

# Occultation Newsletter

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## FROM THE PUBLISHER

For subscription purposes, this is the third issue of 1991. It is the fourth issue of Volume 5.

IOTA annual membership dues, including ON and supplements for U.S.A., Canada, and Mexico \$25.00  
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for all others 25.00

Single issues are 1/4 of the price shown.

Although they are available to IOTA members without charge, nonmembers must pay for these items:

Local circumstance (asteroidal appulse) predictions (for your location) - 1.00  
Graze limit and profile predictions (per graze) 1.50  
Papers explaining the use of the predictions 2.50

Asteroidal occultation supplements will be available at extra cost: for South America through Ignacio Ferrin (Apartado 700; Merida 5101-A; Venezuela), for Europe through Roland Boninsegna (Rue de Mariembourg, 33; B-6381 DOORBES; Belgium) or IOTA/ES (see below), for southern Africa through M. D. Overbeek (Box 212; Edenvale 1610; Republic of South Africa), for Australia and New Zealand through Graham Blow (P.O. Box 2241; Wellington, New Zealand), and for Japan through Toshio Hirose (1-13 Shimomaruko 1-chome; Ota-ku, Tokyo 146, Japan). Supplements for all other areas will be available from Jim Stamm (117891 N. Joi Drive; Tucson, AZ 85737; U.S.A.) for \$2.50.

Observers from Europe and the British isles should join IOTA/ES, sending DM 40.-- to the account IOTA/ES; Bartold-Knaust Strasse 8; 3000 Hannover 91; Postgiro Hannover 555 829 - 303; bank-code-number (Bankleitzahl) 250 100 30.

## IOTA NEWS

David W. Dunham

IOTA members are being sent a table and description of zodiacal variable stars with this issue. This was prepared by David Herald and modified by Joan for publication. Non-IOTA members can obtain a copy from the McManuses, address in the masthead, for \$2.00. Also enclosed with this issue, for ON subscribers in North America, is the Asteroidal Occultation Supplement for North America for 1992, with predictions prepared by Edwin Goffin, selected by Jim Stamm, and charts annotated by David Werner. The main purpose for this issue is to distribute these supplements at least a few weeks before 1992.

Prediction Efforts. I have been writing at least minimal documentation of the major USNO occultation programs and data sets to start a major effort to replace these programs. All of our lunar occultation predictions (total and grazing) have been dependant on USNO's mainframe computer since the modern detailed prediction service was established over 20 years ago. Since that computer is scheduled to be removed by October 1992, starting the replacement program effort is crucial for continuation of the comprehensive prediction service. I have distributed the data sets needed for 1992 graze predictions, and the printed 1992 total occultation predictions; see "Distribution of 1992 Total Occultation Predictions" on p. 109.

European Grazing Occultation Supplement for 1992. I have prepared this supplement. Since most European nations have publications including maps of grazes for their country, and since most observers do not plan to cross national borders to observe grazes, this supplement is not being distributed directly to IOTA/ES members. Europeans can obtain

copies of the 1992 graze supplement upon request to Dr. Eberhard Bredner at the address given on the back page.

IOTA Meetings. The tenth European Symposium on Occultation Projects (ESOP-X), sponsored by IOTA/ES, was held in Hannover, Germany, on Aug. 16 - 19. A list of the titles of papers given at that meeting, and a discussion of highlights of the meeting, is presented on page 120. The next meeting, ESOP-XI, will be held in Castle Gondolpho, Rome, Italy during August 1992. If possible, the meeting will be scheduled to coincide with the best graze in Europe during 1992, a dark-limb graze by the 22% sunlit waning crescent Moon of the 2.8-mag. red giant star Mu Geminorum (Tejat) predicted for central Italy the morning of August 24.

Next Issue. We plan to mail the next issue of ON before Christmas. That issue will contain my predictions of 1992 planetary and asteroidal occultations, and the hemispheric grazing occultation supplements. Observers will be alerted to the major asteroidal occultations by Edwin Goffin's predictions, distributed as the North American Asteroidal Occultation Supplement with this issue, and distributed to IOTA regional coordinators for mailing to members in other parts of the world a few months ago. One event not in the North American supplement is a possible occultation of a faint Astrographic Catalog (AC) star by the giant comet Schwassmann-Wachmann-1 the morning of January 1st. My predicted path, shown in the January issue of Sky and Telescope, crosses the northern U.S.A. from Oregon to New Jersey, but the uncertainty in AC star positions is such that the event could occur anywhere in North America. The faintness of both objects will make last-minute astrometry difficult.

If you want to submit any new contributions for that issue, we need to receive them by December 12th.

## GRAZING OCCULTATIONS

Don Stockbauer

Please send copies of grazing occultation reports to me at 2846 Mayflower Landing; Webster, TX 77598; USA. If a copy can be sent to the International Lunar Occultation Centre (ILOC), this is greatly appreciated; their address is Geodesy and Geophysics Division; Hydrographic Department; Tsukiji-5, Chuo-ku; Tokyo, 104 Japan. For graze reports on diskette, please send me a printed copy of the data file only and send the actual diskette to ILOC. Total occultation reports on any medium need only be sent to ILOC. Due to the use of an inaccurate ephemeris for the 1990 graze predictions (see ON 5 (2), p. 34), 1990 shifts are not directly comparable to those of 1991 and should not be used to upgrade your current version 80K (or equivalent 80L) predictions. Reductions of some well-observed events can be performed to determine the 80K shifts.

Northern-limit dark-limb grazes during waxing crescent phases are shifting to the south from the present USNO predictions, on the average; see David's separate article on page 92 of the last issue. Similar south shifts have not been occurring systematically during the waning crescent phases.

I would like to thank Floridians Tom Campbell and Greg Shanos for organizing an enjoyable graze of Epsilon Arietis on August 31, 1991 near Quincy, Florida. Tom and I obtained video records, while Greg observed visually (we experienced a slight south shift). Although videos are becoming more common, visual observers are still needed to flesh out the observed lunar profile. I generally do not list grazes in this article until the report is finalized since preliminary information often changes upon refinement.

## GRAZE LIST

V					# # S Ap	N							
YRMOYDP	Star#	Mag	%SnI	CA	Location	Sta	Tm	S	Om	Organizer	ShS	WA	B
910324	1128	69	64+	15N	Yamagata, Japan	10	21	1	8	T. Funakoshi	17	-1	
910518	079410	71	20+	16N	Cassoday, KS	4	22	1	21	Craig McManus	1S	16	6
910617	1465	63	27+	10N	Netawaka, KS	7	23	1	20	Richard P. Wilds	0	14	51
910617	1465	63	27+	10N	Peculiar, KS	3	12	1	20	Robert Sandy	3S	14	51
910719	2011	65	57+	10N	Howlong, Austral.	1	0	2	15	Jim Blanksby	>7S	9	63
910807	0954	61	12-	-4S	Coruche, Portugal	2	6	2	15	Joaquim Garcia		179-12	
910903	078118	82	31-	2N	Keene, KS	2	10	1	33	Richard P. Wilds	4S	0-14	
910901	0647	55	51-	8N	Bundaberg, Austrl	2	4	2	20	Phillip Kearney	3N	354-47	
910902	0743	56	44-	4N	Flat Rock, PA	2	10	2	25	John Holtz		0358-29	
910905	1202	69	14-	4S	Eupen, Belgium	2	18	2	16	Jean Schwaenen	5S	182	18

## DISTRIBUTION OF 1992 TOTAL OCCULTATION PREDICTIONS

David W. Dunham

I completed calculation of the detailed total occultation predictions for 1992 last month using the USNO mainframe computer; the results were printed with a laser printer to produce more compact predictions than in the past. Data were computed for everyone who received 1991 predictions from USNO. Predictions for European observers, except for those in the U.S.S.R., were distributed to national coordinators at the ESOP-X meeting in Hannover in August; the national coordinators, who are listed below, were to distribute the predictions to those who had sent verification forms for 1992 predictions to USNO, and to send new copies of the verification forms, with a statement that the form needed to be returned to them to receive the 1992 data, to those who had not sent the form to USNO. I gave predictions for most observers in the U.S.S.R. to Natan Eismont at the Space Research Institute in Moscow, during a spaceflight meeting that both of us attended in Darmstadt, Germany, the first week of October. He was going to mail them soon after his return to Moscow. Most of the U.S.S.R. predictions were to be sent to Alexander Osipov at Kiev University, since Osipov has been a coordinator of occultation activities in the U.S.S.R. for many years.

In October, 1992 predictions for all observers, who had returned their 1992 prediction verification forms, in other countries besides Canada, the U.S.A., the U.S.S.R., and all those in Europe, were mailed by air-mail printed-matter. Also in October, Marie Lukac sent a second notice and 1992 verification form copy to those outside of Europe who, according to her records, had not returned them already. With that mailing, she also enclosed a copy of the June ON article stating the end of USNO's occultation prediction service, and asking observers to send the forms to me rather than to her. She decided not to send such a mailing to everyone on her occultation mailing list, since the others either already had, or soon would, have their 1992 predictions mailed to them by me. The 1992 predictions for observers in the U.S.A. and Canada will be mailed before this newsletter, using third class for bulky predictions.

European National Coordinators. If you live in Europe and were on USNO's active prediction mailing list, you should have already received your 1992

predictions from your national coordinator; as has been noted elsewhere, the European coordinators were given all predictions for their country at the ESOP-X meeting in August. If you have any questions about your 1992 predictions, contact the coordinator for your country listed below:

Belgium and France: Pierre Vingerhoets; Blokmakerstraat 20; B-9120 Haasdonk; Belgium.

