Occultation Newsletter

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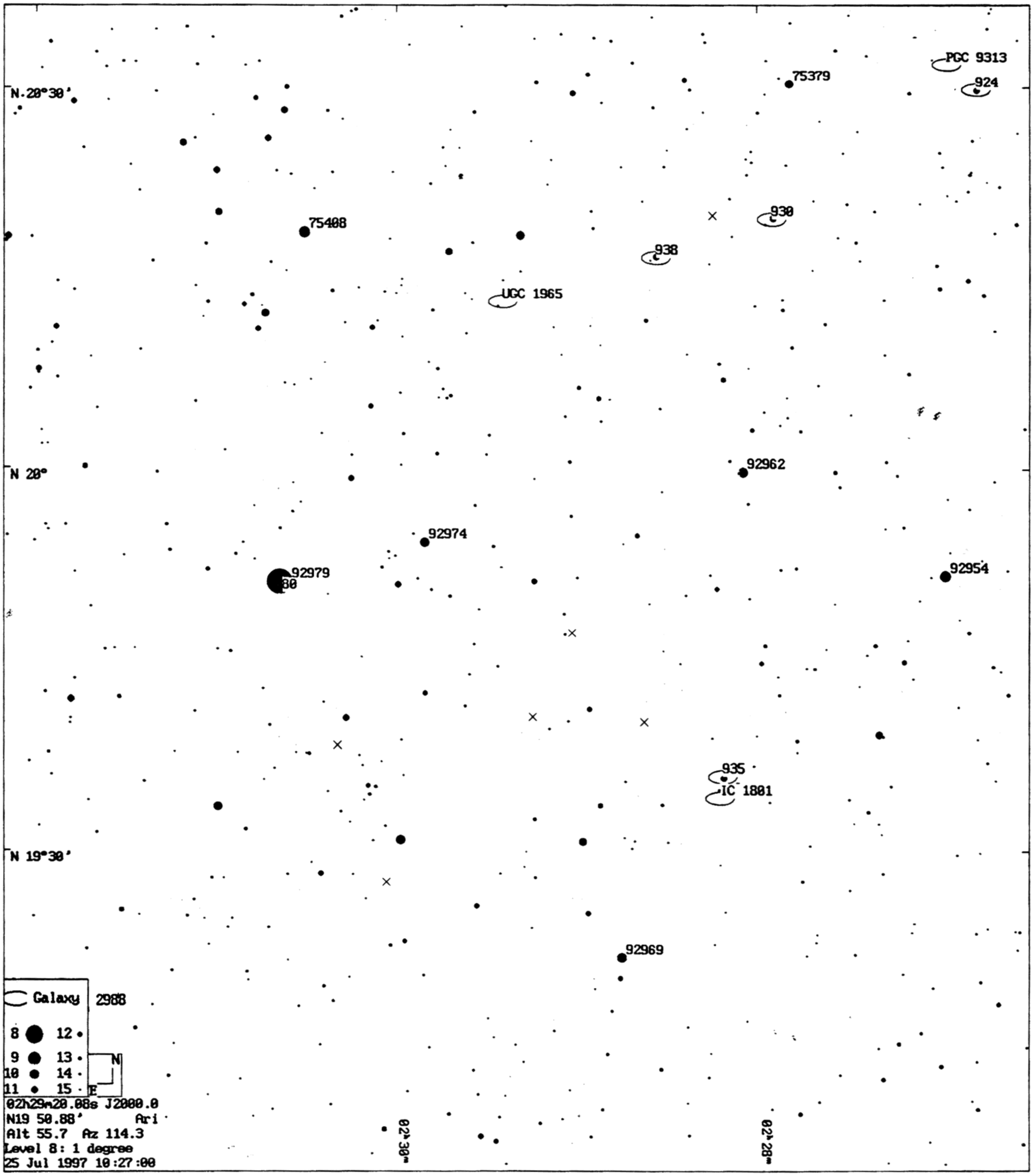

International Occultation Timing Association, Inc. (IOTA)

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For subscription purposes, this the first issue of 1997.

The deadline for submissions to the next issue is 1997 July 1.

On the cover: The July 25 passage of asteroid Sappho (80) in front of 6.1 magnitude SAO 92979. (This star field was printed from Guide v5.1 from Project Pluto.)

International Occultation Timing Association, Inc. (IOTA)

What to Send to Whom

Send new and renewal memberships and subscriptions, back issue requests, address changes, e-mail address changes, graze prediction requests, reimbursement requests, special requests, and other IOTA business, **but not observation reports**, to:

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Membership and Subscription Information

All payments made to IOTA must be in United States funds and drawn on a US bank, or by credit card charge to VISA or MasterCard. If you use VISA or MasterCard, include your account number, expiration date, and signature. (Do not send credit card information through e-mail. It is not secure nor safe to do so.) Make all payments to **IOTA** and send them to the Secretary & Treasurer at the address on the left. Memberships and subscriptions may be made for one or two years, only.

Occultation Newsletter subscriptions (1 year = 4 issues) are US$20.00 per year for USA, Canada, and Mexico; and US$25.00 per year for all others. Single issues, including back issues, are 1/4 of the subscription price.

Memberships include the *Occultation Newsletter* and annual predictions and supplements. Memberships are US$30.00 per year for USA, Canada, and Mexico; and US$35.00 per year for all others. Observers from Europe and the British Isles should join the European Service (IOTA/ES). See the inside back cover for more information.

IOTA Publications

Although the following are included in membership, nonmembers will be charged for:

- Local Circumstances for Appulses of Solar System Objects with Stars predictions US$1.00
- Graze Limit and Profile predictions US$1.50 per graze.
- Papers explaining the use of the above predictions US$2.50
- IOTA Observer's Manual US$5.00

Asteroidal Occultation Supplements will be available for US$2.50 from the following regional coordinators:

- **South America**--Orlando A. Naranjo; Universidad de los Andes; Dept. de Fisica; Mérida, Venezuela
- **Europe**--Roland Boninsegna; Rue de Mariembourg, 33; B-6381 DOURBES; Belgium or IOTA/ES (see back cover)
- **Southern Africa**--M. D. Overbeek; Box 212; Edenvale 1610; Republic of South Africa
- **Australia and New Zealand**--Graham Blow; P.O. Box 2241; Wellington, New Zealand
- **Japan**--Toshiro Hirose; 1-13 Shimomaruko 1-chome; Ota-ku, Tokyo 146, Japan
- **All other areas**--Jim Stamm; (see address at left)

ON Publication Information

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IOTA News

David W. Dunham

IOTA Meetings: The Fifteenth Annual Meeting of the International Occultation Timing Association will be held July 26 through 28 at the Utah Valley State College Planetarium, 800 W 1200 South, Orem, Utah, close to I-15 about 40 miles south of Salt Lake City International Airport and about 5 miles north of Provo. This will allow observation of the grazing occultation of Aldebaran nearby on Tuesday morning, July 29, which is the best graze in the U.S.A. this year, and is one of the best of the current series of Aldebaran grazes in North America; see p. 293 of the January issue of *Occultation Newsletter*.

The official meeting will start at 9 AM MDT Sunday July 27, and will last until 5 PM that day. We also plan to gather there informally late in the afternoon and early evening of Saturday, July 26, to meet casually and make some plans for the grazing occultation of Aldebaran on Tuesday morning, July 29. The planetarium is also available to us Monday afternoon, July 28, starting at 1 PM. We will meet there to complete any of the agenda not covered on Sunday, and to make detailed plans for the Aldebaran event. The meeting will be officially open to students of Utah Valley State College, and to others of the general public interested in attending, especially amateur astronomers from the surrounding area. Paul Mills is our point of contact at the planetarium; his email address is **millspa@uvsc.edu**. The planetarium is easy to reach at the intersection of State Route 265 and S800 West, 0.2 mile east of Route 265's intersection with I-15 (exit 272). A map is on IOTA's web site at **http://www.sky.net/~robinson/iotandx.htm**. There are no motels close to the planetarium, but a relatively inexpensive one (US$34/night for one person, add US$6 for a second adult) is the Motel 6 in Provo near I-15 exit 266 (US 189, University Ave.) 6 miles south of the planetarium. The phone number for information is 801-375-5064 and 800-466-8356 for reservations. For Monday night, the closest Motel 6 to the Aldebaran graze path is at Midvale, at 496 N Catalpa St. just southeast of I-15 exit 301 (7200 S St.). Topics that will be covered at the meeting will include (but not be limited to):

1. the Aldebaran occultations
    a. their value, outreach to the astronomical community and the general public for naked-eye events
    b. videos of the Jan. 19 and April 11 occultations
2. recently-observed (especially Interamnia in December and Campania in March) and upcoming asteroidal occultations
3. IOTA's work with past asteroidal occultations and Hipparcos star catalog data
4. solar eclipse expeditions for Feb. 1998, and Feb. and Aug. 1999
5. changes and improvements to IOTA's predictions
    a. efforts to improve graze profiles from past observed grazes
    b. new capabilities of OCCULT
    c. email distribution
6. instrumentation
    a. video time insertion
    b. recent successes with the IOTA occultation CCD camera
7. status of IOTA's Occultation Manual and analysis of solar eclipse observations

Contact me if you want to give a presentation. In late June an agenda will be prepared and put on our web site.

Bob Sandy (grazebob@sky.net) plans to lead an expedition from the Kansas City, Kansas area to near Casper, Wyoming, for the July 29 Aldebaran graze; some observers from the Denver area will also probably participate. On July 26 through 27, a local-area IOTA meeting might be held in the Kansas City area, primarily to plan for the expedition to Wyoming. If such a meeting is held, I can provide copies of the view graphs and video that I will prepare for the main IOTA meeting in Utah, and it might even be possible to communicate for a short time between this local meeting and the main meeting in Utah. News of any such meeting, and of preparations for the July 29 graze, will be given on our web site mentioned above. We also want to organize and publicize expeditions at as many other locations as possible along the Aldebaran northern limit from central California to western Ontario (and, in the daytime, near Oslo, south of Stockholm, and near Riga). Please provide me with any of your plans so they can be included in the next *ON*, as well as on our web site. The next *ON* will also have more information about the July 29 Aldebaran and Hyades occultation. It is the second of only three good night crescent-Moon Aldebaran occultations visible under good conditions from populous parts of North America. The first was the April 11 occultation described on pages 312-314 of the last issue, and the third will be visible from the northwestern U.S.A. and western Canada on 1999 April 19 UTC.

There will also be an IOTA presentation at the Astronomical League's (AL) meeting at Copper Mountain Resort the first week of July. That will be a good opportunity to reach many AL members to encourage them to organize local observations for the graze and occultation of Aldebaran on July 29. We want as many people as possible to video record that outstanding naked-eye occultation in order to accurately trace the profile of the following edge of the Moon in detail.

Need help with occultation double stars: We thank Tony Murray in Georgetown, GA, for collecting occultation observations indicating stellar duplicity and publishing articles in *ON* tabulating these discoveries during the past several years. Unfortunately, his circumstances changed recently so that he no longer can take the time needed to perform this important job properly, so he requests that someone else take up this work. Please contact me if you might be interested; email access will help with this job. Tony will continue his very important service to IOTA of printing *ON* at the lowest possible cost.

Second Arab Astronomical Conference: This will be held September 8 through 10 at the Royal Jordanian Geographic Center in Amman, Jordan, in cooperation with Al al-Bayt University. Topics that will be covered, among others, are amateur astronomy and astronomical culture; ancient astronomy in the Arabo-Islamic civilization; astronomy and space sciences in education; and modern discoveries in the solar system. Mohammed Odeh is planning a presentation on IOTA work using view graphs and video that I will provide to him. If any IOTA or IOTA/ES members could attend this meeting, it will be a good opportunity to promote occultation observation and our work in the Middle East and northern Africa. The deadline for submission of abstracts is June 30. More information can be obtained from:

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ESOP XVI in UK 1997 September 5 through 10

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The dates for ESOP XVI in the UK are Friday September 5, 1997 through Wednesday September 10. The venue is the Royal Greenwich Observatory (RGO) in Cambridge, NOT AS STATED IN THE LAST *ON* (The date and venue remain the same as I stated at ESOP XV in Berlin last year). [ed.: The dates and location given in the last issue were wrong information obtained from a web site. David Dunham found out the error just as the last issue was sent off to the printer, so unfortunately his last-minute correction didn't make it into the issue. We apologize for any confusion that may have resulted].

The format of the meeting will be as usual--the Symposium will be held on Saturday and Sunday and there will be optional excursions Monday through Wednesday. Planned excursions include:

- Stonehenge ("special" tour), and Avebury, megalithic stone circle sites in Wiltshire. (The Internet virtual reality Stonehenge will also be demonstrated in a workshop!)
- The Mullard Radio Observatory, Stellar Interferometer (Cambridge Optical Aperture Synthesis Telescope - COAST), and Isaac Newton's house, Woolsthorpe Manor (including cream teas!)
- The Old Greenwich Observatory (with planetarium show), and Maritime Museum, in London, with lunch in the Seventeenth Century Trafalgar Tavern overlooking the river Thames.

Accommodation for the duration of ESOP has been arranged in Fitzwilliam College, Cambridge, 10 minutes walk from the RGO. The cost of accommodation will be £27.00 per person per night (bed and breakfast) for a single room, and £25.00 per person sharing a double room. Only 10 double rooms are available and preference will be given to couples. A room with computer(s), Internet connection, video, etc. will be available in the College for evening "workshops". Bert and Sheila Carpenter are also arranging local tours of Cambridge and the surrounding countryside on Friday and Saturday for accompanying guests, and we are hoping to have a reception BQ (barbeque) in the grounds of the RGO on Friday night. The Symposium Dinner will be held on Saturday night in Fitzwilliam College. Finally, there is a grazing occultation on September 11 in South East England. If there is enough support, we are hoping to organize an expedition for participants to observe the graze (weather permitting).

Arrangements are nearing completion but may be subject to last minute changes. We are still finalizing costs for the Symposium fee and excursions. As soon as we have finished this, we will send invitations to IOTA members and former ESOP participants. It would perhaps be as well to warn participants that because of the relatively high cost of living in the UK, and the popularity of Cambridge for conferences, this ESOP will be slightly more costly than previous years. It may be necessary for us to request an accommodation deposit when booking. We have had to pay a deposit on the accommodation and cancellation costs are very high! In order to reduce the cost of the Symposium Program and Proceedings, we will be asking for all papers to be submitted in electronic form--on floppy disk or by email.

Further announcements will be issued in due course but if you have any queries in the meantime please contact me.

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Aldebaran/Camcorder News

David W. Dunham

On Thursday, April 10, John and Mickey Nelson in Bosque Farms, New Mexico, read about "an eclipse of a bright star" in the *Albuquerque Journal*. They had never recorded an astronomical observation before, and had no contact with the Albuquerque Astronomical Society or with any other astronomical organization. Following the instructions in John Fleck's newspaper article about the Aldebaran occultation, the Nelsons used their camcorder to record a few minutes of The Weather Channel a few minutes before the occultation, then took the device, still running, outside and zoomed in on the Moon. After an unsteady moment, the lunar crescent, the Earthlit dark side, and Aldebaran came into view. A short time later, the star disappeared, and the camcorder was brought inside to record some more of The Weather Channel. At the same time, Dale Ireland in Silverdale, Washington, was also recording The Weather Channel along with WWV shortwave time signals (after also recording the occultation directly with his camcorder), and I was doing the same thing in Greenbelt, MD, after having video recorded the occultations of 3 Hyades stars before clouds moved in. By using my copy of Peter Manly's video time inserter with the two calibration tapes, it should be possible to recover the time of the occultation from John Nelson's tape to an accuracy of ±0.05 second or better, considerably better than any of the many visual timings that were made of the occultation. That's quite good for someone who previously didn't know what an occultation was, and Aldebaran's altitude above the western horizon was only 4° at the time. The Nelsons had also recently purchased a small telescope to observe Comet Hale-Bopp.

The process started two days earlier when I faxed a one-page writeup about the occultation, and a simplified Moon figure showing what would happen (with the local time of the event to the nearest minute) in Albuquerque, to the *Albuquerque Journal.* I had sent similar faxes to 32 other newspapers in other large cities across western North America where the occultation would be visible; see my maps on p. 313 of the last *ON*. For his article, John Fleck had also looked at the additional information on our Web site (whose URL was given in the faxed message) and consulted me by telephone. I had also received inquiries from writers at newspapers in Edmonton, Alberta, and Orange County, California; otherwise, I don't know how well the event was really covered by the media. Rather than the hundreds of videotapes that I had hoped would be made, as of late April I have only received 4 tapes, although I know of about 7 others. John Nelson's tape is the only one that I have now that was clearly the result of IOTA's outreach to the public media; the others were made in response to my widely-distributed e-mail messages about the occultation and almost all by amateur astronomers. Some obtained the information about the occultation from online astronomy news groups and from IOTA's Web page.

More effort is needed earlier, to try to publicize naked-eye events like this in weekly news magazines and on television news. Now we have some actual video examples that can be used for the next good event, which will be the Aldebaran occultation on July 29. In April, too many amateur astronomers were unaware of the Aldebaran occultation, or learned of it only shortly before it happened, since there was no coverage of it in *Astronomy*, and only brief mention of it in *Sky & Telescope*. To a large extent, the astronomical community has been almost totally preoccupied with Comet Hale-Bopp and was unaware of the occultation, one of only three crescent-Moon occultations of Aldebaran during the current series that are visible from North America in a dark sky. At least for the July event, there will be a major article in *Sky & Telescope* stressing the need for readers to the spread word about the occultation locally to try to get many camcorder records, and we will also try to get word of the event out at the Astronomical League convention four weeks beforehand. I have rewritten the fax, that I sent to newspapers in April, in a form suitable for the July 29 occultation, so that you might use it as a local press release. It is given here after this article, and is also available on IOTA's sky.net web site, where you can download it for printing on your astronomical society's letterhead, and possibly modifying for local use. You are encouraged to replace my name and contact information at the bottom with your own. I would rather have you than me collect video tapes made in your area. Also needed is a simple Moonview diagram like the one for St. Louis given here. Also here is a more detailed Moonview of the occultation showing the tracks for several other cities; the Sun symbol following the names of some cities indicate that the reappearance will take place after sunrise. The detailed Moon view can be used, along with the table of the occultation disappearance and reappearance cusp angles that includes all of the plotted cities and dozens of others, to make a version of the simple Moonview for your city. Consulting the table, get the cusp angles of the event for your city, and then find the two plotted cities with cusp angles that are closest to those for your city. Then you can interpolate to estimate the path behind the Moon for your city; you don't need to be precise for this relatively crude graphic (if you have OCCULT version 4.0, you could instead generate a detailed view showing the D and R points for your site). Just copy the simplified figure for St. Louis, cut out the lines and labels for that city, make another copy of the bare Moon figure, then add the lines and labels for your city. I don't think that the event will be suitable as a public "camcorder" event where the Sun will be above the horizon, or less than 4° below it. Astronomers, especially those in planetariums and in astronomy clubs (and not just IOTA members) need to understand the almost unique potential for public outreach that these naked-eye occultations can have. They provide a link to our past, since astronomers in ancient Babylon, Rome, Greece, China, Japan, and Arabia observed and recorded many naked-eye occultations. Now hundreds of people, not just astronomers, can video record them.

The April 11 UTC (April 10 local time) occultation was not the first attempt. In early March, we put on IOTA's web site a moonview and maps of Europe for the March 14 occultation of Aldebaran, similar to those in the last *ON* for the April event. I also used OCCULT to compute the times of the occultation for almost 150 European and Middle Eastern cities, and distributed this list and an article, again similar to that for the April occultation in the last *ON*, to many email addresses. Newspaper articles and other public outreach attempts were made to obtain camcorder observations in at least Austria, Germany, Israel, and the Netherlands, but those countries were totally clouded out. One observer in the U.K. managed to videotape the event with a camcorder during a break in the clouds at his location, and said that he would send me a copy, but it has not yet arrived. Reports of several visual timings--from Norway, Russia, Spain, Romania, and Jordan--have been received. But as Ovidiu Vaduvescu explained, very few in Romania (and other eastern European countries, where it was mostly clear, or only with thin clouds, for the event) can afford camcorders with the low average incomes there. Matti Suhonen reported that he and a few others traveled to central Finland to try to observe the northern-limit graze there, although it was clear, they failed for various reasons, mainly in locating suitable observing sites in time. The March 14 occultation was better known by Europeans than the April 11 event was by Americans, since it was almost the five hudredth anniversary of an occultation of Aldebaran observed visually on March 9, 1497, by Copernicus, then a student in Bologna, Italy. A celebration and star party was held in Bologna on March 14, and I heard that the city's street lights were turned off for an hour around the time of the occultation. But the idea of trying to reach the public to use camcorders for the event was not realized until my e-mail message about it was distributed on March 8. I wanted to prepare and send that earlier, but other commitments, including a considerable amount of work that I needed to do for computation and distribution of detailed IOTA graze and other predictions, did not allow it.

For the July 29 occultation, we need more regional coordinators to make recordings of a selected TV station and WWV. I can provide copies of those with accurate time displayed, so that the UTC of every frame in the broadcast can be read easily. In April, I asked many to do this in widely-distributed e-mail messages, but I did not have time to follow up to confirm that it would be done, so few such calibration tapes were made. We should have at least one in each time zone to try to determine any variations that there might be in the local time of broadcast. In order to have a broadcast that is simultaneous across the U.S.A. (that is, without any local programs of half an hour or more, or any time zone shifts), I have recommended The Weather Channel (TWC). But this might not be the best; for example, it is not available in Canada, which has a different weather channel. CNN might be a better choice since it is available in most parts of the world, and doesn't have the local weather interruptions of TWC. However, not everyone has cable, or satellite dishes to receive these directly. Especially if a local coordinator also serves as the collector of tapes made in the region, it would be better to select a local TV station (or a local affiliate of one of the major networks) to avoid the need for cable TV. I have found that pointing the camcorder at the TV screen, just propped up on a table and zoomed right to fill the view, is easy, but getting good reception of WWV in the house is difficult. Reception is helped by extending a 50 foot length of wire down the hallway and attached to the Timekube antenna, but I think it would be even better if the antenna wire could be stretched outside and extended in a direction roughly perpendicular to the direction to the transmitter (in Ft. Collins, Colorado, for WWV). On April 10, a strong auroral display in southern Canada changed reception characteristics, so that WWV was best received most of the evening at 15 MHz, usually a daytime frequency.

More IOTA members, and especially many other amateur astronomers, are also needed to try to make camcorder observations, especially telescopic video observations of the bright-limb events. For July 29, that will be easier than in April, since the star disappears on the bright side, so it should be easy to find the star approaching the Moon just before the occultation.

I can provide a time-inserted copy of your recording of The Weather Channel (or any other station that you selected for your region). Those who have access to WWV are encouraged to use it, and their tape can be time-inserted, as well. Help with playing the tapes will be needed to spread the work around to get the one accurate time from each tape. Anyone with a VCR that can display single frames can help with this, and are encouraged to volunteer.

The whole idea here is that video timings are about ten times more accurate than visual timings, which may soon become obsolete for lunar total occultation observations (but not for grazing occultations). And video timings made from as many locations as possible can trace the lunar profile to incredible detail. Star parties for this occultation are discouraged, since a wide geographical distribution is essential to the success of the effort. Just about anyone anywhere in your area will be able to see the occultation, and they can record it if they have a camcorder.

The Moon moves half a mile in its orbit around the Earth each second, but actually slower after subtracting the velocity of the observer on the rotating Earth's surface. So a video timing to 0.03 second will give a relation to the lunar surface to about 80 feet. That's better than the 1994 Clementine spacecraft laser altimeter measurements, which were at best good to 150 feet. Thus, video recordings of the Aldebaran occultation from hundreds of locations across the region of visibility of the occultation can measure the lunar outline to unprecedented detail. This would be extremely

valuable for IOTA's analyses of not only lunar occultations, but also of total solar eclipse timings that have revealed small variations of the solar diameter during the last several years. Since the heat from the Sun received by the Earth is proportional to its diameter, these variations have an affect on studies of global warming and other short-term variations of the climate. The main thing limiting analysis of those observations is the lunar profile error, since the lunar orbit is now known to an accuracy of about a foot from laser ranging to the retroreflectors placed on the Moon's surface more than 20 years ago. And star position errors will be greatly reduced after the European Hipparcos spacecraft data are released later this year. The solar radius measurements have been limited to solar eclipses observed near the edges of the paths of totality, since the polar lunar features are the same from eclipse to eclipse. But if we had good lunar profile data, determinable from many camcorder observations of total lunar occultations, then we could obtain a much better history of solar radius variations from analysis of the much larger number of contact timings made near the central lines of annular and total solar eclipses.

This will not be the first time that camcorders were used by the general public to record an astronomical event. Twenty to thirty years ago, astronomers in Czechoslovakia, Canada, and the U.S.A. set up elaborate networks of special cameras to photograph and time bright meteors, and each caught one meteorite that was recovered after having its orbit determined from the photos. These relatively expensive networks have now been largely abandoned. But a couple of years ago, the orbit of a fourth meteorite was determined from the "Friday evening football network" of camcorders used by coaches and others at high school football games as a bright meteor streaked over Pennsylvania. The meteorite from this fall was the now famous Peekskill (New York) object that damaged a woman's car.

Direct camcorder observations might be made of occultations of other bright stars. I asked observers to try this for the occultation of 3.6-mag. λ Geminorum on April 14 when the Moon was almost at first quarter, but so far I have not learned of any successes for that event. But I think at least one video record

	UTC			Sun	Moon		Cusp	Pos	W.	a	b
Location	h	m	s	Alt	Alt	Az	Ang	Ang	Ang	m/o	m/o
Austin TX	9	4	58		14	79	-67N	55	64	-0.1	+1.8
Oklahoma City OK	9	15	32		17	82	-52N	40	49	-0.2	+2.3
Brownsville TX	8	57	57		12	77	-79N	67	76	-0.0	+1.4
Wichita KS	9	20	47		19	83	-46N	34	43	-0.3	+2.6
Dallas TX	9	9	35		16	80	-61N	49	58	-0.1	+2.0
Omaha NE	9	30	30		22	87	-36N	24	33	-0.4	+3.1
Tulsa OK	9	16	46		19	83	-52N	40	49	-0.2	+2.3
Topeka KS	9	23	55		21	85	-44N	32	41	-0.2	+2.7
Houston TX	9	3	51		15	80	-71N	59	68	-0.0	+1.7
Kansas City MO	9	23	50		21	86	-45N	33	42	-0.2	+2.7
Des Moines IA	9	30	42		24	88	-39N	26	35	-0.3	+3.0
Minneapolis MN	9	41	52	-12	26	92	-26N	14	23	-0.5	+3.8
Little Rock AR	9	13	20		21	84	-60N	48	57	-0.0	+2.1
Duluth MN	9	48	46	-9	28	95	-20N	8	16	-0.8	+4.7
Guatemala City	8	51	17		14	76	-59S	109	118	+0.6	-0.2
Saint Louis MO	9	22	17		24	88	-52N	40	49	-0.0	+2.5
Jackson MS	9	8	39		21	83	-69N	57	66	+0.1	+1.9
New Orleans LA	9	4	33		20	82	-76N	64	73	+0.2	+1.6
Memphis TN	9	14	15		23	85	-62N	50	59	+0.1	+2.1
Mobile AL	9	6	8		22	83	-76N	64	73	+0.2	+1.7
Milwaukee WI	9	34	6	-11	28	94	-42N	30	38	-0.1	+3.0
Chicago IL	9	30	40		28	92	-46N	34	43	+0.0	+2.8
Montgomery AL	9	9	31		25	85	-73N	61	70	+0.3	+1.8
Indianapolis IN	9	25	24		28	92	-54N	42	50	+0.1	+2.5
Louisville KY	9	21	41		28	90	-58N	46	55	+0.2	+2.3
Cincinnati OH	9	24	6		29	92	-57N	45	54	+0.2	+2.4
Atlanta GA	9	12	41		27	87	-72N	60	69	+0.3	+1.9
San Jose Costa Rica	9	6	46		22	76	-20S	148	157	+3.3	-5.9
Knoxville TN	9	17	14		28	90	-66N	54	63	+0.3	+2.1
Detroit MI	9	32	33	-9	32	96	-50N	38	47	+0.2	+2.7
Tampa FL	9	4	19		26	85	-89N	77	86	+0.6	+1.3
Cleveland OH	9	30	34	-9	32	96	-54N	42	51	+0.3	+2.5
Jacksonville FL	9	8	5		28	87	-84N	72	81	+0.5	+1.5
Charleston WV	9	23	6	-12	31	93	-63N	51	60	+0.4	+2.2
Sudbury ON	9	44	41	-3	35	103	-40N	28	37	+0.1	+3.1
Charlotte NC	9	16	55		31	91	-72N	60	69	+0.5	+1.9
Miami FL	9	3	17		28	84	-82S	86	95	+0.8	+1.0
Pittsburgh PA	9	28	32	-9	33	97	-59N	47	56	+0.4	+2.4
Charleston SC	9	12	58		31	89	-79N	67	76	+0.6	+1.7
Toronto ON	9	36	54	-5	35	101	-51N	39	48	+0.3	+2.7
Buffalo NY	9	35	7	-5	35	100	-54N	42	50	+0.4	+2.6
Raleigh NC	9	19	8	-12	33	93	-73N	61	70	+0.6	+1.9
Richmond VA	9	23	17	-9	35	95	-70N	58	67	+0.6	+2.1
Washington DC	9	26	24	-8	36	97	-67N	55	64	+0.6	+2.2
Baltimore MD	9	27	33	-7	36	98	-66N	54	63	+0.6	+2.2
Norfolk VA	9	22	44	-9	36	96	-73N	61	70	+0.6	+2.0
Dover DE	9	27	53	-6	37	99	-68N	56	64	+0.6	+2.1
Philadelphia PA	9	29	56	-5	37	100	-66N	54	63	+0.6	+2.2
New York NY	9	32	19	-4	39	102	-65N	53	62	+0.6	+2.2
Albany NY	9	36	52	-2	39	104	-60N	48	57	+0.6	+2.4
Montreal PQ	9	44	16	1	40	109	-52N	40	49	+0.5	+2.7
Burlington VT	9	41	43	0	40	107	-56N	44	53	+0.6	+2.6
Hartford CT	9	35	27	-2	40	104	-64N	52	61	+0.7	+2.3
Manchester NH	9	39	9	0	41	107	-62N	50	59	+0.7	+2.4
Providence RI	9	36	29	-1	41	106	-65N	53	62	+0.7	+2.3
Quebec City PQ	9	49	2	3	42	113	-51N	39	48	+0.6	+2.7
Boston MA	9	37	51	0	41	107	-64N	52	61	+0.7	+2.3
Bangor ME	9	45	20	4	43	113	-60N	48	57	+0.7	+2.4
San Juan PR	9	29	8	-8	46	85	-27S	141	150	+3.9	-4.2
Hamilton Bermuda	9	27	23	-2	47	100	-81S	87	96	+1.5	+1.1
Halifax NS	9	49	33	8	47	119	-66N	54	62	+1.0	+2.2
St Johns NF	10	8	6	19	54	141	-67N	55	64	+1.3	+1.9

Lunar Occultation of 1.1-mag. Aldebaran on 1997 July 29
Reappearance, Moon 22- % sunlit, Solar elongation 57°

