Occultation Newsletter

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Joan Bixby Dunham, Editor

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FROM THE PUBLISHER

For subscription purposes, this is the second issue of 1993. It is the twelfth issue of Volume 5. IOTA annual membership dues, including **ON** and supplements for U.S.A., Canada, and Mexico $25.00
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Although they are available to IOTA members without charge, nonmembers must pay for these items:
Local circumstance (asteroidal appulse) predictions 1.00
Graze limit and profile predictions (per graze) 1.50
Papers explaining the use of the predictions 2.50

Asteroidal occultation supplements will be available at extra cost: for South America via Ignacio Ferrin (Apartado 700; Merida 5101-A; Venezuela), for Europe via Roland Boninsegna (Rue de Mariembourg, 33; B-6381 DOURBES; Belgium) or IOTA/ES (see below), for southern Africa via M. D. Overbeek (Box 212; Edenvale 1610; Republic of South Africa), for Australia and New Zealand via Graham Blow (P.O. Box 2241; Wellington, New Zealand), and for Japan via 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

ESOP XII: The 12th European Symposium on Occultation Projects will be held in Roden, the Netherlands, August 27-31. See pages 280 and 281 of the last issue.

IOTA Roster: A combined roster of IOTA members, **ON** subscribers, and IOTA/ES (European Section) members is enclosed with this issue (except for non-USA observers in the region of visibility of the June 4th lunar eclipse; see below). To facilitate communication among members, telephone numbers and electronic mail addresses, as well as a few fax numbers, are also included.

1994 Total Occultation Predictions: Volunteers with PC's are needed to compute 1994 predictions; see p. 307.

IOTA 1993 Annual Meeting: The 11th annual meeting of IOTA will probably be held Saturday, September 11, near Houston, TX, probably at the Lunar and Planetary Institute, where last year's meeting was held. Those who can stay a day and a half after the meeting can participate in an expedition to observe one of the better grazing occultations in the USA this year, a southern-limit graze of 4.3-magnitude Alpha Cancri (Acubens = ZC 1341) by a 10% sunlit waning Moon that will pass near Texas City south of Houston on Monday morning, September 13th. The graze will occur just before 5 AM CDT at a cusp angle of +4°; the Moon will be 8° above the eastern horizon in a dark (no twilight) sky. The southern limit for this occultation is shown on my map on p. 74 of the January issue of **Sky and Telescope**. Paul Maley will soon make arrangements for the meeting, and preliminary plans for the graze. Details will be given in the next **ON** in early August.

Meeting near Milan in June: On Saturday, June 19th, a small meeting on occultations in or near Milan, Italy, is planned. This is the day after the week-long meeting, Asteroids Comets Meteors (ACM) 1993, being held in nearby Belgirate. The occultation meeting may be held in the Hotel Villa Carlotta, the venue of ACM 93 in Belgirate, about a 1-hour drive northwest of Milan. Hans Bode and I plan to attend, as well as one or two other IOTA/ES members from southern Germany. Topics will include programs and procedures for calculating and distributing 1994 total and grazing occultation predictions, planning for this November 29th's lunar eclipse, expeditions for the 1994 solar eclipses, and others. If you are interested in attending, contact Marco Cavagna (see the enclosed IOTA Roster). Bode and some other IOTA/ES members also plan to participate in a small meeting at Paris Observatory just before the ACM meeting, to discuss final reduction of video records of the occultation of 28 Sagittarii by Titan.

IOTA Manual: Wayne Warren has nearly completed editing the changes to the IOTA Occultation Manual discussed on pages 275-276 of the last issue. He needs some more information from me to complete the job, and I expect to get this to him late this month. So review versions will probably be distributed in June, and with some luck, distribution to the IOTA membership might be done with the next **ON**.

Dutch Occultation Book: Henk Bulder has published a book in the Netherlands about observing occultation phenomena. The book, written in Dutch (except for a foreword by me that Bulder kept in English), contains about 200 pages of text and 80 pages with figures and tables. Bulder describes Solar System occultation phenomena, from total lunar occultations to Pluto/Charon mutual events, as well as eclipsing binary stars. Then he discusses observational and timing techniques, including utility programs for observers and expedition leaders. Seven appendices give more detailed information and references. Predictions of rare events, calculated through 2050 by Jean Meeus and some not published before, are included in the tables. Bulder is selling the book for $40; I do not know the price in Dutch guilders. See the IOTA Roster to contact him for more information.

This Issue: The main purpose for this issue is to distribute information about occultations during the total lunar eclipse on June 4th. Due to the critical timing of the eclipse, this issue is being mailed by us only for foreign subscribers in the region of total eclipse visibility. Everyone else will receive their issue from the McManuses. The McManuses will also distribute all copies of the 1993 IOTA Roster.

The Next Issue: The next issue will be distributed in early August, in time to contain information about the 1993 annual meeting to meet the 30-day requirement. It will contain contributions from Tony Murray and Robert Sandy that we have on hand, but ran out of time to include in this issue. We also plan to distribute with it a special supplement by Richard Wilds including copies of the P,D charts from Watts' "The Marginal Zone of the Moon" annotated with the names of craters and mountains. We will need your contributions for the next issue by the middle of July.

NEW TECHNICAL DEVELOPMENTS

David W. Dunham

New CCD Camera: More sensitive CCD cameras are becoming available, presumably based on the new Philips CCD module. Sensitivities as low as 0.02 lux, able to image 9th-mag. stars in real time with a 20-cm telescope, have been advertized. This seems to be about a magnitude more sensitive than the original Philips modules that have been mentioned in previous ON's. Roger Tuthill sells such a camera for $645; see p. 106 of the April issue of **Sky and Tel**. A local IOTA member tried to order one, but Tuthill was temporarily out of stock. We will be interested in reporting on experiences with recording occultations with this camera in a future issue.

New GPS Receiver: Sony is advertizing a new small Global Positioning System receiver, claiming an accuracy of 50 feet, for about $600. I understand that the unit weighs less than a kilogram.

Audio with Portable VCR's: The current video walkmans do not have microphone input. They are as useful for field recording as camcorders operated in VCR mode, with video input from a more sensitive camera attached to the telescope and audio input amplified with a unit such as the VTAC described by Tom Campbell in previous issues, or a commercial amplifier/mixer such as the Omnitrak.

WWV on AM dial: One morning last month, our 2-year-old son inadvertantly tuned in WWV, coming in clearly at about 1630 kilohertz on our AM standard-broadcast radio. I have not heard the signal since, and wonder if it was caused by some rare beat propagation effect in the ionosphere, such as might be caused by a meteor, or was WWV being rebroadcast by someone? See **ON 5** (10), p. 257 for a more reliable WWV receiver.

OCCULTATIONS DURING THE TOTAL LUNAR ECLIPSE OF 1993 JUNE 4

David W. Dunham and Eberhard Riedel

This eclipse, visible from the Pacific Ocean and all Pacific-Rim areas, southeastern Asia as far west as Pakistan, and Antarctica, will probably be only slightly darker than usual due to the lingering effects of material still settling out of the atmosphere from the eruptions of Mt. Pinatubo in 1991. Although there were some reports in **Sky and Telescope** and elsewhere claiming that the December 1992 eclipse was as dark as the one in December 1963, in fact last December's eclipse was probably about 2 magnitudes brighter than the 1963 eclipse, that will perhaps remain the darkest of the last half of this century; see **ON 5** (10), p. 272. Since even more of Pinatubo's dust will have settled out by June, this eclipse is not likely to be darker than last December's event, although the Moon passes closer to the center of the umbra this time. Nevertheless, the June eclipse should be rather good for occultations as the Moon will traverse a relatively rich Milky Way star field in Ophiuchus. Observers of this eclipse should certainly include timing occultations in their program.

Try to gain access to the largest telescope possible and concentrate on timing occultations around the entire Moon's limb, paying attention to reappearances, which are often under-observed during eclipses. Occultation timings made during total lunar eclipses have special value for accurately connecting the Moon's eastern and western hemispheres, and specifically for obtaining corrections to Watts' lunar profile reference system. Also, observations of grazing and near-grazing occultations during lunar eclipses are particularly useful for inproving the knowledge of the lunar profiles that cause Bailey's bead phenomena during solar eclipses. More information about the value of eclipse lunar occultation timings, and methods of observation, appear in articles that are referenced in **ON 5** (9), p. 227. General information about the June eclipse is given on pages 70 and 71 of the June issue of **Sky and Telescope**.

The Star Field: The eclipse star field, shown in two charts, is in southwestern Ophiuchus several degrees northeast of Antares. The brightest star in the field is 5.6-mag. 24 Ophiuchi = ZC 2434, which will be occulted during the final partial phases in the Himalayan Mountains region and western China. The star field is close to the Milky Way and is fairly rich. There are many interesting concentrations of stars, although none of them have been officially designated galactic clusters. One globular cluster, NGC 6235, will be occulted during the last part of totality as seen from most of Australia. The cluster is rather compact, 1!9 in diameter, with a magnitude of 10.4. A few of the brighter members are in the Q-catalog that was used for plotting the star field charts. A large dark cloud hides most stars in the northwestern part of the field, but fortunately that area is traversed by only the northern part of the Moon as seen from Antarctica during the first half of the eclipse. Some small dark clouds block stars from view in only a few other restricted areas of the star field.

One plot shows only the stars, down to magnitude 14.0 from the Q-catalog based on the XZ and the Space Telescope Guide Star (GS) Catalog mentioned in **ON 5** (8), p. 208. The equinox 1950 chart boundaries were determined by David Herald [illegible] boundaries as 16h [illegible] to 16h 57.9m in right ascension and -21° 04' to [illegible] in declination.

Topocentric Par[illegible]: The other chart shows the same star field, but also includes numbers of the brighter stars, a figure of the Moon generated by Bob Bolster with John Westfall's Moonview program, and topocentric tracks for the Moon's center for 16 locations. Apparent place coordinates (with precession, nutation, and aberration applied to 1993 June 4) are used. The Moon's figure is drawn for the right size and orientation during the eclipse. The position angle of the Moon's North Pole (0° of Watts Angle, or WA in IOTA predictions) will be 8°, to help locate reappearing stars with lunar features. In many cases, the pattern of the star field will give a better idea of the point of emersion.

A copy of the Moon figure can be moved with its center along the path, keeping its orientation the same as shown on the chart, to estimate the times and locations of disappearing and reappearing stars. The name of the location, for which a topocentric curve of the Moon's center is plotted, is given along the path. Labels are mannually drawn or typed since Dunham's current software can't generate the labels automatically. A list of the coordinates used for calculation of the paths is given at the top of the right side of this page.

Location	Latitude	E.Long.
AUCKLAND, New Zealand	-36°908	174°777
DUNEDIN, New Zealand	45.873	170.500
BRISBANE, Queensland	-27.516	153.070
MELBOURNE, Victoria	-37.750	145.000
TOKYO, Japan	35.660	139.770
KHABAROVSK, Siberia	48.450	135.100
MANILA, Philippine Is.	14.651	121.062
NANKING, China	32.067	118.821
PERTH, W. Australia	31.950	115.830
NAINI TAL, India	29.361	79.457
KODAIKANAL, India	10.231	77.469
SANTIAGO, Chile	-33.418	-70 630
MEXICO CITY, Mexico	19.250	-99.100
LOS ANGELES, California	34.113	-118.302
VANCOUVER, Brit. Col.	49.500	-123.100
ANCHORAGE, Alaska	61.210	-149.870
HONOLULU, Hawaii	21.300	-157.850
SOUTH POLE, Antarctica	-90.000	----

Time increases from right to left (the Moon's R.A. is always increasing) along the curves. If the Moon is above the horizon both times, the paths start at 11h 00m UT of June 4th and end at 15h 00m UT. Besides the 1-hour tick marks labelled with the December 10th UT hour, unlabelled tick marks along the curves mark the Universal Times below:

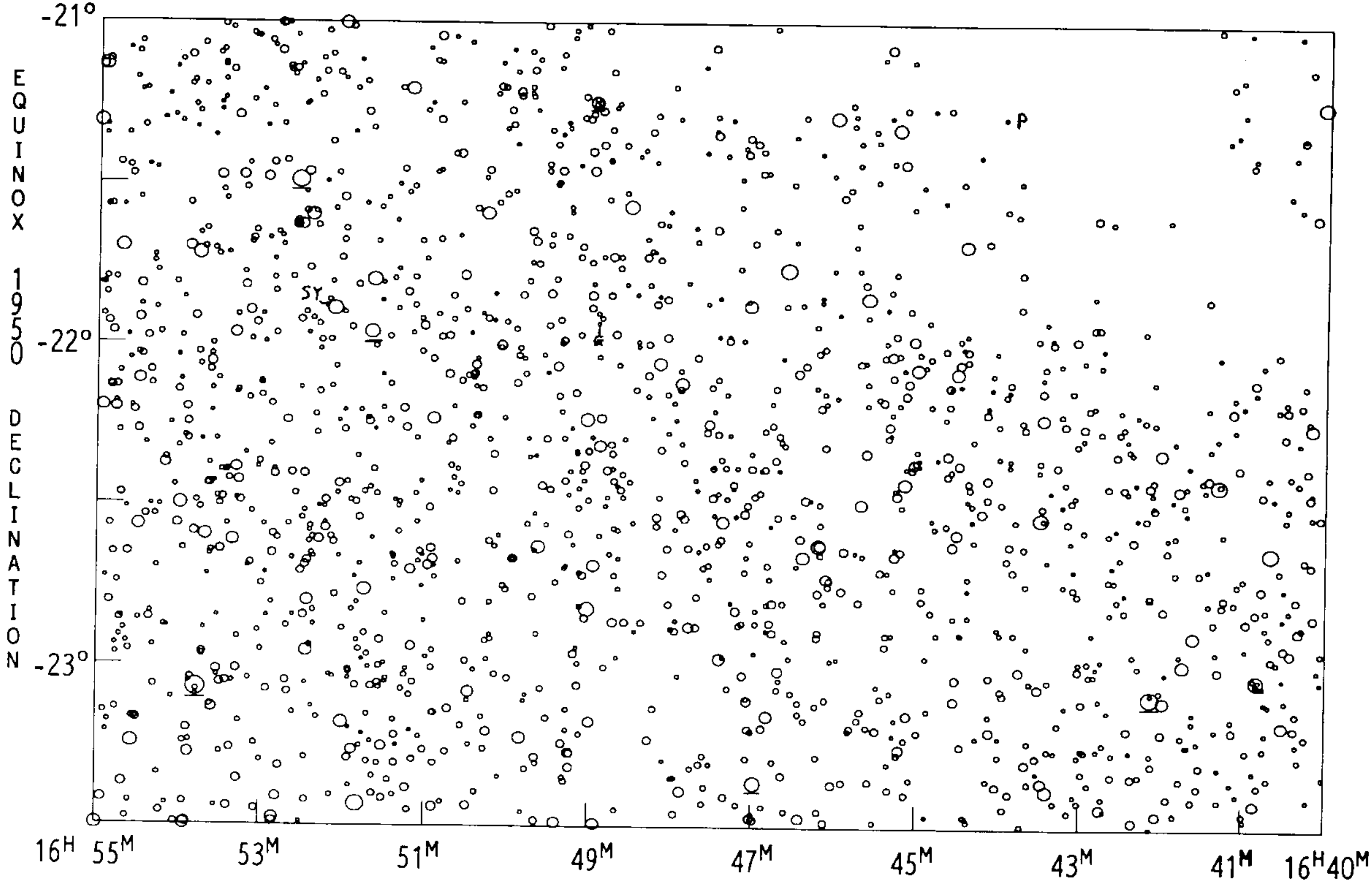
UT
h m
11 11.2 First umbral contact (First Contact)
[illegible] (Second Contact)
13 4[illegible].7 [illegible] (Third Contact)
14 49.7 [illegible] contact (Fourth Contact)

Not shown is central eclipse, which occurs at 13h 00.5m UT, very close to the 13h tickmark. For some unknown reason, a few of the tick marks are not plotted.

Most of the paths include all of the tick marks mentioned above, from right to left. But the path is not plotted when the Moon is below the horizon. Hence, the last parts of the paths for Los Angeles, Vancouver, and Anchorage are not shown. For Los Angeles, the first point (11h UT) is off the map. Only the ends of the paths for the two Indian stations are shown, but the last point (15h UT) for these stations are not shown since they are off the chart. For locations not shown on the chart, interpolate.

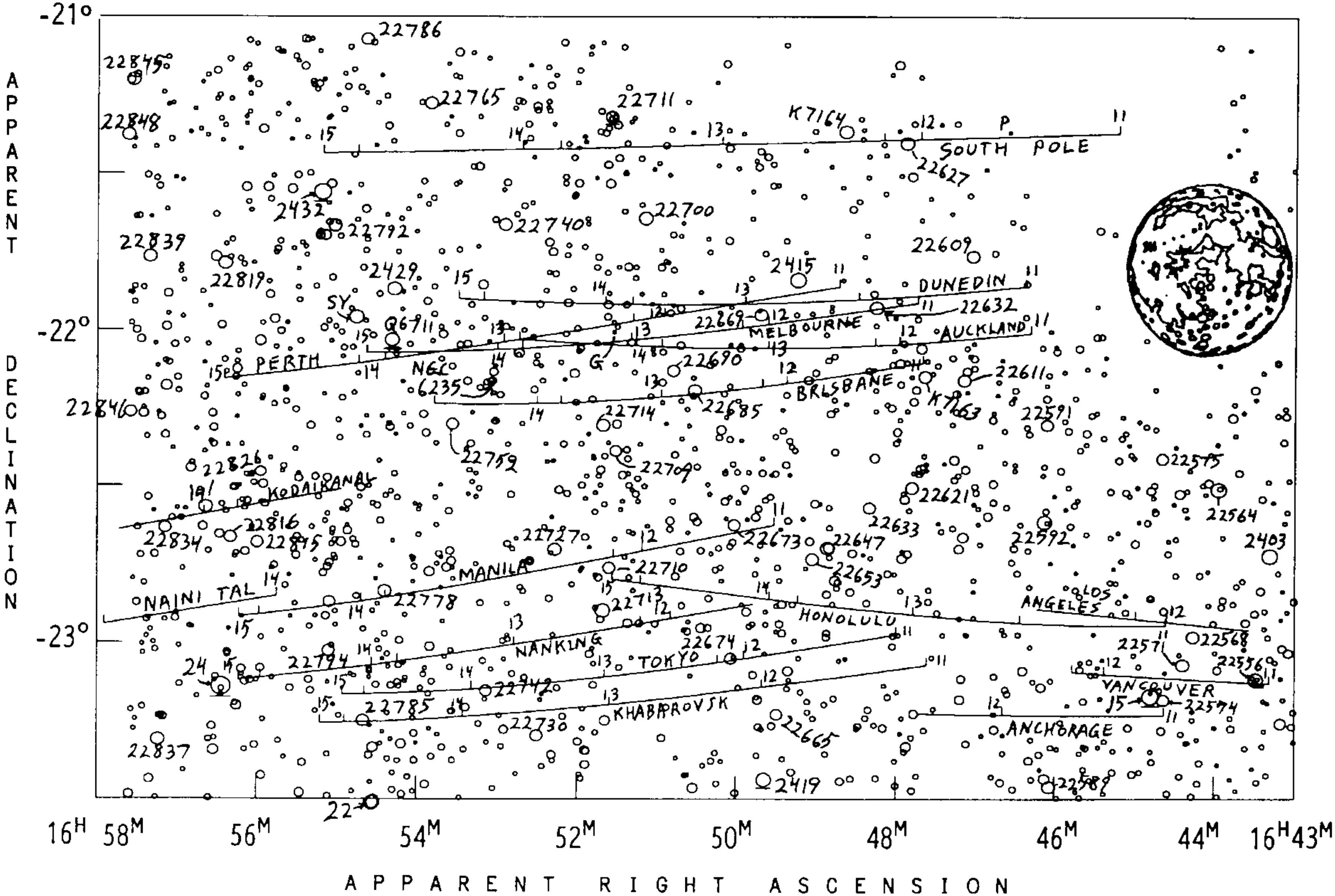
The Stars and their Numbers: Apparent positions were plotted so that the RA and Dec. given in the detailed IOTA predictions could be used to locate stars whose occultations are listed. The RA bound was increased by 3m due to the increase in RA since 1950; stars with equinox 1950 RA's greater than 16h 55m are not shown on the apparent-place chart. Also not shown are a few stars at the bottom of the equinox 1950 chart.

1993 JUNE 4 TOTAL LUNAR ECLIPSE



EQUINOX 1950 RIGHT ASCENSION

1993 JUNE 4 TOTAL LUNAR ECLIPSE



The numbers of some stars have been hand-written on the apparent-place chart. Two-digit numbers are Flamsteed numbers (Ophiuchi). A number in the 2400's is a ZC number. A number in the 22000's is a USNO XZ (or X) number. Numbers in the 5000's, 6000's, and 7000's are Q-catalog numbers, for stars not in the XZ. The numbers of K-catalog stars are preceded with a "K".

Variable Stars: Two variable stars are shown on the chart, both spectral type M semi-regular variables. The brightest is V2106 Ophiuchi = ZC 2415, which has a shallow magnitude range, V = 7.38 to 7.46, in an approximately 22-day period. SY Ophiuchi = X22787 ranges in magnitude from 8.1 to 9.8 in an approximately 132-day period. Dunham was not able to get an estimate of what the magnitude is expected to be before this issue went to press, but he will try to find out before the eclipse and distribute the result by E-Mail to those in western Australia who might have some chance of seeing the star close to the eclipsed Moon. The star will probably be occulted by a part of the Moon in the umbra only as seen from part of the Indian Ocean.

Double Stars: Known double stars are underlined on the charts. Data about them are listed below. Also, other designations of bright stars are listed in a short table after the doubles in the eclipse field.

Double Stars

USNO#	D	SAO/BD	Desig.	Mag1	Mag2	Sep.	P.A.	N
ZC2407	V	184607		7.7	7.7	0".1	90°	1
ZC2419	C	184687	RST3045	8.1	11.9	0.9	320	
X22711	X	184728	RN75912	9.5	10.3	1.02	214	2
Q06711	M	-21°4442	ADS10251	8.9	9.2	1.7	203	3
ZC2432	M	184804	BU 241	7.5	7.7	0.23	10	
ZC2434	M	184822	BU 1117	6.2	6.5	0.86	309	

1 From U. Texas 1974 special list of occultation doubles, no documentation available
2 ON 1 (6), p. 48
3 Duplicity code not in IOTA predictions

Other Designations of Bright Stars

USNO#	Other Desig.	USNO#	Other Desig.
ZC2407	15 Ophiuchi	ZC2430	22 Ophiuchi
ZC2415	V2106 Ophiuchi	ZC2432	74 B. Ophiuchi
X22787	SY Ophiuchi	ZC2434	24 Ophiuchi

Mag1 is the magnitude of the primary, Mag2 is that of the secondary, Sep. is the separation in arc seconds, and P.A. is the position angle. The star's double-star code is given after the USNO#, under D. Under SAO/BD, 6-digit numbers are SAO numbers; one of the stars is a BD star that is not in the SAO. Under Desig. (designation), ADS is Aitken's Double Star and RN is Richard Nolthenius, who suspected the star's duplicity based on a 1975 Sept. occultation observation.

Minor Planets: Using data in Ephemerides of Minor Planets for 1993, Dunham found two asteroids that appear on the charts at the time of the eclipse. The brightest is 15.6-mag. (3606) Ponjola, which is marked "P" on the charts near the edge of the dark cloud (area of no stars) in the northwestern part of the chart. Its occultation will be visible only from Antarctica near first umbral contact, when the Moon will still be very bright. The other asteroid is (3143) Genecampbell, marked with a "G" near a line of 3 faint stars northeast of the center of the chart. At magnitude 16.7, it is doubtful that anyone in Australia or New Zealand will be able to detect Genecampbell's occultation.

May Version of the USNO Q-catalog: This first edition of the Q-catalog was described in ON 5, 208. The range of Q-numbers for the June 1993 lunar eclipse field is 5523 to 7172. The two asteroids mentioned above were added as Q07173 and Q07174, but they were not in the catalog when it was used to generate the data for the 1993 IOTA detailed lunar occultation predictions, so they are not included in those predictions.

Last September, Dunham generated lists of all of the Bonner Durchmusterung (BD) and Cordoba Durchmusterung (CD) stars with approximate B1950 coordinates, to permit a manual crossreferencing with the Q-catalog and insertion of BD and CD numbers for many of the non-XZ Q-catalog stars. He accomplished this at that time for the December 1992 field, but he could not find the lists to do this for the June eclipse field, and did not have time to resurrect the software on another computer to regenerate the lists. So BD numbers are given for only 2 non-XZ Q-catalog stars obtained from other sources. He plans to either find or regenerate the lists so that a crossreference table of Q and BD numbers can be published for the November 29th eclipse field in a later ON. When Dunham first generated the starfield plots, he noticed several obvious duplicated stars in the southern third of the charts, affecting the predictions for only Northern-Hemisphere observers. When the Q-catalog was generated, duplicate stars from different Guide Star Catalog plates were automatically rejected, but in some cases, there were duplicate measurements from the same plate. In all of these cases, the duplicates were within 0".5 of each other, too close to be separate stars. Dunham checked the star field for these stars with the True Visual Magnitude Atlas (TVMA) to estimate the star's magnitude, since the magnitudes of the duplicate pairs often differed by more than 2 magnitudes. In every case, the actual magnitude was within the range of the magnitudes of the pair. Dunham edited the catalog to effectively "reject" one of each pair, and changed the magnitude of the retained member to the TVMA-estimated value. This revised version of the catalog was used to generate the final star field charts published here. But it was not available when the 1993 IOTA Q-catalog total occultation predictions were generated, so Northern-Hemisphere observers should check their predictions with the table at the top of the next page to remove duplicate entries or modify magnitudes as appropriate. If an occultation of one of these stars will be visible from a given site, there should be a prediction for at least the brighter of the pair of stars.

Action on Q-Catalog Duplicate Stars

Rejected Star	mag.	Retained Star	mag.	New mag.
Q05525	11.9	Q05524	13.7	13.0
Q05541	13.8	Q05542	11.5	12.7
Q05546	12.1	Q05545	13.9	13.0
Q05598	10.7	Q05597	12.7	11.6
Q05644	10.7	Q05643	13.0	11.5
Q05673	8.7	X22571	9.0	9.0
Q05720	13.6	Q05719	11.3	11.8
Q05769	11.6	Q05768	14.0	13.0
Q05954	13.4	Q05955	10.7	11.0
Q06040	12.8	Q06041	10.4	11.6
Q06053	12.7	Q06054	10.3	10.3
Q06057	13.3	Q06058	10.9	12.6
Q06061	14.0	Q06062	11.6	13.2
Q06107	13.4	Q06108	11.0	12.6
Q06115	13.8	Q06114	11.4	12.5
Q06141	13.9	Q06140	11.5	12.6
Q06227	13.9	Q06228	11.6	12.6
Q06234	13.4	Q06235	11.1	12.2
Q06396	13.9	Q06395	11.4	11.9
Q06460	8.5	X22727	8.8	8.8
Q06505	13.9	Q06506	11.5	12.5
Q06654	14.0	Q06653	11.6	12.8

Predictions: The Q-catalog predictions and their distribution were described in ON 5 (8), p. 20 and (9), p. 240. More detailed information is in the verification form explanation that was distributed with those predictions. For those without predictions, use the star field charts here to locate both disappearing and reappearing stars, and try to mark the ones without an identifying number. Accurate Q-catalog predictions can be computed to identify the stars after the observations are made.