Czechoslovakia: Bohumil Malecek; namesti Generala Piky 9; CS-30158; Telephone 42-19-40757.

Deutschland (Germany) - East: Karsten Beuche; Sternwarte; Am Mausberg 18; D-O-7280 Eilenburg

Deutschland (Germany) - West: Eberhard Bredner, see address on last page of this issue.

Espana (Spain): Carles Schnabel; c/Comtes de Bell-lloc; 172,1,1; E-08014 Barcelona.

Finland: Matti Suhonen; Teuvo Pakkalantie 12A19; SF-00400 Helsinki 40.

Italy: Dr. Claudio Costa; Viale Colli Portuensi, 345; I-00151 Roma; Telephone 39-6-4451105 (home) or -43602520 (office) or -4131133 (fax).

Netherlands: Henk J. J. Bulder; Mendelssohnrode 72; NL-2717 CS Zoetermeer; Telephone 31-795-17083.

Poland: Marek Inz. Zawilski; Ul Julianowska 5/7 M 369; PL-473 Lodz.

U.S.S.R.: Natan Eismont; Space Research Institute; Academy of Sciences of the USSR, Profsojuznaya 84/32, 117810 Moscow; Telephone 7-095-9361014 (home), -3335089 (office), or -3107023 (fax).

All other nations in Europe not mentioned above: Eberhard Bredner, address on last page of this issue.

1993. Enclosed with the 1992 predictions were verification forms that need to be sent to me in order to receive 1993 predictions. I plan to compute the 1993 predictions at USNO, but then plan to write most of them to a magnetic tape, which I will send to the International Lunar Occultation Centre (ILOC) in Tokyo. ILOC will print the predictions from the tape and distribute them. ILOC plans to convert at least USNO's EVANS program, which generates the predictions from a BEFILE (see the article on occultation software elsewhere in this issue), sometime in 1992, so that they can both produce and distribute the predictions for 1994. I will spend two days at ILOC during my business trip to Japan this month to facilitate the transition of this work. ILOC will also try to run the USNO OCC program on their computer. This may be a difficult task. If successful, much of the preliminary work (star-catalog lunar-ephemeris comparison occultation search runs, creation of the annual BEFILE's needed

for total occultations, and creation of the regional and global graze data sets), now done by me with USNO's computer, could be done at ILOC. If not successful, ILOC will either depend on IOTA's replacement software, or modify their existing software, or a combination, to accomplish the work that needs to be done.

Rather than distribute the 1993 predictions directly to all observers worldwide, ILOC may want to work with national coordinators, such as those for Europe mentioned above, to help with the distribution. In practice, this is already being done for several countries. If you are interested in being a coordinator for your country, please let either ILOC or me know. Especially helpful for me would be coordinators for parts, or all of, the U.S.A. and/or Canada.

#### THE ANNULAR SOLAR ECLIPSE OF 1992 JANUARY 4

David W. Dunham

Northern Limit. Paul Maley's plans to observe this eclipse from the northern limit on Truk Island were mentioned on page 89 of the last issue. Maley has obtained detailed maps of Truk, and at least five people have signed up for his expedition. If you might want to join that effort, call him at 713,488-6871.

Southern Limit. Hans-Joachim Bode plans to lead an expedition of a few IOTA/ES members to Kiribati to observe from an island near the southern limit. If you might be interested in joining this effort, telephone him in Germany at 49-511-424696. Bode has made reservations to fly to Tarawa by way of Fiji. The only islands close enough to the southern limit for useful observations are Arorae, at the south end of the Gilbert chain (which includes Tarawa near its north end) near the International Date Line; and Washington Island, in the Line chain about 450 km northwest of Christmas Island due south of Hawaii.

Alan Fiala, USNO, has ordered hydrographic charts of Tarawa, Arorae, and Christmas Islands. None, however, are cataloged for Washington Island.

According to the Frontiers International agency in Pennsylvania, which arranges tours to Christmas Island, a new airline service will directly link Tarawa and Christmas Island for the first time as this issue goes to press. Unfortunately, the only "scheduled" travel to Washington Island is by freighter that visits it about once a month. The

Gilbert Islands are more populous, so that better arrangements, chartering a flight or possibly renting a large sailboat, can probably be made to travel from Tarawa to Arorae.

There used to be air service from Tarawa to Arorae provided by Air Tungaru, but that is no longer available, since their pilot was jailed and the airplane confiscated, according to an account relayed to Paul Maley. The hydrographic map of Arorae might not have sufficient geodetic accuracy for the eclipse experiment, in which case, both IOTA and IOTA/ES might purchase the relatively inexpensive GPS receivers that are available now. Since these receivers do not have the accuracy available to the special military receivers, two are needed, so that one could be used at the observation site on Arorae and the other simultaneously on an island with a well-determined geodetic position, so that accurate relative positions can be tied to the known location.

California. Since the annular phase of the eclipse occurs at an altitude of less than 3 degrees above the horizon in southwestern California, even if the sky is clear, poor atmospheric seeing will almost certainly render Bailey's bead phenomena too indistinct for usefully-accurate timings for the solar diameter experiment. This was our main assessment of the 1973 December annular eclipse, which we observed and photographed from Puerto Escondido, Mexico, where the Sun's altitude at central eclipse was 4 degrees. Never-the-less, I plan to try to videorecord the event from near the northern limit in California, either from Santa Cruz Island (if arrangements can be made to go there) or from a relatively high-elevation mainland location. Telephone me at 301,474-4722 if you would be interested in joining this effort. Richard Nolthenius; Cabrillo College; Aptos, CA 95003, is planning an effort to observe the eclipse from Santa Catalina Is.; if you are interested in this expedition, write to him or call him at 408,423-6715 (home, answering machine) or 479-6506 (office).

## VIDEO NEWS

Tom Campbell

I use a Fostex MN50 audio mixer/compressor with my video system and it works reasonably well. I bought it in a local music store here in Tampa for a cost of \$80. It is powered by an internal 9 volt battery and it has an external power jack for 9-15 VDC input. The most attractive feature is its size, only 7 X 4 X 1 inches (18 x 10 X 2.5 centimeters) and it weighs only 1 pound (454 grams). The variable compression/release time works very well!

At the graze site I set the MN50 audio gain of the microphone input (WWV signal) until the green light (minimum level where compression begins) and continue to increase the volume until the red light blinks every once in a while (red indicates that maximum compression has occurred). I adjust the compression release time for about 300 milliseconds (1/3 second). The audible time ticks and minute tone signals literally "punch" through on to the sound track of the VCR. The mixer's gain automatically adjusts itself high between each time tick.

The microphone I use is an Electrovoice model 235A with an impedance of 150 ohms into a balanced cable (2 leads inside of a braided outer shield). The cable connector has 3 pins. It is a very good quality and very sensitive microphone. The Fostex mixer has an input impedance of 47k ohms (as do most consumer audio microphones). I use a Radio Shack part # 274-016 impedance matching transformer adapter plug on the end of my mike cable and this low Z balanced line to high Z unbalanced line adapter plugs into the microphone input of the mixer. My audio system works very well for me.

I have read about the marginal audio level problems with some microphone/mixer combinations in ON and I have actually seen some fine video taped grazes with a marginal to poor audio quality sound tracks. Not being familiar with any of the other audio systems I can only offer my experience as an electronics technician to help solve some of these audio system problems we have been experiencing with our video tape occultation recording systems:

- 1) Make sure that you have an amplifier inside your mixer: some do not.
- 2) Make sure that the impedance of your mike matches the input impedance of the mixer.
- 3) If you have a hi Z microphone (47k ohm range or higher), use as short a mike cable as possible (cable capacitance attenuates the higher frequency

signals when using hi Z audio equipment).

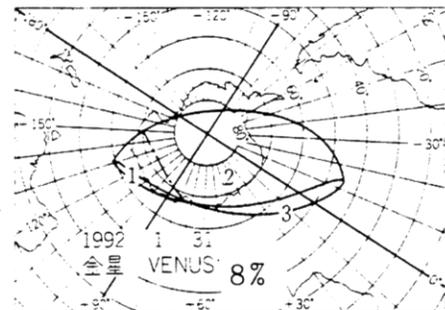
- 4) Do you have a sensitive enough microphone?
- 5) Does your mixer have adequate audio gain?
- 6) If you have to use an lo Z to hi Z impedance matching line transformer (like I do) make sure the transformer is on the end of your cable at the input of the mixer. Placing it on the microphone end of the cable would defeat the purpose of the low Z mike (cable capacitance has practically no affect on the higher frequencies with low Z audio signals).
7. A mixer with audio compression features works very well for video recorded grazes.

