Occultation Newsletter

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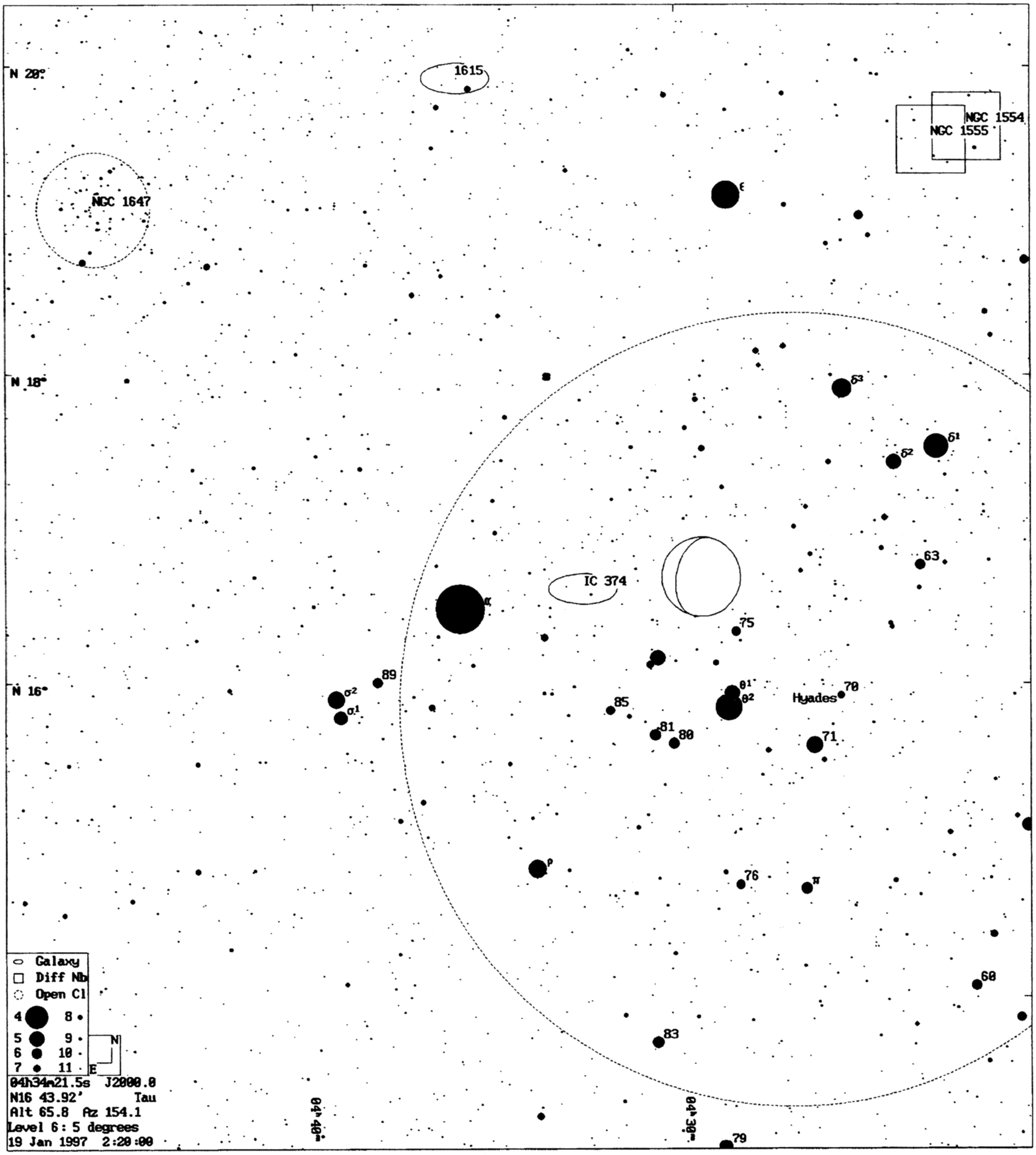

In This Issue

For subscription purposes, this the third issue of 1996.

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

On the cover: The approaching graze of Aldebaran in North America on 1997 January 19. This star field was printed from Guide v5.0 from Project Pluto.

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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Hydrographic Department
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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 lower left)

ON Publication Information

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IOTA News

David W. Dunham

IOTA Meeting: The 14th annual meeting of the International Occultation Timing Association was held at the Lunar and Planetary Institute in Houston, Texas, USA, on Saturday, 1996 December 6, as announced on p. 257 of the last issue. Topics discussed at the meeting included:

IOTA status in USA and Europe
- Work of the officers
- Financial report
- IOTA information on the World Wide Web
- The IOTA Observing Manual
- Next year's elections, meeting, and other business IOTA's plans for the Hipparcos star catalog data
- XZ94E lunar occultation catalog
- Comprehensive Zodiacal and all-sky catalog to about 12 mag.
- Asteroidal occultations for sizes, shapes, and orbit improvement

Past events
- The 1995 October solar eclipse (video)
- The 1994 November 29 Spica graze in Japan (video)
- Improvements from previous grazes of the same and different stars
- Aldebaran
- rho1 Sgr., 6 Leo, alpha Cnc, and others
- Recent asteroidal occultations observed in Japan, Europe, and U.K.
- The 1996 lunar eclipse graze efforts
- Other events

Events of December 1996
- Pi Arietis & Perseverantia, December 10-11, and other events by I. Sato
- The 704 Interamnia occultations on December 15 and 17
- The December 22 Aldebaran graze

Events of 1997
- Occultations and Grazes of Aldebaran and other bright stars
- Grazes of Saturn and other planets
- Lunar eclipse grazes
- Asteroidal occultations

Plans for expeditions
- March 9 total solar eclipse (N. and S. Limits, GPS)
- DGPS site survey expedition to Baja
- 1998 February total solar eclipse
- 1999 February annular solar eclipse
- 1999 August total solar eclipse
- Other

Work that is still waiting to be completed
- Lunar profile improvement from grazes and Clementine
- Solar eclipse observation analysis
- IOTA Manual
- Other

Action items
- Predictions and software
- Analysis of past observations
- Organization of expeditions
- Other

ESOP 15: The 15th meeting of the European Symposium on Occultation Projects was held in Berlin last August 23-27, as announced in *ON* (vol. 6, no. 9, pp. 191-193). A report of the meeting, in Dutch, was published in the most recent issue of *OCCULTUS*, the publication of the Dutch Occultation Association.

IOTA Manual: Completion of the draft *IOTA Manual* will be a high priority item as soon as the 1997 predictions are all in order. We have another high priority job to do during early 1997, and that is the reduction of all asteroidal occultation observations and some star catalog work associated with the Hipparcos mission. We have some funding from NASA for that, and Wayne Warren will be doing much of that work. But he is also key for the manual. Hopefully, we can have a publishable, updated manual ready sometime in March. In the meantime, Rob Robinson has put a .ZIP file with an ASCII version of the current draft manual at a hidden location (that is it can't be found from the IOTA public pages or accessed at all without knowledge of the exact URL) on the Web, just for the benefit of *ON* subscribers. The URL is **http://www.sky.net/~grazebob/occman.zip**. It is left in .ZIP format for downloading only, the size is about 112 KB. It has some drawbacks: It is still out of date, it doesn't include the figures that are important for understanding the prediction process, and there are special non-ASCII characters (for example, for degrees and for overstrikes) in the original that were translated into garbage characters when the ASCII version was created. And it's just a file; those retrieving it would have to print their own hard copy, or just print parts of it, after expanding it with *PKUNZIP* from PKWare at **http://www.pkware.com**. But having it as a file is useful for searching on key words to look something up.

Once the *final* manual is produced, IOTA has decided upon the following rules for its distribution: Any full member who wants one will be sent one immediately. But the manual must be requested. Subscribers may purchase one at cost plus shipping. Honorary and complimentary should not receive one unless they have paid for it or by special decision on each case.

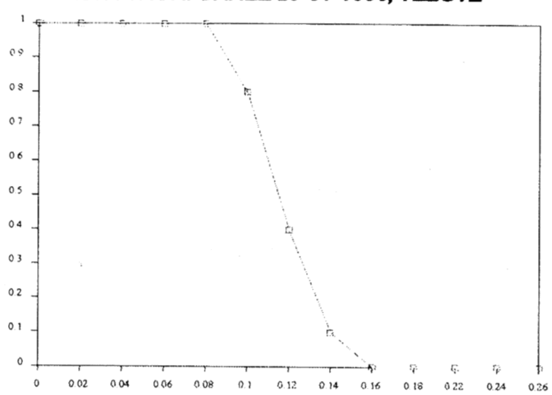
IOTA Roster: Rex L. Easton and the McManuses are working on an IOTA roster that will probably be distributed with the next *ON*. It will be most welcome to replace the last outdated May 1993 roster. ι

Δ^1 Tauri, a Multiple Star Occultation?

Jean Bourgeois

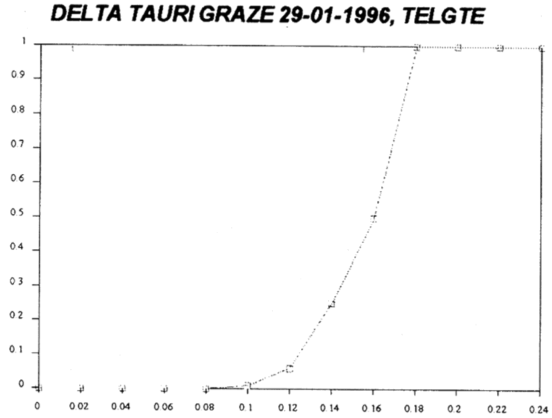
A grazing occultation of Δ^1 Tauri occurred in Europe on 1996 Jaanuary 29 at the Northern lunar limb. Stations from the Netherlands, Germany and Slovaquia recorded a total of 110 timings. Due to excessive cold, only two observers could record this graze videographically, Jan Boonstra in the Netherlands, and myself in Germany, where I participated in an expedition lead by Dr. Eberhard Bredner.

DELTA TAURI GRAZE 29-01-1996, TELGTE



BRIGHTNESS RATIO D1

DELTA TAURI GRAZE 29-01-1996, TELGTE



BRIGHTNESS RATIO R1

Figure 1 shows the evolution of brightness with time during disappearances (D2, D3, D5) and reappearances (R2, R3, R5) on my record. Moreover, one short flash culminated at an intermediate brightness. In my opinion these curves are not only due to a broadening diffraction pattern or to a finite star diameter, but they seem to indicate this star to be multiple. Boonstra's record shows a similar pattern for only one disappearance. Apparently he was not situated at the same critical place where I could record so many fluctuations.

The equipment I used (18 cm Cassegrain telescope and Philips CCD camera) and the sky condition during the observation allowed a limit detection of magnitude 8.5.

Δ^1 Tauri has the J code, meaning a one-line spectroscopic binary, with a probable separation inferior to 0.01". Could I have recorded the spectroscopic companion? Or could this star be more complex than it was thought to be? Marcel Wilmet helped me in gathering information about this star via the Internet. Many correspondents gave us a lot of references, among which D. Dunham, D. Peterson, R. Robinson, W. Warren, R. Griffin, W. Hartkopf, B. Sandy, A. Heck, R. Soubie and others. I thank all of them very much for their collaboration.

It turns out that:

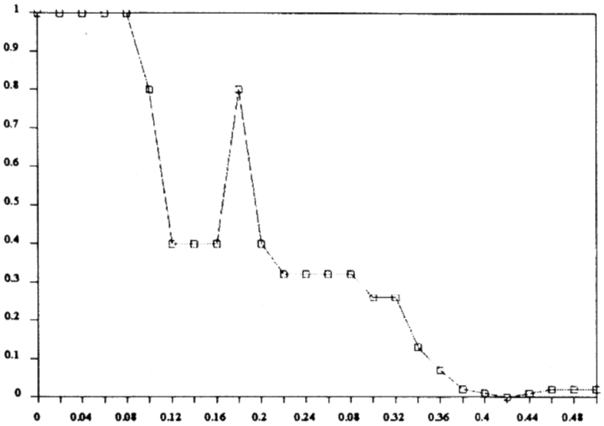
1. Δ^1 Tauri was never observed as double in normal or grazing occultations.
2. Δ^1 Tauri is a wide double star, with a magnitude 13.0v companion at a distance of 195.5" and a pole angle of 338° (WDS, observation of 1959). This component is obviously not recorded in our observation.
3. Δ^1 Tauri is a one-line spectroscopic binary, observed for 25 years by R. Griffin. He concludes this star has a faint companion with a probable magnitude 13, orbiting with a period of 529.8 days (R. F. Griffin and J. E. Gunn, AJ, 82, 176-177).
4. Δ^1 Tauri was once observed as a speckle binary with a separation of 0.273" by Mason in 1991.9 (B. D. MASON, H. A. McAlistor, W. I. Hartkopf and W. G. Bagnuolo, AJ, 105, 220).

This last observation is astonishing. At a distance of 40 parsec, the period would be about 20 years, and R. Griffin did not observe any evidence for such a period. This could be explained if the orbit plane is perpendicular to our line of sight, but it is then hard to understand why other speckle observers could not separate this component in the past.

Other observations with speckle interferometry and occultations are necessary to better understand this stellar system. The ecliptic latitude of Δ^1 Tauri allows lunar occultations only during periods of several years in a series. René Bourtembourg used his program to predict the grazes in the present series. Here are some of the best observable ones:

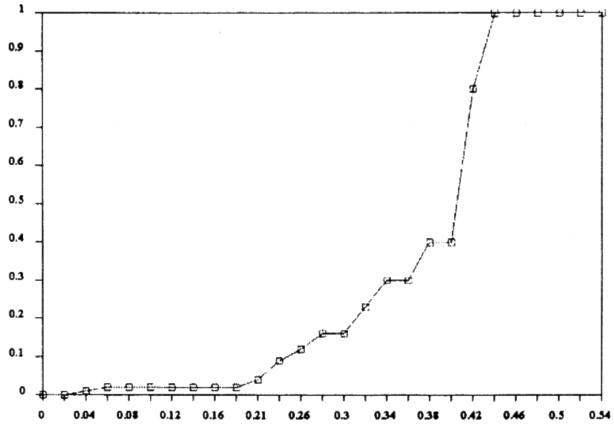
Date	Limb	Location
19-08-95	South	France, Germany, Poland
15-09-95	South	USA
12-10-95	South	China, Japan
06-12-95	South	USA
29-01-96	North	Ireland, England, the Netherlands, Germany
	South	Columbia, Venezuela, Mauritania, Mali
20-04-96	North	Florida
04-09-96	North	Peru, Brazil
01-10-96	North	Australia, New Guinea
18-01-97	North	Brazil
10-04-97	North	Chile, Argentina
15-11-97	North	South Australia
12-12-97	North	South Africa
27-01-99	North	Chile, Argentina
23-02-99	North	New-Zealand
		(continued)

DELTA TAURI GRAZE 29-01-1996, TELGTE



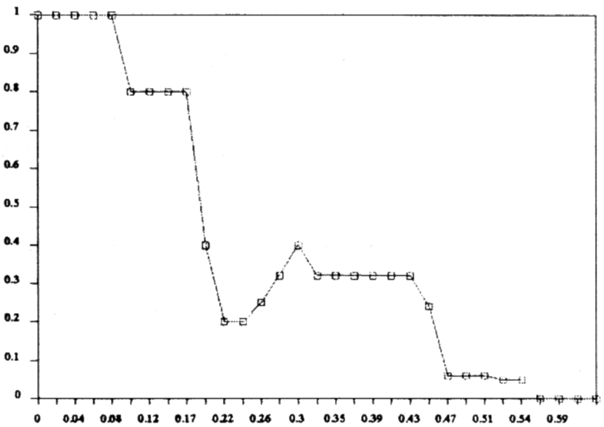
Brightness ratio D2

DELTA TAURI GRAZE 29-01-1996, TELGTE



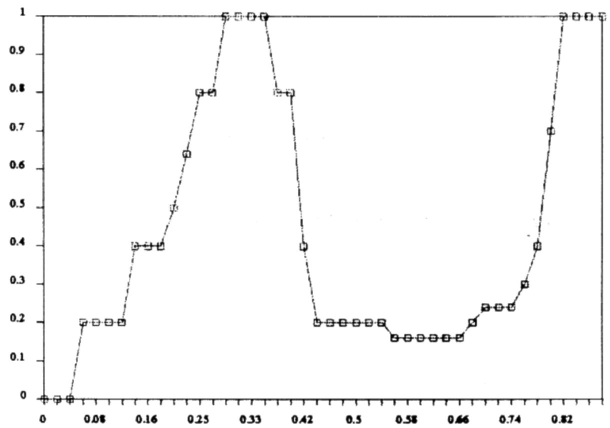
Brightness ratio R2

DELTA TAURI GRAZE 29-01-1996, TELGTE



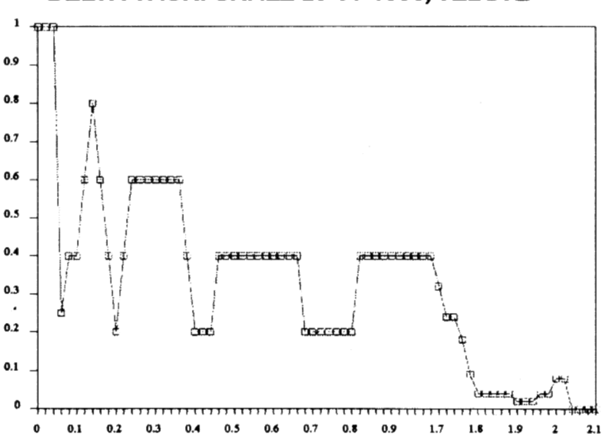
Brightness ratio D3

DELTA TAURI GRAZE 29-01-1996, TELGTE



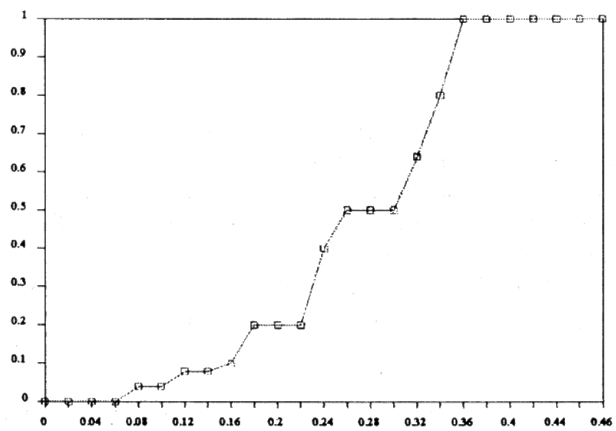
Brightness ratio R3

DELTA TAURI GRAZE 29-01-1996, TELGTE



Brightness ratio D5

DELTA TAURI GRAZE 29-01-96, TELGTE



Brightness Ratio R5

Date	Limb	Location
18-04-99	North	Peru, Bolovia
29-09-99	North	South Africa, Madagascar
27-10-99	North	Columbia, Venezuela
	South	Chile, Argentina, Brazil
23-11-99	North	Thailand, Vietnam
	South	Australia
21-12-99	North	Nicaragua
	South	Chile, Argentina, Paraguay, Brazil
17-01-00	North	Thailand, Vietnam, Philippines
	South	Australia
23-08-00	South	Bolivia, Brazil
19-09-00	North	Canada
	South	Baja California
16-10-00	North	Siberia
	South	South India, China, Japan
13-11-00	South	Costa Rica, France, Europe
06-01-01	South	France, Italia, Greece, Turkey
03-02-01	South	Japan
02-03-01	South	England, Sweden, Finland, Siberia

Northern limb grazes would be the most favorable to detect the possible multiplicity of Δ^1 Tauri. Video or photometric observations in Florida of the 1996 April 20 graze at the Northern limb are very much welcomed!