Reporting Observations: Occultation timings during this eclipse should be reported on the International Lunar Occultation Centre (ILOC) lunar occultation report forms, or the equivalent IOTA/ILOC graze report forms, or in an ASCII file on MS-DOS-compatible diskette [for the latter, see ON 4 (10), p. 237 and ON 4 (5), pp 92-97]. For all occultations that occur during lunar eclipses, please also send a copy of your report to David Herald; P.O. Box 254; Woden, ACT 2606; Australia. He will analyze all timings made during the eclipse and publish his results in ON. For the star number, use the ZC number and catalog code (column 16) "R". If the star is not in the ZC, give its SAO number and put "S" in col. 16. If it is in neither the ZC nor the SAO, give its X number with "X" in col. 16. If the star is in neither of these catalogs, give the star's Q-catalog number, if you have Q-catalog predictions, and put "Q" in col. 16. If you don't know any of these numbers for an observed occultation, include a copy of the star chart with your report marking these fainter stars whose occultations you time.

Grazing Occultations: Riedel has prepared maps and tables of all grazes of XZ stars that will occur against the umbra during this eclipse. They were prepared in the same style as those in the hemispheric grazing occultation supplements for 1993 distributed earlier. Two maps, one for the Eastern (E.H.) and one for the Western Hemisphere (W.H.), and their associated tables, are given on the following pages. The tables do not list names and duplicity information, since this is given in other tables in this article. Paths end in a "B" when they occur at the edge of the umbral shadow. Points along the paths where totality begins and ends are not indicated, but you can tell whether the eclipse occurs during totality or during a partial phase from the time of the event in your area. The altitude limits are too lenient. For example, the line for the southern limit of the occultation of 6.9-mag. 15 Ophiuchi (ZC 2407) is shown extending into Arizona, with the star being only about 1° above the horizon at the east end of the path. Even where the path crosses the California coast at San Diego, the event will be quite difficult, with the star barely 6° high (and the Sun a similar distance down).

Unfortunately, there are no suitable north-south grazes of the same star to conduct a lunar polar diameter experiment. If one limit crosses a region with many occultation observers, the other limit is always either in the ocean, or in either tropical or polar areas with poor weather prospects and no occultation observers.

PRELIMINARY INFORMATION ABOUT GRAZING OCCULTATIONS DURING THE TOTAL LUNAR ECLIPSE OF 1993 NOV. 29

David W. Dunham

Eberhard Riedel has provided maps and tables for the Nov. 29th eclipse that will appear in a future ON. Two occultations offer reasonable possibilities for observation at both the northern and southern limits for an accurate lunar polar diameter measurement. Preliminary information is given here to help those who might want to make long-range plans to travel to observe these valuable events.

Omega Tauri, N. Limit: At mag. 4.8, Omega is the brightest star that will be occulted during the eclipse, around 5:30 UT, during the early partial phases in Europe. The northern limit passes 5 km n. of Alesund and 70 km n. of Oslo, Norway; 35 km n. of Motala, Sweden (Alt. 11°); 10 km s. of Vilnius, Latvia (Moon alt. 5°); and near Minsk, Belorus (but Moon alt. only 2°). Eberhard Bredner may travel to Scandinavia to help efforts to observe this graze.

Omega Tauri, S. Limit: During totality around 6:15 UT, the southern limit passes 20 km south of Villa Cisneros, Southern Sahara, and north of Atar, Mauretania (Moon alt. 12°. Hans Bode is looking into the possibilities for an IOTA/ES expedition to these areas.

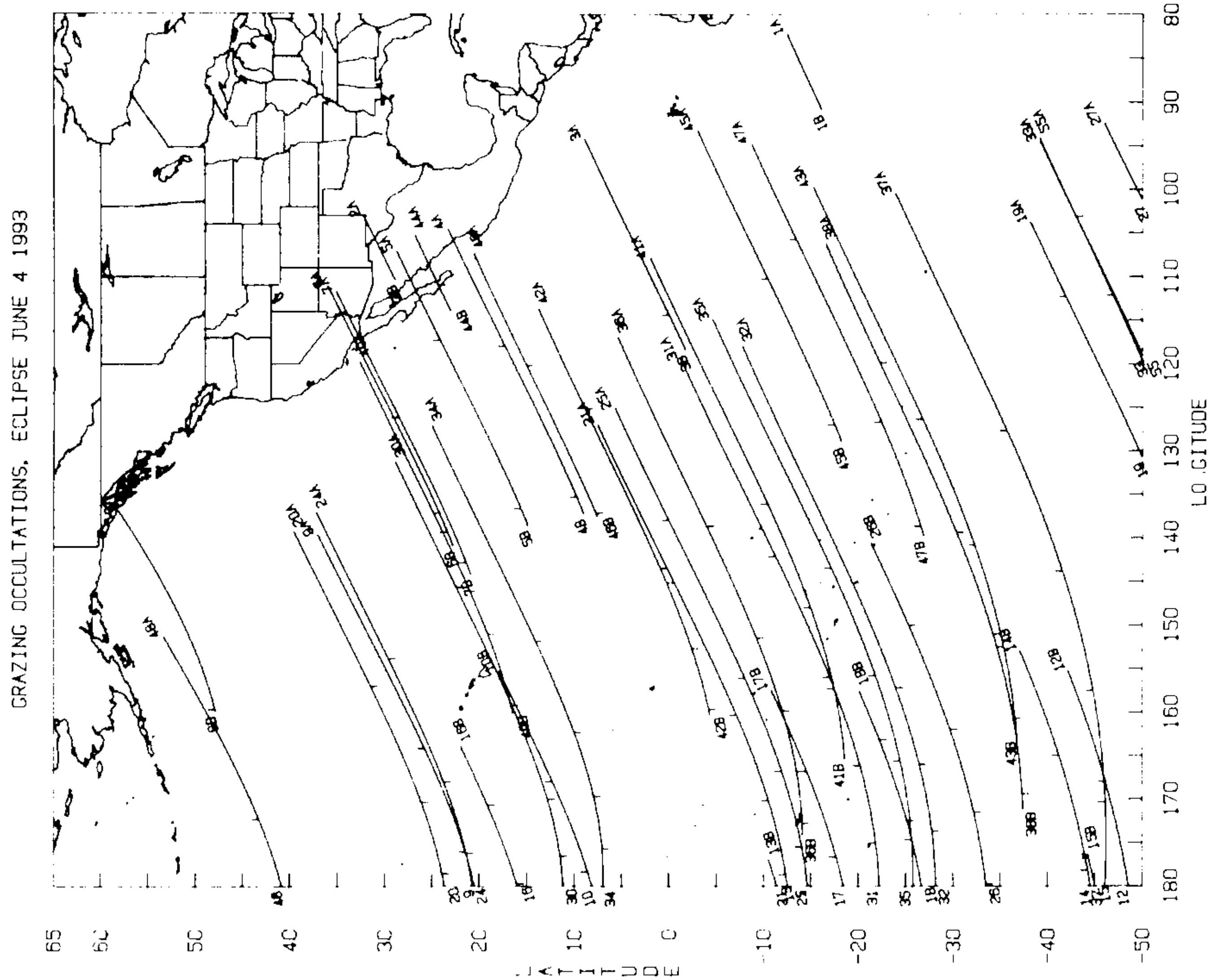
(continued on p. 306)

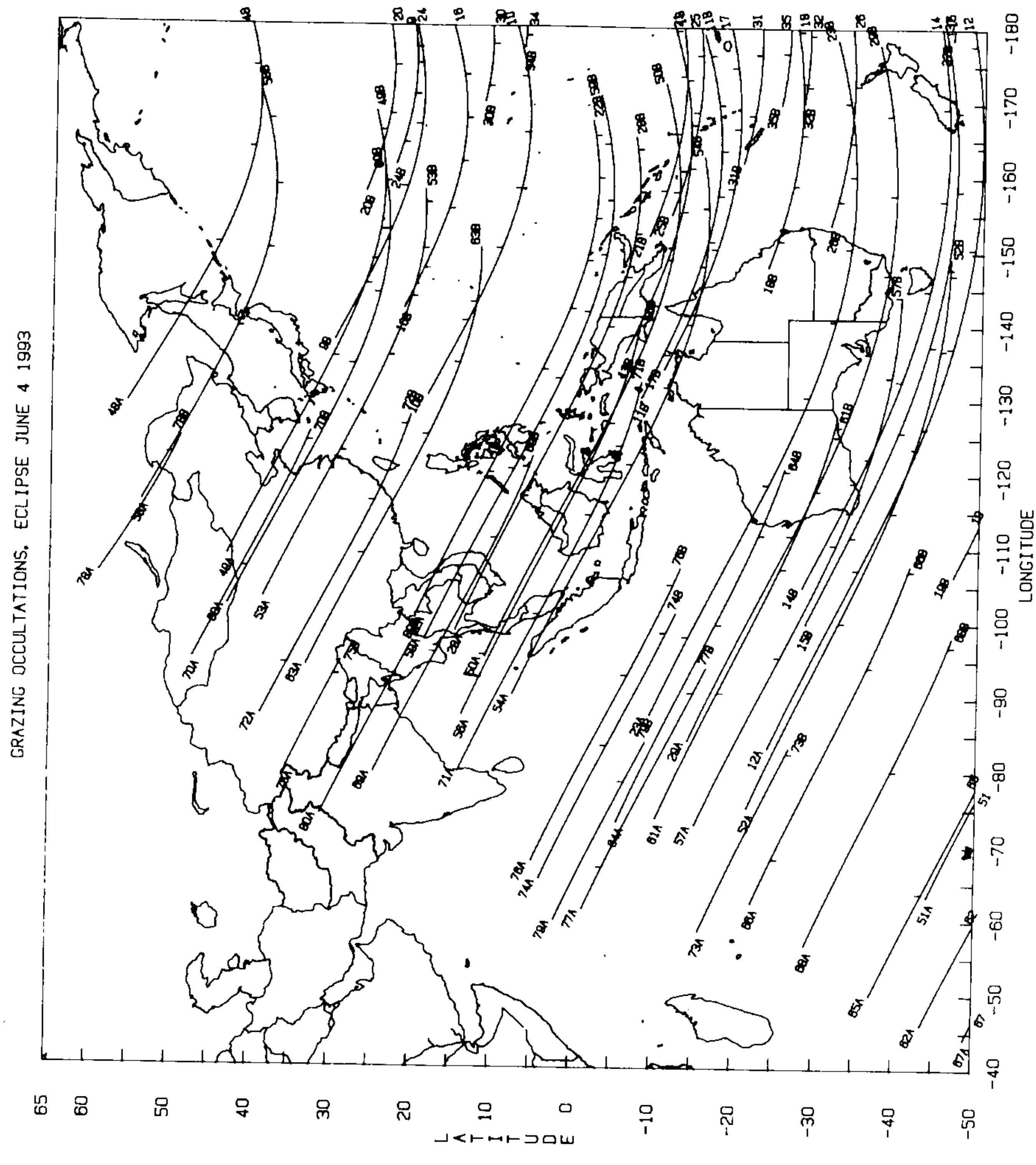
GRAZES DURING LUNAR ECLIPSE OF 1993 JUNE 4, W.H.

NO.	USNO	SAO D	MAG	%SNL	L	W.U.T. h m	LONG	LAT
1	X22543	184573	9.2	60E	S	11 35.6	91°	-16°
2	X22556	184586	8.1	59E	S	11 35.8	110	29
3	2403	184578	7.5	60E	S	11 35.9	118	-2
4	X22568	184597	9.1	59E	S	11 36.9	137	9
5	X22571	184600	9.0	58E	S	11 37.1	138	15
6	X22574	184604	9.4	57E	S	11 37.7	141	23
7	2407	184607V	6.9	57E	S	11 37.8	144	21
8	X22589	184622	9.0	53E	S	11 39.8	160	48
9	X22665	184685	9.6	44E	S	13 12.1	180	21
10	X22674	184693	9.5	43E	S	13 36.8	180	8
12	X22690	184707	9.2	39E	S	13 43.5	180	-49
13	X22685	184704	8.9	37E	N	14 1.5	180	-11
14	X22685	184704	8.9	44E	S	13 37.5	180	-45
15	X22700	184717	8.5	36E	N	14 1.0	180	-45
16	X22673	184692	9.4	36E	N	13 39.8	180	16
17	X22673	184692	9.4	42E	S	13 33.0	180	-18
18	X22669	184688	9.0	34E	N	13 21.4	180	-27
19	X22669	184688	9.0	46E	S	13 49.2	131	-50
20	X22653	184676	9.1	33E	N	12 56.7	180	24
21	X22653	184676	9.1	44E	S	12 57.3	180	-13
24	X22647	184671	8.4	33E	N	12 49.8	180	21
25	X22647	184671	8.4	44E	S	12 49.7	180	-15

GRAZES DURING LUNAR ECLIPSE OF 1993 JUNE 4, W.H.

