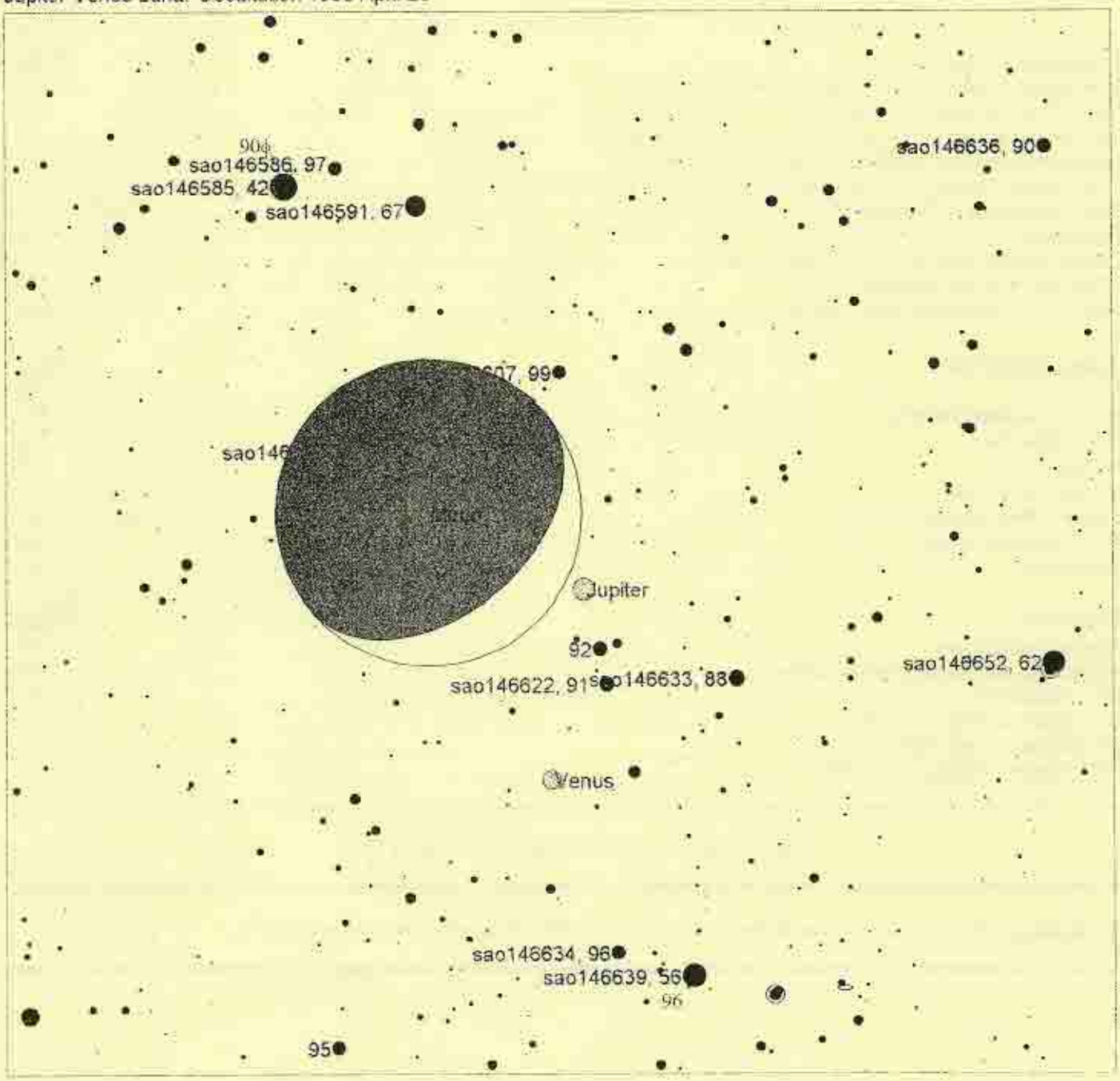
Occultation Newsletter

Volume 6, Number 16 | December 1997 | $5.00 North Am./$6.25 Other

Jupiter-Venus Lunar Occultation 1998 April 23



Center RA:23h 17m Dec:-05d 42' 4/23/98 1:01 AM Width:01d 57' Latitude:-10d 00' 0.0" Longitude:+40d 00' 0.0"

In This Issue

For subscription purposes, this the fourth issue of 1997.

On the cover: This star field was printed from TheSky Level IV. West longitude is shown as positive (+).

What to Send to Whom

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

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2760 SW Jewell Ave
Topeka KS 66611-1614 USA
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Send *ON* articles and editorial matters to:

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Send Lunar Grazing Occultation reports to:

Dr. Mitsuru Sôma
V.P. for Grazing Occultation Services
National Astronomical Observatory
Osawa Mitaka-shi
Tokyo 181, Japan
Email: SomaMT@cc.nao.ac.jp

Send Anecdotal Stories of Lunar Grazing Occultations to:

Richard P. Wilds
3630 SW Belle Ave
Topeka KS 66614-4542 USA
Email: DarkMatter-at-HART@worldnet.att.net

Send Total Occultation and copies of Lunar Grazing Occultation reports to:

International Lunar Occultation Centre (ILOC)
Geodesy and Geophysics Division
Hydrographic Department
Tsukiji-5, Chou-ku
Tokyo, 104 Japan
Email: ILOC@ws11.cue.jhd.go.jp

Send Asteroidal Appulse and Asteroidal Occultation reports to:

Jim Stamm
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11781 N. Joi Drive
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Email: ~~JimStamm@aztec.asu.edu~~ JPMS@FLAG.NET.

Send observations of occultations that indicate stellar duplicity to:

Henk Bulder
Insteek 44
NL-2771 Boskoop
The Netherlands
Email: HJJBulder@compuserve.com

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

Occultation Newsletter (ISSN 0737-6766) is published quarterly by the International Occultation Timing Association, Inc. (IOTA), 2760 SW Jewell Ave, Topeka KS 66611-1614, USA. IOTA is a tax exempt organization under sections 501(c)(3) and 509(a)(2) of the Internal Revenue Code USA, and is incorporated in the state of Texas. First class postage paid at Topeka KS, USA. Printing by Tony Murray of Georgetown, GA, USA. Circulation: 400.

IOTA News

David W. Dunham
dunham@erols.com

Reporting Changes: Changes have been made for reporting observations of lunar grazing occultations and double stars discovered during occultations, as described below. This should make IOTA's analyses of these observations more efficient, and will give observers quicker feedback.

Grazing Occultations: In addition to ILOC, reports of lunar grazing occultations should now be sent to Mitsuru Sôma at the National Observatory in Mitaka, Japan, as now given at the left. Shifts from the predicted profile no longer need to be given in the reports since Dr. Sôma can determine them. He is anxious to receive graze reports, preferably in ILOC's 80-column format (as attached files) or in IOTA's email76 format, but he can use other reasonably well organized formats giving complete information about the station coordinates and timings as well. (However, ILOC can only accept their 80-column format as a uuencoded attached file, or in the email76 format). Dr. Sôma will analyze the observations so that, when appropriate, additions can be made to the observed graze database (mainly Cassini-region events) used by ACLPPP and (starting with 1998 predictions) GRAZEREG. He will also prepare the summary tables of observed grazes for future issues of *ON*. Stories of events with any unusual circumstance, or anecdotal accounts that might be of interest to others should be sent to Richard P. Wilds at **DarkMatter-at-HART@worldnet.att.net** since Richard will co-author the graze articles for *ON* with Dr. Sôma. For those who don't have access to email, stories can also be sent by regular postal mail to Richard at 3630 SW Belle Ave.; Topeka, KS 66614-4542; USA.

A temporary complication will occur in January - March, 1998, when Dr. Sôma will work with Dr. David Smith's group at the Goddard Space Flight Center in Greenbelt, Maryland, to work primarily on the job of determining the best overall lunar topographic model with a combined analysis of both occultation (especially grazing) and Clementine observations. Dr. Sôma's temporary addresses will be published here as soon as they are known, and will be given on our sky.net web site. If at the beginning of 1998, you don't have Dr. Sôma's temporary address and you have some observations to report, send them to me and I will pass them on to him.

Double Stars: Henk Bulder was the first to respond to my request for someone to take over the work of organizing and reporting observations of occultations that indicate stellar duplicity. He should be very capable with this job, having email, **HJJBulder@compuserve.com**, as well as much observational experience with the subject. I have sent him all of the IOTA double star files, and he is doing valuable work to better organize them. If you don't have email, give your observations to Henk by phone at +31-1722-11870 or by postal mail at Insteek 44; NL-2771 Boskoop; The Netherlands.

Henk's offer to help was followed soon by three others: Jan Manek in Prague, Czech Republic; Benoit Rousseau, Paris, France; and Brian Mason, Washington, DC, USA. They can help Henk with some aspects of the work: many errors need to be corrected, information improved, etc. Brian Mason, with his background working with speckle interferometric observations of occultation doubles at the Center for High Angular Resolution Astrometry (CHARA) in Atlanta, GA, but now taking over Dr. Worley's job in maintaining the master double star database at the US Naval Observatory, will be of special help to the project. Brian will work closely with Henk once the IOTA data are in the form that Henk decides is best, amending the files of orbital elements and basic data to include the latest speckle results. Also, much work lies ahead to incorporate the large number of new and improved double star observations from the Hipparcos mission.

Corrections and Additions: Two email addresses for reporting observations have changed from those given in the last issue. Jim Stamm's email for reporting asteroidal appulse and occultation observations is **nemo@flash.net** and Walter "Rob" Robinson's email for sending, or commenting on, IOTA's web Page is **Robinson@sky.net.** Robinson's IOTA site is mainly for lunar occultations and eclipses; Jim Hart also maintains an IOTA web site for asteroidal and planetary occultations; his email address is **jphart@anomalies.com**. Jim also maintains IOTA's FTP site for large files at **ftp.anomalies.com**.

Help Needed with Astrometric Updates: The OCCULT program, version 4.06, can be used to update predictions of occultations of stars by asteroids using astrometric observations that are supplied by observers in email messages in the standard Minor Planet Center format and selected by OCCULT simply by scrolling through the message and marking the appropriate lines. This relieves the need for laborious data entry and, with the whole process controlled from menus, is a relatively easy, user friendly process. Updated central line coordinates are output in a file that can be included in an email message, and a description of the path can be prepared easily from OCCULT's map display of the event, which can also be given in an attached file in email messages to observers.

Now, asteroidal occultations can be updated days and weeks in advance by observing the asteroid pass close to stars in the very accurate Hipparcos and ACT (combination of Astrographic Catalog and Tycho data for much-improved proper motions; see the separate article), and Jim Hart has written a program that produces lists of these appulses that are posted on our anomalies web site and distributed by email to astrometric observers. But this has resulted in an order-of-magnitude increase in astrometric observations that has taken up great amounts of my time, delaying my inputs for *ON* and much other valuable IOTA work. We all want these asteroidal occultation improvements to increase our chances for observing these elusive events, but it has come at the expense of ruining our publication schedule. If you could possibly help with these updates, please obtain the latest version of OCCULT from **ftp.anomalies.com**, or if you already have it, the upgrade file can be obtained there, or sent to you by email by either me or Kent Okasaki (the upgrade .ZIP file is about 1 megabyte). Help is especially needed in North America. Jan Manek has done much good work with OCCULT in Europe, where Martin Federspiel and Edwin Goffin have also updated and

distributed predictions. Part of the job is also preparing the update messages and distributing them to observers by email. I can provide my email address directory as an ASCII file that you could use to enter at least the observers in your region in your address directory. Please let me know if you can help with this important work; I have already had to skip over some observations because I haven't had time to process them all.

Meetings: An accounts of the 15 annual IOTA meeting in Utah in late July is given in a separate article. A longer article about the 16 European Symposium on Occultation Projects in England in early September will appear in the next *ON*; it will include abstracts of most of the papers that were presented.

Since the last issue, presentations have been given at the following meetings to encourage observations of occultations, usually showing a videotape that I provided. The ones before July 29 concentrated on the Aldebaran occultation that morning, especially the possibility of camcorder observations of it, as discussed in the article on pages 351-357 of the last issue.

Riverside Telescope Makers Conference: Steve Edberg gave a presentation at this meeting held near Big Bear Lake, California, in late May.

American Astronomical Society: I gave a poster presentation on observing the Aldebaran occultation with camcorders at a special session on amateur-professional cooperation on June 10 at the AAS meeting in Winston-Salem, North Carolina. My employer, the Applied Physics Laboratory (APL) of the Johns Hopkins University, supported my travel for this meeting.

Association of Lunar and Planetary Observers: Derald Nye gave a presentation on June 28 at ALPO's annual meeting in Las Cruces, New Mexico.

Universe '97: Richard Walker encouraged observations at some educational sessions of this meeting in Chicago, sponsored by the Astronomical Society of the Pacific.

Astronomical League Convention: Derald Nye again presented at this large meeting on July 5 at Copper Mountain Resort, Colorado.

International School for Young Astronomers: This was held in Zanjan, Iran, in July. Arvind Paranjpye from the Indian University College Astronomy and Astrophysics (?) gave some of the courses in Zanjan. Before he left India, he requested occultation predictions for Zanjan, which I provided. Unfortunately, he reports that a Hyades passage and Aldebaran occultation on July 2 were clouded out.

Nebraska Star Party: Richard P. Wilds gave an IOTA presentation here in early August, with some support from the hosts.

Second Arab Astronomical Conference: Paul Maley attended this meeting, with local support from the hosts, on September 8-10 (see pages 350-351 of the last issue). He gave a presentation about IOTA's work, showing a video of some occultations and eclipses. Paul was able to foster some interest in observing occultations and eclipses among the attendees from Jordan, Saudi Arabia, and Syria; some observations might be made near the southern limit of the 1999 August total eclipse in the northernmost part of Syria.

Virginia Association of Astronomical Societies: Brent Archinal showed a videotape and showed some viewgraphs at this meeting in Ashland, Virginia, on September 27. A separate article documents my videotape and figures, which could serve as part of a package that you might be able to present at an astronomical meeting or large star party in your region. It also gives some news of the public campaign for the 1997 July 29 Aldebaran occultation, and new developments about recording occultations with camcorders. We need more observers everywhere, to marshall a larger percentage of the possible astronomical resources for important occultations, so hopefully this material will help accomplish this job.

Double Occultation of Planets: On 1998 April 23, Venus and Jupiter will both be occulted by the Moon, simultaneously in a few areas, as can be seen in the maps reproduced from the **Japanese Ephemeris** elsewhere in this issue. Paul Maley is organizing an expedition to Ascension Island in the Atlantic Ocean between Africa and Brazil to observe and record this rare event, although lunar occultations of the major planets no longer have any scientific value. Contact Paul Maley in Houston, TX, at **Paul.D.Maley1@jsc.nasa.gov**, phone 281-480-9878, for more information.

Next issues: This overdue issue will be a little shorter than other issues this year, but will be a large package at least for North American observers since it will include the 1998 Asteroidal Occultation Supplement for them. We plan to publish the next two issues in intervals of about 5 - 6 weeks to try to get back on schedule. The next issue, which will probably be distributed in late January, will include an account of the ESOP meeting and the presentation abstracts, and will likely be sent along with the hemispheric grazing occultation supplement for 1998.

1997 IOTA Annual Meeting

Rick Frankenberger
rickf@stic.net

The 1997 annual meeting of IOTA was held on Sunday July 27, 1997, at the Planetarium of Utah Valley State College in Orem, Utah. The informal get-acquainted meeting on Saturday evening turned out to be more informal than planned. We milled around in groups of two or three waiting for the other groups who were milling around someplace else to show up. By 10:00 PM we gave up and went our separate ways.