	UTC			Sun	Moon		Cusp	Pos	W.	a	b
Location	h	m	s	Alt	Alt	Az	Ang	Ang	Ang	m/o	m/o
Fresno CA	9	47	52		6	74	15N	333	341	+1.2	-2.7
Los Angeles CA	9	52	9		7	75	34N	314	323	+0.5	-0.5
San Diego CA	9	53	9		8	76	41N	307	316	+0.4	-0.2
Las Vegas NV	9	52	40		11	77	29N	319	328	+0.7	-0.8
Phoenix AZ	9	55	21		13	79	45N	303	312	+0.5	+0.0
Flagstaff AZ	9	55	28		14	79	39N	309	318	+0.6	-0.2
Tucson AZ	9	55	45		14	79	51N	297	306	+0.5	+0.2
La Paz Mexico	9	51	58		12	77	76N	272	281	+0.2	+0.7
Albuquerque NM	9	58	44		18	82	47N	302	310	+0.7	+0.1
El Paso TX	9	57	53		18	81	58N	291	299	+0.6	+0.4
Denver CO	9	59	29		20	85	31N	317	326	+1.1	-0.6
Cheyenne WY	9	58	27		20	86	24N	324	332	+1.4	-1.2
Pueblo CO	10	0	24		21	85	38N	310	319	+0.9	-0.2
Lubbock TX	10	1	42		23	85	58N	290	299	+0.7	+0.5
Pierre SD	10	0	14		24	90	15N	333	341	+2.3	-3.0
Monterrey Mexico	9	56	41		22	82	82N	266	274	+0.5	+1.0
Acapulco Mexico	9	46	8		18	78	71S	239	248	+0.2	+1.5
Mexico City	9	49	54		21	79	78S	246	255	+0.3	+1.4
San Antonio TX	10	1	15		25	84	74N	274	283	+0.7	+0.9
Austin TX	10	2	32		26	85	72N	276	284	+0.7	+0.8
Oklahoma City OK	10	6	18		27	89	57N	291	299	+0.9	+0.5
Brownsville TX	9	58	30		25	83	85N	263	272	+0.6	+1.1
Wichita KS	10	7	30		28	90	51N	297	306	+1.0	+0.3
Dallas TX	10	5	15		28	87	66N	282	290	+0.9	+0.7
Omaha NE	10	9	39	-12	29	93	40N	308	316	+1.2	-0.1
Tulsa OK	10	8	11		29	90	57N	291	299	+1.0	+0.5
Topeka KS	10	9	40		29	92	49N	299	308	+1.1	+0.3
Houston TX	10	3	51		28	86	77N	271	280	+0.8	+0.9
Kansas City MO	10	10	58	-12	31	93	50N	298	307	+1.1	+0.3
Des Moines IA	10	12	35	-10	31	95	43N	305	314	+1.3	+0.0
Minneapolis MN	10	12	5	-7	31	98	30N	318	327	+1.6	-0.7
Little Rock AR	10	10	56		33	92	66N	282	291	+1.0	+0.8
Duluth MN	10	12	9	-6	32	100	23N	325	334	+1.9	-1.5
Guatemala City	9	43	32		26	78	51S	219	228	+0.1	+2.3
Saint Louis MO	10	15	50	-8	35	96	57N	291	299	+1.2	+0.5
Jackson MS	10	11	4		34	91	76N	272	281	+1.0	+1.0
New Orleans LA	10	8	41		34	90	83N	266	274	+1.0	+1.1
Memphis TN	10	13	45	-11	35	94	68N	280	289	+1.1	+0.8
Mobile AL	10	11	27	-12	36	91	83N	265	274	+1.0	+1.1
Milwaukee WI	10	20	28	-4	37	102	46N	302	311	+1.4	+0.1
Chicago IL	10	20	37	-4	37	102	51N	298	306	+1.4	+0.3
Montgomery AL	10	15	19	-9	39	94	80N	268	276	+1.1	+1.1
Indianapolis IN	10	21	48	-4	39	101	59N	289	298	+1.4	+0.6
Louisville KY	10	21	18	-5	40	100	64N	284	293	+1.3	+0.7
Cincinnati OH	10	23	38	-3	41	102	63N	285	294	+1.4	+0.7
Atlanta GA	10	19	6	-6	41	97	79N	269	278	+1.2	+1.1
San Jose Costa Rica	9	24	11		27	76	10S	178	187	-2.2	+8.0
Knoxville TN	10	21	54	-4	41	100	73N	275	284	+1.3	+0.9
Detroit MI	10	27	25	0	42	107	55N	293	302	+1.5	+0.4
Tampa FL	10	13	53	-8	42	92	82S	251	259	+1.1	+1.6
Cleveland OH	10	29	10	1	43	108	60N	289	297	+1.5	+0.5
Jacksonville FL	10	18	19	-6	43	96	88S	256	265	+1.2	+1.4
Charleston WV	10	27	8	-1	44	105	69N	279	288	+1.5	+0.8
Sudbury ON	10	31	26	4	42	113	44N	304	313	+1.7	-0.1
Charlotte NC	10	25	23	-2	45	102	79N	269	278	+1.4	+1.1
Miami FL	10	12	38	-8	44	91	73S	241	250	+1.1	+1.8
Pittsburgh PA	10	31	7	2	45	109	65N	283	292	+1.5	+0.6
Charleston SC	10	23	50	-2	46	100	87N	261	270	+1.4	+1.3
Toronto ON	10	33	40	4	45	113	56N	293	301	+1.6	+0.3
Buffalo NY	10	34	15	4	46	113	59N	290	298	+1.6	+0.4
Raleigh NC	10	29	8	1	47	105	80N	268	277	+1.5	+1.1
Richmond VA	10	32	43	3	48	109	76N	272	281	+1.6	+0.9
Washington DC	10	34	35	4	48	111	73N	275	284	+1.6	+0.8
Baltimore MD	10	35	34	5	49	112	72N	276	285	+1.6	+0.8
Norfolk VA	10	33	56	4	50	109	79N	269	277	+1.6	+1.0
Dover DE	10	37	14	6	50	113	74N	274	283	+1.6	+0.8
Philadelphia PA	10	38	30	7	50	115	72N	277	285	+1.7	+0.8
New York NY	10	41	7	8	51	118	71N	277	286	+1.7	+0.7
Albany NY	10	42	31	9	50	120	65N	283	292	+1.7	+0.5
Montreal PQ	10	43	56	10	49	124	56N	292	300	+1.7	+0.2
Burlington VT	10	44	17	10	50	123	60N	288	297	+1.7	+0.3
Hartford CT	10	43	53	10	52	121	69N	279	288	+1.7	+0.6
Manchester NH	10	46	44	12	52	125	67N	282	290	+1.8	+0.5
Providence RI	10	46	8	11	53	123	70N	278	287	+1.8	+0.6
Quebec City PQ	10	48	12	13	50	129	55N	293	302	+1.8	+0.0
Boston MA	10	47	1	12	53	124	69N	279	288	+1.8	+0.6
Bangor ME	10	52	14	15	53	132	64N	284	293	+1.8	+0.3
San Juan PR	9	59	36	-1	54	87	16S	184	193	-0.8	+7.2
Hamilton Bermuda	10	46	58	14	63	119	74S	242	251	+1.8	+1.8
Halifax NS	11	1	47	20	57	143	69N	279	288	+1.9	+0.3
St Johns NF	11	22	30	31	59	173	67N	281	289	+1.9	-0.3

Lunar Occultation of 1.1-mag. Aldebaran on 1997 June 4
Disappearance, Moon 0- % sunlit, Solar elongation 7°

	UTC			Sun	Moon		Cusp	Pos	W.	a	b
Location	h	m	s	Alt	Alt	Az	Ang	Ang	Ang	m/o	m/o
Vancouver BC	22	43	26	50	43	242	-11S	113	122	+1.0	-2.0
Portland OR	22	52	37	50	43	247	2S	126	135	+1.0	-2.7
Tacoma WA	22	48	23	50	43	245	-4S	119	128	+1.0	-2.3

	UTC			Sun	Moon		Cusp	Pos	W.	a	b
Location	h	m	s	Alt	Alt	Az	Ang	Ang	Ang	m/o	m/o
Seattle WA	22	47	44	49	42	245	-6S	118	127	+1.0	-2.3
Reno NV	23	18	9	44	38	260	34S	158	167	+0.0	-6.7
Boise ID	23	3	17	44	37	257	6S	130	139	+0.7	-2.9

Lunar Occultation of 1.1-mag. Aldebaran on 1997 June 4
Reappearance, Moon 0- % sunlit, Solar elongation 7°

	UTC			Sun	Moon		Cusp	Pos	W.	a	b
Location	h	m	s	Alt	Alt	Az	Ang	Ang	Ang	m/o	m/o
Anchorage AK	23	11	25	49	42	210	33N	267	276	+1.0	-0.7
Juneau AK	23	28	42	45	38	235	39N	261	270	+0.9	-1.0
Vancouver BC	23	45	43	40	33	256	62N	239	248	+0.9	-0.4
Portland OR	23	46	31	40	34	259	75N	227	235	+1.1	+0.3
Reno NV	23	41	50	40	33	264	74S	197	206	+1.9	+4.2

Lunar Occultation of 0.1-mag. Saturn on 1997 June 28
Disappearance, Moon 39- % sunlit, Solar elongation 78°

	UTC			Sun	Moon		Cusp	Pos	W.	a	b
Location	h	m	s	Alt	Alt	Az	Ang	Ang	Ang	m/o	m/o
Acapulco Mexico	10	48	25		49	101	-36N	13	37	+0.4	+3.8
Mexico City	10	59	22		52	107	-26N	3	27	-0.1	+4.8
Guatemala City	10	50	48	-11	59	104	-62N	39	63	+1.4	+2.4
San Jose Costa Rica	10	53	42	-6	67	100	-87N	65	88	+2.3	+1.4
Tampa FL	11	42	0	12	66	157	-30N	8	31	+0.5	+4.3
Jacksonville FL	11	53	40	16	65	167	-20N	357	21	-0.3	+5.8
Miami FL	11	35	54	12	68	157	-45N	22	46	+1.2	+3.2
Charleston SC	12	11	36	22	63	182	-4N	341	5	+9.9	+9.9
San Juan PR	11	49	24	25	74	215	-87S	70	94	+2.6	+0.8
Hamilton Bermuda	12	14	2	35	59	214	-49N	26	50	+1.3	+2.5

Lunar Occultation of 0.1-mag. Saturn on 1997 June 28
Reappearance, Moon 39- % sunlit, Solar elongation 77°

	UTC			Sun	Moon		Cusp	Pos	W.	a	b
Location	h	m	s	Alt	Alt	Az	Ang	Ang	Ang	m/o	m/o
Acapulco Mexico	11	42	53	-7	62	111	48N	290	313	+3.4	-0.9
Mexico City	11	42	21	-5	61	116	37N	300	324	+4.0	-1.9
Guatemala City	12	12	24	7	77	133	76N	261	285	+2.9	+0.6
San Jose Costa Rica	12	24	8	14	86	177	77S	234	258	+2.4	+1.7
Tampa FL	12	33	16	23	67	190	42N	295	319	+3.7	-2.0
Jacksonville FL	12	30	5	24	65	189	30N	307	331	+4.4	-3.7
Miami FL	12	43	53	27	68	204	57N	281	304	+3.2	-0.9
Charleston SC	12	23	50	25	62	189	14N	324	347	+9.9	+9.9
San Juan PR	13	16	48	45	57	251	77S	235	259	+1.9	+1.2
Hamilton Bermuda	13	17	46	48	49	236	54N	284	307	+2.2	-1.6

Lunar Occultation of 0.2-mag. Saturn on 1997 July 25
Disappearance, Moon 61- % sunlit, Solar elongation 103°

	UTC			Sun	Moon		Cusp	Pos	W.	a	b
Location	h	m	s	Alt	Alt	Az	Ang	Ang	Ang	m/o	m/o
Honolulu HI	20	22	40	58	19	269	-80N	58	82	+0.6	+0.4
Hilo HI	20	23	44	61	16	270	-86N	64	88	+0.5	+0.2

Lunar Occultation of 0.2-mag. Saturn on 1997 July 25
Reappearance, Moon 61- % sunlit, Solar elongation 102°

	UTC			Sun	Moon		Cusp	Pos	W.	a	b
Location	h	m	s	Alt	Alt	Az	Ang	Ang	Ang	m/o	m/o
Honolulu HI	21	20	42	72	6	274	70N	268	292	+0.1	-0.6

Lunar Occultation of 1.1-mag. Aldebaran on 1997 August 25
Disappearance, Moon 44- % sunlit, Solar elongation 83°

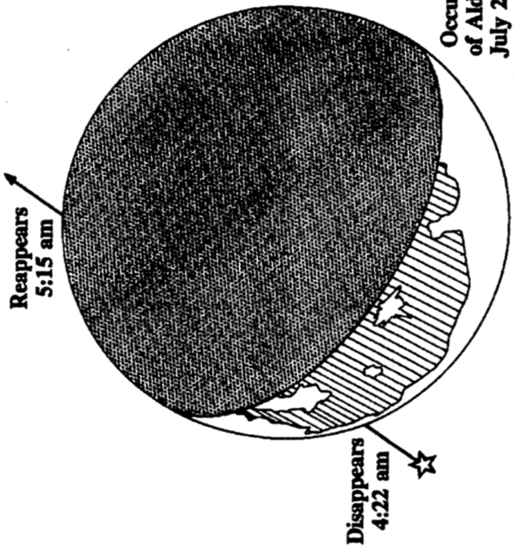
	UTC			Sun	Moon		Cusp	Pos	W.	a	b
Location	h	m	s	Alt	Alt	Az	Ang	Ang	Ang	m/o	m/o
Honolulu HI	15	42	43	-8	73	103	-52S	119	128	+3.4	-1.6
Hilo HI	15	57	6	-2	79	105	-39S	132	141	+4.1	-3.6
Vancouver BC	17	8	33	36	44	238	-33N	24	33	+1.5	+2.6
Portland OR	17	3	9	37	47	240	-52N	43	51	+1.5	+1.0
Tacoma WA	17	5	31	36	46	240	-44N	35	43	+1.5	+1.5
San Francisco CA	17	0	41	39	51	248	-81N	72	80	+1.7	-0.2
Seattle WA	17	6	21	36	45	240	-42N	33	42	+1.5	+1.7

	UTV			Sun	Moon		Cusp	Pos	W.	a	b
Location	h	m	s	Alt	Alt	Az	Ang	Ang	Ang	m/o	m/o
Reno NV	17	4	45	41	47	250	-74N	65	73	+1.6	-0.0
Fresno CA	17	5	19	43	48	253	-83N	74	83	+1.6	-0.3
Los Angeles CA	17	8	56	45	47	257	-88S	83	92	+1.6	-0.7
San Diego CA	17	11	47	47	46	260	-84S	87	96	+1.5	-0.8
Boise ID	17	11	7	43	42	251	-57N	48	57	+1.4	+0.6
Las Vegas NV	17	12	31	48	43	258	-83N	74	83	+1.4	-0.4
Phoenix AZ	17	18	13	52	40	264	-89S	82	90	+1.3	-0.7
Helena MT	17	19	34	45	37	254	-41N	32	41	+1.4	+1.4
Salt Lake City UT	17	16	9	48	39	258	-65N	56	65	+1.3	+0.1
Flagstaff AZ	17	17	46	51	40	263	-84N	75	84	+1.3	-0.5
Tucson AZ	17	20	41	54	39	266	-86S	85	94	+1.2	-0.8
La Paz Mexico	17	31	38	60	36	274	-58S	113	122	+0.9	-1.8
Albuquerque NM	17	23	39	56	34	267	-82N	73	82	+1.1	-0.5
El Paso TX	17	26	2	58	34	269	-87S	84	92	+1.0	-0.8
Denver CO	17	24	20	54	32	265	-64N	55	64	+1.1	+0.0
Cheyenne WY	17	24	41	53	32	264	-59N	50	59	+1.1	+0.2
Pueblo CO	17	24	44	55	32	266	-69N	60	69	+1.1	-0.1
Lubbock TX	17	29	10	61	29	271	-83N	74	83	+0.9	-0.6
Pierre SD	17	31	23	53	27	267	-41N	32	41	+1.1	+1.1
Monterrey Mexico	17	37	12	68	26	277	-72S	99	108	+0.6	-1.2
Acapulco Mexico	17	52	18	76	20	282	-38S	133	142	+0.1	-2.4
Mexico City	17	47	7	75	21	281	-50S	121	130	+0.3	-1.9
San Antonio TX	17	34	37	66	25	276	-86S	85	94	+0.7	-0.8
Austin TX	17	34	27	66	24	276	-89S	82	91	+0.7	-0.7
Oklahoma City OK	17	31	53	62	25	273	-73N	64	73	+0.8	-0.3
Brownsville TX	17	38	32	70	23	278	-75S	96	105	+0.5	-1.1
Wichita KS	17	31	38	60	25	272	-66N	57	65	+0.8	-0.1
Dallas TX	17	33	33	64	24	275	-82N	73	82	+0.7	-0.5
Fargo ND	17	43	4	52	23	270	-15N	6	15	+2.6	+8.0
Omaha NE	17	33	29	57	24	272	-50N	41	50	+0.9	+0.5
Tulsa OK	17	32	56	62	24	274	-70N	61	70	+0.7	-0.2
Topeka KS	17	33	2	59	24	273	-59N	50	59	+0.8	+0.1
Houston TX	17	36	18	68	22	277	-89S	82	90	+0.6	-0.7
Kansas City MO	17	33	54	60	23	273	-58N	49	58	+0.8	+0.2
Des Moines IA	17	35	43	58	22	273	-46N	37	46	+0.9	+0.7
Minneapolis MN	17	40	48	55	21	273	-27N	18	27	+1.4	+2.8
Little Rock AR	17	35	41	65	20	277	-71N	62	71	+0.6	-0.2
Guatemala City	17	56	22	86	10	285	-40S	131	140	-0.3	-2.0
Saint Louis MO	17	37	0	61	19	277	-55N	46	55	+0.7	+0.3
Jackson MS	17	37	39	68	18	279	-78N	69	77	+0.5	-0.4
New Orleans LA	17	38	48	70	17	280	-85N	76	85	+0.4	-0.5
Memphis TN	17	37	1	65	18	278	-68N	59	68	+0.6	-0.1
Mobile AL	17	39	16	70	15	280	-81N	72	81	+0.4	-0.4
Milwaukee WI	17	42	42	57	16	278	-31N	22	30	+1.1	+2.0
Chicago IL	17	41	7	59	16	278	-37N	28	37	+0.9	+1.3
Montgomery AL	17	39	21	68	14	281	-74N	65	74	+0.4	-0.3
Indianapolis IN	17	40	19	61	15	279	-46N	37	45	+0.7	+0.7
Louisville KY	17	39	45	62	14	280	-52N	43	52	+0.6	+0.4
Cincinnati OH	17	40	58	61	13	280	-46N	37	46	+0.6	+0.7
Atlanta GA	17	39	49	67	13	282	-67N	58	67	+0.4	-0.1
Knoxville TN	17	40	6	65	13	281	-59N	50	59	+0.5	+0.2
Detroit MI	17	46	40	58	12	282	-25N	16	25	+1.2	+2.9
Tampa FL	17	42	4	72	9	284	-85N	76	84	+0.2	-0.5
Cleveland OH	17	45	54	59	11	282	-29N	20	29	+1.0	+2.2
Jacksonville FL	17	41	20	70	9	284	-76N	67	76	+0.2	-0.3
Charleston WV	17	42	8	62	11	283	-46N	37	46	+0.5	+0.7
Charlotte NC	17	41	15	65	10	283	-58N	49	58	+0.4	+0.2
Miami FL	17	43	25	74	6	285	-89N	80	89	+0.1	-0.5
Pittsburgh PA	17	45	27	60	9	284	-33N	24	33	+0.8	+1.7
Charleston SC	17	41	22	67	8	284	-66N	57	66	+0.3	-0.0
Raleigh NC	17	42	13	64	8	285	-53N	44	53	+0.4	+0.4
Richmond VA	17	43	38	62	7	285	-44N	35	44	+0.5	+0.8
Washington DC	17	45	14	61	7	286	-37N	28	37	+0.6	+1.3
Baltimore MD	17	46	5	60	7	286	-34N	25	34	+0.7	+1.6

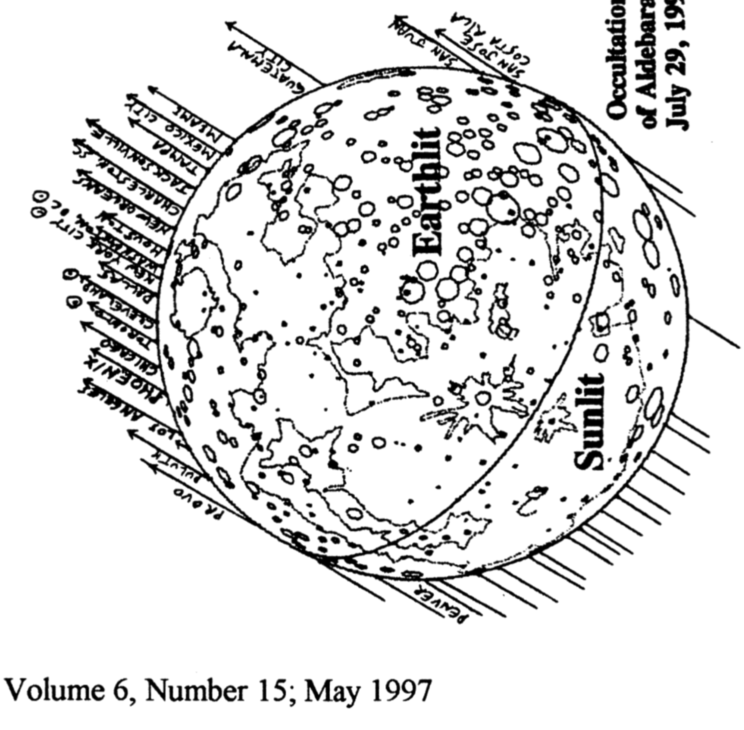
Lunar Occultation of 1.1-mag. Aldebaran on 1997 August 25
Reappearance, Moon 44- % sunlit, Solar elongation 83°

	UTC			Sun	Moon		Cusp	Pos	W.	a	b
Location	h	m	s	Alt	Alt	Az	Ang	Ang	Ang	m/o	m/o
Honolulu HI	16	53	7	8	85	186	41S	213	221	+2.2	+3.7
Hilo HI	16	52	11	11	85	224	29S	200	209	+2.0	+5.5
Vancouver BC	17	44	6	40	39	247	25N	326	334	+0.6	-4.4
Portland OR	17	57	37	45	38	254	43N	308	317	+0.8	-2.9
Tacoma WA	17	52	14	43	38	251	35N	316	324	+0.7	-3.4
San Francisco CA	18	14	23	52	36	263	71N	280	289	+0.9	-1.5
Seattle WA	17	51	4	43	38	251	34N	318	326	+0.7	-3.5
Reno NV	18	13	41	53	34	263	63N	288	296	+0.8	-1.9
Fresno CA	18	18	15	55	34	266	72N	279	287	+0.8	-1.5

Location	UTC h	m	s	Sun Alt	Moon Alt	Az	Cusp Ang	Pos Ang	W. Ang	a m/o	b m/o
Los Angeles CA	18	22	59	58	32	269	80N	271	280	+0.8	-1.1
San Diego CA	18	25	24	60	30	271	84N	268	276	+0.8	-1.0
Boise ID	18	7	0	51	32	262	46N	305	313	+0.5	-2.6
Las Vegas NV	18	22	36	59	29	270	71N	280	289	+0.6	-1.5
Phoenix AZ	18	28	7	63	25	274	77N	274	282	+0.6	-1.2
Helena MT	17	59	23	49	30	262	30N	321	330	+0.2	-3.6
Salt Lake City UT	18	15	56	56	28	268	53N	298	306	+0.4	-2.2
Flagstaff AZ	18	26	6	62	26	273	71N	280	288	+0.5	-1.4
Tucson AZ	18	30	15	65	24	275	80N	271	279	+0.5	-1.1
La Paz Mexico	18	34	53	72	21	279	73S	244	253	+0.8	+0.1
Albuquerque NM	18	28	18	64	21	276	68N	283	292	+0.3	-1.5
El Paso TX	18	32	48	67	20	278	78N	273	282	+0.4	-1.1
Denver CO	18	20	10	59	22	274	51N	300	309	+0.2	-2.2
Cheyenne WY	18	16	53	58	22	273	46N	305	314	+0.1	-2.4
Pueblo CO	18	23	13	61	21	275	56N	295	304	+0.2	-2.0
Lubbock TX	18	31	37	67	16	279	69N	283	291	+0.1	-1.4
Pierre SD	18	7	21	55	21	273	28N	323	332	-0.2	-3.5
Monterrey Mexico	18	39	37	75	12	283	88S	259	268	+0.3	-0.5
Acapulco Mexico	18	37	56	84	10	284	55S	226	235	+0.7	+1.1
Mexico City	18	40	21	81	9	284	67S	238	247	+0.4	+0.4
San Antonio TX	18	37	5	71	11	283	79N	273	281	+0.1	-1.0
Austin TX	18	36	12	70	11	283	75N	276	285	+0.1	-1.1
Oklahoma City OK	18	28	51	65	14	281	59N	292	301	-0.0	-1.7
Brownsville TX	18	39	59	75	9	284	89N	262	271	+0.1	-0.6
Wichita KS	18	24	43	63	15	280	51N	300	309	-0.1	-2.0
Dallas TX	18	33	3	68	12	282	67N	285	293	-0.0	-1.4
Fargo ND	17	52	29	53	21	272	3N	348	357	+9.9	+9.9
Omaha NE	18	15	55	59	16	278	36N	315	323	-0.2	-2.7
Tulsa OK	18	27	36	64	13	281	55N	296	305	-0.1	-1.9
Topeka KS	18	21	35	62	14	280	45N	306	315	-0.2	-2.3
Houston TX	18	36	49	71	9	284	75N	276	285	-0.0	-1.1
Kansas City MO	18	21	15	62	13	280	43N	308	316	-0.2	-2.3
Des Moines IA	18	14	21	59	14	279	32N	319	327	-0.3	-2.9
Minneapolis MN	18	1	38	56	17	277	13N	338	346	-0.8	-5.1
Little Rock AR	18	29	30	65	9	284	56N	295	304	-0.2	-1.7
Saint Louis MO	18	21	3	62	10	283	41N	311	319	-0.4	-2.4
Jackson MS	18	32	54	67	6	286	62N	289	298	-0.2	-1.5
New Orleans LA	18	35	58	69	5	286	69N	282	291	-0.2	-1.2
Memphis TN	18	28	17	65	8	285	53N	298	307	-0.3	-1.8
Milwaukee WI	18	6	9	57	12	281	17N	335	343	-0.8	-4.3
Chicago IL	18	10	41	59	11	283	23N	328	337	-0.7	-3.5
Indianapolis IN	18	16	8	60	8	285	31N	320	329	-0.6	-2.8
Louisville KY	18	20	4	61	7	286	37N	314	323	-0.5	-2.4
Cincinnati OH	18	17	0	60	7	286	32N	319	328	-0.6	-2.7
Detroit MI	18	4	24	58	9	284	11N	340	349	-1.2	-5.1
Cleveland OH	18	7	0	58	7	286	15N	336	345	-1.1	-4.3
Pittsburgh PA	18	9	29	58	5	287	18N	333	342	-1.0	-3.8



Occultation
of Aldebaran
July 29, 1997
St. Louis, Missouri



Occultation
of Aldebaran
July 29, 1997

International Occultation Timing Association, Inc. (IOTA)

Naked Eye Eclipse of Bright Star July 29 Can Aid Global Warming Studies

Just before dawn Tuesday morning, July 29, a rare naked-eye celestial spectacle might be seen in the area. If clouds don't interfere, you can watch the thin crescent Moon uncover Aldebaran, a bright orange star in the constellation Taurus the Bull. Moreover, if you have a camcorder, you can point it at the Moon at the right time to film the star's sudden reappearance. Zoom in on the Moon, whose dark side will be faintly illuminated by sunlight reflected from the Earth, a couple of minutes before the star is due to pop out near the Moon's top. Astronomers use the term "occultation" for such eclipses of stars by the Moon. The International Occultation Timing Association, Inc. (IOTA) is seeking video recordings from as many separate locations as possible in a program to chart the edge of the Moon in unprecedented detail. During the last 20 years, members of IOTA have determined small cyclic variations in the solar diameter from analysis of video recordings of over a dozen solar eclipses. These are probably significant for studies of global warming and other climactic changes, but our work is limited by our current knowledge of the heights of craters and valleys along the Moon's edge.

Select a location where trees or buildings will not block the view of the Moon, which will be rising low in the east. For precise timing, you need to keep the camcorder running, and before and after the reappearance, point the camcorder at your television set and record The Weather Channel, for one or two minutes. Each time, be sure to record part of the national broadcast not including the local forecast. Most camcorders have a time display to the nearest second, and that should be running during your recording.

If you record the occultation, your location needs to be measured to 50 feet or better, which can be done by counting paces from the nearest street intersection (both along the street, and perpendicular to it to the observing location), and by measuring your pace by counting paces between two street intersections. It would be useful to include some views of your observation place in the video. Please send your tape, or a copy of it, with the information about your position, to the author. Enclose a label or piece of paper with your address typed or printed, so that we can return your tape after we analyze it. Also, include a telephone number or an e-mail address so we can communicate with you if we have any questions about your observation.

For those without camcorders, the reappearance can be seen directly with the naked eye. It will help to block the bright part of the Moon with an outstretched finger, or position yourself so that it is blocked by a telephone pole, building, or other obstruction, while the dark side of the Moon remains visible. For those who get up about an hour earlier, camcorders held up to a telescope's eyepiece might catch Aldebaran's disappearance on the Moon's sunlit side not long after moonrise. Some optical aid, possibly binoculars, will be needed to see it.

This is the third occultation of a bright star by the crescent Moon visible from areas where camcorders are now common. The first was an Aldebaran eclipse in Europe in March, but few videos were made due to clouds. The second was visible from the west coast the evening of April 10, but most people interested in the sky were distracted by Comet Hale-Bopp, then at its brightest, so few observed that good event. After July 29, North America will have only one more good opportunity during the current series of Aldebaran events, on the evening of April 18, 1999 in the Northwest. Aldebaran is the brightest star, other than the Sun, that can ever be eclipsed by the Moon. The Aldebaran eclipses come in series that last 4 years, with a 14-year gap before the next series, but only a few occur under good-enough conditions for naked-eye viewing from a given place.

More information about this occultation is on our web site at **http://www.sky.net/~robinson/iotandx.htm**, which includes a list of local times of the event for dozens of cities. A local view of the Moon showing the path of Aldebaran behind it and including local event times is enclosed.

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Grazing Occultation Reduction Status Report

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I give a revised list of corrections to grazing occultations in ILOC's files below (only a few of them are given here, as illustrative examples; the full list is available upon request). I was able to identify almost all events with the extra assistance of the IOTA file (one event had both the year and day wrong in ILOC, and the day wrong in IOTA--a tough one!). {The IOTA file is a summary list prepared by Don Stockbauer and Don Oliver, mainly covering grazes from 1974 to 1986. It is posted on IOTA's "sky.net" web site}. I am using the P and D system, rather than Watts angle, and longitude and latitude librations, since there are not enough observations to reasonably cover the latter 3-D system. In the P and D system for grazes, P is almost the same as Watts angle, and D is close to the latitude libration for southern-limit grazes, and is approximately the negative of the latitude libration for northern-limit grazes. I am undertaking this analysis mainly to create better profiles in the Cassini regions with OCCULT.

I have made the corrections in my data set, and then re-reduced them all. Then I have split the data into bands of 1° total width, at intervals of 1° in the D coordinate (e.g. D from -2.5 to -3.5 in one file), keeping only data for D's and R's (ignoring blinks and flashes) and only had regard to components of doubles indicated as B, i.e., have tried to use reliable observations only (also, limited to certainty code of 1).

I then read the files into Excel, sorted them by P, and plotted the data. From this I was able to deduce fairly reliably the 'average' lunar profile--and erroneous observations generally stand out--for most values of D. Interestingly, the northern Cassini region is very uncertain for D between -2 and -4, whereas the southern Cassini region is uncertain at around -6 (large scatter in the residuals--suggesting that there is something which affects those observations, such as moon illumination?).

I hope to finish what I'm doing in the next few days. I will then send the updated corrections, and my derived profile data (at 0.5° intervals in P, 1° in D--and the data do not justify higher resolution). I think it may also be useful to publish the profile data in *Occultation Newsletter*--at least so people can have a better feel for the probable uncertainties in the data. I should also add that the profile that I have derived for the northern region is significantly different from what I had derived previously from the old ACLPPP data--generally somewhat lower. (I'm still to do the southern.)

When more data becomes available (e.g. pre 1977, post 1993) it should not be too much trouble to repeat the exercise. The most tedious part of the whole thing has been checking the original data for obvious errors.

Finally, I have come to the conclusion that using all of the graze data is far more preferable to using just 'well observed' grazes--e.g. there are several instances where there are a series of events reported which are quite clearly erroneous. Putting all the data into the solution shows up all such inconsistencies (and there is even one very well observed event that, despite my error checking, is clearly out by 3 arcseconds.)

I have attached the consolidated list of corrections to the ILOC graze data. There are only a couple of events that remain unresolved, although for a number of events where the correction is to the site coordinates, the correction is really only a 'best guess' and the original data ought to be checked to confirm. If that's not possible, the only other option I can think of is for someone to look at relevant survey maps to see what coordinates seem likely (e.g. on a road versus in the middle of nowhere!)-- but that will be an incredibly time consuming task. {It might be better to contact the expedition leaders by email and ask them to check the site positions}.

My other observation at this stage concerns the 'certainty' code as reported by observers. Perhaps unsurprisingly, there are a fair few observations reported as certain which are not real. Perhaps observers need more guidance on this--but I suspect there may be an argument that graze organizers ought to be more critical of the reports they receive. For example, there are too many 'certain' events where the residual is more than 3″.

I think I have finished the Northern Cassini region in P, D. I have plotted the resulting data in Excel, and there is better consistency than in my previous data set. The profile varies between a maximum of about +0.5″ (for P around 358° to 1°) and -0.8″ (P around 2° to 3°).

For the Southern region, I haven't directly used the data from the Feb 2 graze in Europe--but that data are entirely consistent with the plots of the residuals that I have generated so far.

Some examples from my list of corrections are given below.

X 18369 = S 138744 on 76 Nov 19 at TA432 7601 Star should be X 19634 = S 158105

R1925 on 1976 Aug 27/28, at TD140 7601 Wrong date. Read 28/29

R1744 on 1977 May 28 at T9585 7781 Site coordinates wrong.