NO.	USNO	SAO D	MAG	%SNL	L	W.U.T. h m	LONG	LAT
26	2415	184681	7.4	33E	N	13 0.2	180*	-33*
27	2415	184681	7.4	47E	S	13 38.2	101	-50
30	X22633	184660	9.5	31E	N	12 29.2	180	11
31	X22633	184660	9.5	46E	S	12 28.9	180	-22
32	X22632	184657	8.5	30E	N	12 23.1	180	-28
33	X22632	184657	8.5	48E	S	13 15.4	119	-50
34	X22621	184650	9.0	29E	N	12 4.7	180	7
35	X22621	184650	9.0	47E	S	12 8.0	180	-26
36	X22611	184641	9.0	27E	N	11 56.4	174	-14
37	X22611	184641	9.0	50E	S	11 44.6	180	-46
38	X22609	184638	9.0	27E	N	11 56.4	171	-37
40	X22592	184625	8.1	24E	N	11 57.7	160	16
41	X22592	184625	8.1	53E	S	11 41.0	165	-19
42	X22591	184624	9.5	23E	N	11 58.5	160	-4
43	X22591	184624	9.5	53E	S	11 40.8	163	-37
44	X22564	184593	7.6	20E	N	11 59.2	114	2
45	X22564	184593	7.6	59E	S	11 37.0	129	-18
46	X22575	184605	9.6	20E	N	11 59.7	138	8
47	X22575	184605	9.6	57E	S	11 38.3	140	-27
48	2419	184687C	8.1	8E	S	13 9.8	180	41
55	X22627	184654	8.6	29E	N	13 10.3	120	-50




GRAZING OCCULTATIONS, ECLIPSE JUNE 4 1993
LONGITUDE
LATITUDE

GRAZES DURING LUNAR ECLIPSE OF 1993 JUNE 4, E.H.

NO.	USNO	SAO D	MAG	%SNL	L	W.U.T. h m	LONG	LAT
9	X22665	184685	9.6	44E	S	11 45.3	-138°	30°
10	X22674	184693	9.5	43E	S	11 46.1	-130	18
11	X22690	184707	9.2	37E	N	11 49.6	-130	-8
12	X22690	184707	9.2	39E	S	11 47.7	-83	-24
13	X22685	184704	8.9	37E	N	11 49.8	-136	-6
14	X22685	184704	8.9	44E	S	11 45.4	-105	-28
15	X22700	184717	8.5	36E	N	11 50.1	-100	-29
16	X22673	184692	9.4	36E	N	11 50.2	-142	22
17	X22673	184692	9.4	42E	S	11 46.7	-134	-11
18	X22669	184688	9.0	34E	N	11 51.6	-148	-23
19	X22669	184688	9.0	46E	S	11 44.4	-107	-47
20	X22653	184676	9.1	33E	N	11 52.0	-158	26
21	X22653	184676	9.1	44E	S	11 46.0	-152	-9
22	X22709	184726	9.6	31E	N	11 52.3	-101	19
23	X22709	184726	9.6	23E	S	11 57.2	-88	-10
24	X22647	184671	8.4	33E	N	11 52.3	-162	23
25	X22647	184671	8.4	44E	S	11 45.9	-155	-11
26	2415	184681	7.4	33E	N	11 52.6	-154	-31
28	X22714	184731	8.8	30E	N	11 53.0	-99	15
29	X22714	184731	8.8	14E	S	12 2.7	-84	-14
30	X22633	184660	9.5	31E	N	11 53.7	-170	12
31	X22633	184660	9.5	46E	S	11 45.0	-162	-20
32	X22632	184657	8.5	30E	N	11 54.4	-170	-28
34	X22621	184650	9.0	29E	N	11 55.1	-177	7
35	X22621	184650	9.0	47E	S	11 44.2	-170	-25
37	X22611	184641	9.0	50E	S	11 42.4	-179	-46
48	2419	184687C	8.1	8E	S	12 6.7	-129	56
49	X22710	184727	9.4	0E	N	12 21.9	-109	43
50	X22710	184727	9.4	18E	S	12 0.3	-96	11
51	X22711	184728X	9.1	0E	N	12 22.1	-64	-44
52	X22740	184751	9.0	0E	N	12 27.4	-75	-22
53	X22727	184740	8.8	0E	N	12 31.2	-103	39
54	X22727	184740	8.8	0E	S	12 15.2	-90	7
56	X22752	184763	9.4	0E	N	12 37.9	-88	14
57	X22752	184763	9.4	0E	S	12 48.3	-73	-15
58	X22713	184730	8.0	0E	N	12 44.4	-116	54
59	X22713	184730	8.0	9E	S	12 6.3	-98	19
60	X22730	184741	9.4	0E	S	12 52.4	-102	43
61	2429	184782	8.1	0E	N	12 54.1	-74	-10
62	2429	184782	8.1	0E	S	13 33.2	-46	-44
63	X22742	184753	9.6	0E	S	12 54.5	-94	33
64	X22787	184796	8.1	0E	N	13 4.1	-73	-6
65	X22787	184796	8.1	0E	S	13 36.1	-50	-37
66	X22792	184799	8.9	0E	N	13 19.4	-62	-22
67	X22765	184772	9.0	0E	N	13 24.4	-44	-49
68	2432	184804M	6.8	0E	N	13 29.4	-57	-29
69	X22794	184801	9.4	0E	S	13 33.3	-80	25
70	X22778	184785	8.9	0E	N	13 36.7	-95	47
71	X22778	184785	8.9	0E	S	13 8.9	-80	14
72	X22785	184793	9.1	0E	S	13 38.7	-88	39
73	X22819	184821	8.4	0E	N	13 47.9	-59	-16
74	X22816	184819	9.2	4E	S	13 52.0	-66	4
75	X22815	184818	9.4	12E	N	13 56.8	-80	35
76	X22815	184818	9.4	0E	S	13 44.1	-68	5
77	X22826	184827	8.7	16E	S	13 59.1	-62	-1
78	2430	184786	7.0	36E	S	14 11.4	-106	59
79	X22834	184831	9.4	36E	S	14 11.4	-60	2
80	2434	184822M	5.6	37E	S	14 11.9	-74	31

ZC 646, N. Limit: Probably the most spectacular graze in the USA will be seen near the northern limit of the occultation of 5th-mag. 53 Tauri, especially in North Carolina, where the graze occurs shortly after totality begins. But the southern limit crosses remote and dangerous parts of Colombia and the Amazon basin. There are similarly problems with the other limit for all grazes in the contiguous USA. However, the northern limit for 6.1-mag. ZC 646 passes 65 miles n. of Ketchikan, AK; 20 mi. s. of Ft. Nelson, Brit. Col.; 7 mi. n. of Meander River and over Ft. Fitzgerald (where totality ends at central graze), Alberta; 40 mi. s. of Ft. Chimo, Quebec; and 25 mi. s. of Nain, Labrador. Some members of an active astronomy club in Ft. McMurray, Alberta, might be persuaded to travel to the northern limit, but if so, they could use some help from one or more experienced IOTA members. So volunteers are sought to bundle up and go north for this very favorable and valuable graze.

ZC 646, S. Limit: During totality, this passes about 100 km northwest of La Paz, Baja California, a little north of where Don Stockbauer and I observed a graze of Atlas during the 1991 July 8th Pleiades passage. Southern Baja California is a free-trade zone with no customs inspections, facilitating the temporary inport of telescopes and other equipment. Paul Maley is making tentative plans to observe this graze, especially if some effort is made at the n. limit. An expedition for this graze might also get some GPS measurements to resolve a large map discrepancy that was found at the Atlas graze sites.

We thank Joe Senne for calculating details of these grazes.

LUNAR OCCULTATION PREDICTION NEWS

David W. Dunham and Walter I. Nissen, Jr.

Detailed Total Occultation Predictions: The 1994 verification form receipt deadline was April 30, but a few are still arriving; most came in April. For those who did not respond, a second mailing will be made in June.

David Herald recently supplied us with his PC-based OCCULT program. He has run similar software during the past few years on a Commodore computer, but has recently developed an IBM PC version. It calculates nearly all of the quantities given in the detailed IOTA total occultation predictions that are generated by the "EVANS" program, while using only about 4 megabytes of hard disk memory. It generates a lunar ephemeris for any year accurate to about 0."07 using software developed by Jean Meeus. It takes about 1 second to generate predictions for one station for one day on Dunham's 486-66 machine. The program has only crude observability logic, so in general, too many events are generated, and some observable twilight events are rejected. Herald is working to incorporate Brad Schaefer's observability algorithms, using the EVANS implementation as a guide, for a future version of OCCULT. OCCULT uses much less memory than EVANS, so it will be easier to distribute, and it already has nearly all of the features needed by visual observers. Besides O-codes, Herald also plans to add terminator distances (when appropriate) and chronological sorting to a future version. About the only other things produced by EVANS not now in OCCULT are star coordinates, lunar occultations of planets, and photoelectric-option output. OCCULT uses a 2-megabyte version of Watts data, based on a 0°5 libration grid that is sufficient for prediction purposes. OCCULT does not yet include geodetic datum corrections, probably explaining the 2 - 3 second differences typically found with the EVANS IOTA predictions. OCCULT also generates graze predictions and profiles, but problems with selection, perhaps caused by day-boundary logic, need to be solved.

Claudio Costa plans to attend the June 19th occultation meeting in Italy mentioned in IOTA News. He plans to give Dunham the PC EVANS software and datasets then. The PC EVANS program now has good agreement with the mainframe EVANS for event selection, and time differences are generally 1-2 seconds, probably due to different Watts height calculations. We will look into those differences, but they are certainly small enough for prediction purposes.

In any case, we are confident that the 1994 predictions can (and we are determined will) be generated with PC-based software, and we will work out details for the software and data distribution at the June 19th meeting and during the following two months. The prediction effort for 1994 will no longer be centrallized here. Information about the prediction distribution will be given in the next issue. National or regional coordinators are sought to run either OCCULT or PC EVANS to generate predictions for themselves and for others in their area.

Graze and Eclipse Software: Mitsuru Sôma's OCCRED program can now generate the lccard and secldadd datasets needed for ACLPPP profiles, and for detailed total and annular solar eclipse predictions and reductions, respectively. We encountered "wrapping" problems with sending the 80-byte lccard datasets by E-mail, so a 75-byte format was designed to get around this. This lccard e-mail (or lccardem) format has been successfully tested by Sôma and Joeseph Senne, who has also written PC-based and mainframe software to convert lccardem data to the lccard format required by ACLPPP. Senne found differences in graze heights between the current OCC program and OCCRED of about 0″3, as expected, and also acceptable differences in the Watts angle of central graze of 0°2 or less. Unexplained larger differences, up to 1°4 degrees, were found in the cusp angle of central graze, which somehow must be related to the calculation of the position angle of the Sun (or center of the sunlit limb). Even these differences are not crucial since in practice the cusp is ill-defined over a range of about 2° due to the changing geometry of mountains along the limb. But in an attempt to resolve the differences, Dunham used the OCCULT program to calculate a few of the cusp angles in Senne's list. The OCCULT results were always between the OCC and OCCRED values, usually closer to OCCRED. In any case, we see no problems in using OCCRED rather than OCC for 1994 graze prediction refinement via lccardem and ACLPPP.

GRAZING OCCULTATION OBSERVATIONS

Richard P. Wilds

The purpose and structure of the graze articles will probably need to be discussed periodically. I feel the primary purpose of this article is to disseminate the latest graze results to all graze leaders, so that they can apply the best information to their current efforts. The most important part of this information, of course, is the shift. A graze leader may lead a team hundreds of miles to do a graze. The team's success or failure may well depend on the shift information provided by other teams. The second area of importance is in the human side. This is the fun and exciting side of doing a graze - i.e. record breaking events, new scientific discoveries, excitement filled expeditions or just funny stories.

For the reasons given above I am asking for the following help:

1. All graze reports MUST include a calculated shift. If you do not know how to do this, then you may contact me for help. The only reason not to be able to provide this information would be if you are leading grazes to observe difficult events not found within the parameters of the current graze predictions. Therefore, you would not have an ACLPPP prediction from which to calculate your shift.
2. Include a copy of your prediction sheet and your profile. If you indicate your predicted location of observers on your profile, then I can calculate the shift from your reported timings.
3. Please feel free to include any discussion with your report that will alert me to any special scientific significance or human interest involved with your graze effort.

There is also one major change in the structure found at the end of the article. A stellar cross reference has been added at the end to assist graze leaders in identifying stars with a variety of names and numbers.

Our current graze list begins on 12\01\92 with three expeditions to observe the same star. This most interesting area of the Moon stretched across the mountains Gamma, Alpha, and Beta Doerfel. The crater Boltzmann is between Alpha and Beta, while the craters Drygalski and Zeeman could be seen off the south slope of Beta. One of the most interesting points about this graze were the different shifts reported by the graze leaders. This should make for an interesting pictoral reduction. Hal Povenmire did another good job of getting observers out to the graze. Many thanks also go out to Tom Campbell in assisting Chris Stephan with his graze work. Tom did a computer reduction of the results of the last two graze teams that was published on p. 293 of the last issue.

We had two eclipse grazes from last December 9. Joaquim Garcia observed his around the crater Hermite, while Tom Campbell observed his around the crater Peary. Tom noted that most of the Moon was "charcoal gray" with "only a little deep red color on the north limb area."