The business meeting was called to order by President David Dunham on Sunday morning. In attendance were: Mark Dakins, David Dunham, Joan Dunham, William Dunham, Daniel E. Falla, Rick Frankenberger, Kim A. Hyatt, Derald D. Nye, Denise Nye, Holly Phaneuf, Richard Tenney, Wayne H. Warren Jr., Patrick Wiggins, and Fulton Wright Jr.

David Dunham presented the treasurer's report, sent by Craig and Terri McManus shortly before the meeting. Cash flow for the eight months since the 1996 meeting was $1,600 negative due mostly to the accelerated publication schedule for the *ON*. It was decided that there was no need for action, since there is still a good cash reserve, and the newsletter is nearly back on schedule. The report was approved by vote of the members.

Wayne Warren gave an update of the status of the IOTA Observer's Manual. With the deactivation of IBM mainframes, the GML Script format is obsolete; the manual needs to be converted to a new format. Wayne suggested either Microsoft Word or LaTeX. Word is very popular and likely to exist for many years; however, the available conversion software from GML to Word does a poor job with tables and formulae. LaTeX is widely used for scientific documents and should be supported for many years also. The conversion from GML to LaTeX is much more complete than the conversion to Word. Wayne will choose the new format and purchase conversion software. A draft, text only, version of the manual is available at http://www.sky.net/~grazebob/occman.zip.

Derald Nye raised the question of storage space for back issues of *ON*. After a brief discussion, it was decided that Derald Nye, David Dunham and Craig and Terri McManus would decide how many copies of each issue should be saved and where to store them. The business meeting was then adjourned.

After lunch, we discussed the Aldebaran occultation and the effectiveness of the outreach effort to get the public involved in recording the event. IOTA members had made presentations at the Riverside Telescope Makers Conference, and the Astronomical League and ALPO conventions. Several of us had contacted local newspapers and obtained some coverage; but perhaps the most attention was generated via a circuitous route that started with a press release sent to about twenty newspapers as well as many clubs and observers in the region of visibility. Steve Maran, the press officer of the American Astronomical Society, forwarded the release to about 600 media outlets, resulting in several newspaper articles and the attention of Time magazine.

Everyone was encouraged to get the latest version, 4.05 [ed. Now the latest version is 4.06], of Occult and to become familiar with using it. Other topics, presented mainly by David Dunham, included the following:

IOTA Predictions: Computors/Regional Coordinators; changes in procedures during 1997; volunteers needed for computing data for the western USA and other areas; a planned, easier -to-prepare lunar occultation report form; GRAZEREG/ACLPPP - changes for grazes in 1997 and 1998.

Lunar Occultation Maps: Maps produced by Occult; maps for *Sky & Telescope*; maps for the general public and news media; maps produced by LUNOCC (by Daniel Falla)

Occultation predictions: Moonview (Dutch Occultation Association and Occult); XZ catalog - changes with Hipparcos data Wayne Warren; Discussion - concerns, new capabilities, etc.

Analysis of Observations: New graze reductions (by M. Sôma, R. Bitchner, and D. Herald); new profile, but no polar diameter, from the 1993 November 29th lunar eclipse grazes.

Observations since the last meeting: Aldebaran grazes and totals; using camcorders for other occultations; asteroidal occultations (NASA Grant for reductions - status, work by Doug Faust, 1996 December, Interamnia [Astrometry; reductions]; 1997 March, Campania); The Hipparcos Revolution (June 10, Maria; June 27, Mathilde and NEAR; July 9, Lotis); Galilean satellites mutual events; Triton Occultations (July 18th observations, especially the effort in Australia by Wolfgang Beisker and his IOTA occultation CCD cameras; Nov. 4 plans).

Plans for upcoming events: 1998 Feb. total solar eclipse - Warren; 1998 Aug. annular eclipse in Vanavatu; 1999 Feb. annular eclipse; 1999 Aug. total solar eclipse in Europe, Turkey; Date and location of the 1998 IOTA meeting (not decided, but it will likely be in the Kansas City and Topeka, Kansas area).

We met for dinner and then split into two groups to scout the primary and secondary sites for observing the Aldebaran graze which would occur at 3:45 MDT on Tuesday morning. Monday morning the sky was completely cloudy and the forecast was that the mini-monsoon would just park itself over Utah and Wyoming for the next couple of days. The group decided to split into three to improve our chances of someone getting a clear sky. Some stayed in Orem, the Dunhams went to California, and the rest went searching for a sucker hole in Wyoming. In Wyoming the moon did pop out of the clouds; unfortunately the graze had just ended. Fort Collins, Colorado, about two hundred miles south of the graze line, had major flooding and rain damage the days before and after the graze. Fortunately, the WWV transmitters located there were not damaged.

IOTA wishes to thank the Utah Valley State College for the use of the planetarium for our meeting and especially Paul Mills who did the leg work to provide all the necessary presentation equipment and make all the arrangements for us. ↓

Solar Eclipse News

David W. Dunham

1998 February 26: Most observer's plans are by now complete for the great Caribbean total solar eclipse of 1998. IOTA efforts to video record Bailey's bead phenomena at the southern limit are being organized on Curacao as part of expeditions being organized by the Johnson Spaceflight Center Astronomy Club by Paul Maley in Houston, TX, at **Paul.D.Maley1@jsc.nasa.gov**, phone 281-480-9878, and by the National Capital Astronomers by Wayne Warren in Greenbelt, MD, at **Wayne.H.Warren.1@gsfc.nasa.gov**, phone 301-474-0814. Also near the southern limit, near the Galapagos Islands, will be an Eclipse Edge expedition organized by Tom Van Flandern, Meta Research, at **metares@well.com** on the Web at **http://www.metaresearch.org**, phone 800-898-EDGE or 202-362-8279. Unfortunately, almost the only land crossed by the northern limit is a very cloudy and primitive part of eastern Panama, and Colombia, where unfortunately it is just too dangerous for foreigners to travel in the countryside (although Patrick Poitevin, Belgium, **pub01023@innet.be**, may try). There is one other chance--the Islas Los Monjes off the northwestern coast of Venezuela. The northern edge of totality just brushed the southern ends of the southernmost two of the small uninhabited islands in this group, which is under the jurisdiction of the Venezuelan navy. Orlando Naranja and Patricia Rosenzweig at the Universidad de Los Andes in Merida, Venezuela, have contacted the Venezuelan defense ministry to negotiate arrangements for

transportation to Los Monjes. Both Hans-Joachim Bode, president of IOTA/ES, and I plan to join this effort. We will be traveling with our families and with a friend fluent in Spanish. Since only a few will be able to go to Los Monjes, observations by our group will also probably be attempted near the southern limit north of Coro on the northern Venezuelan coast. If any other *ON* readers will be in Venezuela for the eclipse, they might contact me to see if it might be possible to meet, and possibly coordinate observations. We will be in Venezuela from February 22 to March 1.

1998 August 22: Paul Maley is planning an expedition to Vanavatu in the southwestern Pacific Ocean to observe this annular solar eclipse near the southern limit. We are interested in the possibility of observations at the northern limit by others, perhaps in Malaysia or Kalimantan (Borneo).

1999 February 16: Paul Maley is planning an expedition to western Australia to observe from the edges of the narrow zone of annularity. Since the angular sizes of the Sun and the Moon will be nearly equal, Bailey's beads promise to be more plentiful than usual, in a short time span--a very dynamic eclipse.

1999 August 11: Paul Maley and Tom Van Flandern are both organizing expeditions to Turkey for this eclipse. Van Flandern's expedition will be another "Eclipse Edge" expedition. Although Maley's expedition will be primarily a central line expedition, some of those in his group will observe near one or both limits. The European Symposium on Occultation Projects (ESOP) will probably be held this month, probably in southern Germany. IOTA/ES is looking into the possibility of chartering a plane at Munich to fly to Romania or Turkey in case of bad weather in western Europe; preliminary inquiries indicate a reasonable price. Otherwise, observers will probably drive to suitable sites anywhere from France to Hungary to optimize weather using the good road network in the region. More information about IOTA/ES's plans will be published in *ON* as soon as they become available. Some observers have already joined expeditions that don't have plans for edge observations.

Although IOTA strongly encourages observations near the edges of eclipse paths since these are currently the best locations for measuring the solar diameter from Bailey's bead observations, we also want observers who are near the central line or elsewhere in the eclipse path to also video record Bailey's beads with small telescopes or high-power telephoto lenses. Improvement of the lunar profile from analysis of Clementine data and of total lunar occultations (especially photoelectric and video timings) with the new Hipparcos-based star catalogs (especially HIP and ACT) holds promise that Bailey's bead observations in the more central zones of eclipse paths might be analyzed well enough to derive solar diameter values. It is important to improve the lunar profile in this way in any case to analyze the more numerous central eclipse timings from past solar eclipses.

FAX JOAN ECLIPSE MAP FOR Aug 1999

JPIERCE207@AOL.COM

Prediction News

David W. Dunham

Some information about predictions is given in other articles in this issue and will not be repeated here, at least not in detail. By the time you receive this issue, the 1998 prediction process should be well underway. If you do not yet have predictions for 1998, you soon should receive them. It is most efficient, less expensive, and quickest to send them by email, so please provide your computor, and IOTA or IOTA/ES, with your email address if you have not already done so.

Lunar Occultation Predictions: Eberhard Riedel, whose email address is now **Eriedel@compuserve.com**, has generated the graze region data for 1998, and these have been distributed to the graze computors, along with a new version of the prediction program, GRAZEREG version 5.1. Note that version 5.0 produced erroneous output, unless the longitude interval was 10'. The new versions for 1998 include the database of Cassini and other observed graze data used by ACLPPP to considerably improve the GRAZEREG profiles, and largely obviate the need for ACLPPP profiles, which might be needed now mainly to portray the separate profiles for grazes of the components of close double stars. The longitudes in the GRAZEREG predictions are now positive towards the east rather than towards the west, the change being made to be consistent with current astronomical practice and with the OCCULT program. A future update to the predictions will be made, now probably early in 1998, when a version of the XZ star catalog using Hipparcos and ACT improved stellar data becomes available, including a re-reduction with the new catalog of the observed grazes used in the database for the profiles. That will significantly improve the accuracy of the predictions especially of grazes of northern-declination stars in the 5 to 8 magnitude range.

Wolfgang Zimmermann has produced the 1998 Besselian elements file (BEFILE) and it has been distributed to European national coordinators for computation of 1998 total lunar occultation predictions with PC-Evans. But as for 1997, these predictions do not include occultations of major or minor planets. Predictions computed with OCCULT version 4.04 or higher now includes these events, as well as essentially all other features of the PC-Evans predictions, including use of the same XZ94E star catalog and a catalog of the brighter star clusters. I have written a program called IOTASTA that reads an IOTA graze prediction station dataset and generates a SITES.DAT file used by OCCULT. That will permit the graze computors to generate total lunar occultation predictions for all IOTA members without the need to use the different files that PC-Evans uses, so we hope to provide total occultation predictions to most members this way.

Those reducing occultation observations, as well as observers, should be cautioned that the XZ94E catalog now being used for graze and total occultation predictions (including by OCCULT) is not the same as the XZ80 catalog that has been used for occultation predictions and reductions for over 20 years. XZ94E of course has many more stars from the PPM catalog not included in the earlier XZ, but also some of the stars numbered 1

to 32221 (the highest number in XZ80) are NOT the same in the two catalogs (that is, a few stars with the same X number in the two catalogs are not in fact the same stars). Some of these problems were corrected in the 1997 total occultation predictions computed with a revised version of the 1997 BEFILE that I produced last January, but the old uncorrected BEFILE was used at least by most European coordinators. Since IOTA will rely on OCCULT more than PC-Evans for the 1998 predictions, the 1998 BEFILE will not be corrected in the same way that the 1997 file was (doing that would take some of my time to resurect one of the conversion programs that somehow has been lost), and OCCULT uses the largely uncorrected XZ94E (although David Herald has identified and corrected some of the errors). Since XZ80 has a long observational history, I prefer that the same stars be identified with the same X numbers in both XZ80 and a new version of XZ94, and after that is accomplished, the positional data in the new XZ catalog can be replaced with Hipparcos, ACT, and Tycho catalog data. This will take some time, which unfortunately will delay the more accurate graze predictions that can be produced with the new catalog data.

Asteroidal and Planetary Occultation Predictions: The charts and basic data for these events for 1998 were generated by Edwin Goffin several months ago. Regional coordinators should have distributed Goffin's charts by now. The charts for North America are being distributed as a supplement to this issue, the charts having been labelled and otherwise annotated by David Werner. Goffin produced his charts and data shortly before the Hipparcos data became available. I recently used the new ACT catalog to update Goffin's datasets to include thse more accurate Hipparcos and Tycho-based stellar data, which should result in a considerable improvement in the 1998 path predictions. By the time you read this, these improved data will have been distributed to the graze computors so they can include 1998 local circumstance appulse (LOCM) predictions with your graze prediction data. Regional maps for the early 1998 events will appear in the next *ON*. I probably will not have time to separate the components of most of the double stars in the dataset before I need to pass them on to the computors for the 1998 predictions, so a future update to the local circumstance predictions early in 1998 is likely. As noted above, an update will be needed for the graze predictions, so the new LOCM predictions will likely be distribued with the new graze (or at least graze profile) data that will be based on the new XZ catalog. ι

The Hipparcos Asteroidal Occultation Revolution Has Begun

David W. Dunham, Bill Owen, Jim Young, and Bob Bolster

(170) Maria is a rather small asteroid, estimated to be 46 km in diameter. On 1997 June 10 it occulted 6.0-mag. SAO 164249 along a narrow path extending nearly due south to north from Argentina to central Canada. Previous attempts to predict easily-observable occultations like this have mostly failed due to the great difference in the star's and asteroid's brightness. If the CCD exposure is long enough to record the asteroid, the star image is overexposed and can not be measured.

About 30 hours before the occultation, David distributed the following prediction by email based on his calculations:

Maria Occultation Path Shifts East

The occultation of 6.0-mag. SAO 164249 (= ZC 3105 = PPM 238586) by 170 Maria will take place along a path 12 path widths east of that shown on my map on p. 73 of the February 1997 issue of *Sky & Telescope*, according to CCD observations by Bill Owen and Jim Young at the Jet Propulsion Laboratory's Table Mountain Observatory in California and reduced with Hipparcos and Tycho reference stars; the Hipparcos position for ZC 3105 has been used for the prediction.

So the updated path crosses central Missouri rather than central Kansas. The formal error is only 0.011" in R.A. or 1/3 of a width of this narrow (expected 46 km wide, or 0.032") path, but the error could be greater; use of the accurate Hipparcos data in this way has not been used for any previous asteroidal occultations, as far as I know (we thank Michael Perryman of the Hipparcos Project for releasing the data for the relevant stars to us). The correction to the time is 1.2 minutes later than that shown on the map in *Sky & Telescope*. The computer-generated path information is given below [not reproduced here, but available upon request to Dunham]; observers within 100 km of this path are encouraged to observe the occultation, and to try to get others to try to time it from stations spaced east and west across the path. A description of the path and some more background information will be given later. A finder chart for the star is in the Celestial Calendar section of the June issue of *Sky & Telescope*, and a more detailed one is in the IOTA 1997 North American asteroidal occultation supplement as well as on both of IOTA's web sites.

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MIN. GEOCENTRIC
U.T.    SE    Path      Comparison of predictions
h  m     "    widths
9 2.5  0.03W    0       PPM star data, E. Goffin, path
in Feb. Sky & Tel.
9 2.2  0.04E    2 east CAMC star data, map on p. 370 of
the last ON
9 3.9  0.21E    7.5 e. 5 obs., June 7, Mallorca
Observatory
9 3.7  0.36E   12.2 e. 6 obs., June1&2, Table Mtn. Obs.
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The observations at Table Mountain Observatory were made with a large-format CCD that included 2 Hipparcos (which were given much higher weight in the frame reduction) and 3 Tycho catalog stars in its field along with Maria. The observations at Mallorca, Spain, were made with a smaller field CCD relative to a star in the Tycho
catalog and using GSC 1.2 stars to define the orientation of the frame. The difference of 0.15" from the prediction based on the Table Mountain can be explained almost entirely by the over 0.1" standard error of the right ascension of the less accurate Tycho catalog position at the epoch of the occultation, so the Table Mountain prediction was considered the best for this event.

