Occultation Newsletter

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FROM THE PUBLISHER

For subscription purposes, this is the second issue of 1992. It is the eighth issue of Volume 5. IOTA annual membership dues, including ON and supplements

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Local circumstance (asteroidal appulse) predictions	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 via Ignacio Ferrin (Apartado 700; Merida 5101-A; Venezuela), for Europe via Roland Boninsegna (Rue de Mariembourg, 33; B-6381 DOURBES; Belgium) or IOTA/ES (see below), for southern Africa via M. D. Overbeek (Box 212; Edenvale 1610; Republic of South Africa), for Australia and New Zealand via Graham Blow (P.O. Box 2241; Wellington, New Zealand), and for Japan via Toshio Hirose (1-13 Shimomaruko 1-chome; Ota-ku, Tokyo 146, Japan). Supplements for all other areas will be available from Jim Stamm (11789 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 Meeting: As noted on p. 154 of the last issue, the next (10th) annual meeting of IOTA will be held on Saturday, October 3, in the Houston, Texas, area. It will be held in the auditorium at the Lunar and Planetary Institute, whose new address is: 3600 Bay Area Blvd.; Houston, Texas 77058. The meeting room has overhead and slide projectors, and video. The planned meeting time is 9:00 am Central Daylight Time, with a lunch break from 11:30 am to 1 pm, and adjournment at 5 pm. As in the past, informal discussions are expected to continue during and after supper. Agenda items will be: Election of officers; business and financial reports; status of occultation and eclipse prediction services, including the new PC-based software; solar and lunar eclipses observed during 1992; eclipse prospects for 1993 and 1994; major asteroidal and lunar grazing occultations during 1993; a report of the ESOP-XI meeting in Italy; and video developments. Other agenda items and presentations are solicited. If you have something for the agenda, or just want more information (directions, etc.) about the meeting, contact the local coordinator: Paul Maley; 11815 Lone Hickory Ct.; Houston, TX 77059; U.S.A.; telephone 1-713-4886871; E-mail (Decnet) sn::maley.

A ballot and an addressed envelope are enclosed in the initial mailing of this issue for each current IOTA member; please mark and return the ballot to Rocky Harper; 622 Utah St.; La Porte, TX 77571 soon so we can meet our quorum requirement, even though, except for possible write-ins, the election is uncontested. The recommended slate of officers is:

President: David Dunham
Executive Vice President: Paul Maley
Executive Secretary: Rocky Harper
Secretary and Treasurer:
Terri and Craig McManus
V.P. for Grazing Occ'n Services:
Joseph Senne
V.P. for Planetary Occ'n Services:
Joseph Carroll
V.P. for Lunar Occ'n Services:
Walter Morgan
Occultation Newsletter Editor:
Joan Dunham

This slate is unchanged from the current officers except for the Executive Secretary and the ON Editor.

See ON 5, #6, p. 129-130 for information about two grazes that occur the evening of October 1st. There will not be time to travel between the two paths to observe both of them, and the 44 Ophiuchi graze will occur at an altitude of less than 3 deg. in the Houston area. Consequently, effort will be concentrated on the graze of 6.3-mag. ZC 2510 in the southwestern suburbs of Houston. Don Stockbauer will not be available for this event, so those interested in observing it should contact Craig or Terri McManus before September 28 at the address in the masthead, or telephone them at 1-913-2323693. After September 28, information about the graze, and a weather go/cancel decision, might be available from Paul Maley at has phone given above.

ESOP XI: The 11th European Symposium on Occultation Projects was held at Castel Gandolfo, near Rome, Italy, August 28-30, 1992. More information about it is given on p. 153 of the last ON, and a summary of it, including a list of all papers presented, will appear in the next issue. It was a very interesting and enjoyable meeting. The graze of Mu Geminorum on August 24 was observed by meeting participants from 6 countries, including 8 video attempts and 4 video successes, each new records. 159 timings were made, a new European record for a graze. Henk Bulder plans to prepare a profile and article about it for the next issue.

Observer's Manual: Wayne Warren has updated the Preliminary Occultation Manual to create a first edition of the IOTA Observer's Manual, and has used a very legible "Script" system for it. He is awaiting my comments, which I will probably not be able to provide until early October; it will then be reviewed by Paul Maley and the McManuses before distribution to IOTA members, which should occur sometime before the end of 1992. In the meantime, Claudio Costa has written an occultation guide in Italian, "Breve guida alle osservazioni", being distributed to members of the Occultation Section of the Union of Italian Amateur Astronomers (Unione Astrofili Italiani).