We start the 1993 observations with a graze from down under. Alfred Kruijshoop observed events around the crater Hermite. He writes that his events occurred on the dark side when they had been predicted to occur on the bright side. One always has to be prepared when taking on the terminator. [Note by D. Dunham: When the Moon is a very thin crescent, only 8% sunlit in this case, the dark sides of mountains near the cusp are presented to us, causing the actual cusp to become an interrupted hairline and retreat onto the "bright" side. Any time the theoretical "smooth Moon" cusp is less than 1" thick (which you can tell from the ACLPPP profile), it is likely to appear as a dark-limb event. At thin crescent phases, events with negative cusp angles of several degrees can occur against apparently dark features. When the Moon is highly gibbous, an opposite effect occurs: Atmospheric seeing and irradiation causes sunlit features to fill in the thin dark cusp, causing events with positive cusp angles of several degrees to seem to be on the bright side. Aggravating this effect is the catching of sunlight by high mountain tops, as predicted in the "worst" terminator region enclosed with W's on the ACLPPP profiles. A 3-km-high mountain on an otherwise smooth Moon will catch sunlight 3°8 from the terminator on the dark side.]

John Holtz was the leader for our last Cassini graze for this article. His team observed a known double star over Beta Doerfel and the craters Drygalski and Zeeman. He reports that team member Ed Honkus had 31 events once they added up the timings from both stars. Only 2 of the events involved the primary star; even the 29 events of the secondary star alone sets a new record number of timings from one station during a graze, as far as David Dunham knows. John only had one comment, "Holy Cow."

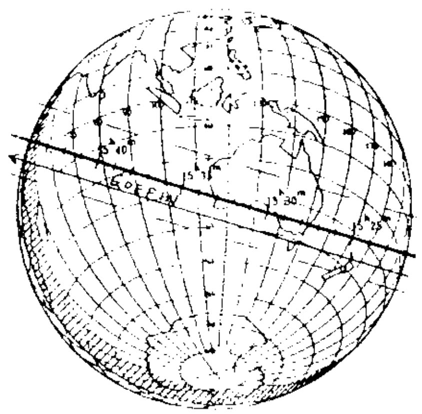
The final set of grazes were all around the crater Brianchon and to its north. Note that Joaquim Garcia's graze of 2\5\93 has no shift listed. This was a difficult graze and so he generated his own predictions. H.A.R.T. produced its first test of our new computer controlled video system on 3\1\93. The star was known to be a spectroscopic binary. Our observations showed that the primary disappeared sharply, while the secondary was of 9th mag. and must be a giant due to its slow events. Craig McManus will have an article in a future ON describing the new H.A.R.T. system. Bob Sandy also had a team on this star. He reports that team member Nick Reuss used a 3"5 Questar to observe 18 events. This observation sounds like it deserves another "Holy Cow."

Graze List

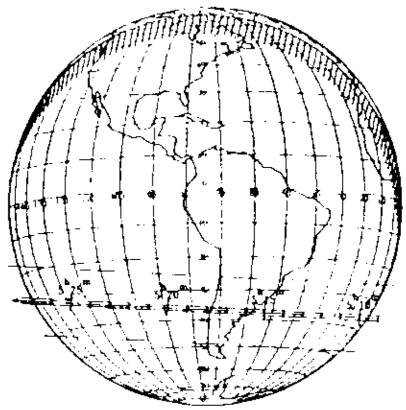
UTDate YYMMDD	V P	Star #	Mag	% Snl	CA	Location	# Sta	# Tm	S S	Ap Cm	Organizer	N Sh S	WA	B
1992														
921201		145637	5.3	38+	14.2S	Palm Bay, Florida	11	74	1	8	Hal Povenmire	1.0S	165	-5.9
921201		145637	5.3	38+	14.0S	Crewsville, Florida	3	34	1	20	Chris Stephan	0.4S	164	-5.7
921201	V	145637	5.3	38+	15.0S	Limestone, Florida	4	24	1	20	Tom Campbell	0.4S	164	-5.9
921209		76977	8.5	E	-21.7N	Caxias, Portugal	1	8	1	20	Joaquim Garcia	0.1S	3	-0.2
921209		77919	7.8	E	19.5N	Verna, Florida	1	5	2	20	Tom Campbell	0.1N	358	-0.1
1993														
930119		185678	6.6	8-	0.0N	Merricks, Australia	1	7	2	20	Alfred Kruijshoop	1.1N	1	-1.2
930125		146239	6.4	9+	2.4S	Flat Rock, PA	2	40	1	15	John Holtz	0.8S	171	-6.3
930131		93052	7.5	52+	10.0N	Fort Scott, Kansas	5	10	2	9	Robert Sandy	0.3S	12	-3.7
930205		96781	7.3	94+	19.0N	Sassoeiros, Portugal	2	11	1	15	Joaquim Garcia	?	15	3.6
930301	V	76438	5.9	44+	9.0N	Dunbar, Nebraska	2	20	1	18	H.A.R.T. R. Wilds	0.4S	11	-1.3
930301		76438	5.9	44+	10.0N	Milan, Missouri	4	20	1	9	Robert Sandy	0.3S	11	-1.3
930301		76456	8.0	44+	12.2N	Venice, Pennsylvania	1	8	1	20	Phil Breidenbach	0.3S	14	-1.2
930327		93211	9.0	12+	13.2N	Le Roy, Kansas	4	13	1	20	H.A.R.T. C. McManus	0.3S	12	-2.7
930330		78406	8.2	47+	13.7N	Porto Alto, Portugal	3	1	1	14	Joaquim Garcia	0.6S	15	2.9
930331		78632	8.1	49+	13.3N	Russellton, PA	2	5	1	25	John Holtz	0.8S	15	3.3

Stellar cross reference:

SAO #	ZC #	Other
145637	3185	46 Cap
76977		X6567
77919		X6638
185678	2549	
146239	3326	207B Aqr
93052	397	
96781	1109	
76438	601	39 Tau
76456		X5352
78632		X9576
93211		X3925
78406		X9117



SAO 209943 by Philosophia 93 Jul 7



SAO 143896 by Aspasia 93 Jul 15

I would like to give a final word of encouragement. The last few graze teams on the list reported a large number of misses and site failures due to technical problems and human error. H.A.R.T. had over 70 grazes clouded out in the past 5 months. Some graze teams have noted frustration as a major feeling at these times. This is understandable, but in the words of a past President of the USA - "We do not do these things because they are easy, but because they are hard." Since the quotation was about space exploration and going to the Moon, I thought it was appropriate to use it in relation to our work.

REMEMBER to apply the following shifts:

1. Northern limit, waxing-phase, dark-limb grazes tend to have a 0".3 south shift from your predicted graze path. One should spread out, however, since star errors could increase this shift or reduce it to a 0" shift.
2. Southern limit, waxing-phase, dark-limb Cassini region grazes tend to have a 0".4 - 0".5 second of arc south shift from your predicted graze path. Cassini region grazes have profile points from 3 to 7. Southern-limit Cassini grazes will also have large negative latitude librations. This correction should continue into waning-phase grazes to Watts angle 187°.

Please report all grazes to:

Richard P. Wilds
3630 S.W. Belle Ave
Topeka, KS 66614-4542
USA

and to the:

International Lunar Occultation Centre (ILOC)
Geodesy and Geophysics Division
Hydrographic Department
Tsukiji-5, Chou-ku
Tokyo, 104 Japan

A CONFRONTATION IN FLORIDA

Tom Campbell

I read the articles about safe expeditions in **ON 5**(11) with great interest. During my 20 years as a local team leader there has been only one occurrance where a gun prevented serious injury to an observer. This happened during the evening of the Pallas occultation in 1983. I had organized more than a dozen observers placed in sites that I considered safe, off the highways. The sites were widely separated, 10 to 50 miles apart, and some of the observers were alone.

Lang Adams drove to his designated site at dusk. His site was a nice roadside public park with picnic tables on the bank of the beautiful Myakka River near Floriday Highway 70. Lang planned to do a few hours of casual observing before the occultation event. He drove around the park looking for a good spot for his equipment. There was another car in the park with 6 people, 3 men and 3 women who were very drunk and very rowdy. Lang looked for a site that would place as much distance from the other car as possible. He stepped outside his car with his binoculars and looked at the sky, and, briefly, at other car. That was too much for the men in the other car. They drove across the park at a high rate of speed to Lang's car, the three men got out, and threatened to drag Lang out of his car and beat him up for staring at their women. Lang replied "that was not my intent", but they did not believe him. When they moved towards his car, he pulled his gun and said "Don't come any closer, get into your car, and get out of here." They did leave, and so did Lang, fearing that they might come back with weapons or more friends. In fact, Lang was too upset to observe, so he went back to his home in Tampa.

Lang and I later agreed that his gun was the only way he could have dealt with those irrational people. Occurances like this are indeed extremely rare, but they do happen. I have a gun which I take with me when I observe alone, but I have never been in a situation where I even though about reaching for it. In Florida, a person without a criminal record can obtain a permit to carry a concealed weapon (in a shoulder harness) for personal protection. I do not have such a permit for my own gun, a 38 revolver, but in Florida it is permissible to carry a gun in the glove box (in a zippered pouch) where 2 or more moves are necessary to access it. When observing behind my car, I place the gun in the spare tire wheel well, the equivalent of the glove box.

I recently bought the PAAL personal alarm device to use while on grazes. I listened to it once myself. The noise it makes at close range is absolutely intolerable. I believe it can be quite effective in protecting from an attacker. The noise would certainly attract the attention of others nearby, exactly what criminals don't want. PAAL sells for $29. I bought it from a local Amway salesman, but it can also be ordered from Pacesetter Marketing (800) 374-8338, as noted on p. 285 of the last issue.

There is another way to reduce the risks of observing alone not mentioned in either of the two articles, and that is to keep the time spent at you station as short as possible. Do not loiter at your site before or after the graze. If you arrive early, make a check of your site to see that it is suitable. Then drive to a local coffee shop or somewhere where you feel safe to wait. When it is time to observe, drive to the site, set up your equipment, make the observation, and leave in as short a time as practical. I do a quick "field pack" of my equipment in my car at the site so that I can leave immediately. The remainder of the packing and stowing of equipment can be done at the motel or when you arrive back home.

To make this even easier, try to select sites near a landmark feature that you can identify on the map. Then you will not need to spend much time measuring your location.

ANALYSIS OF LUNAR OCCULTATION REDUCTIONS 1 JANUARY 1989 TO 8 OCTOBER 1992

Peter E. Anderson

This is an analysis of the O-C results of my total lunar occultations for the period 1 January 1989 to 8 October 1992. These total 1151 occultations, observed from my observatory in Brisbane, Australia. Earlier, I performed a similar analysis of 1069 observations made between 1 January 1986 and 24 September 1988.

As a result of this analysis, I have arrived at the disturbing conclusion that a significant proportion of the ILOC reductions are being corrupted by some problem either in the data base or in the reduction process.

In order to assess trends, it is necessary to know that the data are from observations made in a consistent manner, so that the data are representative, and do not contain significant effects from different observing techniques. In this case, all of the observations have been made by myself, an experienced observer who has made occultation observations since the mid-1970's. Since 1980 with the establishement of the Taylor Range Observatory, I have used a 41cm F6 Newtonian reflector. The number of observations is also important, as there must be a sufficient number for any trends noted to be statistically significant. The number of observations for 1989 to October 1992 are given in Table 1.

From my site, more observations are made during the drier months of our winter and spring, with well over 30 observations being recorded during each of the months between June and October. Nearly all of the observations are made by stopwatch with eye and ear backup to radio time signals.

I have analyzed the observations that had an O-C in the ILOC reduction of greater than 2".0. This 2".0 O-C would represent a variation of a least 4 seconds in time of the observation, depending on the position angle of the event, motion of the Moon, and lunar limb profile. The variations in the predicted accuracy figures shown in the later tables gives an indication of how the first two of these factors can cause significant variations, especially for events near the north and sourth limbs. In such cases, the O-C of 2".0 translates into a significant number of seconds of time. Please note that I have not attempted to relate the data to the age of the Moon or right ascension of the stars in question. This could be a fruitful area for further research.

In my earlier data reduction, I noted early and late events well outside of the predicted accuracy range, suggesting that the stellar positions were in error. From my experience, this problem only becomes significant south of declination about -20° and is a serious problem for declinations of -27° and and -28°. Other problems I have noticed with extreme southern declinations includes the fact that the (catalog) magnitude limits are lower (i.e., fewer fainter stars than in the northern regions) means that there are more unidentified stars with occultations observed in the farthest south declinations of the Moon's orbit than in the more northern parts of its path.

This problem with the stars in the southern regions continued to be apparent in 1989 and 1990, but as the orbit of the Moon no longer took it to such extreme declinations in 1991 and 1992, another problem, previously masked, became apparent.

The problem, put simply, is that the ILOC reductions do not appear to agree with the USNO/IOTA predictions in a disturbing number of cases. This is evidenced by an observation concordant with the predictions producing an excessive O-C. The reverse, which is much less common, is that of an observation outside the predicted accuracy limits producing a small O-C value. The listing of problems for each year in Table 2 clearly illustrates the lack of agreement between the ILOC reductions and the predictions. I concentrated on the 1991 and 1992 results, which clearly demonstrate this lack of agreement, and anlyzed each of the observations that produced an O-C greater than 2".0 for those years. Table 3 shows the observations from those years that produced an O-C greater than 2".0.

I have also examined the accuracy of the USNO/IOTA predictions to establish the number of events which occurred outside the predicted accuracy range and which I had commented upon in my reports. I found 16 in the 1991/1992 period, and I show them in Table 4. Some further events were only marginally outside the limit and did not draw a comment. The listing in Table 3 shows five of these marginal events where the large O-C value points to a reduction rather than a prediction problem. Of the 16 events I found to be outside the predicted accuracy range, 14 were late and two were early. Only two of these gave an O-C greater than 2".0, namely the events of 16 August 1991 and that of 10 April 1992. As noted in Table 3, the first event is a southern declination problem and the second is most likely a faulty observation. The event on 10 April 1992 was a bright limb reappearance, and is most likely a faulty observation. The fact that only two of these events resulted in an O-C of greater than 2".0 indicates some variance between the prediction and the reduction data bases and/or techniques. It is also interesting to note that 7 of the 16 events were of ZC catalog stars. Excluding the observational errors, 14 events were observed outside the predicted accuracy range, all but one in 1991. At least half of these 14 events appear to result from the southern declination problem previously discussed.