Once again many thanks to all the Internet correspondents, Marcel Wilmet, René Bourtembourg and Jean Schwaenen, and to Henk Bulder for his helpful comments. ι

A Successful DGPS Experiment

David W. Dunham and Gary Frishkorn

During a grazing occultation of SAO 95090 on 1995 May 4 observed north of Westminster, MD, USA, Gary observed from a site along a new road far from any landmarks shown on the 7′.5 USGS map of the area. All of the other observers were at sites whose positions can be measured well from the 7′.5 map. So before the 1996 April 10 Westminister Astronomical Society meeting, held at a location near where the graze was observed, Gary went back to his location with David's Global Positioning System (GPS) receiver, and Ray Sterner used Tom Van Flandern's similar receiver at Curt Roelle's site, whose position could easily be measured from the USGS map and which was close to the meeting point intersection used for the graze. They made simultaneous measurements so that differential GPS positions could be determined. Gary's site was west and a little north of Curt's (Ray's) site. The receivers were the US$1,200.00 Motorola PV6-EVAL model that works with laptop PC's described in *ON* (vol. 6, no. 6, p. 135).

David did a quick check of the .POS files that Gary and Ray recorded, and everything looked good. They did record simulaneous data, also the more detailed binary .ALL and .BIN files, which we don't know how to process. But looking at the .POS files, which are ASCII in a form that can be read with spreadsheet software, we noticed that both used the same 6 satellites for the position solutions, and all six were locked on well (code 8). Each recorded two .POS files, for two minutes each time taking observations at 1-second intervals, starting at 22:55 and 23:02 UTC. Gary used spreadsheet software to process the two pairs of files to obtain the following differences in the positions of the two stations:

Start UT		Mean Value	Max. Dev.
22:55	$\Delta\lambda$	36″.98 ±0″.03	0″.06
22:55	$\Delta\phi$	4″.71 ±0″.01	0″.03
22:55	Δh	2.13m ±0.97	2.50m
23:02	$\Delta\lambda$	36″.97 ±0″.03	0″.05
23:02	$\Delta\phi$	4″.61 ±0″.03	0″.05
23:02	Δh	0.38m ±1.10	2.04m

$\Delta\lambda$, $\Delta\phi$, and Δh are the differences between the station longitudes, latitudes, and heights, respectively. "Max. Dev." is the maximum deviation from the mean value. The largest differences between the two times that data were taken was 0″.10 = 3m in latitude, which is typical of the accuracy of a single DGPS measurement for close stations (DGPS accuracies of a few cm can be achieved with either longer data collection times, or with more sophisticated [expensive] receivers). But these accuracies are already much less than the accuracy of the USGS map (0″.4 or 12m for 95% of portrayed features), so they are certainly good enough for IOTA purposes, where errors as large as 30m (but NOT the 100m typical of single civilian receiver GPS measurements) are acceptable. This would also be valuable for future uses of this equipment, as well as the past use for the 1994 November solar eclipse. The equipment should also be tested over longer baselines, up to a degree and more of long. and lat. It would be convenient for future grazes in our area to keep one receiver at a known convenient base location (which we could use for other grazes as well, past and future) and use the other receiver as a rover to get the positions of all of the stations. If the rover and base could keep in touch with portable telephones, they could ensure simultaneous recordings and know when the same satellites were being used for the solutions. Two charts showing all of the differential measurements for one of the quantities listed above, are given on the next two pages. ι

4/10/96
22:55:00 - 22:57:00

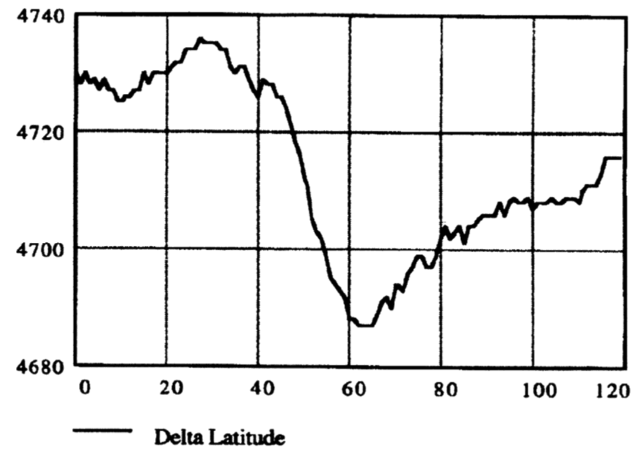
Number of Correlated Samples NC = 120

Latitude Data
(milli-arcseconds)

Mean_ΔLAT = 4.714· 10^3

MAXDev_ΔLAT = 26.567

STDev_ΔLAT = 14.708

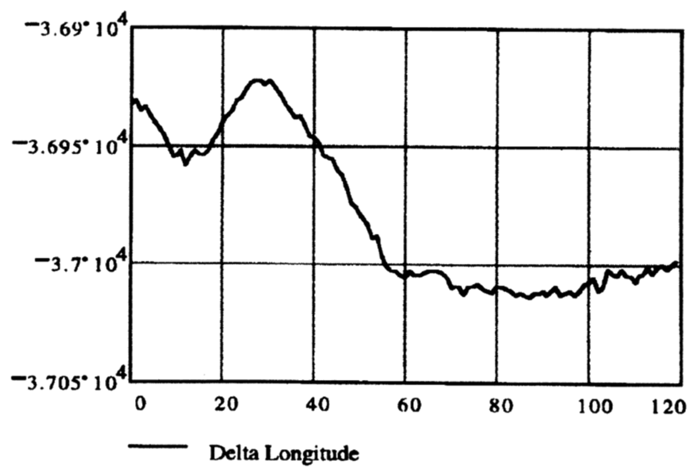


Longitude Data
(milli-arcseconds)

Mean_ΔLONG = −3.698· 10^4

MAXDev_ΔLONG = 57.3

STDev_ΔLONG = 32.568

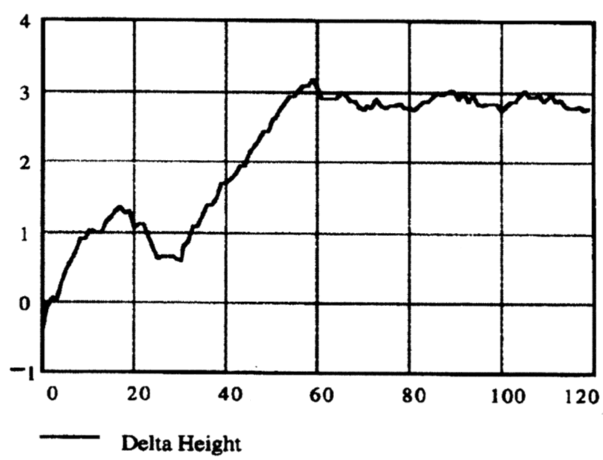


Height Data
(meters)

Mean_ΔHEIGHT = 2.13

MAXDev_ΔHEIGHT = 2.5

STDev_ΔHEIGHT = 0.966



4/10/96
23:02:00 - 23:04:00

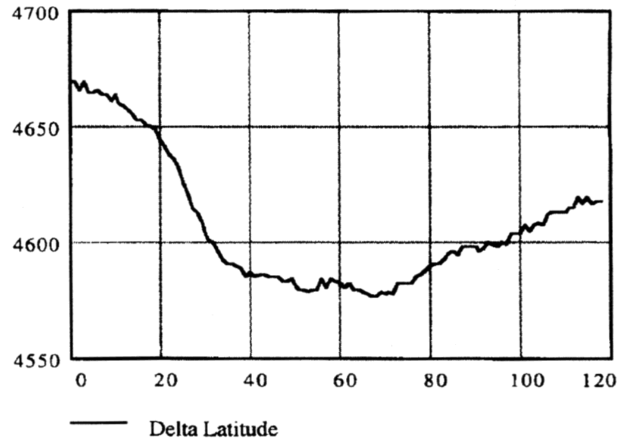
Number of Correlated Samples NC = 119

Latitude Data
(milli-arcseconds)

Mean_ΔLAT = 4.607· 10^3

MAXDev_ΔLAT = 61.588

STDev_ΔLAT = 28.186

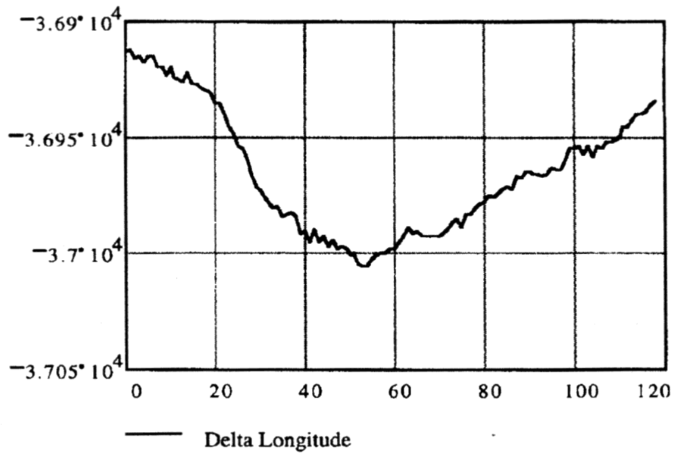


Longitude Data
(milli-arcseconds)

Mean_ΔLONG = −3.697· 10^4

MAXDev_ΔLONG = 53.319

STDev_ΔLONG = 27.157

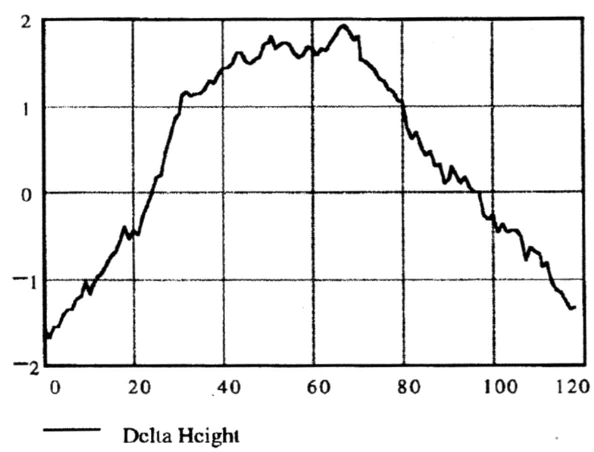


Height Data
(meters)

Mean_ΔHEIGHT = 0.375

MAXDev_ΔHEIGHT = 2.045

STDev_ΔHEIGHT = 1.103



Occultation of SAO 16342 by Comet Hyakutake

Isao Sato
National Astronomical Observatory of Japan
email: satoois@cc.nao.ac.jp

In 1983, Richard Nolthenius observed an unpredicted occultation of 8.7 magnitude SAO 98040 by the nuclear region of Comet IRAS-Araki-Alcock, but he was not prepared to time it accurately; see *ON* (vol. 3, no. 4, pp. 86-87). A couple of days in advance, Jim Hart of Pickering Anomalies predicted that the nucleus of Comet C/1996B2 (Hyakutake) would occult 6.7 mag. SAO 16342 = PPM 18962 on March 25 as seen from western Japan. I revised the prediction using Nakano's latest orbit and distributed information about it all over Japan. This resulted in the first timed occultation of a star by the opaque nuclear region of a comet.

The event was successfully observed visually at one site. Kunio Ikeguchi, at Yonago, Tottori, reported that the nucleus of the comet approached rapidly to the star from the south and the star disappeared abruptly (not gradually) at 18h02m50s UTC. After an extinction for one second or longer, the star reappeared and the nucleus went away. He saw the nucleus pass slightly aside of the star. The way of time keeping was JJY short wave time signal and eye-ear method (no recording). The telescope was a Meade 25cm Schmidt-Cassegrain (fl=1600mm) and the power was 88x. He has been an amateur astronomer for 30 years but not a skillful occultation observer.

Hiroyuki Toda, at Yoshozan, Okayama, recorded the near-miss of the event in video. Apparently, the star was considerably brighter than the nucleus, estimated at about 9 magnitude, and there was no evidence of a shallow extinction by the coma. The closest approach was 18h02m52s or 53s.

Shin-ya Narusawa, Nishiharima Astronomical Observatory, Sayo, Hyogo, also recorded the near-miss in video. The close approach was 18h02m54s and there was also no evidence of extinction.

Bisei Astronomical Observatory, Okayama made a photoelectric observation of the event. The record shows a shallow and gradual extinction around 18h02m45s, 7 seconds before the mid-time. But I do not believe this was true. They said that frequent thin clouds were passing during the observation, and there is no coincidence with the other observations.

Hidehiko Akazawa, Funaho, Okayama attempted a photoelectric observation of the event, but there was no occultation and the attempt was strongly affected by the clouds.

Kuma Kogen Observatory, Ehime must have been located just on the center of the occultation track, but it was cloudy there.

From these observations, I believe the observation by Ikeguchi is true and the coma was optically thin even around the nucleus. The occultation chord shows the minimum diamter of 56km or larger. However, the diameter (if a sphere) should be larger than 65km in order to be coincident with the no occultation observations at Bisei and Yoshozan. Furthermore, if the ephemeris by Nakano is correct and identical to the center of the nucleus, the diameter is about 100km!

The absolute time of Ikeguchi's observation is 3 seconds (1 second is 56km and 0″.75) earlier than expected, using the star's catalog position. This large difference is difficult to explain by the size of nucleus or uncertainty of the ephemeris. However, the star was recently observed at Mitaka, and that resolved the problem. The occulted star is located 1″.4 south of the PPM catalog position. The star's observed position is: SAO 16342 = PPM18962 = GSC440301108, R.A.2000 =14h 19m 54.749s ±0".48, Dec.2000 = +67° 46′ 55″.70 ±0″.32. Therefore, the absolute time of Ikeguchi's observation is only 1.5 second earlier than expected. This is not difficult to be explained by the size of nucleus or the uncertainty of the ephemeris or observational error. So I believe that Ikeguchi's observation was true!