New Business Address: Starting September 14, I will start a new job at the Johns Hopkins University's Applied Physics Laboratory (APL); Bldg. 23, Room 376; Johns Hopkins Road; Laurel, Maryland 20723-6099; fax 1-301-9536556. IOTA business should still be communicated to my home address, 7006 Megan Lane; Greenbelt, Maryland 20770-3012; telephone 301-474-4722 (IOTA occultation line still 301-474-4945). I plan to keep my Decnet electronic mail address, nssdca::dunham, but I expect to get an Internet address at APL, and will announce it in a future issue.

Shanghai Observatory: Dr. Qian Bochen completed his six-month visit to IOTA and the University of Maryland this month, and returned to China on August 27th. His visit was described on p. 154 of the last issue, and the programs and data sets that he took with him should enable Shanghai Observatory to become an effective IOTA center for China, especially for astrometrically updating and observing asteroidal occultations.

Vesta: Dr. William Reach, Code 685 of Goddard Space Flight Center, recently requested a copy of ON 5, #4, p. 93, which gives my value for Vesta's diameter from the January 1991 and August 1989 occultations. He wants to have accurate occultation diameters to test the standard thermal model, and is planning to use Ceres and Vesta as secondary calibrators for the far-infrared bands of COBE (DIRBE experiment). The ON article was referenced by R. Redman et al. in "Millimeter and Submillimeter Observations of the Asteroid 4 Vesta" in Astron. J. 104, #1, p. 405.

Next Issue: I have been busy trying to get the most out of USNO's computer before it is turned off and removed on October 1 (see "Lunar Occultation Prediction and Software News"), so I have not had time to prepare the asteroidal occultation quarterly maps, world maps, and special finder charts for this issue. The next issue of ON (Vol. 5, #9) will be distributed in November; contributions should be received by October 11th.

USA MEMBER ADDRESSES

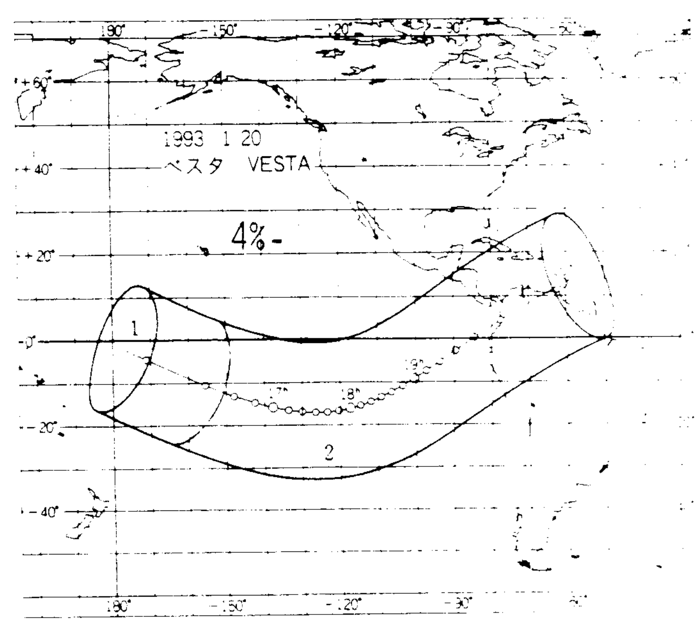
Craig and Terri McManus

As many of you are aware, the United States Postal Service has a bar code address system for USA addresses. Going along with this, we would like to make the IOTA mailings as efficient and timely as possible. We will be converting the IOTA data base to version 6.5 of PC-File. This version will allow us to place bar codes for all USA addresses on the mailing labels. The bar codes can be created based on 5 digit or 9 digit (ZIP + 4) ZIP codes. If you know your 9-digit ZIP code, please use the enclosed address correction form to send it to us. Also, please examine the address used to mail you this issue for correctness, particularly the ZIP code, and send us any corrections. If you wish, you may attach the mailing label from the envelope for this issue to the correction form and mark any corrections on the label.

1993 PLANETARY OCCULTATION MAPS

The maps showing the regions of visibility of lunar occultations of planets are reprinted by permission from the Japanese Ephemeris for 1993, published by the Hydrographic Department of the Maritime Safety Agency of Japan. In region 1, only the reappearance is visible; in region 2, the entire occultation is visible; and in region 3, only the disappearance may be seen. Reappearance occurs at sunset along a dashed curve, while disappearance is at sunrise along a curve of alternating dots and dashes. We have added the lunar percent sunlit to each map.

Those interested in observing partial occultations, which occur within a few kilometers of the northern and southern limits of these occultations, should request predictions at least three months in advance (if possible) from Joseph Senne; P. O. Box 643; Rolla, MO 65401; U.S.A.; phone 1-314-3646233.