R648 on 1977 Feb 26 at TA170 04 hr for 03, read 02 (5 records)

X 23511 = S 160534 on 77 Mar 12 at TB413 7701 The observer's latitude should be 1° further north, i.e. 33°, not 32°.

X 11017 = S 96848 on 77 Nov 2 site TB503030101 Observer's latitude appears to be wrong, but correction is not apparent. Latitude is given as 36° 40′, should be somewhere around 34° 6′ (This is a deep North Cassini graze, so it would be good if the error could be found.)

R 106 on 1981 Feb 8 at SI100 Ignore this graze. The data are unreliable. The star was at an altitude of 8°; 3 of the 6 telescopes were clearly of too small an aperture. Although data from 3 observers with 20 cm telescopes looks OK by themselves, they're inconsistent. Best to ignore all.

R2399 on 81 Sep 6 Site SN108 8142 Latitude for 39°, read 36°. Also, add 10 mins to all times.

R2513 on 1984 Jun 13 at TVG84. Subtract 10 hrs from all times (Local time reported!)

R483 on 1990 Feb 3 at SN286 Although a miss is reported, there is something wrong with the data
(residuals 6700″)

R2417 on 1992 May 18 at TU5B2 Ignore. Star mag 7.0 against a 98% moon with a 20 cm telescope. Star
1 mag too faint for visibility. Residuals all too large.

1997 Planetary, Cometary, and Asteroidal Occultations

David W. Dunham and Edwin Goffin

This is a continuation of the article with the same name on pages 316 to 325 of the last issue. The map on page 322 was not part of that article, but rather should have been with the article on occultations during the March 24 lunar eclipse on page 334. Dunham recently discovered an error in his computer program for these occultations that caused the position of the Moon to be up to 16° ahead of or behind its actual position, causing all of the information about the Moon given in the last 3 columns of Table 1 to be in error by that amount, and also the MR and MS points on the maps to be similarly incorrectly positioned, in the last *ON*. The data in Table 1 in this issue are correct, but the MR and MS points on the three regional maps given here have the error. The lunar data in IOTA's local circumstance appulse (LOCM) predictions, and on the charts by Goffin, are all correct.

The paths for 7 events in North America have been shifted from Goffin's prediction, and from those shown on Dunham's maps on pages 73 and 74 of the February issue of *Sky & Telescope*, based on improved positions and proper motions of the target stars from recent observations of them with the Carlsberg Automated Meridian Circle (CAMC). These stars have source code (under column "S", just before the Apparent R.A. and Dec.) "T" in Table 2. But they are not recent updates if the star's position originally came from a CAMC catalog, which is the case for stars whose "DM/ID No" in the middle of Table 2 starts with "CR".

Notes about Individual Events (April 29, May 22, and June 1 to September 19):

April 29, Kleopatra: In the last issue, I gave predictions for occultations of two GSC stars on this date. Jan Manek of Stefanik Observatory in Prague, Czech Republic, investigated this "double" and found only one star. Although the GSC field number (first 4 digits of the GSC number) of the two "stars" is the same, the stars are actually measures of the same star from two different plates; there are some other false "doubles" nearby. The positions of these stars given in GSC 1.2 are nearly identical (much closer than the 2″ difference of the GSC 1.1 positions) and have been used for a new prediction and path shown on the Western Hemisphere map given here. So rather than the two paths given on page 323 last time (extending down the Alaska peninsula, Vancouver Is., Washington to Texas, Jamaica, and just north of Trinidad for GSC 5559 0096, and across much of the north and equatorial Pacific, southern Peru, Bolivia, and Brazil over Belo Horizonte for GSC 5559 1159), there is only one path that crosses much of the Pacific Ocean missing North America well to the south, then crossing Ecuador (6:49 UTC), northeastern Peru (6:48 UTC), the Amazon basin, and just south of Recife, Brazil (6:45 UTC). The motion is east to west, opposite of the order in which I have described the paths. The GSC 1.2 positions are significantly more accurate than those of GSC 1.1 used for the old predictions, so it is quite certain that the occultation will not occur in North America. Too late for *ON*, I distributed this by email to observers in the areas described above the day before the event, and we also placed the Western Hemisphere map that shows the path (along with those for other good events on May 22 and from June 1 to Sept. 19) on IOTA's asteroidal occultation web site at **http://www.anomalies.com/iota/splash.htm**.

May 22, Eleonora: This was also given in the last issue, but now not only do we have a recent CAMC position for the star, but also the orbit of Eleonora has been updated by Martin Federspiel using dozens of CAMC observations of the asteroid, some of them very recent. The same technique was used to successfully predict last December 17's occultation by (704) Interamnia to within about 0.02", based on the 9 observations of that event made in California, Arizona, and New Mexico that have been reported to me, so the prediction for this occultation is also likely to be good to a small fraction of the path width, making it worthwhile for those who can to travel into the new path in the Pyrennes region (around 3:26 UTC), northern Newfoundland (3:32 UTC), Quebec (3:33 UTC), southern James Bay (3:34 UTC), and near Lake Winnipeg (3:35 UTC) to try to observe it.

June 2, Pallas: The path has been updated with Twin Astrographic Catalog (TAC) data for the star, and this moves the path northward into populous parts of Australia.

June 10: The star is ZC 3105 = HR 8122.

June 15: SAO 187578 is a double star, B 418, with component magnitudes 8.8 and 13.8, separated by 1″.5 in P.A. 156°. Separate predictions are now given for the two components, but any events involving B would be very difficult to observe, even if the seeing is good enough to resolve the components directly.

July 25, Sappho: SAO 92979 = 26 Arietis = ZC 370. Lunar occultation observations by Robert Sandy and others indicate that the star may be a close double, as described in *ON* (vol. 5, no. 2, pg. 57).

Aug. 3, Venus: Venus will be 84% sunlit with only a 2″.05 defect of illumination in P.A. 110°. So the disappearance will be on the dark side, but so close to the sunlit part of Venus for such a faint star that observation will be doubtful. The central line (maybe with a central flash?) crosses New Zealand.

Aug. 12, Fortuna: SAO 146019 is Aitken Double Star (ADS) 15832 with components mag. 8.9 and 12.1, separated by 0″.8 in

P.A. 212°. Separate predictions are given for the two components, but any events involving B would be very difficult to observe, even if the seeing is good enough to resolve the components directly.

Aug. 15: Mars will be 89% sunlit with only a 0".66 defect of illumination in P.A. 111°. So the disappearance will be on the dark side, but so close to the sunlit part of Mars for this faint a star that observation will be doubtful. The central line is in the southern Indian Ocean.

Aug. 19, Simeisa: SAO 78005 = X08360.

Aug. 20, Mathilde: The asteroid is the slow-rotating flyby target of the Near Earth Asteroid Rendezvous (NEAR) mission. That flyby will be on June 27.

Aug. 28, Flora: SAO 128987 is the double star RST 4159 with components mag. 8.9 and 12.4, separated by 0".8 in P.A. 35°. Separate predictions are given for the two components, but any events involving B would be very difficult to observe, even if the seeing is good enough to resolve the components directly. Flora being 0.2 mag. brighter than the primary star will make B events even more difficult.

Aug. 28, Venus: Venus will be 76% sunlit with a 3".4 defect of illumination in P.A. 113°. So the disappearance will be on the dark side, but it will be difficult to see a 9-mag. star this close to the dazzling planet. The central line is in the Atlantic Ocean north of Brazil.

Sep. 3, Mathilde: See Aug. 20 note. Goffin's original prediction had the path on the Earth's surface, but it used the GSC 1.1 position for the star; that catalog also gave the mag. as 5.6, which is much too bright. When the more accurate PPM data are used for this star, SAO 93528, the path misses the Earth's surface to the north, but there is a small chance that the actual path could shift south into Scandinavia.

Sep. 16: SAO 76505 = ZC 621 = HR 1297, a spectroscopic binary.

Sep. 3, Amphitrite: SAO 158462 = ZC 2045 = HR 5344.

Sep. 10, Venus: Venus will be 72% sunlit with a 4".2 defect of illumination in P.A. 112°. So the disappearance will be on the dark side, but it will be difficult to see these two 9-mag. stars this close to the dazzling planet. The central line for PPM 717345 crosses Australia at latitude -20°; maybe a central flash could be seen there? The central line for PPM 717350 is in Antarctica.

Notes for events after Sep. 19 will be given in a future issue. ι

Table 4. Some Priority Events

1997 Date	Occulting Object	North Amer.	Other IOTA	EAON	IOTA /ES
May 12	Rosa	x			
June 2	Pallas		x		
June 9	Polonia				x
June 10	Maria	x			
June 14	Arachne			x	
June 17	Alsatia				x
June 26	Rosalia				x
June 27	Eunomia		x	x	
June 30	Sylvia		x		
June 30	Tercidina		x	x	
July 9	Lotis			x	x
July 13	Priska			x	
July 15	Psyche			x	
July 17	1994 JR1	x			
July 18	Bardwell				x
July 21	Metis	x			
July 24	Ophelia			x	
July 25	Sappho	x			
July 25	Iris		x		
July 27	Pales		x		
Aug. 4	Pallas	x			
Aug. 6	Roberta	x			
Aug. 8	Bavaria				x
Aug. 12	Fortuna		x	x	x
Aug. 13	Alauda		x	x	
Aug. 14	Diotima	x			
Aug. 19	Lanzia		x	x	
Aug. 19	Sylvia		x	x	x
Aug. 22	Marconia				x
Aug. 27	Zelima			x	
Sep. 2	Donnera				x
Sep. 3	Mathilde		x	x	
Sep. 4	Rusthawelia			x	x
Sep. 6	Cora				x
Sep. 13	Rosalia			x	x
Sep. 16	Repsolda	x			
Sep. 18	Euterpe		x	x	x
Sep. 18	Herculina	x			
Sep. 19	Merapi	x			

Table 1. Occultations of stars by major and minor planets during 1997 June - December, and 2 earlier occultations

1997 Date	Universal Time h	m m	PLANET Name	m v	d,AU	STAR SAO No	m v	Sp	R.A.(1950) h	m	Dec. °	'	Occultation dm	dur s	df	P	Possible Path Lo1 °	La1 °	LoM °	LaM °	LoE °	LaE °	El Sun °	MOON El °	%Snl	up °
Apr 29	6	45-56	Kleopatra	12.2	2.497		12.2		13	50.1	-12	15	0.8	8	19	26	-31	-9	-95	6	-160	45	172	88	59-	e107W
May 22*	3	25-35	Eleonora	10.6	1.899		9.8	A2	16	56.3	4	18	1.2	14	24	3	5	42	-40	48	-96	52	151	26	100+	all
Jun 1*	18	20-25	Emma	13.2	2.134		10.4		16	18.9	-31	14	2.8	11	22	21	123	36	97	34	73	47	170	136	15-	e123E
Jun 2	0	11-28	Eunomia	9.4	1.908		11.3		17	55.7	-32	28	0.2	24	24	10	81	-12	9	-22	-58	7	160	119	13-	e 49E
Jun 2*	14	53-61	Pallas	9.9	2.788		9.2		19	53.2	19	45	1.1	52	32	8	145	-52	137	-23	107	-11	117	94	9-	none
Jun 3	22	31	Leto	11.9	2.649		9.9	K5	1	6.2	1	22	2.2	4	9	30	67	9	80	11	95	15	57	40	2-	e 90E
Jun 4*	19	56-63	Irene	10.1	1.603	187684	9.3	B9	19	3.8	-24	16	1.2	19	30	15	171	-55	174	-74	-99	-75	149	143	0-	e171E
Jun 5	12	25-44	Agrippina	15.6	2.820		9.8		19	30.5	-30	59	5.9	3	34128		-102	-9	-167	-38	114	-25	144	145	0+	none
Jun 8	23	36-75	Cornelia	14.7	2.121		9.8		20	24.3	-23	34	4.9	15	64	47	81	10	29	-28	-48	-35	135	172	14+	none
Jun 9	3	13-40	Vinifera	15.0	1.915		10.3		12	31.6	-33	8	4.7	7	38	53	143	-75	-113	-27	-91	38	119	78	15+	w157W
Jun 9	4	16-21	Eurykleia	13.4	2.013		9.3		18	33.7	-33	32	4.2	8	26	33	(Bermuda, s.e. USA)?s						158	150	15+	none
Jun 9	17	10-34	Hammonia	14.8	2.335		9.7		14	30.7	-8	15	5.1	6	44	89	145	-34	75	-34	5	-23	139	88	19+	w 54E
Jun 9	22	6-27	Erigone	14.1	1.951	163078	8.9	F5	19	50.3	-15	10	5.2	10	38	37	126	-37	51	-47	-25	-38	141	164	21+	w 21W
Jun 10*	8	35-89	Maria	14.0	2.010	164249	6.0	G5	21	12.3	-17	33	8.0	12	71	63	50	-71	-74	-19	-111	58	124	175	24+	none
Jun 11	1	52-53	Vibilia	12.4	2.311		14.2		1	8.5	2	39	0.2	4	9	23	21	-37	39	-33	58	-28	63	129	30+	none
Jun 14	4	10	Arachne	14.0	2.591		10.9	K	0	32.9	9	52	3.1	3	11	39	-37	26	-24	32	-11	41	71	169	59+	none
Jun 14	16	20-24	Proserpina	12.7	2.549		9.8		23	58.4	-3	58	3.0	5	17	38	133	-5	161	-2	-168	5	85	169	64+	none
Jun 15	20	17-32	Alsatia	14.6	2.087	187578A	9.3	G2	18	58.2	-27	37	5.3	5	21	46	128	18	66	-19	-14	-16	161	80	74+	w 85E
Jun 15	20	18-31	Alsatia	14.6	2.087	187578B	13.8		18	58.2	-27	37	1.2	5	21	46	110	34	60	2	0	0	161	80	74+	w 81E
Jun 16*	5	44-60	Eunomia	9.2	1.849	209207	9.2	K5	17	41.1	-31	52	0.7	21	20	10	2	-18	-86	-33	-163	4	171	59	78+	w 46W
Jun 16	19	50	Denise	14.7	3.006	99847	9.1	K0	11	51.2	19	3	5.7	5	19	53	54	58	59	50	69	42	85	46	82+	all
Jun 17	11	39-54	Metcalfia	14.5	1.900	187379	8.6	A0	18	49.1	-20	26	5.9	5	22	44	-74	-37	-169	-44	111	-20	164	57	87+	w115W
Jun 18	4	11-28	Herculina	9.9	1.833		11.7		19	37.1	-19	48	0.2	20	24	12	5	20	-49	-18	-125	-28	154	60	92+	w 9W
Jun 18	19	0-40	JUPITER	-2.4	4.419		10.0	G0	21	35.2	-15	12		18691	110	2	IndOc,sAsia,AU,Kyushu,NZ						126	80	95+	w130E
Jun 19*	23	22-49	Eurydike	11.3	1.159	209690	8.6	K0	18	2.3	-32	51	2.8	7	27	29	87	4	10	-25	-74	-3	170	19	99+	all
Jun 21	23	43-59	Eurykleia	13.2	1.980		10.1		18	21.8	-33	52	3.2	7	23	32	73	17	8	-9	-63	10	168	19	98-	all
Jun 22*	4	52-63	Medea	13.2	2.410	185330	9.7	F0	17	19.3	-27	45	3.5	10	22	25	-19	22	-77	11	-135	33	170	29	97-	e134W
Jun 23*	6	38	Aspasia	10.8	1.444	161873	8.5	B9	18	46.7	-11	51	2.4	16	23	12	(e.&central Canada)?s						165	24	92-	all
Jun 23	14	27-34	Hecuba	12.7	2.252	185994	8.7	B8	17	54.6	-29	34	4.0	5	23	49	-179	41	142	31	103	43	173	41	90-	e105E
Jun 23	15	24-39	Eunomia	9.2	1.841		11.0		17	33.1	-31	23	0.2	21	20	10	-156	-9	125	-19	55	16	169	47	89-	e 75E
Jun 24	12	51-63	Cheruskia	14.1	2.371		9.6		16	41.7	-18	22	4.5	6	22	39	-137	6	166	10	110	39	159	71	82-	e132E
Jun 25	3	49-77	Aeolia	12.9	1.326		10.0		19	23.9	-19	37	2.9	5	31	57	26	-7	-48	-19	-124	-4	163	42	76-	e 94W
Jun 26*	16	28-53	Eurydike	11.3	1.140	209533	8.4	K5	17	55.1	-32	54	3.0	7	27	29	179	10	106	-14	29	9	169	85	60-	e 98E
Jun 27*	10	57-67	Pales	13.3	2.688	184160	10.3	F8	16	5.7	-23	14	3.1	13	28	25	-132	24	-177	20	137	38	149	120	51-	e165W
Jun 27*	23	14-23	Eunomia	9.3	1.843		9.7		17	28.6	-31	4	0.6	21	21	10	(Mideast, s.Europe)?s						165	108	45-	e 15E
Jun 28	16	34-48	Sigelinde	13.7	1.942		8.8	A2	17	8.1	-23	29	4.9	8	27	35	-156	-57	83	-64	13	-31	162	123	37-	e144E
Jun 29	1	56-81	Neujmina	15.0	2.176	164039	9.0	A0	20	56.6	-10	27	6.0	5	38	83	66	-30	-8	-20	-78	-1	143	74	33-	e 10W
Jun 29*	9	4	Parthenope	11.4	2.387	110119	9.4	K0	1	43.8	6	50	2.1	6	11	21	(Mont.,s.cen.Canada)?s						71	4	30-	e113W
Jun 30*	15	25-43	Sylvia	12.0	2.353	189520	8.9	K0	20	35.7	-29	26	3.1	26	29	13	-156	15	148	-32	54	-37	152	103	18-	e170E
Jun 30*	16	56-75	Nephthys	11.2	1.313	162812	8.9	K0	19	33.8	-11	21	2.4	8	25	27	-165	-15	129	-41	28	-54	162	116	18-	e153E
Jun 30*	20	16-30	Tercidina	13.1	1.830		11.9		14	17.0	-7	58	1.5	24	64	27	4	39	27	38	53	40	116	164	16-	none
Jul 1*	8	20-27	Herculina	9.6	1.799		9.7		19	26.4	-21	21	0.7	16	20	12	-118	58	-143	32	179	25	169	127	13-	none
Jul 1	15	47-63	Ursula	11.9	2.041		11.0		16	32.7	-44	36	1.3	10	27	28	174	-7	114	-13	71	32	146	151	10-	none
Jul 3	7	55-56	Euterpe	11.8	2.572		10.6	G5	3	0.6	15	48	1.5	3	8	32	-60	-29	-47	-24	-30	-17	54	36	2-	e 39W
Jul 3	22	50-60	Alfaterna	16.6	2.479	165806	8.1	K2	23	35.1	-10	15	8.5	5	34	80	27	49	66	29	96	6	111	101	1-	e 92E
Jul 5*	0	53-68	Massalia	10.0	1.740		10.1		18	41.8	-22	1	0.7	12	21	17	53	20	-16	0	-91	12	178	173	0+	none
Jul 5	9	3-21	Margarita	14.1	1.752		9.8	K0	19	30.3	-17	30	4.3	3	23	71	-61	14	-131	-1	153	6	170	178	1+	none
Jul 6*	15	37-56	Aspasia	10.7	1.446		9.8		18	34.0	-11	6	1.3	16	23	12	-159	0	125	0	49	16	167	152	4+	w 57E
Jul 9	1	22-35	Lotis	13.8	1.741		9.5		17	41.9	-11	24	4.3	7	25	36	26	35	-26	30	-84	35	156	111	17+	w 59W
Jul 9	10	21-37	Saskia	15.9	2.649	185170	9.3	G5	17	10.4	-21	7	6.6	4	28	85	-96	-20	-169	-37	110	-26	152	100	19+	w160E
Jul 9	10	25-51	Patroclus	15.8	4.739	183208	9.2	F0	15	5.9	-25	8	6.6	27	77	46	-127	-25	176	-45	97	-45	124	72	19+	w154E
Jul 10	16	13-25	Brasilia	14.4	2.090	211095	7.9	K0	19	12.2	-38	56	6.5	4	21	52	-152	-17	154	-62	5	-54	163	110	29+	w 79E
Jul 12	6	26-37	Pallas	9.6	2.576		10.5		19	27.8	20	31	0.4	34	20	7	-48	46	-120	31	-176	4	137	100	44+	w107W
Jul 12	15	37-55	Hecuba	13.0	2.323		10.8		17	39.4	-29	15	2.4	6	29	50	-173	-16	112	-33	38	-12	155	69	48+	w125E
Jul 12	21	27-50	Ottegebe	13.4	1.533		9.5		20	54.2	-7	39	3.9	5	35	62	101	36	38	17	-21	11	154	113	50+	w 31E
Jul 12	22	17-37	Eichsfeldia	13.2	1.355		10.3		21	6.1	-14	40	3.0	8	29	29	76	46	25	14	-30	4	155	114	50+	w 20E
Jul 14	2	28-53	Susanna	14.6	2.452		10.1		15	27.9	-3	15	4.6	8	55	83	-106	21	-117	-26	-168	-68	118	19	62+	all
Jul 15*	16	12-36	Unitas	11.3	1.031	164213	9.0	G	21	9.7	-12	1	2.4	9	37	31	-153	-14	170	-48	12	-86	156	81	76+	w165E
Jul 16	13	32-52	Centenaria	13.5	1.637	209838	8.6	A0	18	8.7	-34	36	4.9	6	26	40	-138	-11	145	-22	79	17	156	30	84+	w154W
Jul 16	16	51-70	Hecuba	13.1	2.350		10.7		17	36.9	-29	9	2.6	7	32	51	168	-25	93	-42	16	-20	151	20	85+	w160E
Jul 17*	3	47-56	1994JR1	23.034.131		159935	7.7	A0	16	25.9	-17	53	15.3	12	77275		-32	21	-80	11	-133	14	133	7	88+	all
Jul 17	3	55	Helena	12.7	2.160		11.3		1	50.4	15	40	1.7	3	13	46	-26	-37	0	-22	24	-4	83	136	88+	w 1W
Jul 17*	3	49-68	Eleonora	11.1	2.177	121542	7.9	A0	16	19.7	0	37	3.3	17	30	19	-28	41	-80	-6	-62	-75	126	20	88+	all
Jul 17	9	32-36	Endymion	15.5	2.610		9.5		13	9.0	-8	55	6.0	3	16	58	132	-15	165	-19	-158	-18	85	58	90+	all
Jul 17	17	26-27	Melpomene	12.1	3.155		9.1		11	49.8	7	50	3.0	5	12	31	10	-18	29	-26	53	-33	60	87	92+	all
Jul 18	15	50-91	Pafuri	14.8	2.124	165719	9.6	G5	23	27.0	-17	1	5.2	12	59	52	162	53	163	-18	39	-79	129	72	97+	all
Jul 21*	5	39-40	Metis	10.9	2.224		9.7	K5	2	42.6	11	6	1.6	7	11	17	-65	24	-45	30	-23	38	76	89	98-	all
Jul 22*	3	4-12	Ceres	8.2	2.182	165639	8.0	G0	23	18.3	-19	16	0.9	132	41	3	-61	32	-60	13	-78	1	134	23	94-	all
Jul 24	4	21-29	Ophelia	14.4	3.177		10.6	K0	1	27.4	6	11	3.8	12	34	38	-64	8	-31	16	2	26	98	26	78-	all
Jul 25*	10	27	Sappho	11.8	1.704	92979	6.1	F0	2	27.8	19	38	5.7	3	11	31	-138	-11	-109	1	-76	14	81	27	65-	all
Jul 25*	10	35	Iris	11.2	2.941	157830	8.9	F2	13	14.2	-11	30	2.4	10	17	21	109	-33	143	-37	-176	-34	80	171	65-	none
Jul 26	17	36-45	Edith	14.1	2.325		9.4		19	29.1	-20	16	4.8	7	23	35	134	44	82	29	29	33	168	102	50-	e 87E
Aug 1	0	38-57	Ceres	8.1	2.102		11.9		23	15.5	-20	19	0.0	100	31	3	42	48	3	-3	-59	-23	144	118	5-	e 36E
Aug 1	5	10-36	Aeolia	13.1	1.381	162007	9.3	A3	18	53.7	-19	52	3.9	6	41	59	-40	34	-96	19	-155	21	154	178	4-	none
Aug 1	21	6-21	Maria	12.8	1.678		9.4	G5	20	36.0	-15	36	3.5	4	20	53	128	-30	40	-38	-44	-21	176	165	2-	e126E

Table 2. Occultations of stars by major and minor planets during 1997 June - December, and 2 earlier events

1997	MINOR PLANET						Motion		STAR			Min.		Geocentric	Apparent					Ephem.
Date	No.	Name	km-Diam.	-//	RSOI km	Type	°/day	P.A. °	SAO No	DM/ID No	D	U.T. h	m	Sep. "	S	R.A. h	m	Dec. °	'	Source
Apr 29	216	Kleopatra	137	0.08	722	M	0.215	301.8		55590096		6	50.5	1.43N	9	13	52.6	-12	29	Goffin89
May 22	354*	Eleonora	162	0.12	751	S	0.201	278.0		M 163336		3	29.2	3.19N	T	16	58.6	4	14	CAMC-MF
Jun 1	283*	Emma	150	0.10	742	X	0.204	285.3		M 294969		18	22.7	3.82N	M	16	22.0	-31	20	MPC16554
Jun 2	15	Eunomia	272	0.20	1665	S	0.199	277.9		73821283		0	18.8	0.75N	J	17	58.8	-32	28	MPC24219
Jun 2	2*	Pallas	533	0.26	5341	B	0.121	318.5		16241421		14	57.0	2.79S	8	19	55.3	19	52	Goffin92
Jun 3	68	Leto	127	0.07	417	S	0.448	66.9		M 144306		22	33.6	1.74N	L	1	8.6	1	37	MPC24548
Jun 4	14*	Irene	155	0.13	628	S	0.171	240.4	187684	M 269316		19	57.7	4.81S	M	19	6.7	-24	12	MPC24219
Jun 5	645	Agrippina	32	0.02	86	S	0.116	248.7		M 299120		12	33.3	0.16S	M	19	33.5	-30	53	MPC18085
Jun 8	425	Cornelia	66	0.04	202		0.070	229.6		M 736211		23	52.0	0.45N	M	20	27.2	-23	24	MPC24549
Jun 9	759	Vinifera	52	0.04	124		0.123	21.4		M 744420		3	25.9	0.33S	M	12	34.2	-33	24	MPC16006
Jun 9	195	Eurykleia	89	0.06	322	C	0.180	257.8		M 749868		4	16.0	4.69N	M	18	36.8	-33	29	Goffin96
Jun 9	723	Hammonia	38	0.02	96		0.096	278.7		M 197668		17	23.9	1.54S	M	14	33.2	-8	28	MPC16392
Jun 9	163	Erigone	76	0.05	240	C	0.124	264.9	163078	M 236637		22	14.9	2.39S	M	19	53.0	-15	3	Goffin90
Jun 10	170*	Maria	46	0.03	109	S	0.064	344.7	164249	M 238586		9	2.2	0.06N	T	21	15.0	-17	21	MPC24549
Jun 11	144	Vibilia	146	0.09	467	C	0.498	69.3		CR0 1172		1	55.3	1.20S	T	1	10.9	2	54	Goffin92
Jun 14	407	Arachne	97	0.05	303	C	0.359	59.5		M 116607		4	11.7	2.73N	M	0	35.4	10	8	Goffin92
Jun 14	26	Proserpina	98	0.05	332	S	0.246	69.4		M 181751		16	25.3	0.91N	M	24	0.8	-3	42	Goffin96
Jun 15	971	Alsatia	66	0.04	212		0.210	245.1	187578	M 269206	A	20	24.5	0.78N	O	19	1.1	-27	33	MPC12681
Jun 15	971	Alsatia	66	0.04	212		0.210	245.1	187578	M 269206	B	20	24.5	2.28N	O	19	1.1	-27	33	MPC12681
Jun 16	15*	Eunomia	272	0.20	1651	S	0.236	283.6	209207	M 296743		5	52.1	0.11S	M	17	44.2	-31	53	MPC24219
Jun 16	667	Denise	83	0.04	301		0.196	117.9	99847	M 128632		19	50.0	2.70N	L	11	53.6	18	48	MPC14758
Jun 17	792	Metcalfia	63	0.05	186		0.214	277.5	187379	M 269005		11	46.0	1.99S	M	18	51.9	-20	23	MPC22666
Jun 18	532	Herculina	217	0.16	1145	S	0.200	235.5		63070388		4	18.9	0.65N	J	19	39.9	-19	41	Goffin88
Jun 18		JUPITER	140904	21.98			0.028	242.6		M 239120		19	27.6	7.63N	M	21	37.8	-14	59	DE200
Jun 19	75*	Eurydike	58	0.07	123	M	0.223	265.3	209690	M 297224		23	35.6	0.96N	M	18	5.5	-32	51	Goffin87
Jun 21	195	Eurykleia	89	0.06	323	C	0.205	265.3		C3313181		23	51.0	1.84N	U	18	25.0	-33	51	Goffin96
Jun 22	212*	Medea	140	0.08	729	DCX:	0.189	278.0	185330	M 266771		4	57.3	2.36N	M	17	22.3	-27	47	MPC25033
Jun 23	409*	Aspasia	168	0.16	684	CX	0.236	286.6	161873	M 235073		6	37.8	6.22N	M	18	49.3	-11	47	MPC24549
Jun 23	108	Hecuba	67	0.04	231	S	0.189	271.8	185994	M 267569		14	30.5	3.42N	M	17	57.6	-29	34	Goffin96
Jun 23	15	Eunomia	272	0.20	1644	S	0.237	287.0		73760460		15	31.8	1.06N	J	17	36.2	-31	25	MPC24219
Jun 24	568	Cheruskia	89	0.05	361		0.195	294.3		M 232106		12	57.4	2.10N	M	16	44.5	-18	27	MPC25187
Jun 25	396	Aeolia	34	0.04	59		0.183	269.5		M 720617		4	2.4	0.02N	M	19	26.7	-19	31	MPC19474
Jun 26	75*	Eurydike	58	0.07	122	M	0.229	269.8	209533	M 297067		16	40.7	2.44N	M	17	58.2	-32	54	Goffin87
Jun 27	49*	Pales	154	0.08	885	CG	0.142	286.5	184160	M 265176		11	2.6	2.42N	M	16	8.5	-23	21	Goffin96
Jun 27	15*	Eunomia	272	0.20	1640	S	0.232	289.1		M 748797		23	18.5	4.91N	M	17	31.7	-31	6	MPC24219
Jun 28	552	Sigelinde	81	0.06	275		0.176	288.7		M 266519		16	41.3	2.89S	M	17	11.0	-23	32	MPC16209
Jun 29	1129	Neujmina	38	0.02	92	S	0.116	283.5	164039	M 238184		2	7.7	0.92S	M	20	59.2	-10	16	MPC19483
Jun 29	11*	Parthenope	162	0.09	601	S	0.388	73.5	110119	M 144968		9	6.0	4.16N	M	1	46.3	7	4	MPC24085
Jun 30	87*	Sylvia	271	0.16	1890	P	0.149	231.2	189520	M 271425		15	33.4	0.11N	M	20	38.6	-29	16	MPC24085
Jun 30	287*	Nephthys	70	0.07	174	S	0.227	248.5	162812	M 236234		17	5.6	3.54S	M	19	36.5	-11	15	Goffin93
Jun 30	345*	Tercidina	100	0.08	316	C	0.075	95.3		CR1 1641		20	13.7	3.59N	T	14	19.5	-8	11	MPC23324
Jul 1	532*	Herculina	217	0.17	1154	S	0.243	239.7		631 2129		8	23.4	4.29N	J	19	29.2	-21	15	Goffin88
Jul 1	375	Ursula	106	0.07	413	C	0.167	307.6		78660637		15	55.2	2.60N	J	16	36.1	-44	42	MPC24549
Jul 3	27	Euterpe	118	0.06	352	S	0.490	74.1		M 118780		7	57.9	1.13S	M	3	3.2	15	59	Goffin96
Jul 3	1191	Alfaterna	45	0.03	117		0.121	125.4	165806	M 2 7761		23	0.8	1.13N	M	23	37.6	-9	59	MPC19984
Jul 5	20*	Massalia	151	0.12	659	S	0.241	265.7		M 734362		1	0.2	1.96N	M	18	44.7	-21	58	MPC24085
Jul 5	310	Margarita	36	0.03	77		0.213	264.5		M 720773		9	12.0	1.38N	M	19	33.0	-17	23	Goffin90
Jul 6	409*	Aspasia	168	0.16	686	CX	0.233	280.1		M 234785		15	46.6	1.19N	M	18	36.6	-11	3	MPC24549
Jul 9	429	Lotis	70	0.06	204	C	0.195	272.7		M 233542		1	29.4	3.38N	M	17	44.6	-11	25	MPC15529
Jul 9	461	Saskia	45	0.02	139	FCX	0.142	272.1	185170	M 266577		10	29.5	0.93S	M	17	13.3	-21	10	MPC14755
Jul 9	617	Patroclus	149	0.04	1259	P	0.039	268.4	183208	M 263861		10	42.4	0.75S	M	15	8.7	-25	19	Goffin88
Jul 10	293	Brasilia	58	0.04	175	CX	0.214	251.2	211095	M 298757		16	19.3	2.25S	M	19	15.5	-38	51	Goffin96
Jul 12	2	Pallas	533	0.29	5382	B	0.202	250.9		16090567		6	30.4	1.11N	J	19	29.9	20	37	Goffin92
Jul 12	108	Hecuba	67	0.04	231	S	0.149	279.0		C2913887		15	46.6	0.23S	U	17	42.5	-29	17	Goffin96
Jul 12	670	Ottegebe	36	0.03	69		0.151	253.2		M 2 4643		21	37.4	2.84N	M	20	56.7	-7	28	MPC19476
Jul 12	442	Eichsfeldia	67	0.07	164	C	0.193	240.0		M 722544		22	26.4	3.92N	M	21	8.8	-14	28	MPC15529
Jul 14	542	Susanna	43	0.02	111	S	0.076	187.0		M 198659		2	35.4	0.77W	M	15	30.3	-3	24	MPC19475
Jul 15	306*	Unitas	49	0.07	88	S	0.173	228.5	164213	M 238525		16	22.5	5.97S	M	21	12.3	-11	50	Goffin96
Jul 16	1240	Centenaria	60	0.05	156		0.194	292.2	209838	M 297376		13	42.1	1.40N	M	18	11.9	-34	35	MPC17179
Jul 16	108	Hecuba	67	0.04	231	S	0.134	281.0		C2913837		17	1.8	0.75S	U	17	39.9	-29	11	Goffin96
Jul 17	0*	1994JR1	180	0.01	10838		0.014	273.2	159935	M 231740		3	53.2	0.12N	M	16	28.6	-17	59	MPC25341
Jul 17	101	Helena	68	0.04	164	S	0.337	56.7		CR0 1044		3	58.3	0.79S	T	1	53.0	15	54	MPC22796
Jul 17	354*	Eleonora	162	0.10	768	S	0.145	198.4	121542	M 162546		3	58.8	1.96S	M	16	22.1	0	30	Goffin92
Jul 17	342	Endymion	65	0.03	184	C	0.248	104.2		M 196260		9	30.4	0.17S	M	13	11.5	-9	10	MPC25186
Jul 17	18	Melpomene	148	0.06	648	S	0.310	113.9		+08 2548		17	24.0	0.56S	U	11	52.3	7	34	MPC24085
Jul 18	1032	Pafuri	59	0.04	168		0.076	179.5	165719	M 241712		16	10.2	0.65W	M	23	29.5	-16	45	MPC25188
Jul 21	9*	Metis	190	0.12	747	S	0.389	73.2		M 118511		5	41.6	2.48N	T	2	45.2	11	18	MPC24085
Jul 22	1*	Ceres	933	0.59	10946	G	0.107	202.1	165639	M 241504		3	7.9	3.80N	M	23	20.8	-19	0	Goffin92
Jul 24	171	Ophelia	121	0.05	595	C	0.109	75.2		M 144667		4	30.2	1.03N	M	1	29.9	6	26	MPC25186
Jul 25	80*	Sappho	81	0.07	173	S	0.466	75.9	92979	F5E 2172	V	10	30.1	0.12S	5	2	30.5	19	51	Goffin93
Jul 25	7*	Iris	203	0.10	1093	S	0.225	104.8	157830	M 227055		10	32.3	0.96S	M	13	16.7	-11	45	MPC24084
Jul 26	517	Edith	95	0.06	396	X	0.189	264.1		M 269919		17	40.8	2.86N	M	19	31.9	-20	10	Goffin95
Aug 1	1	Ceres	933	0.61	10948	G	0.146	219.6		64020394		0	46.9	2.01N	J	23	18.0	-20	3	Goffin92
Aug 1	396	Aeolia	34	0.03	60		0.136	266.2	162007	M 235266		5	24.4	3.91N	M	18	56.5	-19	48	MPC19474
Aug 1	170	Maria	46	0.04	108	S	0.256	274.7		M 237723		21	13.3	2.08S	M	20	38.7	-15	26	MPC24549