The orbital elements by Nakano are as follows:

```
     C/1996 B2 (Hyakutake)
Epoch 1996 Apr. 27.0 TT = JDT 2450200.5
T 1996 May 1.39617 TT                                          Nakano
q    0.2300536            (2000.0)            P                  Q
z  +0.0013539       Peri. 130.20662     +0.57803852       +0.80790230
    ±0.0000350      Node  188.04325     +0.23082257       -0.02701502
e    0.9996885      Incl. 124.91129     +0.78268283       -0.58869692
>From 569 observations 1996 Jan. 1-Apr. 2, mean residual 0".61.
```

The positions of the observers mentioned above (Tokyo Datum coordinates) are:

Observer	Location	Longitude	Latitude	Height
Ikeguchi K.	Yonago	133°20′58″E	35°26′33″N	10m
Akazawa H.	Funaho	133 42 43.3	34 34 42.6	8
Bisei A.O.	Bisei	133 32 52.1	34 32 52.1	
Yoshozan A.O.	Kamogata	133 36 41.3	34 34 00.5	365
Nishiharima	Sayo	134 20 19	35 05 54	446
Kuma Kogen	Kuma	132 56 39.1	33 40 26.8	620

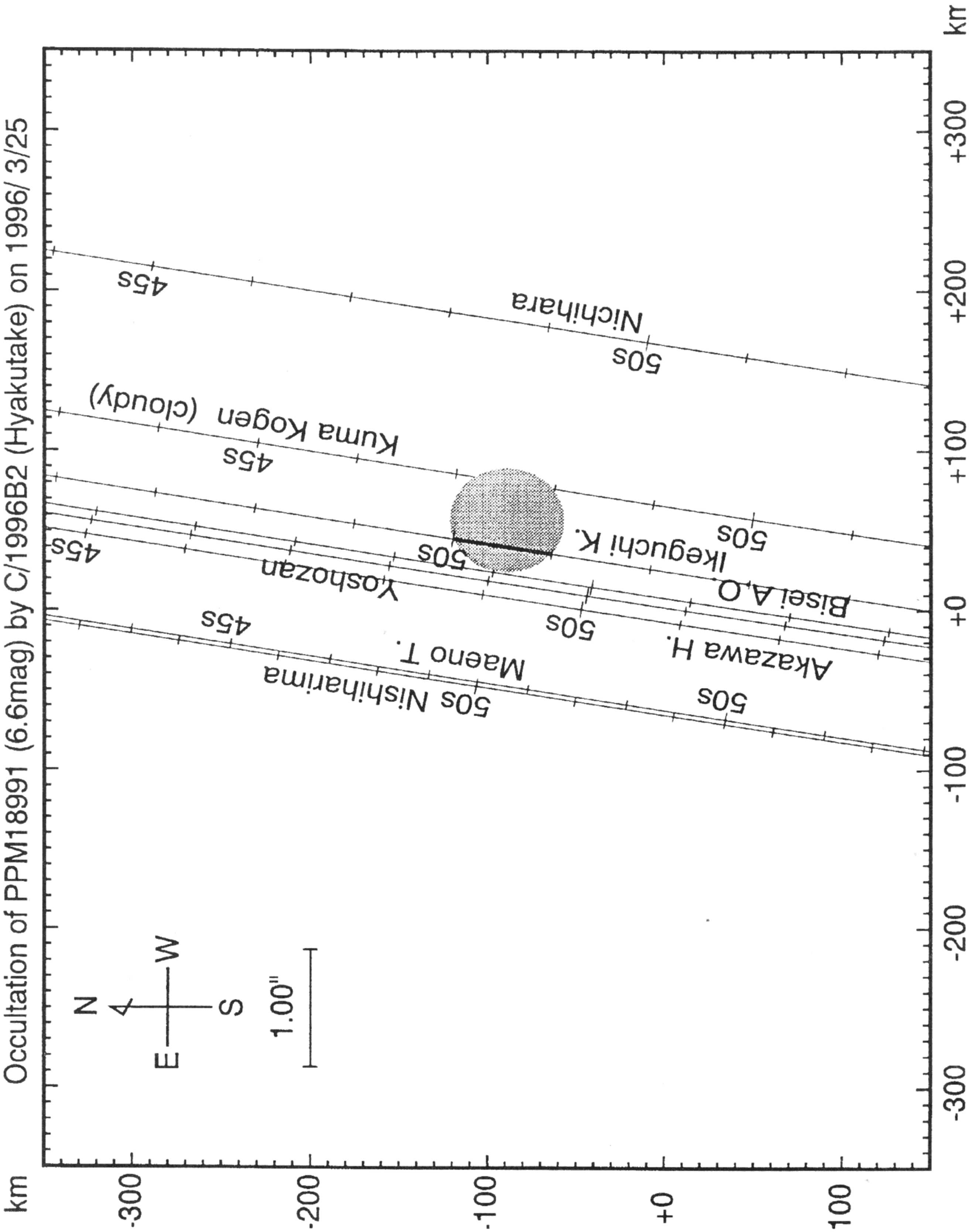
The result of the reduction is shown in the figure on the next page.

The assumed size of nucleus is very large compared with Halley. The angular diameter of the nucleus was almost 1 arcsec at the close approach to the Earth on March 25. So the residuals of the astrometry may include some systematic variations caused by the rotation of the nucleus and the phase effect. The photocenter is NOT the center of the nucleus! (Brian Marsden makes the following important remark about this observation: Thanks for your account of the occultation. I still think that the occultation must have been by dense inner coma. There is no way the nucleus could be as large as 65 km. My early guess had been "less than 5 km". Steve Ostro's recent radar detection indicates only 1-3 km, a range that certainly does not surprise me.)

Lunar Occultations of Planets in 1997

David W. Dunham
Joseph Senne
David Herald
Eberhard Riedel

The maps, published on pages 268-273 of the last issue, show the regions of visibility of lunar occultations of planets and are reprinted by permission, from the Japanese Ephemeris for 1997, published by the Hydrographic Office of the Maritime Safety Agency of Japan. In region 1, only the reappearance is visible; in


Occultation of PPM18991 (6.6mag) by C/1996B2 (Hyakutake) on 1996/ 3/25
Nichihara
Kuma Kogen (cloudy)
Ikeguchi K.
Bisei A.O.
Yoshozan
Akazawa H.
Maeno T.
Nishiharima
45s
50s
km
X
+300
+200
+100
+0
-100
-200
-300
100
N
S
E
W
1.00"

region 2, the entire occultation is visible; and in region 3, only the disappearance may be seen. Reappearance occurs at sunset along a dashed curve, while disappearance is at sunrise along a curve of alternating dots and dashes. We have added a label to each map indicating the phase of the Moon at event time.

Predictions of lunar occultations of planets are not included in the IOTA PC-Evans total occultation predictions for 1997. For 1997, they need to be computed with OCCULT.

Grazes of the major planets are now included in IOTA's regular graze predictions of stars produced by the Grazereg program. However, these predictions are for the center of the planet, and not for the inner edge of the partial occultation zone, which is where the most interesting graze like phenomena, and the partial occultation with maximum duration, occur. Those interested in observing partial occultations should request predictions at least three months in advance (if possible) from Joseph Senne; P.O. Box 643; Rolla, MO 65401; U.S.A.; phone 1-314-363-6233; e-mail Senne@umr.edu. Senne will not be able to compute predictions from 1996 December 15 through 1997 mid January. It is no longer possible to supply the necessary information to produce data for producing ACLPPP profiles of grazes of the planets, so now they must be generated with OCCULT. OCCULT version 4.0, which will be available by the time this issue reaches you, can compute the inner or outer edges (that is, the north edge for southern limits, or the south edge for northern limits) of the partial occultation zone, but earlier versions of OCCULT only compute the graze for the center of the planet (that is, the center of the partial occultation zone). ι

Grazing Occultation Observations

Richard P. Wilds

We begin this month's report once again with some housekeeping chores. When reporting grazes keep in mind you can mail them to me in the following forms: 1. Electronically using the E-Mail 76 format by e-mail or on 3.5 or 5.25 inch floppy disk; 2. On paper using the IOTA report form.

Please remember to include all the information found in the graze list. A large number of graze reports are not being published due to a lack of appropriate information. If you sent me a report and it is not in the list, then I would suggest careful reading of the following. The shift is the most important information. If the shift is not included, then your report can not be used. The reason for this is that without the shift your report is just not helpful to the next graze team to go out and observe. Many observers send me a copy of their predictions. This is excellent and it is even better if you have the observing sites plotted on the profile as they were predicted before the event and compare this with what was observed. This is, of course, the information needed to determine the shift. The predictions are also a help in preparing the "Stellar Cross Reference." I have access to a vast array of astronomical databases and can track down many objects, but the predictions just make this job easier. Also remember the "PP" column on my report is not a column on the IOTA report form. This is a temporary fix to the current problem of having several different prediction programs around while we are in a state of transition from the USNO. However, the "PP" information is needed just like the shifts, if your reports are to be useful to the next graze team going out to make an observation. I would like to thank all organizers for making this report a valuable tool to graze teams world wide.

The current graze list begins with several grazes from back in 1995. It was good to hear that Donald Stotz managed to get another videotape of the Rho Sgr. graze back in November of 1995. This list also includes several grazes from the September 1996 Lunar Eclipse. Craig A. McManus and I had to drive to central Nebraska to get clear skies for the eclipse. We broke out of the cloud cover just an hour before the event. The other SAO 109119 eclipse graze observation was submitted by Robert Sandy, but it was observed by George Allen who lived near the observation sites. Mr. Sandy did not go due to the cloud possibilities, but he got the information to Mr. Allen in time to make the observations. Mr. Allen sent the results back to Mr. Sandy, who then submitted the formal report in the appropriate format. We hope to report later on the successful grazes of this star that we know from e-mail reports to have been observed further west. Unfortunately the NASA effort to South America to observe the same star at the southern limb of the moon did not have success. They reported the star in view until one minute before the graze. Then clouds covered the moon and star and no data was collected. There goes another attempt to make an accurate measure of the polar diameter of the moon, but it was not without an honest effort by all involved. We would like to end this graze list article with an action and information report from John Holtz. He includes an interesting idea about reducing observations with the help of a computer.

Succeeding in Spite of it All

John Holtz JWHoltz@aol.com

During our early morning expedition for the 1996 October 4 graze of 26 Geminorum, we experienced the usual problems: complete cloud cover until minutes before the graze, broken clouds during the graze itself, poor seeing, etc. To make matters worse for one member of the expedition (Martin Ratcliffe), his radio was not receiving any time signals. Was it a "wasted trip" for him? Fortunately, it was not. Each member had CB radios which we used to communicate with each other as the caravan took up positions along the graze path. After setting up, Martin was able to contact another member, Ed Honkus, via the CB. Ed was receiving WWV, so he broadcasted short segments of WWV over the CB. During the event, I heard Ed and Martin calling back and forth "What time is it Ed?" and "(beep) (beep) (beep) . . . That was 8:12 UT." (Realize that they did all of this without looking away from the eyepiece!) In spite of these extra distractions, both were able to get some good data. The next problem was to analyze Martin's tape which had only sporadic time references. Doing the interpolations the *old fashion way* would have been time consuming and not necessarily enjoyable. You play the tape several times and use a stop watch to interpolate each call out. I found a much easier analysis method using my computer. It came pre-loaded with a software packaged called Creative WaveStudio.. This program acts like a tape recorder, but it has two advantages well suited for occultation analysis:

- It displays the waveform, so you can *see* the events.
- The cursor's position can be displayed in milliseconds.

Lunar Grazing Occultation Results

UT Date	V	P			%			#	#	S	Ap			N		
yymmdd	P	P	Star #	Mag	Snl	CA	Location	Sta	Tm	S	Cm	Organizer	Sh	S	WA	B
95/04/27		A	117751	5.3	63	4.6N	Pine Prairie, Texas USA	3	8	1	11	Wayne Hutchinson	0.7	S	2	6.2
95/11/26	V	A	162512	3.9	15	4.9S	Venus, Texas USA	5	28	1	8	Donald Stotz	0.3	S	171	-6.0
96/05/21		A	96786	7.3	16	1.5S	L'Ordal, Spain	3	13	2	20	Carles Schnabel	0.0		187	7.3
96/09/04		A	93934	8.0	55-	6.5N	Port St. Lucie, Florida USA	1	4	1	41	Hal Povenmire	0.1	N	359	6.1
96/09/27	V	A	109119	6.4	00E	82.0U	Mason City, Nebraska USA	2	6	1	25	R. Wilds	0.4	N	2	0.5
96/09/27		A	109119	6.4	00E	82.0U	Union Center, Iowa USA	1	2	1	15	Robert Sandy	0.4	N	2	0.5
96/09/27		A	109117	9.1	00E	?	Vero Beach, Florida USA	1	9	1	41	Hal Povenmire	0.2	S	179	0.5
96/10/04		A	96015	5.1	52-	5.0N	Navarre, Ohio USA	3	25	1	15	David Gill	0.0		355	7.3
96/10/04		A	96015	5.1	52-	4.8N	Portersville, Pennsylvania USA	4	19	2	14	John Holtz	0.0		356	7.3
96/10/07		A	98382	7.7	24-	4.5N	Washington, Pennsylvania USA	1	5	1	25	John Holtz	0.0		352	-5.8
96/10/31		O	95337	6.4	79-	7.2N	Torres Vedras, Portugal	1	2	2	20	Rui Goncalves	0.5	N	357	7.1

Stellar Cross Reference and Lunar Topography
from *WATTS Charts: Marginal Zone of the Moon*

SAO #	ZC #	Other Ref.	Lunar Feature Name
117751	1410	6 h Leo	The Crater Rozhdestvenskiy.
162512	2826	Rho Sgr	The Mountain Doerfel B and the Crater Zeeman.
96786		X10911	The Mountain Leibnitz B and the Crater Scott.
93934		X5731	The Crater Plaskett.
109119	35	98B. Psc	The Crater Hermite.
109117		X301	The Mountain M2, The Crater Cabeus and the Mountain Leibnitz A.
96015	1029	26 Gem	The Crater Plaskett.
98382		X13874	The Crater de Sitter.
95337	934		The Crater Plaskett.

Plus you get all of the nice features expected from a fancy program, such as:

- You can highlight a segment of the recording and play it over and over. No more rewinding or fast forwarding the tape!
- If the time signal recording is strong and clear, the time ticks are visible in the wave form! This makes it very easy to establish the time of the call out. Even if the individual seconds are not visible, you can still use the cursor to read off the time index and correlate this to the real time heard in other parts of the recording.
- It's easy to separate events that happen in rapid succession. No longer do I have to listen to the tape 20 times to get it straightened out.
- If you want to archive your recording, just cut and paste the sections you want and save it to a disc.

This procedure would also work well for cases where an expedition member without a time source uses a local radio station for their time source. Someone else creates the master time source by recording the time signals along with the local station. Now, you have two tapes to analyze, which normally would be double the amount of work (i.e., *a real drag*). But, by loading the appropriate segments from each tape into the computer, it's very easy to compare the two recordings and establish the time of each event. This process is easy and virtually eliminates the guesswork of your call outs. In fact, I may start using it for my total occultation timings! Now if the reaction time could be eliminated . . .

REMEMBER to apply the following shifts, which past experience has shown to be useful when using the ACLPPP (version 80N), Riedel's GRAZEREG and Herald's OCCULT profiles: See your hemispheric grazing occultation supplement for 1996 for Northern limit--Page 9, and for Southern limit--Page 10. ı

Reports of Asteroidal Occultations in 1994

Jim Stamm

If you do not have a regional coordinator who forwards your reports, they should be sent to me at the address listed in "What to Send to Whom" at the beginning of this issue. Names and addresses of regional coordinators are given in "IOTA Publicatons" also at the beginning of this issue. All times in this report are UTC.

Beginning with this issue we are publishing only those events that include positive reports. All reports that I receive (including negative and partial) will be archived and made available to any member who requests them. This new policy should permit faster reporting here and make it easier to analyze those events with more useful data.

When an occultation is reported, we will collect all of the information that we can as soon as we can, and then write it up for the *ON*, so your report (either positive or negative) should be sent to your coordinator as soon as possible.

1994 was a very sparse year for asteroidal occultations. The following list summarizes all of the reports that I have received that include positive observations:

January 20 P/Schwassman-Wachmann 1 and GSC 1918 0124. Roger Venable reported on this event in Dec. 1994. See *ON* (vol. 6, no. 6, p. 45).

February 16 (712) Boliviana and PPM 177438. D. Ewald reported a 7.4 sec. occultation beginning at 20:00:19.2 from Melchow, Germany. This was minutes sooner than predicted, and not in agreement with updated predictions from Uccle Observatory, which showed a 0".4 south shift.

March 9 (2060) Chiron and an 11.9 mag. GSC star. See *ON* (vol. 6, no. 2, p. 45).

March 11 (152) Atala and PPM 100177. Tatsuo Minobe recorded a 5.3 sec. dimming (2.5 mag.) beginning at 11:09:12.5, from Miyazaki, Japan.

March 14 (56) Melete and PPM 156834. Tony George reports that he was "99% confident of a 7 second occultation." The disappearance occurred at 07:33 from Umatilla, Oregon.

July 3 P/Shoemaker-Levy 9 and PPM 228372. A half magnitude 1.6 sec. blink was reported by A. Patak from Pecs, Hungary. Seven other Europeans also monitored the star

August 22 (1) Ceres and GSC 1909 1721. Two reports of a possible occultation come from Portimao, Portugal and Brest, France. The observation was difficult because of sky brightness and a small drop in magnitude, and the timings were not precise.

December 15 (336) Lacadiera and PPM 121569. Danie Overbeek has determined a lower limit of 52 km for the diameter of the minor planet from a 4.3 sec. occultation that he timed from Edenvale, South Africa, which began at 01:26:45.6. Misses were observed in Cape Town and Pretoria. ı

On Organizing an Asteroid Occultation Expedition

Richard Nugent
RNugent@ghg.net

While I have traveled to observe several asteroid occultations with Paul Maley and others, this past spring was my first opportunity to organize an asteroid occultation expedition. After receiving the February 1996 *Sky & Telescope* and later the Asteroid Occultation Supplement, I learned that 372 Palma was to occult the 9.7 mag star SAO 117650 on the evening of May 18 over west Texas--right during the Texas Star Party (TSP) at the Prude Ranch in Ft. Davis, Texas, USA! The occultation was scheduled for 11:53 P.M. Central Time on Saturday evening (the final night) of the week long TSP. With nearly 800 amateur astronomers attending TSP, this was surely looking like "asteroid occultation heaven." In not too many other places do you find several hundred observers with portable equipment and traveling gear.

This was one of the more favorable occultations this year due to the relatively bright star being occulted and the large 4.0 magnitude drop expected. Palma's estimated size is 195 km so its asteroidal "shadow" would cover a wide area on Earth during the occultation.

Prior to the event I had the Houston Astronomical Society (HAS), the Fort Bend Astronomy Club and the Johnson Space Center Astronomical Society place this event on their home web pages. I also prepared an 8 page handout for observers at TSP. I had began receiving requests for the handout in April and had mailed several out. I had e-mailed Bill Wren of McDonald Observatory (just 12 miles [19 km] from the Prude Ranch) and asked if he could observe with a photometer the occultation of Palma on the 30 inch [76 cm] telescope. Unfortunately, Bill had another observing commitment that evening.

When I arrived at TSP I had placed some large (2ft x 3 [60 cm x 91]) signs advertising the occultation and directing interested parties to my tent setup. At my tent, I had another large sign

"Asteroid Occultation INFO" and a packet containing the handouts. This way interested observers could take a handout and learn about these types of occultations (when, why, and how). On Thursday I scheduled a meeting of observers and we went over the plan and strategy and where we would station ourselves. Most everyone was relieved that the occultation would occur after the "Great Texas Giveaway" on Saturday night following the main speaker and yearly observing award presentations. (Unfortunately none of the occultation observers won the Meade LX-50 7 inch [17.8 cm] Maksutov-Cassegrain door prize)

Derald Nye was at TSP this year and was planning to observe the occultation at his backyard observatory in Tucson. Some other TSP attendees who were leaving early said they would try and observe the occultation from their home areas.