GRAZING OCCULTATION OBSERVATIONS

Richard Wilds

Before going into this quarter's report I thought a few comments of personal introduction would be in order. I joined the Occultation Project with my friend Don Stotz in 1967 at the age of 15. We received a package of papers from the U.S. Naval Observatory telling us about grazing occultations. They began with the comment, "should you or any member of your team have difficulty with any law enforcement organization, then the U.S. Naval Observatory and the U.S. Government assumes no responsibility." This sounded like the popular T.V. show "Mission Impossible," and a sure ticket to fun work in science.

Without a driver's license or a car we had to take the bus to Kansas City to go on graze expeditions with Ronald Abileah and Robert Sandy. All but one of these grazes over the next four years were clouded out. We began to lead our own grazes in 1971. Our first expedition included our major professor from the local university - just a little pressure. It was a great success! We went on to do 15 grazes through 1977. My time was then taken up by graduate school and career, so I did not return to leading graze expeditions until 1986. Our Topeka graze team has observed over 55 grazes since 1986, with expeditions being led by several different members of our Heartland you are ever in Kansas or states nearby, then please feel free to join us on an expedition.

Our Australian friends reported quite a few grazes according to Graham L. Blow, Director, Royal Astronomical Society of New Zealand. Their first two grazes of 1991 occurred around the huge mountain Leibnitz B. This was followed by Craig McManus' Halsey, NE graze around the crater Admundsen. However, Tom Campbell's graze at Jennings, FL covered an interesting Cassini (Luna Incognita) region between the craters Drygalski, Boltzman and Zeeman. Craig McManus and Mike Kazmierczak joined Tom in this area of the Moon on their first two grazes of 1992. They were all near the proposed crater Joseph Ashbrook, late editor of Sky and Telescope. This name was proposed by Dr. John E. Westfall of ALPO and professor at San Francisco State University. The last two grazes of 1991 were also deep in the Cassini region, but these were well beyond the craters Malapert and Cabaeus. This area contains huge mountains with the old designations M4, M5, and M6. All the grazes from Don Stockbauer's Hankamer, TX graze to the end of the list occurred around the crater Brianchon in the north. I will try to bring out more information in the future about where our various grazes inform us of Lunar surface features [ed. See also D. Buettner's article in this issue]. Plus we will be making a special effort to assist Dr. Westfall in his effort to produce a second edition of the map of Luna Incognito. To do this he needs more information on grazes in the Cassini region.

REMEMBER to apply a 0.3 second of arc south shift to your predicted path of northern limit, waxing-phase, dark-limb grazes. One should spread out, however, since star errors could increase this shift or reduce it to a 0 shift. This happened with a lot of our H.A.R.T. expeditions of 1992, since the stars were faint - ie. larger positional errors. See David's article on graze corrections.

Please report all grazes to Richard P. Wilds, 3630 SW Belle Ave., Topeka, Kansas 66614-4542 USA. Try to include a copy of your profile. Remember to send copies of reports to the International Lunar Occultation Centre (ILOC) at: Geodesy and Geophysics Division; Hydrographic Department; Tsukiji-5, Chou-ku; Tokyo, 104 Japan.

