Occultation Newsletter

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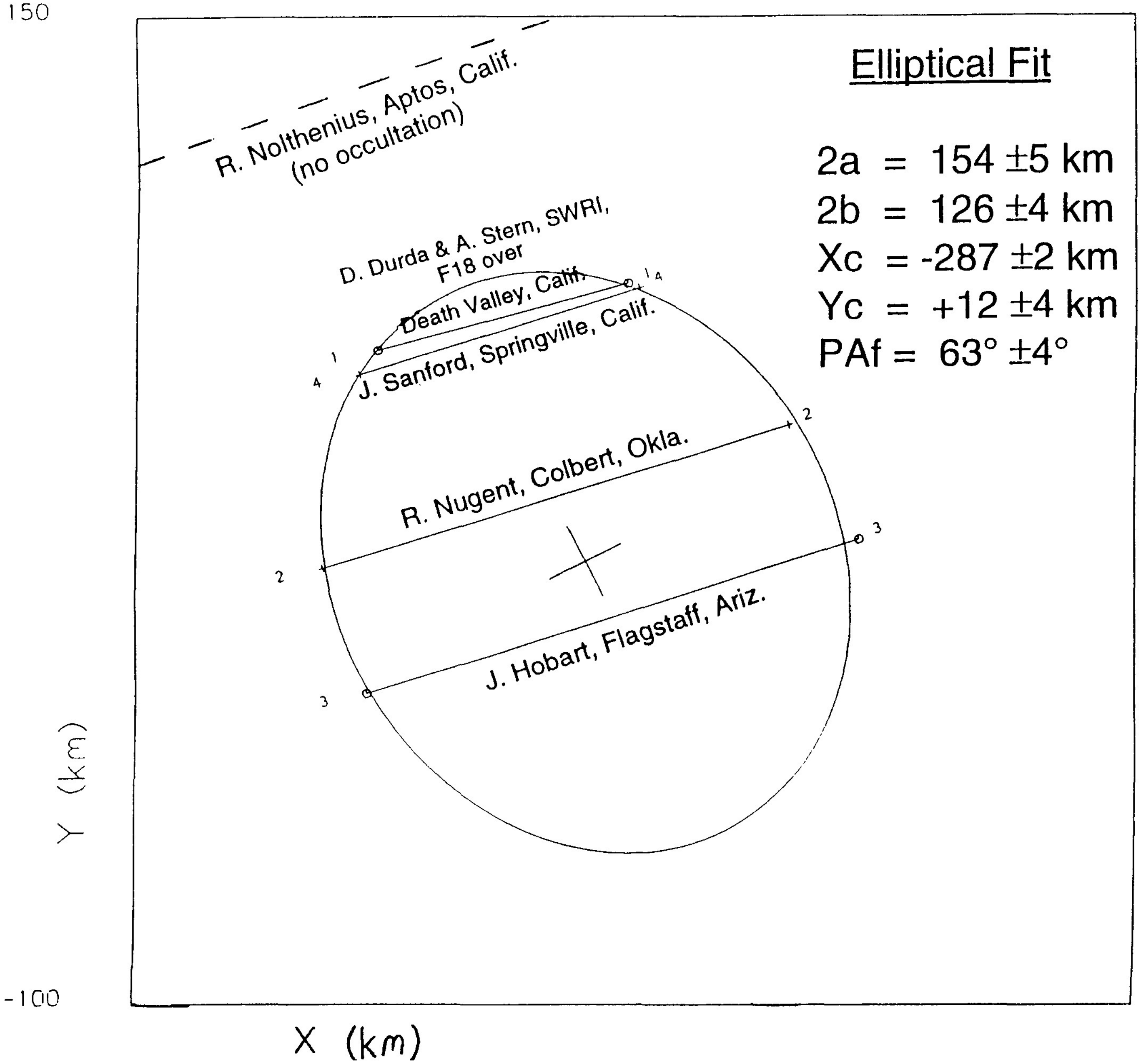
Revised Edition

Occultation of SAO 118158 by (308) Polyxo, 2000 Jan. 10



International Occultation Timing Association, Inc.

In this Issue

Articles

Resources

For subscription purposes, this is the fourth issue of 1998.

ON THE COVER: The shape/size profile of the asteroid 308 Polyxo, first successful observation from a F-18 Jet Aircraft on Ja nuary 10, 2000. Three other ground based observers contributed to the profile of this asteroid.

This is a revised edition of *ON Volume 8, No. 2* by The *Occultation Newsletter* Heritage Project.

There were to different versions of this *ON* available. One was better readable but had some formatting problems.
This issue was choosen for revision.
Therefore "In this Issue"and "Resources" were rewritten and some articles were shifted compared to the original version.

O. Klös, IOTA/ES, The *Occultation Newsletter* Heritage Project, April 2018

International Occultation Timing Association, Inc. (IOTA)

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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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**-Jan Manek, (see address at left)

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IOTA News

David Dunham, dunham@erols.com

Several exciting things have been happening within IOTA along with upcoming major Occultation and eclipse events.

New European Web Address: IOTA/ES has a new web address: **http://www.iota-es.de.** From this site, users can find out about what's going on at the European Section of IOTA, including grazes, occultations and links to sites that offer free Occultation related software for downloading.

Time Insertion of Video Tapes: Rick Frankenberger has taken over from Don Stockbauer the task of video time insertion of your occultation video tapes. Send video tapes to
Rick Frankenberger
8702 Timberbriar Drive
San Antonio, Texas 78250
Email: rickf@stic.net.
Contact Rick for additional information, if needed.

November 1999 Leonids: The first confirmed impacts of meteors on the Moon's surface were made by IOTA members in a well planned visual and video campaign during last November's 1999 Leonid meteor shower. Following Brian Cudnik's visual observation of a flash on the dark side of the Moon, several observers across North America were able to confirm this flash as a most probably meteor impact on the Lunar surface. See the article in this issue of *ON* for more details.

308 Polyxo: On January 10, 2000, this asteroid occultation was the first successful occultation observed from a military F-18 jet aircraft over Death Valley California by Drs. Alan Stern and Dan Durda of the SWRI in Colorado. Several visual observers obtained chords also - J. Sanford, Sprigville, CA, Joe Hobart, Flagstaff, AZ and Richard Nugent, Colbert, OK.

GPS Selective Availability: The S/A function that causes large errors in obtaining GPS positions was turned off by the government on May 2, 2000. Now even low cost GPS receivers can obtain accurate ground coordinates to within 10 meters most of the time after averaging data for about 10 minutes. An article in this issue of *ON*, shows some preliminary tests done by Joe Hobart of Flagstaff, Arizona. A brief article on the S/A appeared in *Sky and Telescope* for August, 2000, page 68. While coordinates can now be obtained to 10 meter accuracy after just a few minutes of data collection, users should continue to use the USGS TOPO maps for altitudes. On-line low resolution maps are available from **http://www.topozone.com**.

IOTA Annual Meeting: The 18th annual meeting of IOTA was held in conjunction with the Mid-States Region of the Astronomical League in Kansas City, MI on June 11-12, 2000. The minutes of this meeting will be published in the next *ON* issue. Highlights from this meeting include

1) New GPS developments and low cost receivers/software useful for IOTA purposes now that S/A is turned off,
2) Some IOTA history presented to Mid-Con IOTA/Attendees,
3) Release of the Tycho-2 star catalogue. Tycho-2 contains 2.5 million stars (approx 20 per square degree) with the highest accuracy proper motions available to date. See this issue of *ON* for additional details,
4) 216 Kleopatra was imaged by the upgraded radar at Arecibo in Puerto Rico and by the 10 meter Keck telescope in Hawaii. Both new sets of images confirmed the highly elongated shape of Kleopatra discovered by IOTA during the January 19, 1991 occultation over the United States.
5) One of the finest telescope/video setups used for Occulatation work was described by Craig and Terry McManus (IOTA Treasurers). Their system has a computer driven Meade 10" LX-200 telescope, image intensifier, GPS receiver and Horita time inserter which takes GPS time and inserts it *directly on the video during observations in real time!!*
6) Presentation of a high resolution video taken by Richard Nugent of Baily's Beads from the August 11, 1999 solar eclipse from southeastern Turkey.
7) Results from the April 19, 1999 Aldebaran graze from Denver. Bob Sandy had reduced the event which included 122 timings from 38 observers in 10 expeditions.
8) Graze Guru Hal Povenmire gave many tips on how he has succeeded in over 350 grazes.

WATTS profile errors: The recent graze of 95 Tauri over central Florida confirmed errors in the northern Watts data (Watts angle between 345 - 355°, with latitude libration greater than 3°). Corrections to the Watts profiles are given in an article in this *ON*. i

GPS Time For Occultations

Richard Nugent, RNugent@ghg.net

With a growing need for alternative accurate timing methods for occultation work, the use of GPS time is becoming more attractive. Occultation observers in Japan are already using a device to use GPS time for occultations since their shortwave signals, JJY will be terminated soon. The discussion that follows between Patrick Purcell, David Dunham, Joe Hobart and Mitsuru Sôma explains some of the methods, problems associated with the use, construction and acquisition of devices to use GPS time.

Dear David,

Recently we were threatened with shutdown of the VNG standard time and frequency broadcasting service. We have persuaded the powers that be to postpone the evil day. However, it does raise the question of what will happen when the axe finally falls. (It seems everyone is cost-cutting these days.)

Has your organisation considered alternative methods and equipment e.g. for using the time off the GPS satellites? Is there suitable equipment already available or being developed? If so how much is it likely to cost? How does one obtain it? Who sells it? etc.

Patrick Purcell

Patrick,

Yes, we've considered the problem, and the Japanese have even solved it, since their own shortwave time signals, JJY, will be shut down soon. For visual timings, the alarms from clocks that automatically set themselves from longwave time signal broadcasts should be good enough; we can buy them for less than $40 in the USA, but I don't know if VNG has a longwave broadcast that will continue after the shortwave broadcast is shut down. Tests have shown that for video timing accuracies, these cheap clocks are not accurate enough. Therefore, a couple of observers in Japan with electronic knowledge, working with Mitsuru Sôma, designed equipment that can be used with inexpensive GPS receivers to produce both a video and audio time display on video frames. Tests show that this device is accurate to about a microsecond, of course much more accurate than any IOTA requirement and much less than video time resolution. The cost is about $200 and instructions are on a Japanese Web site, but for now, only in Japanese; many Japanese occultation observers are acquiring these devices. Since Japanese video is NTSC, the same as used in the USA, their device should be useable directly here. But I think PAL is used in Australia, which would necessitate some changes. Work in this direction has also occurred in the USA, but at a less advanced stage, apparently, than in Japan, although there is a commercial GPS video time inserter available here for about $500.

David Dunham

David,

I am keenly interested in the Japanese effort. What is this $500 device I keep seeing mentioned??? The ONLY one I know of costs closer to $1000 when you add all the necessary accessories. If we ever finish the project our time inserter will cost $300 to $400.