Patrick O'Connor traveled from his home in Pinawa, Manitoba, to a location within a kilometer of my predicted central

line and observed a short occultation there. His observation is given below:

Maria Occultation in Manitoba
Patrick O'Connor, email: OCONNORP@WL.AECL.CA

I observed the Occultation of Z.C. 3105 by 170 Maria at location: 97 deg. 17m 34s ±9s West 50deg. 8m 11s ± 6s North. I was 2.1 kilometers East of Stonewall (2.1 km from NE junction of 67 & 236) on Highway 67 [This is north of Winnipeg, much of which must have been within the shadow's path]. I was 0.5 km East of intersection of Summit Rd / Road 7 East with 67, on the south shoulder of Highway 67. I have not been able to get the elevation except it is above 750 Ft. I hope this location is accurate enough.

I was about 1 km from my plot of the center line without correcting for elevation [that correction would have been less than 200 meters]. The star disappeared for between 2 and 4 seconds.

The observation was made with a C8 telescope. The observation was made by recording WWV and yelling the observations to the tape recorder. This may not be the best, but it was all I could manage on short notice.

I have done lunar occultations and grazing occultations, but this was the first time I observed an asteroidal occultation. I was not sure I was looking at the right star. I expected the occultation to occur just before 4:29 AM, so when 4:29 came I looked at other stars in the eye piece, not moving the telescope, to see if any of them had disappeared.

Then I noticed the bright star was gone. I yelled "Hey, its gone now". Next I thought I should be ready for the re-appearance. Then it re-appeared and I yelled "Its back." All this is on the tape with the WWV signal.

So I determined when the first word in each sentence was spoken. For the disappearance I get 9:29:08.8 UTC and for the re-appearance I get 9:29:10.8 UTC. The disappearance may have occurred 1, 2, or 3 seconds earlier. The re-appearance would have been within 1 second of the time.

I hope these measurements are accurate enough for you. To do more accurate work requires practice and I will not have time to practice for 3 to 6 months. I only went for this one because I felt it was an emergency. The path correction had moved it away from anyone preparing to see it, and into my area, so I thought I should try.

I also posted the occultation on the Winnipeg RASC Email list server, at 10:00 AM Monday, but I do not know if anyone else observed it. [Patrick later asked several other possible observers in the Winnipeg area, but unfortunately none of them tried to observe the event.]

David's reply to Patrick's message follows:

Many thanks for your successful observation of the occultation by Maria from very close to my predicted central line based on the Table Mountain Observatory CCD astrometry relative to Hipparcos stars. It is a great confirmation of the validity of this new technique, and offers the promise of accurately predicting even narrow paths like that for Maria many days, and even weeks, in advance. It also has ramifications for our Near Earth Asteroid Rendezvous (NEAR) spacecraft flyby of (253) Mathilde later this month, since similar recent observations of that asteroid, just coming out from several months of invisibility due to proximity to the Sun, have shown a substantial correction to Mathilde's orbit. We will be computing a maneuver to target NEAR to the proper aim point in Mathilde's "B-plane" later today. Your success gives us more confidence in the recent Mathilde observations, and that the new update to its orbit is real [Note added July 8: The Mathilde orbit update was good, and NEAR successfully imaged Mathilde's heavily-cratered surface, a feat that was almost forgotten in the deluge of publicity about Mars Pathfinder's successful landing a week after the Mathilde flyby].

Besides greatly improving predictions of asteroidal occultations and spacecraft flybys, the technique promises great improvements in the determination of orbital elements of several asteroids, work that could lead to improved mass determinations for some of them. Once the orbital elements of asteroids are accurately determined in the Hipparcos system, then it will be possible to accurately predict occultations of Hipparcos stars by them months in advance, and of stars not in the Hipparcos catalog as soon as suitable CCD observations can link them to the Hipparcos frame. But it will be necessary to pay more attention to the accuracies of the different types of observations (with appropriate weighting) than has been done for most asteroids in the past, in order to make good determinations of the orbital elements, which should also include error estimates.

The fact that you had a short occultation, rather than the 12 seconds expected, indicates that you must have been near the eastern or western edge of this almost south-to-north path. With Maria's expected 46 km = 0.032" diameter, or 0.016" radius, this indicates an error in the prediction of probably not more than 0.014" in the cross-path correction, a very good prediction considering that the observations on which it was based were made 9 to 10 days before the event at about 30 deg. altitude above the horizon. Also, my software currently reads positions only to 0.001s in R.A. and 0.01" in Dec., which may be too coarse to get the full value from these observations. The error in the less-important along-track direction was worse. The predicted time for your location was 9:28:53 UT, so your event was about 16 seconds late, for an along-track error of about 0.043".

So far, I've only heard from two other observers, one near the central line in Rolla, Missouri [Joe Senne], who was clouded out, and from Grinnell College Observatory [Bob Cadmus] in Iowa, where it was clear but no occultation occurred - that was about 48 km east of my predicted line. Hopefully, someone else in the Winnipeg area also observed it, but the twilight was rather bright with the Sun altitude about -7 deg., so some who tried might not have found the
star on that account. In any case, thanks again for traveling to the central line on a weekday morning. If other timings of the occultation were made, then we may want you to get the appropriate topographic map of the area to refine your position, or

maybe at least obtain 100m (or better with significant stay time and recording capability) accuracy with GPS measurements.

No other observations of the occultation have been reported, so we do not know whether the central line was east or west of O'Connor's site. But the success should encourage observers to travel to the paths for future asteroidal occultations with similar updates, and the method of observing the asteroid pass close to Hipparcos stars a week or more in advance can give more time to prepare for these events, a very important consideration for their success. A second attempt to improve an asteroidal occultation prediction is given below, in David's messages distributed to observers:

July 9 429 Lotis Path in Austria, France, Nova Scotia, N.B., & Quebec

Three CCD exposures of PPM 233542 and 429 Lotis taken by Bob Bolster, Alexandria, Virginia, on July 4 U.T. shows that the path will be 0.74" north of Edwin Goffin's nominal prediction with a negligible +0.1 minute correction to the time. The path starts in SE Slovakia at 1:23 UTC (Wed. morning), then extends westward across Austria, Alpine Italy, s. France, and then across the Atlantic to Nova Scotia at 1:32 UTC, then extends westward more until twilight becomes too strong just west of Quebec City. Circumstances in the newly computed central line are given below, along with remarks about the locations. The event should occur within a minute of the time of closest approach for your longitude, but a five-minute or more observing period is recommended.

The formal error of the observations is small, only about 0.06" or about one path-width (122 km). But the actual 1-sigma error is larger, about 2 path-widths, as explained in the astrometric basis paragraph below. Mobile observers can increase their chance for seeing an event by traveling towards the new central line, but nothing is guaranteed.

An 8-inch or larger telescope is recommended to reliably observe this occultation since Bolster's observations found that the PPM magnitude of 9.5 is wrong; it appeared closer to the value of 11.3 given in GSC 1.2. A finder chart is on IOTA's web site at **http://www.anomalies.com/iota/splash.htm**.

The astrometric basis of the prediction: The CCD observations were reduced with GSC 1.2. Lotis was observed relative to a Hipparcos catalog star, while PPM 233542, which is in neither the Tycho nor Hipparcos catalogs, was observed separately relative to the Tycho star PPM 233562 to provide the link for both objects in the Hipparcos system. The error in the Tycho declination of PPM 233562 at the current epoch is ± 0.12" or ± 2 path-widths, so the actual error of the prediction could be at least this large.

For the above prediction, we thank Angel Lopez at the Mallorca Observatory for providing the Hipparcos and Tycho data that were used. "Standard" same CCD-field "last-second" astrometry was also obtained for the occultation, as described in David's later message:

Mallorca Observations Confirm Lotis Path Northward Shift

The 4 CCD exposures with both Lotis and PPM 233542 in the same field obtained last night at the Observatorio Astronomico de Mallorca confirm the general northward shift of the path determined from Bob Bolster's observations of July 4 that were linked with Hipparcos and Tycho data. The new (Mallorca) path is 1.0 path width (about 125 km) north of the path computed with Bolster's data that is now shown at IOTA's web site. The correction to the time is 0.4 minute early relative to the Bolster prediction. The new path, not relying on an external system to link the star and asteroid, should be a little more accurate. Its formal uncertainty is ±0.10" in declination or ± 1.5 path widths (or about ± 200 km), and of course the error could be a little larger.

[Some routine observing information and path description has been omitted from this version; the important point is that even with the target star linked to the Hipparcos system with only a Tycho position gave a prediction in good agreement with the "last-second" prediction, and the Hipparcos/Tycho update was available early enough to warn more potential observers in the region of the occultation path, which was several hundred kilometers north of the nominal prediction.]