I had asked David Dunham to fax to the Prude Ranch any last minute astrometric updates since asteroid shadow paths can shift by several path widths or more. No faxes came in since apparently there were no last minute observations made to determine Palma's position with respect to the target star. Nevertheless during the night of the occultation I drove about 30 miles [48.3 km] south of the Prude Ranch and Matt Delavoryas of HAS drove about 25 miles [40 km] north. Six other observers at TSP stayed at the Prude Ranch. The sky conditions that night were excellent.

I had used the highly portable 4 inch [10.2 cm] Meade 2045D Schmidt-Cassegrain on the hood of my car just off County Road 118. I could see the target star (when no headlights interfered) but the asteroid was too faint to see (visual mag = 12.7). Knowing that asteroid occultations can be late, I observed for about 10 minutes after the predicted time occasionally glancing away from the star to avoid eyestrain and spurious illusory flashes.

No one saw the occultation. However, at the Prude Ranch, observers did see the asteroid drift by the star with apparently no merging of the star and asteroid. With an estimated 0.5 - 1 arcsecond resolving power, this would have placed Palma's shadow at least 980 km off the predicted path. In this case, the shadow path may have even missed the Earth. This error range is clearly seen on the 1996 Asteroid Occultation Supplement chart on page 22.

Only a handful of asteroid shapes and diameters have been obtained with the occultation method. These types of occultations can be observed with the same equipment as lunar occultations and grazes. If an occultation appears to be visible over your area, please try and observe it. Even a "miss" over you area is still a useful result placing upper limits on the size/shape of the asteroid. Send all reports (even "misses") to Jim Stamm at the address in the "What to Send to Whom" section at the beginning of this newsletter. ι

Another Excellent Shortwave Radio

Richard Nugent
RNugent@ghg.net

Richard P. Wilds in the November *ON* (vol. 6, no. 12, p. 263) described an excellent low cost short wave radio for receiving time signals. The old Radio Shack time cubes are indeed history. However, Radio Shack does offer an excellent digital shortwave radio which comes ready to use--no assembly required.

The DX-375 (Catalog No. 20-212, $99.95) is a small simple to use digital (no tuning knobs) radio that has an earphone jack that can feed WWV directly into the audio input of a camcorder for critical graze and occultation timings. Among its other features I have found most useful:

- 30 frequency memory--allows storing of various WWV, CHU and other time signal frequencies, so you don't have to go searching for them at the last minute. You simply touch the memory location on the keypad and out comes the desired station.
- LED Tuning indicator--lights when the receiver is tuned to a signal. Its brightness is proportional to the signal strength.
- Safety lock--prevents from accidentally turning the radio off at critical times, and from accidentally turning the radio on while traveling to your site and thus draining the batteries.
- Headphone/earphone jack--with a standard output cable. This allows you to feed the time signals directly into a camcorder or VCR when video taping those critical graze and other occultation timings. So when you view an asteroid occultation, you can jump and down and scream all you want knowing that the video tape input won't hear you
- Car Battery Power option--with an adapter, you can run the radio off your car battery.
- Carrying strap--you can even hang this radio from your telescope tripod or mount.
- Shortwave frequency range--from 2300 - 6250 kHz and 7100 - 21850 kHz, plus AM (580 - 1610 kHz) and FM (88.1 - 107.9 MHz).

The radio's convenient folding stand, and ball and socket antenna allows for easy setup on any car, minivan, or pickup truck hood or trunk. Its small size of 7 in x 5 x 1.5 (17.8 cm x 12.7 x 3.8) fits in your telescope case or camera bag easily.

Also, while your at Radio Shack buying this radio, pick up the 25 ft (7.6 m) extension antenna (Catalog 278-1374 $8.99). It rolls up like a fishing line in a plastic reel and has a nice clip-on adapter that can clip on to most antennas to improve the signal strength. ι

Statistical Analysis of Asteroidal Occultations

David Harold

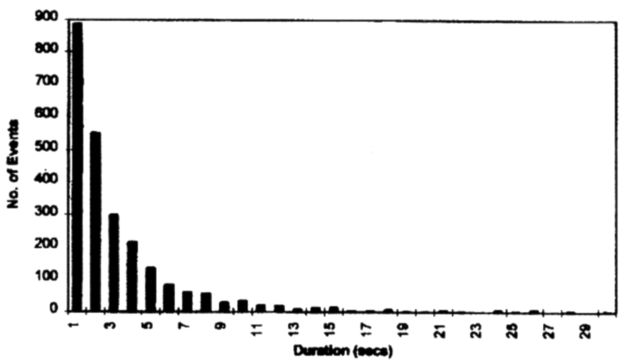
Using the program OCCULT that I have written, I have computed predictions of asteroidal occultations for 1996. OCCULT creates a file containing the details of all occultations visible from somewhere on the Earth, identifying all possible. I thought it would be interesting to statistically analyze the predictions for a twelve month period, as this might provide interesting information about asteroidal occultations.

OCCULT uses a database of 1,403 asteroids having a diameter of >=26 km, and computes predictions using stars in the PPM catalogue. For the year 1996, 2,521 occultations of PPM stars were identified. That is, on average there are almost 7 asteroidal occultations each day, and for any one asteroid there are on average 1.8 occultations per year. The sum of the diameters of those 1,403 asteroids is 94,000 km. Assuming an average elongation from the sun of the occultation of 90 deg., the probable number of occultations that will in fact occur each year as seen from a particular site is about 6.

Most asteroidal occultations are of short duration. Plotting the number of occultations against duration shows that the vast majority of events have a maximum duration of less than 5 seconds.

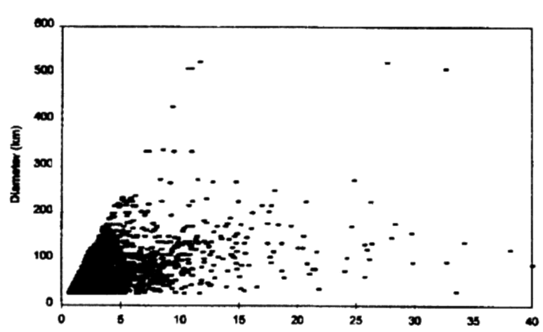
Interestingly, if one looks at the maximum duration of an occultation against the asteroid diameter, it becomes apparent that the asteroid's diameter is not a major determinant of long duration occultations; as can readily be seen in the following chart, long durations occur for asteroids of all sizes. The reason for this is that when an asteroid is near its 'stationary point', its motion relative to the star is very slow--and therefore any occultation will be correspondingly long.

Events against Duration



Another interesting fact is that there is a clear relationship between the diameter of an asteroid and the minimum duration of a central occultation. The minimum duration (in seconds) of a central occultation is approximately the diameter (km) divided by 45.

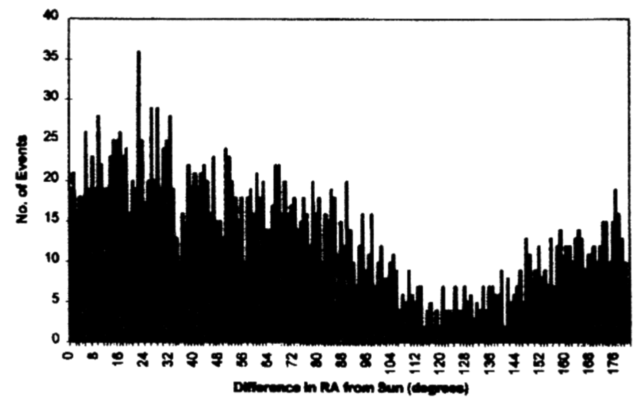
Diameter against Duration



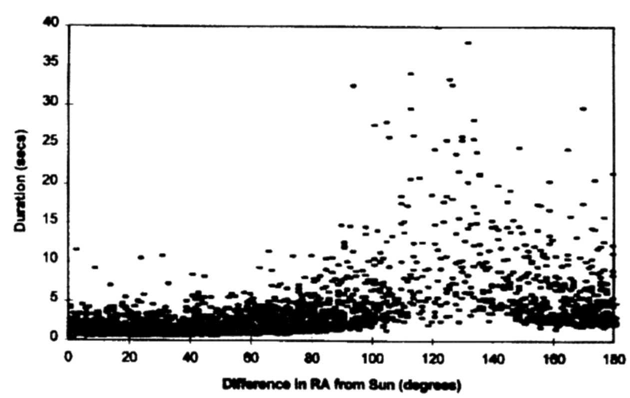
It is interesting to look at how far from the sun asteroidal occultations occur. The next figure plots the number of events against the difference in right ascension. As can be seen, the majority of events occur less than 90 deg from the sun. There is a very marked minimum at around 120 degrees, rising to a secondary maximum at 180 degrees. The minimum at 120 degrees corresponds approximately to the solar elongation when asteroids are at their stationary point.

The last plot shows the duration of occultations against elongation. Interestingly, while the previous plot shows a minimum in the number of events at 120 deg, the duration of the events is at a maximum at around 130 deg. Indeed, this plot shows that almost all events having a duration of 10 seconds or more occur at a solar elongation of greater than 90 degrees.

Events against Elongation



Duration against Elongation



For visual observervation of asteroidal occultations, where durations greater than 7 secs are required for useful data to be reliably obtained, this shows that most occultations will occur at a solar elongation >90 deg. Also, this clearly shows that the longest occultation durations occur in circumstances where the relative probability of there being an occultation is lowest. ι

Occultations of Aldebaran, 1996 - 1999

David Dunham
Bob Sandy
Eberhard Riedel

The first occultation of Aldebaran (= alpha Tauri = Z.C. 0692, at mag. 0.8 the brightest star that is ever occulted by the Moon) during the current series occurred on 1996 August 8, and the star is occulted each month after that until late 1999. We want to make the most of this opportunity; it has been 14 years since the last series ended. Some of the better events can be seen without optical aid, so they could be observed by the general public, not just amateur and professional astronomers. Many of the occultations can be recorded to 0.03s with an ordinary camcorder using its own lens, without a telescope, so again the general public could collect accurate data about the Moon's profile with these ubiquitous cameras, as long as a local or regional radio broadcast is time-calibrated with shortwave time signals, or timings are made relative to the U.S. Naval Observatory master clock or by other accurate telephone time (but beware; most telephone time services are not accurate enough for occultation work). The orange giant star has an angular diameter of 0.03", large enough for visual observers near the occultation limits to notice gradual events as the star's disk is covered or uncovered by the edge of the Moon. To add interest, the Moon moves along the southern arm of the "V" of the Hyades during the several hours preceding an Aldebaran occultation, usually producing several other occultations of relatively bright stars. Aldebaran is a foreground star, nearly 3 times closer than the Hyades stars.

The first two occultations occurred over northern polar regions and were not observed, as far as I know. An observer from Newfoundland was at a camp in northern Labrador on August 8, but the southern limit of the graze that morning was still more than 200 km north of his location. As far as I know, the first timing of the current series was made during the third occultation on October 1, when Aldebaran disappeared at 20h 46m 15.7s +/-0.3s UT, as timed by Ovidiu Vaduvescu at his site in Bucharest, Romania, at longitude 1h 44m 23.115s E., latitude +44 deg. 24' 50", alt. 100m. The disappearance was timed one minute later by observers in Slovakia, and the event was also timed under good conditions in Poland and Russia. But clouds from an approaching front covered the Czech Republic at the time, and most of western Europe apparently also was clouded out. At least one observer in England managed to time the reappearance, but that was after the emersion in Bucharest. Conditions were not good enough to observe the very low-altitude disappearance from the United Kingdom. As far as I know, nobody has observed a graze of Aldebaran during the current series, as of early December, 1996. The southern limit of the October 1 occultation crossed southern Greece, Turkey, central Asia, and Siberia, areas where we have no active graze chasers. The November full moon graze followed a similar path. On October 29, the southern limit crossed over Everette, Washington, just north of Seattle, and was also accessible by observers from Calgary and Saskatoon in southwestern Canada. Dunham prepared several maps showing the path that were placed on IOTA's Web site, and he sent e-mail notification of the graze to many potential observers in the region. But a large storm dumped snow over most of the area at the time. It just passed the Seattle area and some breaks in the cloud cover occurred in the Seattle area just 20 minutes before the event, which was not expected and, with snow on the roads, did not give time to try to observe the event.

Southern limit data and small-scale maps showing all of the 1996 Aldebaran southern limits, and predictions of the total occultations for dozens of North American cities, were generated with OCCULT and placed on IOTA's Web site. Riedel's maps published here show all of the Aldebaran grazes that pass over or near the mainland USA and Europe, keyed to the listing below by the number printed at the ends of each path; the table and maps use the same formats as the hemispheric graze supplements, except that the information about the star on individual lines has been removed, since they are all the same star.

The first grazes of the series are southern limits, so Sandy has reduced three of the better-observed southern-limit Aldebaran grazes from the last series. The resulting pictorial reductions, described in a separate article by Sandy, are given on the following pages.

GRAZING OCCULTATIONS OF ALDEBARAN 1996 - 1999
(alpha Tauri, ZC 692, SAO 94027, mag. 0.8)

USA, southern Canada, northern Mexico

NO.	YEAR	MO	DAY	%SNL	L	W.U.T.	LONG	LAT
1	1996	AUG	8	30-	S	5 53.9	84	51
2	1996	SEP	4	53-	S	13 39.3	135	57
3	1996	OCT	29	92-	S	6 27.7	135	43
4	1996	DEC	22	96+	S	22 21.3	95	38
5	1997	JAN	19	82+	S	5 25.1	135	48
6	1997	MAR	14	37+	N	17 31.3	105	43
7	1997	APR	11	17+	N	4 47.2	102	60
8	1997	MAY	8	4+	N	12 47.3	95	56
9	1997	JUL	29	23-	N	9 41.4	123	36
10	1997	AUG	25	44-	N	17 10.1	135	52
11	1997	OCT	19	87-	N	8 18.2	135	45
12	1997	OCT	19	87-	S	8 45.4	100	20
13	1997	DEC	13	99+	N	4 45.5	135	58
14	1997	DEC	13	99+	S	4 7.3	118	20
15	1998	MAR	4	45+	N	23 11.6	135	31
16	1998	APR	28	7+	N	16 39.5	132	33
17	1998	JUN	22	4-	N	12 30.1	129	36
18	1998	JUL	19	16-	N	21 55.7	135	54
19	1998	SEP	12	59-	N	6 49.4	119	23
20	1998	OCT	9	80-	N	16 38.3	135	58
21	1998	NOV	6	95-	N	0 46.0	91	44
22	1998	DEC	30	93+	N	22 20.0	105	45
23	1999	JAN	27	77+	N	7 55.0	87	60
24	1999	JAN	27	77+	S	7 55.0	135	30
25	1999	MAR	22	31+	N	17 24.5	112	47
26	1999	APR	19	12+	S	3 21.1	135	46
27	1999	AUG	6	29-	S	16 12.2	135	45

Europe

NO.	YEAR	MO	DAY	%SNL	L	W.U.T.	LONG	LAT
1	1996	OCT	1	74-	S	20 49.0	-9	30
2	1996	DEC	22	96+	S	23 46.9	19	61
3	1997	FEB	15	62+	N	10 22.4	-24	53
4	1997	MAR	14	37+	N	18 52.2	19	67
5	1997	MAR	14	37+	S	18 48.9	19	30
6	1997	MAY	8	4+	S	12 49.1	19	32
7	1997	JUL	2	7-	N	4 25.8	19	53
8	1997	JUL	29	23-	N	11 27.4	19	63
9	1997	SEP	21	66-	N	22 24.1	-8	28
10	1997	NOV	15	98-	N	18 25.5	3	39

11	1997	DEC	13	99+	N	6	12.2	19	62
12	1998	FEB	5	70+	N	17	34.6	19	37
13	1998	APR	28	7+	N	18	38.0	19	59
14	1998	JUN	22	4-	N	14	14.0	19	64
15	1998	AUG	16	35-	N	1	16.8	-10	28
16	1998	SEP	12	59-	N	8	59.3	19	51
17	1998	NOV	6	95-	S	1	7.5	16	28
18	1998	DEC	30	93+	S	23	16.6	19	33
19	1999	FEB	23	56+	N	11	20.0	-10	36
20	1999	MAR	22	31+	S	18	35.0	19	35
21	1999	MAY	16	2+	S	11	48.4	19	44
22	1999	JUL	10	11-	S	8	4.1	19	39
23	1999	SEP	30	72-	S	3	12.9	19	57

Below are total occultation predictions for several North American cities for the first 3 months of 1997:

Lunar Occultation of 1.1-mag. Aldebaran on 1997 January 19
Disappearance, Moon 82+ % sunlit, Solar elongation 130

	Univ. T.			Sun	Moon		Cusp	Pos	W.	a	b
Location	h	m	s	Alt	Alt	Az	Ang	Ang	Ang	m/o	m/o
Anchorage AK	4	40	0		40	141	71S	96	105	+1.0	+0.9
Juneau AK	4	57	48		48	165	56S	111	121	+1.4	-0.4
Calgary AB	5	47	3		51	216	16S	152	161	+1.5	-5.8
Edmonton AB	5	37	20		50	212	31S	136	145	+1.4	-3.2
Regina SK	6	1	58		46	233	13S	154	163	+0.9	-6.1
Winnipeg MB	6	10	42		41	244	15S	152	161	+0.6	-5.4
Sudbury ON	6	31	10		28	265	11S	156	165	-0.3	-5.5
Montreal PQ	6	33	31		22	271	16S	151	160	-0.3	-4.3
Burlington VT	6	38	5		21	273	10S	157	166	-0.6	-5.2
Manchester NH	6	45	32		19	276	1S	167	176	-1.6	-8.2
Quebec City PQ	6	28	0		22	271	26S	141	150	-0.1	-3.3
Bangor ME	6	34	44		19	275	19S	148	157	-0.4	-3.8
Halifax NS	6	33	3		15	278	25S	142	151	-0.4	-3.2
St Johns NF	6	22	31		10	283	46S	121	130	-0.3	-2.1