Errors in the prediction process are often readily apparent at the time of observation. As examples, observations during one evening may be generally late, or early, or events at the northern or southern limb, by being late or early, would indicate a small shift to the north or south. As an example, note the two observations at the north limb on 12 November 1991.

In the period from 1 Jnauary 1991 to 8 October 1992, occultations from a total of 17 unidentified stars from magnitude 8.8 to 11.2 were observed (unpredicted observations). The majority of these were in the 9.0 to 10.0 range. All unidentified stars brighter than visual magnitude 10.0 were located sourth of -20°, with the exception of an 8.8-magnitude star at +20° occulted at 09 59 38.8 UTC on 10

April 1992 (WA 105°). In the preceding 1990/1991 period there were no unidentified stars worthy of special comment.

SUMMARY: I make no appology for concentrating on the 1991/1992 period since it is in this period that the "prediction/reduction" problem became very evident as the "southerly declination" problem subsided. It is already well known that stars with far southerly declinations are less well charted, and though the extent and magnitude of this problem may come as a surprise to the non-specialized reader, its existence should not. What I believe is not well known is the phenomenon I have referred to as the "reduction problem" which may be corrupting the results for many other events where the computed O-C does not exceed the parameters for unacceptability as well as causing perfectly good observations to be disregarded. In this respect it appears from comparing the relative numbers of variations between observations and predictions with the computed O-C of greater than 2."0 that the bulk of the problem lies with the data base or techniques used for reduction rather than with the prediction process.

Table 1. Number of Observations Reported and Reduced

Year	Number of Observations	Number Reduced by ILOC	Comments
1989	310	302	Events of unidentified stars not reduced
1990	336	310	Includes a 20 event graze and 12 events from Jupiter contacts 1 to 4 and satellites
1991	290	290	Includes a 6 event graze
1992 to 8/10	215	215	289 for the whole year

Table 2. Summary of Observations with Large O-C's

YEAR	TOTAL OBS	NUMBER			
		O-C > 2."0	SOUTHERN DEC	REDUCTION PROBLEM	OTHER†
1989	310	27	16	8	3
1990	336	19	4	11	4
1991	290	23	2	19	2
1992 TO 8/10	215	16		14	2

†Near grazes (misses), low certainty timings, wrong keying, etc.

Table 3. Observations with Large O-C's for 1991 and 1992

DATE	STAR	OBSERVED		PREDICTED		O-C (")	RED PROB	NOTES
		TIME	ACC (s)	TIME	ACC			
1991								
04 26	X18318	10:17:59.8	0.2	10:17:59	2	2.19	Y	1
06 23	X20983	08:54:35.9	0.1	08:54:36	2	5.14	Y	
06 24	X21977	10:20:37.0	1.0	10:20:36	3	-2.28	Y	
06 23	X22739	08:06:00.1	0.15	08:06:03	4	2.09	Y	
07 19	X19935	08:45:23.0	0.1	08:45:15	12	2.05	Y	2
07 19	X19935	08:58:28.5	0.2	08:58:30	46	5.45	Y	2
07 19	X19946	09:06:02.0	0.1	09:06:00	2	2.34	Y	
07 25	X26764	10:20:20.7	0.3	10:20:18	3	3.27	Y	
08 16	X20483	10:37:31.9	0.1	10:37:24	5	3.03		3
08 20	X24810	10:45:03.0	0.1	10:45:03	2	-2.03	Y	
08 20	X24891	12:36:21.0	0.1	12:36:21	2	-2.60	Y	
08 21	R 2777	10:51:13.7				4.80		4
08 21	X26391	12:41:42.5	0.1	12:41:41	2	2.09	Y	
09 12	X20195	10:09:39.0	0.5	10:09:42	22	2.51	Y	5
09 14	X22010	09:45:04.3	0.1	09:45:02	3	3.43	Y	
09 14	X22043	10:34:38.4				5.17		6
09 15	X22902	10:04:30.4	0.15	10:04:37	5	3.32	?	7
09 15	X22953	11:20:30.5	0.1	11:20:28	2	3.16	Y	8
09 16	X24123	09:45:35.7	0.1	09:45:34	3	-3.12	Y	
09 16	X24264	13:00:11.4	0.1	13:00:13	3	2.56	Y	
09 19	X28435	11:45:21.4	0.1	11:45:19	2	2.10	Y	9
09 21	X30247	09:19:40.7	0.15	09:19:39	2	2.04	Y	
11 12	X27653	11:52:41.2	0.15	11:52:40	2	3.48	Y	
1992								
01 10	K07554	09:43:28.7	0.3	09:43:27	2	9.99	Y	10
04 10	X11908	09:48:35.0	1.0	09:48:46	5	2.05		11
06 10	X19275	11:00:00				9.99		12
06 11	X20065	10:37:22.1	0.1	10:37:20	2	3.00	Y	13
06 11	X20080	11:38:37.6	0.15	11:38:39	2	-7.24	Y	
07 06	X18217	12:19:50.4	0.1	12:19:53	2	2.08	Y	14
08 06	X21371	10:00:13.9	0.1	10:00:14	4	2.14	Y	
08 09	X24893	09:25:26.0	0.5	09:25:26	3	-2.56	Y	
08 09	X24980	11:25:30.1	0.1	11:25:28	3	-2.25	Y	

DATE	STAR	OBSERVED		PREDICTED		O-C	RED	NOTES
		TIME	ACC (s)	TIME	ACC	(")	PROB	
08 10	X26513	12:40:07.6	0.1	12:40:07	2	2.30	Y	
09 05	X24335	09:47:47.1	0.1	09:47:46	3	-2.57	Y	
09 05	X24434	11:32:06.7	0.1	11:32:06	2	-2.09	Y	15
09 06	X26035	10:29:43.7	0.1	10:29:44	2	2.67	Y	
09 08	X28577	11:19:58.6	0.1	11:19:58	2	3.04	Y	
10 01	X22568	09:35:26.6	0.1	09:35:27	2	-2.78	Y	16
10 01	X22574	09:36:09.3	0.1	09:36:09	2	-5.66	Y	

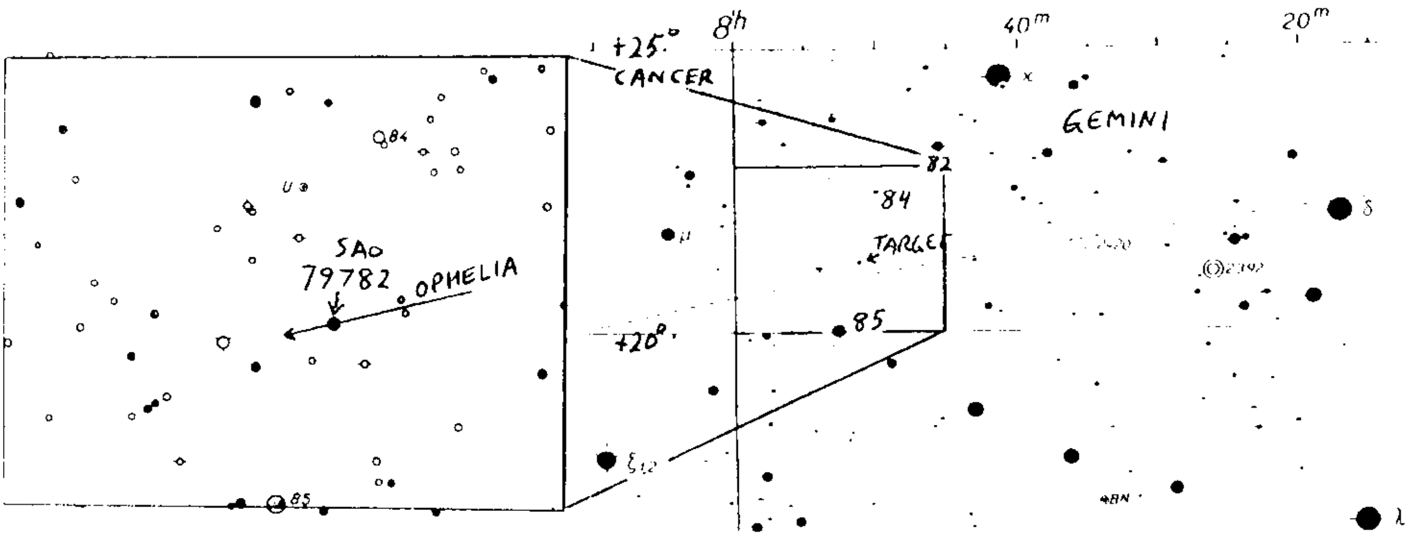
Notes to Table 3

Number	Comment
1	Fast fade of 0.3-second
2	Star dec. -17° and a near graze at N limb
3	Star dec. -20°. Southern declination problem.
4	This a secondary component of a binary, data keyed as for the primary. The primary O-C was 0".22.
5	Near graze at N limb
6	My error in reporting: should be 10:34:48.4
7	Star dec. -25°, Southern declination problem, possible reduction problem
8	Star dec. -24°
9	Star dec. -17°; observation following (X28443) was 2.9 seconds late, O-C was 1".90
10	ILOC position error
11	Certainty code of 3, likely faulty observation. Star dec. +20°
12	Near graze and a miss at my site; incorrect time entered by ILOC but a miss anyway
13	Star dec. -17°
14	Previous observation (R1761) was 3.2 seconds earlier than predictions (O-C of 1".12) at same PA of 106°. Therefore, this is a reduction problem.
15	0.5-second stepped disappearance
16	0.3-second fade disappearance

Table 4. Events Outside the Predicted Accuracy Range

Date	Star	Observed Time	Observed Accuracy	Predicted Time	Predicted Accuracy	O-C	Declination
1991							
07 20	R2146	14:26:19.4	0.15	14:26:23	2	0.56	-21
08 16	X20483	10:37:31.9	0.1	10:37:24	5	3.03	-20
08 20	X24864	12:32:45.5	0.1	12:32:41	3	0.88	-24
08 24	R3137	08:09:28.0	0.1	08:09:25	2	-0.30	-12
09 15	R2443	10:28:13.5	0.1	10:28:10	2	-0.37	-24
09 17	X25798	10:14:04.7	0.1	10:14:00	3	-0.09	-23
09 21	R3216	08:43:10.2	0.1	08:43:06	2	0.51	-8
10 18	R3185	13:43:35.1	0.1	13:43:25	4	-0.96	-9
11 11	X26178	09:28:35.9	0.1	09:28:31	2	1.89	-21
11 12	X27554	09:31:57.6	0.1	09:31:50	4	-1.58	-19
11 12	X27641	11:45:28.5	0.2	11:45:25	2	1.66	-18
11 15	X30421	10:41:08.3	0.1	10:41:05	2	-0.30	-6
12 17	R0266	08:42:09.7	0.1	08:42:06	2	-0.11	+16
1992							
04 10	X11098	09:48:35.0	1.0	09:48:46	5	2.05	+20
05 08	X12405	10:15:35.7	0.1	10:15:32	2	-0.49	+17
05 08	R1236	11:10:47.5	+0.0-1.0	11:10:42	1	1.62	+17

Notes to Table 4:
X27554 at PA 351° and X27641 at PA 17°
X11098 and R1236 certainty code 3



171 Ophelia SAO 79782 1993 Aug. 13

REPORTS OF ASTEROIDAL 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 Drive, Tucson, AZ 85737 USA. Names and addresses of regional coordinators are given in "From the Publisher" on the ON's front page. All times in this report are UTC.

The following are positive reports (from experienced observers and/or with some sort of confirmation) for asteroidal occultations during 1991:

(4) Vesta and SAO 93228, Jan 04. [**ON** 5(3), p. 62]. No details have been published in **ON** because David Dunham is preparing an article for publication in a professional journal for this and the next two events. The January 1992 issue of **S&T** also has some remarks on these events.

(381) Myrrha and Gamma Geminorum, Jan 13. [**ON** 5(3), p. 62]. The Japanese will publish an analysis of this event in the **Astronomical Journal** very soon. Chinese observers are also planning to publish their analysis in a professional journal.

(216) Kleopatra and SAO 115296, Jan 19. [**ON** 5(3), p. 62]. (See (4) Vesta above.)

(230) Athamantis and SAO 156876, Jan 21. [**ON** 5(6), p. 145]. Seven of eleven European (EAON) observers recorded occultations for this event. An article about this event will be prepared from material supplied by EAON for a future issue.

(5) Astraea and SAO 96089, Feb 02. Charlie Smith at Woodridge, Queensland observed a 17.2-second occultation beginning at 10:04:09.5, and Peter Anderson at The Gap, Queensland observed a 17.4-second occultation beginning at 10:04:13.9. Both noted 0.2-second fades.

(217) Eudora and PPM 179112, Apr 02. Lou St. George feels a high probability that a 3.2-second occultation occurred at 12:07:41.0, despite some fast moving clouds at Aukland, New Zealand. Both the disappearance and reappearance were instantaneous.

(423) Diotima and SAO 1852, Jun 13. Ross Dickie saw a definite disappearance beginning at 12:33:09.1 from Gore, New Zealand. However, he states that the reappearance took about a minute.