Joe Hobart
Flagstaff, AZ

Reply from Mitsuru Sôma:

As David Dunham wrote, two occultation observers Hiroyuki Geshiro and Tsutomu Hayamizu designed equipment at my suggestion that can be used for video occultation observations to get precise timings of the events. The equipment is named "GHS (Geshiro-Hayamizu-Sôma) clock". It makes an LED flash and also makes a sound at each second, and they are accurate to about a microsecond. Many Japanese occultation observers are aquiring the GHS clocks, and the Japanese Hydrographic Department has introduced four GHS clocks for their observations so far. The information about the clock is given on the Web page **http://www2.synapse.ne.jp/uchukan/data/occult/gpsradio/ghsclock.html**.

The explanation is only in Japanese now and we are planning to make its English page, but for now you can at least see the circuit diagram given on the page. The main cost is from GSP receiver Jupiter, whose price is 19,800 yen (approximately US $200, but you also need to pay the postage and 10% handling fee for the bank when buying it from abroad). You can buy Jupiter from SPA (System Producer Associates) Ltd. in Tokyo by sending e-mail in English to gps@spa-japan.co.jp, but you will need to pay by transferring the Japanese yen to the company's bank account. For creating the GHS clock, you will also need to get an LSI for it, which will be difficult to get from abroad. In that case please refer to the circuit diagram given at:
http://www2.synapse.ne.jp/uchukan/data/occult/gpsradio/gpsradio.html and you may be able to make the clock by yourself. There is a plan that some Japanese company is selling the GHS clocks. I will let you know the detail when the plan is fixed.

David wrote, "a couple of observers in Japan ... designed equipment... to produce both a video and audio time display on video frames. ... Since Japanese video is NTSC, the same as used in the USA, their device should be useable directly here. But I think PAL is used in Australia, which would necessitate some changes."

The GHS clock is used to brighten or darken the video frames by the flash of the LED, so it is not a matter whether your video is NTSC or PAL. When the sound (seconds pips) from the GHS clock is recorded on the video, the precise event times are measured at Sendai Space Hall in Kyushu (in southern Japan), where Tsutomu Hayamizu can use some equipment that can play back the video frame by frame with the pips.

David also wrote, "For visual timings, the alarms from clocks that automatically set themselves from longwave time signal broadcasts should be good enough; we can buy them for less than $40 in the USA, ... Tests have shown that for video timing accuracy, these cheap clocks are not accurate enough." I examined such cheap clocks sold here in Japan, and found that they have delays of about 0.1 sec to 0.3 sec even just after the automatic adjustment, so in my opinion those clocks should not be used even for visual observations.

Sincerely yours,

Mitsuru Sôma
IOTA Vice President for Grazing Occutation Services
National Astronomical Observatory
Mitaka, Tokyo 181-8588, Japan i

GPS Precision with Selective Availability Off

David Dunham, dunham@erols.com

On May 2, 2000 the Selective Availability function (SA) used to degrade GPS position accuracy was turned off. From the test results shown below Joe Hobart performed in Flagstaff, AZ, it is clear that some averaging is preferred to obtain the accuracy that IOTA would require in ground positions. Probably 10 minutes of data collection would be sufficient in almost all cases, but a reasonably unobstructed view and reasonably good satellite geometry are important -with them, probably even only two or three minutes would be all right. If you are not sure how good the geometry is, then record data for 10 minutes. If that shows some periods of large excursions, record for 5 or 10 more minutes so that either obviously discordant data can be removed, or to ensure that the averaged position is accurate enough. These are my impressions, to achieve 15m accuracy that IOTA would prefer to have - others might have some better advice after more observations are made. Of course, longer averaging times will always give a better result, but times longer than 10 - 15 minutes become impractical when more than a few stations need to be surveyed for a distant lunar grazing or asteroid occultation expedition.

In any case, now I agree that scaling positions from USGS maps will soon become obsolete as observers acquire inexpensive GPS receivers. The maps may be useful for checking (or determining) heights above sea level (which can be obtained from online versions of the maps, such as those at **www.topozone.com**), but I think even for heights, several minutes of GPS measurements will usually be good enough. When getting heights from other sources, be sure that the coordinates are all referenced to the same datum. That is another reason to use just GPS measurements, which usually use the GPS WGS84 datum, since maps always give the heights relative to the local geodetic datum.

The next step will be to build something like the Japanese GHS clock (GPS-based for video time insertion, see the accompanying article in this issue) that can be used with commonly-available inexpensive GPS receivers (the GHS clock only works with the Jupiter GPS receiver, which might not be well-suited for averaging positional observations). Information about it is on the IOTA Web site at:

http://www.lunar-occultations.com/iota

On May 2, 2000 Joe Hobart from Flagstaff, AZ reported the following:

Hello all, And S/A is indeed off!! Despite what others say about being within feet, the following were observed:

For some time after SA was turned off the altitude reading was 2100 meters or about 25 meters above my "reference". It later improved to about 4 meters above my "reference". Also there was one time of five to ten minutes when the error was as much as 18 meters in horizontal (18 meters at 171 degrees true). This was very obviously due to poor satellite configuration.

These figures were taken from the SA Watch program with a Motorola GT+ GPS receiver running without differential corrections. The antenna is mounted on top of an unused wood stove chimney about six meters above ground. Preliminary report for the first eight hours without SA:Average: 35 05 59.21 N 111 41 34.86 W 2078 meters altitude
Reference: 35 05 59.20 N 111 41 34.87 W 2074 meters altitude

Difference is 0.4 meter @ .051 degree true from a position determined by MONTHS of averaging with SA turned on. The results for this eight hour period,

% Readings	Accurate to
99	10 meters
95	10 meters
68	4 meters
50	3 meters

Joe Hobart
Flagstaff, AZ i

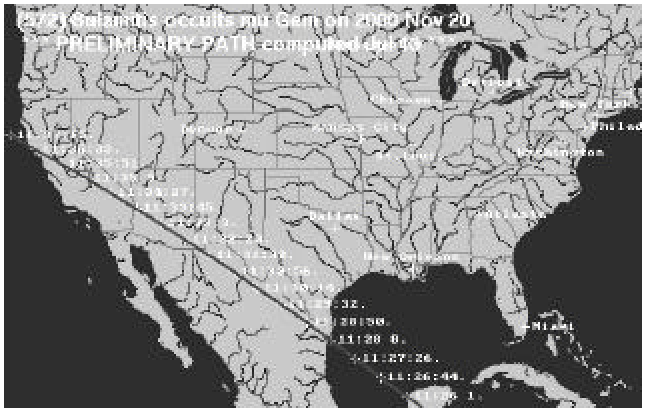
A Spectacular Naked Eye Asteroid Occultation Over North America

Richard Nugent, RNugent@ghg.net

In the early morning hours of November 20, 2000, the 40 mile wide asteroid 752 Sulamitis will occult the naked eye star μ GEM, $m = +2.9$. This will be the brightest star occulted by an asteroid in recent history over the northern hemisphere, only surpassed by an occultation of Regulus somewhere over the Pacific Ocean in April 1998.

An early updated path has been predicted by Martin Federspiel. It shows a substantial south shift from Edwin Goffin's nominal prediction. From observations provided by Ron Stone of the Naval Observatory, the Sulamitis path moves in a line crossing the Yucatan peninsula, then south of Brownsville, TX moving northwestward through Mexico, Tucson, Phoenix, and over Santa Rosa, CA. See the diagram below. Since the Sulamitis observations only cover 1998/99 dates, Federspiel and David Dunham caution that this update is preliminary. Estimated errors in of 0.2" - 0.5" could push the path as far northeast as Denver or off the California coast and over parts of southwestern Mexico.

Observers are encouraged to organize and prepare for this rare event. Observation and helpful video tips are described in Sky and Telescope, February 2000, page 103. Future updates of this spectacular event, the next expected in late September after new observations can be made as Sulamitis gets far enough away from the Sun, can be obtained from the website,
www.lunar-occultations.com/IOTA/asteroids/astrndx.htm.



Preliminary path of 572 Sulamitis, November 20, 2000 i

The Tycho-2 Star Catalogue

Richard Nugent, RNugent@ghg.net

The Tycho-2 Star Catalogue was released on February 8, 2000. This new important star catalogue contains positions, proper motions and two color photometry for the 2.5 million brightest stars in the sky. In addition, components of double stars with separations down to 0.8 arcsec are included. The positions and the magnitudes were derived from a new reduction of the original observations from the Tycho experiment on the ESA HIPPARCOS satellite and have a stated epoch of 1991.5. The stars have been reduced to the ICRS (epoch 2000) reference frame defined by the HIPPARCOS catalogue. The proper motions in TYCHO-2 are probably the most accurate attainable in modern day astrometry - by direct comparison from the older positions of the Astrographic Catalogue (average epoch 1909) and more than 143 ground based catalogues, all brought to the HIPPARCOS based system. Proper motions precise to about 2.5 mas/yr (0.0025”/yr.) For only about 100,000 stars, no proper motion could be derived. Tycho-2 supersedes Tycho-1, and the ACT and TRC catalogues based on Tycho-1.

The average density of stars is about twice that of the ACT catalogue. It is thus more likely that TYCHO-2 catalogue stars would be occulted by asteroids providing high accuracy in predicting ground paths of these highly location sensitive events. Further details on the Tycho-2 catalogue are available from the Tycho-2 web site:

http://www.astro.ku.dk/~erik/Tycho-2/

The Tycho-2 Catalogue is available for ftp download from:

The Tycho-2 web site:
http://www.astro.ku.dk/~erik/Tycho-2/
and from the CDS web site: **http://vizer.u-strasbg.fr/cgi-bin/VizieR?-source=Tycho-2**

The Hipparcos and Tycho Multiparameter Search Tool is now online at the Hipparcos web site. This tool allows users to create complex queries using a combination of (some of) the following paramters: right ascension, declination, parallax, V magnitude and B-V color index.

This tool also allows users to query the Tycho-2 Catalogue.. The tool is available at:

http://astro.estec.esa.nl/Hipparcos/research.html i

Beware - Watts Profile Too Low for Northern-Limit Waning Phase Grazing Occultations

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Mitsuru Soma, somamt@cc.nao.ac.ip,
Harold Povenmire, cpovenmire@cfl.rr.com and Chris Stephans.

On Thursday morning, 27 July 2000, Harold Povenmire, at least six other Florida observers, and I timed multiple events during the grazing occultation of +5.1 mag. 97 Tauri = ZC 730 from near Lake Wales and Cocoa, Florida. Chris and Andrew Stephan observed the event from Alturas, Florida and recorded 16 events. Most of us were positioned above the Watts profile, which was very low. We were alerted to the possibility of a significant north shift of the Moon's shadow based on observations of a graze of the same star observed in Virginia in July 1995 by Robert Stewart and me. But in 1995, the graze occurred deep within the northern Cassini region, an area that has been known to be in fact near the lunar mean limb rather than far below it as indicated by Watts' grossly extrapolated data, and this has been taken into account in the ACLPPP, Grazereg, and Occult predicted graze profiles.