Lunar Occultation of 1.1-mag. Aldebaran on 1997 January 19
Reappearance, Moon 82+ % sunlit, Solar elongation 130

	Univ. T.			Sun	Moon		Cusp	Pos	W.	a	b
Location	h	m	s	Alt	Alt	Az	Ang	Ang	Ang	m/o	m/o
Anchorage AK	5	50	19		44	163	-77S	244	253	+1.0	+1.2
Juneau AK	6	4	4		48	189	-64S	231	240	+1.2	+1.1
Calgary AB	6	17	12		48	226	-29S	197	206	+1.6	+4.4
Edmonton AB	6	24	53		45	227	-45S	212	221	+1.4	+1.7
Regina SK	6	30	15		42	241	-30S	197	206	+1.7	+3.8
Winnipeg MB	6	40	44		36	251	-34S	201	210	+1.5	+2.7
Sudbury ON	6	55	54		24	269	-33S	200	209	+1.4	+2.5
Montreal PQ	7	2	42		17	276	-39S	206	215	+0.9	+1.3
Burlington VT	7	1	14		17	277	-33S	201	210	+1.2	+2.3
Manchester NH	6	58	52		16	278	-24S	191	200	+2.0	+5.3
Quebec City PQ	7	5	27		15	278	-49S	216	225	+0.6	+0.4
Bangor ME	7	5	45		13	280	-42S	210	219	+0.7	+0.9
Halifax NS	7	8	35		9	284	-49S	216	225	+0.4	+0.4

Lunar Occultation of 1.1-mag. Aldebaran on 1997 February 15
Disappearance, Moon 61+ % sunlit, Solar elongation 103

	Univ. T.			Sun	Moon		Cusp	Pos	W.	a	b
Location	h	m	s	Alt	Alt	Az	Ang	Ang	Ang	m/o	m/o
Anchorage AK	11	56	24		7	292	37N	28	37	+0.2	-0.1

Lunar Occultation of 1.1-mag. Aldebaran on 1997 February 15
Reappearance, Moon 61+ % sunlit, Solar elongation 103

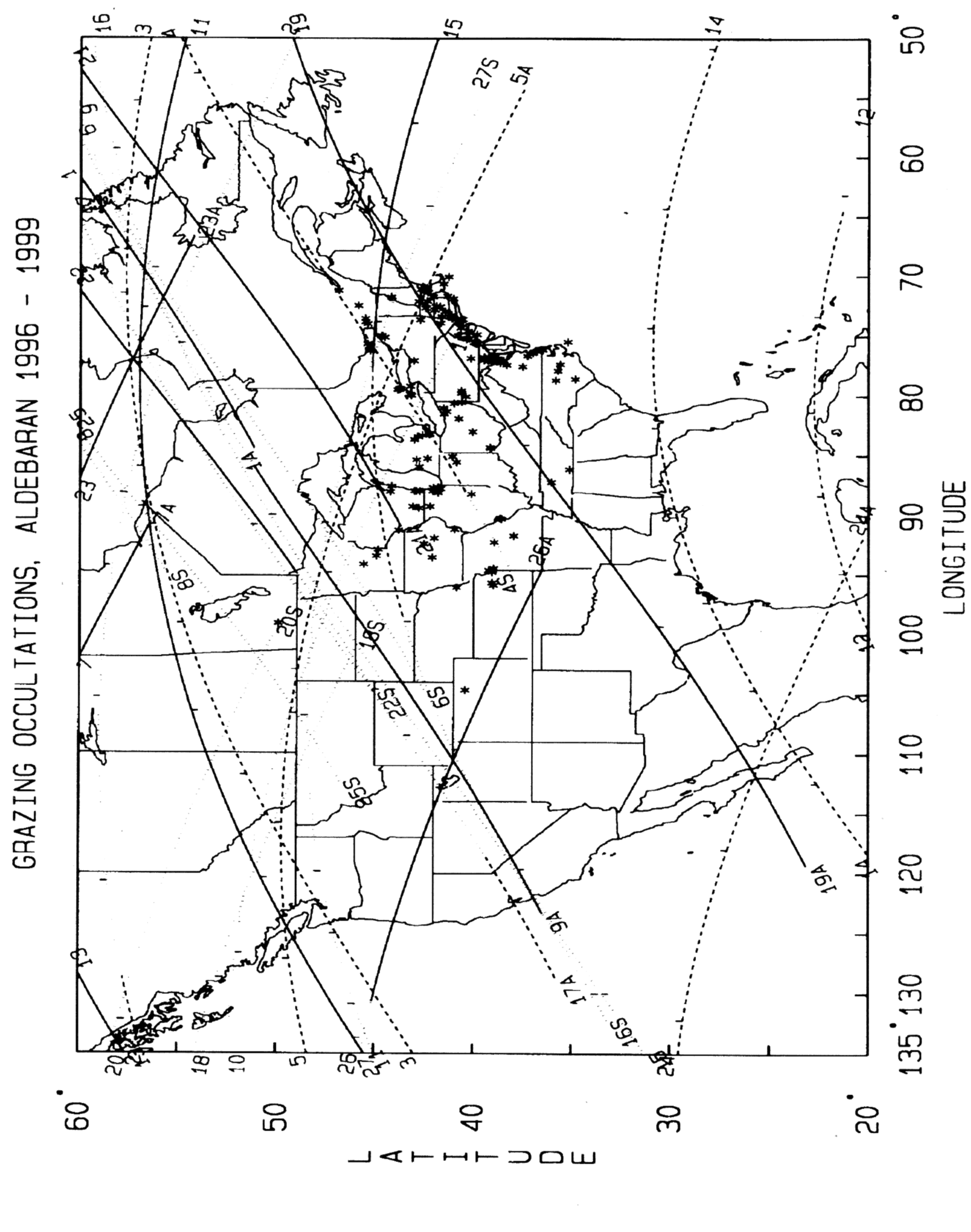
	Univ. T.			Sun	Moon		Cusp	Pos	W.	a	b
Location	h	m	s	Alt	Alt	Az	Ang	Ang	Ang	m/o	m/o
Anchorage AK	12	24	7		4	298	-24N	326	335	-0.7	-2.5

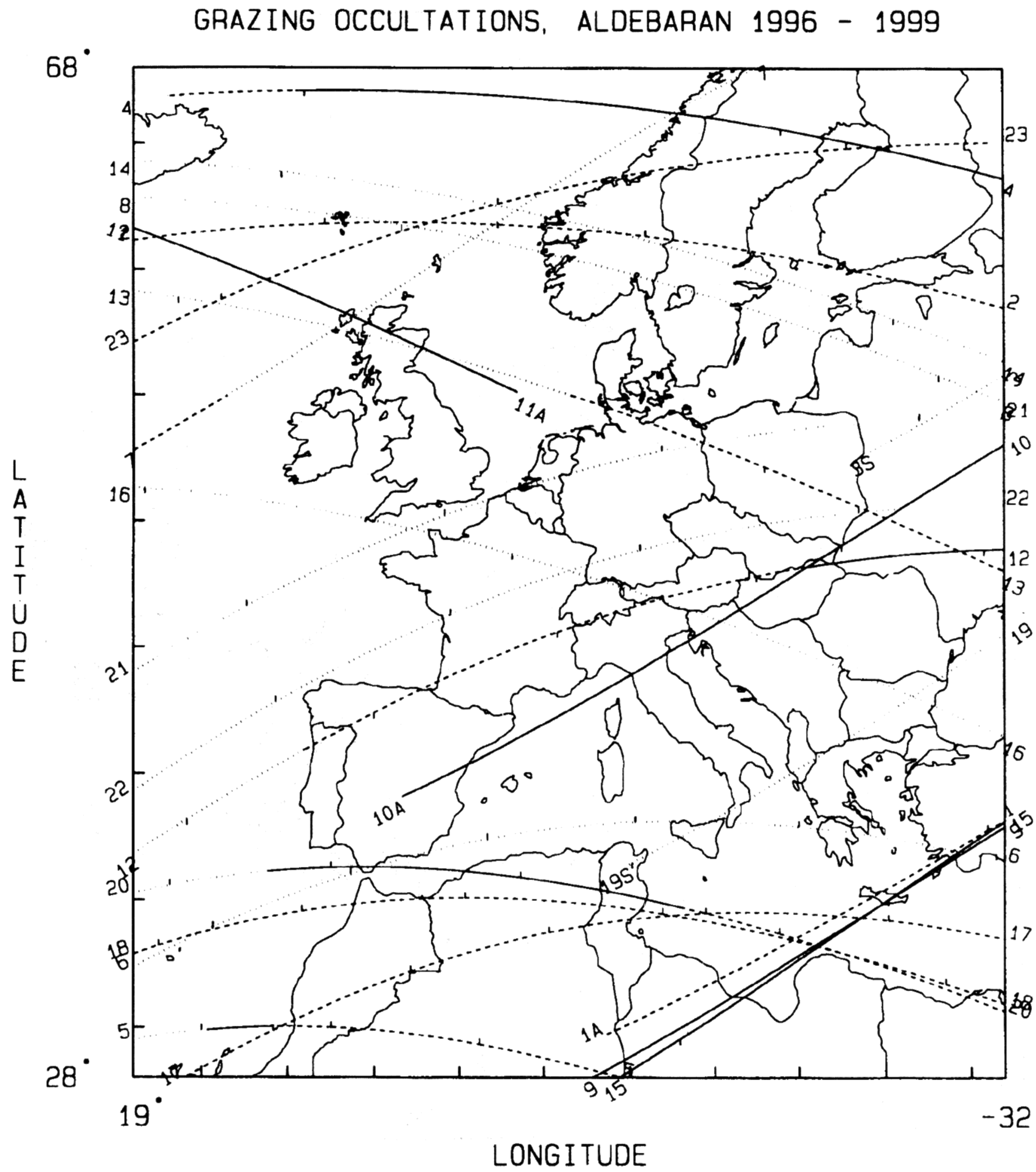
Lunar Occultation of 1.1-mag. Aldebaran on 1997 March 14
Disappearance, Moon 37+ % sunlit, Solar elongation 75

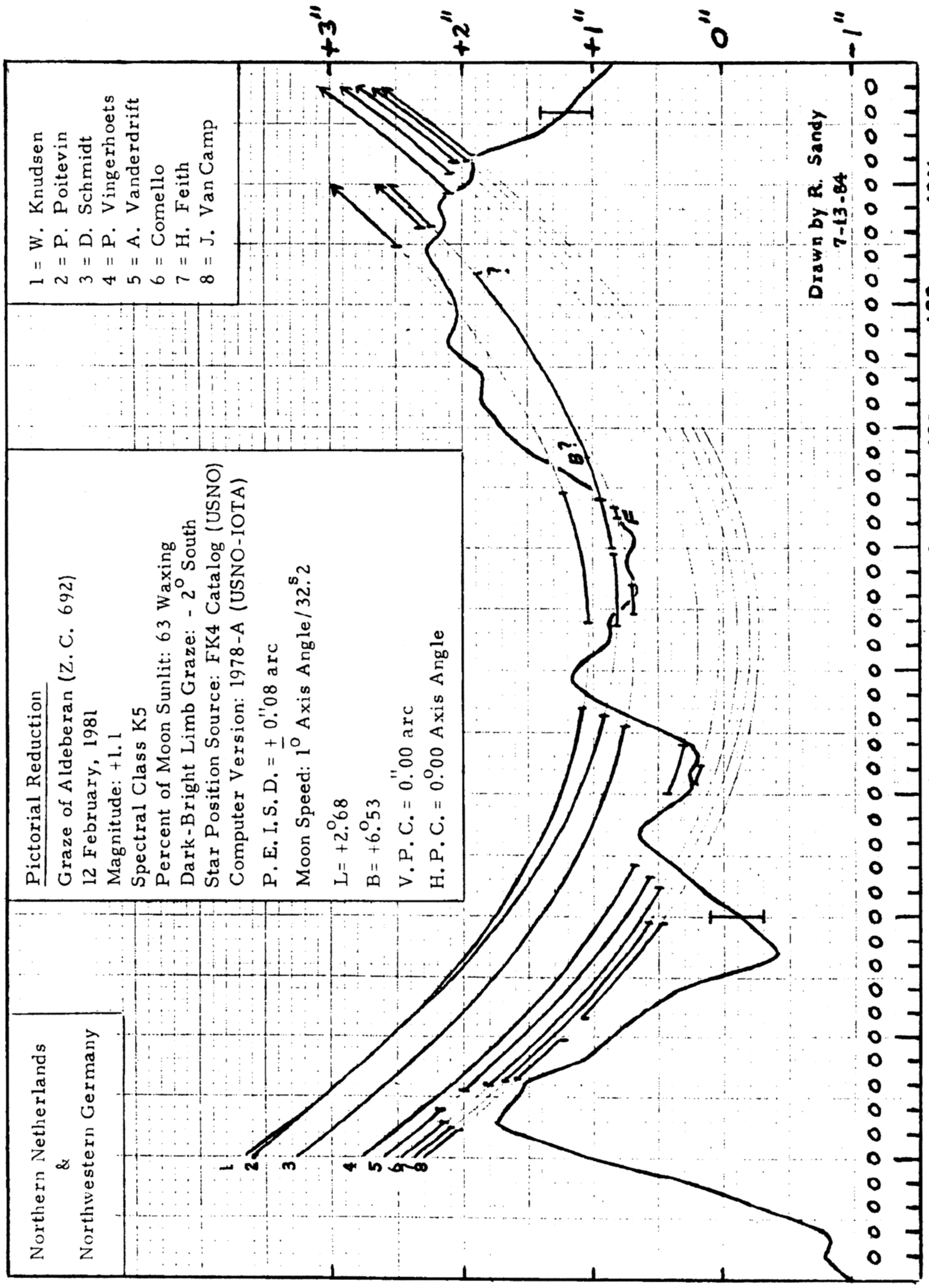
	Univ. T.			Sun	Moon		Cusp	Pos	W.	a	b
Location	h	m	s	Alt	Alt	Az	Ang	Ang	Ang	m/o	m/o
Omaha NE	17	13	39	43	8	75	27N	20	29	-0.7	+3.0
Topeka KS	17	7	18	44	6	74	35N	28	37	-0.6	+2.5
Kansas City MO	17	6	43	45	7	74	36N	29	39	-0.6	+2.5
Des Moines IA	17	12	54	43	9	76	29N	22	31	-0.7	+2.9
Minneapolis MN	17	24	4	41	12	79	15N	8	17	-1.1	+4.2
Little Rock AR	16	55	58	48	5	74	52N	45	54	-0.4	+2.0
Duluth MN	17	31	54	40	15	82	4N	357	6	-2.3	+7.3
Saint Louis MO	17	3	22	46	9	76	42N	36	45	-0.5	+2.3
Jackson MS	16	50	37	51	5	74	60N	53	62	-0.4	+1.7
Memphis TN	16	55	44	49	7	75	53N	46	55	-0.4	+2.0
Mobile AL	16	47	10	53	6	74	66N	59	68	-0.3	+1.6
Milwaukee WI	17	13	44	44	14	80	31N	24	33	-0.5	+2.9
Chicago IL	17	10	16	45	13	80	36N	29	38	-0.5	+2.7
Montgomery AL	16	49	26	52	8	76	63N	57	66	-0.3	+1.7
Indianapolis IN	17	4	26	46	13	79	43N	37	46	-0.4	+2.4
Louisville KY	17	0	44	48	12	79	48N	41	51	-0.3	+2.2
Cincinnati OH	17	2	25	47	14	80	47N	40	49	-0.3	+2.3
Atlanta GA	16	51	26	52	11	77	62N	55	64	-0.2	+1.8
Knoxville TN	16	55	30	50	12	78	56N	49	58	-0.2	+2.0
Detroit MI	17	9	51	45	17	83	39N	33	42	-0.3	+2.6
Tampa FL	16	42	6	57	9	76	78N	72	81	-0.1	+1.3
Cleveland OH	17	7	10	46	17	83	44N	37	46	-0.3	+2.5
Jacksonville FL	16	45	15	55	11	77	73N	66	75	-0.1	+1.5
Charleston WV	16	59	56	49	15	81	52N	45	54	-0.2	+2.2
Sudbury ON	17	20	46	41	20	87	29N	22	31	-0.4	+3.1
Charlotte NC	16	53	29	51	14	80	61N	54	63	-0.1	+1.9
Miami FL	16	39	22	59	10	76	86N	80	89	+0.0	+1.1
Pittsburgh PA	17	4	20	47	18	83	48N	41	51	-0.2	+2.3
Charleston SC	16	49	3	54	13	79	68N	61	70	-0.1	+1.7
Toronto ON	17	12	10	44	20	86	40N	33	42	-0.2	+2.7
Buffalo NY	17	10	7	45	20	86	43N	36	45	-0.2	+2.6
Raleigh NC	16	54	21	51	16	81	62N	55	64	-0.1	+1.9
Richmond VA	16	57	41	50	18	83	59N	52	61	-0.1	+2.0
Washington DC	17	0	28	49	19	84	56N	49	58	-0.1	+2.1
Baltimore MD	17	1	22	48	20	84	55N	48	57	-0.1	+2.2
Norfolk VA	16	56	24	51	19	83	61N	54	64	-0.0	+2.0
Dover DE	17	1	2	49	20	85	56N	49	59	-0.0	+2.1
Philadelphia PA	17	2	50	48	21	86	55N	48	57	-0.0	+2.2
New York NY	17	4	29	47	22	87	54N	47	56	+0.0	+2.3
Albany NY	17	9	1	45	23	89	49N	42	51	-0.0	+2.4
Montreal PQ	17	16	17	42	25	91	41N	35	44	-0.1	+2.7
Burlington VT	17	13	32	43	25	91	45N	38	47	-0.0	+2.6
Hartford CT	17	6	54	46	24	89	53N	46	55	+0.0	+2.3
Manchester NH	17	9	52	45	25	91	51N	44	53	+0.1	+2.4
Providence RI	17	7	6	46	25	90	54N	47	56	+0.1	+2.3
Quebec City PQ	17	19	45	41	27	94	40N	34	43	-0.0	+2.8
Boston MA	17	8	19	45	25	90	53N	46	55	+0.1	+2.3
Bangor ME	17	14	33	43	28	94	49N	42	51	+0.1	+2.5
San Juan PR	16	42	23	69	22	79	53S	120	129	+1.1	-0.6
Hamilton Bermuda	16	51	25	55	27	87	85N	78	87	+0.5	+1.4
Halifax NS	17	15	22	42	32	98	55N	48	57	+0.3	+2.4
St Johns NF	17	27	47	35	40	112	58N	51	61	+0.7	+2.3