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MIN. GEOCENTRIC
 U.T.     SEP.     Prediction comparison
h   m      "
1 29.4   3.38N  E. Goffin nominal
1 29.5   4.12N  Update, Bob Bolster, with HIP and TYC
link & GSC1.2
1 29.1   4.18N  Update, Mallorca Astron. Obs., same
field, GSC1.2
```

Since the Hipparcos and Tycho data were publicly released only in late June, we do not know yet just how far this revolution in asteroidal occultation predictions will go. Martin Federspiel has recently computed improved orbital elements for (1) Ceres using only Hipparcos observations of that asteroid, and the residuals of the many observations have values of only a few hundredths of an arc second. Even these are larger than expected for Hipparcos observations, so Martin thinks that they could be reduced even more by including the masses of Ceres, Pallas, and Vesta (which have been measured from the perturbations that they cause on other asteroids that have passed near them) in his model. With good orbits determined in the same system as the Hipparcos and Tycho catalogs, it should be possible to compute good predictions of occultations of stars in those catalogs years in advance. The experience so far has shown that the Hipparcos positions and proper motions are incredibly accurate in their system, better than those for most FK5 stars. The Tycho star positions are not nearly as good as those for the less numerous Hipparcos stars, but most of the Tycho data at current epochs rivals PPM catalog data.

The 1997 July 29 Aldebaran Graze

David W. Dunham

This summarizes the expeditions that I know about, and gives what I know of their results. Most observers were in the rather narrow multiple events zone for this spectacular northern-limit graze, thanks to a special prediction prepared by me and by Mitsuru Sôma using Hipparcos data for Aldebaran for the new profile, and for reductions of previous graze observations covering the same region at rather similar librations, mostly involving Aldebaran during grazes observed a Saros cycle ago (and most important of these was the 17 station expedition near China Lake, California, for the graze of 1979 September 12).

If you observed the graze and have not already sent your tape to Tom Campbell or to me, please either prepare an email-76 format report (if you don't have it, it's available at IOTA's web site, **http://www.sky.net/~robinson/iotandx.htm** of your expedition's observations, or send your USGS map-measured coordinates and videotapes to:

Tom Campbell, Jr.
13418 Thomasville Circle
Temple Terrace, FL 33617
Phone: 813-985-1842
Email: thcamp@ix.netcom.com

I collected the available observations and sent them to Mitsuru Sôma in early October. He used them to prepare the reduction profile shown here, computed using Hipparcos data for Aldebaran. We were able to use the results to make a special prediction for another Aldebaran graze that occurred in the same Watts angle range and similar librations in British Columbia and Alberta on Saturday night, October 18-19. As a result, Franklin Loehde's large expedition for that graze near Crestomere, Alberta, was very successful. Also with similar geometry is the following Aldebaran graze, near Bologna, Italy, and in eastern Slovakia on Saturday, November 15; major European expeditions are being organized in those regions. Claudio Costa, leader of that effort, and Slovakian observers have been sent prediction data for that event based on the July 29 data, like those provided to Loehde in October, and the profile for the November graze might be further refined based on analysis of the Alberta data that is in progress as this is written.

Watsonville/Gilroy, CA: Richard Nolthenius, **rickn@lick.ucolick.org**, phone 408-459-3839 (attempt from a ridge)
Results: Moon rose in clouds over ridge, probably 1 valid vis. last R timing at 9:43:11 UTC.

Orchard Rd., N. of Santa Nella, CA: David W. Dunham. **dunham@erols.com** phone 301-474-4722
Results: 4 stations, 2 video (1 direct, 1 with 8-in), both videos recorded several events only after star crossed terminator; alt. 4.2 deg., very clear. Observers from north to south were Jim Hart, video with 8-inch **jphart@anomalies.com** David Dunham, direct 12x camcorder, Bob Sills, visual, 4-in. refr., 6 events **sills@etec.com**, phone 510-887-3324; Joan Dunham, vis., binoculars, 7 events. Times have been determined to visual accuracy, station locations have been measured, and email-76 report has been completed. Picture in Aug. 11 Time magazine, p. 68.

Whitworth Rd., N. of Santa Nella, CA: Ben Thomas, **bthomas@anergen.com**
Results: Arrived at last minute, saw a couple of events at end of graze with binoculars, no timings.

Route 165 E. of Gustine, CA: David Anderson, **dmand@best.com**, phone 510-661-4249
Results: 1 D & 1 R timed visually, 6" Dobsonian.

Atwater N. of Merced, CA: Carlos Avalle, Walter Morgan, **cavalle@ix.netcom.com** (not working)
Results: Multiple events timed at 5 stations, 150 ft. apart, good video with 12 events but poor WWV at Avalle's station.

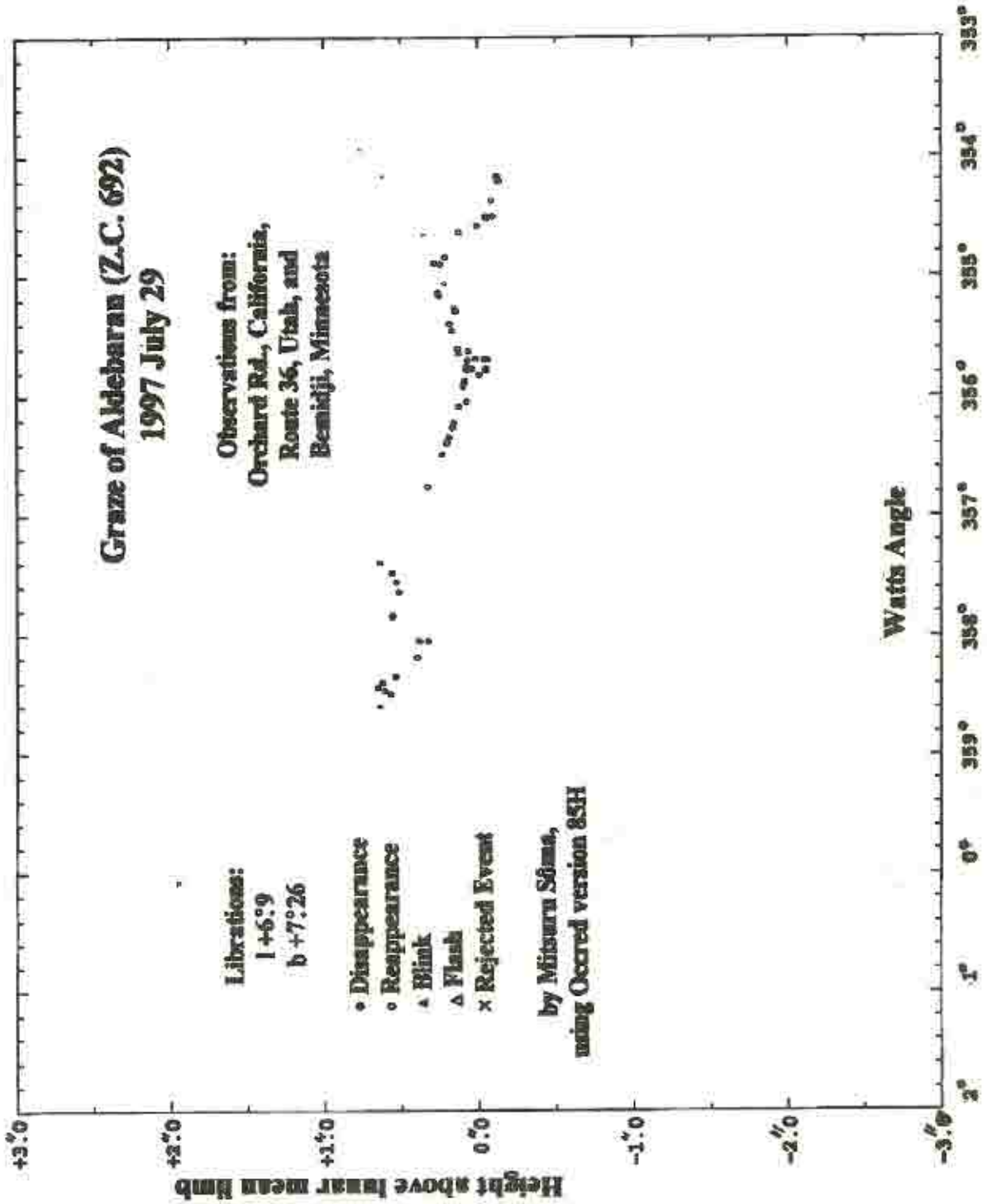
N. or W. of Tonopah, NV (Tonopah Junction or NV378): Kent Okasaki, **73112.3157@compuserve.com**, John Westfall, **73737.1102@compuserve.com**
Results: 3 videos & 1 audio tape from stations between .5 and 1.6 mi. s. of the limit; at least the northernmost tape has multiple events.

UT 36 near Tooele: Patrick Wiggins, **w@apeleon.com**, Army Depot
Results: Clouds parted and observations made at 5 stations, 1 video; those who stayed from the IOTA meeting participated in this effort, including Mark Dakins **mark_dakins@novell.com**, Derald Nye **nye@goodnet.com**, and Fulton Wright (timed 12 events; **bc_fw@yavapai.cc.az.com**; his report has been received).

Rock Springs, WY: Wayne H. Warren, Jr. **wayne.h.warren.1@gsfc.nasa.gov**
Results: With Rick Frankenburger, **rickf@atic.net**, from the IOTA meeting, clouds parted 1 min. after the graze period, no observations possible.

Glenrock (E. of Casper), WY:: Don Asquin, Gates Plm., Denver **dasquin@du.edu**, phone 303-370-6374; Dave Street, BVAA, Thornton, **street@juno.com**, phone 303-428-2288
Results: This area was surely clouded out, probably with rain; expedition probably canceled, but I haven't heard exactly what happened. Some from the Denver area joined the effort east of Rapid City, SD.

New Underwood, SD about 30 mi. E. of Rapid City: Harold Povenmire and Steve Parker from Rapid City, SD. Clouds too thick for any observations.



About 140 mi. E. of Rapid City, SD (I believe along Hwy.. 34 near mile marker 127): Bob Sandy, **grazebob@sky.net**
Results: 8 stations timed multiple events through clouds that were thin enough to observe the star well at least 70% of the time. Accurate positions unfortunately can not be recovered since single GPS observations were made and information about landmark references were not preserved. But since they were on a north-south road, the longitude is known, and the latitudes of most stations can probably be determined to useable accuracy by careful comparison of the reduction profile with other expeditions. Scott Degenhardt, **dega@nashville.com** video recorded the graze.

S. of Moorhead City, MN: James Fox, **Jhfox@mnmpec.org**
Results: 2 videos, 9 timings, observers had impression that a small south shift occurred, opposite the impression of the observers near Bemidji and Santa Nella.

Bemidji, MN: Patrick O'Connor, **OCONNORP@wLaec.ca**, phone home: 204-753-2440, business: 204-753-2311 x. 2746
Results: 6 stations, all video (direct, without telescopes). 4 had just 1 D and 1 R; one had 2 D's and 2 R's; and Stuart Levy, **slevy@geom.umn.edu**, at the northernmost station video recorded 12 events. The path shifted about 0.3 miles north of what was expected. Timings and distances from the predicted limit for all 6 stations are in O'Connor's message, but I don't think that the longitudes, latitudes, and heights above sea level have been sent yet. ↓

Reports from the Field

Triton-TR176 occultation report: The European Section of the International Occultation Timing Association and the Astronomical Association of Queensland announces the successful observation of the occultation of the TR176 star by Triton from four stations in Queensland, Australia.
1.) Observatory of the Bundaberg Astronomical Society 48 cm Newton 1:6 , IOTA Occultation Camera, 3 images per second
2.) Field station of the Astronomical Association of Queensland at Lochington at 23.945° South and 147.523° East C14, IOTA Occultation Camera, 1.5 images per second
3.) Field station of the University of Southern Queensland at Ducabrook at 23.8995° South and 147.444° East C14, IOTA Occultation Camera, 1.5 images per second
4.) Brendan Downs at Ipswich private observatory 12 inch SC telescope and ST-7

Disappearance was around 10h 17m UTC, Reappearance around 10h 18m UTC. No central flash occurred, weather conditions were exceptional.

Observers in alphabetical order were Peter Anderson, Lindsay Ball, Wolfgang Beisker, Brendan Downs, Evi Hummel, Steve Hutcheon, Mike Moy, Garry Nielsen, Ian Pink, and Ross Walters.

We thank Cathy Olkins of MIT for the excellent predictions and the local associations for their great support as well

as Bruno Sicardy from the Observatoire de Paris for financial support and many discussions.

[I understand that the occultation was also recorded by Rik Hill and Bill Hubbard, with a much more expensive system I think in southern Texas. Their observations indicated that the central line was about 100 km south of the final prediction, indicating an error of only about 0.005" at Triton's distance. David W. Dunham]

The 1997 September 19 Merapi Occultation: A Lost Opportunity

David W. Dunham

The occultation by 536 Merapi on Thursday morning, 1997 September 19, could have been one of the better-observed asteroidal occultations. Dozens of observatories were in parts of the path where the sky was perfectly clear, but as far as Jim Stamm and I know, only one observer, myself, located the star in time and recorded the occultation. Even in this day of rapid email communication, great opportunities like this are being lost. The account below was written for my annual article on planetary occultations that will appear in the February issue of *Sky & Telescope*, but space did not permit including it there. I have copied it below so that you, and your friends and colleagues, might read it; feel free to reproduce it in local newsletters. Hopefully, it will encourage more observations of such close appulses so that opportunities like this might not so easily slip through our fingers and be lost in the future, especially now with the improvement of nominal predictions using the new Hipparcos, Tycho, and ACT star catalogs.

One of the widest areas of the USA covered by an asteroid shadow during 1997 was on September 19 when 536 Merapi occulted 9-magnitude SAO 214169 about 6° south of Fomalhaut; the actual path was a little north of that shown on p. 74 of the issue a year ago. It was a fine clear night in the path east of the Appalachian Mountains, from Connecticut to southern Pennsylvania to Virginia, as well as across Missouri. But we can draw no profile for Merapi like we did above for Euterpe and Io (a reference to figures for occultations by these asteroids on 1993 October 9 and 1995 December 10, respectively, that will appear in the February 1998 issue of *S&T*), and we can not even fit a circle to estimate its true diameter. I had to clip some branches from a small tree that otherwise blocked the view between two houses in my backyard in Greenbelt, Maryland. My well-used C-8 is modest compared with telescopes at most observatories across the region. But it has a 60-mm finder that showed, with difficulty in the moonlight and glow of nearby Washington, DC 13° above the southern horizon, a 6-magnitude star a degree away from the target star, which I then found with a low-power eyepiece. But the 11-second occultation that I timed doesn't have nearly the value it would have had if even one other observer in the 400-km wide path had also timed it. One about four miles away found the star a few minutes after the event. A large tree prevented another local observation. Separate astrometric observations of Merapi and the star indicated a more southern path, and a few observers from Texas to California reported a miss. But in the message I distributed by email a couple of days before also to dozens of observers in the actual path, I warned that the astrometry had not linked the two objects in the same reference frame, so that an event in or even north of the nominal path was quite possible.