But this event occurred at a central graze Watts angle of 345.6°, well outside the Cassini region, and the ACLPPP profile indicated good-quality (*) Watts data, with no previous observed graze data to improve the profile. However, before the graze, I asked Mitsuru Soma to analyze the 1995 observations, and also any other grazes within a few degrees of the 2000 Watts angle and librations (-3.9° in long. and +4.9° in lat.). He found a few grazes of other stars observed in Japan, Florida, and elsewhere that showed clearly that the actual lunar profile was close to the lunar mean limb, between 0.5" and 1.0" higher than Watts' profile. Based on this information, we adjusted our observing fence for this morning's graze northward, and succeeded in observing the actual profile well; none of the observers had a miss. [Mitsuru Soma's later reductions of data from two of the 2000 July 27th 97 Tauri graze stations show that the actual profile was a full 1.0" north of the Watts profile.]

For most northern-limit waning-phase grazing occultation (Watts angle of central graze between 340° and 355°) with latitude libration greater than 3.0°, for that part of the profile defined by Watts data of any quality (indicated by *, 1, or 2 on the ACLPPP profile), observers should IGNORE the Watts data and instead plan for the actual profile being

0.2" to 0.7" south of the mean limb. Divide this by the VPS given at the center bottom of the ACLPPP profile to obtain the values in miles or km distance on the ground measured perpendicularly to the limit line; since VPS is typically about 0.7"/mi. or 0.5"/km, the distance range will usually be 0.3 to 1.0 mile, or from 0.4 to 1.6 km.

If there is already observed graze data (profile points indicated with 3's and 4's on the ACLPPP profile), they will supersede the Watts data or the approximate corrections described above. We hope to analyze this July 27 graze so that it can be included as observed data in the predictions for 2001. Of course, the best solution is to obtain and analyze many more observations so that most of the Watts' data can be replaced with better observed graze data. We will do this as much as possible for the 2001 predictions, and will modify ACLPPP to automatically apply the corrections described above so that we are not misled by these incorrect Watts' data in the future. Similar corrections are expected for the 2001 Grazereg and Occult profiles. But during the rest of 2000, beware of northern-limit waning-phase grazes and heed the advice above. i

1999 Leonid Meteor Impacts on the Moon The Observing Campaign

Brian Cudnik, cudnik @flash.net

When David Goldstein of the University of Texas proposed the possibility of visible flashes from Leonid meteors striking the Moon, David Dunham organized a campaign to videotape such flashes. I, being without videocamera, decided to try this visually, since I would be at a dark sky location watching for Leonid storms in the Earth's atmosphere. Thus I would also watch for some hitting the moon's surface in the evening and make an all-nighter of it (and catch some occultations of stars since I was watching the moon anyway!).

The campaign was systematic such that people whose last names began with the first 8 letters of the alphabet (approximately) were assigned the northern third of the moon; people whose last names began with the second 8 letters of the alphabet, the middle third; and the remainder, the southern third. This was to ensure that the Moon was adequately covered. It was calculated that the Leonid storm peak would occur around 2hUT, which was evening for North America. The dense part of the stream, after passing Earth, would take about three hours to reach the Moon, which would mean the Moon would experience a storm around 5h UT. The Moon was well placed to be viewed at this time, which increased the chances of observing impacts from Leonid meteors.

I was a bit skeptical, so my sessions of vigil at the scope only lasted from five to 20 minutes. After all, I thought, how much light will a speck of dust give off as it is incinerated a quarter of a million miles away? I persisted and did witness, without a doubt, a flash of substantial brightness. It was quite brief, but I was not certain if it was a true lunar impact. I did note the time within a few seconds, as well as the position within a few arcminutes, but I was a bit slow due to fatigue. I knew that I needed to have an observation from someone at a remote location watching simultaneously to confirm this, as the flash could have also been produced by a point meteor which happened to be situated in front of the moon from my viewing perspective.

The next day, after an all nighter, I went to work and e-mailed David Dunham my observation, hoping he or someone within IOTA was videotaping the same location of the Moon where I observed the flash. Afterwards, I conveniently left town to visit family in Phoenix and San Diego for the Thanksgiving holiday. David did confirm this sighting with his videotape and sent word to others to check their tapes for more events. Soon, others came forward with reports of other events they observed between 3:49 and 5:15UT, 18 November 1999. After several weeks, five events were independently confirmed, with several others awaiting confirmation.

Since the sightings, several groups attempted to calculate the size of the impactors and have arrived at values ranging from several hundred grams to several hundred kilograms. Most sources believed the object that caused the flash I observed was about the size of a grapefruit. i

Heliga Bode, 1949 March 10 - 2000 June 1

David W. Dunham, dunham@erols.com

Nearly 30 years ago, Heliga Diederich married Hans-Joachim Bode,who has been president of the European Section of IOTA since it was established in the 1970's soon after IOTA was founded. From their home in Hannover, Germany, they were instrumental in organizing most of the highly successful annual European Symposia on Occultation Projects (ESOP) held in different countries of Europe since IOTA/ES was formed. In addition, they travelled around the world, even to primitive jungle villages in West Irian and Borneo, to observe total and annular solar eclipses from near the path edges to help measure small variations of the solar diameter. I had the pleasure of their company at many of the ESOP meetings and some of the eclipses.

The Bode's close friend, Wolfgang Beisker, wrote: "I have the very sad duty to tell you, that Heliga, the wife of Hans-Joachim Bode has died from a sudden heart attack on June 1st. I received the terrible news from Hans, who, to make it even worse, is since late May in a hospital with serious heart problems. I am shocked and can still not believe it. I talked to Heli only a day before it happened. I knew her since about 30 years, since the very early times in Hannover, where Astronomy brought me to a close friendship with him and her. Her interest in the arts, her warm hospitality, whenever we met, that is hard to believe that its all gone. At the Regensburg workshop, just about a month ago, I met her the last time. Never I thought, I would not see her again.

A large number of trips together to the highlights of Astronomy and culture from Kenya to Indonesia, from Rome to Tenerife where we had time to talk also about many aspects of life remain as milestones in my memory. Now we can all say all the things, what people say in these situations, but nothing may describe the true feelings.

The only good in this situation is, that Hans has two children, Immelyn and Fabian, who can help him to overcome the loneliness of this terrible loss. I wish everything I can for him to recover his own health."

A service was held for Heliga in Hannover on June 13th. Hans is now at home recovering with help from his children and other relatives. i

IOTA's Role in the Dog Bone Asteroid Discovery

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The asteroid 216 Kleopatra, the size of New Jersey, is the largest of the rare M-class asteroids that have reflectance spectra indicating the presence of nickel-iron metal, and also has the largest amplitude light curve of the large main-belt asteroids. In this year's May 5, 2000 issue of *Science*, the cover shows several images of a stunning dog-bone-shaped model of Kleopatra determined from radar observations made with the upgraded Arecibo giant radio telescope last November, 1999 by JPL astronomer Steven Ostro and colleagues. These images were also published in the July 2000, issue of *Sky and Telescope*, page 19 (and are online at **www.jpl.nasa.gov/pictures/kleopatra**). Not mentioned in the *Sky and Telescope* article was IOTA's role in the discovery of the remarkable shape of this asteroid.

On 1980 October 10, an occultation by Kleopatra was timed at 9 locations in Washington State, Alberta, and British Columbia. Unfortunately, this occultation occurred close to the minimum of Kleopatra's light curve. The shape determined from the observations seemed to be not far from a relatively ordinary ellipse, as shown in *ON* Vol. 2, p. 139 (1981). A few years later, the first low-resolution radar observations indicated a bifurcated, possibly contact-binary-like object.

On 1991 January 19, another occultation by Kleopatra was timed from 9 stations across the northern U.S.A. from New York to Washington State. But this time, the event occurred near the maximum of the object's light curve, and Kleopatra's elongated shape, 4 times as long as its width, was revealed. The strange profile was published in my article on planetary occultations on p. 73 of the January 1992 issue of *Sky and Telescope*, and was also presented by me at the Asteroids, Comets, and Meteors (ACM) convention held in Flagstaff, Arizona, in 1991 July. In the audience at the ACM presentation was Steven Ostro, lead author of the recent *Science* article; he was impressed with the shape determined from the occultation. It was partly for this reason that Kleopatra was selected as the first main-belt asteroid to be observed at Arecibo after the substantial upgrade due to the recently-installed Gregorian antenna feed. In the *Science* article, Ostro credits the two occultations, giving the above references, as suggesting Kleopatra's elongated shape. He also noted that the asteroid's pole direction was adjusted in order to make the size of the radar shape fit the occultation observations, removing a correlation between the radar size and the asteroid latitude of the Earth inherent in the analysis of the radar data. It is not clear why the 1991 occultation observations only showed an elongated shape, and not the dog bone appearance found by the recent radar observations. At some orientations, the asteroid has a flatter profile at the ends, and possibly we were unlucky. But also there were few observations near the ends of the asteroid in 1991, and those may have missed the largest dimensions of the end lobes.

Kleopatra was also observed directly using an infrared speckle interferometer on the 10 meter Keck telescope in Hawaii last November 17, 1999. This series of speckle images were published in *Sky and Telescope* for April, 2000, page 19 and again show the highly elongated shaped first discovered by IOTA during the 1991 January 19 occultation.

The *Science* article notes that the resolution of the radar data is about 15 kilometers. Accurate timings of asteroidal occultations typically have a resolution of only a few kilometers. Although a given occultation only gives a shape at one aspect versus the multiple aspects possible during radar observations made during a full rotation cycle, the accuracy of the occultation data and the correlation with the asteroid latitude noted above make the two types of observation complementary. So far, many more asteroids have been observed to occult stars than have been observed with the upgraded Arecibo radio telescope, and this will likely continue well into the future, especially now with the better accuracy of the occultation predictions.

The next Arecibo main belt target is 324 Bamberga, to be observed this October. Mike Nolan at Arecibo has asked about occultation observations that might be made during the current apparition, but unfortunately those occultations observable from astronomically populated areas involve stars considerably fainter than Bamberga, making their occultations very difficult to observe. An occultation by Bamberga was observed from China, Japan, New Mexico, and Texas on 1987 December 8 with the results published by Millis et al. in 1989 in vol. 98 of the Astronomical Journal, pp. 1094-1099.

Other asteroids that have had shape profiles obtained using radar include 1999 JMB (discovered May 19, 1999) and 1998 KY26 (discovered June 1, 1998). The profile of asteroid 1998 KY26 was published in *Science*, July 23, 1999 pp. 557-559. i

Confirmed Lunar Meteor Impacts From The November 1999 Leonids

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(Editor's Note: The following article highlights the discovery and confirmation by IOTA members the 1999 Leonid meteor impacts on the Moon. It has been condensed from a longer paper being written for one of the major scientific journals)

Meteor impacts were seen and videorecorded using small telescopes at widely separated locations in North America during the 1999 Leonid meteor storm. Six impacts have been confirmed by different observers. These are the first lunar meteor impacts confirmed by observation at separate locations. The impact flashes are brief, appearing in only two 1/60th second half-frames of the video records. The 0brightest impacts are estimated at 3rd magnitude. The dark edge of the Moon, visible by edge-enhancing processing of the video images, was used to locate the impact points on the Moon approximately. The largest impacting meteoroids probably were a few kilograms, consistent with estimates of the largest objects in the Leonid stream seen on the Earth. The geometry was very favorable for observing lunar Leonids in 1999, with the densest part of the 1899 Leonid stream hitting the Moon two to three hours after a less dense part of it hit the Earth. Unfortunately, the prospects for observing lunar Leonids during the next few years are poor. However, the observations show that lunar meteor impacts from other high-speed meteor streams, including the eta Aquarids, Perseids, and Geminids, might also be recorded to help estimate the distribution of meteoroids in these streams, and determine the risk to spacecraft that they might pose.