(356) Liguria and SAO 210543, Jun 15. New observer H. Lund recorded an occultation beginning at 04:10:34 lasting 9 seconds from Johannesburg, South Africa.

(198) Ampella and SAO 161512, Sep 08. Fraser Farrell at Hockham West, South Australia reports a distinct 2-magnitude drop in brightness beginning at 12:50:14.12, and lasting 0.24-seconds. Jeff Byron at Sydney, New South Wales saw a disappearance at about 12:51:19, lasting 3.7-seconds. He thought the dimming was due to eye fatigue at first. Graham Blow's analysis of this event shows the two observations to be incompatible. Using the individual reports and the observers' experience, Blow feels Byron's observation should be accepted. If the diameter is assumed to be 59 km (from ASTEROIDS II), the chord from this observation would be about 28 km on the southern side of the planet, since three observers were a few km to the south.

(18) Melpomene and SAO 160736, Oct 10. Ross Dickie recorded at 3.9-second occultation beginning at 11:22:01.2 from Gore, New Zealand. The reappearance seemed to take 2.5 seconds.

(50) Virginia and SAO 093933, Dec 31. D. Ewald at Biesenthal, Germany recorded a 4.6-second occultation beginning at 18:05:49.0, along with two blinks at 18:05:59.9 and 18:08:58.3.

I have not included the 1992 events. I will present them when I receive all of the overseas reports.

ECLIPSES AND OCCULTATIONS OF IAPETUS IN 1993

David W. Dunham

In **Astron. Astrophys. 265**, pages L21-L24 (1992), Mitsuru Sôma published predictions about two eclipses of Iapetus by Saturn that occur during 1993. Information about them was also published in **Astronomy**. Since the interesting magnitude variations range from 11 to 14, the phenomena are best observed photoelectrically with relatively large telescopes. The first event occurred on May 1-2. I have received only one report, from Mt. John Observatory in New Zealand saying they were clouded out. Before that event, John Spencer at Lowell Observatory distributed an E-mail message giving basic information, a reference to Sôma's article, and noting that infrared observations could give important information about Iapetus' thermal properties. I copied Spencer's message to my fairly extensive list of occultation observers with E-mail addresses.

The next eclipse will start sometime during the 21st hour U.T. of July 20 and will end shortly after 5h U.T. July 21. It will be followed for 6 hours with a grazing eclipse by the A-Ring, which will have a maximum depth from 0.3 to 1.3 magnitude, the uncertainty caused by current errors in Iapetus' ephemeris. In response to an E-mail question by Steve Albers in Colorado, Sôma notes that there will be occultations of Iapetus by Saturn around October 7 and December 26. These events will be more difficult than the eclipses to observe, and useful observations of them will probably be impossible. But if there is a serious interest in the occultations, Sôma will calculate predictions. He is at the Japanese National Observatory, under "Kouritsu" in the IOTA Roster.

SOLAR SYSTEM OCCULTATIONS IN 1993

David W. Dunham

This is a continuation of the article on pages 287-289 of the last issue, which in turn was started on p. 257 of **ON 5** (10). A finder chart for an event potentially observable from North America that was not included in Edwin Goffin's coverage, and selected world charts [see **ON 5**

(10), p. 259], are included in this issue where space allows. Regional maps showing asteroidal and planetary occultation paths from June through September, similar to those in **ON** 5 (10) for February through May, are included in this issue.

Notes about Individual Events:

June 11: Mercury will be 53% sunlit. The star will disappear on the dark side.

June 21: SAO 75188 is 16 Arietis.

June 23: SAO 144153 is ADS 13475. The 8.8-mag. companion, itself a close double with an 11th-mag. star 2″ away, is 120″ away from SAO 144153 in PA 63° and will not be occulted.

June 25: Venus will be 57% sunlit. The star will reappear on the dark side.

July 3: SAO 186204 = 9 Sagittarii = ZC 2607. The star is in M8, the Lagoon Nebula, but the nebula will not be visible due to the nearly full Moon only 3° to the north. The Moon is shown on the finder chart on p. 15 of the 1993 Asteroidal Occultation Supplement for North American Observers. This is the brightest star predicted to be occulted by an asteroid in North America this year, so observers throughout the continent should mark the night of July 2-3 on their calendar and practice locating the star in moonlight either the previous night or the evening of the event, well before it occurs. Since 9 Sgtr. is relatively far south, a small error in Themis' orbit relative to the star could move the path large distances, even into the southern USA. See the world map on p. 296 of the last issue. The event has high priority for an astrometric update, but the moonlight may make these efforts difficult.

July 17, Berbericia: SAO 94332 = 104 Tauri = ZC 764 = HR 1656 = ADS 3701. This close double has equal components, each mag. 5.8 with spectral type G4V. The predicted separation is 0″075 in PA 322°. However, the motion is quite rapid and even the period could be a rational fraction of the true period, so especially the PA is very uncertain.

Aug. 12: SAO 146585 = ϕ Aquarii = ZC 3412 is the brightest star that will be occulted by an asteroid in 1993. It is a red giant star; see Table 3 in **ON** 5 (10), p. 267.

Aug. 13, Ophelia: SAO 79782 = ZC1191, also a red giant.

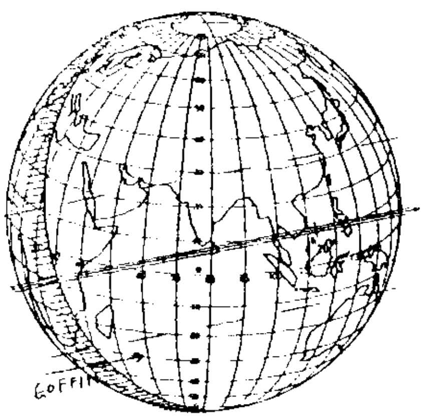
Aug. 17, Olga: SAO 128584 is ZC 9.

Aug. 18, Fortuna: SAO 163155 is ZC 2915.

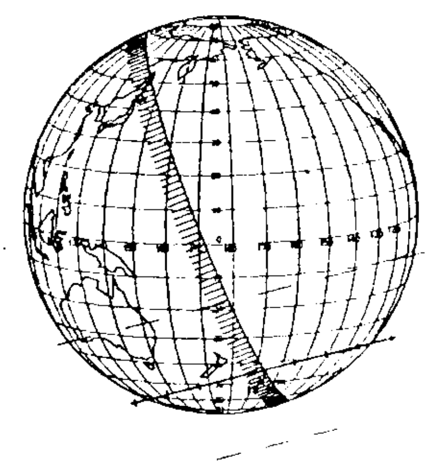
Aug. 21: Venus will be 79% sunlit with a 2″9 defect of illumination. The star will reappear on the dark side.

Sept. 5: The slow motion of this asteroid in an almost due north-to-south direction confused my computer program so that its path was not plotted on the regional maps on the next pages. The path crosses northern Norway, eastern Saudi Arabia, the Seychelles, and part of Antarctica.

Oct. 3, Pluto: This note, and the world chart on p. 320, are given a little early since this is the brightest star that might be occulted by Pluto during the rest of this century. As such, it might be recorded with CCD cameras on moderate-sized telescopes to determine information about Pluto's changing atmosphere, so special efforts are being made to try to observe it. During the next few months, astrometry will be obtained to tell whether the occultation is likely to be visible from eastern Australia, Japan, part of Micronesia, or off the Earth's surface. Wolfgang Beisker and other IOTA/ES members are making preliminary plans to go to Australia for it.

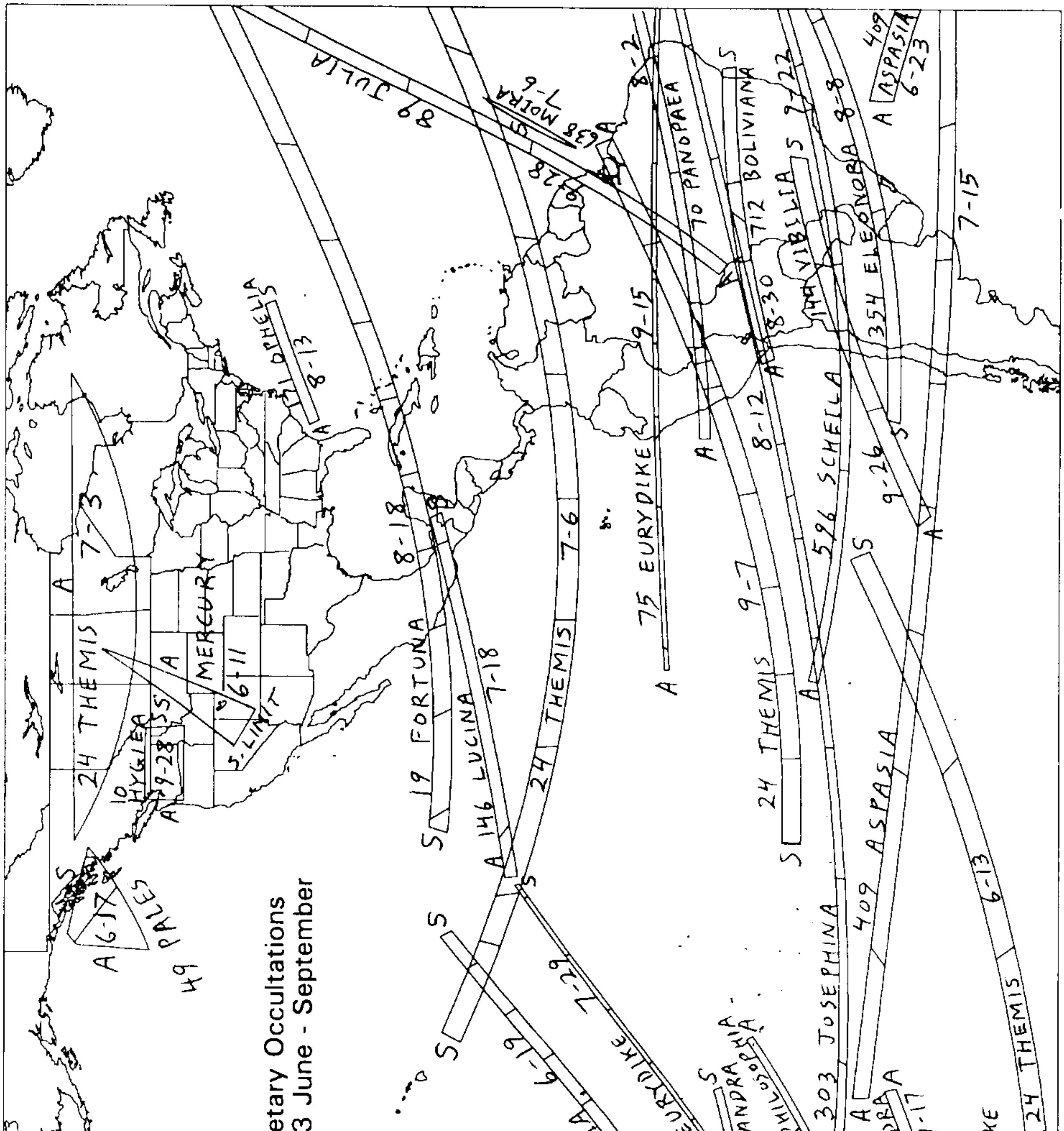


104 Tau by Berbericia 93 Jul 17

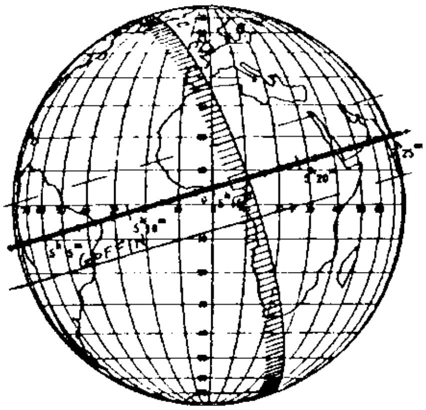


Anonymous by Glauke 93 Jul 17

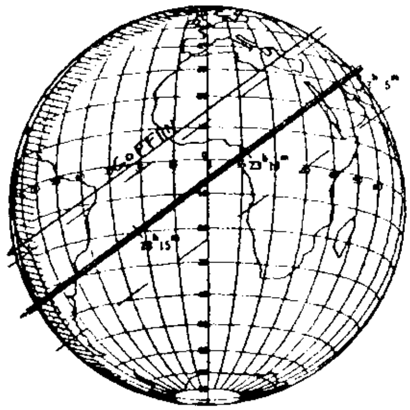
FAC 74923 by Lucina 93 Jul 18



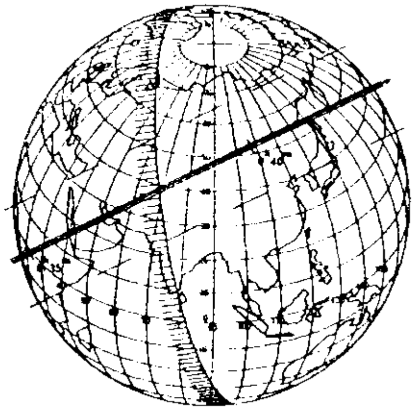
Planetary Occultations
1993 June - September