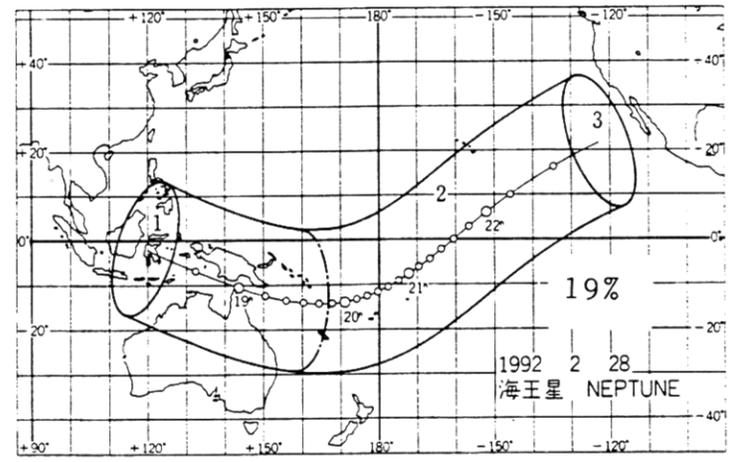
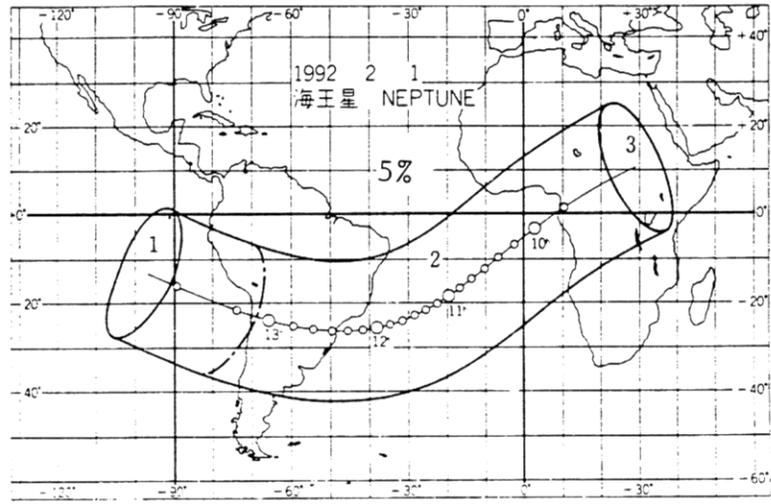
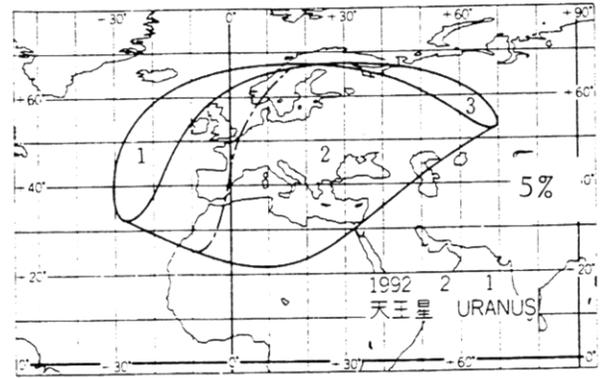
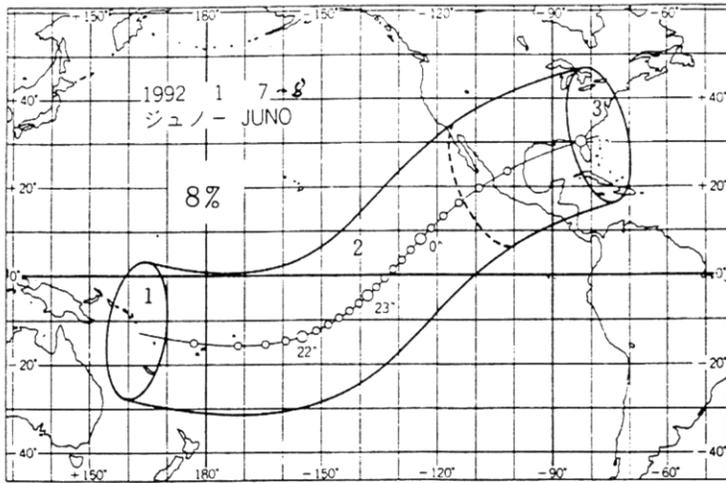
Most all of us with new video tape equipment are still "rookies" just like we were years ago when we began observing grazes visually with an audio cassette recorder. More time and experience will show us the best combination of video equipment to use. I hope that I have been of some help to you with my video experience. The ON is a very good way to share information on good practical application. Lets hear from more video station observers!

## LUNAR OCCULTATIONS OF PLANETS

The maps showing the regions of visibility of lunar occultations of planets are reprinted by permission, from the Japanese ephemeris of 1992, published by the Hydrographic Department of the Maritime Safety Agency of Japan. In region 1, only the reappearance is visible; in region 2 both the entire occultation is visible, and in region 3, only the disappearance may be seen. Reappearance occurs at sunset along a dashed curve, while disappearance is at sunrise along a curve of alternating dots and dashed. We have added a legend to each map indicating the phase of the Moon at event time.

Those interested in observing partial occultations should request predictions at least three months in advance (if possible) from Joseph Senne; P. O. Box 643; Rolla, Mo 65401; U.S.A; phone 314,363-6233.

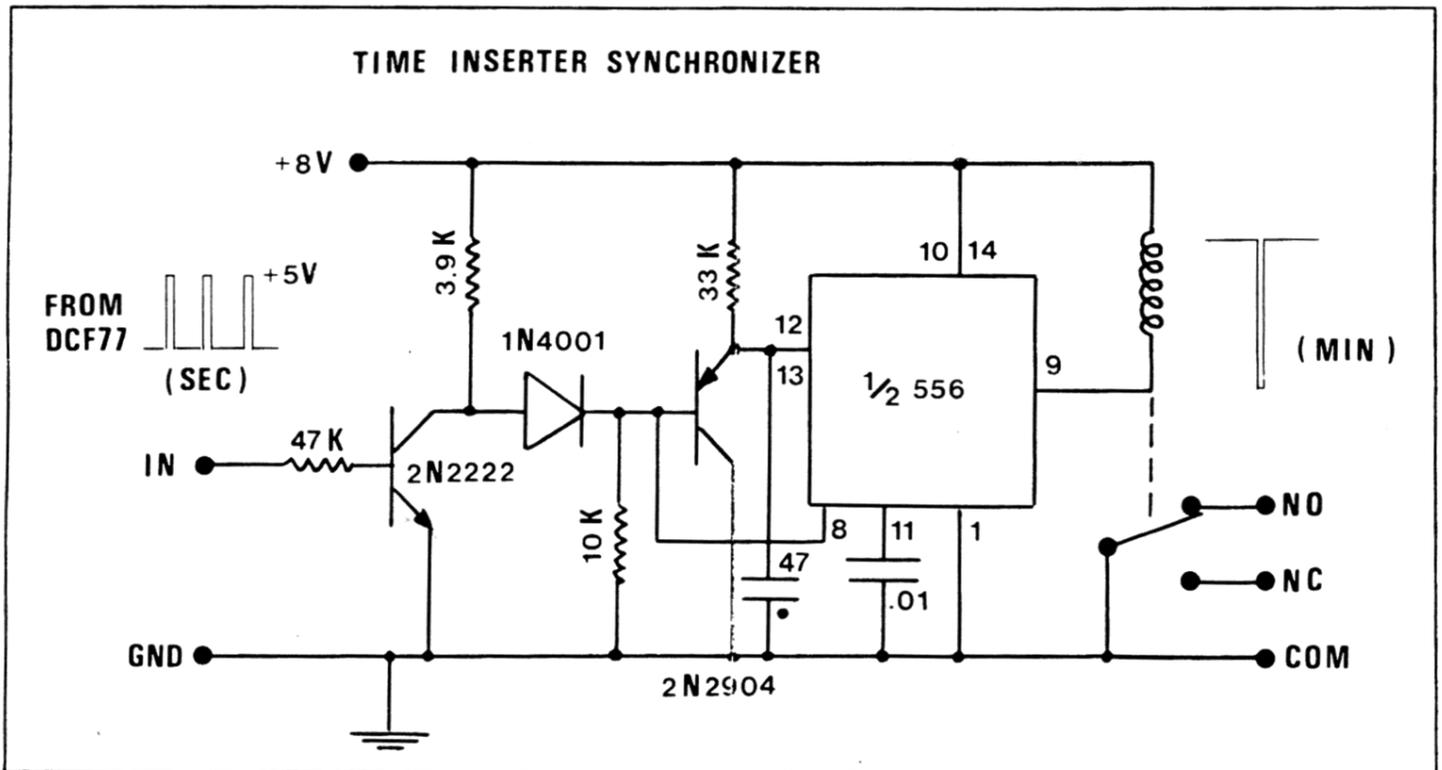
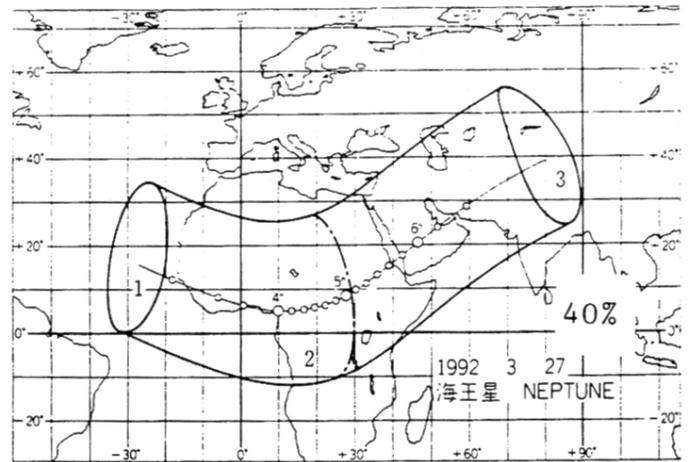




TIME INSERTERS

Jean Bourgeois

I noticed the report in ON 5(4) on Peter Manly's use of an electronically triggered time inserter. I also use such a device. I use a RCA TC1440B date and time generator, but my device is right for a JVC character generator too, or for any other time inserter. The diagram shows how it works. It is triggered by DCF77 on 77.5 KHz, whose 59th second is missing. Half of a NE556 time is used as a missing pulse detector, so the second zero gives a pulse that actuates a relay. Its normally open or normally closed contact may then be used to act in parallel with the push-button that must be pushed on to initialize the generator. Laboratory measurements showed that the minute pulse is delayed by less than 0.001 sec compared to the time signal. In my case, this synchronization is done every minute.