Many times in the past observers saw or recorded brief flashes of light apparently on the Moon's surface [1-4], but none were verified by observations at two or more widely separated stations, with one artificial exception, the impact of the Japanese Hiten spacecraft [5]. North American observers recorded at least six meteors striking the Moon's surface during the Leonid shower on 1999 November 18 around 4h Universal Time (UT). Each of these meteors produced a flash of light that was seen with a video camera or the eye by at least two independent observers, marking the first confirmed observations of lunar meteor impacts. The observations were orchestrated by D. Dunham, president of the International Occultation Timing Association (IOTA).

First Report: B. Cudnik watched with a 35cm telescope near Columbus, Texas. At about 4:46:20 UT (10:46 pm local time of Nov. 17), he saw a very brief orange flash near the center of the Moon's dark side and estimated that it was 3rd magnitude. Dunham found the flash in his own black-andwhite video record obtained that night with a 13cm telescopeset up at observer George Varros' home in dark rural country near Mount Airy, Maryland, about 60 kilometers northwest of Washington, DC. The time determined from his tape was 4:46:15.5 UT (11:46 pm local time of Nov. 17). Cudnik's visual observation was crucial for the lunar impact discovery. Without it, the videotapes would likely not have been examined closely enough to find the flashes for months. Fainter flashes that would be more difficult to find were expected.

The Observations: More flashes were soon reported. A summary of the six confirmed lunar impacts is given in Table 1. Letters have been assigned in the order of discovery. The UT date is 1999 November 18. In each case, the events were confirmed on D. Dunham's videotapes and the timings are from those tapes. Mag is the approximate magnitude of the flash estimated from the videotape on the half-frame on which it first appears. The selenographic locations shown in Fig. 1 should be accurate to within 1 deg. or 30 km. Their locations were determined with a grid overlay including lunar craters that was generated for the topocentric librations at Mount Airy. It was used with an addition of adjacent images that was processed to determine the edge of the Moon. Accurate times were determined by Don Stockbauer. Information about the observation stations is on the Web site given at the end of the abstract.

Table 1: Impact Times and Magnitudes

Name	UTC h m s		Mag.	Discoverer
F	3:05:44.89	0.02	5	David Palmer
D	3:49:40.40	0.02	3	David Palmer
E	4:08:04.10	0.03	5	David Palmer
A	4:46:15.52	0.05	3	Brian Cudnik
B	5:14:12.92	0.02	7	Pedro Sada
C	5:15:20.22	0.02	4	Pedro Sada

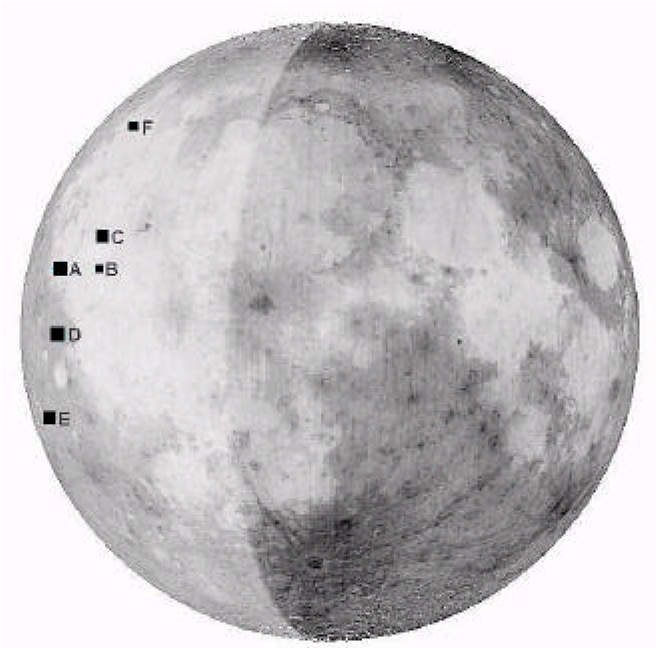

Fig. 1. Lunar Meteor Impact Locations.

The D impact is on videotapes by Pedro Sada and by Rick Frankenberger in San Antonio, Texas, as well as in Palmer's and Dunham's tapes. Dunham's images, (an average of 10 frames, only two with the impact) shows SAO 146577, SAO 146578, and SAO 146574, whose occultations were recorded a few minutes later. Two of the stars are in Palmer's frame of the impact, allowing good triangulation on both tapes.

Lunar Leonid Predictions: D. Asher had correctly predicted the display of visual meteors seen in Europe, Africa, and the Middle East on November 18. His model showed that the Moon passed closer to the center of the 1899 Leonid stream (which had caused the terrestrial display) than the Earth and almost three hours later, around 4:49 UT, very close to the times of the observed impacts. The model indicated that the intensity at the Moon in 1999 must have been similar to that of the strong Leonid storm, also caused by the 1899 stream, that struck the Earth in 1966. Bill Cooke, Marshall Space Flight Center, Huntsville, Alabama, had predicted this last September.

Lunar Impactor Sizes: J. Melosh calculates that the mass of the impacting meteoroids ranged from several tens of kilograms to a few hundred kilograms and that they were up to 0.5 meter in diameter. The resulting craters are probably 10 to 20 meters in diameter. However, such large bodies in the Leonid meteor streams are thought to be significantly rarer than the new lunar observations imply. Mark Matney, in the Orbital Debris Program Office at NASA Johnson Space Flight Center, notes that much more energy was converted into light than expected from standard theories during artificial satellite collision tests. So the meteoroids causing the observed lunar impacts may be ten to a hundred times smaller than Melosh indicates, making them more compatible with the expected Leonid stream distribution. Melosh admits there is great uncertainty in the calculation of the sizes since there are no experimental measurements of impacts with velocities anywhere near the 71m/sec that Leonids hit the Moon. M. Beech also predicted smaller Leonid impactors [6].

Other Probable Impacts: Several more fainter impacts will probably be confirmed in the videotapes. R. Venable tried to videorecord the Moon's dark side with his 41cm telescope in Georgia, but glare from the sunlit part of the Moon spoiled that effort. He had a much better view watching visually, starting at 2:15 UT. He saw dozens of faint flashes, in groups at 10th to 12th magnitude, but he became exhausted by the intense observation and stopped watching at 2:57 UT. This was similar to video observations made by L. Pellerin with the 66cm telescope at the University of Central Florida's Robinson Observatory the previous night, November 17 UT. He recorded several flashes, but unfortunately a technical problem prevented accurate timing of the tape. Nevertheless, Dunham and a few other IOTA observers recorded that night as well, so some of the brighter flashes may appear in the timed videos made with their smaller telescopes. Pellerin was unable to obtain use of the Robinson Observatory telescope on November 18.

Sunglints: Sunlight briefly shining off of artificial satellites or space debris has been proposed as a possible explanation of the flash observations. But the flash observations were made late at night local time when most orbiting space objects were deep in the Earth's shadow. Also, with six flashes simultaneously recorded at two or more separated locations, the chances are much greater that the flashes are lunar phenomena than something closer; none of the known geosynchronous satellites were near the Moon as seen from Maryland. In two cases, lunar location information is available in the separate video records, and the agreement is consistent with the flashes occurring on or near the Moon, but not from distances more than 50,000 km from the lunar surface. That rules out the possibility for those events being caused by sunglints.

Additional Information: Images, more information, and a history of previous probable lunar impact sightings and attempts, are at http://iota.jhuapl.edu.

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The Newly Discovered Binary Star 44 Eta Librae

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On August 7, 2000 there was a very favorable grazing occultation of ZC 2128 across Boca Raton, FL. Three experienced observers set up and under ideal conditions had an observation of a miss at two stations and a 1.5 second occultation at the base station. This indicated a strong south shift of the Moon.

The following night, August 8, there was a very favorable grazing occultation of 44 Eta Librae across Vero Beach, FL. In many respects the conditions were very similar. On this graze the Moon was 59% sunlit and in a waxing phase. The star was magnitude +5.45 and of spectral class A6IV. This star is also known as SAO 159466, ZC 2247 and HIP 77060.

The time of central graze was 1:37 U.T. As the Moon moved over the star, the star did not blink out sharply but dimmed in and out in several steps. This almost certainly indicates that the star is a binary. There were three experienced observers who were set up in an ideal span using the corrections from the previous night's observation. The observers were this writer, Richie Bookamer and Bryan Craven. The number of times recorded was approximately 32. The reduction showed almost certainly that this star was a previously undetected binary star. The companion appeared to be about magnitude +8.0. Another observer, Michael Palermiti of Palermiti Observatory west of Jupiter, FL also videotaped this event and captured the dimming phenomena on videotape.

This data has been sent to the International Lunar Occultation Center in Tokyo, the Center for High Angular Resolution Astronomy (CHARA) in Atlanta, the United States Naval Observatory in Washington, D.C. i

Asteroid 12753 Povenmire

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This past month in July, 2000, the main belt asteroid No. 12753 has been named in honor of Harold and Katie Povenmire, for their many contributions to IOTA, and for their long term studies of meteors and meteorites. No. 12753 was discovered on April 18, 1993 by Gene and Carolyn Shoemaker and she chose the name Povenmire last month. The announcement was made at the Houston Astronomical Society's monthly meeting on August 4, 2000 where Hal Povenmire was the featured speaker.

12753 Povenmire has an H (absolute magnitude) of +12.5. The absolute magnitude is how bright the asteroid would be when it is one astronomical unit (A.U.) from the Earth and from the Sun. This would suggest that if this asteroid is of normal reflectance or albedo, that it is probably about 9 miles in diameter. It comes to opposition about every 15 months and can reach about 15th magnitude under favorable conditions. This is larger and brighter than most new asteroids being discovered today.

At perihelion, it distance from the Sun is 2.238 A.U.'s. At aphelion, (it's farthest point from the Sun) it distance is 3.010 A.U.'s. The period of revolution around the Sun is 4.26 years, with an orbit inclination of 14.77006 degrees.

Congratulations to Hal and Katie for this great honor ! i

Occultations of Mercury, the Sun, & Venus seen in 3 days

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A few months ago when writing ahead to the July issue of Astronomy, my dear friend Alister Ling pointed out to me that this week we would have a chance to observe a remarkable "hat trick". The Moon was to occult, or eclipse, all three inner solar system bodies on three consecutive days. On Saturday morning, the Moon would pass in front of Mercury, on Sunday evening it would partially eclipse the Sun, then Monday evening it would occult Venus. More remarkably still, all three events were visible from the same part of Earth, an inhabited land mass no less! I was fortunate enough indeed to successfully observe all three in broad daylight from familiar territory, namely the Public Observatory of the Edmonton Space & Science Centre.