SAO 129531 by Panopaea 93 Aug 2

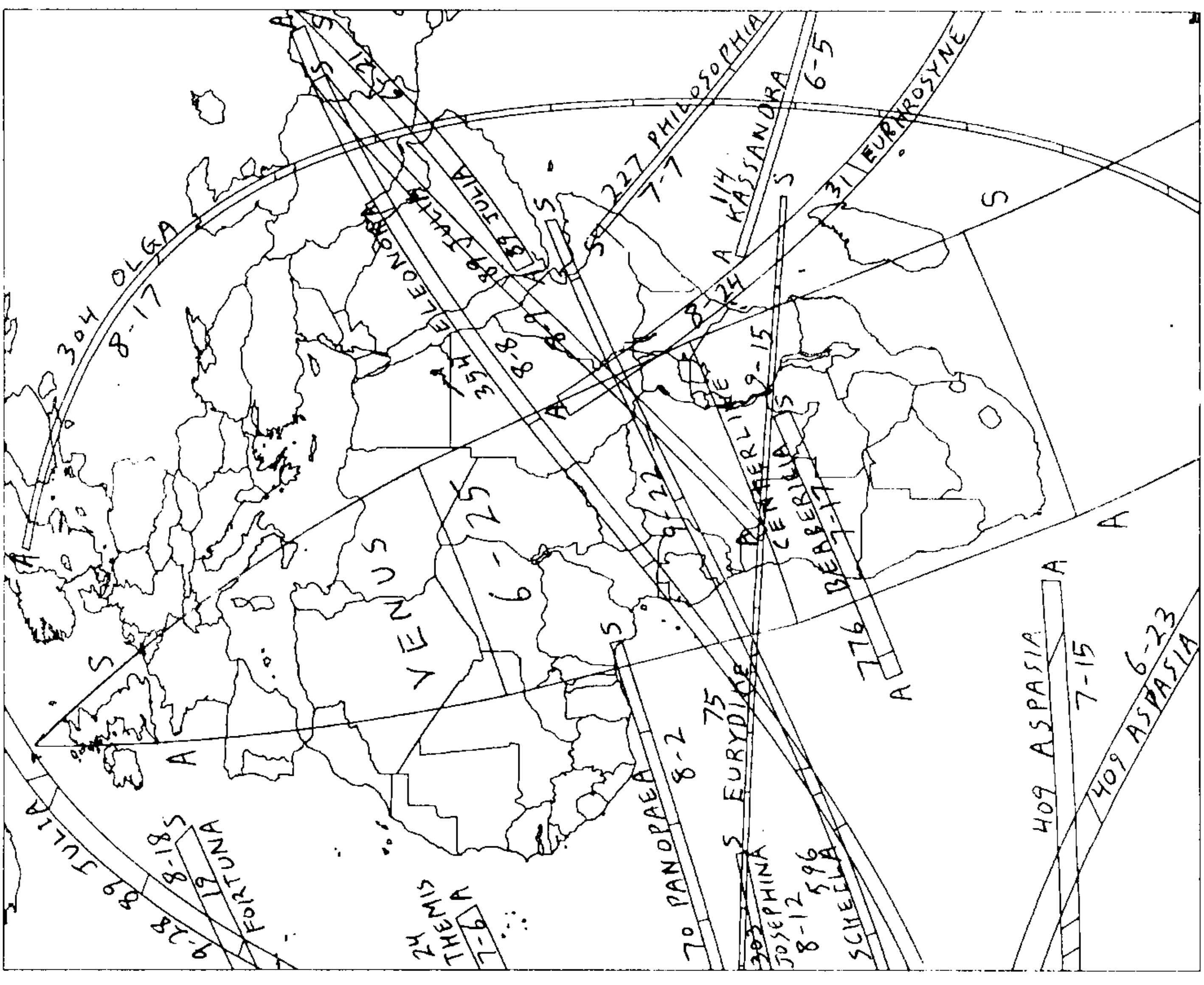


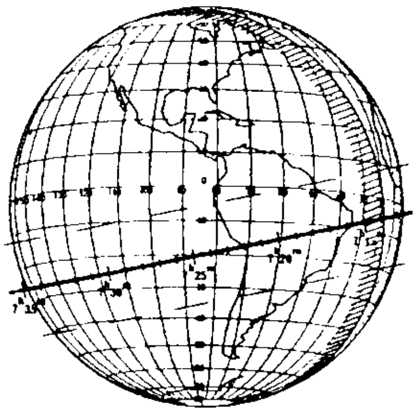
L 5 3323 by Eleonora 93 Aug 8



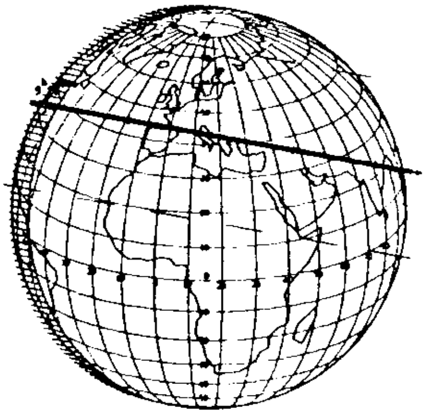
SAO 56655 by Julia 93 Aug 9

Planetary Occultations 1993 June - September

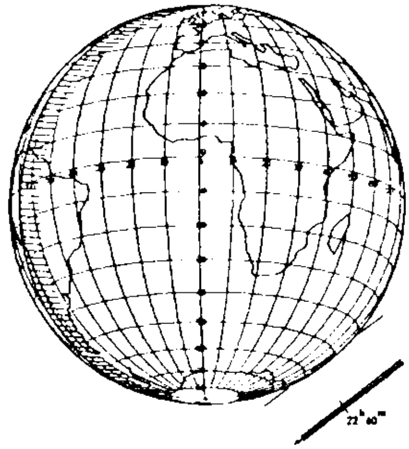




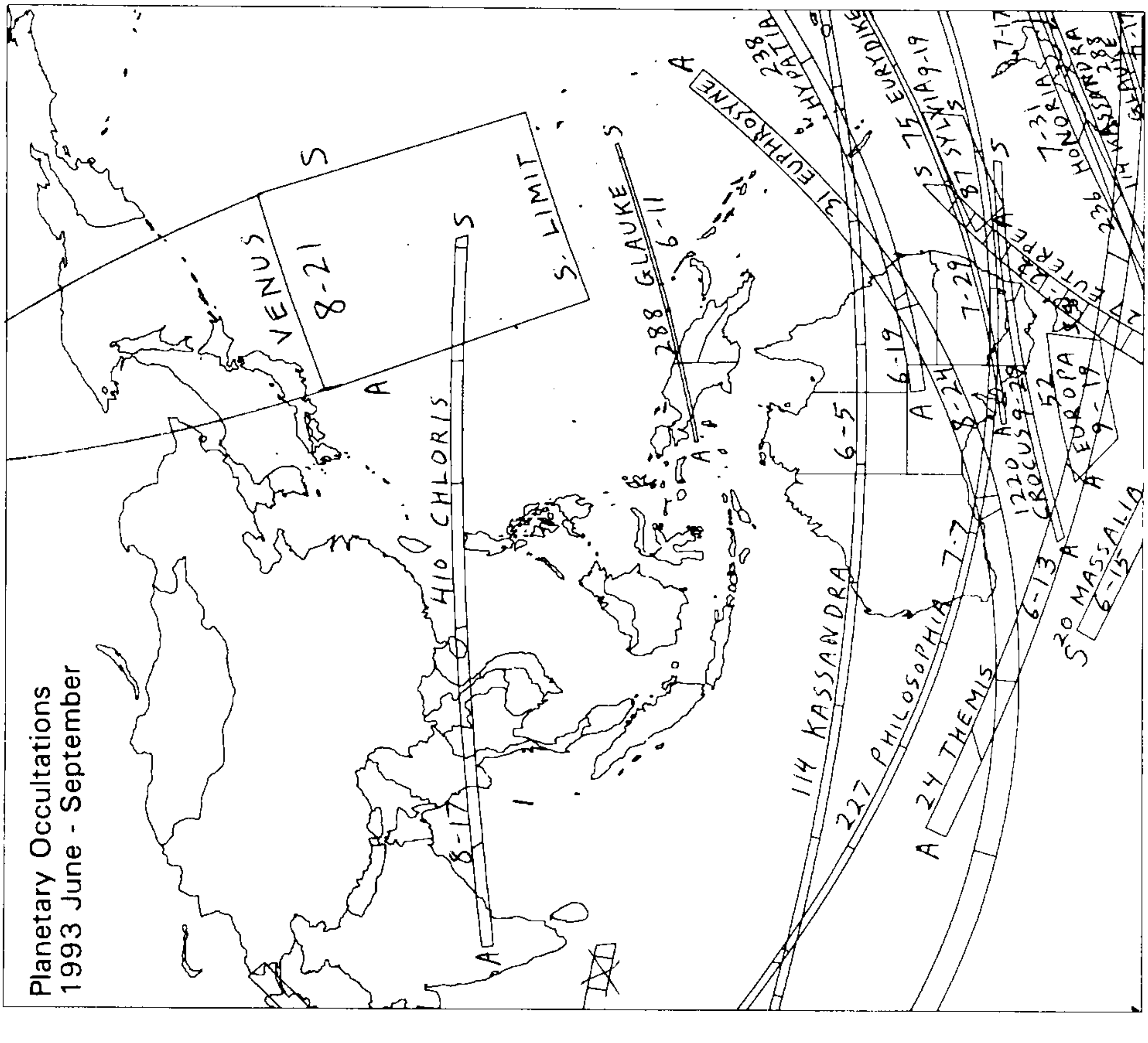
ϕ Aqr by Josephina 93 Aug 12



ZC 1191 by Ophelia 93 Aug 13



SAO 163419 by Eleonora Aug 13



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.

The ON is the IOTA newsletter and is published approximately four times a year. It is also available separately to non-members.

The officers of IOTA are:

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Addresses, membership and subscription rates, and information on where to write for predictions are found on the front page.

The Dunhams maintain the occultation information line at 301-474-4945. Messages may also be left at that number. When updates become available for asteroidal occultations in the central U.S.A., the information can also be obtained from either 708-259-2376 (Chicago) or 713-488-6871 (Houston).

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.

The addresses for IOTA/ES are:

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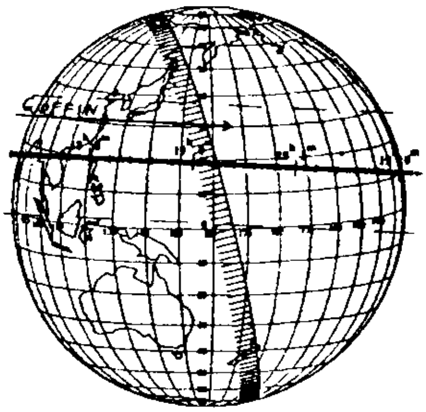
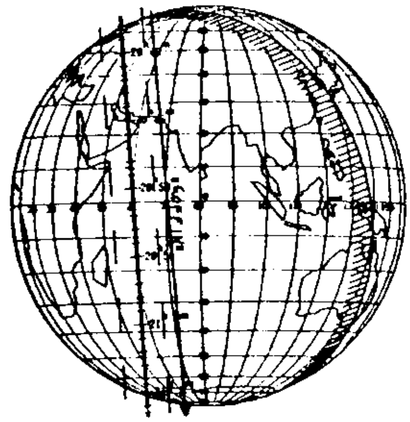
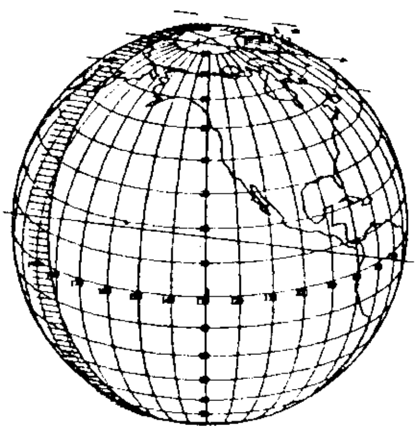
Germany	Germany
Telephones (49- for Germany, or 0- within Germany)	
-2388-3658	-511-424696
Fax -2381-36770	-511-233112



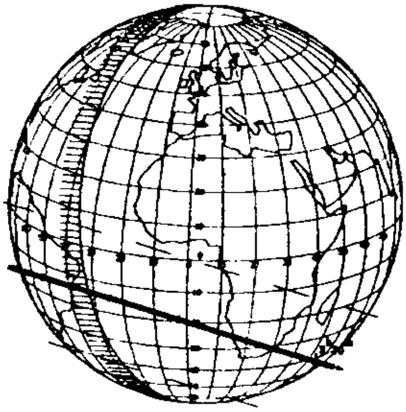
SAO 111107 by Chloris 93 Aug 17



ZC 9 by Olga 93 Aug 17



SAO 79587 by Venus 93 Aug 21



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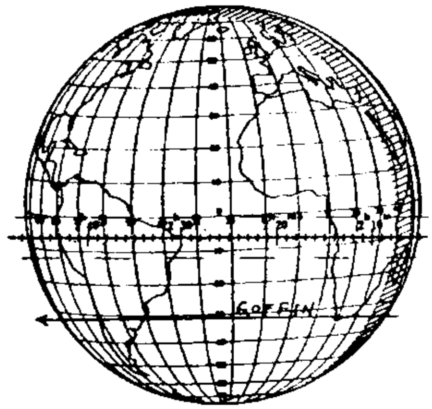
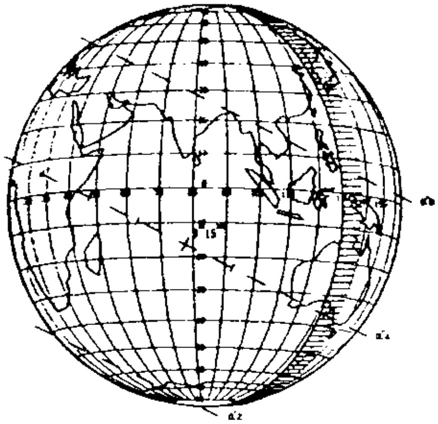


+2° 60 by Eurydike 93 Sep 15



P 20 by Pluto 93 Oct 3