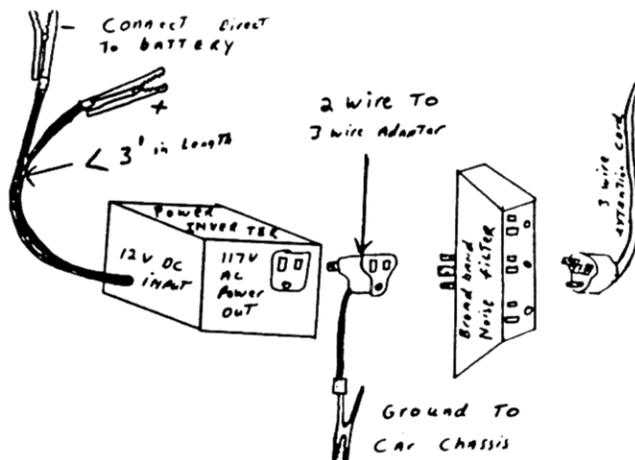


## POWER INVERTERS

Tom Campbell

Power inverters enable observers to use low cost AC powered equipment (e.g., table top VHS video recorders, AC only TV sets for video monitors, etc.) in the field for video taping grazes and other events. However, they can cause a lot of RFI noise interference that can wipe out your radio time signal reception and cause video noise in the form of bars and random spots on your video frames if you are a "video rookie" and don't connect the inverter properly. I know this from experience as I lost valuable data on my first two video recorded grazes. Here is what I did to almost totally eliminate the power inverter RFI noise problem:

- 1) I discarded my 12 volt extension cord with a cigarette lighter plug on end and a cigarette lighter receptacle on the other end.
- 2) I cut off the cigarette lighter plug on the power inverter 12 volt cord, made the cord less than 3 feet long, installed battery clips on the cord and connected it directly to my car battery underneath the hood.
- 3) I plugged a 2 prong to 3 prong AC adapter into the AC socket of the inverter and connected the ground wire from this adapter with an alligator clip directly to the frame of the car (do not use the 3rd wire ground of the inverter. Let it and the inverter float!). This bypassed the noisy inverter ground.



4) I plugged a RFI/EMI line filter (like the ones used on PC computers) into the back of the 2 to 3 prong adapter.

5) I used a 25 foot AC extension cord to bring filtered AC power to my equipment with the hood almost closed. The engine compartment itself is a good RF shield.

The diagram below illustrates the above noise elimination method. The basic concept is to use as short a 12 volt dc leads as possible and use long AC cords to bring power to your equipment. Long DC cords carry chopped and noisy DC current that can act as RF noise antennas.

## ASTRONOMY AND PERSONAL COMPUTERS

Joan Bixby Dunham

Power Failures - In a recent power failure, I was reminded of a problem I had noticed earlier and forgotten, that of power switches whose setting ("on" or "off") cannot be determined when the power is off. I use several power strips at home and at my office with no obvious indication of the switch position, other than having the switch light up when it is on. But when there is a power failure, the switch does not light up in either the "on" or the "off" position. Also, when there is no power, there are room lights are off as well, making it difficult to read subtle markings on switches. We wanted to turn off the power strips, because we were worried that there might be a surge when the power came back. We gave up and pulled the plug, a low-tech but reliable method. I wrote "OFF" in large letters with a felt-tip marker the next day. Also, I later noticed that the switch light in a number of these power strips is either dead (so the light is always off) or flickering.

X-Rays of Computers and Software - During a recent trip to Europe, we found airport security personnel absolutely adamant on x-raying computers, computer software, and film. Their position was that we could have our things x-rayed and take them on the plane with us, or we could give them away. No amount of arguing or discussion would change that. The x-ray machines had stickers labeling them as "film safe" and "computer safe". Are they? Probably not. X-ray exposure is cumulative -- a pass through an airport security machine is unlikely to be noticeable, except on very sensitive film of ASA

1200 or more. But multiple passes will be. An extended trip can often include numerous passages through airport security. A portable computer might be taken on many trips. If the computer display or software develops a problem, can we say if it was or was not caused by being x-rayed too many times?

Our computer and the software we have checked seem to be OK, or at least no worse than before the trip. We returned with 70 diskettes containing the Watts Charts of the Marginal Zone of the Moon which David was sold by Wolfgang Zimmerman in Germany. He had converted the data from an IBM mainframe binary data set to an ASCII PC data file. They were X-rayed once, and seem to be OK. We have been told not to put film, software, computers, or cameras in checked baggage because that might be x-rayed or mishandled. Or put on the wrong plane, as our bags were.

The security checking was inconsistent from location to location. At one security check, the baby and his stroller were pushed through unexamined along the outside of the metal detector while his mother and father and belongings were x-rayed and metal-detected. Another time, I was asked to hold the baby while he was searched. I must have looked as startled as I felt, because the security person explained that I could easily fool a metal detector by holding something between the two of us. So she waved a metal detector over his Pamper to make sure I hadn't put a film cartridge or diskette or machine pistol in there. I was told more than once that, if the stroller did not fold up into a small enough package to fit through the x-ray machine, it did not have to be x-rayed. Perhaps we should have attached the computer to the stroller and said it was a non-folding computer-operated stroller.

Does this security checking accomplish much besides annoying lots of travelers? To a security guard who does not use computers, a computer is a collection of wires, metal and perhaps a battery. A bomb is a collection of wires, metal, perhaps a battery, and some explosive. What can be learned by x-raying either one? The computer, under an x-ray, looks like a collection of wires, metal, and perhaps a battery. A bomb must not look much different. I suppose the x-rays are useful to prove that we have not concealed a gun in the computer. Then what purpose is served by x-raying computer diskettes or cans of film?

I can see that at some point, we may be asked to prove that the object that has just been x-rayed is indeed a computer. We will be asked to turn it on. That is when we want the autoexec.bat file that

displays the message "ready.... aim... <pause>" (Note for the record -- This is a joke. If you do this, you are on your own.)

The lead foil bags sold for film protection are not much protection against the airport x-ray machines. If you use them, then the next time you travel, send it through the x-ray by itself and position yourself so you can see the screen as it goes through. You will have no trouble determining what is inside the bag. (You might already have concluded this from the fact that you are rarely asked to open the bag after it is x-rayed.) You might also ask yourself just how safe an x-ray machine than can punch through a lead foil bag really is.

Star Catalogs in Data Bases I have been working on two projects recently which I did by creating data bases of star catalog data. I found this to be a very nice way to manipulate the catalog data. I did have a few problems, though. The biggest problem was one which frequently occurs when creating or updating star catalogs: handling the -0 degree declination zone. Computer languages, data base managers, and spreadsheet programs do not see any difference between +0 and -0. They are 0. In spherical coordinates, though, -0 is that region between the equator and -1 degree. We like to represent coordinates in degrees, minutes, and seconds, and we also like to have the sign of the coordinates always appear in the same location and not sometimes attached to the seconds of arc, sometimes the minutes. I have seen negative signs attached to all three, so coordinates might be -1 -2 -3.4 for something at -1 degree 2 minute 3.4 arc seconds. That is OK, but it looks a little lame. I solved the problem by creating a character field for each record that held either a + or a -, and testing on that to determine the sign of the declination.

I also had another problem with signs: the data base manager did not like blanks between the sign and the number. The star catalog data were nicely formatted so that the signs lined up, which meant that there were many entries with one or more fields with a blank or two between the + or - and the number. The data base manager interpreted all of these as zero.

One thing I have not checked was whether or not the data base needs more room than the original files. I was not attempting to minimize file space, but what I did notice was that the files were not using significantly more disk space than the origi-

nal files. I think that someone trying to be clever in data space usage could arrange to use less space for the data base than the original input file by truncating all of the fields which have blanks.

When converting a file of data to a data base, I have found the easiest method to be to define my data base fields so that each is exactly the same length as the data, and that their total length is exactly the same as the individual records in the files. This assumes that the file is a fixed field representation -- that is, the same information is presented in the same place for each field. Then I import the data (in PC-File) or append it (DBase terminology), and check to see that I counted the record lengths correctly. I did any modifications after the data base was created. For example, the records from the machine-readable General Catalog of Variable Stars included lots of blanks that I wanted to remove. I defined a field that was always empty, and, after creating a data base, I modified it to remove that field. That is not difficult to do with PC-File, and is very easy to do with DBase III+.

#### NEW DOUBLE STARS

Tony Murray

Since the last article on new double stars appeared in ON 5 (3), response from observers has been overwhelming. We have since received reports of 213 observations. Many of these are confirmations of previously discovered stars but the majority are new discoveries. Reports were received from four observers in three countries. We received reports from observers Robert Hays of Worth, Illinois and Richard Wilds of Topeka, Kansas, Carlo Gualdoni of Milan, Italy and Jean Bourgeois of Reux, Belgium.

Carlo Gualdoni sent in two photometric records made at Sormano Observatory. Jean Bourgeois sent in 179 observations made at three stations in Belgium and at Pic du Midi Observatory in France. Bourgeois' observations were made between 1975 and 1990. Most of his observations during 1986-89 were made with the 105 cm Cassegrain at Pic du Midi.

The accompanying table of double stars does not contain all of the 213 observations. The principle reason is that sufficient time was not available to thoroughly check all of the reports and make all of the necessary additions and changes to the IOTA Catalog of Double Stars of the Moon's Occultation Zone. I will attempt to finish the work for the

next issue of ON.

The reports received since the last article have been very interesting, especially to those of us who are visual observers.