Despite having had a great interest in occultations since seeing my first, Spica on 1987 February 18, I had only once previously seen the occultation of a planet. And that was under less than ideal circumstances, at 5:47 a.m. on 1987 April 25 when a rising Venus was unocculted by a thin waning Moon less than 2 degrees above the horizon. The Handbook had listed it as unobservable from Edmonton (code GSM), but at the end of a long observing session, three of us (Alister, Mike Noble and myself) sought a clear eastern horizon at Waskehegan and somehow managed to glimpse the Moon through thick crud, and watched Venus emerge with binoculars. It didn't so much as get bigger, just brighter. But subsequent occultations were entirely clouded out, and for 13 years I never saw another.

Until now. Saturday morning, Alister called me bright and early to remind me of the Mercury event, and three of us (Alister, Larry Wood and myself) arrived at the deck with about half hour to spare. We acquired Mercury in the C-14 (Alister) and the 7-inch Starfire (me), while Larry set up his 12.5 Newtonian on the lawn. I was surprised to be able to see the slender crescent Moon in the 7-inch in broad daylight, with Mercury hanging right by its bottom edge. The lunar cusps were so short that effectively both the disappearance and reappearance occurred on a dark limb. Seeing was not particularly great in the area, and at 123x I had difficulty in holding Mercury's shape (46% thick waxing crescent). Nonetheless, at 16:33.13 UT I became convinced that the event was indeed underway, and all three of us got a good view of Mercury gradually shrinking down to nothing at 16:33.35.

With the event being a near graze, reappearance was to occur only 18 minutes later. My spotless record of never properly seeing a reappearance 0unfortunately remains intact, however, as somehow none of us spotted the elusive planet until it was completely out. My mistake was in going to too low a power (50x) so that I could use the Moon's bright limb as a reference point, but being so close to the Sun I was foiled by internal reflections. So, yet another null result on that one.

Before packing up, we swung the 7-inch over onto Jupiter and were rewarded with a superb view. Both equatorial belts were easily visible, as was the subtle shading in the polar regions. In fleeting moments of steady seeing, both Larry and I glimpsed, but never quite held, three of the moons. Buoyed by this, we swung over to Saturn, and got a great view of the planet and the rings against a deep blue sky, despite the fact that it was almost noon!

The partial solar eclipse of Sunday evening was attended by some 300 people (and 40 trillion mosquitoes) at the Observatory, leaving precious little observing time for those of us with hosting duties. Nonetheless, I did get a good view of first contact in the C-14, which occurred at roughly 30 seconds after 8:17 MDT (delayed action watch timing only). I enjoyed a brief view of the silhouetted mountains and valleys of the lunar limb as the mated pair played hide and seek with the only bank of clouds in the sky (brought to us by the good folks of Murphy). One highlight occurred when one of the volunteers, Shelly Sodergren, conducted a telephone interview with the Edmonton Sun. Upon being told that it was only a partial eclipse, the interviewer wondered whether this was because it was a crescent Moon!!!! Nice to know the dissemination of science information is in such capable hands.

Finally, tonight came the completion of the rare triple play. I anxiously watched clouds building up in the west throughout the afternoon, and by suppertime it looked like we were sunk. Alister phoned to say that he was heading west to find a hole in the clouds, but I was anchored to the Observatory, since I was scheduled to work there. I didn't mind having the decision taken out of my hands, given my history in this department. I just had to wait and hope. Shortly after opening the deck just before (!) 8, the sky started to blue up low in the west. By 8:10, with only ten minutes to spare, I had acquired Venus at the top of the approaching hole, and it looked like luck would be on my side. None of the RASC regulars were around, so my son Kevin got the 4-inch refractor, and some guy who had brought me his 4.5 inch Newtonian so I could tell him why he couldn't see anything - turns out he thought the eyepiece belonged at the bottom, so he was pointing the mirror at the ground! - got the C-14. I had waited 13 years for this event, this guy about 13 minutes. Anyway, I settled in at the beautiful 7-inch Starfire, crossed my fingers, and waited. The seeing was absolutely terrible, especially at 150x: Venus boiled and bubbled like a distant mirage, but at least it was there, and it was real. It was nearly full, and the "soft" edge of its terminator which has become more visible in recent days could not be discerned. At 2:21.14 UT (August 1), I watched a black, curved shadow begin to sweep across the disc of the planet. Unlike the instantaneous disappearance of occulted stars, this event lasted fully 17 seconds, with Venus going through a series of faux phases like a mini-eclipse. I even thought I glimpsed some rugged terrain on the limb of the encroaching Moon, but that may well have been just the seeing. By 2:21.31, the brilliant white planet was completely gone. Reverting to low power, I tried to glimpse the wafer thin crescent Moon that had swallowed it, but to no avail. Within five or six minutes, both were obscured by thick clouds which prevented any possibility of seeing the reappearance; the hole hovered overhead for a while allowing visitors to see a few stars, but within an hour the entire sky was gone for good. My 15-minute hole had appeared at *just* the right time, unlike poor Alister who drove to Wabamun only to be skunked; his hole closed just minutes before the event. Having seen the two events in such rapid succession, it's interesting to compare them. Despite the fact that Mercury appeared considerably smaller at 7.3 arc seconds compared to Venus' 10.1, the Mercury event took considerably longer. This was due to the much more grazing angle of the Moon in its polar regions. (I had previously observed this effect in occultation/eclipses involving Jupiter's moons, particularly Callisto.) In this case this had the added bonus of effectively immersing Mercury from top to bottom - the long axis of its crescent shape - rather than from left to right. The Venus event was much closer to the lunar equator and the Moon's angle was effectively perpendicular. I deliberately did not look at animations in advance as I did not want to bias my observations, but tonight I was shocked to find that Guide 6.0 demonstrated the Mercury event should have lasted a full 60 seconds! This far exceeds what any of the three of us actually witnessed; was the seeing so poor that Mercury was more than half gone before we even noticed?? Seems hard to believe. If it was just me, I might wonder, but Alister and Larry are two of the finest observers in the country. On the other hand, the Guide simulation for the Venus event lasted 19 seconds, in reasonable agreement with the 17 seconds I actually experienced. Given that 2000 was supposed to be a poor year for occultations - Meeus' Astronomical Tables lists only 17 major events (planets and first-magnitude stars) after 45 and 48 in 1998 and '99 respectively - I guess I can count my lucky stars, or planets, that I was able to catch two in such close succession - with a bonus eclipse to boot! i

New Double Stars

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This is the resumption of publications of reports on occultation double stars since Tony Murray resigned this task. Not all reports he received since his last publication in ON VI,11, pp 249-251 have been published yet. These reports are published here together with new reports I received via email or by letter. Although letters are fine, email is preferred in reporting new double star observations to me. Please always use the standard ILOC report format. Those using email will receive a confirmation of receipt of their report(s), a week or so later followed by a first analyses of their data and, if necessary, a request for additional data or clarification. This way I hope we can reduce the number of reports that have to be discarded because of insufficient or erroneous data.

To get started I received files DSFILE.DAT, ABBREV.DAT and DOC.DAT from David Dunham. From Tony Murray I received several files, among which DSFILE.DAT. The format of the latter was different from the one I received from David. It took me quite some time to update David's file using Tony's publications in ON and to figure out the remaining differences. I used the ZX catalog print Tony sent me to fill in all missing X and DM numbers. I found out this ZX catalog contains quite a lot of doubles not included in DSFILE. I will have to work on that in the future. I used the ZC catalog of Isao Sato to change the X numbers for all ZC stars. I used the WDS digital catalog David Herald sent me to fill in most of the missing abbreviations of discoverers. Some ambiguities remain, though, since abbreviations in ABBREV.DAT and in WDS catalog sometimes point to different discoverers. Hopefully some of the older ON publications can help solve those. I have renamed the abbreviation file to DSFILE.ABB. I've tried to correct some of the errors and inconsistancies I encountered using DOC.DAT and several other sources. I have included the method of discovery in DSFILE. It is likely I've introduced a few mistakes here since I had to rely on at least some assumptions. For confirmations of previously discovered double stars I've created a separate confirmation file (DSFILE.CFM). This file is far from complete since it contains only recent confirmations. I hope to include at least some of the older ones when older ON publications become available to me. Although I had some time to get acquainted now, I still feel uncomfortable about several aspects of double stars.

It is very likely that I will make some additional changes to the system to further improve it and to be ready for the next millenium. Lots of work remain to complete DSFILE from XZ and WDS catalogs. Additional work is expected to include data from Hipparcos/Tycho catalogs. Anyone, who comes across an article in any astronomical journal about the discovery of new double stars or about any new measurements on existing double stars, is encouraged to send me a copy.

The three files DSFILE.DAT, DSFILE.CFM and DSFILE.ABB form the heart of the double star system now. I've made two small programs to extract information from these files (DSFILE.EXE and ABBREV.EXE). Those interested in receiving the double star system, please send me an email. I will not send out any floppy disks, so, if you have no access to an email system, please find someone in your neighborhood who does. Every time I have finished an article for publication in ON, I will send out updates on the double star system to all that previously received it, so, please keep me informed on any changes in your email address.

The Tables below contain all reports that have been sent to Tony and me since last publication. Several of the new discoveries and confirmations are very interesting. However, I will not comment on any individual events here because it would certainly have further delayed this publication.

Table 1 contains a list of all observers (alphabetical name order) from which reports on double stars were received since the last publication and the number of reports split into confirmations (Cfm) and new double stars (New). Table 2 lists all confirmations of previously known doubles and any resulting changes in double star code. This list will also contain discoveries of new components of known doubles. Table 3 lists all new double stars included in the double star file.

I wish to thank all observers that have forwarded reports and urge them to continue this valuable work. Thanks go to Tony Murray, David Dunham and David Herald for their support in answering questions about the system and to Jan Manek, Brian Mason, Benoit Rousseau and Wayne Warren who offered their assistance in case it is needed.