Timing and Reporting Occultation Events with a Camcorder

David W. Dunham

TIMINGS: We want to be able to determine the accurate times of the disappearance (D) and/or the reappearance (R) of the star from behind the Moon. You just need to record for 2 to 3 minutes around the D and R events. If you have a receiver for WWV shortwave time signals at 2.5, 5.0, 10.0, 15.0, and 20.0 megahertz, record them while you make the observation, including at least 3 minute marks before and after each event. 5.0 and 10.0 megahertz are the best night frequencies (10.0 is best in twilight conditions); 15.0 megahertz is usually needed in the daytime. Digital shortwave radios that can receive WWV can be purchased for about US$100.00 from electronics stores such as Radio Shack; a 50-foot copper wire attached to the antenna can improve reception. If you don't have WWV, then record the Cable News Network (CNN; it is easier to use than the previously-used Weather Channel since CNN has much less local broadcasting) for about a minute starting 4 or 5 minutes before the event time, then go outside with the camcorder still recording to be ready for the D or R 2 minutes before the expected time. After the event happens (if it was recorded), go back inside with the camcorder still running, and record more of CNN for 1 to 2 minutes. If your camcorder has a running time display with seconds, keep it running the whole time. It does not need to be set accurately since we will precisely calibrate it with the CNN broadcast that you have recorded before and after the event. You do not need to keep the camcorder running through the whole occultation. But be sure that you have several minutes of tape, enough to record everything for the event, and if you have a telescope, enough for both the D and R as well.

*** IMPORTANT *** If you record CNN, we need to know whether it was received by cable from a local Cable TV company, or if it was received with a satellite dish (direct satellite broadcast). If you have receivers for both WWV and CNN, please record some of both together before and after the occultation, and preferably for several minutes; they will help us calibrate the more numerous CNN only tapes made in your area.

ALTERNATIVE TIMING METHODS: If you have neither cable with CNN nor a WWV receiver, then soon before and after the occultation while your camcorder is still running, record the accurate telephone time from the US Naval Observatory (USNO) Master Clock that can be obtained by calling 900-410-8463; the call should be placed via AT&T to ensure use of land lines, which

will give an accuracy of a few hundredths of a second. If the call is not made via AT&T, or if the National Bureau of Standards' WWV 303-area-code number is used, the call might (or might not, you would not know) be routed through a geosynchronous satellite, causing a quarter-second delay, which is unacceptable, even for visual timings. In the Washington, DC area, the USNO Master Clock can be reached with a local call to 202-762-1401, but those outside of the Washington, DC toll-free area should not use that number, because it might go through a satellite. The 900 number must be a charged number, set to the minimum of 50 cents per minute. Once connected, you have one minute, then the call is automatically disconnected. So you will need to redial to get the number after the occultation event.

Two other ways of obtaining accurate time have been suggested. Although GPS receivers aren't accurate enough for positions for our work, the time display on most (but maybe not all) receivers may be very accurate and could be recorded shortly before and after the occultation event. Another way is to use the US Naval Observatory Master Clock to set your PC clock accurately. Software for doing that can be downloaded from the USNO Time Service's web page at **http://tycho.usno.navy.mil** (go to the item "setting your computer to USNO time"). I have not used or tested any of this software myself; some accuracy comparisons with WWV are needed. We are trying to test these alternatives; if you have a WWV receiver, you could help us to determine equipment and software that really works. Until we are sure they are all right, it is recommended that you don't rely on these new methods primarily, but include at least one of the sources described in the paragraphs above this one on your tape as well.

YOUR LOCATION: If you successfully record the occultation, we need to determine the location from which you observed to an accuracy of about 10 meters (or about 30 feet). If you can tell us the names of the streets at the nearest intersection, and the distances of the observation site measured along and perpendicular to one of the streets, we can measure your position from a detailed topographic map (scale 1:24,000 or 1:50,000) of your area that we will acquire. For the accuracy that we need, it is sufficient to just count paces from the middle of the intersection for the distances, as long as the distances are 200 meters (600 ft.) or less and you also pace the distance between two street intersections so that we can measure your pace. For larger distances, a tape measure should be used; get a friend to help with that.

Some of you have obtained the detailed map for your area and have provided your longitude, latitude, and height above sea level measured from the map (if not, you can skip the rest of this long paragraph and the one on GPS below it). This must be done carefully, since the coordinates should be given to a precision of 0.1" (0.1 arc second) in longitude and latitude (that is, the nearest whole arc second, about 100 feet on the Earth's surface, is not good enough), although the measurement accuracy can be up to 0.3", which can be achieved by using a ruler with mm scale and measuring to an accuracy of a quarter of a millimeter or so. Those measuring their own coordinates are encouraged to double check them on the following web site: **http://www.MapsOnUs.com/index.html**. Go to "maps", then specify your address for drawing a map of your area. Then zoom in (using the "zoom" box in the lower right), which can also give you a menu, one of whose items is "Lat/Long". Place the cursor at your observation site for the "home" location and click on "Lat/Long" to get a display of the longitude and latitude for the site. This is not as accurate as we need (we've found errors of 2" are typical), but it is a good check to see if any big mistakes have been made in the calculation of your coordinates from the topographic map (using it, I found an error of 12" that I had made in the longitude of a site from which I observed occultations for ten years!). The web site does not give elevation (height) above sea level, so the topographic map is needed for that, but since the elevation contours are normally at ten or twenty-foot intervals, it is easy to achieve the 30-foot accuracy that we need in that coordinate.

GPS POSITIONS: Due to the degradation of the civilian GPS signals, single GPS measurements are only accurate to about 100 meters (300 feet), much larger than our requirement. There are two ways that suitably accurate measurements can be made with GPS: 1. Make simultaneous differential measurements with two receivers (the relatively expensive differential-capable receivers must be used for this) relative to a benchmark or landmark whose position has already been determined or 2. Make hundreds of measurements of the position over a period of 4 hours or more, and average the results. For those who try to provide the coordinates rather than just measurements relative to roads, the height above sea level (available from the detailed topographic maps) is needed as well as longitude and latitude.

*** IMPORTANT *** In any case, if you provide geographical coordinates, it is important that we know how you determined it (measured from a topographic map, determined from a web site, GPS, etc.), and what datum (survey system) it is in (North American Datum 1927, or NAD27, is preferred from topographic maps; GPS usually uses the WGS 84 system; and for differential GPS measurements, the datum of the base station used as the reference must be known.

WHAT TO SEND WHERE: Unless an IOTA regional coordinator has given you his or her address, tapes should be sent either to Tom Campbell or to me; Tom will be doing the time inserting, and most of the tapes that I have already received have been sent to him. Send him any tape with WWV (preferred), GPS, or USNO time signals, and any that have The Weather Channel (TWC; for the April and July Aldebaran occultations; CNN for events after July 29) and DO NOT have a running display of the time to the nearest SECOND. If your tape has only TWC or CNN for a time reference and it does have a running display of the time, including seconds (just hours and minutes are not sufficient), then send the tape to me at the address at the bottom. Otherwise, send it to:

Tom Campbell, Jr.
13418 Thomasville Circle
Temple Terrace, FL 33617
Phone: 813-985-1842
Email: thcamp@ix.netcom.com

He prefers receiving 8-mm tapes, and preferably original tapes, but a good ½-inch VHS copy can be used. We also now have adaptors for playing VHS-C (compact VHS) tapes. We will try to acknowledge receipt of the tapes by email (for those who provide email addresses) within a week of receipt. Enclose a self-addressed label, or just a piece of paper with your address on it, to help us return your tape after we get the time from it. Due to much other work demanding our attention, it will probably be 2 or 3 months after an event before the accurate times can be determined from the tapes.

After sending your first tape (that will be, or have been, of the 1997 July 29 Aldebaran occultation for most of you), don't send us another tape right away after recording the next event, but rather save the tape to accumulate any other observations that might be made during 1997. Then, send the tape of your accumulated 1997 observations at the start of 1998. Information about the next events that might be recorded directly with camcorders are given on IOTA's web page. Those with telescopes will be able to record other occultations as well, and predictions will be provided for their site when we get a chance.

THANKS. This is a long-term project that will take a few years to achieve its goal of providing accurate measurements of the edge of the Moon. These are mainly needed for the proper analysis of past solar eclipse timings, which in turn are used to determine small but climatically significant cyclical variations of the Sun's diameter. We greatly appreciate your contribution to this effort.

David Dunham, President
International Occultation Timing Association
7006 Megan Lane — Phone: 301-474-4722
Greenbelt, MD 20770-3012 — Weekdays: 301-953-5609 x

A Presentation Package on Using Camcorders and Other Timely Occultation Topics

David Dunham

On September 27, 1997, the Virginia Association of Astronomical Societies (VAAS) held their annual meeting at Randolph-Macon College in Ashland, Virginia, about 15 miles north of Richmond. I was not able to attend the meeting, but had produced a good video and had on hand many viewgraphs that I had used earlier that month at the ESOP meeting in the U.K., preparation for which built on earlier work for the annual IOTA meeting, as well as earlier meetings. Although it was too late to get on the formal agenda, Brent Archinal, from the nearby Northern Virginia Astronomy Club, offered to give a short presentation when the schedule permitted, which did occur at the end of the meeting. So I sent him a copy of the videotape and viewgraphs, and wrote the information below to stress the points I wanted to make. The timely information should also be of interest to many *ON* readers, so it is copied below. I encourage presentation of this material at other astronomical meetings, so please contact me to arrange a loan of the video and figures if you can get on the schedule for one. Especially good are regional meetings and large, organized star parties that are attended by many observers.

The viewgraphs in the package are as follows; some involve predictions that should be replaced with appropriate figures for your area and for the time of the meeting:

1. Figure 2-1a - Shows geometry of an occultation
2. Lunar profile from graze of delta Cancri - 1981 May 9-10
3. Silhouette of Kleopatra, Jan. 19, 1991
4. Predicted asteroidal occultation paths, Sept. - Dec. (1997)
5. Occultation of SAO 76505 (ZC 621) by (906) Repsolda, 1997 Sept. 16
6. Your camcorder record of naked-eye eclipse with view of Moon for the Aldebaran occultation of 1997 July 29
7. Local time maps of the July 29 Aldebaran occultation