First is the report by Robert Hays of his timing made April 22, 1983. That evening he timed a step event at the disappearance of SAO 98828 at  $02^{\text{h}} 23^{\text{m}} 36.6^{\text{s}}$  at position angle 106. That same evening David Evans' group at the University of Texas was observing the same star with the 30-inch telescope at McDonald Observatory. They photometrically timed the disappearance of 98828 at  $02^{\text{h}} 20^{\text{m}} 11.48^{\text{s}}$  at position angle 167.6. Hays confirmed the Texas group's discovery  $3^{\text{m}} 25^{\text{s}}$  after it was made. In addition, in his notes Hays reports that the "star stepped down to about half brightness." The Texas photometry produced results for the two components of 9.6 and 9.7. Certainly this and other examples lend credence to the reports of experienced observers.

Many of Jean Bourgeois' reports are remarkable in their own way. They give evidence of the experienced observer's ability to evaluate the non-instantaneous event at the reappearance. Many observers do not report non-instantaneous reappearances even though they suspect such. Each observer is the best judge of his abilities and should report accordingly, but there may be a tendency to discard useful observations by being overly cautious.

In the past, non-instantaneous reappearances were rejected. As an example, in his analysis of 423 occultations are reported in the J. Brit. Astron. Assoc. 90 (6), G. M. Appleby said "It was decided to reject the reappearance observations as probably being due to the inherently unexpected nature of a reappearance." This idea should be rejected in light of observations such as these reported by Bourgeois. Of the 179 occultations he reported, 83 were confirmations of earlier discoveries. Some of these earlier discoveries were made by the Texas group under Nather, Evans, and others from 1968 to 1987. The projected separation of these discoveries that Bourgeois confirmed ranged from .02" to .1". Of these, Bourgeois' notes described the reappearances as "fade" or "gradual". The most interesting example of these is SAO 93955. This double star was discovered by Griffin and Gunn in 1975. Shortly thereafter, Hays observed a reappearance and noted that it was a step event. Bourgeois' two reappearances of 93955 both occurred at the same position angle, the first on August 25, 1978 and the second September 28, 1980. The results speak for them-

selves.

The table accompanying this article contains 69 new double stars that will now go into the IOTA Catalog of Double Stars of the Moon's Occultation Zone.

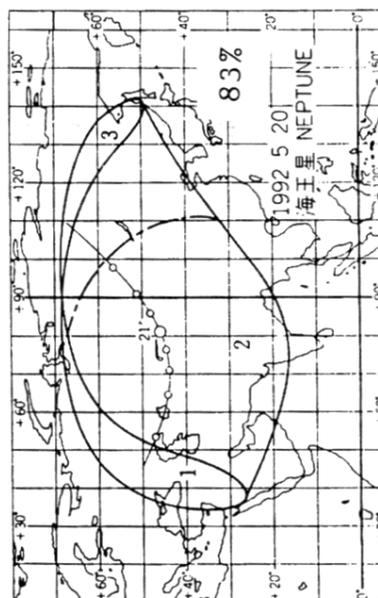
The star DM +25° 707 was incorrectly credited to B. Loader in ON 5(3) p. 66. This double star was discovered by H. Bulder. The catalog has been corrected.

In addition, 37 stars were reported as doubles whose duplicity had previously been discovered. These stars are the following:

- 075764 Hays observed 88Jan27  
 076152 Bourgeois observed 88Aug06  
 076573 The star is ZC647 = ADS3161 Bourgeois observed 87Mch06, confirming that the primary of this wide double is itself double.  
 076951 Hays observed 88Aug07.  
 077224 Bourgeois observed 87Feb08, confirming previously suspected duplicity. Code is now X.  
 077322 Gualdoni observed 90Mch04.  
 077415 Bourgeois observed 88Apr20 and 89Jan19. Code is X.  
 077478 Bourgeois observed 88Apr20.  
 077578 The star is ZC881. Hays observed 81Nov14.  
 077980 Bourgeois observed 89Nov15.  
 078050 Bourgeois observed 83Feb22.  
 078063 Bourgeois observed 83Feb22.  
 078233 Hays observed 87Oct13.  
 078407 Bourgeois observed 83Oct27  
 079206 Hays observed 89Mch16.  
 079286 Bourgeois observed 87Dec08. Code is now V.  
 079680 Hays observed 82Apr02.  
 092954 Hays observed 91Jan24.  
 093359 Hays observed 84Aug19.  
 093933 Bourgeois observed 77Sep05, confirming previously suspected duplicity. Code is now V.  
 093955 Discovered by Griffin and Gunn in 1975, observations reported by Hays and Bourgeois. Discussed in article.  
 093957 Bourgeois observed 78Aug25.  
 093981 Bourgeois observed 78Aug29, confirming previously suspected duplicity. Code is now V.  
 096547 Bourgeois observed 78Aug29.  
 098189 Bourgeois observed 90Nov09.  
 098828 Hays observed 83Apr22, 3.5 min. after

U. of Texas observations. Discussed in article.

- 099206 Bourgeois observed 87Mch14.  
 099421 Bourgeois observed 82May02.  
 109763 Hays observed 87Mch 03, confirming previously suspected duplicity from J. VanNuland observation of 76Dec02. Code is now V.  
 110089 Bourgeois observed 86Jan17.  
 118554 Hays observed 89Nov21.  
 161033 Already accredited to Bourgeois in IOTA Catalog.  
 161043 Already accredited to Bourgeois in IOTA Catalog.  
 162260 Bourgeois observed 75May01.  
 163645 Bourgeois observed 77Aug02.  
 164303 Bourgeois observed 78Jun24.  
 184822 Hays observed 83Oct11.



SAO	M	N	Mag 1	Mag 2	PA	Date	Dis
075635	T	X	9.5	9.5	231	88Aug05	JB
075715	T	X	8.2	8.2	222	88Sep28	JB
075741	G	K	9.6	9.6	351	91Feb21	RW
075773	T	X	8.8	8.6	97	88Jan27	RH
975990	T	K	8.7	8.7	85	89Dec11	JB
076216	T	X	7.7	7.7	228	88AUG06	JB
076225	T	X	9.8	9.8	93	88Feb24	RH
076740	T	X	8.3	8.3	203	86Nov18	JB
076764	T	K	8.6	8.6	160	88Feb25	RH
076939	T	K	7.1	7.1	0	83Feb21	JB
077267	T	X	8.9	8.9	311	86Nov19	JB
077415	T	X	9.3	9.3	135	88Apr20	JB
077452	T	X	9.0	9.0	83	84Feb12	JB
077514	T	X	9.7	9.7	79	87Feb09	JB
077521	T	X	9.9	9.9	50	87Feb09	JB
077565	T	X	9.7	9.7	257	83Sep29	JB
077981	T	X	9.8	9.8	121	83Feb22	JB
078030	T	X	9.5	9.5	72	83Feb22	JB
078060	T	X	9.8	9.8	50	83Feb22	JB
078238	T	X	9.6	9.6	300	87Dec07	JB
078283	T	X	8.3	8.3	273	87Dec07	JB
078480	T	X	8.3	8.3	63	87May02	JB
078486	T	X	9.9	9.9	95	87May02	JB
078805	T	X	6.1	6.1	132	82Feb25	JB
079384	T	X	9.8	9.8	308	83Oct27	JB
079386	T	X	7.3	7.3	96	82Apr01	JB
079615	T	X	8.2	8.2	61	90May27	JB
079740	T	X	9.2	9.2	143	84Feb14	JB
079853	T	X	9.8	9.8	257	88Dec25	JB

SAO	M	N	Mag 1	Mag 2	PA	Date	Dis
079932	T	X	9.6	9.6	319	88Oct04	JB
079938	T	X	10.1	10.1	110	88May20	JM
079957	T	X	9.9	9.9	96	87Mch11	JB
079966	T	K	9.5	9.5	72	88May20	JB
080334	T	X	9.5	9.5	123	83Apr20	JB
080514	T	X	9.1	9.1	87	87Mch12	JB
080524	T	K	8.8	8.8	122	88May21	JB
092530	T	X	7.0	7.0	121	90Nov02	JB
092733	T	X	9.5	9.5	172	87Sep11	JB
092737	T	X	9.3	9.3	224	87Sep11	JB
092756	T	K	7.6	7.6	37	87Nov05	JB
092950	T	K	8.6	8.6	35	85Jan29	RH
093275	T	X	8.1	8.1	54	80Feb21	JB
093561	T	X	7.9	7.9	201	83Oct24	JB
093884	T	X	8.7	8.7		77Sep05	JB
094345	T	X	7.3	7.3	82	82Apr26	JB
095361	T	X	8.7	8.7	303	80Oct28	JB
096153	T	X	8.4	8.4	302	80Sep04	JB
097628	T	K	7.0	7.0	333	75Nov23	JB
098124	T	X	9.8	9.8	257	88Dec26	JB
098471	T	X	9.0	9.0	146	88Apr24	JB
098477	T	X	9.5	9.5	132	88Apr24	JB
099050	T	K	9.4	9.4	331	88Dec28	JB
099193	T	X	10.0	10.0	112	87Mch14	JB
109117	T	X	9.8	9.8	103	87Nov02	JB
119146	T	X	9.4	9.4	131	83Jun17	JB
128800	T	X	9.8	9.8	71	83Dec13	JB
138962	T	X	9.2	9.2	181	83Jun18	JB
138981	T	K	9.7	9.7	336	87Mch16	JB