Table 1. Occultations of stars by major and minor planets during 1997 (continued)

1997	Universal		P L A N E T			S T A R							Occultation				Possible Path			El	M O O N		
Date	Time		Name	m	d,AU	SAO No	m	Sp	R.A.(1950)		Dec.		dm	dur	df	P	Lo1La1	LoMLaM	LoELaE	Sun	El	%Snl	up
	h	m m		v			v		h	m	°	'		s			° °	° °	° °	°	°		°
Aug 2	12	8-25	Brucia	12.9	1.307		9.7		18	36.9	-34	30	3.2	3	21	51	-143 8	174-37	63-66	146	153	1-	none
Aug 3	6	27	VENUS	-3.2	1.344		9.7	F5	10	56.4	8	11		251	5	1	172-37	176-39	-176-40	32	33	0-	none
Aug 3	11	49	JUPITER	-2.7	4.055		10.1	F8	21	19.5	-16	37		4462	25	2	Antarctica?n			173	174	0+	none
Aug 3	17	14-20	Laurentia	14.4	2.674		9.7		15	18.0	-22	30	4.7	10	30	37	30 24	55 22	81 27	102	98	0+	none
Aug 3	21	4-31	Unitas	10.6	0.988		10.1		20	56.1	-14	42	1.1	7	26	29	105 40	38 -5	-45-29	177	175	0+	none
Aug 4	1	0- 7	Angelica	16.4	3.684	182669	7.6	G5	14	31.6	-22	10	8.8	5	32	99	-93 8	-63 0	-31 5	92	84	0+	none
Aug 4	1	20-25	Nuwa	14.1	3.094		10.3		14	15.3	-12	26	3.9	9	20	29	-105-19	-73-24	-37-23	85	77	1+	w105W
Aug 4*	4	17-21	Pallas	9.6	2.599	104597	7.5	F0	19	10.3	17	55	2.3	31	18	7	(sw Canada, w USA)?s			136	135	1+	none
Aug 5*	0	30	Hygiea	11.9	3.946	76809	8.6	F8	4	50.3	24	49	3.4	14	13	13	29 8	45 16	65 25	58	76	3+	none
Aug 5	6	28	Amalthea	13.3	2.126		12.4		1	50.6	5	36	1.3	5	32	66	-95 60	-90 60	-82 61	105	125	3+	none
Aug 6*	5	1-89	Roberta	12.4	1.402	128727	9.1	G5	0	20.3	-0	6	3.3	40	100	22	-92 62	-36 5	7-58	129	160	7+	none
Aug 7	10	1-18	Barbara	12.3	1.306		9.4		16	51.6	-5	47	3.0	5	23	43	142 32	161-20	-136-58	117	74	14+	w160E
Aug 8	0	52-72	Nora	12.0	0.814		9.8		20	4.7	-15	25	2.4	7	30	29	51 0	25-33	66-67	164	114	19+	none
Aug 8*	16	49-60	Hestia	13.2	2.091		9.3		15	41.0	-16	47	3.9	13	28	23	23-14	62-22	108-18	101	43	24+	w 75E
Aug 8*	17	55-109	Marghanna	13.0	1.397	227999	8.5	G5	17	24.8	-46	50	4.5	29	89	26	-23-70	5-31	0 13	124	72	24+	all
Aug 8	18	44	Bavaria	13.5	1.587		9.3		20	33.9	-17	2	4.2	5	24	42	32 56	30 54	26 52	171	112	24+	all
Aug 8	22	46	Elpis	13.8	3.189	139550	9.5	K2	13	45.2	-3	44	4.3	7	14	27	-71-33	-46-40	-14-43	70	10	26+	all
Aug 9	7	26-43	Elfriede	13.5	2.421		9.3		1	55.4	-9	37	4.2	12	30	28	-119 3	-73-26	-5-67	111	163	29+	none
Aug 9	23	24-39	Chryseos	12.1	2.358	164538	7.5	G5	21	35.5	-15	8	4.6	6	21	40	82 31	9 -7	-75-21	176	112	35+	w 9W
Aug 10	14	23-39	Ceres	7.9	2.044		11.3		23	10.7	-21	26	0.0	83	25	3	-159 47	151 0	87-13	153	123	41+	w130E
Aug 10	16	17-38	Helga	14.7	2.699	187092	9.6	A0	18	36.1	-22	21	5.1	15	44	35	137 30	87 6	30 -3	141	61	42+	w100E
Aug 12	20	49-54	Philia	17.1	3.065	183078	9.4	A7	14	57.5	-23	46	7.7	3	22	93	-37-23	-1-21	34-11	89	20	63+	all
Aug 12*	23	16-37	Fortuna	9.8	1.237	146019A	8.9	G5	22	17.1	-7	56	1.3	22	28	10	72 48	5 23	-58 12	166	86	65+	w 15E
Aug 12	23	18-37	Fortuna	9.8	1.237	146019B	12.1		22	17.1	-7	56	0.1	22	28	10	62 51	1 27	-55 17	166	86	65+	w 13E
Aug 13*	4	12	Alauda	13.4	3.375		11.5		4	8.0	38	35	2.1	8	15	24	-41 8	-25 24	-3 43	73	157	67+	none
Aug 13	15	57-82	Brasilia	15.0	2.291	210565	8.6	A2	18	43.8	-39	37	6.4	9	46	57	149 9	94 -8	37 14	136	31	72+	w143E
Aug 14	8	9-22	Ianthe	13.5	2.179		10.4		21	6.0	-32	13	3.2	8	20	29	-39-19	-121-46	149-23	161	48	78+	w 76W
Aug 14*	8	35-42	Diotima	11.5	1.986	213195	9.2	F0	21	37.9	-30	54	2.5	18	24	13	-123 49	-149 29	175 29	164	55	78+	all
Aug 14	9	55-71	Ceres	7.8	2.027	191707	9.3	K0	23	8.3	-21	52	0.2	79	24	3	-68 5	-122-38	129-52	156	76	79+	w106W
Aug 15	13	40	MARS	1.1	1.552	158218	9.0	F8	13	51.1	-12	4		234	8	1	64-39	94-42	127-41	68	72	88+	all
Aug 17*	21	18-58	Flora	9.0	1.095		9.5		0	48.1	-4	25	0.5	42	62	11	7 3	36-27	9-73	134	54	100+	all
Aug 19*	0	51-69	Lanzia	13.7	2.319	143691	8.7	A0	19	38.5	-2	26	5.0	12	31	29	32 30	-33 20	-97 8	146	41	99-	all
Aug 19*	20	12-22	Sylvia	12.0	2.365		10.4		19	59.9	-32	40	1.8	31	35	13	49 44	20 31	-12 37	147	51	97-	all
Aug 19	23	30-31	Simeisa	15.2	3.666	78005	7.7	B8	6	5.0	23	45	7.5	3	11	50	44 11	61 18	83 25	55	103	97-	all
Aug 20	0	16-48	Nora	12.4	0.864		9.6		20	0.0	-17	44	2.9	8	38	31	36 26	8-21	62-62	152	50	96-	all
Aug 20	17	34-39	Mathilde	14.3	1.736		9.0		3	21.7	15	6	5.3	4	17	41	92 21	126 30	167 36	95	53	92-	all
Aug 21	18	51-62	Telamon	16.4	4.313		10.0	F8	0	12.7	3	44	6.4	10	37	54	137 52	79 39	27 29	144	11	84-	all
Aug 22*	7	11-24	Bertholda	13.4	2.511		11.8		22	18.6	-0	31	1.8	11	23	25	-47 46	-119 26	175 11	168	47	80-	e150W
Aug 23*	20	45-55	Merapi	13.0	2.314		10.5		23	12.4	-35	20	2.6	13	24	21	76 43	43 13	-2 14	152	70	63-	e 26E
Aug 26	0	27	Ornamenta	13.9	3.261		10.3	G	7	9.0	22	36	3.7	3	9	38	45 11	56 15	69 21	46	33	40-	all
Aug 26	11	50-60	Ohio	14.7	2.264	126477	7.6	A0	20	59.4	7	20	7.1	6	22	42	-175 73	135 39	98 8	153	120	35-	e161E
Aug 27	2	29-40	Eriphyla	12.6	1.626		9.7	G0	22	43.4	-12	27	3.0	4	24	62	(Icel., e.N.America)?s			174	109	30-	none
Aug 28*	7	19-54	Flora	8.7	1.018	128987A	8.9	F8	0	48.7	-5	27	0.7	38	54	10	-30 13	-44-23	-26-63	144	93	19-	all
Aug 28	7	17-52	Flora	8.7	1.018	128987B	12.4		0	48.7	-5	27	0.0	38	54	10	-32 13	-46-23	-32-63	144	93	19-	all
Aug 28	21	33	VENUS	-3.3	1.178	138982	9.2	A5	12	47.0	-4	51		291	5	1	-43 9	-37 9	-28 8	38	83	15-	none
Aug 28	22	14-18	Wratislavia	13.8	3.204		9.1	K2	15	48.4	-19	7	4.7	8	20	33	-57-21	-24-17	8 -8	84	129	15-	none
Aug 29*	6	4- 8	Alauda	13.2	3.168		11.0		4	24.3	39	51	2.3	11	20	23	-94 22	-78 43	-62 68	85	48	12-	e 70W
Aug 30	22	26-35	Eurydike	12.3	1.385		10.9		17	43.3	-29	46	1.7	6	24	35	-55 3	-29 14	-2 33	109	131	4-	none
Sep 1	20	53-66	Hecuba	13.9	2.888		9.7		17	33.1	-27	52	4.2	8	39	63	-39-54	13-38	52-15	105	106	0-	none
Sep 2	0	8-26	Felicitas	12.8	1.703		10.0		20	45.4	-26	46	2.9	10	29	27	33 20	-23 8	-83 24	147	146	0-	none
Sep 2*	4	10	Germania	13.6	3.453	78707	8.3	K2	6	42.3	23	42	5.3	6	12	30	7-44	15-41	24-39	59	61	0+	none
Sep 2*	23	3	Aurora	13.3	3.004		11.7		5	39.3	30	16	1.8	9	14	21	41 0	61 12	87 26	74	85	1+	none
Sep 3	1	49-53	Mathilde	14.1	1.621	93528	8.2	G5	3	35.6	14	59	5.9	6	24	39	Scandinavia?s			105	116	1+	none
Sep 3*	6	17	Amphitrite	11.4	3.147	158462	6.2	G5	14	14.3	-18	21	5.2	7	11	21	177-38	-158-37	-130-32	58	44	1+	w172W
Sep 3	10	55-77	Silesia	15.3	2.896		10.0		17	55.2	-27	26	5.3	13	60	58	112-32	155-18	-166 4	109	93	2+	w119E
Sep 3	13	24-36	Ceres	7.7	2.000		9.9		22	52.4	-23	58	0.1	73	22	3	-117-21	-167-53	69-68	164	153	2+	w 77E
Sep 3	14	29-67	Unitas	11.5	1.092		9.7	G0	20	36.9	-18	56	2.0	13	53	32	-175 11	151-32	-140-73	146	128	2+	none
Sep 4	0	56-71	Rusthawelia	13.6	1.786	146603	8.9	F8	23	13.9	-8	26	4.8	7	24	35	47 58	-25 23	-91 6	174	163	4+	w 87W
Sep 5	3	28-39	Flora	8.5	0.971	128967	9.3	K0	0	46.7	-6	27	0.4	29	40	10	southern Africa?2"n			152	168	9+	none
Sep 5	9	42	Adeona	13.8	3.066		9.5		15	21.5	-17	19	4.4	6	13	29	145 51	146 51	149 51	70	33	10+	all
Sep 5	22	46-62	Leona	14.0	2.000	146204	9.4	K0	22	34.7	-1	54	4.6	6	22	40	90 13	25-17	-63-56	173	133	14+	w 25W
Sep 6*	9	2	Eukrate	12.8	2.473	41851	9.4	F8	7	30.3	43	10	3.4	4	8	26	-82 -1	-72 7	-57 18	58	101	16+	none
Sep 8	19	11-41	Dudu	14.5	1.711		11.9		2	22.2	-9	52	2.7	9	46	50	140 45	91 4	33-15	131	145	37+	w 52E
Sep 9	12	37-59	Nike	15.7	2.666		12.3		18	22.2	-24	51	3.4	10	58	67	89-14	129-16	170 -5	109	26	44+	w159E
Sep 9	14	44	Emanuela	14.9	2.919		9.7		15	19.8	-25	20	5.2	3	12	49	58 10	71 14	87 21	68	21	45+	all
Sep 10	9	10	VENUS	-3.3	1.091		9.6		13	40.7	-11	4		318	5	1	138-20	149-20	162-19	40	54	53+	all
Sep 10	9	36	VENUS	-3.3	1.091		9.7		13	40.7	-11	5		318	5	1	159-83	159-83	168-83	40	54	54+	all
Sep 10*	13	14-27	Massalia	11.4	2.284		11.5		18	15.5	-22	33	0.7	20	40	22	80-49	128-44	171-30	106	11	55+	all
Sep 12	9	57	Isis	12.0	2.172		10.2		15	44.7	-20	5	2.0	4	10	29	127-29	152-29	-178-23	69	50	75+	all
Sep 12*	21	56-69	Massalia	11.4	2.314	186655	9.5	A5	18	16.6	-22	33	2.1	18	35	22	-53-33	-6-28	35-14	104	22	79+	all
Sep 13	0	0-21	Rosalia	13.4	1.679		9.8		21	31.5	-8	25	3.6	7	29	40	16 61	-35 11	-87-33	152	26	80+	w 8E
Sep 16*	6	2-17	Repsolda	14.6	2.324	76505	6.1	B9	4	9.9	22	17	8.4	5	39	80	-111 14	-88 46	-155 75	108	79	100+	all
Sep 17	10	36	Nanon	15.1	3.072	96449	8.1	F5	7	1.7	18	48	7.0	3	13	56	-136 21	-111 28	-81 33	69	101	99-	all
Sep 17	21	56-61	Sapientia	14.3	2.678	94857	7.8	K0	5	44.5	18	43	6.5	6	18	38	38 1	73 11	111 14	88	76	98-	all
Sep 18*	0	22	Euterpe	11.0	1.689	77160	9.5	B8	5	22.5	21	52	1.7	6	14	21	-17 45	11 57	56 67	93	70	98-	all

Table 2. Occultations of stars by major and minor planets during 1997 (continued)

1997	MINOR PLANET						Motion		STAR			Min. Geocentric			Apparent					Ephem.
Date	No.	Name	km-Diam.	-//	RSOI km	Type	°/day	P.A. °	SAO No	DM/ID No	D	U.T. h	m	Sep. "	S	R.A. h	m	Dec. °	'	Source
Aug 2	323	Brucia	37	0.04	64	S	0.273	232.0		M 749929		12	17.2	2.21S	M	18	40.1	-34	27	Goffin96
Aug 3		VENUS	12220	12.53			1.199	114.0		M 157396		6	24.8	2.26S	M	10	58.9	7	56	DE200
Aug 3		JUPITER	140904	23.95			0.129	251.0		M 238746		11	48.8	25.20S	M	21	22.1	-16	24	DE200
Aug 3	162	Laurentia	105	0.05	423	STU	0.132	103.4		M 264126		17	13.7	2.46N	M	15	20.7	-22	41	Goffin94
Aug 3	306	Unitas	49	0.07	88	S	0.251	231.8		M 722366		21	17.2	1.51N	M	20	58.7	-14	30	Goffin96
Aug 4	965	Angelica	54	0.02	197		0.107	115.3	182669	M 263126		0	59.4	1.34N	M	14	34.3	-22	23	MPC25188
Aug 4	150	Nuwa	157	0.07	802	CX	0.188	108.9		M 228586		1	18.8	0.12S	M	14	17.9	-12	39	MPC25186
Aug 4	2*	Pallas	533	0.28	5398	B	0.221	224.9	104597	M 135945		4	19.8	2.74N	L	19	12.4	18	0	Goffin92
Aug 5	10*	Hygiea	429	0.15	4020	C	0.251	83.2	76809	M 93855		0	33.9	0.44N	L	4	53.1	24	54	MPC24219
Aug 5	113	Amalthea	47	0.03	107	S	0.141	87.1		CR0 1944		6	32.6	3.60N	T	1	53.1	5	50	MPC25033
Aug 6	335*	Roberta	93	0.09	252	FP	0.055	154.2	128727	M 143429		5	45.9	0.04N	T	0	22.8	0	10	MPC25034
Aug 7	234	Barbara	44	0.05	74	S	0.245	158.1		M 2 142		10	7.3	1.06N	O	16	54.2	-5	52	Goffin93
Aug 8	783	Nora	41	0.07	61	---	0.244	212.6		M 721505		1	1.6	8.65S	M	20	7.4	-15	16	MPC19478
Aug 8	46*	Hestia	131	0.09	482	P	0.164	107.8		M 230659		16	49.7	0.12N	M	15	43.7	-16	56	Goffin95
Aug 8	735*	Marghanna	77	0.08	186	C	0.062	356.6	227999	M 322995		18	15.1	1.98W	M	17	28.4	-46	52	Goffin94
Aug 8	301	Bavaria	55	0.05	136		0.213	245.9		M 722052		18	45.1	5.43N	M	20	36.6	-16	52	Goffin94
Aug 8	59	Elpis	173	0.07	880	CP	0.263	113.6	139550	M 196887		22	43.9	0.94S	M	13	47.6	-3	58	MPC24219
Aug 9	618	Elfriede	124	0.07	524	C	0.138	127.6		M 184063		7	35.1	1.94S	M	1	57.7	-9	23	MPC16389
Aug 9	202	Chryseos	85	0.05	340	S	0.200	241.4	164538	M 239128		23	31.5	0.53N	M	21	38.1	-14	55	Goffin94
Aug 10	1	Ceres	933	0.63	10948	G	0.182	229.7		64010097		14	31.0	2.09N	J	23	13.2	-21	10	Goffin92
Aug 10	522	Helga	113	0.06	548	X	0.090	254.7	187092	M 268703		16	30.1	1.30N	M	18	39.0	-22	19	MPC18085
Aug 12	280	Philia	48	0.02	138		0.172	100.3	183078	M 263664		20	47.8	0.11N	M	15	0.2	-23	57	Goffin95
Aug 12	19*	Fortuna	171	0.19	644	G	0.211	248.9	146019	M 2 6231	A	23	26.2	4.06N	O	22	19.6	-7	41	MPC24219
Aug 12	19	Fortuna	171	0.19	644	G	0.211	248.9	146019	M 2 6231	B	23	27.4	4.54N	O	22	19.6	-7	41	MPC24219
Aug 13	702*	Alauda	202	0.08	1195	C	0.235	69.4		28780902		4	15.2	0.91N	J	4	11.2	38	42	MPC24086
Aug 13	293	Brasilia	58	0.03	176	CX	0.093	282.5	210565	M 298159		16	10.2	2.09N	M	18	47.1	-39	34	Goffin96
Aug 14	98	Ianthe	109	0.07	462	CG	0.220	270.6		M 3 1051		8	15.8	1.04S	M	21	9.0	-32	1	MPC24219
Aug 14	423*	Diotima	217	0.15	1224	C	0.196	247.2	213195	M 3 1695		8	38.4	3.96N	T	21	40.7	-30	41	Goffin92
Aug 14	1	Ceres	933	0.63	10948	G	0.193	232.9	191707	M 274679		10	2.8	1.14S	M	23	10.8	-21	37	Goffin92
Aug 15		MARS	6782	6.02			0.617	111.7	158218	M 227981		13	37.1	1.78S	M	13	53.6	-12	18	DE200
Aug 17	8*	Flora	141	0.18	419	S	0.100	144.8		M 182724		21	38.2	6.11S	M	0	50.5	-4	9	MPC24084
Aug 19	683*	Lanzia	116	0.07	516		0.139	257.5	143691	M 2 3178		1	1.6	1.23N	M	19	41.0	-2	19	Goffin87
Aug 19	87*	Sylvia	271	0.16	1875	P	0.121	261.8		M 751167		20	16.8	3.35N	M	20	2.9	-32	32	MPC24085
Aug 19	748	Simeisa	107	0.04	456	P	0.308	91.8	78005	M 95450		23	32.9	0.32N	M	6	7.9	23	44	MPC14759
Aug 20	783	Nora	41	0.07	62	---	0.186	195.3		M 721397		0	31.9	6.74S	M	20	2.7	-17	36	MPC19478
Aug 20	253	Mathilde	61	0.05	128		0.289	88.6		12331090		17	40.0	1.84N	J	3	24.4	15	16	Goffin95
Aug 21	1749	Telamon	115	0.04	820		0.084	256.7		M 143298		18	55.1	1.35N	M	0	15.1	4	0	EMP 1986
Aug 22	420*	Bertholda	146	0.08	797	P	0.178	250.6		CR2 651		7	17.4	1.76N	T	22	21.0	-0	18	MPC16005
Aug 23	536*	Merapi	158	0.09	830	X	0.175	242.3		M 3 3520		20	49.9	3.00N	M	23	15.0	-35	4	MPC17407
Aug 26	350	Ornamenta	123	0.05	468	C	0.383	84.4		L4 365		0	29.6	0.59N	H	7	11.8	22	31	Goffin93
Aug 26	439	Ohio	79	0.05	289	X:	0.197	230.0	126477	M 171151		11	54.8	2.46N	M	21	1.7	7	31	MPC25034
Aug 27	462	Eriphyla	38	0.03	79	S	0.211	243.5		M 723191		2	34.3	5.45N	M	22	45.9	-12	11	MPC17797
Aug 28	8*	Flora	141	0.19	416	S	0.120	194.3	128987	M 182735	A	7	32.6	4.95S	O	0	51.1	-5	12	MPC24084
Aug 28	8	Flora	141	0.19	416	S	0.120	194.3	128987	M 182735	B	7	30.1	4.66S	O	0	51.1	-5	12	MPC24084
Aug 28		VENUS	12220	14.30			1.180	115.6	138982	M 195871		21	31.5	4.27N	M	12	49.5	-5	7	DE200
Aug 28	690	Wratislavia	140	0.06	696	CPF	0.181	93.3		M 230846		22	12.4	0.10S	M	15	51.2	-19	15	Goffin89
Aug 29	702*	Alauda	202	0.09	1196	C	0.187	66.4		28832408		6	8.1	1.86N	J	4	27.6	39	58	MPC24086
Aug 30	75	Eurydike	58	0.06	112	M	0.229	75.1		C2913959		22	25.8	3.55N	U	17	46.4	-29	47	Goffin87
Sep 1	108	Hecuba	67	0.03	233	S	0.100	76.8		M 733353		20	55.6	1.28S	M	17	36.1	-27	54	Goffin96
Sep 2	109	Felicitas	91	0.07	291	GC	0.175	276.0		M 736434		0	17.4	2.97N	M	20	48.2	-26	35	MPC23226
Sep 2	241*	Germania	169	0.07	867	CP	0.291	97.1	78707	M 96490		4	11.4	2.25S	M	6	45.2	23	39	MPC24085
Sep 2	94*	Aurora	212	0.10	1154	CP	0.275	79.4		24051682		23	7.2	0.19N	J	5	42.4	30	18	Goffin94
Sep 3	253	Mathilde	61	0.05	130		0.212	96.7	93528	M 119242		1	55.0	5.32N	M	3	38.3	15	8	Goffin95
Sep 3	29*	Amphitrite	219	0.10	1144	S	0.344	108.2	158462	M 228564		6	15.3	0.63S	M	14	16.9	-18	34	MPC23111
Sep 3	257	Silesia	73	0.03	270	SCTU	0.064	76.5		C2712180		10	58.0	0.16S	U	17	58.2	-27	26	MPC17796
Sep 3	1	Ceres	933	0.64	10946	G	0.212	246.7		M 737272		13	29.9	2.75S	M	22	55.0	-23	42	Goffin92
Sep 3	306	Unitas	49	0.06	89	S	0.117	209.4		M 237747		14	48.2	5.53S	M	20	39.7	-18	46	Goffin96
Sep 4	1171	Rusthawelia	73	0.06	224	P	0.200	242.2	146603	M 2 7355		1	3.4	2.84N	M	23	16.4	-8	10	MPC25036
Sep 5	8	Flora	141	0.20	414	S	0.165	215.1	128967	M 182697		3	39.1	9.03S	M	0	49.1	-6	11	MPC24084
Sep 5	145	Adeona	155	0.07	717	C	0.289	113.2		M 230194		9	41.9	2.81N	M	15	24.2	-17	29	MPC15527
Sep 5	319	Leona	73	0.05	241		0.205	233.9	146204	M 181497		22	54.0	1.58S	M	22	37.1	-1	39	MPC25034
Sep 6	247*	Eukrate	137	0.08	439	CP	0.490	89.0	41851	M 49956		9	4.8	0.64S	M	7	33.6	43	4	MPC24220
Sep 8	564	Dudu	50	0.04	114	CDX:	0.109	228.6		CR0 1615		19	24.8	2.30N	T	2	24.5	-9	39	MPC23111
Sep 9	307	Nike	58	0.03	179	CX	0.069	98.5		C2414300		12	40.5	0.50N	U	18	25.1	-24	49	MPC16996
Sep 9	576	Emanuela	86	0.04	278		0.320	94.9		M 264169		14	41.9	1.67N	M	15	22.6	-25	30	Goffin95
Sep 10		VENUS	12220	15.45			1.167	114.1		M 717345		9	7.6	0.82N	M	13	43.2	-11	19	DE200
Sep 10		VENUS	12220	15.45			1.167	114.1		M 717350		9	34.4	6.78S	M	13	43.3	-11	19	DE200
Sep 10	20*	Massalia	151	0.09	656	S	0.109	90.7		L3 5380		13	14.8	1.72S	H	18	18.3	-22	31	MPC24085
Sep 12	42	Isis	107	0.07	292	S	0.439	108.9		M 732355		9	55.2	0.17S	M	15	47.4	-20	14	MPC22796
Sep 12	20*	Massalia	151	0.09	656	S	0.121	90.3	186655	M 268243		21	57.0	0.72S	M	18	19.5	-22	32	MPC24085
Sep 13	314	Rosalia	61	0.05	160		0.174	215.6		M 7 9119		0	11.2	1.38N	M	21	34.0	-8	12	MPC25034
Sep 16	906*	Repsolda	42	0.02	98		0.109	47.1	76505	M 93337	J	6	9.9	3.13N	M	4	12.7	22	24	MPC16396
Sep 17	559	Nanon	80	0.04	265	C	0.281	94.2	96449	M 123481		10	40.0	0.74N	M	7	4.5	18	44	Goffin89
Sep 17	275	Sapientia	103	0.05	381	X	0.219	93.2	94857	M 121398		22	1.9	0.23S	M	5	47.3	18	44	MPC25033
Sep 18	27*	Euterpe	118	0.10	332	S	0.359	86.4	77160	M 94351		0	24.5	3.80N	M	5	25.4	21	55	Goffin96

Table 1. Occultations of stars by major and minor planets during 1997 (continued)