8. Astronomy Project - article in The Dallas Morning News
9. Calling All Amateurs - IOTA mentioned in Time magazine
10. Occultation Table from Jan. *S&T*, especially Oct. 19 events
11. Grazing Occultations, Aldebaran 1996 - 1999 (North America)
12. Mid-Atlantic grazes, 1997 Oct. - mid Nov.
13. Asteroidal Appulses & Venus Occultation, October 1997

If there is time, the presentation could start with Figure 1 (geometry) - just say this shows the geometry of an occultation, and that as the Moon moves in its orbit, a region is defined on the Earth's surface from which the occultation will be visible. Those within a mile or two of the northern and southern limits of the region of visibility will see the star pass along a tangent line relative to the Moon, and within a few minutes of closest approach, it can disappear repeatedly among lunar mountains and craters, the phenomenon being called a grazing occultation, or graze. Alternatively,
this might be shown along with the first segment of the video.

An important point is that occultations and grazes are not difficult to observe - you just need an inexpensive tape recorder (or camcorder that can be used like one, for the audio) and time source. For frequent observations, it is best to get a shortwave radio for receiving WWV time signals, available for about US$100.00. Otherwise, use the US Naval Observatory Master Clock available by phone at 1-900-410-8463, or 1-202-762-1401 in the Washington, DC free-calling area. You are not getting the full value of your telescope if you don't make room in your schedule to observe some of these dynamic, interesting, and scientifically valuable events. IOTA especially needs deep sky observers, those who have good finder scopes and/or setting circles, and who are used to finding obscure objects, since this skill is useful for observing the rare but valuable asteroidal occultations.

The videotape, a little more than 15 minutes long, has the following:

First, observations to illustrate different occultations using relatively complex and expensive "old-style" equipment that gives very good results. Observations in this group made by David Dunham with C-8 and image-intensifier unless otherwise described.

1. Total occultations of 6 to 9-mag. stars on the dark side of a 15% sunlit crescent Moon, during a 1987 Praesepe passage by Hans Bode using my video and his C-8 in Sicily. Viewgraph 11 might be shown during this.

2. Graze of 5.1-mag. 97 Tauri by 16% waning Moon, Sunday morning, 1995 July 23, Doswell, VA, observed only five miles north of here. Graze at north cusp (1 D on sunlit feature near cusp); other events indicate a newly discovered 8-mag. component a few hundredths of an arc second north of the main component. During this, show Viewgraph 2 (graze profile). Unfortunately, we did not get a good profile for this warm weekend graze because only one other observer, from Norfolk, timed the graze. A few observers from the Richmond and Fredericksburg areas could have added much to this spectacular event, so we hope that you might try some of these events in the future.

3. Graze of 8.0-mag. SAO 95090 by 16% sunlit Moon on 1995 May 4 (UTC) at Westminster, Maryland, cusp angle 6N; this shows that good action can also be timed with grazes of relatively faint stars. Timings from 6 stations defined the profile reasonably well.

4. 1991 January asteroidal occultations: a. Jan. 4 occultation of 7.4-mag. SAO 93228 by 4 Vesta, using C-5 with image intensifier, D. Dunham in Avis parking lot at Detroit airport; both D and R occurred just after a jet flew overhead (not affecting the view towards the side about 40 deg. up). Vesta also mag. 7.4; b. Jan. 13 occultation of 1.9-mag. Alhena (Gamma Gem) by 381 Myrhha, Tokyo, Japan (local observer, no image intensifier); c. Jan. 19 occultation of 9.1-mag. SAO 115296 by 10.5-mag. 216 Kleopatra, assisted by Wayne Warren at Maryland, NJ, 40 miles sw of New York City, NY. (If possible, stop the tape just after this event to give the discussion below, or do this after showing the tape).

Show viewgraph 3, showing the unusual shape of the M (metallic) type asteroid Kleopatra determined from the observations (from Jan. 1992 *S&T*). At the time, I lamented the fact that the event was timed from only one station in each of several States (only Ohio had two); hundreds of telescopes were in that path under clear skies, so the profile could have been traced in much more detail if more observers had used them.

Then show viewgraph 4, pointing out the Sept. 19 Merapi path, and say: Unfortunately, even though the accuracy of asteroidal occultations has improved since 1991, the observational situation seems to be even worse now. The predictions are good enough for PPM stars that for all but the very narrow paths, there is a very high probability that the event will occur within a path-width of the nominal prediction. On Sept. 19, I timed an 11-second occultation by Merapi from my backyard in Greenbelt, Maryland, indicating a small northward shift of the path. The expected central duration was 14 seconds. I don't know whether I was north or south of the center of the path - there can be no profile like that for Kleopatra - since nobody else observed the occultation, although the satellite image showed that it was clear across New Jersey, southern Penn., Maryland, most of Virginia, and Missouri, where the path must have passed. If just one other observer in those States had timed the occultation, at least a circular fit could have been made to measure Merapi's diameter.

5. This shows the equipment setup, except for the camcorder used for this footage, which is used in VCR mode to record the more sensitive output of the image intensifier and camera shown. 1991 July 8, Baja California., for graze of Atlas and Pleiades passage (not shown), 3 days before the total solar eclipse that I observed near Puerto Vallarta.

Next, simpler observations that are possible with camcorders are shown. First are shown some direct segments that anyone with a suitable camcorder can make, not just amateur astronomers with telescopes.

6. First, Jim Miller's view of The Weather Channel broadcast for timing, (since he doesn't have a WWV receiver), then his recording of the D of Aldebaran by the 17% sunlit waxing Moon, 1997 April 10, Northridge, California (NW of Los Angeles).

Show viewgraph 6, "your camcorder . . .", IOTA handout and press release for the 1997 July 29 occultation. Then show viewgraph 7, local time map for July 29, which [has been] put on IOTA's web site.

7. Reappearance of 3.9-mag. gamma Tauri from dark side of 47% waning Moon, 1997 Aug. 25, from safe and precisely locatable, but well-lit 7-11 parking lot at Barco, NC. It shows that even more common occultations of 4-mag. stars can be recorded with camcorders. David was on vacation at the beach, but it was cloudy at his motel, so he drove 40 miles to this location for clear sky.

8. Northern-limit graze of Aldebaran by 23% waning Moon, 1997 July 29, by Stuart Levy at Bemidji, Minnesota; 12 events recorded.

During this, can show viewgraph 8, from Dallas Morning News - this good, concise set of instructions resulted in a dozen videotapes being sent to me by members of the general public in northeastern Texas.

Viewgraph 9 from Time magazine - there are some mistakes, but IOTA received good publicity after the July 29 event from this. Most amateur astronomers have telescopes. The following shows what they can record by pointing a camcorder at the eyepiece of their telescope.

9. Total disappearance of Aldebaran, 1997 July 29, on bright side (helps [to have] auto focus), at sunrise, Alan MacRobert, Bedford, Massachusetts. Randy Tatum made a similar video of the D from his home in Richmond.

9.5 Total disappearance of 6.0-mag. ZC 2828 (rho 2 Sagittarii) well on dark limb of 30% sunlit Moon, 1997 Nov. 6 UTC, D. Dunham with C-8 at home in Greenbelt, Maryland. Normally, it is easiest to focus when zoomed in (higher power), but in this case, he zoomed out (lowest power, widest field) and used manual focus for focusing stability. The Earthshine shows well and recording occultations of even 8-mag. stars should be possible with this

equipment. This event occurred after the VAAS meeting, but was added at the last moment for a presentation by John Sanford at the AstroImage conference in Fullerton, California., on Nov. 8.
10. Northern-limit graze of Aldebaran, 1997 July 29 again, also 12 events, by Carlos Avalle, Atwater, Calif. (Moon alt. 4.5°). The camcorder is firmly attached to the telescope to give a stable view.
11. Video of an Aldebaran graze, on bright side of 82% sunlit waxing Moon, D. Dunham with C-5, 1997 January 19 at Acton, Massachusetts; 0F° (-18C°) temperature caused no problems.
12. More numerous fainter grazes can also be recorded this way. D. Dunham had only 2 events during this graze of 6.5-mag. 25 Arietis by the 70% sunlit waning Moon, C-8, 1997 Aug. 23, at Nags Head, a beach resort in North Carolina (sometimes grazes occur in nice places).
13. Miss of 6.4-mag. ZC 934 by D. Dunham at Myersville, Maryland, 1997 Aug. 27, Moon 27% sunlit waning, showing what can be done in bright twilight (Sun alt. -4 deg.). The miss was caused by a bad position for the star; use of the Hipparcos catalog data would have predicted a more southern path, and we will use these data when possible for future grazes. I would stop the tape here (unless there is time to fill), and show the last viewgraphs.
14. Occultation table - point out Hyades & Aldebaran occultations Sunday morning, October 19 - reappearances will be on the dark side of the highly gibbous Moon.
15. The current series of Aldebaran grazes, from p. 293 of last January's issue of *ON*, v. 6, n. 13. Note that a very good total occultation dark side disappearance by the 45% sunlit waxing crescent Moon (a good camcorder opportunity - tell your friends) will be visible throughout the Mid-Atlantic states (as well as the rest of the USA east of the Mississippi River) on 1998 March 4. Then there's a great graze the morning of 1998 Sept. 12 in W. Va. and Penn., with a total occultation R visible with camcorders across Virginia (and most of the southeastern USA).
16. Handouts of this list of Mid-Atlantic grazes coming up are available. It gives a Web site and contact data to obtain more information. Please send an email message to me at **dunham@erols.com** so I can add you to my notification list for occultations.
17. Asteroidal appulses - not necessary to show, the information is on the back side of the handout.
18. Some might be interested in the updated prediction of the Repsolda occultation shown here (show only if there is time, or there are questions about it). But the actual path was not near the center, according to the approx. ten observers who watched for an occultation and didn't see one (nobody did). The actual path could have been near the edges of the uncertainty zone, or maybe a little west of it, indicating a little larger astrometric error than expected - it was a very small asteroid, subtending only 0.025", so it was a tough one to predict.

Solar Eclipse Videos (these might be shown later in the meeting, and might be of interest to those planning to travel for the Feb. 1998 and/or Aug. 1999 total solar eclipses).

19. 1994 November 3 total solar eclipse near the northern limit at Colluri, Bolivia. C-5 without image intensifier; views show equipment. The camcorder used in input mode with the Panasonic black-and-white camera introduced a horizontal line that moves through the image.
20. 1995 April 29 annular eclipse in the Amazon near Iquitos, Peru, near the southern limit, C-5 by Paul Maley.
21. 1984 May 30 broken annular eclipse, eyepiece projection, D. Dunham, at Fairplay, South Carolina.

Best occultation video from an Islamic country

22. 1985 May 4, graze of 2.9-mag. alpha 2 Librae (Zubenelgenubi; 5.3-mag. alpha 1 was not occulted and remains visible) during a total lunar eclipse, near Hag Abdullah, Sudan, D. Dunham, C-5.(this is quite spectacular, not using an image intensifier, which I didn't have then. I included this since the tape was also used at a meeting of Arab astronomers that was held in Amman, Jordan, early this month.)

Lunar Occultations of Planets in 1998

David W. Dunham, Joseph Senne,
David Herald, and Eberhard Riedel

The maps show the regions of visibility of lunar occultations of planets and are reprinted by permission, from the **Japanese Ephemeris** for 1998, published by the Hydrographic Office of the Maritime Safety Agency of Japan. In region 1, only the reappearance is visible; in 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 (percent sunlit and whether waxing, +, or waning, -) at event time.