SAO	M	N	Mag 1	Mag 2	PA	Date	Dis
146509	T	X	8.1	8.1	67	86Nov10	JB
146991	T	X	9.6	9.6	80	84Feb05	JB
160326	T	K	7.7	7.7	335	77Mch12	JB
164394	T	X	9.7	9.7	277	88Jul29	JB
165061	T	K	9.9	9.9	214	88Jul30	JB
165106	T	K	9.9	9.9	85	87Sep07	JB
185004	T	X	9.8	9.8	130	87Sep01	JB
185161	T	X	10.0	10.0	100	88Jul25	JB
185187	T	X	9.8	9.8	53	88Jul25	JB
188134	T	X	10.3	10.3	43	88Jul28	JB
188724	T	X	8.4	8.4	45	87Oct01	JB

**NOTES:**

**Observers:**

JB = Jean Bourgeois

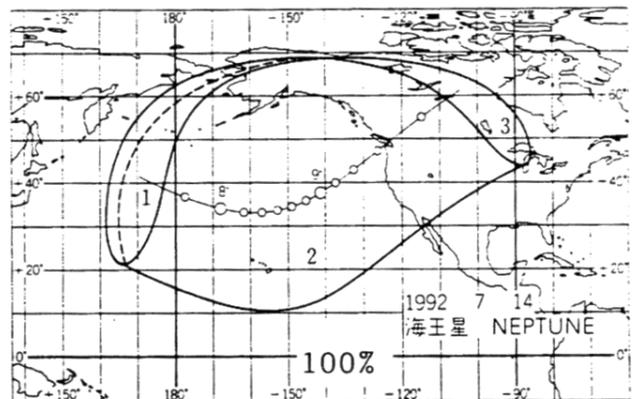
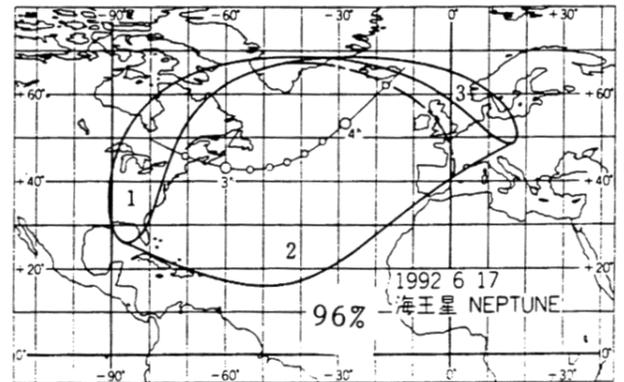
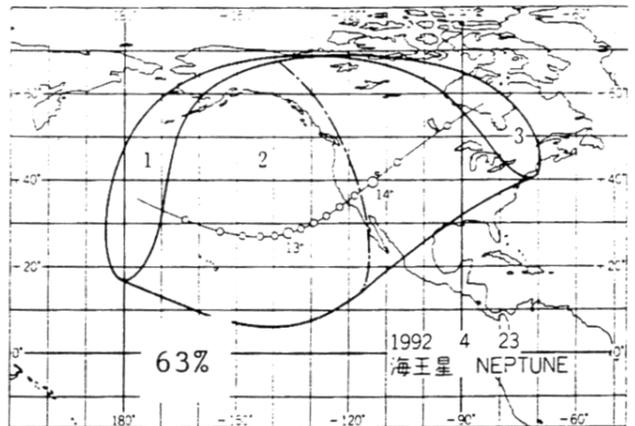
RH = Robert Hays

RW = Richard Wilds

**SAO Number**

**Note**

- 075741 graze
- 076255 = P 495
- 076764 near graze
- 076939 near graze
- 077415 Observed again as fade by JB 89Jan19.
- 078805 = 36 Gem.
- 092530 = 101 Psc.
- 092950 = ZC 359



## A NEW BRIGHT BINARY STAR

Harold Povenmire

On Sunday evening, September 15, 1991, three members of the Canaveral Area Graze observers traveled to just south of Jacksonville, Florida to observe a favorable grazing occultation. The observers were Robert J. Wood, Sean Sullivan, and myself.

The star, ZC 2524, is a 6.0-magnitude blue (B9) star also known as 151 G. Ophiuchi (SAO 185474). Because of some middle layer cirrus clouds and twilight, the star was not visible until about seven minutes before central graze.

When the star blinked out at my station, I noticed that it was a sluggish rather than a sharp disappearance. After several more events, when the star was in deep occultation, I noticed that a very faint secondary was visible along the marginally visible earthshine. I estimated this companion star to be about magnitude 8.6 in my 10-inch telescope. The companion star remained visible for about 119 seconds until the primary star reappeared.

After we carefully measured our positions, we went to the nearest telephone and called David Dunham. He confirmed that the star, which is very far south in Ophiuchus, was a previously unknown binary. From the 28 timings, we were able to compute that the most probably position angle of the secondary companion was about 160 degrees and the separation is several tenths of an arc second.

The reduced timings and positions have been reported to IOTA and to ILOC. This with the 274th successful grazing occultation observed by the Canaveral Area Graze Observers since October, 1963.

## THE TENTH MEETING OF THE EUROPEAN SYMPOSIUM ON OCCULTATION PROJECTS

David W. Dunham

I was fortunate in being able to attend this tenth anniversary meeting of ESOP, with help from Hans Bode's company. The meeting, sponsored by the European Section (ES) of IOTA, was held at Hannover University and at the Volkssternwarte Hannover August 16-20. Unfortunately, I had to return to Maryland on the 19th, so I missed the last 2 days. Over 50 observers from 9 countries attended, making it the most interesting and dynamic meeting on

occultations that I have ever attended. A rich variety of topics was addressed, as can be deduced from the titles below. Presentations were in either English or German, with partial translation into the other language. Abstracts for all papers were distributed to participants. I have added some comments following some of the papers.

August 16, evening, public lecture by Hans Bode, primarily describing IOTA's program to measure variations of the solar diameter from solar eclipse observations, concentrating on IOTA/ES's contributions from expeditions around the world. The talk culminated in the trip to Mexico made just a month before. Interesting slides illustrated the eclipses and the locations visited, which ranged from arctic Siberia to wild jungles of West Irian to New Zealand.

August 17, morning, Total Occultations.

Testing ILOC-Reductions using Occultations of Pleiades, by Marek Zwilski, Lodz, Poland. This was an update of Leslie Morrison's 1970 paper about occultation accuracies from analysis of a well-observed 1969 Pleiades occultation. Zwilski found no change to Morrison's conclusion that the value of photoelectric to visual occultation timings remains in the ratio of 6 to 5, due to the remaining significant errors in star positions and Watts' limb correction data.

The Value of Visual Observation of Lunar Occultation, by Jean Bourgeois, Conneux, Belgium. Unfortunately, Bourgeois was not able to attend. His comparison of video and visual timings between 1977 and 1988 also confirmed no change in Morrison's ratio noted above.

A Way to Estimate Reaction Time for Lunar Occultation Observations, by Claudio Costa, Rome, Italy. A variety of total and grazing lunar occultations were simulated on a PC, with observers pressing a key or button to measure their reaction time.

Speckle-Interferometry for Amateurs?, by Karl-L. Bath, Emmendingen, Germany. A speckle image video, taken with the 1-m Cassegrain telescope of Bonn University at Hoher List, was shown.

Observation and Reduction of Lunar Occultations in Italy, by Claudio Costa.

Occultation Work in the Czecho-Slovak Federated Republic, Bohumil Malecek, Plzen.

Short Story of Occultation Observations since 1610, Marek Zawilski. Solar eclipses observed in Europe in the 18th century were also covered.

August 17, early afternoon, Occultation Mathematics.

Notes on the IOTA Programs for the Computation of Occultations, by Wolfgang Zimmermann, Hannover. Zimmermann mainly discussed the USNO EVANS and OCC programs, written by Tom Van Flandern about 20 years ago, discussed elsewhere in this issue. I had provided these programs, and their data sets, to him on magnetic tape three months before. Zimmermann noted that these Fortran programs were optimized for use on old IBM mainframe computers that were less powerful than modern 386-type PC's, and contained much machine-dependant code with very few comment statements explaining what was done. Zimmermann concluded that it would be practical to compile the programs only with an old Fortran-66 compiler on a computer with IBM-370-type architecture. To try to convert these programs to run on other computers, especially modern high-powered personal computers, would take as much effort as writing new software to replace the functions of EVANS and OCC. I had to agree with his basic assessments, and after some discussion, we decided that it would be better to write replacement software compatible with modern Fortran-77. New software would be easier to document, maintain, and transport to different computers so that the whole prediction effort could be widely distributed and not dependant on just one person or organization. The effort resulting from this decision is the subject of a separate article in this issue. Zimmermann also said that ASCII versions of the OCC binary data sets were needed. He described his own PC software for reading Watts' data stored on a hard drive, and he sold me a copy of this software and the ASCII-form Watts' data, on over 70 3.5-inch diskettes, for the cost of the diskettes.

Database-System for Total Occultation (Version 3.3), by Gerhard Lehmann, Drebach, Germany.

August 17, middle afternoon, Grazing Occultations.

The Graze of Antares on April 4th, 1991, in Spain, by Carlos Schnabel, Sabadell. A reduction profile and videotape of this graze, the last of this star until 2005, was shown. Successful timings were obtained by 4 observers at Alcania and by 4 at Escorial. Nobody saw the secondary star, since the Moon was 76% sunlit and events, although on the dark side, were close to sunlit features.

Practical Experiences in Observing Grazing Occultations, by Dietmar Buettner and Andreas Viertel, Chemnitz, Germany. Buettner gave this talk. Among other things, he recommended that a computer program be written to determine graze shifts from the observations, so that this could be done in a

consistent manner.

August 17, late afternoon, Planetary Occultations.

Calculation and Observation of Phenomena of Jupiter's Galilean Satellites, by Martin Federspiel, Heuweiler, Germany.