Lunar Occultation of 1.1-mag. Aldebaran on 1997 March 14
Reappearance, Moon 38+ % sunlit, Solar elongation 76

	Univ. T.			Sun	Moon		Cusp	Pos	W.	a	b
Location	h	m	s	Alt	Alt	Az	Ang	Ang	Ang	m/o	m/o
San Antonio TX	17	38	57	55	8	75	-72N	281	290	+0.1	+0.6
Austin TX	17	39	32	54	9	76	-70N	283	292	+0.1	+0.6
Oklahoma City OK	17	42	13	50	11	77	-55N	298	307	+0.3	+0.3
Brownsville TX	17	36	32	58	7	75	-83N	271	279	+0.0	+0.8
Wichita KS	17	42	51	48	11	78	-49N	305	314	+0.4	+0.2
Dallas TX	17	41	11	53	10	77	-64N	289	298	+0.2	+0.5
Omaha NE	17	43	30	45	13	80	-37N	316	325	+0.6	-0.2
Tulsa OK	17	42	59	50	12	78	-55N	298	307	+0.4	+0.4
Topeka KS	17	43	48	47	13	79	-46N	307	316	+0.5	+0.1
Houston TX	17	39	32	56	11	77	-74N	279	288	+0.2	+0.7
Kansas City MO	17	44	22	48	14	80	-47N	306	315	+0.5	+0.2
Des Moines IA	17	45	1	45	15	81	-40N	314	323	+0.7	-0.1
Minneapolis MN	17	43	33	42	16	82	-25N	328	337	+1.2	-1.3
Little Rock AR	17	43	37	52	15	80	-63N	290	299	+0.4	+0.6
Duluth MN	17	41	7	40	16	83	-15N	339	348	+2.4	-4.3
Guatemala City	17	22	45	69	7	75	-57S	230	239	-0.3	+1.6
Saint Louis MO	17	46	35	49	18	83	-54N	299	308	+0.6	+0.4
Jackson MS	17	42	47	55	16	80	-72N	281	290	+0.4	+0.7
New Orleans LA	17	40	57	57	15	80	-79N	274	283	+0.3	+0.9
Memphis TN	17	44	50	52	17	82	-65N	289	297	+0.5	+0.6
Mobile AL	17	42	13	57	17	81	-79N	274	283	+0.4	+0.9
Milwaukee WI	17	49	19	45	20	86	-43N	311	320	+0.8	+0.1
Chicago IL	17	49	23	46	21	86	-47N	306	315	+0.8	+0.2
Montgomery AL	17	44	26	55	20	82	-76N	277	286	+0.5	+0.9
Indianapolis IN	17	49	46	48	22	86	-56N	298	307	+0.7	+0.5
Louisville KY	17	49	7	50	22	86	-61N	293	302	+0.7	+0.6
Cincinnati OH	17	50	31	49	23	87	-59N	294	303	+0.7	+0.6
Atlanta GA	17	46	36	54	22	84	-75N	279	288	+0.6	+0.9

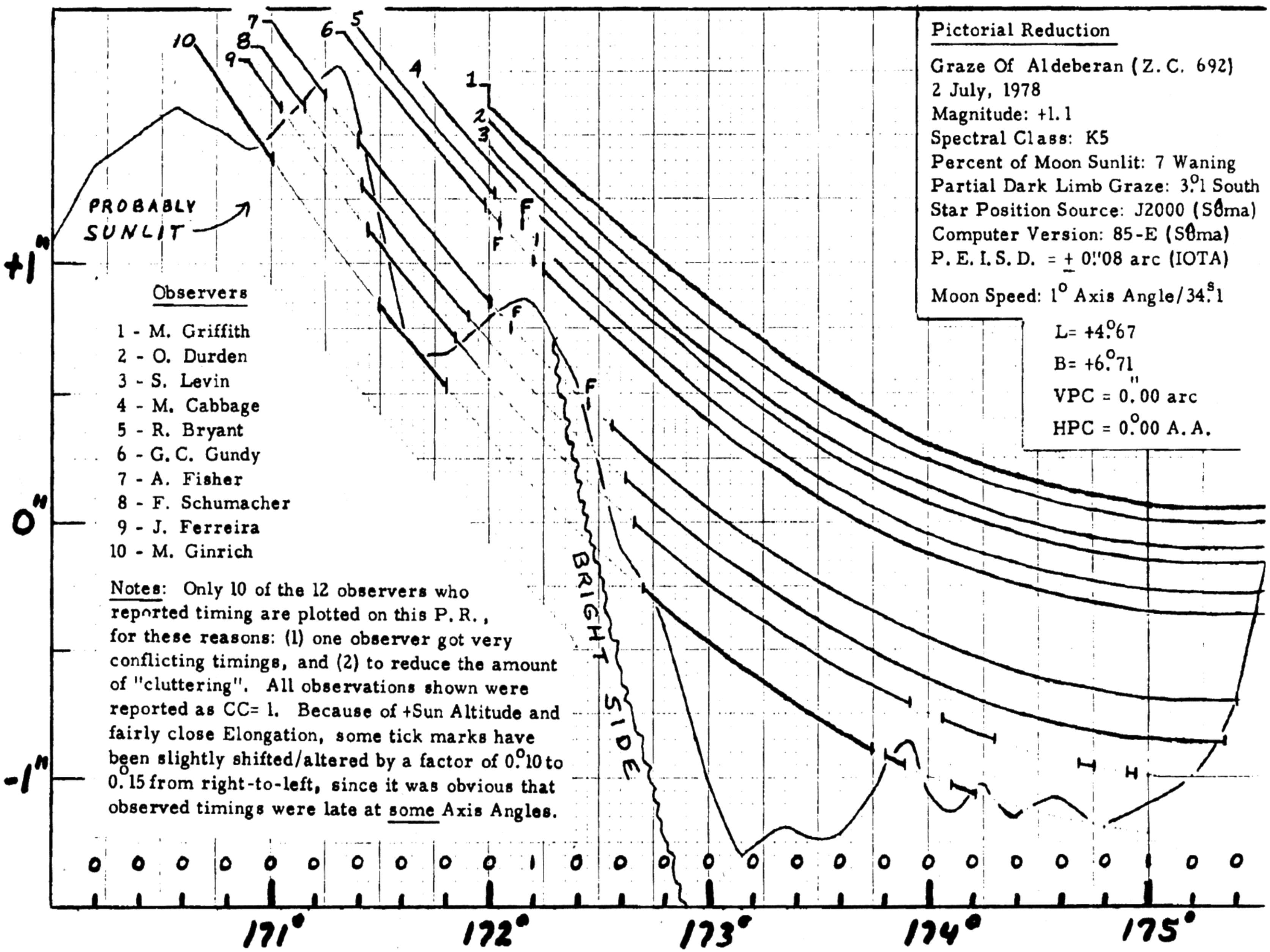

GRAZING OCCULTATIONS, ALDEBARAN 1996 - 1999
LONGITUDE
LATITUDE


GRAZING OCCULTATIONS, ALDEBARAN 1996 - 1999
68°
28°
19°
-32°
LATITUDE
LONGITUDE
11A
10A
1A
95

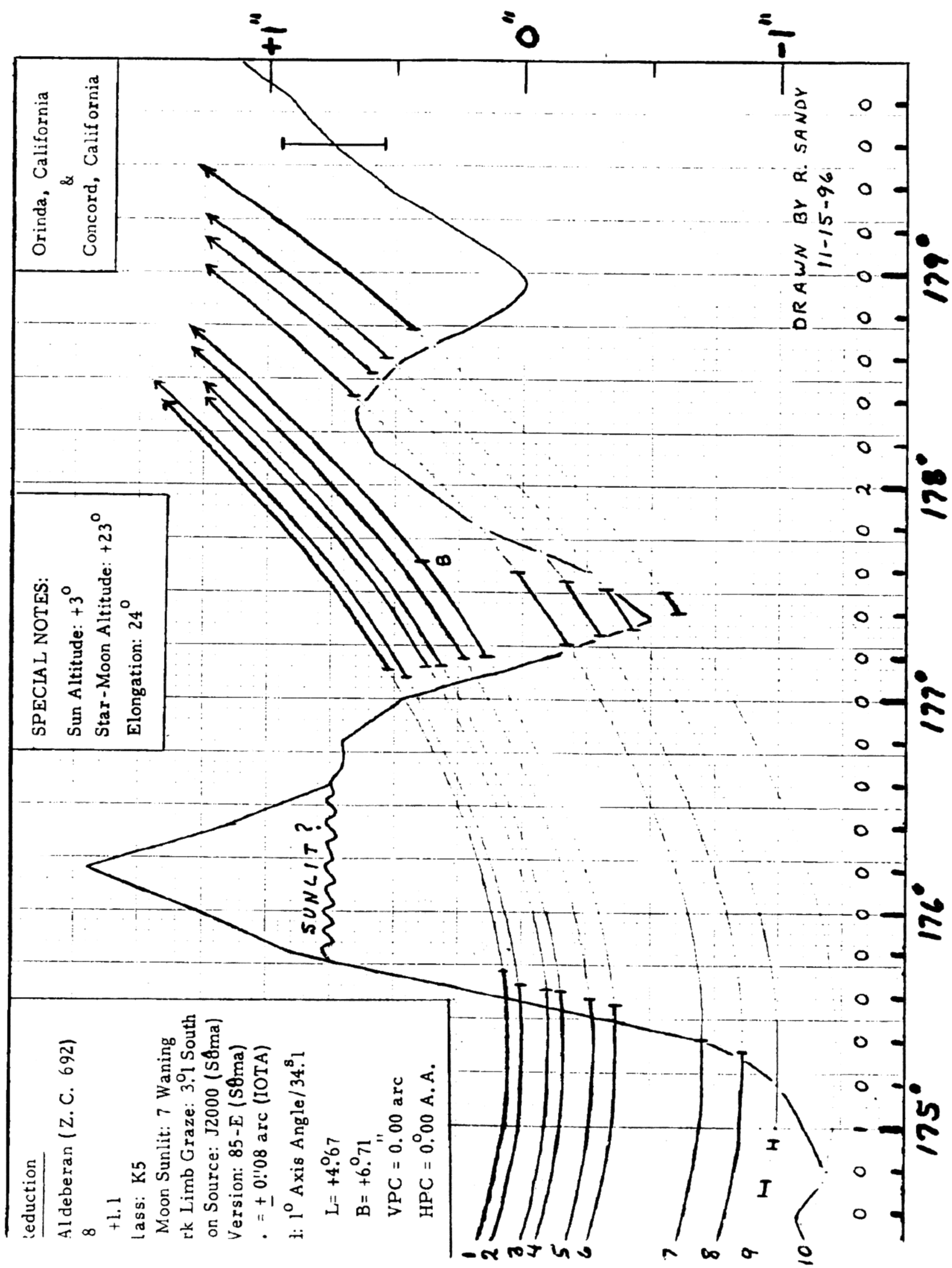


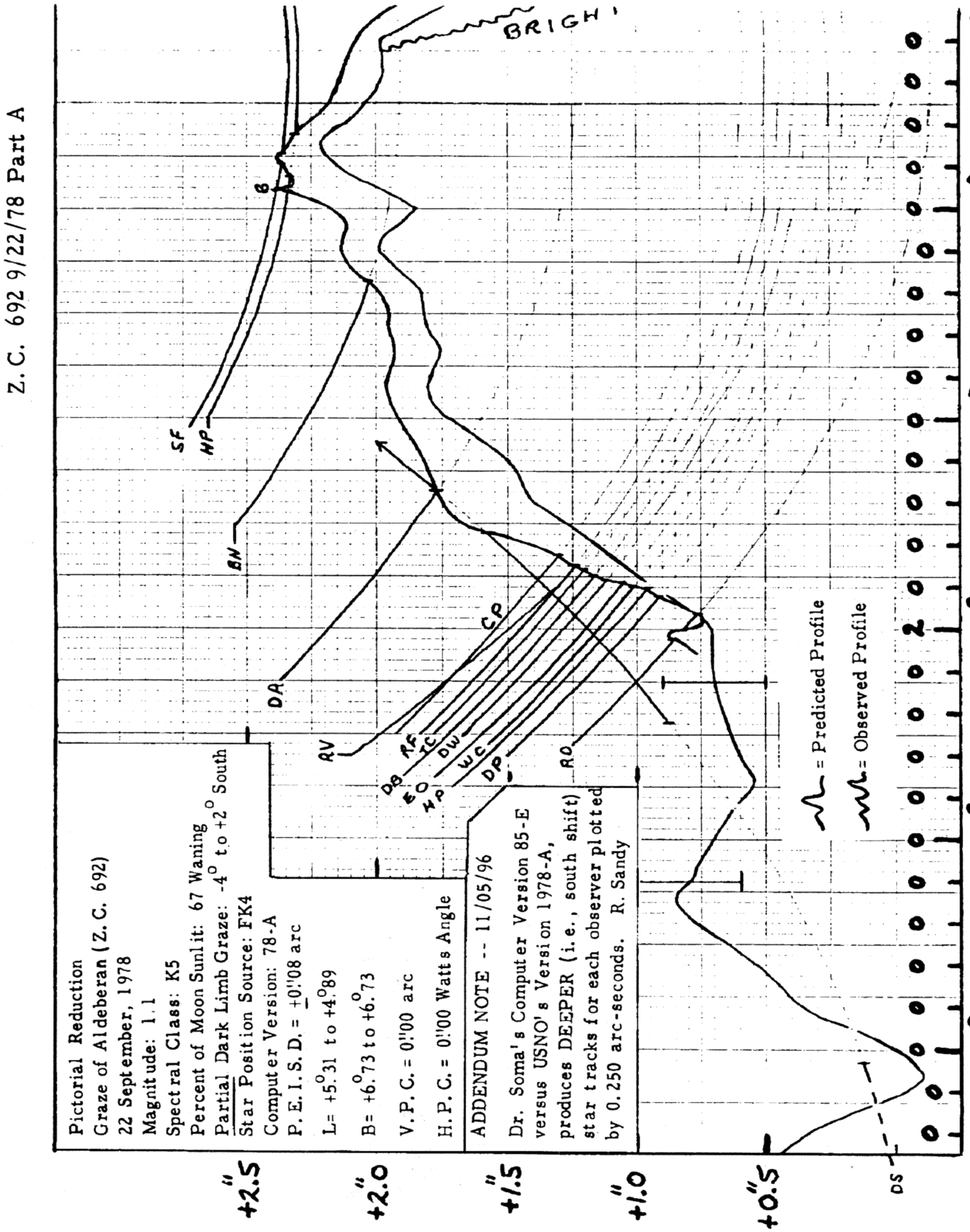
Dr. Soma's Computer Version 85-E produces DEEPER star tracks, than what is shown above by 0.100 arc-seconds. R. Sandy 12-4-96