Predictions of lunar occultations of planets are not included in the IOTA "PC-Evans" total occultation predictions for 1998. For 1998, they need to be computed with OCCULT, which can also now be used to compute full XZ94E-catalog predictions, including the possibility of photoelectric or extended outputs. OCCULT predictions can now effectively replace the PC-Evans predictions. With the new IOTASTA program that permits OCCULT station input from IOTA's basic grazing occultation station data, OCCULT will replace PC-Evans for most regions of the world, the main exception being Europe, where PC-Evans predictions for 1998 have already been distributed.

Grazes of the major planets are 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. The inner and outer edges of the partial occultation zone are computed with the latest versions of the OCCULT program, which most of the grazing occultation computors have, so those interested in

observing partial occultations should request predictions from the graze computor for their region preferably a month in advance. Inner (and outer) edge partial zone predictions can also be computed with the older IOTA partial occultation program that has been used for about 30 years now and has been upgraded and maintained by Joseph Senne. If you want predictions computed with that program, request them at least three months in advance (if possible) from Joseph Senne; P. O. Box 643; Rolla, MO 65401; USA; phone 1-314-363-6233; email **senne@umr.edu**. Senne will not be able to compute predictions from 1997 mid December through 1998 mid January. It is no longer possible to supply the necessary information to produce data for producing ACLPPP profiles for these events, so for detailed work where the profile is important, OCCULT must be used.

The most unusual occurrence in 1998 will be the simultaneous occultations of Venus and Jupiter on April 23, visible from part of the South Atlantic Ocean and perhaps northeastern Brazil. See the end of IOTA News near the beginning of this issue for information to contact Paul Maley, who is planning an expedition to Ascension Island to observe this rare event. ι

Important Web Sites for IOTA

David W. Dunham

This is an update of the articles, "Web Sites for IOTA" in *ON*, v. 6, n. 14, pp. 339-341, and "More Web Sites for IOTA" on pages 374-375 of the last issue. The first site below is "required reading" for all IOTA members with Web access, and the second is similarly very important for all of those in the USA.

The IOTA membership roster, distributed earlier this year, is now on-line at **http://www.inlandnet.net/~iota**
Please visit the site and check your entry, and send any corrections to **IOTA@inlandnet.net** and copy the message to me at **Dunham@erols.com**. I know that some of the email addresses in the roster are no longer valid, and others are not given. IOTA can keep your information current only if you let us know of any changes. We don't want you to miss an asteroidal occultation update or other important timely message because the information we have for you is wrong.

The coordinates of your observing site are also important, and those in the USA can (and should) check them on the Web. The positions are accurate to 1" to 2", not quite good enough for reporting lunar occultation observations, but fine for all predictions and for reporting most asteroidal and planetary occultation observations. This is also good for checking for errors in measuring coordinates from the USGS topographic maps, and should be done even to check coordinates of sites from which grazing occultations are observed. The coordinates that IOTA has for you may be for an old, no-longer-used site, or may have been determined by the McManuses to only 0'.1 accuracy from a small-scale atlas, in which case, better coordinates can be found from the Web. The ETAKGUIDE site for doing this given at the top of p. 374 of the last issue no longer works; it seems best now to use the Etak subsidiary site, **http://www.MapsOnUs.com**, selecting "maps" from the menu and, once a good-scale map showing your site appears, go to the bottom of the map, bring up the "Map clicking will" menu by selecting it with your mouse, and select "Show Lat/Long". The maps menu has an option that prepares a map and locates virtually all postal addresses in the USA, and in some cases I have used postal addresses supplied by observers to find their coordinates. But this feature of MapsOnUs is not very reliable; the locations of some addresses are indicated as much as 3 blocks, or 10" or more, from their true locations. But you know where your site is, and you can move the cursor on the map to locate it, and then click your mouse to get the coordinates. Don't try to be real precise in positioning the cursor, since the coordinates will only be good to about 2" (or about 60 meters), anyway. Save the precise work for measuring the topographic map, which is needed for all lunar (total and grazing) occultation observations. Also, MapsOnUs does not give heights above sea level, so those need to be determined by another means, best of course being a good-scale topographic map, but for prediction purposes, an accuracy of 100 meters or so is all right. That can be obtained even from a 1:1,000,000-scale aeronautical chart, or just by telephoning the local airport and using their height, which, unless you live in a mountainous area, will be within 100 meters of the height of your site. In mountainous areas, topographic maps are needed for other purposes and are more commonly available, usually at sporting goods stores. Overall, MapsOnUs is like a single GPS receiver, good for checking coordinates, and determining them for predictions, but not good enough for reporting lunar occultation timings. Unfortunately, I have not found any equivalent sites for other countries; if you know of any, please let me know. Maps of other countries are available from **http://www.MapQuest.com** but longitudes and latitudes are not available there. Maps for some countries and areas are quite detailed. I was able to find Hans Bode's street in Hannover, Germany. But I was unable to find Fitzwilliam College, site of the ESOP-XVI meeting, in Cambridge, England; MapQuest only showed about five streets in that city of over 100,000 population.

Articles from many past issues of the major astronomical journals, including AJ (Astronomical Journal), ApJ (Astrophysical Journal), PASP (Proceedings of the Astronomical Society of the Pacific), and MNRAS (Monthly Notices of the Royal Astronomical Society), can be obtained from the NASA Astrophysics Data System at **http://adsbit.harvard.edu** From the menu there, go to the ADS article service.

PostScript files are generated by many applications to graph occultations. Edwin Goffin generates these files for his charts that are used by IOTA around the world, and they can be sent by email for rapid distribution. Isao Sato's charts are also available as PostScript files, as are Mitsuru Sôma's reduction profiles for grazing occultations. My own software can produce these files, for the occultation maps and asteroidal occultation observed profiles that I produce. These files can be displayed and printed easily with GhostView, software that, along with the needed GhostScript, can be downloaded from the web following the directions at **http://www.cs.wisc.edu/~ghost**. This software is highly recommended for regional and national occultation

coordinators.

At least the first two weather URLs given in *ON*, v. 6, n. 14, pp 340-341, are no longer valid. There are many weather sites now, and I'm not sure which one is best, but I have found rather good the "Real-Time Weather Data" site at **http://www.rap.ucar.edu/weather/satellite.html**. Also on page 340, the important GSC 1.2 request site is now **http://pixels.stsci.edu/gsc/gsc12/gsc12_form.html**.

Sky & Telescope now has an online occultation page at **http://www.skypub.com/occults/occults.html**. It gives the main information in the magazine's articles about occultations, and some update information such as asteroidal occultation shifts that I supply them. They have links to our IOTA sites for obtaining more detailed information. They have some nice graphics and animations for which we don't have room or access. But be sure to visit the IOTA sites, which almost always will have the very latest, most up-to-date, as well as the most detailed, information.

There is much interest among professional astronomers in the atmosphere of Neptune's large moon, Triton. A special site about Triton occultations has been established at **http://occult.mit.edu/**. Another very useful site is the planetary ring node site at NASA's Ames Research Center at **http://ringside.arc.nasa.gov/**. From it you can generate an ephemeris of the satellites of any of the outer planets except Pluto, in either J2000 RA and Dec or differential coordinates relative to the planet. Jeff Metcalf in Arizona recommended this site, from which I could find Triton's location relative to Neptune for the recent occultations. Also, PostScript files can be generated and downloaded that show the planet, its rings, and specified satellites at a given time, very useful for portraying planetary occultations.

Predictions and other information for Galilean satellite mutual events are at: **http://www.bdl.fr/phemu97_eng.html**.

The Totally Accurate Clock (TAC) is a relatively inexpensive device that works with a GPS receiver to provide accurate time. This is of value especially for solar eclipse expeditions to locations where shortwave or longwave time signals may be weak or unavailable. Dr. Cuno hopes to use TAC with a version of his video time inserter. Information about TAC can be obtained from **http://www.tapr.org/tapr/html/tac2.html**.

Information about symposia and members of the International Astronomical Union can be found at **http://www.lsw.uni-heidelberg.de/iau.html**. ι

IOTA Treasurer's Report

Terri A. McManus, Treasurer

At the IOTA Annual meeting held in December 1996 at Houston, Texas, there were some questions regarding the financial reports. In question were the November 1994 - November 1995 Cash Flow statement categories : Expenses - Other, -$1,539.20; Other Expenses, -$3.35; and Newsletter Only, -$3.35. I reviewed all entries in Quicken and found when items were entered as a split entry, problems occurred. The items were recorded twice, sometimes adding amounts, sometimes subtracting amounts. Split entries occur when making deposits or reimbursements. For example: I write one check for reimbursements, but in Quicken, I list the categories that make up the amount of the check: e.g. printing, mailing, office, etc.. Craig and I again waded through the Quicken register and repaired all the split problems. Following are the corrected reports. The ending balance for December 31, 1996 was US$6,670.45. The balance as of July 8, 1997 was US$4,344.20. ι

Corrections

From A. J. Elliott (ajc@compuserve.com): In a recent IOTA *ON*, I was listed as being the graze "computor" for the UK. In actual fact, we split the duties in the UK. I compute total occultation predictions and Bert Carpenter computes graze predictions. Bert's address is:

Bert Carpenter
27 Highbanks Close
WELLING
Kent DA16 3ES
UK
Telephone: +44 (0)181 854 6411
Email: bert.carpenter@craybbs.co.uk

From Paul Schlyter (paul.schlyter@ansys.se): I noticed that you included my site with the *ZC* online in digital form in the last *ON*. Unfortunately the URL was wrong--the "spitfile" should read "spitfire", and the URL then becomes: **http://spitfire.ausys.se/pur/zc/zc.zip**. ι

Coincidences

Guy Nason
Guy_Nason@tvo.org

Five or six years ago, when I my grazing career was just getting started, I organized a group from the Toronto Centre of the RASC to observe a graze about 90 minutes east of Toronto. Because I was new at this I relied on the experience and advice of "Bill" (not his real name), an experienced graze leader who belonged to another astronomy club in the Toronto area, and whom I knew was also planning an expedition for the same event. (You'll soon see why I'm protecting his identity.) We agreed that we would coordinate our efforts so that our data would complement each others', but that we would choose different locations for our respective "picket lines."

Anyway, on the evening of the graze, our group assembled at a Harvey's Restaurant not far from our pre-scouted "picket line." I was explaining the set-up to our crew when "Bill" walked in. Mildly surprised that we had chosen the same rendezvous point, I went over to him and asked where he was planning to set up. "What do you mean?", he asked. "The graze