1997	Universal		P L A N E T			S T A R							Occultation				Possible Path			El	M O O N		
Date	Time		Name	m	d,AU	SAO No	m	Sp	R.A.(1950)		Dec.		dm	dur	df	P	Lo1La1	LoMLaM	LoELaE	Sun	El	%Snl	up
	h	m m		v			v		h	m	°	'		s			° °	° °	° °	°	°		°
Sep 18*	23	25-33	Herculina	11.0	2.494	187475	9.4	A0	18	53.3	-27	34	1.8	26	37	17	-70 44	-46 36	-19 39	106	104	93-	e 59W
Sep 19*	5	26-34	Merapi	13.2	2.371	214169	9.2	G5	22	51.0	-36	15	4.0	14	28	22	-58 36	-90 27	-122 41	143	62	91-	all
Sep 20	3	50	Lutetia	12.7	2.741	79297	10.3	M0	7	17.5	22	33	2.5	4	13	40	-37 32	-14 39	16 46	69	64	84-	all
Sep 21*	2	16-21	Dembowska	10.7	2.314		10.0	F8	4	52.0	26	8	1.2	13	28	23	6-46	24-30	44-14	103	20	75-	all
Sep 23	15	42-61	Drakonia	13.7	1.156	109421	9.6	F8	0	42.0	6	24	4.1	4	25	51	-158-29	130-27	55-35	168	79	49-	e130E
Sep 25*	7	18-24	Philomela	11.6	2.336	93227	8.5	K0	2	57.1	10	18	3.2	25	52	23	-160 81	-147 71	-161 61	136	67	33-	e148W
Sep 25	19	9-29	Joklla	13.0	1.011		9.8	K2	21	3.0	12	54	3.3	8	33	31	115 58	76 26	95-11	133	146	28-	e 80E
Sep 28*	3	37-68	Polyxo	12.7	2.033		9.3		20	14.6	-16	8	3.5	31	59	20	-138 6	-94 -7	-43 -4	118	156	11-	none
Sep 30*	23	20	Egeria	12.3	3.350	183040	5.7	K4	14	54.6	-21	13	6.6	5	9	23	-77 -8	-66 -6	-52 -3	41	48	0-	none
Oct 2	2	33-82	Mathilde	13.6	1.403		9.7		3	48.2	13	20	4.0	16	63	33	38 58	8 -1	0-66	130	135	0+	none
Oct 2*	9	3-27	Frigga	12.2	1.578	146387	8.1	K0	22	52.6	-7	48	4.1	9	32	32	-88 27	-156 9	133 -3	153	145	0+	w133E
Oct 2	9	45-50	Protogeneia	14.0	2.922		11.6		18	36.9	-21	38	2.6	8	20	31	132-11	162 -5	-164 6	90	82	1+	none
Oct 3*	20	16-39	Elektra	10.9	1.622		9.9		22	58.9	-23	16	1.4	24	32	12	71 46	32 -2	-23-48	144	123	4+	w 10W
Oct 3*	22	41-66	Julia	10.3	1.506	39208	8.4	A0	3	53.3	44	43	2.1	26	39	14	18-23	11 30	-61 38	121	139	5+	w 61W
Oct 4*	2	0-34	Chaldaea	13.5	2.024	145293A	9.1	F5	21	16.6	-9	47	4.4	17	49	29	-29 57	-72 -2	-87-72	128	101	5+	w 85W
Oct 4*	2	1-34	Chaldaea	13.5	2.024	145293B	9.1	F5	21	16.6	-9	47	4.4	17	49	29	-29 57	-72 -2	-86-72	128	101	5+	w 84W
Oct 4*	8	3	Thisbe	13.2	3.670		9.8		9	8.6	14	28	3.4	7	12	23	-87 58	-69 60	-42 60	55	85	6+	none
Oct 4	8	14-17	Hecuba	14.2	3.361		10.6		17	56.6	-27	14	3.7	3	16	73	154-22	-177-13	-150 0	79	50	6+	w174E
Oct 5	8	19-22	Nanon	14.9	2.828	96851	8.5	A5	7	21.0	18	26	6.4	4	17	51	-100-19	-74-13	-47-10	82	123	12+	none
Oct 5*	11	58-77	Eugenia	11.8	1.896		10.0		23	4.1	-10	35	2.0	25	31	13	-148 50	149 19	91 -2	151	109	13+	w125E
Oct 6	0	5-20	Valentine	13.0	1.885	110030A	9.8	K0	1	36.4	3	52	3.3	7	24	33	79 48	-5 31	-75 12	167	144	17+	w 53W
Oct 6	0	6-22	Valentine	13.0	1.885	110030B	12.8		1	36.4	3	52	0.9	7	24	33	74 42	-3 25	-73 6	167	144	17+	w 52W
Oct 8	4	59-71	Belisana	14.2	2.154		8.8	A2	6	6.7	24	9	5.4	4	30	84	-75 -6	-39 8	2 17	103	173	36+	none
Oct 8*	11	9-26	Pretoria	13.5	2.637	56031	5.1	A0	2	54.2	31	44	8.4	17	31	22	-79 50	-169 34	136 -5	142	135	39+	w167E
Oct 8	19	10	Nysa	12.1	2.713		10.8		18	36.3	-22	24	1.6	4	17	54	-13 30	4 33	25 40	84	5	42+	all
Oct 10*	11	22	Thisbe	13.2	3.596	98475	8.9	F8	9	15.1	13	52	4.3	8	13	22	-146 62	-119 64	-87 64	60	162	61+	none
Oct 10	12	33-56	Ninina	13.6	2.209	111850	9.1	G5	4	26.9	1	12	4.5	17	45	29	149 61	174 14	136-26	128	125	61+	w151E
Oct 11	10	48	Erigone	15.0	2.569	162282	9.8	F0	19	8.3	-19	46	5.2	5	20	49	109 43	128 44	149 50	89	26	71+	all
Oct 12*	1	7-59	Palatia	11.8	1.107		10.0	F5	3	14.5	2	26	2.0	20	53	20	65 54	1 0	-69-54	148	86	77+	w 8E
Oct 13*	22	20-27	Daphne	13.0	2.956		10.9		6	52.4	5	38	2.2	13	25	24	26 29	66 20	99 -3	96	114	93+	w 81E
Oct 14	10	40-40	VENUS	-3.5	0.840	184295	8.7	K0	16	14.8	-24	1		437	6	1	-171-73	-169-72	-165-69	46	110	96+	all
Oct 14*	21	11-19	Daphne	13.0	2.942		11.0		6	52.8	5	32	2.1	14	26	23	43 30	84 19	116 -5	97	100	98+	w110E
Oct 15*	6	2	Pallas	10.3	3.291		10.2		19	11.0	4	32	0.8	24	16	9	-113 69	-127 44	-106 24	89	81	99+	all
Oct 15	14	50-59	Pariana	13.5	2.065		11.4		0	44.5	-13	16	2.2	7	22	31	165 57	112 42	61 40	157	17	100+	all
Oct 16*	16	6-28	Leto	10.1	1.419		9.5	K2	2	42.5	13	26	1.1	14	26	16	-161 21	122 27	45 15	160	13	100-	all
Oct 17	11	39	Deiphobus	16.4	5.585	207560	9.1	K0	16	16.5	-32	47	7.3	4	13	62	108-37	121-29	136-19	46	150	97-	e117E
Oct 18	19	48-66	JUPITER	-2.3	4.663		9.7		20	57.4	-18	13		14246	86	2	4-59	41-42	73-25	107	109	90-	e 24E
Oct 18	23	31-35	Pallas	10.4	3.340		11.8		19	13.6	3	59	0.3	23	16	9	-76 3	-50-14	-17-27	86	130	89-	e 42W
Oct 19*	2	47	Eukrate	12.6	2.148	42775	7.7	K0	9	12.7	42	38	4.9	6	12	23	-21 12	5 33	45 48	79	67	88-	all
Oct 19*	12	21-27	Polyxo	13.1	2.304		9.9		20	26.5	-16	15	3.2	11	23	23	84 30	115 34	149 43	99	126	85-	e115E
Oct 20	16	0- 9	Bathilde	13.3	2.195	79096	8.0	F8	7	5.4	20	57	5.3	6	25	44	102 41	152 47	-156 36	101	19	75-	all
Oct 22*	18	21-80	Hygiea	11.2	2.845		11.2		5	36.8	25	50	0.8	173	134	10	166 29	99 29	41 10	124	30	54-	e 59E
Oct 23	3	0-14	Letaba	13.8	2.060	90645	8.9	G0	22	34.5	21	29	4.9	6	21	39	-11 64	-102 22	-87-49	133	127	50-	e 93W
Oct 25	21	15-31	Vesta	6.5	1.521		9.7		1	34.6	-2	29	0.1	68	22	3	111-16	47-28	-31-43	164	129	25-	e 74E
Oct 26	4	26	Ino	13.9	3.885		10.4	K0	11	40.1	5	19	3.6	4	10	35	2 69	12 68	26 68	39	19	23-	all
Oct 26*	19	36	Kalliope	12.2	3.430	99609	8.9	F8	11	24.3	16	15	3.3	5	10	27	114 30	130 33	151 34	48	12	18-	all
Oct 27	2	58-61	Huberta	15.7	4.001	98692	8.9	A5	9	36.4	10	26	6.8	4	17	57	-20 33	7 34	39 30	70	23	16-	e 6W
Oct 27	3	45	Edith	15.3	3.201	162794	8.8	K2	19	32.4	-19	54	6.5	5	17	49	-147 27	-128 34	-105 43	79	125	16-	none
Oct 27*	23	3	VENUS	-3.7	0.737	185305	7.8	A0	17	18.3	-26	27		522	7	1	-79 26	-72 28	-62 33	47	85	11-	none
Oct 29	16	31-50	Parthenope	9.5	1.389		12.1		2	30.0	6	26	0.1	15	22	12	-169 33	107 20	31 -1	172	159	3-	e176W
Oct 30*	1	58	Davida	11.9	3.173		11.2		10	51.7	15	42	1.2	10	11	14	9 39	30 43	54 45	58	43	2-	e 49E
Oct 30*	8	37-56	Alauda	12.5	2.439		10.9		4	35.1	42	54	1.8	23	35	18	-48 25	-121 36	179 4	138	127	1-	e 50W
Oct 30*	21	45	Nemausa	12.5	2.547	162691	9.4	F5	19	27.3	-15	25	3.2	5	12	27	-60 39	-40 41	-17 46	74	80	0-	none
Oct 31	10	31	VENUS	-3.7	0.711	185557	9.5	F8	17	34.5	-26	46		550	7	1	111 22	117 24	126 28	47	47	0+	none
Oct 31*	16	59-74	Daphne	12.7	2.686		10.1		6	57.8	3	54	2.7	22	39	21	90 19	118-10	99-51	111	116	0+	none
Nov 1*	22	26-44	Daphne	12.7	2.669		9.2		6	58.0	3	47	3.6	23	40	21	23 75	78 32	90-19	112	130	2+	none
Nov 2	7	18-24	Delia	16.0	2.813	98033	7.6	F0	8	38.1	16	41	8.4	4	23	76	-109 24	-69 28	-27 20	92	114	4+	none
Nov 2*	13	6	Pallas	10.5	3.530	124651	7.4	K2	19	25.3	2	4	3.1	20	14	10	79-13	102-22	132-28	75	51	5+	w102E
Nov 2	15	16-21	Bruchsalia	14.6	3.011	80937	9.4	G0	9	35.3	23	11	5.3	5	19	50	142 29	176 42	-138 49	81	106	5+	none
Nov 3	4	29	Fidelio	14.9	2.497	98737	8.5	G5	9	41.3	17	54	6.4	3	14	49	-58 46	-20 51	23 46	79	110	8+	none
Nov 4*	10	38-48	Daphne	12.7	2.633		11.9		6	58.2	3	32	1.2	24	42	21	-62 68	-78 45	-82 16	115	158	16+	none
Nov 7	8	4-12	Hedda	14.3	1.947		10.5	K2	8	35.9	23	4	3.9	5	21	47	-125 25	-85 37	-35 39	99	172	44+	none
Nov 7*	9	20-28	Diomedes	15.2	4.031	38564A	7.2	F5	3	2.4	43	31	8.0	11	25	34	-31 65	156 74	120 34	152	105	44+	w154E
Nov 7	9	19-27	Diomedes	15.2	4.031	38564B	8.6	A3	3	2.4	43	31	6.6	11	25	34	-31 68	152 74	121 37	152	105	44+	w150E
Nov 7	20	35-53	Mathilde	13.0	1.306		10.1	G5	3	26.8	9	31	3.0	6	23	31	126 -6	63-20	-8-49	169	98	50+	w 54E
Nov 9*	11	2-18	Hygiea	10.9	2.653		10.3		5	31.0	25	46	1.1	46	34	9	-72 50	-160 53	134 30	143	107	67+	w157W
Nov 9	21	56	Iclea	15.0	3.433	162764	8.3	K0	19	31.0	-15	56	6.7	3	12	52	-67 38	-47 39	-25 44	65	52	72+	all
Nov 10	16	27	MARS	1.3	1.960	186240	7.8	B0	18	1.9	-24	41		152	6	1	86-64	88-62	93-59	43	84	80+	all
Nov 11	16	47-52	JUPITER	-2.1	5.029		9.8		21	4.3	-17	42		4314	27	2	Eur.,e.Africa,sw Asia			85	56	89+	-2
Nov 12	21	59-71	Elsa	12.8	1.539	97837	9.1	F0	8	25.2	18	46	3.8	4	24	50	20 15	63 23	111 19	106	97	96+	w 96E
Nov 13*	2	37-42	JUPITER	-2.1	5.051	164156	6.6	A0	21	4.9	-17	39		4148	26	2	N.&S.America;not e.Can.			83	77	97+	all
Nov 15*	19	34-42	Elektra	11.7	2.031	191659	9.6	F8	23	4.3	-24	25	2.3	19	29	16	20-54	53-34	82-15	104	90	98-	all
Nov 16	0	38-44	Garumna	15.7	2.617		12.0		22	27.8	-8	55	3.8	4	37	119	-105 40	-83 51	-53 64	102	97	97-	e100W
Nov 16	3	57-78	Carmen	13.6	2.012	129270	9.1	K	1	21.3	-3	14	4.5	8	38	48	-13-20	-68-28	-133-37	143	56	97-	e121W
Nov 16	23	46-61	Mabella	13.9	1.928	94052	8.5	F0	4	36.3	12	26	5.4	4	20	47	87 15	14 4	-59-24	162	17	92-	e 53W

Table 2. Occultations of stars by major and minor planets during 1997 (continued)

1997 Date	MINOR PLANET No.	Name	km-Diam.	-//	RSOI km	Type	Motion °/day	P.A. °	STAR SAO No	DM/ID No	D	Min. U.T. h	m	Geocentric Sep. "	S	Apparent R.A. h	m	Dec. °	'	Ephem. Source
Sep 18	532	*Herculina	217	0.12	1210	S	0.111	102.6	187475	M 269105		23	28.0	3.22N	M	18	56.3	-27	30	Goffin88
Sep 19	536	*Merapi	158	0.09	827	X	0.154	276.1	214169	M 3 3137		5	30.3	3.33N	T	22	53.6	-36	0	MPC17407
Sep 20	21	Lutetia	99	0.05	324	M	0.314	95.5	79297	M 97385		3	53.2	1.32N	M	7	20.3	22	28	Goffin96
Sep 21	349	*Dembowska	143	0.09	599	R	0.153	62.4		M 93885		2	23.3	2.39S	M	4	55.0	26	13	Goffin92
Sep 23	620	Drakonia	33	0.04	52	E	0.246	267.1	109421	M 143831		15	51.4	4.31S	M	0	44.5	6	40	MPC14757
Sep 25	196	*Philomela	146	0.09	713	S	0.082	252.1	93227	M 118731		7	20.4	3.65N	M	2	59.7	10	30	MPC15528
Sep 25	726	Joklla	47	0.06	77		0.197	158.1		M 139583		19	19.0	6.88N	M	21	5.2	13	5	MPC14758
Sep 28	308	*Polyxo	148	0.10	615	T	0.078	106.6		M 237200		3	46.7	1.06N	M	20	17.3	-15	59	Goffin94
Sep 30	13	*Egeria	215	0.09	1084	G	0.396	111.9	183040	FK5 1391	F	23	17.6	0.95N	5	14	57.3	-21	24	Goffin96
Oct 2	253	Mathilde	61	0.06	134		0.088	187.8		06640977		2	54.5	1.01E	J	3	50.9	13	29	Goffin95
Oct 2	77	*Frigga	71	0.06	193	MU	0.165	254.2	146387	M 2 6926		9	16.2	1.29N	M	22	55.1	-7	33	MPC21760
Oct 2	147	Protogeneia	137	0.06	638	C	0.186	87.0		L3 8973		9	44.0	0.48N	H	18	39.7	-21	35	MPC16685
Oct 3	130	*Elektra	189	0.16	837	G	0.158	214.7		M 737333		20	29.6	0.60N	M	23	1.5	-23	1	Goffin96
Oct 3	89	*Julia	159	0.15	567	S	0.136	0.8	39208	M 46655		22	53.7	3.91W	M	3	56.6	44	51	MPC24085
Oct 4	313	*Chaldaea	101	0.07	360	C	0.094	192.9	145293	M 2 5063	A	2	17.8	0.94E	O	21	19.1	-9	35	MPC24549
Oct 4	313	*Chaldaea	101	0.07	360	C	0.094	192.9	145293	M 2 5063	B	2	18.3	0.97E	O	21	19.1	-9	35	MPC24549
Oct 4	88	*Thisbe	232	0.09	1460	CF	0.281	110.7		08180534		8	5.8	1.41N	8	9	11.2	14	17	MPC22572
Oct 4	108	Hecuba	67	0.03	234	S	0.217	84.5		C2712214		8	12.3	0.04N	U	17	59.6	-27	14	Goffin96
Oct 5	559	Nanon	80	0.04	265	C	0.228	95.2	96851	M 123954	K	8	23.4	1.52S	M	7	23.7	18	21	Goffin89
Oct 5	45	*Eugenia	214	0.16	1135	FC	0.152	241.2		M 723316		12	8.8	2.09N	M	23	6.6	-10	20	MPC25033
Oct 6	447	Valentine	82	0.06	274	TD	0.201	251.2	110030	M 144836	A	0	12.2	2.31N	O	1	38.9	4	7	MPC24550
Oct 6	447	Valentine	82	0.06	274	TD	0.201	251.2	110030	M 144836	B	0	13.9	1.85N	O	1	38.8	4	7	MPC24550
Oct 8	178	Belisana	37	0.02	74	S	0.149	85.9		M 95521		5	10.0	0.51S	M	6	9.6	24	9	MPC19472
Oct 8	790	*Pretoria	176	0.09	1045	P	0.130	246.2	56031	F5E 2205		11	16.3	0.76N	5	2	57.2	31	55	Goffin94
Oct 8	44	Nysa	73	0.04	224	E	0.234	90.2		C2213181		19	9.2	2.55N	U	18	39.2	-22	22	MPC24548
Oct 10	88	*Thisbe	232	0.09	1461	CF	0.269	111.6	98475	M 126296		11	24.8	1.56N	L	9	17.7	13	40	Goffin96
Oct 10	357	Ninina	110	0.07	436	CX	0.097	197.9	111850	M 147597		12	44.2	2.74N	M	4	29.4	1	19	MPC19474
Oct 11	163	Erigone	76	0.04	233	C	0.207	91.3	162282	M 235612		10	47.6	3.04N	M	19	11.1	-19	41	Goffin90
Oct 12	415	*Palatia	80	0.10	186	DP	0.118	211.9		M 146409		1	32.4	0.19N	M	3	17.0	2	36	MPC14754
Oct 13	41	*Daphne	182	0.08	1018	C	0.152	129.5		01570277		22	27.1	0.51S	J	6	54.9	5	34	MPC22385
Oct 14		VENUS	12220	20.06			1.101	102.7	184295	M 265368		10	38.0	9.10S	M	16	17.6	-24	8	DE200
Oct 14	41	*Daphne	182	0.09	1017	C	0.149	130.6		01570783		21	18.7	0.55S	J	6	55.3	5	29	MPC22385
Oct 15	2	*Pallas	533	0.22	5418	B	0.225	132.7		04712220		6	2.3	2.41N	J	19	13.4	4	38	Goffin92
Oct 15	347	Pariana	96	0.06	364	M	0.211	258.7		CR0 516		14	54.4	3.52N	T	0	47.0	-13	0	Goffin92
Oct 16	68	*Leto	127	0.12	439	S	0.208	269.4		M 118509		16	16.4	1.52N	M	2	45.1	13	38	MPC24548
Oct 17	1867	Deiphobus	131	0.03	954	D	0.209	84.8	207560	M 294927		11	36.5	0.61S	M	16	19.6	-32	54	Goffin88
Oct 18		JUPITER	140904	20.83		S	0.035	71.2		M 722396		19	50.6	1.26S	M	21	0.1	-18	2	DE200
Oct 18	2	Pallas	533	0.22	5418	B	0.230	129.1		04721023		23	30.3	0.42N	J	19	16.0	4	4	Goffin92
Oct 19	247	*Eukrate	137	0.09	452	CP	0.373	93.2	42775	M 51129		2	50.5	0.49N	M	9	15.8	42	26	MPC24220
Oct 19	308	*Polyxo	148	0.09	616	T	0.188	86.1		M 721904		12	21.6	2.78N	M	20	29.2	-16	5	Goffin94
Oct 20	441	Bathilde	73	0.05	208	M	0.179	112.9	79096	M 97079		16	8.9	1.19N	L	7	8.2	20	52	MPC24549
Oct 22	10	*Hygiea	429	0.21	4005	C	0.029	269.6		18652411		18	38.5	0.34N	J	5	39.8	25	51	MPC24219
Oct 23	1264	Letaba	77	0.05	246		0.213	177.9	90645	M 114635		5	6.8	1.79E	M	22	36.8	21	44	MPC14762
Oct 25	4	Vesta	759	0.69	6714	V	0.242	256.1		46851451		21	23.3	2.89S	J	1	37.1	-2	14	Goffin95
Oct 26	173	Ino	159	0.06	820	C	0.319	106.5		M 158132		4	27.7	1.77N	M	11	42.5	5	3	Goffin96
Oct 26	22	*Kalliope	187	0.08	945	M	0.355	107.4	99609	M 128256		19	39.3	0.51N	M	11	26.8	15	59	Goffin96
Oct 27	260	Huberta	101	0.03	494	CX:	0.194	109.7	98692	M 126662		3	2.8	0.49N	M	9	38.9	10	13	MPC16554
Oct 27	517	Edith	95	0.04	377	X	0.217	80.8	162794	M 236211		3	43.4	1.91N	M	19	35.2	-19	47	Goffin95
Oct 27		VENUS	12220	22.85			1.051	95.7	185305	M 266736		23	1.1	8.92N	M	17	21.3	-26	30	DE200
Oct 29	11	Parthenope	162	0.16	631	S	0.250	252.3		CR0 2610		16	40.3	1.56N	T	2	32.5	6	38	MPC24085
Oct 30	511	*Davida	337	0.15	2215	C	0.346	100.3		14290270		2	0.3	1.25N	J	10	54.2	15	27	Goffin89
Oct 30	702	*Alauda	202	0.11	1201	C	0.121	269.7		28881043		8	44.8	0.30S	J	4	38.5	43	0	MPC24086
Oct 30	51	*Nemausa	137	0.07	511	CU	0.342	91.7	162691	M 236078	A	21	44.8	2.81N	O	19	30.0	-15	19	Goffin94
Oct 31		VENUS	12220	23.70			1.034	93.7	185557	M 267079		10	28.3	8.38N	M	17	37.4	-26	48	DE200
Oct 31	41	*Daphne	182	0.09	1007	C	0.102	161.9		017 2432		17	6.9	2.59S	J	7	0.4	3	50	MPC22385
Nov 1	41	*Daphne	182	0.09	1006	C	0.100	165.3		01662183		22	38.8	0.08N	J	7	0.5	3	43	MPC22385
Nov 2	395	Delia	54	0.03	154	C	0.170	111.2	98033	M 125588		7	25.0	0.10N	M	8	40.8	16	30	Goffin92
Nov 2	2	*Pallas	533	0.21	5416	B	0.252	117.3	124651	M 167901		13	4.2	0.10S	L	19	27.7	2	10	Goffin92
Nov 2	455	Bruchsalia	87	0.04	316	CP	0.202	90.2	80937	M 99739		15	21.5	1.32N	L	9	38.0	22	58	Goffin93
Nov 3	524	Fidelio	74	0.04	205	XC	0.294	111.7	98737	M 126743		4	33.0	1.40N	L	9	43.9	17	41	Goffin96
Nov 4	41	*Daphne	182	0.10	1004	C	0.096	173.0		01662479		10	50.2	1.08E	J	7	0.7	3	28	MPC22385
Nov 7	207	Hedda	60	0.04	139	C	0.220	95.8		M 98898		8	12.0	1.33N	M	8	38.7	22	54	Goffin95
Nov 7	1437	*Diomedes	171	0.06	1420	DP	0.131	257.6	38564	M 45832	A	9	23.3	1.40N	O	3	5.7	43	42	Goffin88
Nov 7	1437	Diomedes	171	0.06	1420	DP	0.131	257.6	38564	M 45832	B	9	22.3	1.44N	O	3	5.7	43	42	Goffin88
Nov 7	253	Mathilde	61	0.06	140		0.251	246.8		M 146608		20	43.8	3.49S	M	3	29.4	9	41	Goffin95
Nov 9	10	*Hygiea	429	0.22	3999	C	0.117	266.1		18520469		11	8.3	1.71N	9	5	34.0	25	47	MPC24219
Nov 9	286	Iclea	96	0.04	382	CX	0.284	94.9	162764	M 236172		21	55.1	2.10N	M	19	33.7	-15	50	MPC16383
Nov 10		MARS	6782	4.77			0.753	89.7	186240	M 267816		16	26.3	3.97S	M	18	4.8	-24	41	DE200
Nov 11		JUPITER	140904	19.31			0.107	72.4		M 722517		16	45.5	4.59N	M	21	7.0	-17	30	DE200
Nov 12	182	Elsa	45	0.04	79	S	0.216	100.3	97837	M 125302		22	9.6	0.30N	M	8	27.9	18	37	MPC19472
Nov 13	5	JUPITER	140904	19.23			0.111	72.4	164156	M 238409		2	35.9	15.71N	M	21	7.6	-17	28	DE200
Nov 15	130	*Elektra	189	0.13	825	G	0.160	68.0	191659	M 274606		19	33.6	2.45S	M	23	6.9	-24	10	Goffin96
Nov 16	180	Garumna	32	0.02	70	S	0.108	69.1		CR1 5280		0	37.1	2.66N	T	22	30.3	-8	40	MPC19472
Nov 16	558	Carmen	61	0.04	176	M	0.120	260.6	129270	M 183388		4	9.7	2.15S	M	1	23.7	-2	59	Goffin94
Nov 16	510	Mabella	59	0.04	168	PD	0.232	249.7	94052	M 120107		23	53.6	0.59S	M	4	39.0	12	31	MPC16387

Table 1. Occultations of stars by major and minor planets during 1997 (concluded)

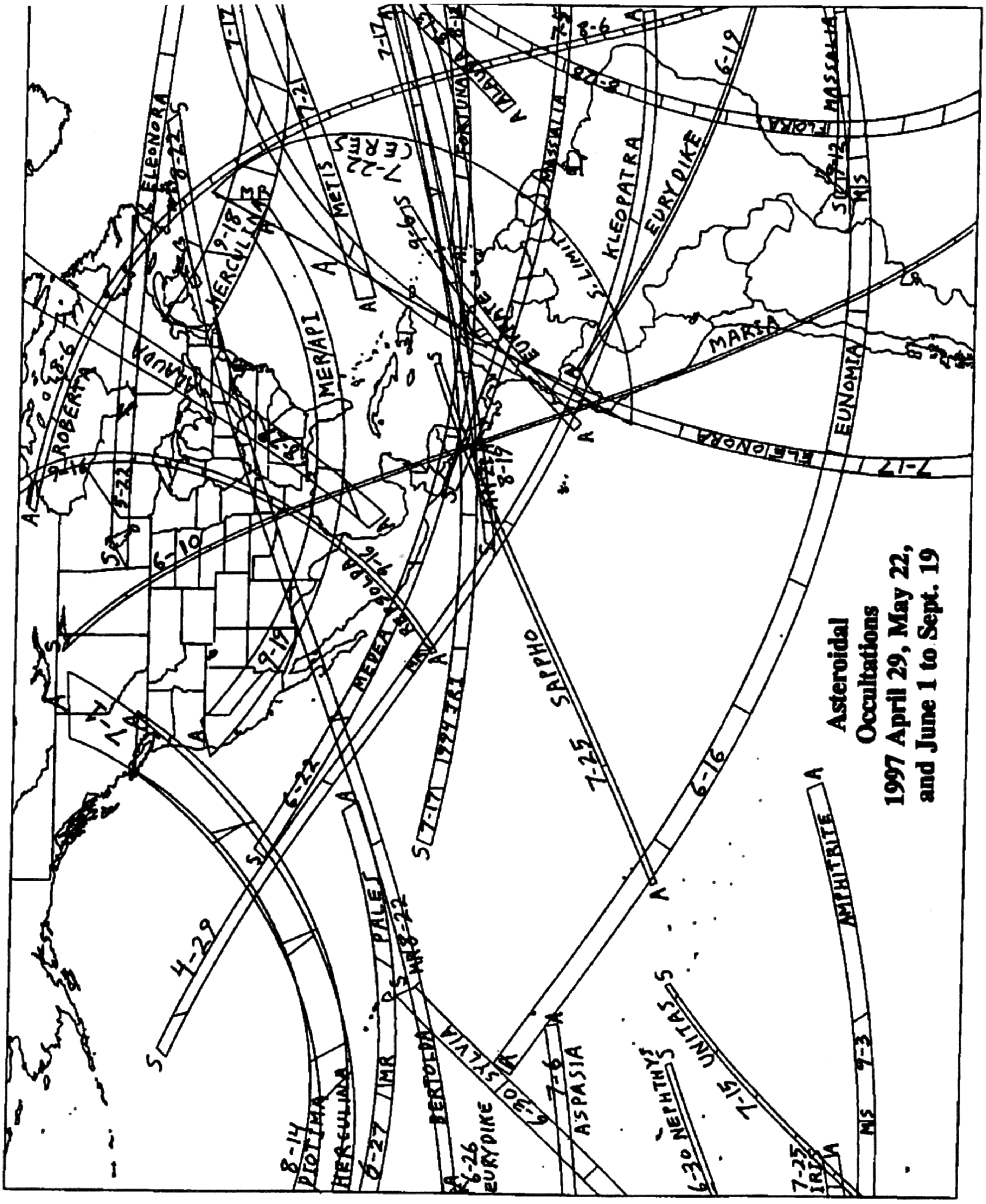
1997 Date	Universal Time h	m m	PLANET Name	m v	d,AU	STAR SAO No	m v	Sp	R.A.(1950) h	m	Dec. °	'	Occultation dm	dur s	df	P	Possible Path Lo1 °	La1 °	LoM °	LaM °	LoE °	LaE °	El Sun °	MOON El °	%Snl	up °
Nov 17	7	43-80	Lutetia	12.1	2.067	79984	9.2	F2	8	6.5	21	35	3.0	36	104	30	(Alaska,Yukon,ArcticO)?s						115	30	90-	all
Nov 20*	8	5-37	Galatea	12.6	1.675		10.0	K	6	49.8	17	20	2.8	27	56	20	-43	0	-93	-12	-147	-36	135	27	66-	e136W
Nov 21	18	7	MARS	1.3	2.000	187145	7.9	F0	18	38.8	-24	24		147	6	1	-13	39	-9	41	-4	44	40	133	52-	none
Nov 21*	19	7-27	Flora	9.2	1.162		9.7		0	11.3	-9	2	0.5	22	33	12	32	-55	54	-17	87	9	120	146	52-	e 67E
Nov 22	11	17	Nemausa	12.7	2.826		11.5	G	20	1.6	-15	13	1.5	4	10	30	102	17	118	21	137	26	60	144	46-	none
Nov 22	20	34	Comacina	14.4	3.229		9.2	K0	21	40.8	-12	29	5.2	7	18	33	-12	-39	13	-33	39	-27	83	164	42-	none
Nov 23*	2	39-58	Daphne	12.3	2.390		10.9		6	55.2	1	54	1.7	21	35	19	53	75	-25	31	-81	0	132	60	40-	e 33W
Nov 24	13	1	Eunike	13.2	3.424		9.6		18	24.0	-10	7	3.6	4	9	30	64	38	74	38	85	40	37	97	27-	none
Nov 24	13	18-40	Hertha	12.3	1.764		9.8	G0	6	39.8	26	28	2.6	10	32	31	-114	19	176	35	103	18	143	80	27-	e175W
Nov 24	16	22	JUPITER	-2.0	5.227		9.9	G0	21	10.8	-17	13		3175	20	2	Eur.,e.Africa,sw Asia						73	134	26-	none
Nov 24*	16	21-36	Daphne	12.3	2.372		11.6		6	54.6	1	46	1.2	20	34	19	-169	-1	149	-28	87	-55	133	78	26-	e140E
Nov 25	17	57-64	Echo	12.5	1.957		9.7		22	57.5	-6	22	2.9	6	25	47	-5	33	27	43	71	54	100	150	18-	none
Nov 26*	0	28-35	Fides	10.1	1.256		10.4	G0	2	25.8	18	21	0.6	17	34	16	(Yukon, Alberta)?s						157	156	16-	none
Nov 27	15	38	Felicitas	13.8	2.433	164357	9.1	F2	21	20.6	-18	30	4.7	4	12	39	eastern Europe?s						72	101	6-	none
Nov 28	12	15	Chaldaea	14.3	2.704	164672	9.5	K2	21	46.3	-11	14	4.8	5	16	39	85	16	113	22	145	30	79	98	3-	none
Nov 29	7	44-46	VENUS	-4.1	0.494	188326	6.0	A3	19	33.0	-24	50		1065	12	1	166	-21	178	-14	-166	-6	45	54	1-	none
Nov 29	11	0	NEPTUNE	8.0	30.762	188797	8.9	K0	19	56.8	-20	21		2022	44	1	e.Asia,Indon.,Austral.						51	58	1-	none
Nov 29*	18	49-71	Thalia	9.5	1.202	77068	9.8	G0	5	13.3	25	21	0.6	12	24	16	155	2	86	39	-11	36	167	162	0-	none
Dec 1	3	51	Huenna	14.1	2.642		9.4	K5	21	33.0	-14	17	4.7	3	11	40	-153	28	-133	36	-106	47	73	60	1+	w146W
Dec 2	0	26-44	Neoptolemus	16.5	4.278		9.4		1	43.5	-7	55	7.1	8	38	73	28	-4	-37	14	-116	52	129	109	4+	w 98W
Dec 2	5	11-38	Catriona	13.1	1.414	26053	8.7	A0	6	53.0	50	4	4.4	6	35	51	-28	-29	-69	27	-150	18	140	148	5+	none
Dec 2*	9	51-74	Eurynome	9.8	1.017	93928	7.5	G0	4	23.3	15	25	2.4	9	27	22	-75	-14	-141	-16	148	-44	173	149	6+	w160E
Dec 3	7	22-31	Dike	14.5	2.358		10.8	G0	10	28.2	26	57	3.7	6	23	43	AK-low;(nwNAmer,Svalb.)?s						101	137	12+	none
Dec 3*	22	58	Herculina	11.7	3.603	189113	9.0	K2	20	15.1	-26	23	2.8	6	11	24	-81	31	-74	35	-65	40	49	10	16+	all
Dec 4*	12	7-25	Artemis	13.1	1.929	134036	6.0	B9	6	58.0	-8	20	7.1	11	24	23	-81	47	-158	4	120	-21	135	147	21+	w145E
Dec 4*	14	12-32	Galatea	12.4	1.601		9.9		6	41.7	17	0	2.6	14	28	19	-118	36	159	40	84	22	151	152	22+	w100E
Dec 5*	3	40-58	Aurora	11.9	1.988		11.6		6	7.6	35	8	0.9	19	25	14	24	6	-46	34	-126	14	158	134	27+	w 92W
Dec 7*	8	31-49	Dembowska	9.7	1.790	76598	8.6	A3	4	22.1	29	41	1.4	12	22	18	-60	-2	-135	20	145	-2	170	83	51+	w130W
Dec 8*	2	23	Berbericia	12.5	2.445		9.8		22	59.8	-26	14	2.7	7	13	19	-127	23	-118	35	-106	51	81	27	60+	all
Dec 8	20	14-26	Hygiea	10.3	2.499		11.9		5	9.0	25	13	0.2	28	20	8	149	40	48	54	-34	24	177	71	68+	w 76E
Dec 9	19	10-24	Alkeste	12.3	1.904		10.5	G	7	2.3	18	17	2.0	8	27	35	137	-27	85	-22	32	-32	152	84	78+	w101E
Dec 10	11	12-20	VENUS	-4.2	0.416		9.8		20	4.0	-22	28		1739	18	1	Australia,Indonesia,PI						41	92	84+	all
Dec 10*	17	26-35	Daphne	12.0	2.218		11.0		6	45.3	0	50	1.3	15	23	18	159	-30	114	-40	56	-49	148	68	86+	w135E
Dec 12	13	21-28	Lucina	13.6	2.580		9.6		0	9.6	-13	34	4.0	9	22	27	83	-11	104	18	139	46	97	63	97+	all
Dec 12*	19	6-17	Hektor	14.9	4.473	55368	8.7	F5	2	11.1	34	23	6.2	20	35	28	170	61	9	74	-27	32	138	32	98+	all
Dec 13	22	42-51	Thalia	9.2	1.166		10.7		4	57.5	26	34	0.2	12	22	15	114	46	91	72	-140	75	173	9	100+	all
Dec 14	10	3	Hilda	14.3	4.132		9.5		12	24.6	-9	8	4.8	7	17	34	-120	27	-94	18	-68	5	73	103	100-	all
Dec 15	1	34	Ceres	9.1	3.061		11.8		22	51.4	-18	18	0.1	39	14	5	(se Alaska, Yukon)?s						75	116	99-	none
Dec 15	13	26-34	Ostanina	15.8	2.942	116054	6.3	M4	7	49.5	3	24	9.5	4	28	95	-143	-41	169	-46	115	-51	141	22	97-	all
Dec 17	1	6-23	Brunhild	12.4	1.489		9.0		7	39.8	26	6	3.4	7	33	44	97	59	-16	73	-96	48	152	11	90-	e 93W
Dec 19	0	31-43	Hygiea	10.4	2.506		11.2		5	0.2	24	53	0.4	29	21	8	77	42	-21	56	-102	29	170	69	76-	e 54W
Dec 20	18	58-62	VENUS	-4.3	0.352		9.0	G0	20	19.7	-20	2		3819	37	1	-3	-5	0	0	7	4	34	137	61-	none
Dec 21	0	35-46	Arsinok	13.4	2.005		9.9	K2	4	25.0	15	3	3.5	7	20	29	33	-36	-26	-18	-85	-13	158	102	58-	e 17W
Dec 21	7	11-27	Belisana	12.6	1.586		13.3		5	38.6	25	9	0.5	3	21	62	-27	20	-108	41	162	22	176	87	56-	e119W
Dec 22	9	15-18	Kalypso	13.7	2.370		11.4	G	12	48.1	-2	48	2.4	5	13	29	-115	0	-90	-3	-65	-10	78	7	46-	all
Dec 22	23	49-59	Santa	16.5	2.381	91945	7.4	K0	0	29.1	12	38	9.1	3	25	89	-90	23	-44	25	2	18	101	169	40-	none
Dec 25*	1	14-65	VENUS	-4.3	0.329		9.5	G0	20	21.6	-19	2		5401	50	1	-73	-40	-114	17	-109	23	31	86	22-	none
Dec 25	18	19-38	Brunhild	12.1	1.452		10.9	K5	7	32.4	26	5	1.5	5	26	43	179	36	93	51	10	28	162	115	16-	e139E
Dec 26	9	59-68	Kolga	13.2	1.821	112393	9.5	K0	5	2.0	5	39	3.7	5	25	52	-86	50	-143	63	114	73	155	156	12-	none
Dec 27*	6	39-54	Nipponia	13.1	1.455	111845	5.5	B3	4	25.9	1	16	7.5	4	26	57	-44	12	-90	37	-130	85	144	165	7-	none
Dec 27*	15	28-43	Germania	12.2	2.203		9.9	A	7	14.4	20	30	2.4	12	22	19	-143	16	137	31	54	14	168	142	5-	e161W