Z. C. 692 7/02/78 Part A

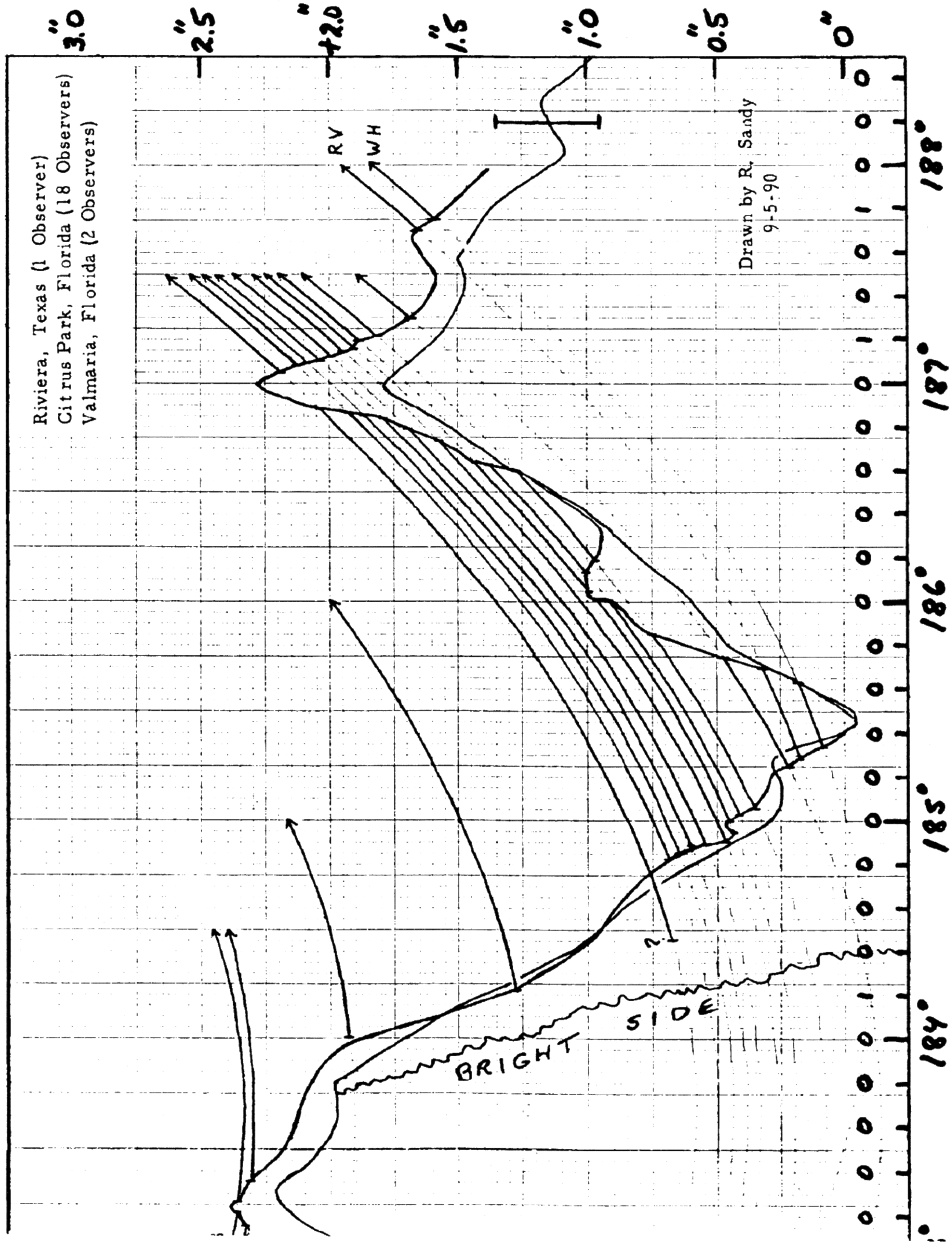


Z. C. 692 7/02/78 Part B




Z. C. 692 9/22/78 Part A
BRIGHT
SF
HP
BN
DA
CP
RV
RF
TC
DW
WC
DP
DB
EO
HP
RO
DS
= Predicted Profile
= Observed Profile
179°
180°
181°
182°
183°
+2.5"
+2.0"
+1.5"
+1.0"
+0.5"
Pictorial Reduction
Graze of Aldebaran (Z. C. 692)
22 September, 1978
Magnitude: 1.1
Spectral Class: K5
Percent of Moon Sunlit: 67 Waning
Partial Dark Limb Graze: -4° to +2° South
Star Position Source: FK4
Computer Version: 78-A
P. E. I. S. D. = ±0.08 arc
L= +5.31 to +4.89
B= +6.73 to +6.73
V. P. C. = 0.00 arc
H. P. C. = 0.00 Watts Angle
ADDENDUM NOTE -- 11/05/96
Dr. Soma's Computer Version 85-E versus USNO's Version 1978-A, produces DEEPER (i.e., south shift) star tracks for each observer plotted by 0.250 arc-seconds. R. Sandy

Z. C. 692 9/22/78 Part B



San Jose Costa Rica	17	9	55	75	9	75	-28S	201	210	-0.7	+3.1
Knoxville TN	17	48	43	52	23	86	-69N	284	293	+0.6	+0.8
Detroit MI	17	53	16	45	25	90	-51N	302	311	+0.9	+0.4
Tampa FL	17	41	41	60	22	82	-88S	261	270	+0.4	+1.2
Cleveland OH	17	54	8	46	26	90	-56N	297	306	+0.9	+0.5
Jacksonville FL	17	44	43	57	23	84	-87N	266	275	+0.5	+1.1
Charleston WV	17	52	9	49	26	89	-65N	288	297	+0.8	+0.7
Sudbury ON	17	56	13	41	27	94	-41N	313	322	+1.1	-0.0
Charlotte NC	17	50	9	52	26	87	-75N	279	288	+0.7	+0.9
Miami FL	17	39	50	62	23	82	-79S	252	261	+0.4	+1.4
Pittsburgh PA	17	54	57	47	27	91	-61N	292	301	+0.9	+0.6
Charleston SC	17	48	24	55	26	86	-82N	271	280	+0.6	+1.0
Toronto ON	17	57	16	44	28	94	-52N	301	310	+1.0	+0.4
Buffalo NY	17	57	30	44	29	94	-55N	298	307	+1.0	+0.5
Raleigh NC	17	52	18	51	28	89	-75N	278	287	+0.8	+0.9
Richmond VA	17	54	52	49	29	91	-72N	281	290	+0.9	+0.9
Washington DC	17	56	24	48	30	92	-69N	284	293	+0.9	+0.8
Baltimore MD	17	57	7	47	30	93	-68N	285	294	+0.9	+0.8
Norfolk VA	17	55	18	50	30	92	-75N	278	287	+0.9	+1.0
Dover DE	17	58	0	47	31	94	-70N	283	292	+1.0	+0.8
Philadelphia PA	17	59	5	46	32	95	-68N	285	294	+1.0	+0.8
New York NY	18	0	54	45	33	96	-67N	286	295	+1.0	+0.8
Albany NY	18	2	30	43	33	98	-62N	291	300	+1.1	+0.7
Montreal PQ	18	4	23	40	33	100	-54N	299	308	+1.2	+0.4
Burlington VT	18	4	17	41	34	100	-57N	296	305	+1.1	+0.5
Hartford CT	18	3	3	44	34	98	-66N	287	296	+1.1	+0.8
Manchester NH	18	5	20	42	35	101	-64N	290	298	+1.2	+0.7
Providence RI	18	4	28	43	35	100	-67N	286	295	+1.1	+0.8
Quebec City PQ	18	7	44	38	35	104	-53N	301	310	+1.2	+0.4
Boston MA	18	5	15	43	36	100	-66N	287	296	+1.1	+0.8
Bangor ME	18	9	44	39	38	105	-62N	292	300	+1.3	+0.6
San Juan PR	17	29	45	65	33	82	-36S	209	218	+0.1	+3.1
Hamilton Bermuda	18	0	44	49	41	96	-79S	253	261	+1.1	+1.6
Halifax NS	18	16	25	37	42	111	-68N	285	294	+1.4	+0.7
St Johns NF	18	34	32	27	50	130	-70N	283	292	+1.6	+0.5

This is a list of some of the stations used in the predictions for the occultations of Aldebaran and Saturn for 1996 and 1997; data for the others are given in the table for last September's lunar eclipse occultation of ZC 35 (*ON* vol. 6, no. 11, pg. 234). These coordinates can be used with the a and b factors given in the predictions to calculate predictions for other nearby locations using the formula

$$UT_n = UT_o + a \times (Long_n - Long_o) + b \times (Lat_n - Lat_o)$$

where **n** denotes the neighboring station and **o** denotes the city for which the time (UT_o) is given in the prediction lists. In the formula above, the UT should be expressed in minutes and decimals of a minute, and the longitudes and latitudes in degrees and decimals, as they are given in the table below. Note that longitudes are measured eastward from Greenwich, so the **a** factor has the opposite sign from some other predictions that use west longitudes as positive.

Location	E. Long.	Lat.	h,m
Honolulu HI	-157.840	21.310	13
Hilo HI	-155.017	19.733	13
Anchorage AK	-149.800	61.200	28
Juneau AK	-134.408	58.303	4
Vancouver BC	-123.117	49.267	42
Portland OR	-122.650	45.520	7
Tacoma WA	-122.500	47.267	36
San Francisco CA	-122.440	37.760	21
Seattle WA	-122.330	47.630	131
Reno NV	-119.812	39.525	1445
Fresno CA	-119.780	36.770	94
Boise ID	-116.220	43.610	931
Calgary AB	-114.083	51.050	1161
Edmonton AB	-113.467	53.550	2010
Helena MT	-112.030	46.590	1363
Salt Lake City UT	-111.870	40.760	1385
Denver CO	-104.980	39.720	1732
Cheyenne WY	-104.800	41.147	2010
Regina SK	-104.650	50.417	618
Pueblo CO	-104.640	38.290	1539
Pierre SD	-100.340	44.370	486
Winnipeg MB	-97.150	49.883	257
Fargo ND	-96.790	46.870	295
Minneapolis MN	-93.270	44.960	274
Duluth MN	-92.110	46.790	200

Recent Results from Asteroidal Occultations

During the past year, dimensions have been determined for the outlines of asteroids from several occultations, some from previously reported events. In the table, the dimensions are the major and minor axes of an ellipse that has been fitted to the observed chords. If they are the same, a circle rather than an ellipse was fitted to the data. Some results are preliminary. "Obs." gives the number of stations from which the event was timed. "Author" is the person who published or computed the dimensions.

Dimensions of Asteroids from Recent Occultations
(profiles are on the following pages)

Date	Asteroid	SAO	Obs.	Location	Dimensions km	Dimensions km	Author
1993 Oct. 9	27 Euterpe	128735	9	Ariz.,N.M.,Tex.	124	75	D. Dunham
1993 Dec. 31	144 Vibilia	078468	2	Mass., Poland	178	178	D. Dunham
1994 Jan. 8	444 Gyptis	110612	6	SE Australia	193	135	G. Blow
1995 Dec. 10	85 Io	145700	8	Ariz., Kans., Mo., Ontario	178	178	L. Wasserman
1996 Jan. 24	14 Irene	079988	2	Japan	167	139	I. Sato
1996 Jan. 29	893 Leopo-dina	114705	4	north France, Belgium	90	65	R. Boninsegna
1996 Nov. 25	93 Minerva	058142	2	Japan	132	132	I. Sato

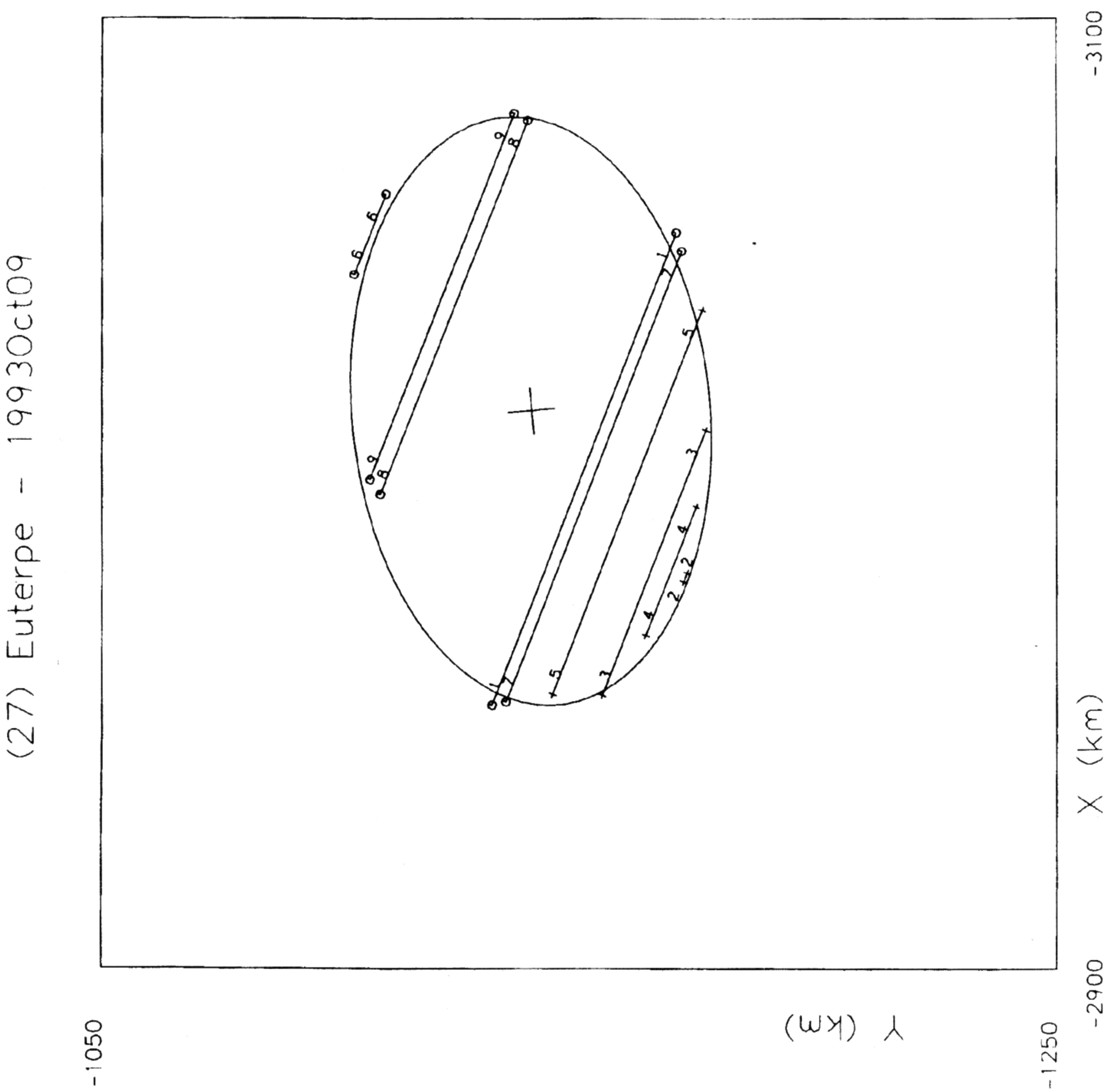
SAO 58142 was found to be a close double, with the B component 0.81 mag. fainter than A, and with separation 0.0065" in P.A. 249 deg. An occultation of SAO 81431 by 532 Herculina last February 18 was timed by K. Uta and M. Ida in Shiga Prefecture, Japan, but the separation between their stations was too small to determine the outline. Several other events were unconfirmed, seen by just one observer. For example, an occultation of 11 mag. GSC 4695 0543 by 892 Seeligeria was timed by Richard Miles from Cheshire last November 9, the first asteroidal occultation seen from the U.K. More information about these and other observed asteroidal occultations will be organized for publication later this year.