is tomorrow night".

"Oh oh", I thought, and checked the IOTA data. No, it's tonight. I showed it to "Bill". He had made the fundamental error of forgetting to adjust the date of the graze to account for the difference between UTC (02h XXm) and Eastern Time (22:XX, 4 hours earlier, before midnight). Deeply embarrassed, and without a word, "Bill" quickly left the restaurant. We all felt very bad for him and understood why he didn't want to hang around.

Or so we thought. Far from slinking out in shame, he had rushed home, collected his gear, alerted his crew and they made it to their observing stations in time to record a successful event. His appearance at our rendezvous site was sheer coincidence; he had been on his way home from his cottage to prepare for (he thought) the next night's graze. What luck that, of all the burger-joints in all the world he had to walk into ours! Mission accomplished. Never give up. ı

Current Value of Timings of Total Lunar Occultations

David W. Dunham

Some observers have expressed an opinion that total lunar occultation timings, espeically visual timings, are no longer of value in the wake of the 1994 Clementine lunar mapping mission. But Watts' data are currently still being used for occultation analyses, and they have large enough errors so that occultations timed carefully visually still have value, even with the improved stellar data from Hipparcos. An analysis of the Clementine data should be helpful in refining the Watts' data by removing systematic errors, and an attempt to do this will occur this winter when Mitsuru Sôma will work at Goddard Space Flight Center with the Clementine laser altimeter data and occultation data. But the Clementine altimeter data are too sparse to replace Watts' data. Nevertheless, when all the analyses are complete, visual timings of total occultations may become less useful than photoelectric and video timings. Video timing accuracies are smaller than the Clementine laser altimeter errors, and it is for that reason that I am strongly encouraging them. The Clementine laser did not probe the lunar polar regions, so visual graze observations, inherently more accurate in any case, will continue to be valuable in the foreseeable future. Improved lunar profile information, from both Clementine and new analyses of occultation timings, are needed to properly analyze past solar eclipse observations, especially the many timings made during the past two centuries from near the central lines of total lunar occultations, to study small variations of the solar radius.

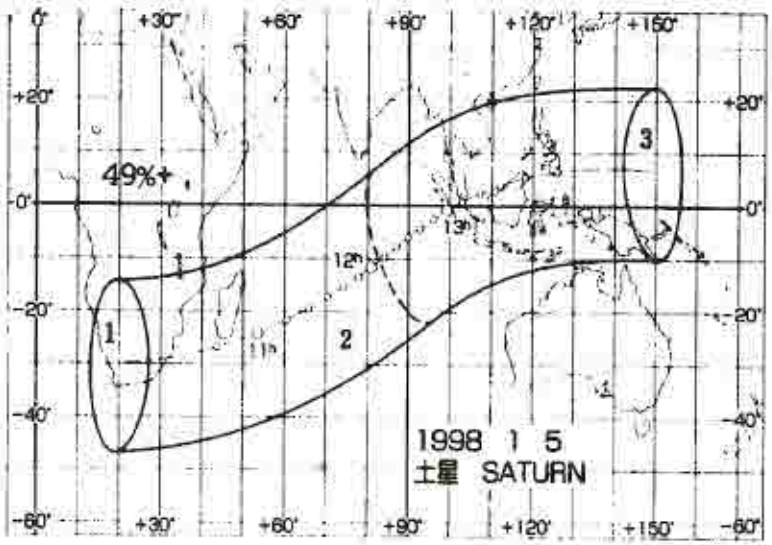
Dr. Sôma has also found some discrepancies when analyzing observations of grazing occultations in the same parts of the lunar limb a Saros cycle (about 18 years) apart, even using Hipparcos data for the stars. He writes:

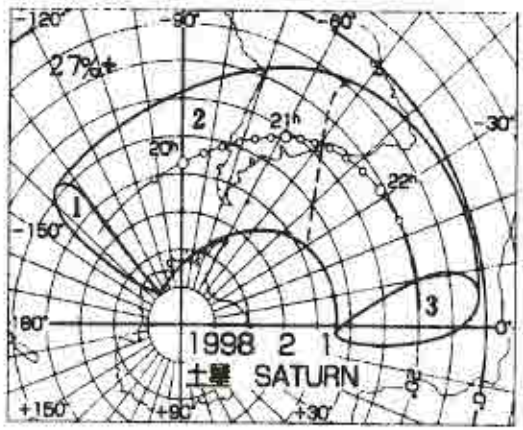
> Concerning the value of total occultation observations, I agree with David Dunham that they are still useful in refining the limb corrections. In addition to that, I think occultations can be used to analyze the errors of the Hipparcos proper motion system. The Hipparcos team claims that the Hipparcos reference frame is linked to the ICRS (International Celestial Reference System, the VLBI reference frame based on the extragalactic radio sources) with the accuracy of 0.25 mas/year. But the direct comparison of the proper motions between Hipparcos and FK5 gave inconsistent results with the precession error of -3 mas/year of the FK5, which had been independently obtained from VLBI, Lunar laser ranging, and proper motion analyses (Based on the preliminary results of the differences of Hipparcos - FK5 by F. Mignard of CERGA in France, I pointed out this fact in a letter addressed to him, and he admitted it at the IAU General Assembly held in Kyoto this August). Now that the lunar positions in the latest JPL planetary and lunar ephemeris DE405/LE405 have the mas level accuracy with respect to the ICRS, I think the problem can be resolved by analyzing lunar occultations using the DE405/LE405 ephemeris and the Hipparcos catalog.

In 1971, Leslie Morrison at the Royal Greenwich Observatory performed an error analysis that showed, due to lunar ephemeris, star catalog, and lunar limb error sources, then all about the same size and also about as large as good visual timing errors, the improved accuracy of photoelectric timings were of value by only 7/6 times that of a visual observation. Since then, lunar ephemeris errors have been virtually eliminated with laser ranging observations to retroreflectors placed on the lunar surface, and stellar data have been greatly improved with the Hipparcos mission. With the impending improvement also of the profile discussed above, the value of photoelectric and video timings will certainly increase relative to visual timings, but determination of the numerical ratio awaits completion of the new studies. ı

1998 年の惑星食図　世界時

LUNAR OCCULTATIONS OF PLANETS IN 1998　UT





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In region 3 only disappearance visible.

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————Disappearance at Sunrise. In region east of the line, occultation begins after Sunrise.

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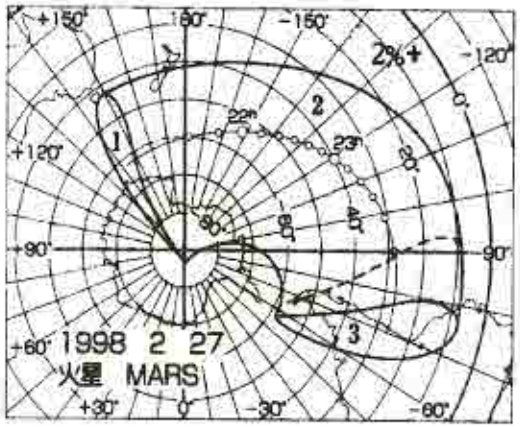
– – – – –Reappearance at Sunset. In region west of the line, occultation ends before Sunset.



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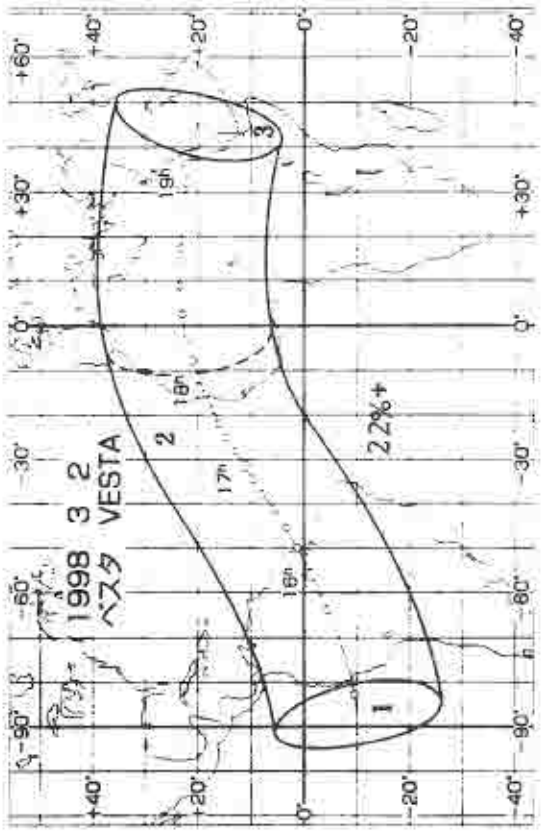

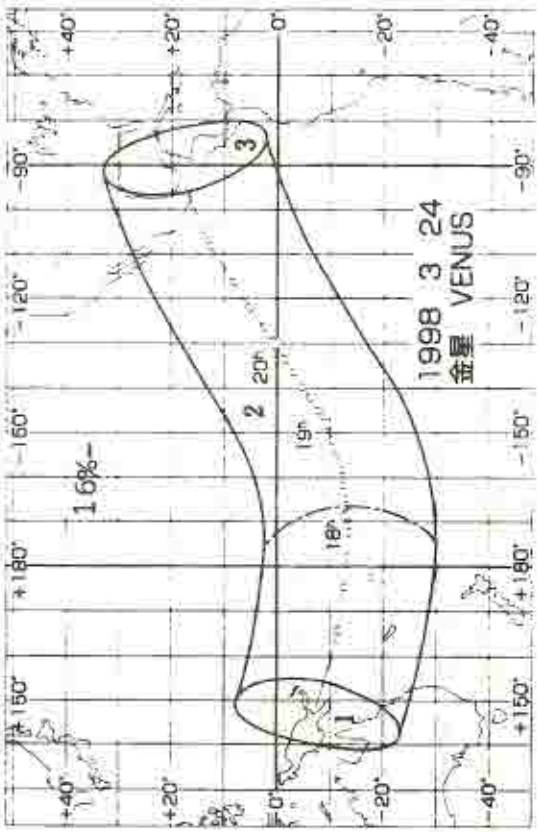

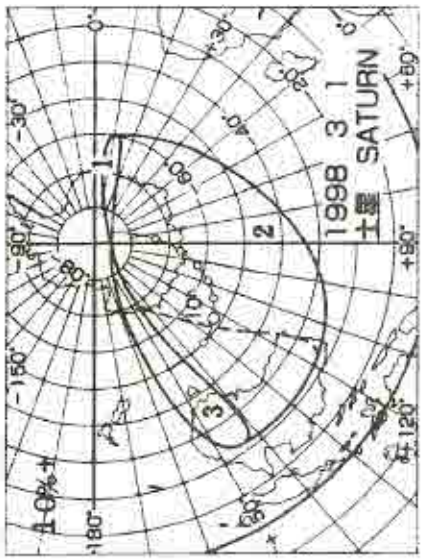

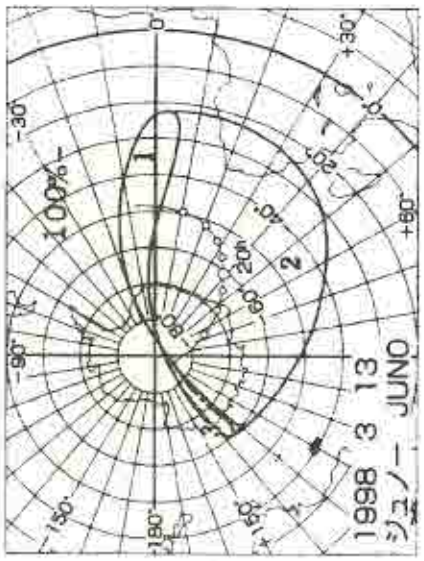

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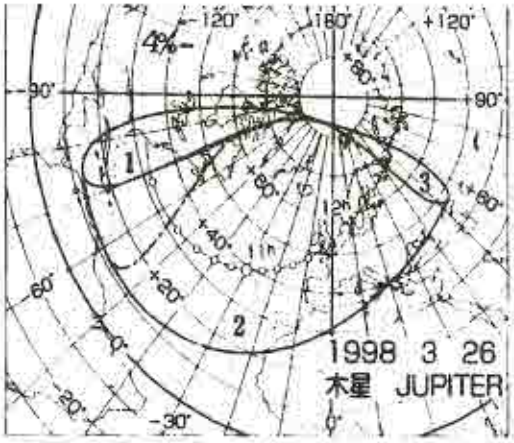

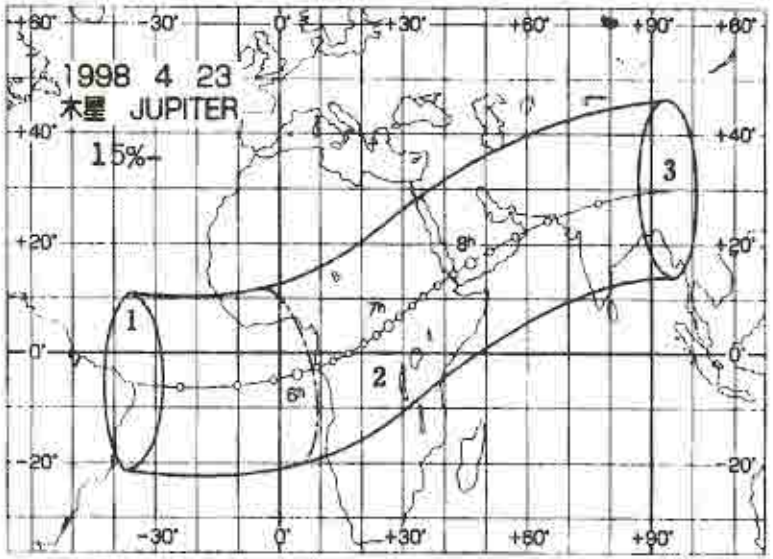

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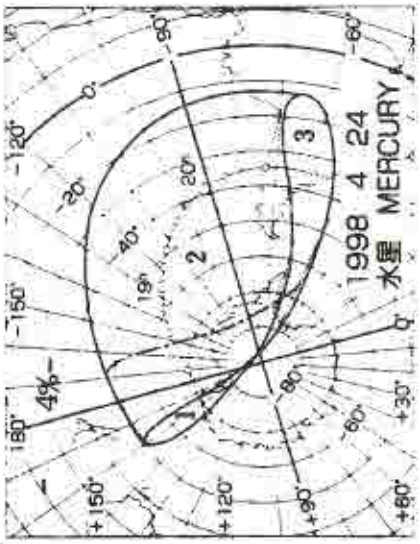
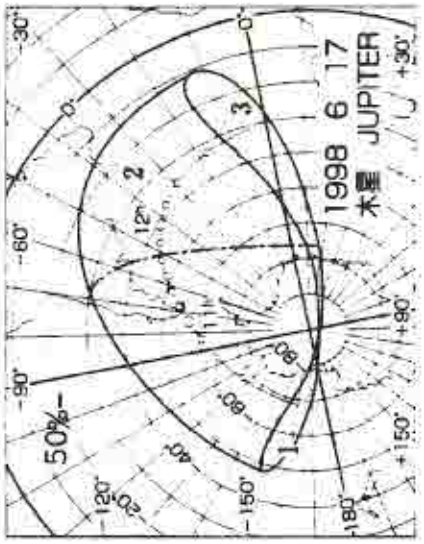
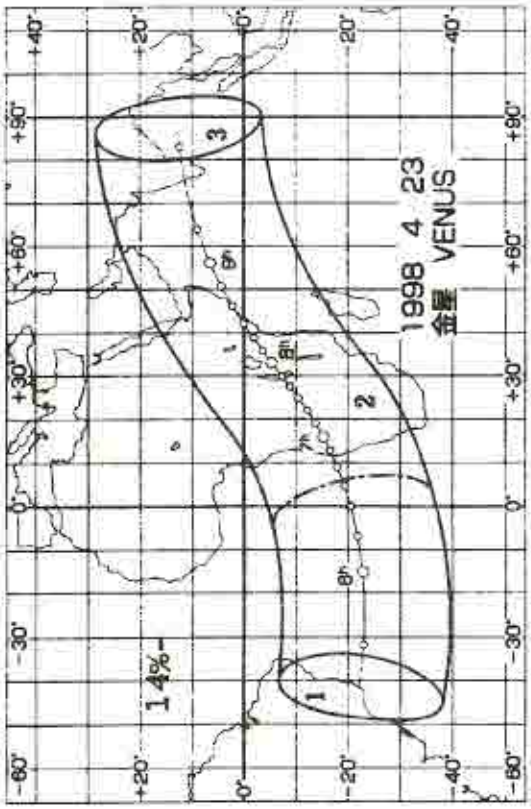
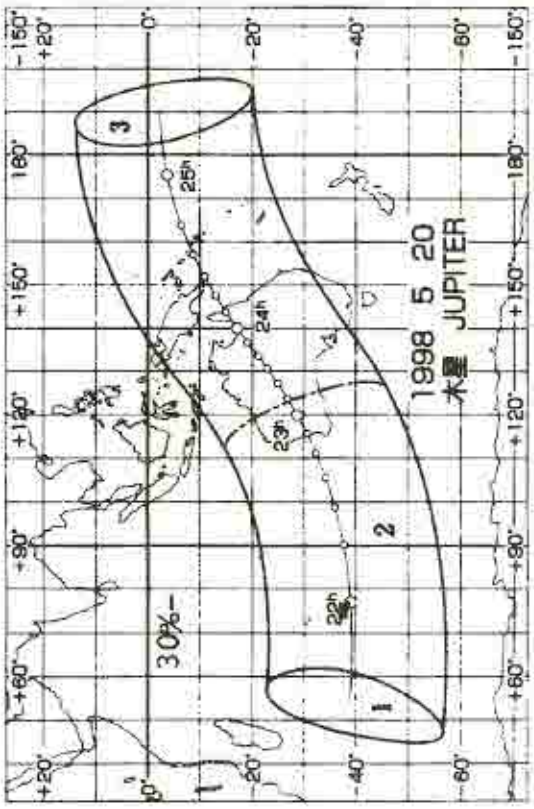
LUNAR OCCULTATIONS OF PLANETS IN 1998









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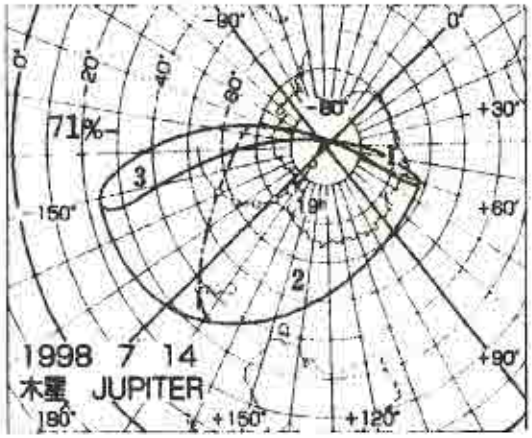

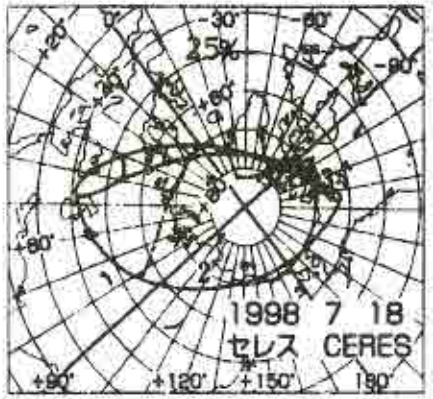

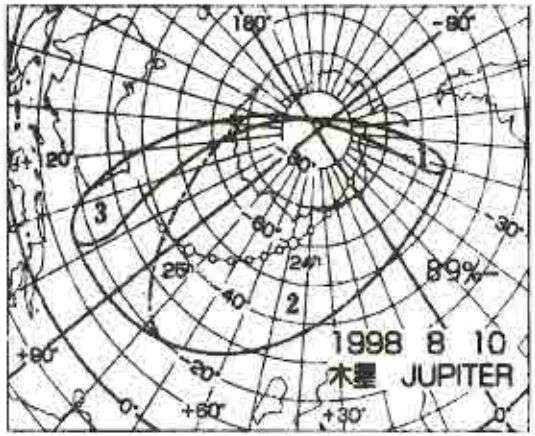

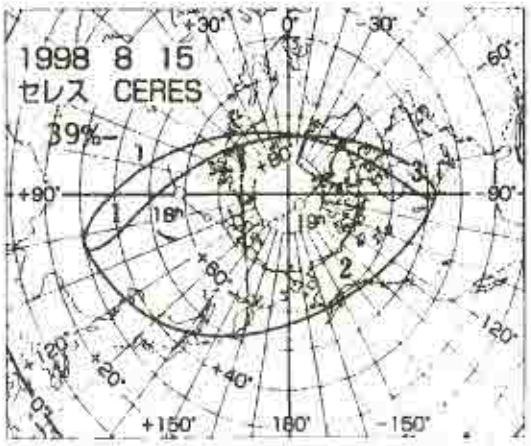

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1998 年の惑星食図　世界時
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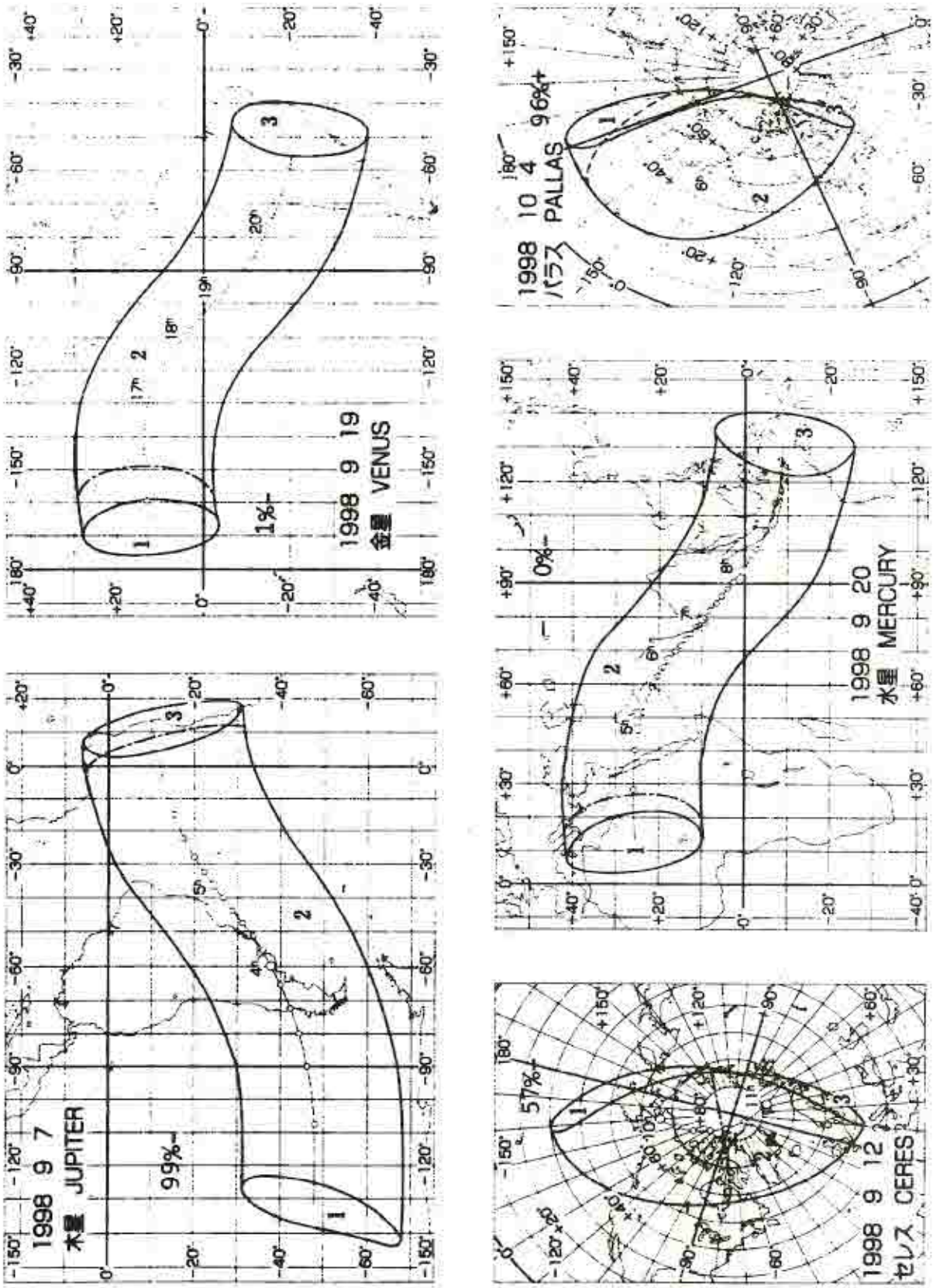

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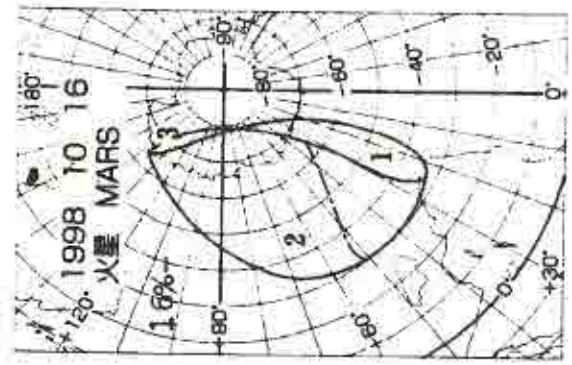

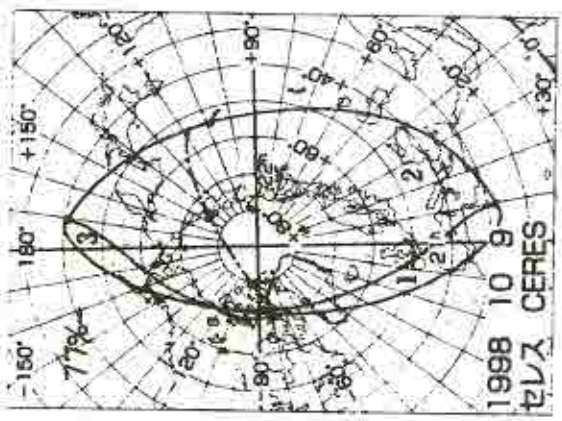

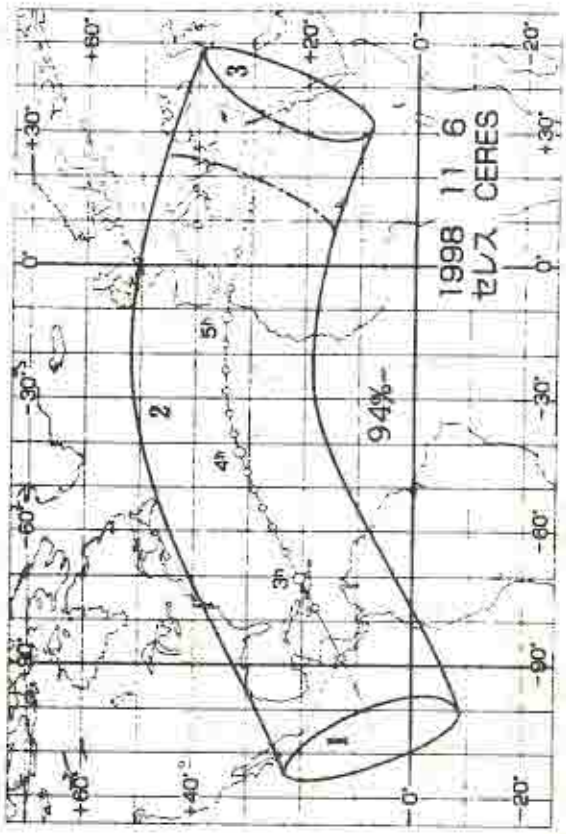

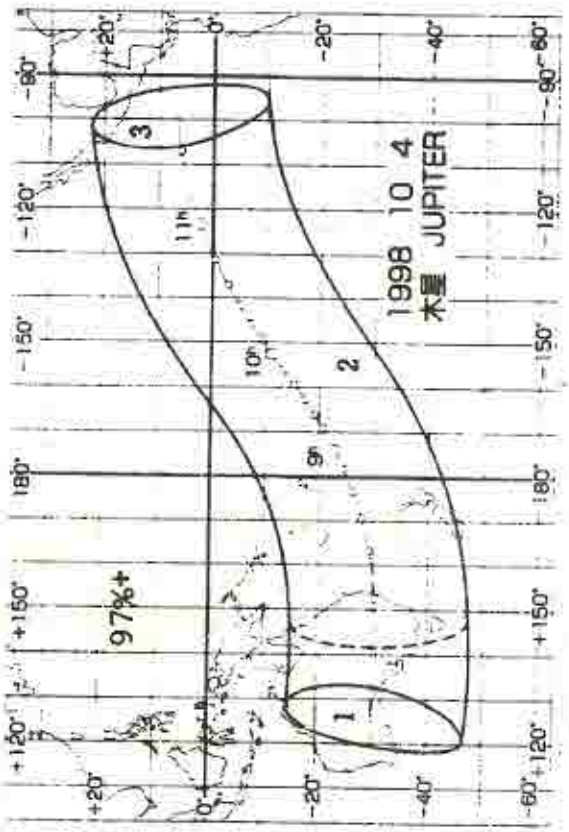

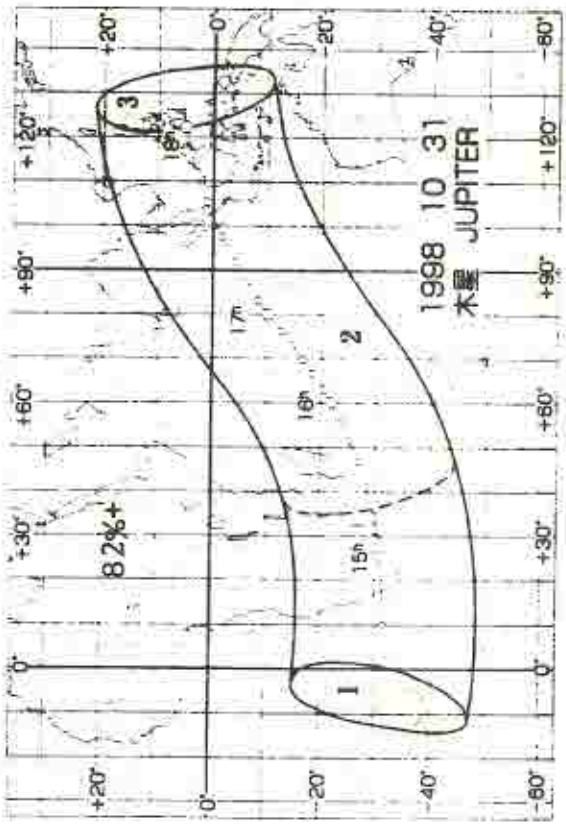

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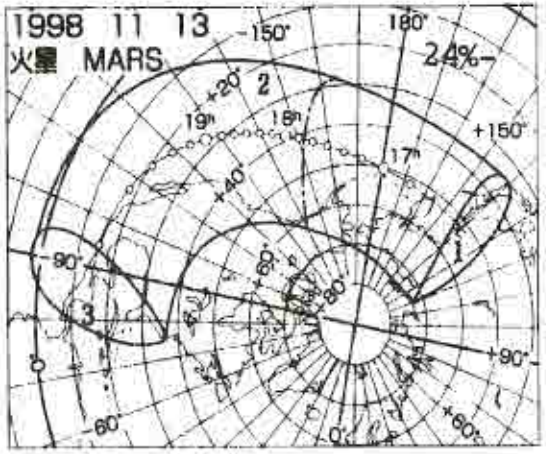

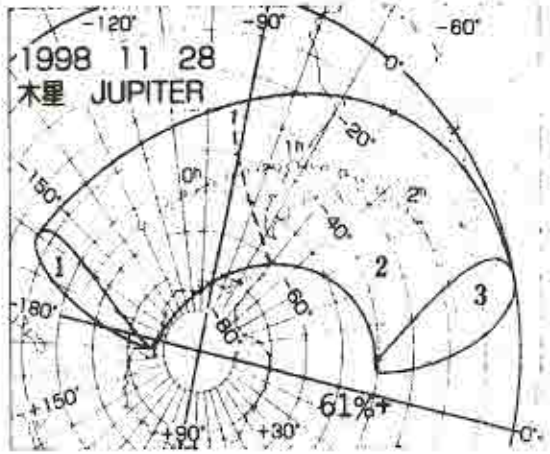

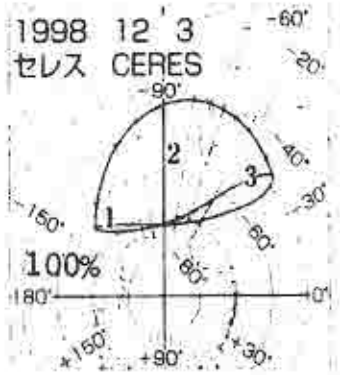

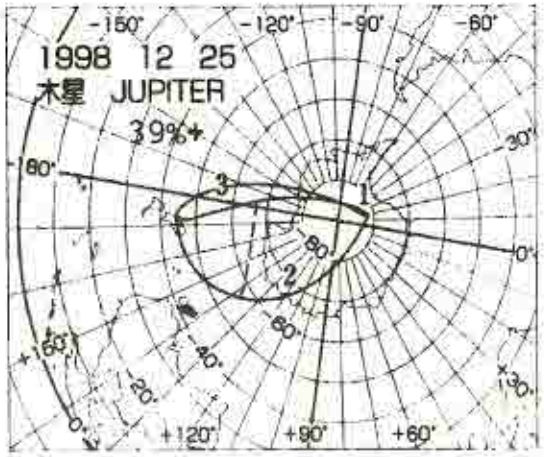

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GPS Versus Map Measurements

David W. Dunham

The ease of making single GPS measurements has resulted in some disasters recently, when insufficiently accurate data were obtained for sites that were not permanently marked. The inaccuracy of such measurements, and the means to improve them, have been discussed extensively in this volume of *ON*, especially in issue #6 (two long articles) and issue #13, p. 281.

The following remarks were recently made regarding measurement of the positions of observing stations for the 1997 October 19 grazing occultation of Aldebaran in Alberta:

"My feelings at measuring from a 1:50000 map will only give you a confidence level of 20 to 30 meters in positional accuracy due to many factors in production in these maps. The control adjustments used for 1:50000 mapping will give an initial error ellipse of 2-3 meters for each control point. That's just the start of the of the errors possible in our topo maps. A sharp pencil line you place on a map is 5 meters in width. The human eye and hand are only so accurate."

Scott Degenhardt, who has done some interesting studies with inexpensive GPS receivers and documented them on IOTA's lunar web site, wrote in response to this:

"I have been worried for YEARS about my confidence in topo map cartography because of this very same thing. An error just in the offset caused by drawing down the edge of your ruler can be costly to your error budget! I'm going to stick by my GPS."

My response: Note that the comments were made about 1:50,000-scale maps. Things are rather easier, more forgiving, with the 1:24,000-scale maps that we have in the USA. I still find scaling maps easier than either making differential GPS measurements, or sitting at a site for half an hour or more to gather enough data to confidently reduce the S/A error. If you observe from just one place, then yes, GPS may be worth the effort, but for grazes, I'm waiting either for an easier way to make DGPS measurements, or for S/A to be turned off.

Since blunders can be made when scaling topo maps, I am checking all new measurements, as well as some old ones, with the MapsOnUs web site, to spot and correct major errors, but with its accuracy of 1" to 2", it's not quite good enough for final coordinates for lunar occultation analyses.

Scott also mentioned that his limited attempts to make simple DGPS measurements have not been successful, but that these would be resumed after an observatory project was completed near the end of 1997.

Most CCD Systems Can't Time Occultations

David W. Dunham

I now know of two cases where asteroidal occultations were detected with CCD systems, but with timing resolution of a few seconds, making the observations much less useful for determining the size and shape of the asteroids involved than if the observers had observed visually and timed the occultation with a tape recorder and time signals. Not only can most astronomical CCD systems record no faster than one image a second (they are optimized for long integration times to record faint objects, making them great for astrometry), but they also often do not record continuously, causing gaps of a few seconds between each observation as data are transferred from the CCD. In the most recent case, I wrote to the observer: "Since the expected central duration was 5 seconds, with 2-second 'dead' times you could have missed a short, non-central event. It would have been better in this case, where there would be a 3-magnitude drop with a 9-mag. star, to remove the CCD and use an eyepiece, and a tape recorder to time the occultation visually to an accuracy of 0.2 second or so; also, you wouldn't have missed any short events. Unless you can record faster than 0.2 sec. with no 'dead' times, it's better to observe the occultation visually when that is possible. In some cases, when the asteroid is brighter than the star, the magnitude change is small and might not be noticed visually, in which case, CCD observation is better."

Even better is software that can be used with some CCD systems to record at the visual rate or faster without "dead" times, like the IOTA Occultation Camera designed by Wolfgang Beisker in Germany (more about this will be published in *ON* soon).

Of course, it's interesting to record some CCD images several minutes before and after an occultation, just before and just after the objects merge then you can examine them afterwards to get an idea of whether the asteroid passed to one side (and which side) of the star, or if the event was nearly central so that the occultation shadow was nearby.

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.

The Offices and Officers of IOTA

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Executive Vice President	Paul Maley, Paul.D.Maley1@jsc.nasa.gov
Executive Secretary	Rocky Harper, HarperR@webster.wireline.slb.com
Secretary & Treasurer	Craig A. and Terri A. McManus, IOTA@inlandnet.net
Vice President for Grazing Occultation Services	Dr. Mitsuru Sôma, SomaMT@cc.nao.ac.jp
Vice President for Planetary Occultation Services	Jim Stamm, JimStamm@aztec.asu.edu
Vice President for Lunar Occultation Services	Kent Okasaki, KentO@hpctgjm.hpl.hp.com
Editor for *Occultation Newsletter*	Rex L. Easton, SkyGazer@inlandnet.net
IOTA/ES Section President	Hans-Joachim Bode, Bode@kphunix.han.de
IOTA/ES Secretary	Eberhard Bredner
IOTA/ES Treasurer	Alfons Gabel
IOTA/ES Research & Development	Wolfgang Beisker, Beisker@gsf.de
IOTA/ES Public Relations	Eberhard Riedel, 100756.3510@compuserve.com

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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