Table 3. Stars with Significant Angular Diameters

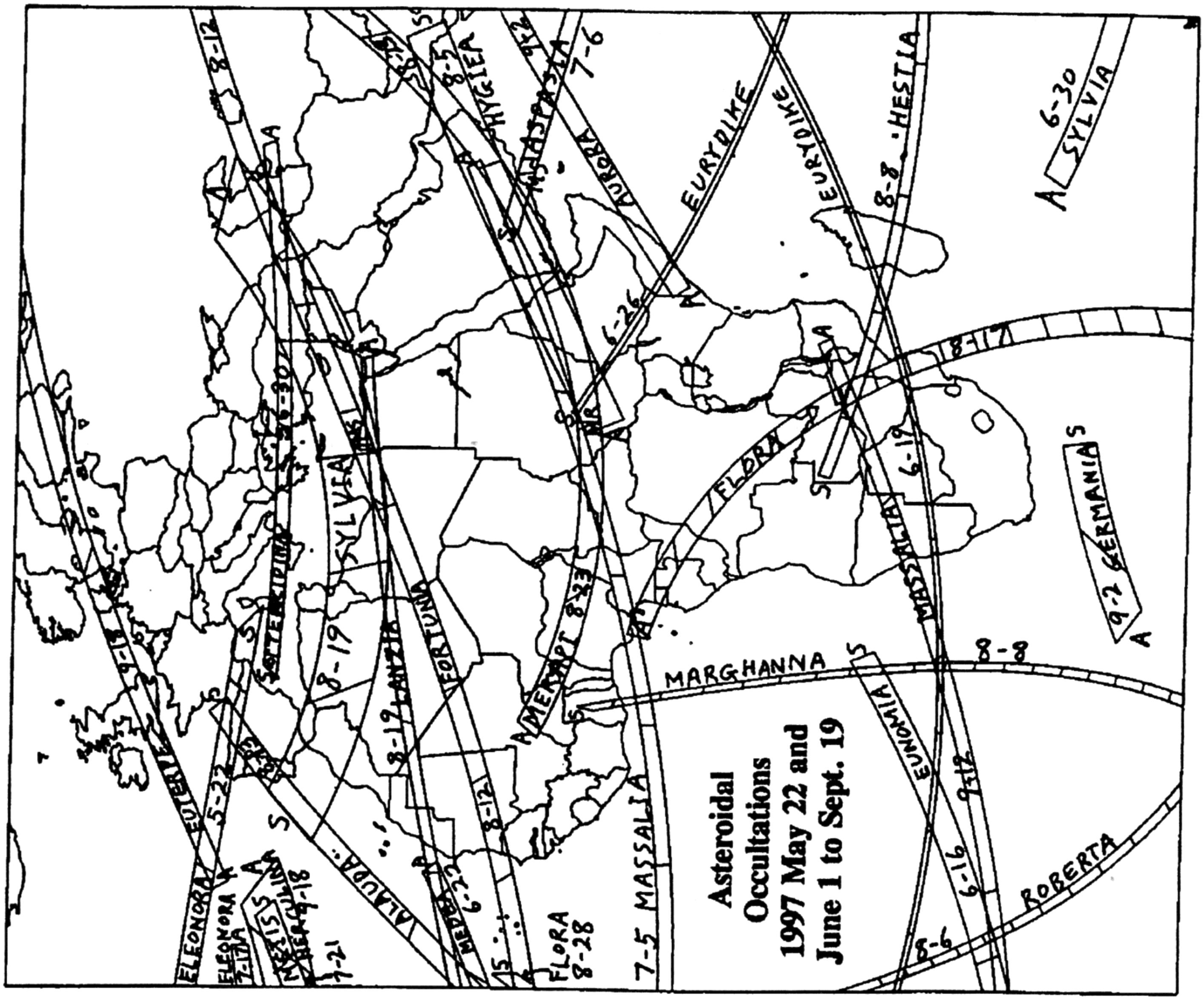
1997 Date	PLANET No.	Name	STAR SAO/DM/ID	STELLAR DIAMETER m//	m	time	df
Jun 2	2	Pallas	162 41421	0.39	798	78	2.4
Jun 10	170	Maria	164249	0.96	1394	356	5.0
Aug 6	335	Roberta	128727	0.14	141	60	0.6
Sep 3	29	Amphitrite	158462	0.91	2079	64	5.9
Sep 16	906	Repsolda	76505J	0.25	426	55	1.4
Sep 30	13	Egeria	183040F	1.41	3434	86	9.5
Oct 2	253	Mathilde	066 40977	0.19	194	52	0.8
Oct 22	10	Hygiea	186 52411	0.09	195	79	0.6
Nov 1	41	Daphne	016 62183	0.24	464	58	1.4
Nov 2	2	Pallas	124651	0.95	2421	90	6.5
Nov 17	21	Lutetia	79984	0.10	154	57	0.5
Nov 20	74	Galatea	L1 1884	0.22	264	58	1.0
Dec 15	1369	Ostanina	116054	2.44	5198	437	15.4

Table 2. Occultations of stars by major and minor planets during 1997 (concluded)

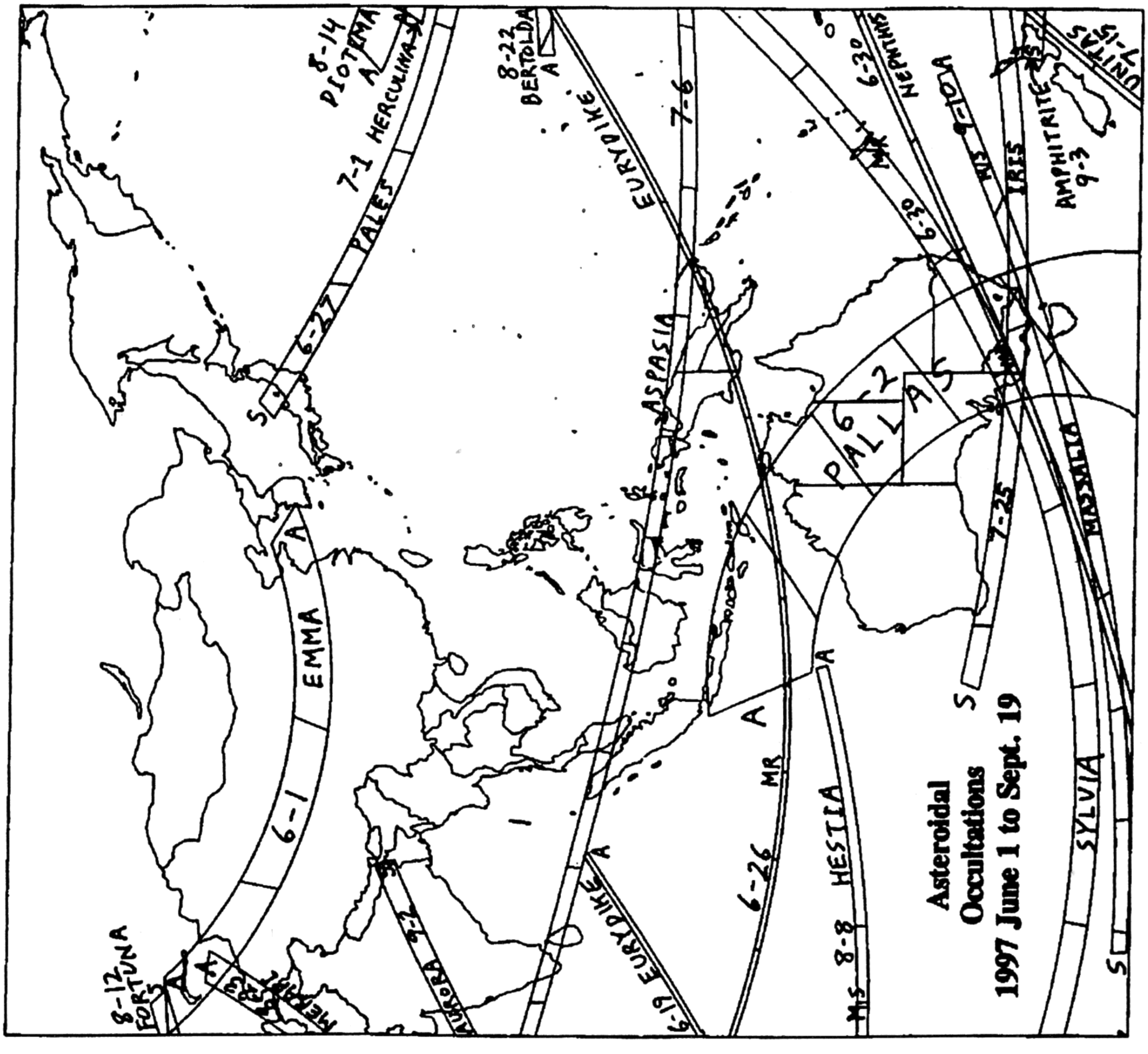
1997	MINOR PLANET						Motion		STAR			Min. Geocentric			Apparent					Ephem.
Date	No.	Name	km-Diam.	-//	RSOI km	Type	°/day	P.A. °	SAO No	DM/ID No	D	U.T. h	m	Sep. "	S	R.A. h	m	Dec. °	'	Source
Nov 17	21	Lutetia	99	0.07	335	M	0.044	72.7	79984	M 98407		7	59.9	4.53N	M	8	9.3	21	26	Goffin96
Nov 20	74*	Galatea	123	0.10	435	C	0.091	250.9		L1 1884		8	16.0	2.13S	H	6	52.5	17	16	MPC24716
Nov 21		MARS	6782	4.68		V	0.763	85.9	187145	M 268761		18	5.7	3.50N	M	18	41.7	-24	21	DE200
Nov 21	8*	Flora	141	0.17	401	S	0.182	40.7		M 182000		19	14.4	4.54S	M	0	13.7	-8	46	MPC24084
Nov 22	51	Nemausa	137	0.07	513	CU	0.389	85.6		L5 2401		11	15.4	1.41N	H	20	4.3	-15	5	Goffin94
Nov 22	489	Comacina	144	0.06	727	C	0.199	83.3		M 239257		20	30.9	1.43S	M	21	43.4	-12	16	Goffin87
Nov 23	41*	Daphne	182	0.11	992	C	0.121	230.5		01492148		2	48.7	2.26N	J	6	57.7	1	50	MPC22385
Nov 24	185	Eunike	165	0.07	736	C	0.412	98.4		M 719296		12	59.3	2.00N	M	18	26.6	-10	5	MPC24549
Nov 24	135	Hertha	82	0.06	250	M	0.152	278.6		M 96422		13	27.4	0.65N	M	6	42.8	26	25	MPC24085
Nov 24		JUPITER	140904	18.58			0.140	72.2		M 722611		16	19.2	3.69N	M	21	13.4	-17	1	DE200
Nov 24	41*	Daphne	182	0.11	990	C	0.126	233.9		01492652		16	25.9	1.38S	J	6	57.1	1	43	MPC22385
Nov 25	60	Echo	61	0.04	144	S	0.187	74.2		M 7 9581		17	57.4	3.00N	M	23	0.0	-6	7	Goffin96
Nov 26	37*	Fides	112	0.12	336	S	0.172	254.5		M 118259		0	28.5	7.05N	M	2	28.4	18	33	Goffin94
Nov 27	109	Felicitas	91	0.05	260	GC	0.352	64.0	164357	M 238772		15	36.8	3.56N	M	21	23.3	-18	18	MPC23226
Nov 28	313	Chaldaea	101	0.05	353	C	0.256	82.0	164672	M 239387		12	12.6	1.41N	M	21	48.8	-11	1	MPC24549
Nov 29		VENUS	12220	34.09			0.768	75.8	188326	M 270015		7	37.6	5.46S	M	19	35.9	-24	43	DE200
Nov 29		NEPTUNE	50184	2.25			0.027	79.3	188797	M 270539		10	57.7	0.43S	M	19	59.6	-20	13	DE200
Nov 29	23*	Thalia	111	0.13	328	S	0.248	292.1	77068	M 94222		18	59.5	1.67N	M	5	16.2	25	24	Goffin96
Dec 1	379	Huenna	96	0.05	306	B	0.352	72.6		M 722751		3	49.4	1.97N	M	21	35.6	-14	4	MPC25034
Dec 2	2260	Neoptolemus	85	0.03	501	DTU:	0.083	300.3		M 183823		0	35.0	0.92N	M	1	45.9	-7	41	Goffin87
Dec 2	1116	Catriona	40	0.04	74		0.156	317.3	26053	M 30802		5	24.6	2.90S	M	6	56.7	50	0	MPC 9459
Dec 2	79*	Eurynome	68	0.09	144	S	0.241	251.8	93928	M 119888		10	2.9	4.98S	L	4	26.0	15	31	Goffin89
Dec 3	99	Dike	79	0.05	247	C	0.182	81.0		M 1 426		7	27.8	3.66N	M	10	30.8	26	42	MPC15525
Dec 3	532*	Herculina	217	0.08	1257	S	0.327	80.1	189113	M 270948		22	56.4	1.71N	M	20	17.9	-26	14	Goffin88
Dec 4	105*	Artemis	123	0.09	477	C	0.193	234.4	134036	FK5 1181		12	15.6	1.14N	5	7	0.3	-8	24	Goffin94
Dec 4	74*	Galatea	123	0.11	441	C	0.181	265.5		13340104		14	21.2	2.27N	8	6	44.5	16	57	MPC24716
Dec 5	94*	Aurora	212	0.15	1162	CP	0.182	280.7		24281069		3	48.7	0.09S	J	6	10.8	35	7	Goffin94
Dec 7	349*	Dembowska	143	0.11	609	R	0.220	268.5	76598	A 38625		8	40.2	0.81S	B	4	25.1	29	47	Goffin92
Dec 8	776*	Berbericia	183	0.10	793	C	0.334	47.4		M 274531		2	20.8	2.02N	M	23	2.4	-25	59	MPC19478
Dec 8	10	Hygiea	429	0.24	3987	C	0.202	262.0		185 1920		20	20.0	1.72N	J	5	12.0	25	16	MPC24219
Dec 9	124	Alkeste	79	0.06	254	S	0.172	271.3		L4 97		19	16.1	2.97S	H	7	5.2	18	13	Goffin95
Dec 10		VENUS	12220	40.46			0.558	65.3		M 735914		11	6.1	21.05S	M	20	6.8	-22	20	DE200
Dec 10	41*	Daphne	182	0.11	979	C	0.187	257.6		01481138		17	29.2	2.48S	J	6	47.8	0	46	MPC22385
Dec 12	146	Lucina	137	0.07	592	C	0.189	37.0		M 2 8474		13	20.5	0.03S	M	0	12.0	-13	18	Goffin89
Dec 12	624*	Hektor	234	0.07	2420	D	0.088	228.5	55368	M 67094		19	13.2	1.04N	M	2	14.0	34	37	Goffin93
Dec 13	23	Thalia	111	0.13	323	S	0.269	287.3		CR0 4850		22	46.5	6.63N	T	5	0.5	26	38	Goffin96
Dec 14	153	Hilda	175	0.06	1178	P	0.191	116.7		M 195501		10	6.5	0.13N	M	12	27.0	-9	23	Goffin93
Dec 15	1	Ceres	933	0.42	10876	G	0.261	56.4		639 252		1	31.8	3.34N	J	22	54.0	-18	2	Goffin92
Dec 15	1369	Ostanina	45	0.02	146		0.134	264.5	116054	M 153472		13	28.3	2.18S	L	7	52.0	3	17	MPC15860
Dec 17	123	Brunhild	49	0.05	106	S	0.165	270.2		+26 1630		1	13.4	4.41N	U	7	42.7	25	59	Goffin90
Dec 19	10	Hygiea	429	0.24	3982	C	0.196	260.2		18490751		0	37.1	1.81N	J	5	3.1	24	57	MPC24219
Dec 20		VENUS	12220	47.86			0.301	37.9		M 237331		18	38.5	16.78S	M	20	22.4	-19	52	DE200
Dec 21	404	Arsinok	101	0.07	384	C	0.227	280.9		M 119917		0	41.1	2.27S	M	4	27.8	15	9	Goffin89
Dec 21	178	Belisana	37	0.03	74	S	0.252	270.3		CR0 5447		7	19.0	1.58N	T	5	41.6	25	11	MPC19472
Dec 22	53	Kalypso	119	0.07	396	XC	0.323	106.8		L2 239		9	19.6	0.95S	H	12	50.5	-3	3	Goffin87
Dec 22	1288	Santa	39	0.02	86		0.170	84.0	91945	M 116542		23	50.3	0.72N	L	0	31.6	12	54	MPC19986
Dec 25		VENUS	12220	51.27			0.228	5.1		M 721824		1	39.4	21.80E	M	20	24.3	-18	53	DE200
Dec 25	123	Brunhild	49	0.05	106	S	0.212	269.3		M 97719		18	28.0	2.59N	M	7	35.3	25	58	Goffin90
Dec 26	191	Kolga	51	0.04	129	XC:	0.194	281.9	112393	M 148407		10	3.2	4.19N	M	5	4.6	5	42	Goffin90
Dec 27	727*	Nipponia	37	0.04	67	DT	0.209	308.6	111845	FK5 1123	J	6	46.6	4.69N	5	4	28.4	1	22	MPC25187
Dec 27	241*	Germania	169	0.11	898	CP	0.204	270.5		L4 577		15	35.1	0.77N	H	7	17.2	20	25	MPC24085



Asteroidal Occultations
1997 April 29, May 22,
and June 1 to Sept. 19



Asteroidal Occultations 1997 May 22 and June 1 to Sept. 19



Asteroidal Occultations
1997 June 1 to Sept. 19

IOTA Occultation Predictions

David W. Dunham

All IOTA members who want them should now have 1997 predictions of lunar grazing and total occultations for their region, and local circumstance appulse predictions for planetary and asteroidal occultations. If that is not the case, contact the graze computor given for your region listed on p. 8 of the 1997 Grazing Occultation Supplement for your hemisphere, or IOTA or IOTA/ES, or me. In that list, the telephone number for Henk Bulder is incorrect; it should be 31,1722,11870. Also, the e-mail address for Andrew Elliott in the U.K. has been simplified to **aje@compuserve.com**.

The graze computors will try to supply you with the updated predictions described below usually only if you can receive the prediction files in a zipped, attached file, as described on p. 9 of the 1997 graze supplement. However, they will supply them upon request in files on an IBM-compatible diskette if you can not easily receive attached files by email, and they will be printed if you do not have free access to a PC and printer.

A few more graze computors are needed to help compute all IOTA predictions for some areas; part of the problem with distribution of this year's predictions has been too much work being done by too few people. Especially needed is help with the predictions for western North America. If you are interested in helping, have an IBM-compatible PC with math co-processor, and can receive relatively large attached files by e-mail, please contact me. The graze computors now also generate and distribute predictions of total lunar occultations, and of local data for appulses by major and minor planets, as well as of lunar grazing occultations.

Total lunar occultations: By the time you receive this, I will have distributed to all of the graze computors a small computer program called IOTASTA that creates a file in the sites.dat format needed by the OCCULT program from the file of stations that is used by the GRAZEREG graze prediction program. This will make it easy for the graze computors to generate total lunar occultation predictions for all IOTA members with OCCULT. However, the GRAZEREG station file does not include the telescope aperture needed by OCCULT, so if you want your OCCULT total occultation predictions to use an aperture other than the default value of 20 cm, send the value you want used to your graze computor. The OCCULT predictions include lunar occultations of major and minor planets that are no longer included in the PC-Evans predictions. If you already have the latter, which have stellar data that is at least as comprehensive as that which can be generated by OCCULT, your computor may send you OCCULT data only for the lunar occultations of the planets. I have not had a chance to complete a program to convert the PC-Evans station and observer information files to the OCCULT sites.dat format, but with the IOTASTA program, that might not be necessary. It is certainly more efficient for the computors to work with only one station file, the GRAZEREG station file (a change to that file that we hope to make will be to include the observer's telescope aperture in cm, probably in place of the currently unused spectacular travel radius). So for 1998, we may stop using both PC-Evans and its associated station and observer files. In order to efficiently generate the .zip files for e-mail transmission of all predictions, the OCCULT-produced prediction file will have a name such as brocc022.997, which would be a code for B-region OCCULT data for station 22 (number in the IOTA station deck for the region) for 1997. "Brocc022" would also be the first 8 characters of the name of the location given in the OCCULT prediction heading, followed by the first several characters (but usually not all of them) of your actual location (usually city) name.

Grazing occultations: Basic information is included in the hemispheric grazing occultation supplement distributed with the last issue. The latest version of the ACLPPP program now (as of the start of May) lists at the top of each profile "IOTA 1997 MAR.9 ACLPPP WITH 1997 MAR.14 OBSERVED GRAZE DATA". Previous versions of the program only identified the month that it was created, and only starting with the March version is the date of the observed graze dataset also identified, important now that we are adding observed graze data to correct various errors. In general, we will not provide updated ACLPPP profiles for 1997, unless it is relatively easy to do so as part of a prediction update distribution for other reasons, such as described in the sections above and below. So at least if you can receive attached files by e-mail, you should have by now been provided with a new file of ACLPPP profiles with the above dates given at the top, and possibly with a later version of the observed graze data. If you can not receive attached files by e-mail, you will be supplied by your computor a new file of ACLPPP profiles upon request if you plan an expedition for a graze under one of the following circumstances:

If the ACLPPP observed dataset is earlier than 1997 May (or no date is given at the top for the observed data), "ZC 1821 05/25/80" is one of the observed grazes listed at the bottom, and the graze profile includes the Watts angle range 180.0 to 180.8, then a new profile is needed, or you should ignore the "mountain" that appears in the described Watts angle range. The observations on which this was based are about 1″.5 too high and will be removed from the observed graze dataset for predictions computed in May and later.

If the ACLPPP version is earlier than 1997 MAR.9 and you plan to observe a graze of ZC 1029 (26 Geminorum), then you need a new profile. Only the 1997 MAR.9 and later versions take into account the significant known error in the declination of this star (previous grazes show that it is about 0″.3 south of its catalog position, so that the graze shadows computed with the earlier versions are about 0.5 km too far south). Also, if your version is earlier than Mar. 9 and ZC 1029 is one of the stars listed for used observed grazes at the bottom (for a graze of any star), then you also need a new profile.

If the ACLPPP observed dataset is earlier than 1997 MAR. 14 (or no date is given at the top for the observed data), "ZC 970 05/01/79" is one of the observed grazes listed at the bottom, and the graze profile includes Watts angle 183.4 and 183.6, the profile at those points will be plotted about 1″.0 too high. This erroneous dataset has been removed from the Mar. 14 version of the dataset.

If the ACLPPP version is earlier than 1997 MAR., then you should make the correction for southern Cassini-region waning-phase grazes mentioned in the lower left side of p. 9 of the 1997 graze supplement, and you should ignore a "mountain" around Watts angle 182 - 183, especially when observed data for a graze of ZC 2072 are listed at the bottom (that is, the "mountain" in that area is too high by almost 1″). These problems have been taken care of if observed data are listed at the bottom for "ZC 2771 02/02/97" or "ZC 2771 52/02/97". This is the θ Librae graze observed in Europe, and for which a new profile by Henk Bulder is printed on page 377. This dataset will be updated to include the more detailed information of that profile in the 1997 May update to the observed graze dataset.

Observers are reminded that the UTC time, and the longitude and latitude given at the bottom of each ACLPPP profile are for a standard point in the predicted limit used to compute the basic profile information, and not for the point in the predicted limit closest to their location. The standard point is often many degrees of longitude west of the closest point for the observer. However, the important thing is that the profile has been adjusted to the Watts and position angles of central graze for the closest point to the observer, so it is valid for his region, in spite of the location and time information given. The position angles of central graze never differ by more than 1° from the standard point to the closest point. The standard point is generally used for many observers until the central graze P.A. difference exceeds 1°, then a new standard point is computed. In a future version of the program, either the coordinates and/or time for the standard point will be labeled as such, or just eliminated to avoid confusion.

Local circumstance appulses: By the time you receive this, your graze computor will have been sent a final version of the 1997 input dataset of occultations of stars by major and minor planets. They now include SAO numbers whenever these are available for the star, and predictions of the separate components of double stars are now given. Also, improved data for some stars have been used; see the separate article by Edwin Goffin and myself about 1997 predictions of asteroidal and planetary occultations. Even when there are no new updates for the star or asteroid, there may be a small change in the prediction since the formula for ΔT used by the program has been updated.

Errors in XZ94E: Some errors in XZ94E star designations were corrected in PC-Evans total occultation predictions distributed in February 1997 or later, as mentioned on p. 311 of the last issue. The errors may exist in PC-Evans predictions computed before then (but I found that none of the stars in question actually were occulted at my location near latitude +39° during 1997), as well as other programs that use XZ94E, including GRAZEREG graze predictions and OCCULT version 4.0 and higher versions. Only a few stars are involved. The corrections can be found on IOTA's "sky.net" web site and will be published in the next issue. ι

More Web Sites for IOTA

David W. Dunham

Many valuable web sites were listed on pages 339-341 of the last issue. An important site that Kevin Krisciunas told me about recently is the U.S.A. mapping site **http://www.etakguide.com/#FindLocation** which will generate a detailed map given any address or street intersection in the country. But most important for IOTA, it will also give a rather accurate longitude and latitude for the address, or for any point on which a cursor arrow is set on the detailed map. Our tests of these coordinates show that they are accurate to about 2″, not accurate enough for reporting lunar occultation timings, but good enough for reporting asteroidal occultations, and for all predictions. Residents of the U.S.A. should enter their address to check their map measurements. I was surprised to discover with this site that the longitude for my observing location in Silver Spring, MD, where I lived from 1977 to 1988, was in error by 12″. A remeasurement of the 1:24,000-scale U.S. Geological Survey map of the area confirmed the Etak position within 1″. That sold me on this site's value. Also, the database seems to be very up-to-date, including streets in my neighborhood that were laid out only 3 years ago. One drawback to the site is that it does not give height above sea level, so you still need the detailed topographic map for that, as well as for measuring coordinates accurate enough (to the nearest 1″, that is, within ±0″5, of longitude and latitude) for reporting lunar occultation timings. There is a good discussion of this site, and of other mapping sites, by Rob Robinson on IOTA's main Web site at **http://www.sky.net/~robinson/iotandx.htm**. The Etak coordinates might be more accurate than 2″ if they are on the WGS 84 (GPS) system, or perhaps on the 1983 North American Datum; that could explain the differences that we get from measuring the maps to give positions on the 1927 North American Datum. An inquiry to Etak when we get a chance might resolve this. If anyone knows of any sites like this for other countries, please let me know and I will share that in a future *ON*.

Not mentioned last time was another IOTA site, Robert Sandy's site at **http://www.sky.net/~grazebob/index.html** which includes many reduction profiles of grazing occultations, as well as other useful prediction and observing information. It also has an image of one of the best photos ever made of an occultation, taken by Bob of the 1978 Dec. 26 occultation of Venus by the 14% sunlit waning Moon. It is directly linked to from the main IOTA site maintained by Rob Robinson, which is why I did not include it in the article in the last issue. It does have one important item that is NOT linked to anything else, and hence is available only to *ON* readers--replace "index.html" in the URL above with "occman.zip" and you have the downloadable .zip file containing an ASCII version of IOTA's draft observing manual, as noted in *ON* (vol. 6, no. 13, pg. 278, January, 1997).