GRAZE LIST

UTDate YYMMDD	V P	Star Num	Mag	% Snl	CA	Location	# Sta	# Tm	S S	Ap Cm	Organizer	N ShS	WA	B
1987														
870416		ZC 2227	5.8	93-	9.3S	Pauatahanui, NZ	3	6	3	20	A. W. Dodson	?	196	+4.4
870817		ZC 0696	7.4	35-	14.6N	Stowell, Vic	1	7	2	15	J. Blanksby	0.3S	347	-6.9
870930		S186945	8.4	50+	8.8S	Christchurch, NZ	2	0	1	20	B. Loader	2.5?	171	+6.2
871030		S164335	8.2	59+	10.0S	Gore, NZ	1	5	1	20	R. Dickie	?	169	+4.0
871109		S078143	4.4	84-	4.4N	Keith, SA	1	1	2	15	J. Blanksby	2.1	350	-7.4
871228		S109696	6.9	61+	13.7S	Patchewollock, Vic	1	4	1	15	J. Blanksby	0.3S	166	-3.3
1988														
880111		S138967	6.3	56-	15.0S	Waimkariri, NZ	1	4	1	20	G. Evans	0.5S	197	+1.3
880111		S138967	6.3	56-	15.0S	Burnham, NZ	1	2	1	20	L. Hussey	?	197	+1.3
880214		S187672	7.2	12-	12.0S	Benella, Vic	1	3	1	15	J. Blanksby	0.4S	187	+5.9
880408		S186704	6.1	62-	7.0S	Kilmore, Vic	5	14	2	15	J. Blanksby	0.3S	189	+6.3
880410		S189391	8.4	38-	2.4N	Bowser. Vic	1	1	1	15	J. Blanksby	1.8N	356	+4.9
880411		S164447	8.4	27-	6.9N	Bulla, Vic	4	16	1	15	J. Blanksby	0	351	+3.5
880413		S146621	8.5	9-	6.1N	Tarnook, Vic	1	8	1	15	J. Blanksby	0.2S	352	+0.3
880421		S078095	7.4	26+	14.7N	Colac, Vic	1	2	1	15	J. Blanksby	0.9S	12	-7.4
880720		ZC 1787	6.0	33+	8.8N	Gore, NZ	2	4	3	9	R. Dickie	0.4S	11	+2.3
880815		S118918	7.9	7+	9.9N	Mangalore, Vic	2	9	1	15	J. Blanksby	0.3S	13	+0.8
880905		S079066	6.2	24-	7.7N	Tabilk, Vic	3	22	3	15	A. Kruijshoop	0	356	-6.7
880915		S158448	5.6	15+	0.4S	Eden Park, Vic	1	6	1	15	J. Blanksby	0.2S	185	+5.4
881015		S184415	1.2	15+	5.4N	Oaro, NZ	7	30	3	15	B. Loader	?	10	+6.4
881129		S098673	5.9	64-	15.8S	Swanpool, Vic	1	4	1	15	J. Blanksby	0.1S	197	-2.8
881205		S158270	8.5	12-	13.3S	Cathkin, Vic	1	4	2	15	J. Blanksby	0.3N	191	+4.6
1989														
890304		S189210	8.2	13-	4.7S	Whakatane, NZ	3	9	1	20	B. Thompson	?	181	+3.4
1990														
900409		ZC 1815	4.8	99+	?	Washpool, NZ	1	2	2	20	R. Dickie	0.7N	16	+5.0
904021		S146402	6.6	6-	9.0N	Gore, NZ	1	2	1	9	N. Dickie	0.5S	352	-3.7
900625		S097928	6.6	8+	18.0N	Whangarei, NZ	3	5	1	15	R. Crowsen	1.4N	19	-0.7
900625		S097928	6.6	8+	17.0N	Gisborne, NZ	3	12	2	4	D. W. Orchiston	?	18	-0.7
900826		S158556	6.7	31+	3.8S	Palmerston North, NZ	1	4	1	20	N. Munford	?	178	+6.6
1991														
910111		S184075	6.4	16-	7.8S	Mahoe, NZ	4	18	1	15	G. Blow	0.3S	184	+4.9
910309		S186350	6.3	38-	4.3S	Paraparaumu, NZ	4	9	1	20	A. W. Dodson	0.7N	183	+2.4
910929		ZC 740	6.3	67-	4.7S	Halsey, NE	5	9	1	20	H.A.R.T. McManus	0.0	185	-3.0
911011		S183665	6.2	12+	14.2S	Lower Hutt, NZ	4	26	1	20	A. W. Dodson	0	169	+4.4
911117	V	ZC 3453	4.9	74-	15.0S	Jennings, FL	1	5	1	20	T. Campbell	0.1S	168	-6.1
911025		S076199	3.0	94-	10.8S	Porirua, NZ	4	29	1	20	A. W. Dodson	?	184	-5.4
911219		ZC 560	3.8	95+	11.0S	Dapto, NSW	12	62	2	7	R. Giller	?	178	-5.2
1992														
920110		ZC 3354	7.9	21-	8.9S	Bartlett, KS	2	8	1	33	H.A.R.T. McManus	0.1N	168	-5.8
920111		S128275	8.4	29+	9.0S	Conyers, GA	2	4	2	20	M. Kazmierczak	1.0S	169	-6.4
920114		S092801	6.5	61+	3.5N	Chilocco, OK	1	12	1	33	H.A.R.T. R. Wilds	0.0	6	-5.9
920211		S075531	7.8	44+	7.0N	Silver Lake, KS	3	6	1	20	H.A.R.T. McManus	0.5S	8	-5.2
920226		S185260	9.1	38-	-1.0S	Holton, KS	2	2	1	33	H.A.R.T. R. Wilds	?	177	+2.8
920229		S188656	9.4	14-	2.0N	Baker, KS	1	1	1	33	H.A.R.T. R. Wilds	1.5N	357	-1.3
920313		ZC 982	6.8	61+	15.0N	Hankamer. TX	8	27	1	8	D. Stockbauer	0.4S	16	+0.1
920407		S076463	8.4	16+	13.9N	Netawaka, KS	1	3	2	33	H.A.R.T. R. Wilds	0.0	13	-2.9
920409		S077995	9.0	35+	13.6N	Holton, KS	2	2	3	33	H.A.R.T. R. Wilds	0.0	15	+0.1
920506		K003014	9.8	13+	12.1N	Hoyt, KS	1	2	1	33	H.A.R.T. R. Wilds	3.5N	14	+0.3
920507		S078889	9.3	22+	12.1N	Alta Vista, KS	1	3	1	33	H.A.R.T. McManus	0.3S	14	+1.9
920507		S078919	8.4	22+	10.9N	Padonia, KS	1	6	1	33	H.A.R.T. R. Wilds	0.0	14	+2.0
920507		S078958	9.0	23+	9.7N	Whiting, KS	1	1	1	33	H.A.R.T. R. Wilds	0.0	12	+2.1
920610		ZC 1858	6.5	74+	11.9N	Evans City, PA	1	0	1	25	J. Holtz	>0.3S	9	+7.2

