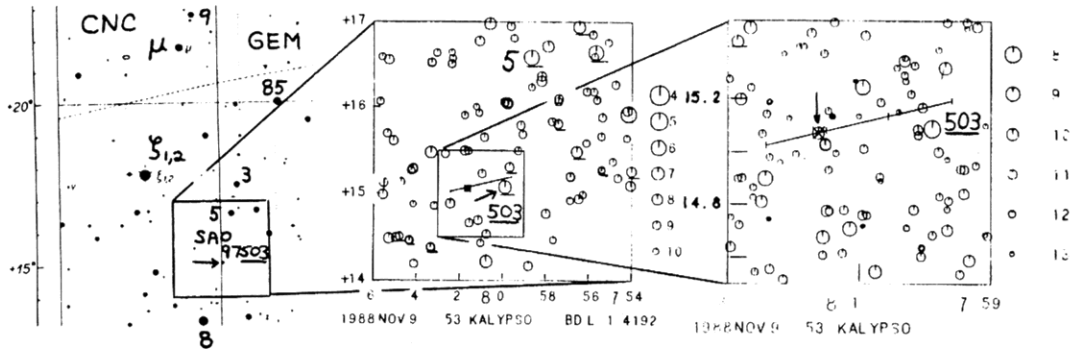
SAO 12704 by Notburga 1988 Nov 25



+7°2430 by Europa 1988 Nov 16

SAO 12704





L 1 4192 by Kalypso 1988 Nov 9



SAO 187992 by Julia 1988 Nov 13



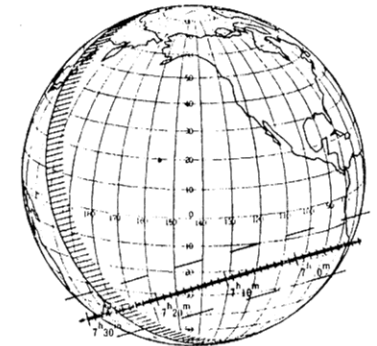
+32°1673 by Ligura 1988 Nov 14



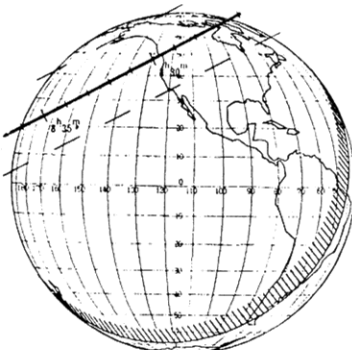
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Anonymous by Iris 1988 Nov 24



SAO 92660 by Maja 1988 Nov 24



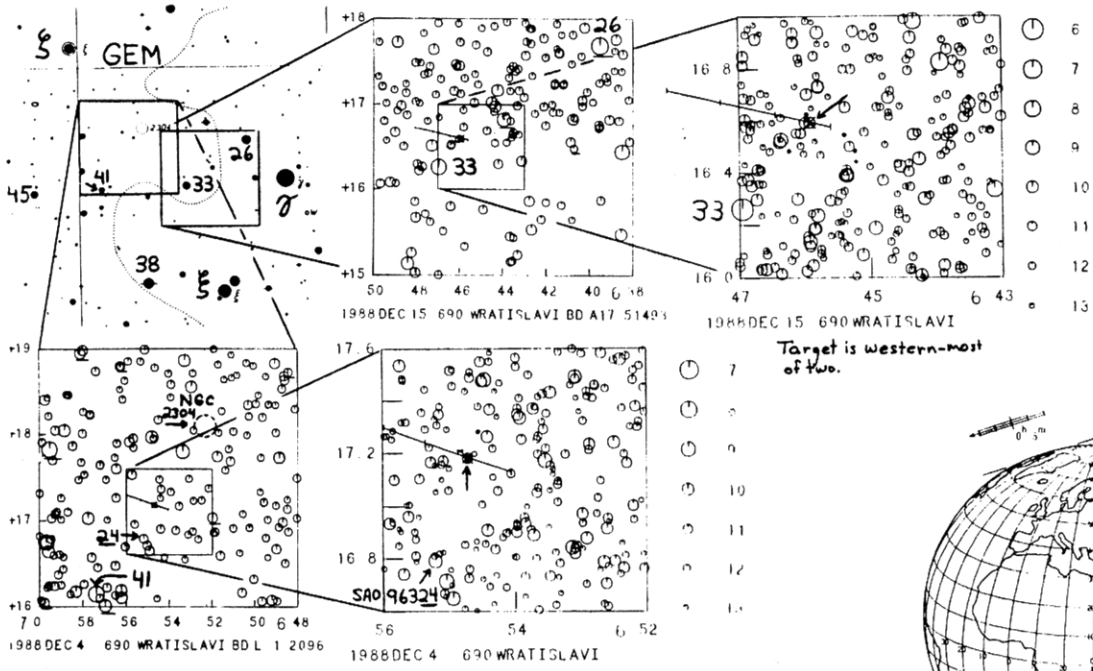
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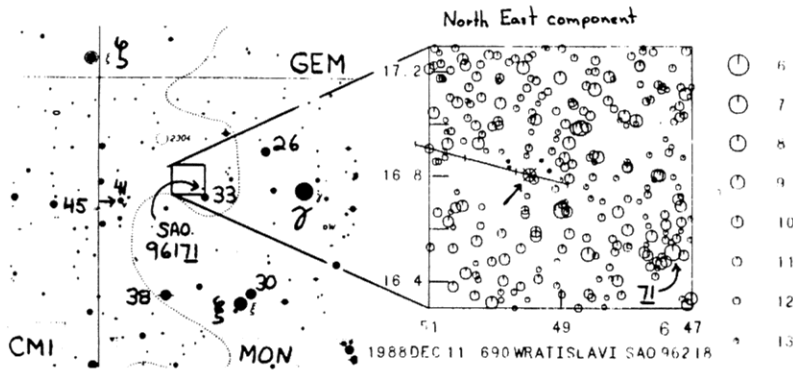
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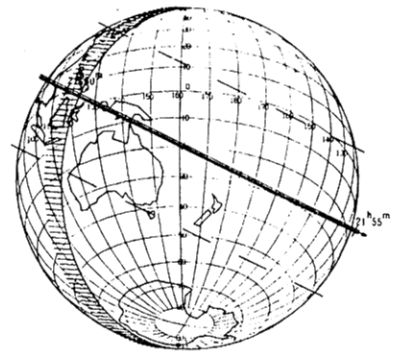
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L 1 2096 by Wratislavia 1988 Dec 4



SAO 78770 by Andromache 1988 Dec 4



SAO 96218 by Wratislavia 88 Dec 11

A1751493 by Wratislavia '88 Dec 15

SAO 20533 by Tisiphone '88Dec 15