There is a link to Fred Espenak's eclipse (mainly solar) web site from the main IOTA web site. Fred has recently completed a new web site for the total solar eclipse of 1999 August 11. The URL is: **http://planets.gsfc.nasa.gov/eclipse/TSE1999/TSE1999.html**. This eclipse path passes through

Europe, the Middle East and India. The site includes many maps, tables, weather prospects, and other information. There are also instructions for ordering the new NASA bulletin on this eclipse. The URL for Fred's main eclipse site is: **http://planets.gsfc.nasa.gov/eclipse/eclipse.html**.

Ovidiu Vaduvescu informs us of a web page about the 1999 solar eclipse in Romania: **http://roastro.astro.ro**. The central line crosses Bucharest.

The last issue incorrectly listed the URL for the AAO Lunar Occultations Homepage. The correct URL is **http://www.arcetri.asto.it/~luna/index.html**. ι

Recently Observed Asteroidal Occultations

David W. Dunham

This gives very preliminary information about some asteroidal occultations that have been reported to me since I wrote "Recent Results from Asteroidal Occultations" in *ON* (vol. 6, no. 13, pg. 300). Jim Stamm will publish more complete information about them later. The observations indicate in general that the nominal predictions for occultations of PPM stars are pretty good, much better than the 1″.0 error bars that we commonly give the predictions. These events usually seem to be within 0″.2 to 0″.3 of the prediction so that chances of seeing an event at distances greater than 0″.5 from the nominal path seem to be quite small. But observers within this distance have a better chance of seeing the event, and are encouraged to monitor these events, even when there is conflicting CCD astrometry. However, the nominal predictions aren't yet accurate enough for portable observers to travel into the paths and have a high (more than 50%) chance of seeing the event. There is good hope of that happening after orbits for the asteroids are redetermined using Hipparcos data, and those data are also used for the stars. The Hipparcos data are due to be released in June, so improvements in the predictions can be expected later this year.

1996 Dec. 17, (704) Interamnia and B.D. +33° 633: Timings of this event have been reported from 9 stations in southern California, Arizona, and New Mexico. An ellipse with dimensions 337 km and 321 km can be fit to these chords. A plot and some details are given on IOTA's asteroidal occultation web site. In addition, timings were made by four stations from Lowell Observatory. The path of the occultation was predicted almost exactly (s. limit within about 0″.01) by Martin Federspiel from extensive observations made with the Carlsberg Automated Meridian Circle (CAMC) on La Palma in the Canary Islands. Some observers were misled by astrometry from the Flagstaff (USNO) transit circle that gave a path 3/4 path-widths farther south, so few observations were obtained across the northern half of the asteroid, and none in the northern third of the path. Three "last-second" CCD astrometric predictions gave conflicting results. After the event, Jan Manek re-reduced his measurements using GSC 1.2 data, and that gave a good result, within about 0″.06 of the truth. That showed that GSC 1.2 data, available from the Web (see p. 340 of the last issue) are really needed for effective CCD astrometry; the more widely used GSC 1.1 data are just not accurate enough.

1997 Jan. 6, (363) Padua and SAO 77818: A 3-second occultation was timed by Jose Gomez Castano at Fuenlabrada, near Madrid, Spain. He was near the northern limit since Jose Ripero Osorio, about 20 km to the north at Torrejon, had a miss. The event occurred within a path width (0″.07) of my prediction using Jim Roe's GSC 1.2 astrometry obtained the night before with his 20 cm telescope at Oaxaca, Mexico. This confirmed the value of GSC 1.2. The actual path was also well within a path width of the nominal prediction.

Jan. 22, (50) Virginia and PPM 156720: A 1.5-second occultation was video recorded by Leszek Bendedyktowicz at Cracow Observatory, Poland. This was near Federspiel's path update based on CAMC data for the asteroid only; the prediction remained uncertain due to a lack of observations of the star. The event was very short relative to the expected 9 seconds for a central event, and the observer reported "strong oscillation" 15 seconds after the reappearance. Also, Rui Goncalves near Lisbon, Portugal, saw no occultation, but obtained CCD images before and after the event, showing that the path passed 0″.11 north of his position, in better agreement with the nominal prediction but far from Cracow. There have been no confirming observations; the short Cracow event might have been a secondary extinction rather than one by Virginia itself.

Feb. 4, (84) Klio and PPM 91967: A certain occultation was timed by Orlouf Mitskogen near Oslo, Norway, less than 0″.2 south of the nominal prediction. Rui Goncalves obtained CCD astrometry at Lisbon and calculated that the path was 1″.5 ±0″.2 north of his site; the Oslo observation shows that the distance at Lisbon was really 1″.7 to 1″.8.

Feb. 26, (386) Siegena and PPM 153989: Jan Manek timed the disappearance at Stefanik Observatory in Prague, Czech Republic, but clouds moved in 4 seconds later, preventing a timing of the reappearance. Jan could usually resolve the star's companion (PPM 153990), about 0.5 mag. fainter and 4″.7 away, and at the time of the D, the stars were resolved and only the brighter star disappeared, so he is 95% confident that an occultation by Siegena occurred. The stellar duplicity prevented CAMC astrometry.

1997 March 21, (377) Campania and SAO 138801: Rik Hill and Jim McGaha, observing at separate observatories in Tucson, Arizona, timed the occultation. Their location was about a path width south of the nominal prediction. Observers east of downtown Phoenix had a miss. The path must have passed over the western half of Phoenix, but nobody observed there. Some observers were misled by CCD astrometry that indicated the path would be a few path widths southwest, along the southern California coast, where no occultation was seen. ι

Venus and Jupiter Double Occultation

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Dear colleagues: A very interesting event, simultaneous lunar occultations of Venus and Jupiter, will be seen from the southern part of the Atlantic Ocean near dawn on April 23, 1998. The event will be seen in the daylight from the southern part of Africa. The best site to see it from is the Ascension Islands (belonging to the UK) in the south Atlantic Ocean. The Venus occultation is nearly a northern graze and it occurs at almost the same time as when Jupiter reappears from the dark limb at 6 h 10 m UTC. It should be a wonderful sight!

Successive lunar occultations of Saturn and Vesta will be seen from the north part of Japan in 2002. ι

PHEMU97: First Observation by IOTA/ES

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For the PHEMU97 campaign IOTA/ES observed the first event for this year observable from Munich with the IOTA Occultation Camera (IOC) this morning at 3 h 56 m UTC. J4 occulted J2. The elevation of Jupiter was around 17 degrees, the sun was only -2 degrees below the horizon. An RG850nm longpath filter was used to sufficiently suppress the sky background. An 11 inch Schmidt-Cassegrain telescope with f/10 was used. Exposure time was 0.4 seconds, the image interval time was 0.714 seconds. 1500 images were taken.

All IOTA/ES members are reminded of the PHEMU97 campaign announced by Dr. J. E. Arlot of the BDL (arlot@bdl.fr). In order to get more information, contact the BDL WWW pages at **www.bdl.fr** . Information is also available by snail-mail from IOTA/ES. [Also, see Arlot and Wilds' article about these events on pages 325-333 of the previous issue]. Good luck with further observations. ι

1997 July 18 Triton Occultation

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Due to the very slow motion and small angular size, occultations of stars brighter than Triton by that satellite of Neptune are rare. One will occur on July 18, and professional astronomers are mobilizing to record it, to learn more about Triton's tenuous atmosphere that was discovered by Voyager 2. My latest predicted path, based upon CCD observations by Lowell Observatory's Ted Dunham made at Perth Observatory, shows that the occultation path starts in southern Texas and Mexico at 10:13 UTC, then crosses the central Pacific Ocean, then clips the northern part of North Island, New Zealand at 10:19, and includes most of Australia at 10:20. The 13.0-mag. star is at J2000 R.A. 20 h 2 m 51.3 s, Dec. -20° 0′ 57″. Triton will be just a few tenths of a magnitude fainter, so the total magnitude drop will be about 1.0. A central event should last 118 seconds. Neptune is near opposition (solar elongation 177°) and the Moon is nearly full (96% sunlit) and 26° away from the 8-mag. planet, which will be only a few arcseconds from the star and Triton. These are challenging circumstances, but suitably equipped observers are invited to attempt observations. Wolfgang Beisker estimates that observations will be marginal with his IOTA occultation CCD camera system with an 11-inch telescope, so 14-inch or larger telescopes are recommended. Since there is still some uncertainty in the prediction, observers in the southwestern U.S.A. and New Zealand, in addition to those throughout Mexico and Australia, are encouraged to attempt observations. A map showing the latest path can be viewed on IOTA's asteroidal occultation web site at URL **http://www.anomalies.com/iota/splash.htm**. A finder chart for Neptune is also available there. ι

1997 February 02 Mainz Graze Results

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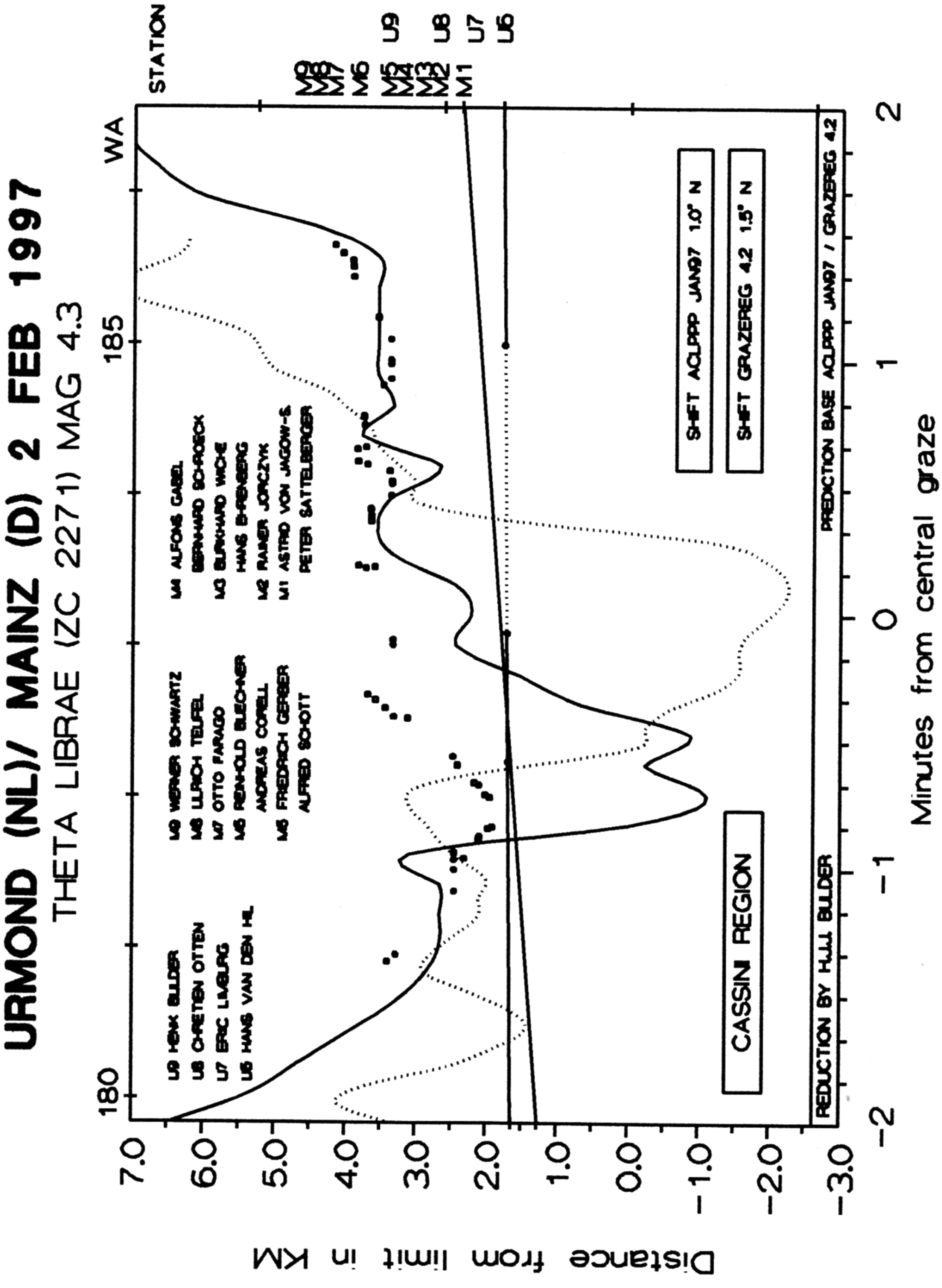
Here is the profile containing the data of the 1997 February 02 Mainz graze expedition, which I received form Hans Ehrenberg, combined with the Urmond (Maasband) expedition. The observations agree very well. The Mainz expedition gives a lot of additional datapoints. Only 3 of the 16 observers recorded a miss and one had technical problems preventing timings. After skipping some spurious timings made at the bright limb with small instruments, 62 timings remain including 27 coming from a video record which shows many gradual and step events, confirming the suspected duplicity reported in the Urmond (Maasband) expedition. The coordinates for the Mainz expedition are in Potsdam Datum. I didn't correct for European Datum in the graph, since I don't know how to do that. I expect the resulting differences would be very small, though. [The profile is on the following page.] ι


URMOND (NL)/ MAINZ (D) 2 FEB 1997
THETA LIBRAE (ZC 2271) MAG 4.3
U9 HENK BULDER
U8 CHRETIEN OTTEN
U7 ERIC LIMBURG
U6 HANS VAN DEN HL
M9 WERNER SCHWARTZ
M8 ULRICH TEUFEL
M7 OTTO FARAGO
M6 REINHOLD BUECHNER
ANDREAS COPELL
M5 FREDRICH GERBER
ALFRED SCHOTT
M4 ALFONS GABEL
BERNHARD SCHROECK
M3 BURKHARD WICHE
HANS EHRENBERG
M2 RAINER JORCZYK
M1 ASTRID VON JAGOW-S.
PETER SATTELBERGER
WA
180
185
STATION
M9
M8
M7
M6
M5
M4
M3
M2
M1
U9
U8
U7
U6
SHIFT ACLPP JAN97 1.0" N
SHIFT GRAZEREG 4.2 1.5" N
CASSINI REGION
REDUCTION BY H.J.J. BULDER
PREDICTION BASE ACLPP JAN97 / GRAZEREG 4.2
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
−1.0
−2.0
−3.0
Distance from limit in KM
−2
−1
0
1
2
Minutes from central graze

An Analysis of Observations of the Z.C. 1029 Graze on 1996 Oct. 4

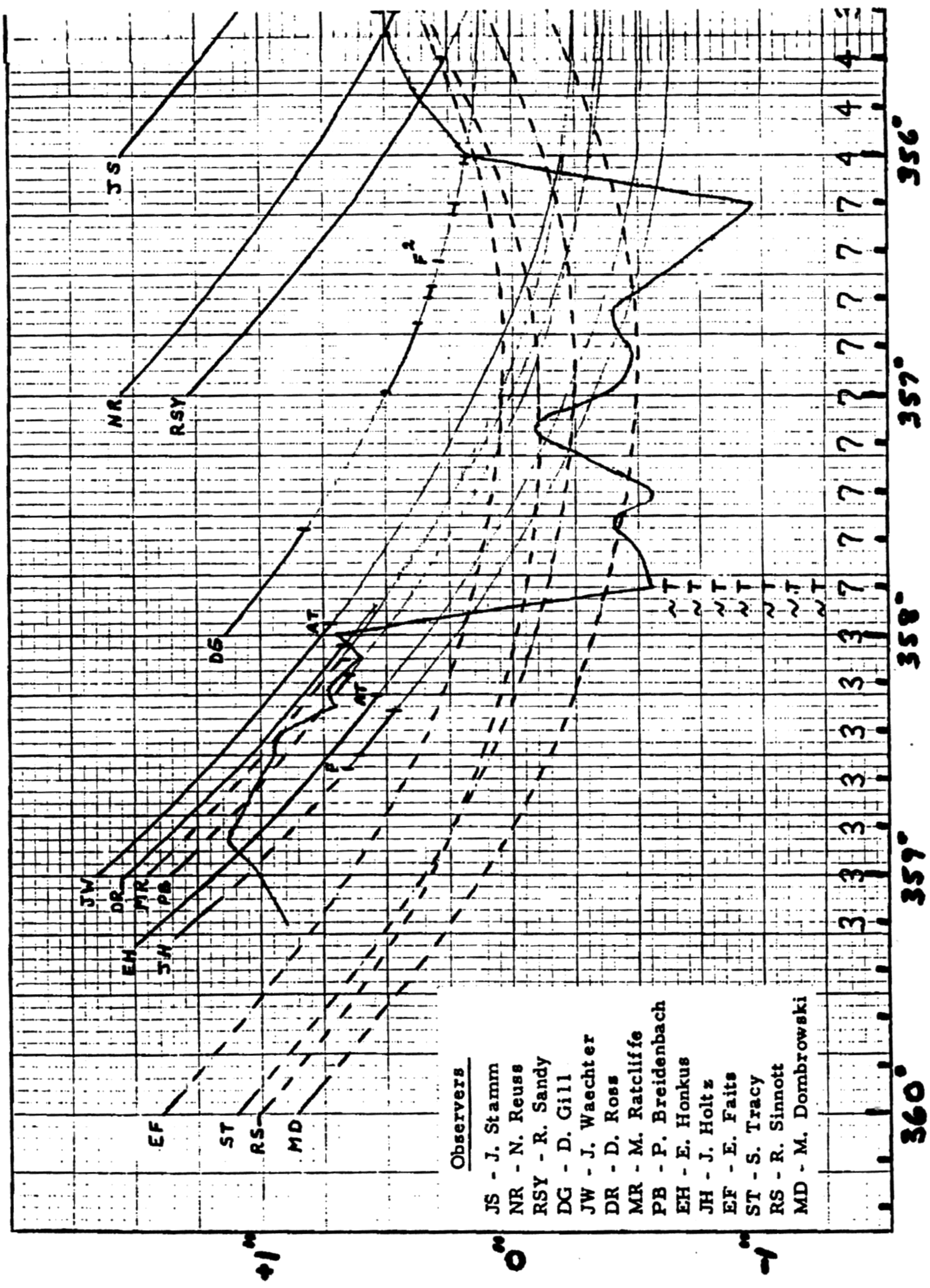
Robert L. Sandy
grazebob@sky.net

On 4 October, 1996, seventeen observers from across the USA, from Arizona to Massachusetts, were successful (estimated at 90%+) in observing the northern limit graze of +5.1-mag. suspected double star 26 Geminorum. With much time spent in correspondence with expedition leaders beforehand, the writer's Pictorial Reduction (henceforth known as P.R.) was completed on 12/02/1996, and snail-mailed to some of the observers. Of the seventeen observers who observed the graze, only fourteen were plotted on the P.R. for the reasons that (1) three (including Stamm) of the four observers in J. Stamm's expedition observed a miss, Stamm's star plot being the only one shown on the P.R.; and (2) another observer in Stamm's team was running late getting to the graze limit, and therefore set up about six miles (pretty deep into the moon) perpendicular south of the limit, and observed just one D and R, so his observations were not plotted. Of the fourteen observers tracks plotted, a total of 50 timings were plotted, a good 92% of them being considered excellent in accuracy and of non-questionable quality! Considering that the star was lost by some of the observers against the moon's bright features at the initial onset of the graze, I think everyone got very good data during the early morning hours and on a work-day morning.

In past-times, the writer has been plotting on my P.R.'s the pre-predicted profile using the same profile datum from I.O.T.A.'s ACLPPP, but in this case I have plotted the predicted profile based on very detailed/observed data from two observed grazes (of my choosing) that I have in my files, and for which I have drawn P.R.'s. Thus, the data from 359.2 to 358.0 degrees were derived from the observed graze of Z.C. 667 on 9/22/1978, when 6 observers made 10 timings in this Watts Angle region (the other six timings, for a total of 16, were made in the W.A. range of 354.6 to 353.1), and when L = +6.0 and B = +7.1, a very good choice since the B (latitude libration) was +7.3 for the subject graze. Then from 355.1 to 352.2 degrees W.A., data from the graze of Z.C. 692 (Aldebaran) on 9/12/1979 were used, when 16 observers made a total of 68 timings all the way from W.A. 355.1 to 348.0 degrees, and when L = +8.3 and B = +7.3; again a good choice since the B (lat. lib.) was exactly the same as for subject graze. It is also good that the Longitude Libration (L) value/s for both chosen data grazes had the same sign and were fairly close (in value) to the subject graze L-value. Special Note: As noted on one of the P.R. captions (upper right corner), the faint predicted profile area from 357.8 to 355.6-degrees W.A. (Code 7 & 4) should not be considered very accurate; this part of my plotted profile was taken straight off of the pre-graze ACLPPP, since I had no good past-observed profile data in my files for this Watts Angle range. Keep in mind that the error bars for Codes 7 & 4's are very long (see *ON* vol. 6, no. 13, pages 304-305 (January. 1997) for the definitions of Codes 7 & 4).

Now, before the Subject plotted predicted profile (shown faintly on P.R.--but not so faint on the copy here so that it would print) could have any meaning at all in relation to the Z.C. 1029 observations, the vertical baseline for both Z.C. 667 and Z.C. 692 had to be related to the same Grazing Elements Computer Version (i.e., 85-E) base line as that for the subject Z.C. 1029 graze. This matching was accomplished by asking Dr. Soma to run 85-E Grazing Elements for some of the observers in the ZC 667 and ZC 692 expeditions, since both the grazes of 667 and 692 were based on an entirely different Computer Version when this writer/P.R. plotter originally drew the data P.R.'s. for 667 and 692.

Summary: Although several observers were unable to get a good timing of their first star disappearance (due to the star making contact with bright limb features at the beginning of the graze period), many good timings were made from then on, as stated in paragraph #1. Therefore, several conclusions can be made, namely (1) the somewhat incoherent timings made by observers JW (he did make a slight late D-timing just a few sec. later than the AT shown on the P.R.), DR, MR, PB, EH, and JH agree partially with the predicted profile plotted in the W.A. region from 358.6 to 358.0-deg.; (2) observer DG's observations starting at 357.6 to 356.0-deg. definitely define the true limb profile (it has been this writers' opinion, for quite sometime, that IOTA's ACLPPP limb datums 4's and 7's have been too low in relation to the moon's mean limb/0.0"); (3) from W.A. 356.0 through 352.2-deg., the reported observation agree pretty well with the predicted (faint) profile, except where I (i.e., RSY) reported events quite a bit higher in the W.A. range between 353.0 to 352.4. It's this writer's (RSY) opinion that the deviation here is mainly caused by three factors, (1) the lunar libration L-value between that for subject vs. Z.C. 692 was a difference of 4.6-degrees, enough of a difference to (probably) cause this deviation This same deviation would also apply to other observer's observations from 356.0 through 353.0, except that the deviation seems to (at some W.A.'s, like between 356..0 to 355.0) be a little less extensive. The other factor (#2) is the Probable Error In Star Declination (P.E.I.S.D.) differences between that for subject graze star vs. that for Z.C. 692 (Aldebaran); as we know, usually the brighter the star, the greater the accuracy of its position in the sky!! Now (#3) since subject star was a double star, with equal 5.9-mag. components at a predicted separation of 0.05", the fact that the star is double usually causes its position in the sky to not be as accurate as with single stars of the same magnitude (although this is usually the case with double-star components of quite unequal magnitudes and a greater separation between them than just 0.05"). Prior to Subject graze, the Heading of this writer's IOTA Limit Predictions GRAZEREG-VER. 4.0 BY IOTA/ES, E.RIEDEL, AND J.H.SENNE showed a Probable Error for ZC 1029 = ± 0.10", but recent information from Dr. Soma (Japan) indicates that it is really ± 0.28". So in my P.R. Heading, the P.E.I.S.D. should be changed to read ±0.28". ι


JS
NR
RSY
DG
JW
DR
MR
PB
EH
JH
EF
ST
RS
MD
AT
AT
F²
F
356°
357°
358°
359°
360°
+1"
0"
-1"
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Observers
JS - J. Stamm
NR - N. Reuss
RSY - R. Sandy
DG - D. Gill
JW - J. Waechter
DR - D. Ross
MR - M. Ratcliffe
PB - P. Breidenbach
EH - E. Honkus
JH - J. Holtz
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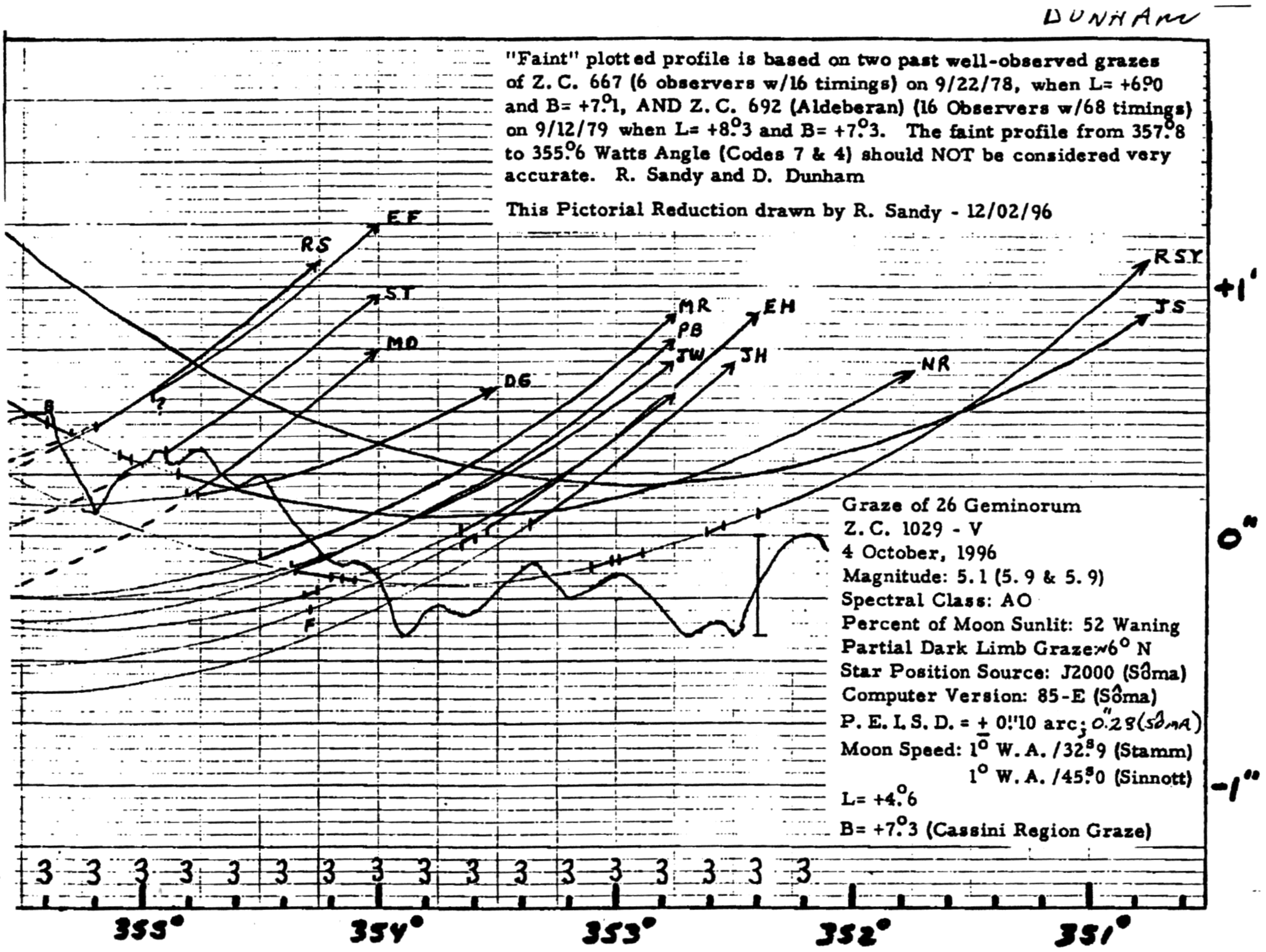
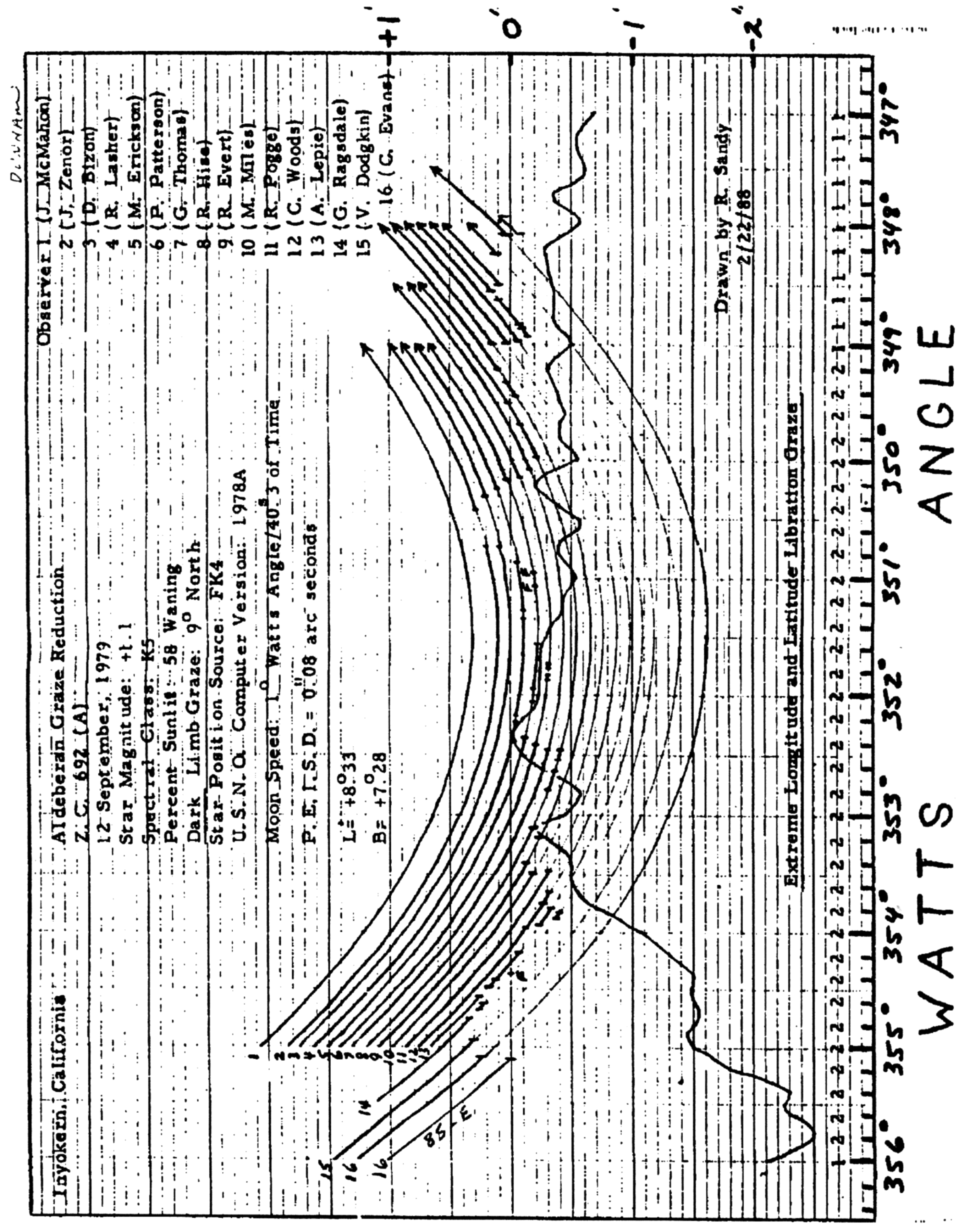
ST - S. Tracy
RS - R. Sinnott
MD - M. Dombrowski