Timing Galilean Satellite Eclipses and Mutual Events Using a CCD Video Camera, by Henk Bulder, Zoetermeer, Netherlands. Bulder showed his videotape of one of these events, and described some quite sophisticated methods for analyzing the data, including using an uneclipsed/unocculted satellite as a reference and, in the cases of eclipses by Jupiter, subtracting Jupiter's background. He showed a camera that he had recently obtained, with an image intensifier coupled to the camera with fibre optics. He recorded the DCF (German) long-wave signal time display before and after each observation. He and Vingerhoets mentioned that work was progressing well on a method for inserting a time display, linked accurately to DCF with a modified DCF receiver (available in Europe for about the price of a Timecube in the U.S.A.), directly onto video observations. Unfortunately, a WWVB receiver equivalent to the inexpensive European DCF receiver is not commercially available, as far as I know, although Tom Campbell sent me a copy of a "Phase Locked Loop Application Note" entitled "Self-resetting Digital Clock" by Don Lancaster, Goodyear, AZ, which describes how this could be done with WWVB.

August 18, early morning, Planetary Occultations, continued.

The Structure of Titan's Atmosphere as Derived from the Occultation of 28 Sgr, by Wolfgang Beisker, Neufahrn, Germany. Beisker described and demonstrated his DAS PC software for analyzing light curves of occultations by planets and satellites with atmospheres. Since the ESOP meeting, Beisker attended a Titan workshop meeting in Toulouse, France, in September, where he met Bruce Sicardy, Meudon Observatory, to work for a comprehensive analysis of the available observations.

The Sizes and Shapes of Vesta, Kleopatra and Myrrha from Occultations Observed during January 1991, by me. This was essentially the same paper that I gave at the Asteroids, Comets, Meteorites conference in Flagstaff, AZ, in June discussed on p. 93 of the last issue of ON.

Status of IOTA/ES Last Minute Predictions, by Hans Bode, Hannover. Plans for astrometry using Bode's 6-inch astrograph and measuring the plates, were described; 0.2 arc seconds accuracy is expected.

August 18, late morning, Solar Eclipses.

Results of the Annular Eclipse of January 16th, 1991, by Bode. Efforts in New Zealand were clouded out at the critical time, but the equipment worked.

Total Eclipse of July 11th, 1991, Problems and Proposals, by Bode.

First Results of the July 11th Total Solar Eclipse, by Reinhold Buechner, Oberursel, Germany, and by W. Beisker, Hans and Heliga Bode, and G. and I. Rupprecht. Videotapes obtained near both limits were shown. The times of 5 Bailey's bead events at each limit were determined and analyzed to obtain a correction to the mean solar radius of +0.08 arc second.

The Eclipses of 1992, by Bode and me. We gave the status of planned expeditions as they were known at the time.

August 18, afternoon, Workshop on Occultation Mathematics. I chaired most of this session, which was devoted to distribution of the 1992 "USNO" total occultation predictions (and who would do this for Europe), and to defining the work that was needed to replace USNO's occultation software, and deciding who would perform the major work items in this international effort. These are the subjects of separate articles in this issue.

In addition to the formal agenda, interesting and useful discussions were held during coffee breaks and group meals. Unfortunately, I missed the last two days of the meeting, whose agenda is given below.

August 19, morning, Workshop on Electronics for Occultation Purposes, chaired by W. Beisker and Horst Schmidt, Freiburg, Germany.

August 20, morning, Workshop on the Numerical Analysis of Photoelectric Occultation Tracks with Application of the DAS Software, chaired by Beisker.

August 19 and 20, afternoons, sightseeing.

Participants are looking forward to next year's meeting in Italy; see IOTA NEWS on page 107.

#### A COMPREHENSIVE SYSTEM OF OCCULTATION SOFTWARE

David W. Dunham

With the uncertainties faced with use of the mainframe programs, especially those at the U.S. Naval Observatory (USNO), we decided to initiate an effort to produce a new set of programs at the tenth European Symposium on Occultation Projects (ESOP-X) held in Hannover, Germany, in August. The goal is

to have a relatively complete set of software that can generate predictions and, perhaps later, perform reductions and analyses, that can be easily transported to different machines, including high-powered PC's, such as IBM 386 PC's. This will provide continuity in case of single-point failures and allow distribution of the prediction effort, giving better local service and not putting too great a burden on any one person (such as myself!) or organization. Hopefully, the final programs can be run in each nation where there are ten or more occultation observers. This article is not meant to give detailed information, but only a general outline, so that ON readers can become aware of the magnitude of the task that is in progress, and see what software and prediction functions are involved.

If you are a programmer and see some aspect of the work discussed below, especially those not already covered by others, to which you think that you might be able to contribute, contact me at 700F Megan Lane; Greenbelt, MD 20770; U.S.A.; telephone 1-301-4744722.

As part of the effort to replace the USNO lunar occultation software, I wrote an outline of the current programs, their functions, and the data sets that are passed between them to form the linkages that define the current lunar (total and grazing) occultation prediction service. In addition, I described some of the important new programs that need to be written, and how they relate to the current USNO programs. This represents an overall system of occultation prediction and analysis. I have written a brief documentation of the elements of this system, to be expanded as time permits in the future, to serve as requirements for the new programs and provide descriptions of the necessary data sets needed for communication between programs, has been written. The accompanying chart shows the programs and their interconnecting data file transfers. Four programs are circled twice; these are programs whose function is currently accomplished by USNO's OCC program at the moment. The grazing occultation prediction programs are on the right top side of the chart. Programs relating to total occultation predictions, including USNO's EVANS program that is used to generate detailed total occultation predictions for observers around the world, are on the left top side of the chart. Wolfgang Zimmermann has provided guidelines for writing programs in machine-independent Fortran-77. Zimmermann has also written some further notes about the current software, especially relating to USNO's

OCC program and other programs that I have written.

The chart shows other software besides the major graze and total lunar occultation programs mentioned above. Occultation reduction and analysis programs are in the center of the combined diagram, centered on the OCCRED circle. Solar eclipse path edge and Bailey's bead analysis programs are in the upper left part of the bottom page. Asteroidal and planetary occultation programs are in the lower right side of the bottom page. They are linked to the lunar occultation system only by the NUMIN program (which produces astrometric ephemerides of asteroids) and the Worldata file of ocean, lake, and political boundaries for plotting maps of predicted paths. Predictions of planetary/asteroidal events are on the right side, while analysis of asteroidal occultation observations are on the left side. Only a few of the programs and data sets are described below; others will be added as my time permits.

The GRAZE and ACLPPP programs produce the detailed grazing occultation limit predictions and profiles distributed by IOTA. These programs, and their associated data sets, are described in COMPUMAN.DOC, an ASCII file written by Don Oliver in 1986.

The functions of several of the most important programs, along with their current status, are described below. In addition, major input and output files used and/or generated by the programs, and detailed descriptions of the major files, are available to serious workers, but most of these are not reproduced here due to space limitations.

New Programs to Replace the Functions of the USNO OCC Program. Some of the new programs might use the NOVAS software that we obtained from George Kaplan at USNO, which calculates apparent place data from star catalogs, or from planetary or lunar ephemerides.

OCCSERCH - Finds worldwide total lunar occultations for a specified time span. Either Zimmermann will write this, or it will be derived from a version of GRAZSRCH. Its main purpose is to compare a lunar ephemeris file with a zodiacal star catalog (usually the XZ80L catalog) file to identify lunar occultations that will be visible from anywhere on the Earth's surface, and write basic information about these occultations to a "Besselian elements" file, called a BEFILE.

MAJPLCAL and MINPLCAL - Creates a BEFILE like that of OCCSERCH, but for lunar occultations of major and minor planets. Inputs are the lunar ephemeris ("SMBDN") file, apparent planetary ephemeris file, and lines for each event, CONJCPLN.DAT, produced by

conjunction programs. The latter includes the date and hour of the conjunction and the planet #. The binary minor planet ephemeris file now used by OCC needs to be replaced with an ascii equivalent. The NUMIN program already produces ascii minor planet ephemeris files that could probably be used by both MINPLCAL and CONJCMIN (which computes usable conjunctions of minor planets and the Moon), possibly with some modification. Something needs to be done in any case for 1993, since the current binary minor planet file used by OCC ends in early January, 1993. The conjunction programs still need to be downloaded from the USNO computer (either to diskette or tape) and documented, which I plan to accomplish in January, 1992. Output is PLBEFL, similar to BEFILE for stars.

GRAZSRCH - This program compares a star catalog with a lunar ephemeris to calculate grazing occultations than might occur in a specified region. Eberhard Riedel has offered to write this program, and already has some capacity to generate such data with a program written in PASCAL. Zimmermann has offered to translate the program to Fortran-77 when the new GRAZSRCH is complete, and is needed. Inputs are the SMBDN file, the XZ star catalog, and the coordinates of a super standard station (SSS) center, as listed in the IOTA hemispheric annual grazing occultation supplements. Output consists of a GRAZINP file specifying the date, U.T. of closest approach, star number, and whether the event is a northern or southern limit, for all grazes that might be visible within a 500-mile (804-km) radius of the SSS center, the radius actually being inscribed on a plane tangent to the Earth's surface at the SSS center. The USNO OCC program excludes all stars fainter than magnitude 8.5, and brighter during the gibbous phases, reaching a limit of 4.0 for daytime and bright-limb events.