Table 1. Observer tally

Name	(Abbreviation)	Place (Country)		Cfm	New
Bourgeois, Jean	(JB)	Reux	(B)	41	61
Bulder, Henk	(HB)	Boskoop	(NL)	14	20
Degenhardt, Scott	(SD)	Murfreesboro	(USA,TN)	1	2
Farago, Otto	(OF)	Stuttgart	(GER)	-	1
Gingrich, Mark	(MG)	Oakland	(USA,CA)	5	3
Hays, Robert	(RH)	Worth	(USA,IL)	8	2
Perillat, James	(PR)	Oakland	(USA,CA)	1	2
Povenmire, Hal	(HP)	I.H.Beach	(USA,FL)	3	2
Rousseau, Benoit	(BR)	Paris	(FR)	5	2
Vandenbulcke,Geert	(GV)	Koksijde	(B)	1	2
Total	(9)		(5)	79	97

Table 2. Confirmations and new components

SAO/X	Date	Obs	Method	Changes	Notes
X 6276	97-02-15	JB	Q		
X 9426	96-02-28	HB	T	Type K->X	
76971	94-04-15	JB	G	Type K->X	
77098	94-08-03	JB	Q	Type A->Y	*1
77911	93-11-03	BR	T	Type V->L	*1
92669	95-08-16	GV	T		
92952	97-01-16	JB	T		
93396	93-09-07	RH	T		
93757	96-09-03	HB	T		
93775	97-08-25	JB	Q	Type M->$	*2
93803	96-09-04	JB	Q		
93897	95-08-19	JB	Y	Type J->L	*1
93897	96-01-29	JB	G	*3	
93939	95-01-12	BR	T	*4	
94027	97-07-29	JB	Q	*5	
94132	95-09-15	JB	Q		
94227	97-02-15	JB	Y	Type X->V	
94288	96-09-05	JB	Q	Type X->V	
94297	96-09-05	JB	Q	Type K->X	
94309	96-09-05	JB	Q	Type K->X	
94385	97-04-11	HB	T		

94431	77-02-27	MG	T	Type M->$	*2
94554	96-12-23	JB	Q		
94865	97-02-16	JB	Q		
94920	95-05-03	JB	Y	Type K->X	
95084	96-04-22	HB	T		
95286	97-04-12	HB	T		
95359	94-04-17	RH	T	Type C->Y	*1
95419	97-10-21	JB	Q		
95748	96-02-28	HB	T		
95795	96-02-28	HB	T		
95795	97-09-24	JB	Q		
95985	95-05-04	BR	T		
95985	95-05-04	JB	Q	Type M->H	*1
96015	95-05-04	JB	Q		
96015	95-11-11	JB	Q		
96897	80-04-21	MG	T		
97016	95-05-05	JB	T		
97016	95-11-12	JB	Q		
97074	97-02-19	HB	T	Type K->X	
97564	77-04-26	MG	T	Type K->X	
97564	77-04-26	PR	T		
97827	96-09-09	JB	Q	Type K->X	
98267	93-05-27	HP	Y		
98267	93-05-27	RH	G		
98267	93-09-13	HP	Y		
98267	95-10-18	HP	Y	Type A->Y	*1
98378	95-03-14	RH	T		
98378	95-09-21	JB	Q		
98709	96-12-29	JB	Q		
98770	81-05-11	MG	T		
109739	95-12-29	JB	Q		
109816	95-03-04	JB	T		
117751	96-03-30	HB	G		
117777	94-10-29	JB	T	Type K->X	
118577	94-06-16	RH	T		
128319	95-07-17	JB	Q		
139011	97-01-02	HB	T	Type K->X	
146639	97-08-20	JB	Q		
146774	97-12-07	JB	Q	Type K->X	
160044	97-07-16	BR	T		
160447	81-09-17	MG	T		
161217	97-08-14	HB	T		*6
161257	97-08-14	HB	T		
161273	79-09-29	RH	T		*5
161273	95-09-04	RH	T		
162413	94-07-22	JB	T		
162512	95-11-25	SD	G		
163322	94-10-12	JB	Q		
163356	94-10-12	JB	T		
163371	94-10-12	JB	T		
163384	97-08-16	HB	T	Type K->X	
163481	95-10-30	JB	Q		*7
163645	96-09-23	RH	T		
163771	96-08-26	HB	G		
164253	96-12-14	JB	Q	Type K->X	
164640	97-09-14	BR	T	Type X->V	
164711	97-01-11	JB	Y	Type K->X	
186544	94-10-10	JB	T		

Notes table 2:
*1 first component is double itself
*2 second component is double itself
*3 star is complex triple or quadruple no new components added
*4 this faint component of 93940 is itself double, type for 93940 has been changed from A to Y
*5 according to OCCULT prediction list a known double type A, not in DSFILE though
*6 according to OCCULT prediction list a known triple type T, not in DSFILE though
*7 this triple was confirmed during both disappearance and reappearance

Editoral remark: Table 3:New Double Stars *(see page 16)* *(O. Klös, 2018)*

Table 3. New Double Stars

SAO/X	Type	Mag1	Mag2	Sep	PA	Date	Obs	Method
X 4036	K	9.8	9.8	.1	49	94-02-17	JB	T
X 4579	K	10.0	10.0	.06	226	95-08-18	JB	Q
X 5185	K	9.2	9.2	.08	229	95-09-14	JB	Q
X 5311	K	10.8	10.8	.06	206	95-09-15	JB	Y
X 6475	K	9.6	9.6	.01	263	96-09-05	JB	Q
X 6556	X	10.4	10.4	.1	101	94-04-15	JB	T
X 8699	X	10.1	10.1	.15	111	95-04-07	RH	T
X 9857	K	10.1	10.1	.1	97	96-04-23	HB	T
X12866	K	10.8	10.8	.1	74	96-04-25	HB	T
X13226	K	10.3	10.3	.1	100	96-03-29	HB	T
X14102	K	10.0	10.0	.05	103	94-05-17	JB	T
X49950	K	9.8	9.8	.05	5	96-12-14	JB	Q
92819	K	9.3	9.3	.04	237	95-07-20	JB	Q
92932	K	6.3	6.3	.05	46	97-01-16	JB	Y
92953	K	9.3	9.3	.1	87	97-01-16	HB	T
92964	K	9.5	9.5	.1	27	97-01-16	JB	T
92989	K	9.7	9.7	.05	74	97-01-16	JB	Y
92992	X	9.5	9.5	.3	86	97-01-16	JB	T
93074	K	9.6	9.6	.1	37	95-02-07	RH	T
93452	K	9.3	9.3	.06	311	95-08-18	JB	Q
93491	K	8.9	8.9	.2	311	94-08-01	JB	T
93529	X	9.4	9.5	.1	238	97-09-20	JB	Q
93746	X	8.2	11.0	.03	271	97-08-25	JB	Q
93774	$	9.4	9.5	.08	212	97-08-25	JB	Q *1
93860	X	8.9	11.0	.06	244	95-08-19	JB	Y
93868	K	4.7	4.7	.03	250	97-07-29	JB	Q
93907	X	5.6	5.6	.04	53	96-01-29	JB	Q
93918	K	6.8	6.8	.1	71	95-01-12	BR	T
93958	K	9.0	9.0	.5	279	77-10-02	PR	T
94019	K	7.9	7.9	.05	89	96-03-24	JB	T
94036	K	8.0	8.0	.1	107	95-04-05	SD	T
94631	K	7.3	7.3	.1	213	97-09-22	HB	T *2
94779	K	9.9	9.9	.06	310	95-09-17	JB	Q
93788	K	9.3	9.3	.03	239	94-08-29	JB	Q
94478	K	7.2	7.2	.03	223	94-08-03	JB	Q
94858	K	5.6	9.0	.03	84	97-02-16	JB	Q
94870	K	9.4	9.4	.05	145	97-02-16	JB	Q
95052	K	10.2	10.2	.05	238	96-09-06	HB	T
95168	X	8.7	9.5	.15	221	95-08-21	JB	T
95390	K	8.3	8.3	.05	13	95-04-07	HP	G
95941	K	9.5	9.5	.03	87	95-05-04	JB	Q
96002	K	8.8	8.8	.1	68	95-05-04	JB	T
96466	X	9.1	9.1	.05	103	96-03-27	JB	Y
96496	X	8.8	8.8	.1	101	96-03-27	JB	T
96529	K	8.7	9.5	.1	271	97-10-22	JB	Q
96595	K	9.8	9.8	.03	312	97-10-22	JB	Q
96681	K	9.0	9.0	.1	111	97-03-17	HB	T
96753	K	9.5	9.5	.08	96	97-03-17	HB	T

SAO/X	Type	Mag1	Mag2	Sep	PA	Date	Obs	Method
96895	K	9.6	9.6	.03	372	97-09-25	JB	Q
97074	X	8.6	11.0	.8	326	96-09-08	HB	T
97211	K	8.9	8.9	.05	114	94-04-18	JB	T
97230	K	9.3	9.3	.1	174	94-04-18	JB	T
97243	K	9.3	9.3	.05	152	94-04-18	JB	T
97246	X	9.4	9.4	.1	53	95-04-08	JB	Y
97286	K	9.0	9.0	.05	83	95-04-08	JB	T
97440	K	9.5	9.5	.3	132	77-03-02	PR	T
97477	K	9.1	9.1	.03	338	97-10-23	JB	Q
97500	K	9.2	9.2	.03	279	97-10-23	JB	Q
97721	K	9.8	9.8	.05	55	95-05-06	JB	T
97890	K	8.4	8.4	.1	139	96-04-25	HB	T
98152	X	9.5	9.5	.2	114	96-03-29	HB	T
98462	K	8.9	8.9	.1	126	96-04-26	JB	T
98495	K	8.2	8.2	.05	81	95-05-08	SD	Q
109032	K	9.0	9.0	.05	57	94-01-17	JB	T
109180	K	8.8	8.8	.1	35	95-12-28	JB	T
109323	K	9.1	9.1	.2	355	97-01-14	HB	T
109599	X	8.3	9.5	.1	356	96-08-04	JB	Q
109814	X	9.5	9.5	.4	6	95-03-04	JB	T
109817	K	9.4	9.4	.4	148	95-03-04	JB	T
110390	K	6.5	6.5	.04	322	97-10-16	JB	Q
117570	K	9.3	9.3	.1	104	94-05-17	JB	T
128654	K	8.2	8.2	.05	143	79-12-26	MG	T
128677	K	9.1	9.1	.1	84	79-12-26	MG	T
138890	K	9.3	9.3	.1	313	76-01-22	MG	T
146374	X	9.2	9.2	.1	109	97-01-12	JB	T
146730	X	9.5	9.5	.1	131	95-12-27	GV	T
146731	K	9.9	9.9	.1	43	95-12-27	HB	T
146838	K	9.6	9.6	.2	76	96-10-23	HB	T
146899	K	9.9	9.9	.1	38	97-01-13	JB	T
146905	K	9.6	9.6	.03	54	97-01-13	JB	Q
158105	K	8.2	8.2	.05	120	95-07-06	JB	T
159280	K	6.7	6.7	.05	199	96-02-12	HP	G
159563	X	5.1	5.1	.05	196	97-02-02	OF	G
160378	X	8.9	9.5	.04	66	97-08-13	JB	Q
161540	K	6.6	6.6	.1	322	97-03-04	HB	T
161656	K	9.0	9.0	.1	67	96-11-14	HB	T
162772	K	9.4	9.4	.2	23	96-11-15	HB	T
163066	K	8.7	8.7	.05	161	94-11-08	JB	G
163384	X	8.8	8.8	.06	93	97-08-16	JB	Q
163551	K	9.8	9.8	.1	89	94-12-06	JB	T
163882	K	9.9	9.9	.1	83	97-12-04	HB	T
164051	K	9.7	9.7	.05	109	97-11-07	JB	Q
164080	K	8.1	8.1	.1	107	94-10-13	JB	T
164225	K	9.6	9.6	.2	26	96-12-14	HB	T
164253	K	9.4	9.4	.1	111	96-12-14	HB	Q
164604	K	9.8	9.8	.1	94	95-12-25	GV	T
164642	K	9.7	9.7	.1	66	97-09-14	BR	T

Notes to Table 3:

*1 This new double is discovered to be a triple. The 3rd component is m = +11.0, Sep. = 0.03", PA = 0°

*2 SAO 94631 forms a double pair with SAO 94630. Star SAO 94631 is a double itself and is now entered in DSFILE separately

The 1999 IOTA Annual Meeting

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The 17th annual meeting of the International Occultation Timing Association was held Saturday April 17, 1999 at the University of Denver's Chamberlin Observatory in Denver, Colorado, and at Gates Planetarium Sunday April 18, 1999. This meeting place was chosen so that IOTA members and other local astronomers could observe the spectacular graze of Aldebaran by the crescent moon Sunday evening the 18th south of Denver.