CORRECTIONS TO IOTA GRAZE PREDICTIONS

David W. Dunham

You should apply a southward correction of 0"3 to the predictions of northern-limit waxing-phase dark-limb grazes. An average correction of about this magnitude was noted for grazes under these circumstances during early 1991, and recent observations seem to confirm that it should still be applied this year. This has not been incorporated into the predictions, since a different correction (perhaps none) will be needed for 1993 graze predictions when we shift from the USNO OCC 80L system to Mitsuru Soma's OCCRED program when producing ACLPPP profiles; see my article on occultation software. Note that, since the declinations of most stars in the XZ (especially those with position source ZZ87) are really accurate to only about ±0"3 (with some larger errors, in spite of the always-smaller value for the "probable error of star's declination" given in the IOTA graze prediction heading), the south shifts can be larger, and some recently-observed events have had 0 shifts. As a general rule of thumb, one observer should be at least 0"7 south of the highest mountain top shown on the ACLPPP profile for northern-limit grazes, and if possible, someone should be 0"3 south of the best multiple-events zone indicated by the profile.

1980 TOTAL OCCULTATION TALLY

Joseph Carroll

It has been over four years since I last reported the "scores" in the "occultation wars"! New discipline will have to follow in the future - see later.

Table 1 and 2 of this article - one by country and one by individual - present the ordered counting of total occultations reported for the year 1980. In the individual list (Table 2) B. F. Sincheskul of the USSR is the leader followed by Brian Loader of New Zealand and Weith-Knudsen of Denmark who are close to each other. In the country list (Table 1), the USA leads by virtue of its large number of observers with New Zealand and Australia second and third.

These values were again computed (as since 1975) via the formula: Value = Disappearances + C*Reappearances, where C is the ratio of total disappearances to total reappearances for the entire year. In 1980, 460 plus observers (when multiple observers are counted) from 31 countries reported 7398 observations of which 2209 were reappearances. That makes C=2.349, which is the factor by which reappearances are weighted over disappearances.

B. F. Sincheskul, the leading observer for 1979, was also the eighth observer for 1975 and may have placed in the top 10 in 1978 were it not for the fact that only the total USSR occultation observations were available. Weith-Knudsen and Hays continue their consistent observing since 1975. They have been in the top four each of those years. It is also interesting to note that four of the top 10 observers live in the Southern Hemisphere.

The listing by country shows that 31 countries contained active observers with the USA leading in the values column followed by New Zealand and Australia. On an individual observer productivity basis, however, the USSR is tops followed by Zimbabwe and then the Philippines.

From a personal standpoint, I wish to express my apologies for the long lapse between publication of the 1979 and 1980 tallies: 4-plus years! This was due principally to the excessive time it takes to strip some of the data from magnetic tape (from ILOC) and, obviously, to my reluctance to get on with it. In the future, this is NOT going to happen. Why? Because I will restrict my attention ONLY to the coupons sent to me or to other easily digested mailings. This will obviously exclude many observers over the world, especially those not members of IOTA or who have other difficulties. But the effort of stripping things from tape, performing the counting myself, correcting for innumerable spelling and other errors is too much. Besides, the yield beyond what I already have with the coupons is usually a plethora of single-event observers.

Each individual IOTA member can contribute by continuing to send the coupons to me. Also, I would appreciate receiving any tallies done by individual countries for their internal use. I can copy those into the data base quite easily as long as I don't have to count. So, encourage your compatriots to forward the necessary data to me. I will now start to catch up through, say, 1988. Then I will stay some three to four years behind - hoping that this will permit individual countries to provide me with counts and listings if they have them.