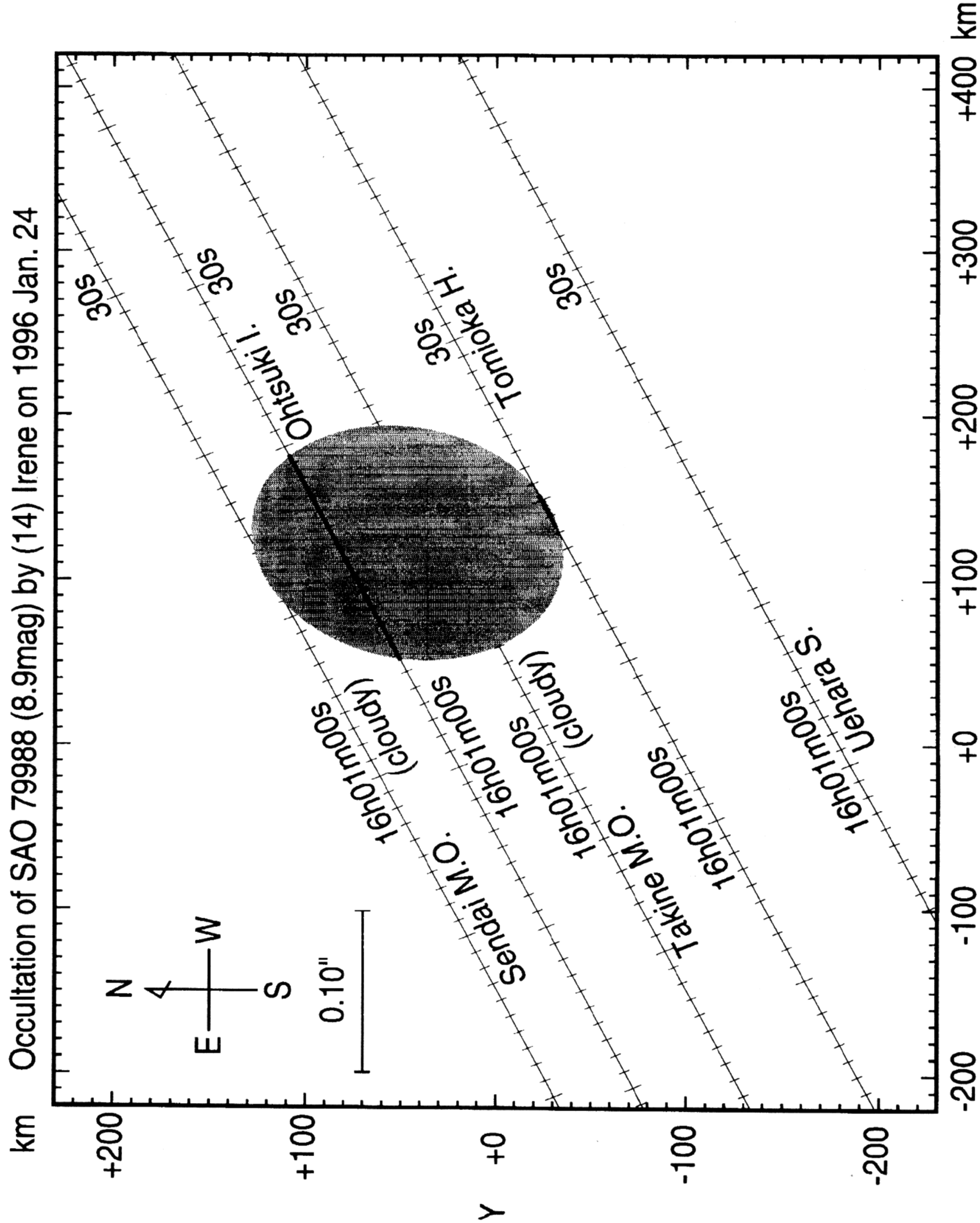
Reductions of Grazing Occultations

Robert Sandy
GrazeBob@sky.net

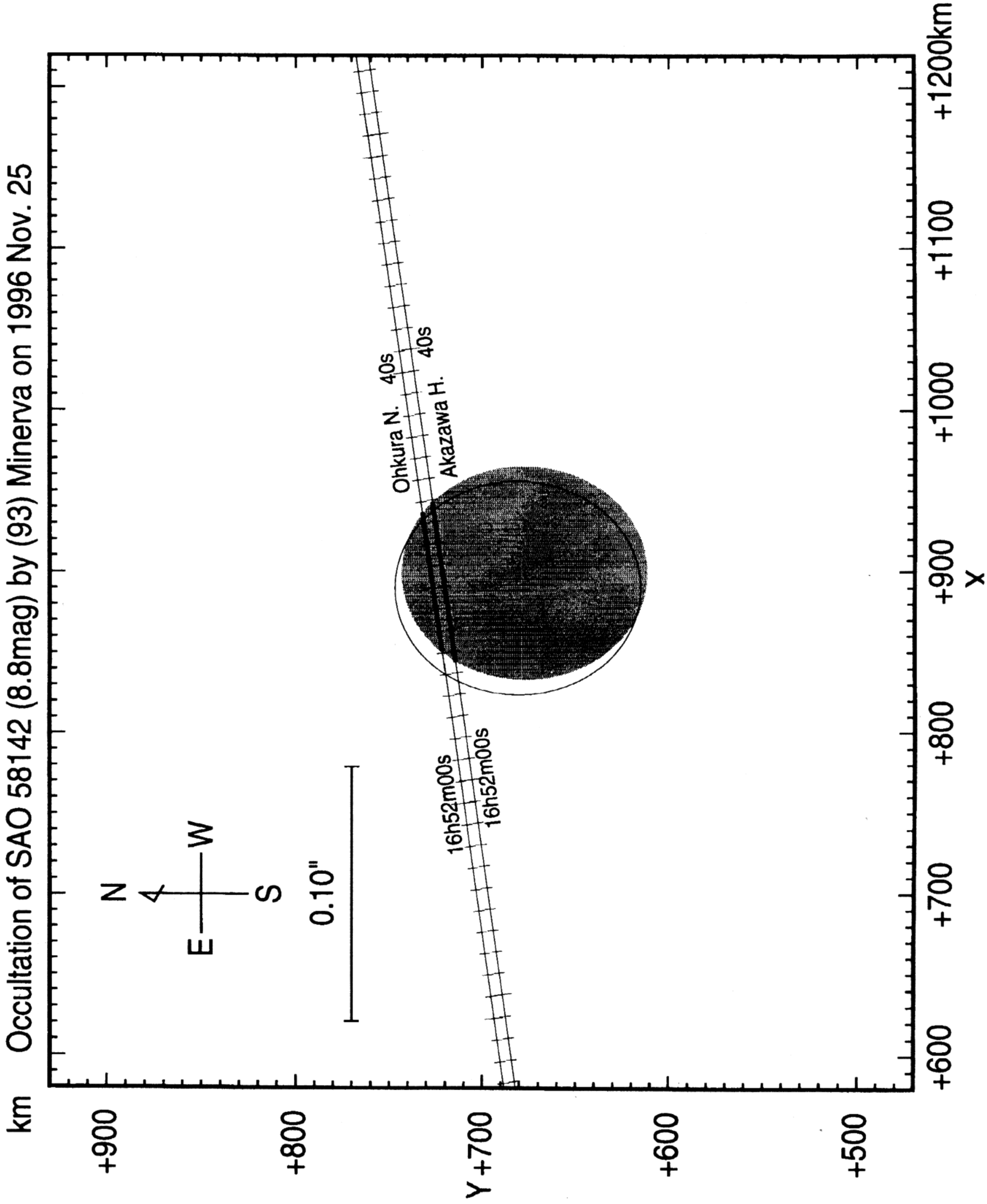
This is adopted from my Web Site (**http://www.sky.net/~grazebob/index.html**), which was last revised there on 1996 December 6. Graze reduction profiles have appeared frequently in ON, and several are now posted on my Web site, which is linked to the IOTA lunar occultation Web site maintained by Rob Robinson. I also often mail copies to observers. These Pictorial Reductions (P.R.'s) are quite simply drawings that give a visual comparison of what was predicted to occur versus what was seen as reported by the observers.

<u>Explanation of Reduction</u>: In order to visually analyze observed phenomena associated with grazing occultations, the predicted profile of the moon's limb (the edge) in the graze region,


(27) Euterpe - 1993Oct09
X (km)
Y (km)
-1050
-1250
-2900
-3100



Occultation of SAO 79988 (8.9mag) by (14) Irene on 1996 Jan. 24
Ohtsuki I.
Tomioka H.
Sendai M.O.
Takine M.O.
Uehara S.
16h01m00s
(cloudy)
30s
0.10"
N
S
E
W
km
+200
+100
+0
-100
-200
+400
+300
X
Y



Occultation of SAO 58142 (8.8mag) by (93) Minerva on 1996 Nov. 25
km
+900
+800
Y +700
+600
+500
+600
+700
+800
+900
X
+1000
+1100
+1200km
N
E
W
S
0.10"
Ohkura N.
40s
Akazawa H.
40s
16h52m00s
16h52m00s

must first be plotted; this is accomplished through the use of limb correction charts by Dr. C.B. Watts (*The Marginal Zone of the Moon*, Astronomical Papers of the American Ephemeris, Vol. 17, U.S. Government Printing Office, Washington, D.C., 1963). The Watts' limb corrections have been, for several years now, been placed into computer "memory".

The predicted lunar profile plotted is reliant on the predicted lunar librations (topocentric) at time of the subject graze, and these are calculated by Dr. Mitsuro Soma at the National Astronomical Observatory in Japan, using OCCRED, a computer program he wrote. Sometimes, though, the predicted profile shown on the P.R. may be derived from excellent observations taken from one, or several past-observed grazes that occurred in the Watts angle region of the subject graze, especially when (1) many accurate timings were made, and (2) the lunar librations (especially Latitude=B) during past graze/s and the subject graze are similar. If this is the case, a statement will be made in a "cover" letter enclosed with my P.R. will state such, or this "case" may be noted on the P.R. itself. The statement will indicate (1) what past graze datum's were used, (2) how many accurate timings were made, and (3) the Longitude (i.e., L) and Latitude (i.e., B) librations of the Moon during the past graze(s).

Next, the predicted path of the star in relation to the Moon is plotted for each observer (again, calculated by Soma, and based on the reported geographical coordinates and elevation of each observer) with the reported points of star contact with the lunar features indicated by "tick" marks. For each observer, the star moves along a curved path from left-to-right, observer designations being indicated at the left-hand side. Periods when the star was reported visible are indicated by a solid line, while during periods of reported invisibility, the line is "greyed". A dashed line plotted (at times) indicates that observations were discontinued, or that no timings were made because of timing equipment failure, etc. Note: If the viewer of Subject P.R. notices some "jiggling" of the observer star tracks, the jiggling is caused from observer-reported star "quivering" (pun)!!!

<u>Explanation of Abbreviations and Symbols Shown on P.R.</u>: V.P.C.= Vertical Profile Correction applied to the predicted profile to bring it into closer agreement with observations (usually VPC is set at 0."00 anyway). H.P.C. = Horizontal Profile Correction in the position of lunar limb features (again, usually set at 0.00-degrees of Axis Angle). P.E.I.S.D. = Probable Error in Star's Declination (expressed in seconds of arc). This value is taken from the prediction GRAZEREG-VER. 4.0 by IOTA/ES limit prediction heading. Note: Any value shown for PEISD should only be considered correct to within a 50-50 probability of being within a radius of the stated PEISD value.

<u>Computer Version</u>: (i.e., 85-C, 85-D, 85-E by Soma, or 1978-A, 1980-H, etc., by the USNO several years ago)---the designation of the set of empirical corrections made to the lunar ephemeris that were used in producing the Subject P.R.

<u>Symbols</u>: B = (blink; a D followed by an R in less than one-second); F (flash; an R followed by a D in less than one-second of time); note: B's and F's may not be plotted on my P.R., for reason of not "cluttering" the P.R., especially if many observer "tracks" are plotted. ? = Uncertain timing or events that are reported by observer(s), or observer(s) timing(s) are questioned because of an obvious discrepancy of timing(s) when compared with timings made at other observing stations/sites). A.T. = Altered Time (an observer made an obvious error in a reported timing, but time has been adjusted for reduction purposes). It should be noted, though, that (1) a reported timing is altered only when there is considerable indication that a particular timing may be in error by several seconds (in most cases, this amounts to either a thirty-second or sixty-second mistake in the reported timing), and (2) that even though the timing has been altered, it should not be considered as being as accurate as other reported timings.

<u>Error Codes</u>:
The numerical codes for the profile limb points are:
0 (or *): Good limb correction, usually accurate to within +/-0.2" (or Error Bar Length of 0.4").

1 Fair limb correction with some extrapolation from Watts' observed data, accurate to +/-0.4" (or Error Bar Length of 0.8").
2 Meaningless limb correction due to extrapolation far beyond Watts' observed data, either extreme librations or in the Cassini region (see "The Lunar Profile" on page 8). It is best to use observed graze data instead for these points, but if none are available, in most cases 0.0" can be used as the limb correction. In the southern Cassini region (Watts angle angles between 174 deg. and 188 deg., and latitude libration less than -2 deg.), use -0.7" (or Error Bar Length of 1.0") for the limb correction; this low region beyond the Moon's south pole is part of the Aitken Basin established by Clementine observations in 1994, but known from graze observations since late 1964. In most cases, the result should then be within +/-0.5" of the actual limb (Error Bar probably shown on R. Sandy's P.R.'s as 1.0" long).
3 Good limb correction from previously observed graze data, accurate to better than +/-0.1" (or Error Bar 0.2" long) at the same latitude libration and using the same prediction basis as the reduction basis, for the observed graze. However, due mainly to limited coverage of observed grazes (that is, the latitude librations being different) and star position errors, the errors are usually +/-0.2" (Error Bar Length = 0.4") if the prediction/reduction bases are the same, and +/-0.4" (Error Bar Length = 0.8") if they are different.
4 Limb correction from previously observed graze data, but poorer than 3 because the data have been extrapolated by 0.4 deg. to 0.8 deg. of Watts angle from the observed data, so the accuracy is about twice that of code 3 described above. Most of the Cassini regions have been crudely "mapped" with previously observed grazes, so 3's and 4's usually dominate the profile when a graze occurs in these regions.
5 Good limb correction with an empirical vertical correction applied (* [or 0] + 5) based on previous graze observations; like *, the accuracy is expected to be +/-0.2" (Error Bar Length then shown = 0.4"). Watts' data are still used, but with an overall vertical shift. In general, it is better to use specific observed graze data (codes 3 and 4), and we are working to replace the 5, 6, and 7 codes with 3 and 4 codes when that is practical.
6 Fair limb correction with an empirical correction applied (1 + 5); see discussion for code 5. Since a vertical correction based on

observed grazes has been applied, the accuracy should be +/-0.3" (Error Bar Length = 0.6"), a little better than uncorrected code 1.

7 "Meaningless" limb correction with an empirical correction applied (2 + 5). In this case, based partly on observed data, the correction should not be as "meaningless" as code 2. An accuracy of +/-0.5" (Error Bar Length = 1.0") is expected.

Correspondence about Pictorial Reductions of grazes should be sent to:

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Blue Springs, MO. 64015
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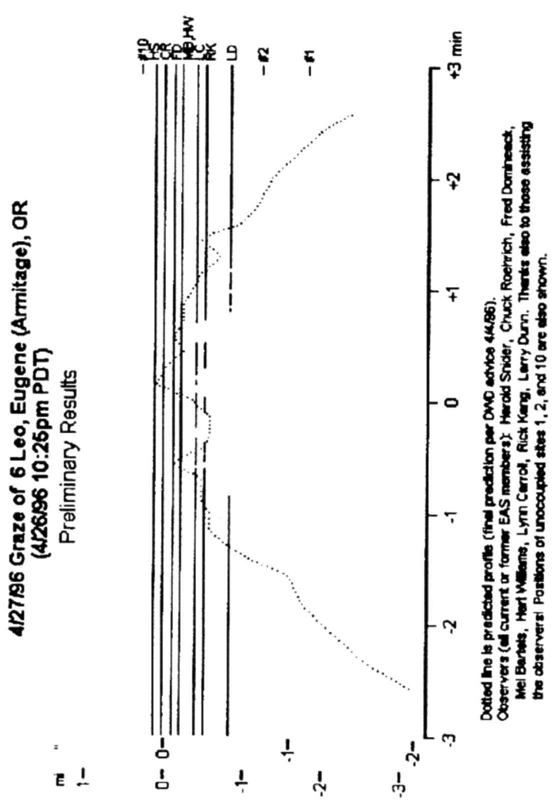
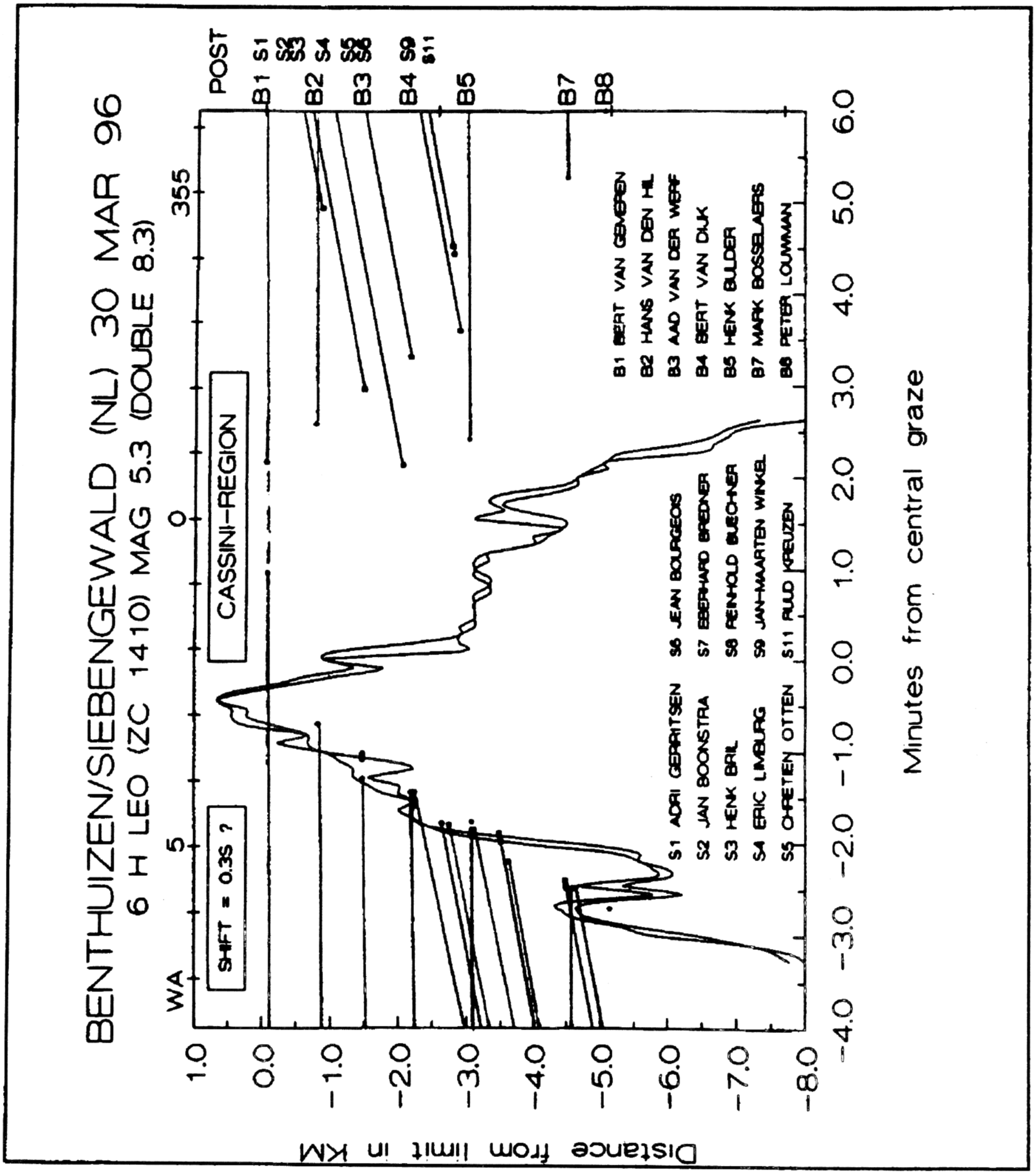
Home Phone: 816-795-8116

Correction

Below are two graze profiles that were mentioned in the article "Using Past Graze Observations" (*ON*, vol. 6, no. 12, pg. 263), but were left out by mistake. They are repoduced here and on the next page.





Werkgroep Sterbedekkingen N.V.W.S.

IOTA's Mission

The International Occultation Timing Association, Inc. was established to encourage and facilitate the observation of occultations and eclipses. It provides predictions for grazing occultations of stars by the Moon and predictions for occultations of stars by asteroids and planets, information on observing equipment and techniques, and reports to the members of observations made.

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IOTA Online--Timely Updates

The Occultation Information Line at 301-474-4945 is maintained by David and Joan Dunham. Messages may also be left at that number. When updates become available for asteroidal occultations in the central USA, the information can also be obtained from either 708-259-2376 (Chicago, IL) or 713-480-9878 (Houston, TX). The IOTA WWW Home Pages are at **http://www.sky.net/~robinson/iotandx.htm** for Lunar Occultations and Eclipses--maintained by Walter L. "Rob" Robinson--and **http://www.anomalies.com/iota/splash.htm** for Asteroidal Occultations--maintained by Jim Hart.

IOTA European Service (IOTA/ES)

Observers from Europe and the British Isles should join IOTA/ES, sending a Eurocheck for DM 40,00 to the account IOTA/ES; Bartold-Knaust Strasse 8; D-30459 Hannover, Germany; Postgiro Hannover 555 829-303; bank-code-number (Bankleitzahl) 250 100 30. German members should give IOTA/ES an "authorization for collection" or "Einzugs-Ermaechtigung" to their bank account. Please contact the secretary for a blank form. Full membership in IOTA/ES includes the supplement for European observers (total and grazing occultations) and minor planet occultation data, including last-minute predictions, when available. The addresses for IOTA/ES are:

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