Twenty-seven members were present at the meeting and included: Officers President David W. Dunham from Maryland, Executive Secretary Richard Nugent from Texas, Bob Stencel, Director of Chamberlin Observatory, University of Denver, Dave Miller, Terry Chatterton, Franklin Miller, Pat Rasor, Richard Keen, John Reiss, Jr., Bernie Ansell, Patti Kurtz, Ron Pearson, Dick Dietz from Colorado, Dan Durda and Alan Stern from the Southwest Research Institute in Boulder, Colorado, Derald Nye and Gene Lucas from Arizona, Danny Falla, Frank Anet and wife, Sandy Bumgarner from California, Don Cooke from New Hamshire, Bob Sandy from Missouri, Rick Frankenberger from Texas, Oliver Staigler from Switzerland, Tom Bisque (of Software Bisque) from Colorado, Don Asquin, Director of Gates Planetarium, Denver, CO,

Prior to the start of the meeting, a brief history of the Chamberlin Observatory was given by its Director, Dr. Bob Stencel. The Observatory was built in the early 1890's. The main telescope, which was installed in 1894 is a 20" refractor with a 28 foot long tube, made by the famous lens maker Alvan Clark. This telescope is the 12th largest refractor in the world and the largest used on a regular basis for public viewing. On August 1, 1994, Chamberlin Observatory recently celebrated its 100th anniversary of "first light." At the same time, the Denver Landmark Commission proclaimed the Observatory as a Historical Landmark. This designation helps protect the historic facility and enhance opportunities for restoration grants.

Following the introductions, David Dunham mentioned 2 grazes he observed during the first National Amateur Astronomers (NAA) meeting in the Denver area in the late 1960's. Former President of the Denver Astronomical Society, Derald Nye gave a little history, when he described the IOTA meeting in 1977 which was held in Boulder, CO along with the NAA.

FINANCIAL REPORT, In Treasurer's Craig and Terri McManus absence, Richard Nugent read their report which showed IOTA to be in good financial shape with over $6,200 in the checking account. As of April 4, 1999, the previous 12 months did show a $254 loss, however this was due to the choice of dates used for the cash flow analysis. The cash flow report is shown below:

Cash Flow Report
9/1/98 Through 4/12/99

Category Description	
INCOME	
Interest Inc	65.11
Member dues	2,671.71
Other Inc	43.09
Subscriber	695.00
TOTAL INCOME	3,474.91
EXPENSES	
Card Cost	20.15
Internet Cost	522.40
Office Supplies	117.73
Postage	1,040.94
Printing	1,605.32
Reimburse	99.57
Web Site Costs	323.49
TOTAL EXPENSES	3,729.60
OVERALL TOTAL	-254.69

David Dunham motioned the members present to accept the financial report as it was presented and Richard Nugent seconded the motion. The motion carried without any opposition.

PUBLICATION REPORT - In Rex Easton's absence, David Dunham updated the attendees on IOTA's Occultation Newsletter (ON) publication status. At the previous IOTA annual meeting in Nashville in September 1998, it was agreed that the ON would go online for downloading by IOTA members with a password. In return, the annual dues

IOTA MANUAL STATUS - David Dunham reported that Wayne Warren is currently working on updating the IOTA manual. It is now currently on a hidden URL on the IOTA web site. Gene Lucas proposed that the manual be converted to a more user friendly format such as Acrobat Reader. The advantages of this format is that it can be read by readers, but not changed. A discussion by several attendees suggested that two versions of the manual be made, one for beginners, those new to the occultation business, and one for advanced members with experience. Rick Frankenberger questioned the need for two versions. Gene Lucas added that classical IOTA timing methods, such as those timings made by stopwatches, should be included in the manual for historical purposes. At the end of the discussion, no firm decision was made on what to do - have one version of the manual or two. **IOTA WEBSITE REPORT** - In the absence of Rob Robinson, Rex Easton and Jim Hart, Richard Nugent briefly described the current status of the IOTA web pages on the internet. The new web page address is synonymous with IOTA's name, **www.lunar-occultations.com/IOTA** Currently 30 meg of space is available with only 12 meg being used at this time. This should allow room to place many additional IOTA last minute news updates of upcoming events and for future growth. Gene Lucas suggested removing the IOTA logo on the top of the web page to speed up the downloading.

An important step in cataloging all asteroid occultation information in a single place was made with the publication and presentation of the paper "Catalogs of Asteroidal Occultation Observations and Stars" at the 1998 Division of Planetary Science of the AAS meeting by David Dunham. Other authors of the paper were Wayne Warren Jr., Douglas Faust, Isao Sato, and Edwin Goffin. This work was supported by NASA grant NAGW-4714.

In the absence of **Paul Maley**, Richard Nugent presented to the attendees several key points that Maley wished to bring forward. Currently Trimble Navigation has been loaning to Maley for eclipse expeditions one of their top of the line GPS receivers. Trimble has questioned the future of these equipment loans since their company name has not publicized or acknowledged as much as they would like to see. One such paper acknowledging Trimble Navigation was published in the June, 1997 issue of Publications of the Astronomical Society of the Pacific (PASP), however nothing has appeared since in the way of solar eclipse results. This is an ongoing problem mainly having to do with funding for data reductions of solar eclipse video tapes. Despite rejected funding proposals in this area, Drs.Dunham and Warren are still seeking such funding.

Another Maley item was the duplication or under representation of resources during the recent February annular eclipse over Australia. It was suggested that better coordination of observers prior to such a major event should take place. Email is common now so there should be no real communications issues.

Paul Maley also had noted that the recent asteroid occultation by 580 Selene on March 3, 1999 resulted in a miss for several observers. Even Nugent was 15 miles short of the path after driving 180 miles. This may have been due to a late last minute update on the asteroidal shadow path moving south. Selene is a relatively small asteroid whose angular diameter was less than the expected error of the ACT target star's position. The event was below IOTA's criteria for priority updates, but was updated and attempted only because the Southwest Research Institute requested it for their airborne observation campaign; the prediction for most events now relative to the asteroid's angular diameter are better. In any case, Dunham will attempt to get last minute updates out ASAP but he suggested that observers are encouraged to call the IOTA hotline at 301-474-4945 when in doubt of the circumstances of these types of events. Dunham remarked about a problem with the answering machine on this line, but should have it corrected shortly (the machine was replaced soon after the meeting). Gene Lucas suggested that in order to help avoid a miss on such events, observers set themselves up along a "fence" perpendicular to the asteroidal path. Dunham pointed out that this is the responsibility of coordination of local observers and he (Dunham) cannot control how observers along the shadow path set up.

David Dunham mentioned the upcoming IOTA-ES meeting August 5-11, 1999 in Stuttgart, Germany coinciding with the August 11 total eclipse. IOTA-ES has the largest meetings with an estimated 50-60 persons in attendance over several days.

After a short break, David Dunham showed graze charts for the upcoming April 18, 1999 Aldebaran event. The event was being led south of Denver by Bob Sandy. Dunham mentioned the other planned graze expeditions from Nevada to Kansas.

David Dunham then described some history about his occultation experience to the attendees with his first graze predictions and attempts. On October 30, 1957, Dunham described the Beta Cap event over the Los Angeles area, showing a map of the southern limit computed with the Occult program. On that night, from his home in La Cañada, the 15-year-old Dunham saw the star get closer and closer to the moon, and skim over the mountains above the South Pole, but he never saw the occultation. An occultation had been predicted for the "standard station" in central California. That's when he realized that he was a short distance on the wrong (south) side of the southern limit of the occultation, and that if he had been a little farther north, at the limit, the star would disappear and reappear among those southern lunar mountains. Dunham thought that it would be neat if someone would calculate those lines, so that one could travel to them to observe grazes, but at the time he didn't think he would ever be able to do that.

But the situation changed after Dunham took a course in solid geometry at the University of California at Berkeley. For the March 12, 1962 Aldebaran graze, Dunham was armed with sine/cosine, log tables along with a "BIG CLUNKY" Frieden calculator. He found that the path was to go just south of the San Jose area. He had a 2.4 inch telescope but not a car. He finally located a ride that Sunday evening. While being driven, he was watching the star get closer to the moon. He saw and timed the reappearance at Palo Alto, but missed timing the disappearance - he saw it from the car while crossing the Dumbarton Bridge. Time had run out on the last Aldebaran graze in the U.S.A. during that

Saros (actually, Meton) 19-year cycle.

On April 10, 1962 the 2nd graze he attempted, of 64 Ori m = 5.2, was predicted for nearby Concord. Dunham tried to observe the graze but only saw a total occultation. He showed the results to his professor, who told him that he forgot to account for the rotation of the Earth, which changes the angle of the graze on the Moon.

On September 18, 1962 Dunham made predictions of the graze of 5 Tau, m = 4.3. His predictions showed the graze path about 40 miles north of Los Angeles. Dunham could not travel to see this one but he did notify several observers. One of them, Leonard Kalish, traveled from his home in L.A. to the path just north of Castaic Junction and saw several disappearances and reappearances of the star. This was Dunham's first successful graze prediction, and as far as we know, the first time ever that someone had traveled to an occultation limit and seen a graze. The first graze observed by David Dunham was on March 31, 1963 of Z.C. 0881, B9, m = 5.9 near Roseville north of Sacramento, California, but timings were not possible since the event was on the sunlit limb. It wasn't until September that year that he made his first good timings of a dark-limb graze near Davis, California.

Alan Stern asked if there was any predictions of occultations of asteroids by the moon. Dunham said that they are available for some of the brighter ones on the IOTA web page, and in the Occult-generated total occultation predictions in the rare cases when they are observable.

February 16, Annular Eclipse - **Derald Nye** showed an excellent video he took of Baily's Beads from the northernmost station at the northern limit of this annular eclipse. He took video through a 1000mm Nikon lens and recorded time signals on VGN 16 Mhz. Numerous beads were seen. The magnitude of this eclipse was 99.2 - making it nearly total.

Olivier Staigler traveled all the way from Switzerland to be at the IOTA meeting. He showed some slides of past solar eclipses he has observed: Mongolia in March 1997, Aruba in February 1998 and Bolivia from November 1994. For the April 1998 double occultation of Venus and Jupiter over Ascension Island he hitched a ride on a military aircraft from the Royal Air Force. Computations show this to be the first double occultation event like this since 547 AD. He met Derald and Denise Nye, and Craig Small there. The slides he presented showed the reappearance of Jupiter's moon Io, then Jupiter, then Venus. They were taken with a 400mm f/5.6 lens. The last slide shown of the reappearance of Venus and Jupiter was recently published in a Dutch book entitled "*Eclips*" by Govert Schilling.