GRAZCAL reads the GRAZINP file to generate the GRAZREG-BASIC file, which consists of 8 lines of card-image data, called "graze cards", which, after the addition of double star data using UPDAT5, are read by the standard IOTA GRAZE program to generate detailed limit predictions for observers, or are read by the MEEUSMAP program to eventually generate maps showing grazing occultation paths. Riedel has offered to write this program, also, since his current software is actually a combination of this and GRAZSRCH, as well as part of GRAZE. But the new IOTA software will need to generate GRAZINP and GRAZREG-BASIC files to preserve the complete IOTA graze prediction system. Riedel has achieved

agreement with IOTA's limit calculations to within a few hundredths of an arc minute of latitude, certainly sufficiently accurate, so if he can later duplicate all of the other functions of IOTA's GRAZE and MEEUSMAP programs, as described in COMPUMAN.DOC, the intermediate files might not be needed. However, the ability to generate data for any specific graze, such as one by a faint star given in a "graze nearby" message in detailed total occultation predictions, is wanted, so the ability to read manually-typed GRAZIMP data needs to be kept.

OCCRED - Occultation reduction program. Among other things, this program does the precise calculation needed for generating the LC card images read by ACLPPP, which serves as the final correction for graze predictions. The other programs above only need to achieve an accuracy of one arc second at the Moon's distance (or about one arc minute in the latitude of an occultation limit). Mitsuru Soma at the National Observatory in Mitaka, Japan, is writing this program. He has already achieved an accuracy of about 0.2 arc seconds, relative to USNO's OCC program, which I feel is sufficient. I hope to replace OCC with Soma's OCCRED as soon as possible, after some more tests to be sure that its formats are compatible with the other programs. My meetings with Soma during my trip to Japan this month will facilitate this effort. Inputs are the Profile card images generated by the GRAZE program; the XZ catalog; the SMBDN file (or equivalent); and WATTS limb correction data. It would also be useful to accept as input observations given in ILOC's format. For solar eclipse calculations, the program will also need to read solar eclipse observation data files specifying the date, U.T., and geodetic coordinates for a solar eclipse, similar to the Profile card images for lunar grazes. Possibly a separate version of OCCRED could be developed for this purpose, but if so, the two programs should be compatible, using the same ephemerides and empirical corrections. Outputs are mainly the Limb correction cards read by the ACLPPP program. Other output includes GRAZELEM grazing elements output, which is printer output generated by the OCC program. This could be read by a future GRAZRED program to compute graze shifts and generate a reduction profile. Programs to do this job have been written, such as by Bob Bolster in Apple basic, but they do not read automatically-produced GRAZELEM data, needed for extensive use. Other output includes total occultation residuals.

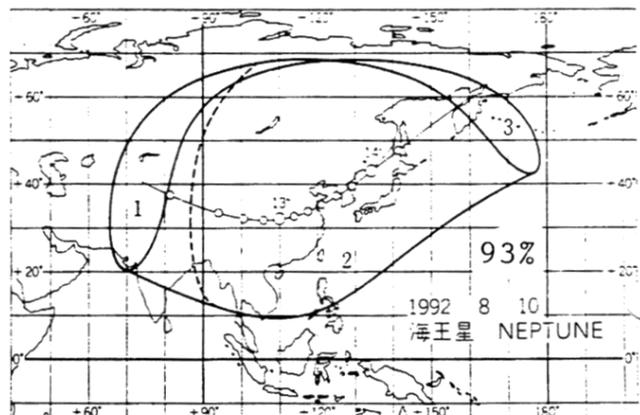
OCCANALS - Occultation analysis program. Although

OCC can do this job, only Tom Van Flandern knows how, so it has not been run for this purpose since he left USNO in 1984. Mitsuru Soma, however, has a program which now does this job, and he can produce new analyses using the new XZ catalog with star positions that have been improved considerably since 1984.

#### OTHER LUNAR OCCULTATION PROGRAMS

EVANS - reads the BEFILE described above to generate detailed total occultation predictions. Claudio Costa offered to write a PC version that will replace the USNO program. He already has written a total occultation prediction program that can generate fairly accurate predictions for a given location, and this can be upgraded to eventually produce predictions very similar to those generated by the USNO EVANS program.

UPDAT5 - adds double star information to GRAZREG-BASIC or GRAZEDAT-BASIC data. The program was written in Fortran-77 for a PC by Don Stockbauer, and run on the USNO computer by me, using the VS-Fortran compiler.





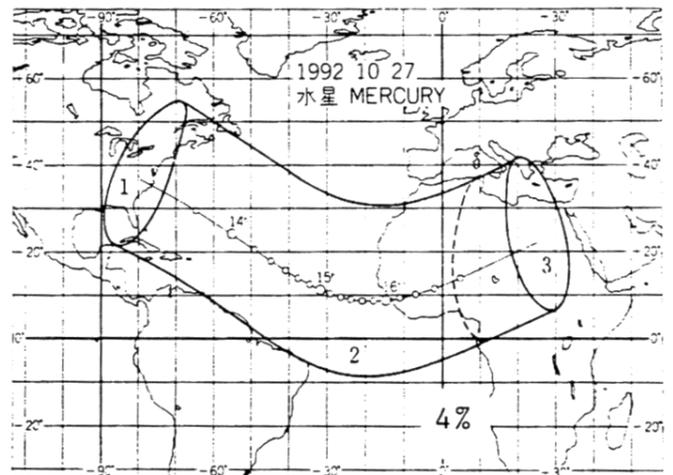
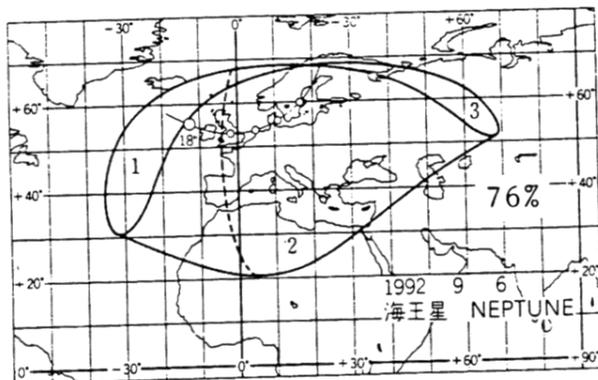
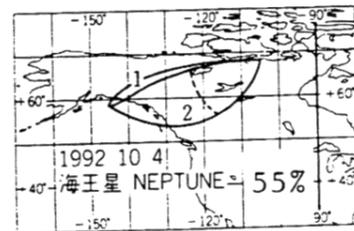
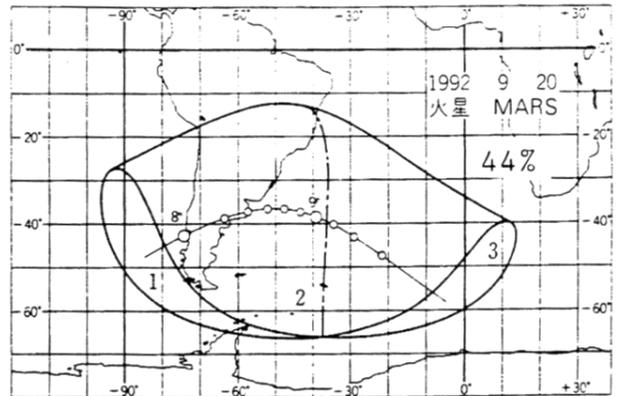


OCCULTATION NEWSLETTER PRODUCTION

Joan Bixby Dunham

The ON has been produced for the last year with WordPerfect on a PC XT with a (very temperamental) daisywheel printer. Graphics have been included by cutting and pasting, as are some articles prepared by others. The newsletter was pasted together on 11" x 17" sheets of paper, cut to about 14" long, and then reproduced by a commercial outfit by photo offset. This was the format set up by Homer DaBoll, who did it on a typewriter. We could use this format indefinitely, but for the fact that the costs of photo offset seem to be increasing at a much faster rate than inflation. Also, we have failed to establish a good relationship with a local printing firm: In 6 issues of ON, we have used 4 different firms. The firm most willing to accommodate the ON needs (and charge the least) went bankrupt. It seems to me to be time to experiment with formats that would be easier to produce and cost less to reproduce.

I am preparing this issue with WordPerfect 5.1 and a Panasonic 24-pin dot matrix printer. The copies will probably be reproduced with Xerox equipment. The print size is larger than in the past, since the dot matrix print is not as good a quality as the daisy wheel print. At some point in the future, when either we find ourselves wealthier or their prices decrease even further, we will purchase a laser printer. I probably will make more modifications in the future but I do not expect to change the masthead or the double column format. I also will leave the 3/4-inch margins to allow for holes for those who like to put their newsletters in binders.



## IOTA

The International Occultation Timing Association was established to encourage and facilitate the observation of occultations and eclipses. It provides predictions for grazing occultations of stars by the Moon and predictions for occultations of stars by asteroids and planets, information on observing equipment and techniques, and reports to the members of observations made. IOTA is a tax-exempt organization under section 509(a)(2) of the (USA) Internal Revenue Code, and is incorporated in the state of Texas.

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

The officers of IOTA are:

President	David W. Dunham
Executive Vice President	Paul Maley
Executive Secretary	Gary Nealis
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Addresses, membership and subscription rates, and information on where to write for predictions are found on the front page.

The Dunhams maintain the occultation information line at (301) 474-4945. Messages may also be left at that number.

Observers from Europe and the British isles should join IOTA/ES, sending DM 40.-- to the account IOTA/ES; Bartold-Knaust Strasse 8; 3000 Hannover 91; Postgiro Hannover 555 829 - 303; bank-code-number (Bankleitzahl) 250 100 30. Full membership in IOTA/ES includes the supplement for European observers (total and grazing occultations) and minor planet occultation data, including last-minute predictions, when available. The addresses for IOTA/ES are:

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