Table 1: Country Listing of 1980 Occultation Tally

Rank	Value	Total	Reap	Country	# Obs.	Value/Obs.
1	2972.1	2160	602	USA	127	23.4
2	1225.4	903	239	New Zealand	26	47.1
3	799.6	666	99	Australia	43	18.6
4	488.2	244	181	Denmark	7	69.7
5	485.5	360	93	Italy	24	20.2
6	472.8	288	137	USSR	3	157.6
7	451.2	319	98	South Africa	10	45.1
8	410.8	315	71	England	40	10.3
9	389.8	263	94	GDR	32	12.2
10	385.9	282	77	Zimbabwe	3	128.6
11	341.8	215	94	Netherlands	17	20.1
12	270.6	160	82	Belgium	11	24.6
13	258.5	156	76	Poland	17	15.2
14	199.4	163	27	Brazil	16	12.5
15	187.8	146	31	Switzerland	7	26.8
16	175.1	113	46	Philippines	2	87.5
17	140.3	85	41	Spain	6	23.4
18	114.8	77	28	FRG	5	23.0
19	114.6	89	19	Finland	11	10.4
20	75.8	61	11	Japan	12	6.3
21	73.9	51	17	Austria	11	6.7
22	67.1	59	6	Portugal	7	9.6
23	66.8	52	11	Greece	2	33.4
24	56.2	40	12	Canada	9	6.2
25	50.1	42	6	Norway	5	10.0
26	29.8	19	8	India	1	29.8
27	28.0	28	0	Argentina	2	14.0
28	17.3	16	1	Yugoslavia	1	17.3
29	13.3	12	1	Ireland	1	13.3
30	9.3	8	1	Venezuela	1	9.3
31	6.0	6	0	France	1	6.0
	Totals:	7398	2209		460	

1980 Occultation Observations Summary

Order	Value	Name	Location	T	R
1	457.8	B. F. Sincheskul	Poltava, USSR	281	133
2	393.9	Brian Loader	Blenheim, New Zealand	265	97
3	392.0	N. P. Weith-Knudsen	Tisvildeleje, Sealand, Denmark	174	164
4	323.3	Robert H. Hays, Jr.	Worth, IL, USA	209	86
5	305.5	David Evans, et. al.	McDonald Observatory, TX, USA	239	50
6	215.8	James H. Van Nuland	San Jose, CA, USA	160	42
7	213.5	Noel Munford	Palmerston North, New Zealand	143	53
8	200.2	John Korintus	Sun City, AZ, USA	143	43
9	187.8	A. G. F. Morrisby	Bulawayo, Zimbabwe	120	51
10	185.3	Peter E. Anderson	Brisbane, Australia	184	1
11	184.1	Henk J. J. Bulder	Zoetermeer, Netherlands	111	55
12	166.8	Jean Bourbeois	Namur, Furfooz, Belgium	95	54
13	162.2	Lionel E. Hussey	Christchurch, New Zealand	105	43
14	157.2	J. Vincent	Salisbury, Zimbabwe	124	25
15	154.5	Adriano Filippone	Rome, Italy	104	38
16	153.4	Brian A. Skiff	Flagstaff, AZ, USA	79	56
17	144.5	K. G. Fuhr	Cape Town, South Africa	98	35
18	130.2	Juan O. Silvestre	Quezon City, Philippines	93	28
19	120.9	Michael J. Morrow	Ewa Beach, HI, USA	93	21
20	106.0	G. Herdman	Auckland, New Zealand	90	12
21	103.2	Franz Zehnder	Birmenstorf, Switzerland	74	22
22	96.9	Joseph E. Carroll	Minnetonka, MN, USA	53	33
23	86.9	M. Daniel Overbeek	Edenvale, TVL, South Africa	63	18
24	83.6	Robert Lasch	Green Valley, AZ, USA	53	23
25	67.9	Erich Karkoschka	Stuttgart, FRG	36	24
26	67.6	Juhani Salmi	Helsinki, Finland	57	8
27	67.0	Richard Wayne Baldridge	Mountain View, CA, USA	63	3
28	64.9	Lance McKewen	Brisbane, Australia	45	15
29	61.9	G. N. Walker	Bloemfontein, South Africa	30	24
30	61.6	Demetrius P. Elias	Attikis, Greece	47	11
31	60.3	Paul J. Newman	Garland, TX, USA	35	19
32	58.0	Roberto Haver	Rome, Italy	42	12
33	56.3	Robert A. James	Greenfield, WI, USA	51	4
34	55.9	Carl grunnet	Virum, Denmark	35	15
35	52.0	Jorge Polman	Receife, Pernambuco, Brazil	52	0
36	50.6	R. Stabenow	Victoria, Australia	40	8
37	50.0	Vello Tabur	Adelaide, Australia	38	9
38	46.9	C. Booy	De Rips, Netherlands	23	18
39	46.3	Paul R. Kilbey	Auckland, New Zealand	29	13
40	45.3	David P. Steicke	Murray Bridge, Australia	32	10
41	45.0	Dietmar Buttner	Karl-Marx-Statd, GDR	29	12
42	45.0	Alfred C. Webber	Chadds Ford, PA, USA	45	0
43	44.0	Douglas Hall	Leicester, England	36	6
44	43.9	Cesario E. Taganas	Quezon City, Philippines	20	18
45	43.6	H. F. DaBoll	St. Charles, IL, USA	37	5
46	42.3	W. Mellor	Sheffield, England	21	16
47	42.0	H. Krumm	Langebaan, South Africa	42	0
48	41.7	Roger H. Giller	Sidney, NSW, Australia	39	2
49	41.3	Harald Marx	Stuttgart, FRG	36	4
50	40.9	Marek Zawilski	Lodz, Poland	21	15
51	40.3	Neal D. Blackburn	Kansas City, MO, USA	31	7
52	40.0	Domenec Barbany	Granollers, Catalonia, Spain	28	9
53	39.6	I. V. Freitas	Receife, Pernambuco, Brazil	17	17
54	39.3	Richard W. Fleet	Salisbury, Zimbabwe	38	1
55	38.3	Patrick Poitevin	Limbur, Herk-de-Stad, Belgium	21	13
56	38.3	Jan Hers	Sedgefield, Cape Prov., South Africa	29	7