In the absence of Bob Collins from Electro Optics (**www.ceoptics.com**), **Dr. Bob Stencel** gave spec sheets to the group about a potentially useful device for occultation observers: The I3 image intensifier piece invented by Bill Collins. The I3 piece can give real time video images with a 2-4 magnitude improvement over existing image viewing equipment and low light CCD video cameras on the market today. Specifications include a power source of just 3 volts needed to run the tube which boasts a useful life of 10,000 hours (that's a lot of occultations !). Bob Sandy stated that he can reach m = 10 stars with his PC-23C Supercircuits camera on his 6" telescope. David Dunham mentioned that experience has shown that shorter focal length telescopes will show fainter magnitude limits that longer focal length Schmidt-Cassegrains. This is due to the fact that there is more light falling on fewer pixels.

Gene Lucas described an image intensified system he has been using with a C-14 telescope since 1985. It was used to broadcast live images of Halley's Comet in 1986. Gene had also used this system to view the Spica graze in June 1995. He had 17 observers with five of them using video. This event produced a very accurate limb profile.

Following a lunch break **Bob Sandy** explained some of the symbols used on graze profiles and how to read them, including his reduction of the June 1995 Spica graze. The graze elements were computed by Dr. Mitsuru Sôma of Japan. There were 48 observers on 5 expeditions from California, Arizona and New Mexico. A total of 209 timings were made. The expeditions were close to Temecula, CA; near Salton Sea, CA; Gila Bend, AZ; Almagordo, NM and Lincoln National Forest, NM. (One of the observers was Alan Hale of Comet Hale-Bopp fame). For the graze profiles Bob Sandy showed, not all of the observer's timings could be plotted due the cluttering up of the diagram. He discussed several key timings in which the data clearly showed the size/shape of mountain peaks. Bob recommended that graze leaders reduce their profiles ASAP so that future observers can use their data at similar Watts angles. This can help avoid a "miss" and help maximize coverage.

David Dunham then showed that using Hipparcos proper motion data, previous asteroid occultations could be rereduced to update profiles. David then proceeded to show some slides of previous asteroid occultations including those from Isao Sato's PhD thesis, "*Asteroidal Occultation Observations From Japan*." Those profiles shown were:

29 May, 1983 - 2 PALLAS profile showed some surface roughness. Had 131 observers with 13 on video.
1 CERES event from 1984- Lowell observatory profile. The data, when re-reduced with Hipparcos data showed the profiles matched quite well.

Other profiles with multiple chords shown included:

85 IO- 12 December 1995. ....From Sky and Telescope
27 EUTERPE - 9 October 1993. ....From Sky and Telescope
1437 DIOMEDES-7 November 1997...From Japan
105 ARTEMIS-4 December 1997. Profile from Sky and Telescope Feb. 1999 page 106. There was a possible blink seen by one observer near the southern limit.

39 LAETITIA 21 March 1998- seen from 16 European sites. Profile in Sky a d Telescope Feb. 1999 page 106.
25 PHOCAEA 13 May 1998- 8.94 mag star timed by Derald Nye with the Sun only 8(below the horizon!
248 LAMEIA-27 June 1998, observed from South Africa
75 EURYDIKE-3 April 1999. This event was clouded out over most of the New York area. Only Alan McRoberts of Sky and Tel. observed this event from his backyard through thin cirrus clouds.
123 HERMIONE-3 April 1999- Bad weather over Texas/Oklahoma, Florida fogged in. Only one observer in Vidalia, GA timed the occultation.

Dan Durda and Alan Stern from the Southwest Research Institute gave a presentation on the Airborne Asteroid and Planetary Occultation observations project. With this observation program, it is hoped to provide diameters, masses, densities and albedos of asteroids. The observations are made aboard an F-18 Hornet jet operated by NASA's Dryden and Edwards bases. This concept of airborne occultation observations has the following advantages: 1) an unobstructed overhead canopy. 2) The F-18 is a common aircraft - available worldwide. 3) Cost effective - several $1,000/hr operation cost versus the much higher cost of operating large airborne observatories like the KAO and SOFIA. 4) Range 420 miles between refueling.

The equipment used for the airborne flights includes a Xybiaon intensified CCD camera with video frame rates of 60 fps with a Nikon 85mm f1.4 lens. This setup can reach 10th-mag. stars with a 6.7(X 5.7(FOV. A Sony 8mm camera is used as a backup. The monitor is a Citizen LCD. The primary recording is signaled off an onboard GPS navigation system. Test Flights 1-3 confirmed that the system worked as expected.

Test Flight 3 (a night flight) was on December 11, 1998. This flight happened to coincide with an occultation by 245 VERA. The system detected the target star easily but did not see the occultation due to a shift in the path. Current plans are to adapt this system to other jets such as the F-15/T-38's. In the planning is to fly two planes in formation to obtain chords. Dan Durda showed some slides of the setup on the F-18 hornet and a video showing the amazing stability of the system from one of the test flights.

Following this talk the attendees took a break and posed outside Chamberlin Observatory for a group photo.

President Dunham briefly described a popular B&W video camera that he and several IOTA members use - the Supercircuits PC-23C video camera. It is available from Supercircuits in Round Rock, Texas (**www.supercircuits.com**, 1-800-335-9777). Price is about $79. Bob Sandy then showed the system he uses for occultation work: an approximately $250 Wal-Mart 9" TV/VCR combo with the PC-23C video camera. The camera has a built in microphone jack so that observers can make live comments during events. This is useful so critical information can be recorded about sky conditions, possible spurious events and other needed info to analyze the tapes afterwards. Sandy, who has been observing occultations since 1960, uses a Radio Shack SW radio and a cassette recorder as a backup. Richard Nugent then showed his compact Sharp 8mm camcorder model VL-E650U (price about $550) that has a built in 3" color LCD screen for viewing events as they are recorded. This 8mm camcorder also has direct cable feed audio and a built in speaker so the observer can hear WWV time signals as he sees the live video. This being a battery powered unit that fits in your hands, this makes a very portable lightweight system for traveling.

The meeting was adjourned at about 4:30 PM. Following this started informal discussions. Some of the attendees watched an occultation smorgasbord video while others talked about their own occultation and astronomy research. Following dinner, some attendees returned to the Chamberlin Observatory for some views of Mars and other objects through the 20" Clark refractor courtesy of Dr. Bob Stencel.

Sunday, April 18, 1999

The IOTA meeting continued at 10:00 AM at Denver's Gates Planetarium. David Dunham showed a 9:15AM satellite photo showing a standing wave of cloudiness over Denver and the Front Range. In preparation for the Aldebaran graze later that evening, the weather situation would be monitored throughout the day.

Don Asquin, the Director of Gates Planetarium/IMAX theatre opened the meeting and welcomed IOTA members to the Denver Museum of Natural Science. He would keep the satellite web pages active on the office computers for monitoring the weather status through out the day.

Sandy Bumgarner then described his ideas for a Remotely Operated Bright Object Telescope (ROBOT) and passed out an information sheet showing its proposed features and capabilities. The system would be designed with a narrow field, minimum setup and tear down capability. The proposed large 20-30" f/2 system would be solely for occultation videos. A video camera would be placed at the normal location of the secondary mirror. The mount would be an Alt-Az with a jack type screw altitude and friction drive driven by a jack-type servo using precision sensors. Pointing would also be done by precision angle sensors. This proposed 12V system could potentially reach occultation stars to 15th magnitude and would fit into a standard mini van. Gene Lucas mentioned a few existing systems to simplify the construction of such a system. Interested parties in passing ideas around about this system can contact Sandy Bumgarner directly at job@garlic.com.

Frank Anet from Los Angeles spoke on a video-audio software system that would display WWV audio signals as .wav files for timing purposes. Such a system would provide accurate details on all parts of an occultation, including "light curves" during the rise and fall of light variations during an occultation. Such recordings could be downloaded to a computer system for frame by frame analysis.

David Dunham described the OCCULT program in it current form. OCCULT was written by David Herald originally in BASIC on a Commodore 64K computer, although now it is PC compatible. It is a widely useful-program to predict Lunar and Grazing occultations, occultation observations needing reduction to ILOC format, asteroidal occultations, solar and lunar eclipse predictions, and transits of Mercury and Venus. The program is currently downloadable by ftp from the IOTA website, where more details can be found. Another program described by Dunham was GRAZEREG; it generates IOTA's official graze predictions and was written by E. Riedel.

Rick Frankenberger (rickf@stic.net) mentioned a program by Fugawi that would plot lines on USGS topo maps. This would be extremely useful for coordinating graze expeditions and save much time in locating and positioning observers.

Steve Bisque of Software Bisque briefly described The Sky software program version 4. It has the addition of the Hipparcos and Tycho catalogues in its database. Steve also described his own automated telescope system and how TPoint, a telescope slewing system works. Steve was planning on joining the Aldebaran graze effort later that evening.

Prior to the lunch break, the discussion among attendees centered on the Public outreach effort for the evening's graze (media coverage, or lack of it) and previous experience with camcorder timings including satellite transmission processing delays, camcorder recordings, and their calibrating with TV/cable stations. David Dunham showed predicted times and moonview charts of the Aldebaran occultation from cities across the USA. He said that although the January 26-27 Aldebaran occultation was seen by many well known astronomers, few of them advertised this event to the local public or made any timings. Dunham also showed moonview predictions for local Denver/ Cheyenne area in the hope that local residents with camcorders could record the occultation. But lack of publicity prevented that.

As an attempt for further public outreach on this event, **David Dunham's** mentor student, Eric Schindhelm of Maryland, wrote an article about the May 21st Regulus occultation and its scientific importance in "High School Views", a publication read by about 10,000 high school students in Howard County, Maryland. It is hoped that this timely article would foster astronomy, occultation, and other IOTA activities by students in the area.

Following lunch, David Dunham went over the graze plan for the evening Aldebaran event. Since the weather was still cloudy over Denver, plans were discussed about driving to alternate sites. The current plan was to meet at the Kiowa Feed store in Kiowa, Colorado at 7 PM. Contingency plans were also discussed.

Additional discussion was made for the location of the year 2000 IOTA annual meeting. Dunham preferred to have it in Kansas City, where many key IOTA members live. Bob Sandy was quick to point out that these meetings should be in the path of major grazing events.

With this, the meeting closed at 3:35 PM.

P.S. The skies over Kiowa, CO cleared after sunset. The Aldebaran graze was successful under clear skies. Details of the event will appear elsewhere. i

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

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; Bartoldknaust 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 one 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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International Occultation Timing Association, Inc. (IOTA)

IOTA on the World Wide Web

(IOTA maintains the following web sites for your information and ıapid notification of events.)

IOTA Member Site
http://www.occultations.org

This site contains information about the organization known as IOTA and provides information about joining IOTA and IOTA/ES, topics related to the *Occultation Newsletter*, and information about the membership--including the membership directory.

IOTA Lunar Occultations, Eclipses, and Asteroidal and Planetary Occultations Site
http://www.lunar-occultations.com

This site contains information on lunar occultations, eclipses, and asteroidal and planetary occultations and the latest information on upcoming events. It also includes information explaining what occultations are and how to report them.

IOTA's Telephone Network

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).