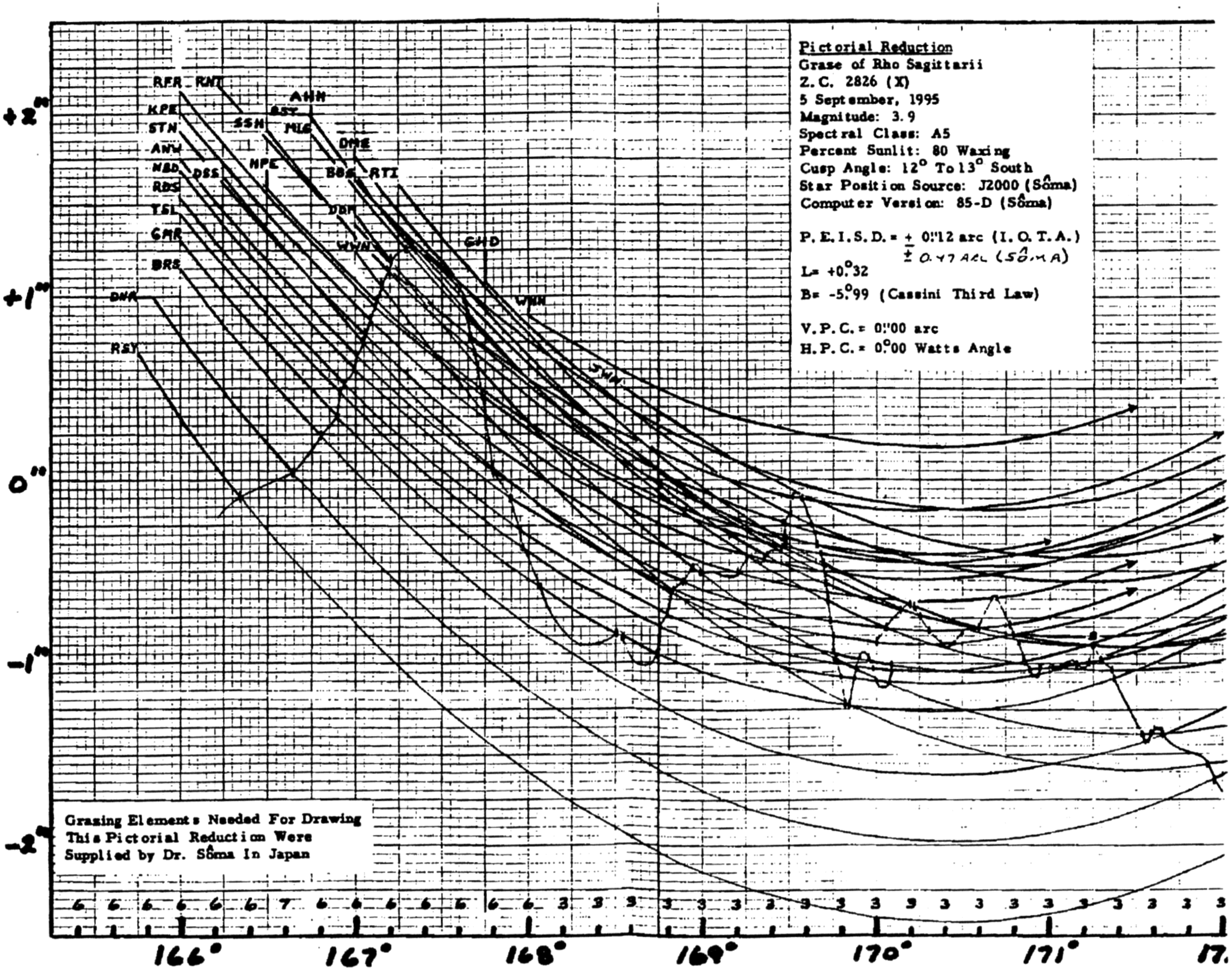


"Faint" plotted profile is based on two past well-observed grazes of Z. C. 667 (6 observers w/16 timings) on 9/22/78, when L= +6.°0 and B= +7.°1, AND Z. C. 692 (Aldeberan) (16 Observers w/68 timings) on 9/12/79 when L= +8.°3 and B= +7.°3. The faint profile from 357.°8 to 355.°6 Watts Angle (Codes 7 & 4) should NOT be considered very accurate. R. Sandy and D. Dunham

This Pictorial Reduction drawn by R. Sandy - 12/02/96

Graze of 26 Geminorum
Z. C. 1029 - V
4 October, 1996
Magnitude: 5.1 (5.9 & 5.9)
Spectral Class: AO
Percent of Moon Sunlit: 52 Waning
Partial Dark Limb Graze: ~6° N
Star Position Source: J2000 (Sôma)
Computer Version: 85-E (Sôma)
P. E. L. S. D. = ± 0."10 arc; 0."28 (Sôma)
Moon Speed: 1° W. A. /$32^{s}.9$ (Stamm)
1° W. A. /$45^{s}.0$ (Sinnott)
L= +4.°6
B= +7.°3 (Cassini Region Graze)


Inyokern, California
Aldeberan Graze Reduction
Z.C. 692 (A)
12 September, 1979
Star Magnitude: +1.1
Spectral Class: K5
Percent Sunlit: 58 Waning
Dark Limb Graze: 9° North
Star Position Source: FK4
U.S.N.O. Computer Version: 1978A
Moon Speed: 1° Watts Angle/40.3s of Time
P.E.I.S.D. = 0".08 arc seconds
L = +8°.33
B = +7°.28
Observer 1 (J. McMahon)
2 (J. Zenor)
3 (D. Bizon)
4 (R. Lasher)
5 (M. Erickson)
6 (P. Patterson)
7 (G. Thomas)
8 (R. Hise)
9 (R. Evert)
10 (M. Miles)
11 (R. Pogge)
12 (C. Woods)
13 (A. Lepie)
14 (G. Ragsdale)
15 (V. Dodgkin)
16 (C. Evans)
D. Dunham
+1'
0'
-1'
-2'
1 2 3 4 5 6 7 8 9 10 11 12 13
14
15
16
16
85 E
Drawn by R. Sandy
2/22/88
Extreme Longitude and Latitude Libration Graze
356°
355°
354°
353°
352°
351°
350°
349°
348°
347°
WATTS ANGLE



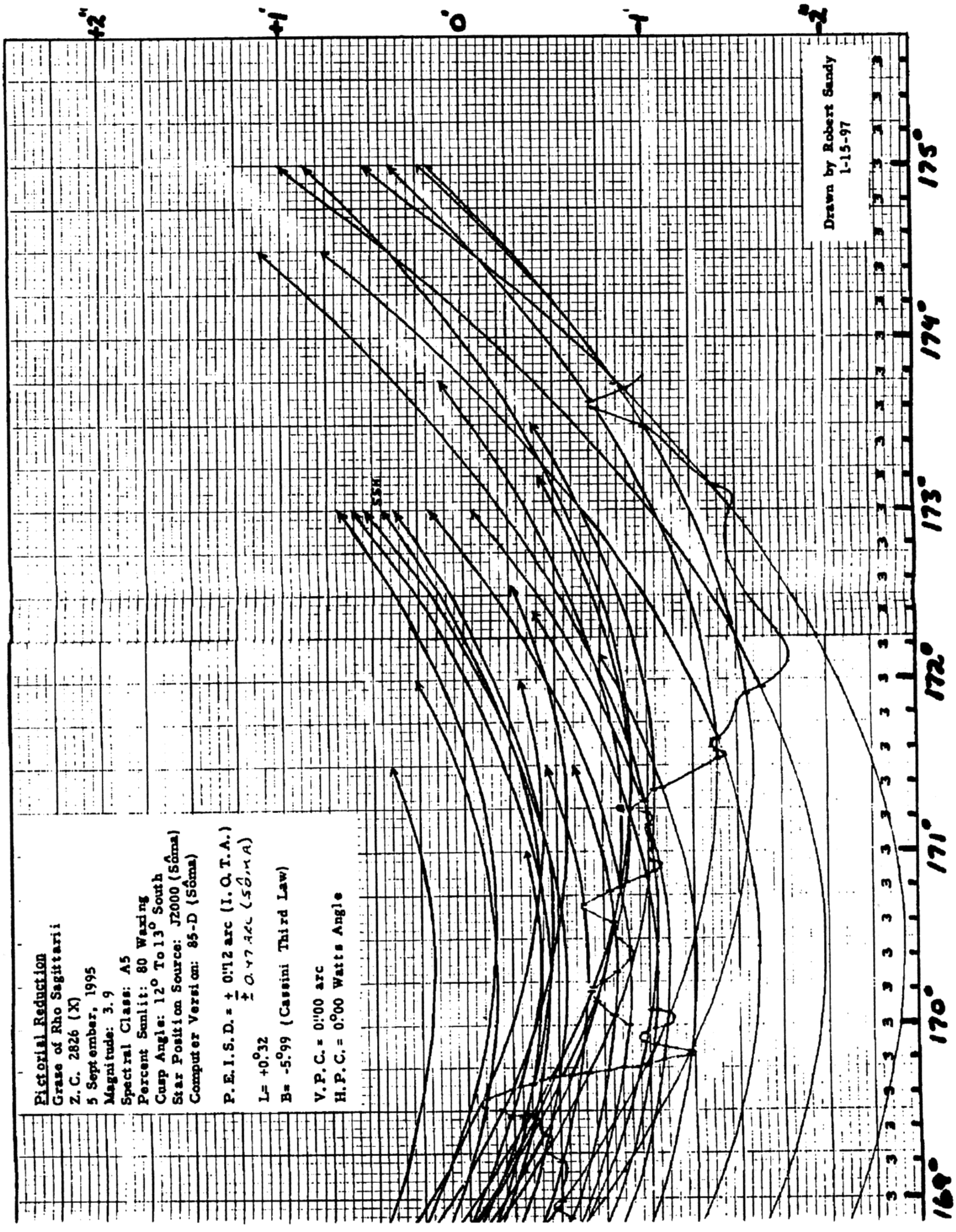
Pictorial Reduction
Grase of Rho Sagittarii
Z.C. 2826 (X)
5 September, 1995
Magnitude: 3.9
Spectral Class: A5
Percent Sunlit: 80 Waxing
Cusp Angle: 12° To 13° South
Star Position Source: J2000 (Sôma)
Computer Version: 85-D (Sôma)

P.E.I.S.D. = ± 0.″12 arc (I.O.T.A.)
± 0.47 arc (Sôma)

L= +0.°32
B= -5.°99 (Cassini Third Law)

V.P.C. = 0.″00 arc
H.P.C. = 0.°00 Watts Angle

Grazing Elements Needed For Drawing
This Pictorial Reduction Were
Supplied by Dr. Sôma In Japan



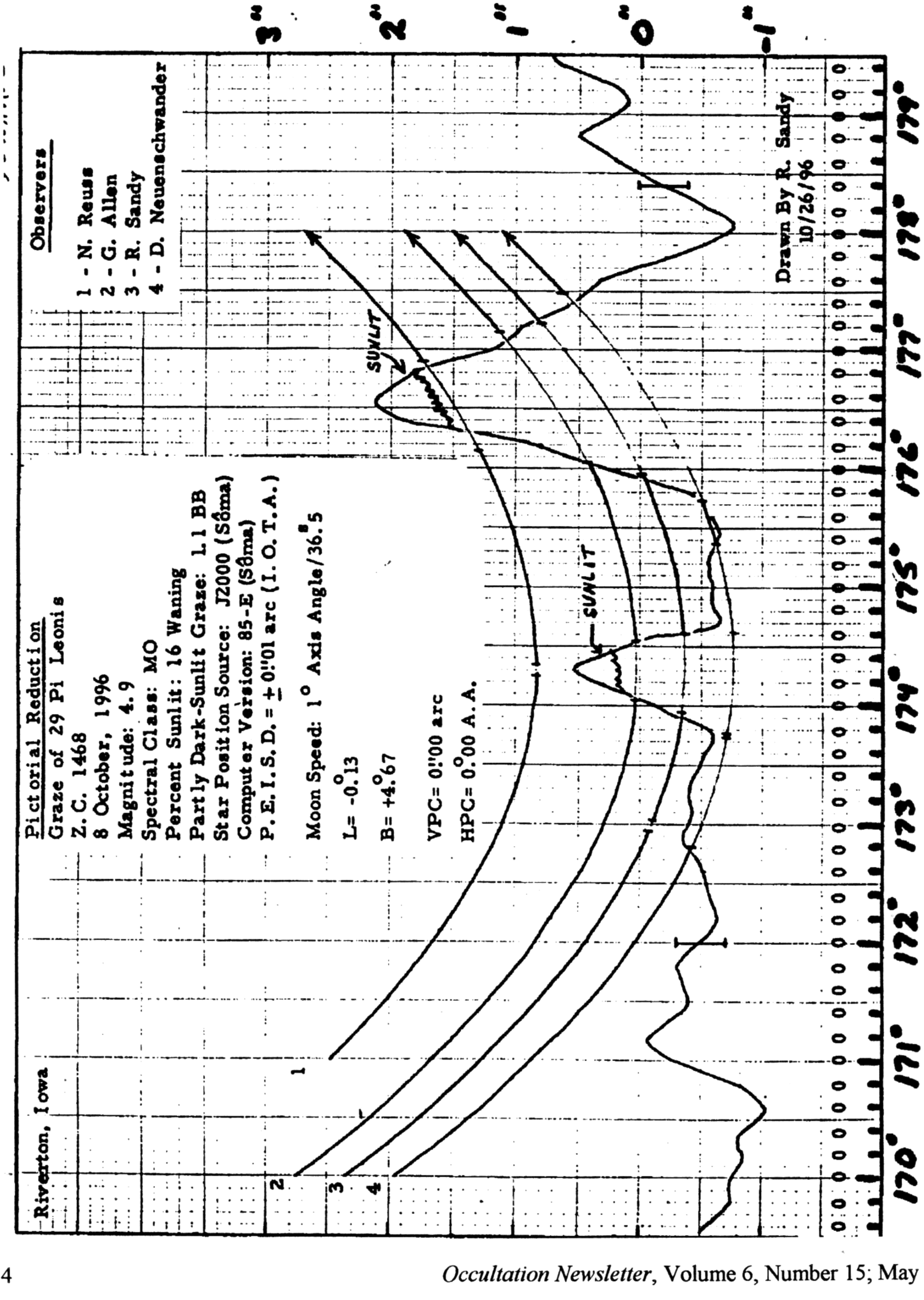
Pictorial Reduction
Graze of Rho Sagittarii
Z. C. 2826 (X)
5 September, 1995
Magnitude: 3.9
Spectral Class: A5
Percent Sunlit: 80 Waxing
Cusp Angle: 12° To 13° South
Star Position Source: J2000 (Sôma)
Computer Version: 85-D (Sôma)

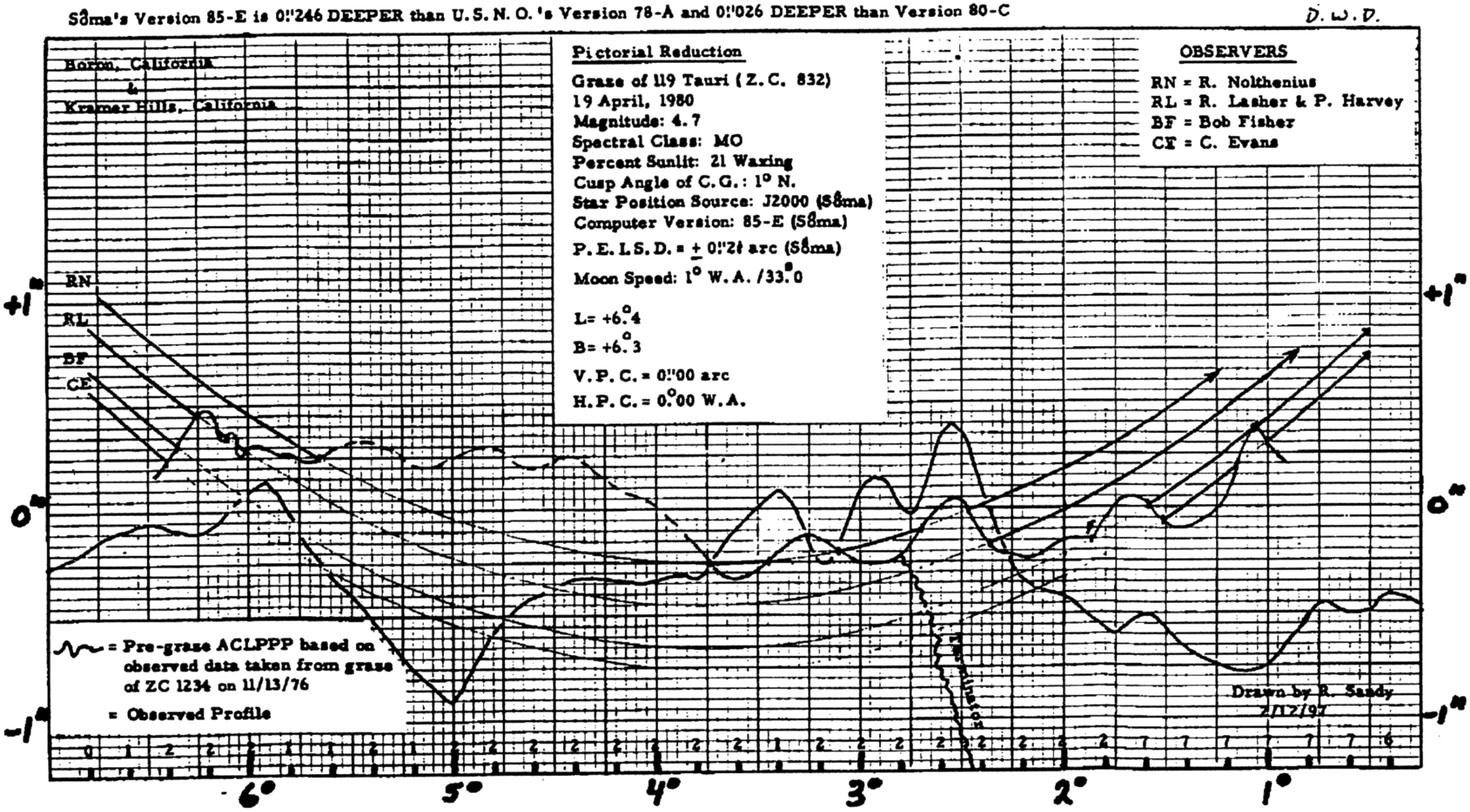
P. E. I. S. D. = ± 0."12 arc (I. O. T. A.)
± 0.47 arc (Sôma)

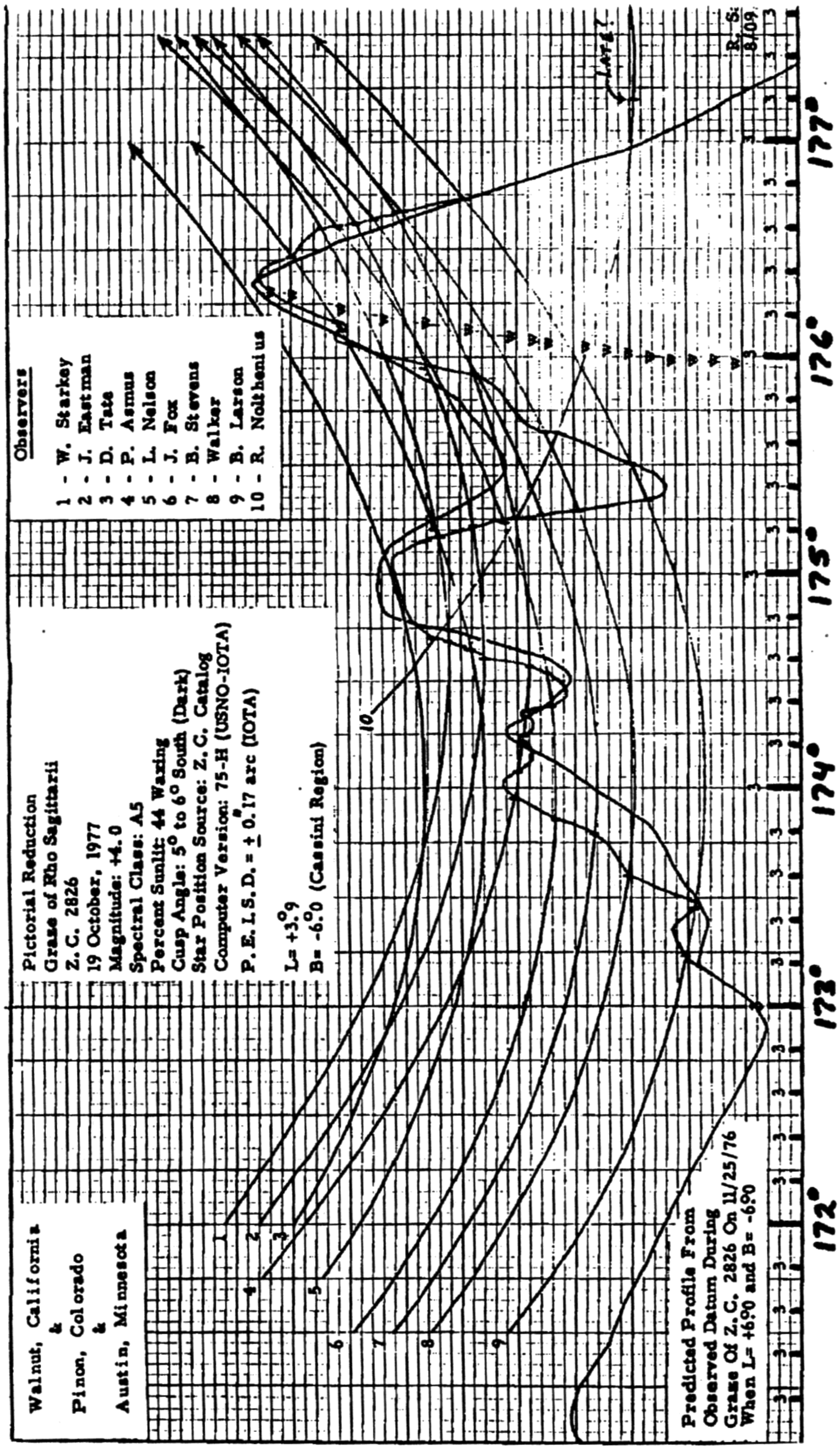
L= +0.°32
B= -5.°99 (Cassini Third Law)

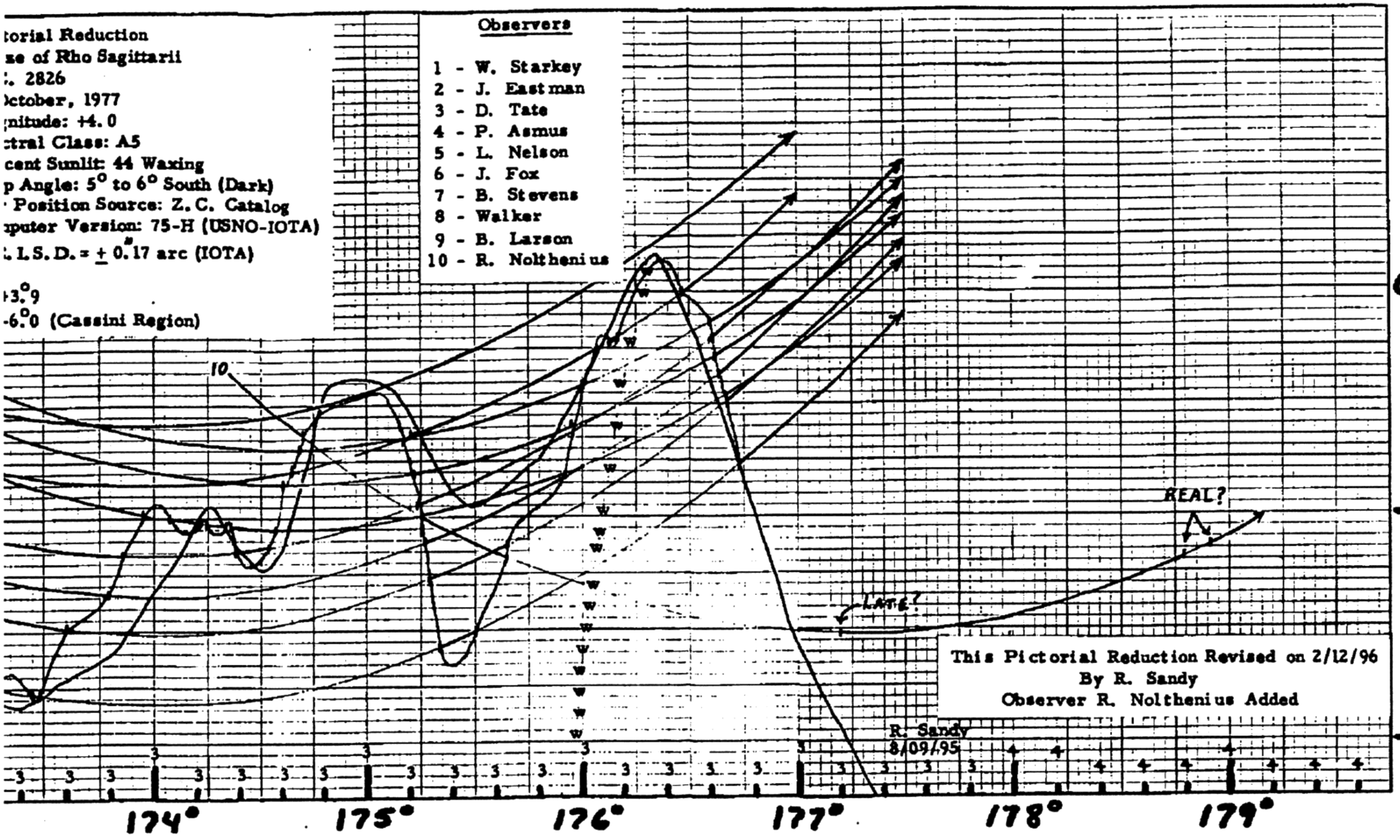
V. P. C. = 0."00 arc
H. P. C. = 0.°00 Watts Angle

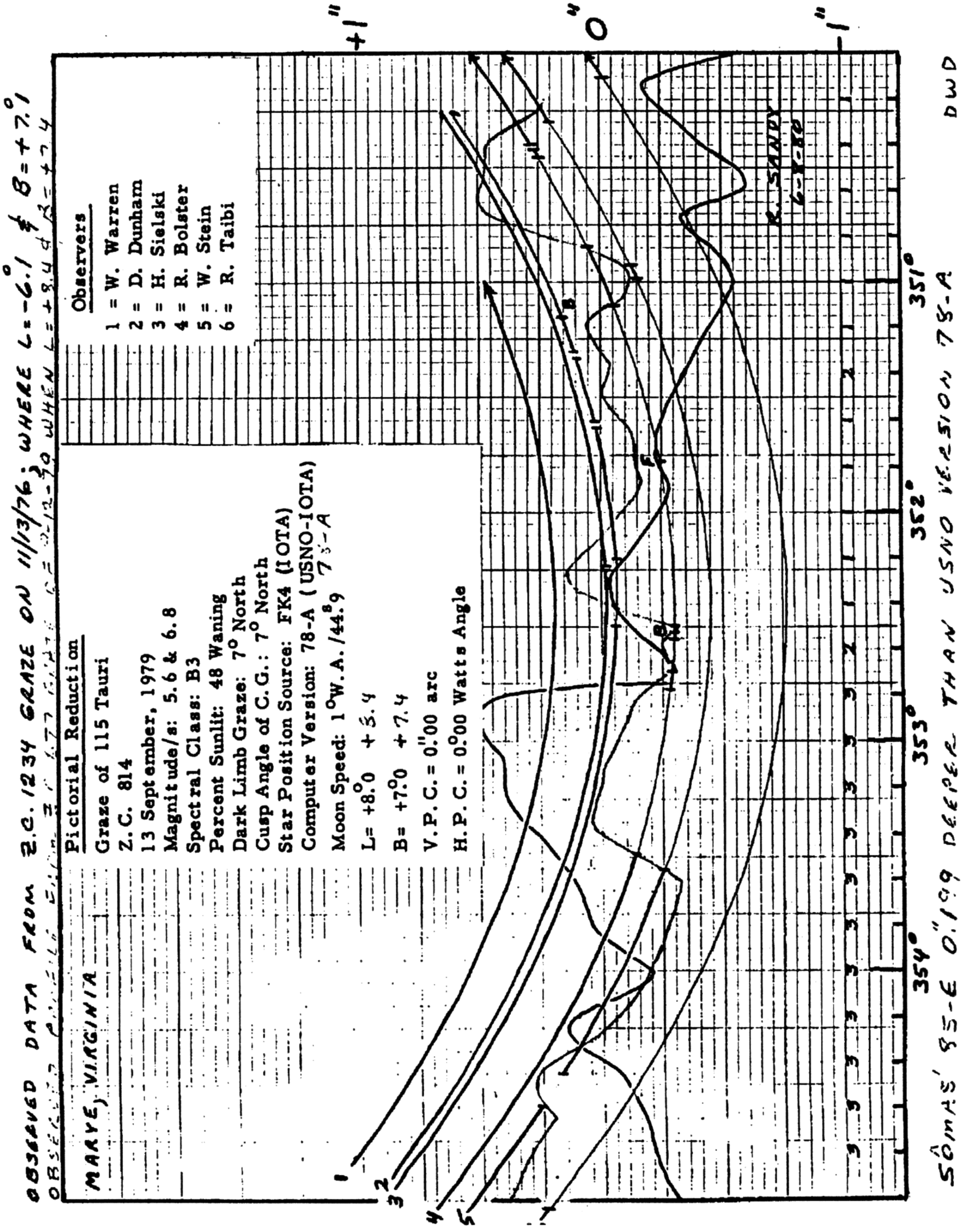
Drawn by Robert Sandy
1-15-97


Riverton, Iowa
Pictorial Reduction
Graze of 29 Pi Leonis
Z.C. 1468
8 October, 1996
Magnitude: 4.9
Spectral Class: MO
Percent Sunlit: 16 Waning
Partly Dark-Sunlit Graze: 1.1 BB
Star Position Source: J2000 (Sôma)
Computer Version: 85-E (Sôma)
P.E.I.S.D. = ±0''01 arc (I.O.T.A.)
Moon Speed: 1° Axis Angle/36.5s
L= -0.13°
B= +4.67°
VPC= 0''00 arc
HPC= 0.00° A.A.
Observers
1 - N. Reuss
2 - G. Allen
3 - R. Sandy
4 - D. Neuenschwander
Drawn By R. Sandy
10/26/96
SUNLIT
SUNLIT
1
2
3
4
3"
2"
1"
0"
-1"
170°
171°
172°
173°
174°
175°
176°
177°
178°
179°


Sôma's Version 85-E is 0.''246 DEEPER than U.S.N.O.'s Version 78-A and 0.''026 DEEPER than Version 80-C
D.W.D.
Boron, California
&
Kramer Hills, California
Pictorial Reduction
Graze of 119 Tauri (Z.C. 832)
19 April, 1980
Magnitude: 4.7
Spectral Class: MO
Percent Sunlit: 21 Waxing
Cusp Angle of C.G.: 1° N.
Star Position Source: J2000 (Sôma)
Computer Version: 85-E (Sôma)
P.E.L.S.D. = ± 0.''21 arc (Sôma)
Moon Speed: 1° W.A. /33.°0
L= +6.°4
B= +6.°3
V.P.C. = 0.''00 arc
H.P.C. = 0.°00 W.A.
OBSERVERS
RN = R. Nolthenius
RL = R. Lasher & P. Harvey
BF = Bob Fisher
CE = C. Evans
RN
RL
BF
CE
+1"
0"
-1"
= Pre-graze ACLPPP based on observed data taken from graze of ZC 1234 on 11/13/76
= Observed Profile
Terminator
Drawn by R. Sandy
2/12/97
6°
5°
4°
3°
2°
1°


Walnut, California
&
Pinon, Colorado
&
Austin, Minnesota
Pictorial Reduction
Graze of Rho Sagittarii
Z. C. 2826
19 October, 1977
Magnitude: +4.0
Spectral Class: A5
Percent Sunlit: 44 Waxing
Cusp Angle: 5° to 6° South (Dark)
Star Position Source: Z. C. Catalog
Computer Version: 75-H (USNO-IOTA)
P. E. L S. D. = ± 0.″17 arc (IOTA)
L= +3.°9
B= -6.°0 (Cassini Region)
Observers
1 - W. Starkey
2 - J. Eastman
3 - D. Tate
4 - P. Asmus
5 - L. Nelson
6 - J. Fox
7 - B. Stevens
8 - Walker
9 - B. Larson
10 - R. Nolthenius
Predicted Profile From
Observed Datum During
Graze Of Z. C. 2826 On 11/25/76
When L= +6.°0 and B= -6.°0
1
2
3
4
5
6
7
8
9
10
172°
173°
174°
175°
176°
177°
LATE?
R. S.
8/09


torial Reduction
ze of Rho Sagittarii
. 2826
October, 1977
nitude: +4.0
tral Class: A5
cent Sunlit: 44 Waxing
p Angle: 5° to 6° South (Dark)
Position Source: Z.C. Catalog
puter Version: 75-H (USNO-IOTA)
L.S.D. = ± 0."17 arc (IOTA)
+3.°9
-6.°0 (Cassini Region)
Observers
1 - W. Starkey
2 - J. Eastman
3 - D. Tate
4 - P. Asmus
5 - L. Nelson
6 - J. Fox
7 - B. Stevens
8 - Walker
9 - B. Larson
10 - R. Noltheni us
10
REAL?
LATE?
This Pictorial Reduction Revised on 2/12/96
By R. Sandy
Observer R. Nolthenius Added
R. Sandy
8/09/95
0"
-1"
-2"
174°
175°
176°
177°
178°
179°



Pictorial Reduction

Graze of 115 Tauri
Z.C. 814
13 September, 1979
Magnitude/s: 5.6 & 6.8
Spectral Class: B3
Percent Sunlit: 48 Waning
Dark Limb Graze: 7° North
Cusp Angle of C.G.: 7° North
Star Position Source: FK4 (IOTA)
Computer Version: 78-A (USNO-IOTA) 75-A
Moon Speed: 1°W.A./44.9
L= +8.0° +3.4
B= +7.0° +7.4
V.P.C. = 0."00 arc
H.P.C. = 0.°00 Watts Angle

Observers

1 = W. Warren
2 = D. Dunham
3 = H. Sielski
4 = R. Bolster
5 = W. Stein
6 = R. Taibi

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