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Order	Value	Name	Location	T	R
57	38.0	G. Couling	Tawa, New Zealand	30	6
58	38.0	Zbigniew Szalkiewicz	Olsztyn, Poland	22	12
59	38.0	T. Hickey	Whangarei, New Zealand	38	0
60	37.7	Barry Menzies	Auckland, New Zealand	35	2
61	36.6	David Herald	Michelago, Australia	26	8
62	36.3	Joseph Zoda	Maple Park, IL, USA	19	13
63	36.3	R. Koschack	Wismar, GDR	19	13
64	35.6	James E. Sulluvan	N. Little Rock, AR, USA	25	8
65	34.6	Robert Germann	Wald, ZH, Switzerland	28	5
66	34.6	A. Salazar	San Fernando, Spain	20	11
67	33.7	Gene Hanson	Elm Grove, WI, USA	31	2
68	33.0	Richard Nolthenius	Mountain View, CA, USA	29	3
69	32.6	F. Gutierrez	San Fernando, Spain	18	11
70	32.6	Peter Lipski	Dresden, GDR	18	11
71	32.0	Ben Hudgens	Clinton, MS, USA	24	6
72	31.0	Ornulf Midtskogen	Tranby, Norway	23	6
73	30.0	Luis Gustavo	Receive, Pernambuco, Brazil	30	0
74	30.0	Harold Povenmire	Bradenton, FL, USA	18	9
75	30.0	R. Koschack	Sternbedeckungen, GDR	14	12
76	29.7	R. T. Price	SV206, Australia	27	2
77	29.6	Col. J. E. S. Singh	Delhi, India	19	8
78	29.3	F. Freitas	Tapada, Lisboa, Portugal	24	4
79	29.0	Carl Schweers	Ardmore, OK, USA	21	6
80	29.0	W. T. Zanstra	Appingedam, Netherlands	21	6
81	28.6	Roman Fangor	Warszawa, Poland	18	8
82	28.6	R. and V. Boninsegna	Dourbes, Belgium	14	11
83	28.3	Graham Broadbent	Merseyside, England	23	4
84	28.0	William L. Stein	Chester, VA, USA	20	6
85	27.7	Saudro Baroni	Milano, Italy	25	2
86	27.6	Bryan Viljjoen	Bloemfontein, South Africa	17	8
87	27.3	Mieczystaw Szulc	Tuchola, Poland	18	7
88	27.0	Tatuo Sato	Kawaguti, Saitama, Japan	19	6
89	26.7	Erust Reusser	Ennetbaden, Switzerland	24	2
90	26.6	Maurice Stoker	Auckland, New Zealand	20	5
91	26.3	Jari Hoffren	Helsinki, Finland	13	10
92	26.3	Btazej Feret	Lodz, Poland	13	10
93	26.0	Graham L. Blow	Black Birch, New Zealand	26	0
94	25.0	Eduardo V. Przybyl	Rafaela, Santa Fe, Argentina	25	0
95	24.0	L. Pazzi	Nigel, Transvaal, South Africa	24	0
96	24.0	Roberto Iorio	Naples, Italy	12	9
97	23.3	Karl Silber	Gmunden, Austria	14	7
98	23.3	Clay Sherrod	N. Little Rock, AK, USA	22	1
99	23.0	Marco Cafagan	Milano, Italy	23	0
100	23.0	Lance Allred	St. Paul, MN, USA	19	3
101	22.7	C. G. Morse	Penhow, England	20	2
102	22.3	Claudio Costa	Rome, Italy	17	4
103	22.3	Gerry D. Allcott	Auckland, New Zealand	21	1
104	22.3	W. Bentitez	San Fernando, Spain	13	7
105	22.3	Klaus Diete Kalauch	Annahutte, GDR	17	4
106	22.3	Ina Eichhorn	Toepchin, GDR	13	7
107	22.0	WIlliam Golz	Sindney, NSW, Australia	22	0
108	22.0	D. Brauckhoff	Berlin, GDR	11	8
109	21.3	David W. Dunham	Silver Spring, MD, USA	16	4
110	21.3	Antonello Volpi	Roma, Italy	16	4
111	21.0	F. Sampaio	Recife, Pernambuco, Brazil	21	0
112	20.7	Herbert A. Luft	Oakland, CA, USA	18	2

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Order	Value	Name	Location	T	R
113	20.6	L. K. Brundle	Haywards Heath, England	14	5
114	20.3	Kyril W. Fabrin	Aalborg, Denmark	19	1
115	20.3	Melvyn D. Taylor	Leeds, W. York, England	11	7
116	20.0	G. Patterson	Christchurch, New Zealand	20	0
117	20.0	C. Schobel	Dresden, GDR	12	6
118	20.0	N. Wunsche	Berlin, GDR	20	0
119	20.0	T. Bruce Tregaskis	Birregurra, Australia	12	6
120	19.7	Peter Wade	Lancaster, England	17	2
121	19.3	Richard P. Binzel	St. Paul, MN, USA	18	1
122	19.0	W. H. Robertson	Sidney, NSW, Australia	19	0
123	19.0	Sergio Buonaiuto	Naples, Italy	11	6
124	19.0	Richard Taibi	Temple Hills, MD, USA	15	3
125	19.0	W. Lindsay Ball	Brisbane, Australia	19	0
126	19.0	Gerald W. Rattley	Greenfield, CA, USA	15	3
127	18.6	A. R. Pratt	Leeds, W. York, England	12	5
128	18.3	Edwin Sabin	Greenfield, CA, USA	13	4
129	18.3	Robert Andras	New Orleans, LA, USA	13	4
130	18.0	Fritz Zollmer	Bloemfontein, South Africa	10	6
131	17.7	Flavio Gambino	Chieri, Torino, Italy	15	2
132	17.6	P. Enskonatus	Berlin, GDR	11	5
133	17.6	Pat Bulman	Chester, VA, USA	11	5
134	17.3	Francesco Cerchio	Rivalba, Torino, Italy	16	1
135	17.3	Wayne Osborn	Mt. Pleasant, MI, USA	16	1
136	17.3	Paul N. Goodwin	Shreveport, LA, USA	16	1
137	17.3	B. P. Vojislava	Belgrad, Yugoslavia	16	1
138	17.3	Wayne H. Warren	Chester, VA, USA	12	4
139	17.0	Klerber R. Almeida	Belo Horizonte, Brazil	17	0
140	17.0	Mark Taylor	Canberra, Australia	13	3
141	16.6	Janusz Wiland	Warszawa, Poland	10	5
142	16.3	Fred Robinson	Memphis, TN, USA	11	4
143	16.3	Ian Jameson	Noracoorte, Australia	11	4
144	16.0	Steve J. Zvara	Whittier, CA, USA	16	0
145	15.6	Schonfeld	Halle, GDR	9	5
146	15.6	Doug Cunningham	Stratford, Canada	9	5
147	15.3	Laird D. Cuthill	West Berlin, NJ, USA	14	1
148	15.3	James Corkin	Brisbane, Australia	10	4
149	15.3	N. Plever	Birregurra, Australia	10	4
150	15.0	Ken Anderson	West Melton, New Aealand	11	3
151	15.0	Harry O. Williams	Auckland, New Aealand	15	0
152	15.0	Brad Timerson	Newark, NY, USA	11	3
153	15.0	Elisabeth Ahnert	Sonneberg, GDR	15	0
154	14.6	Januz Bankowski	Betchatow, Poland	8	5
155	14.3	David Arganbright	MT Pleasant, MI, USA	13	1
156	14.3	A. J. Ceograni	Southashford, England	13	1
157	14.3	Michael M. Dorr	New Burg, WI, USA	9	4
158	14.3	B. Soulsby	Gunaroo, Australia	9	4
159	14.0	L. J. Victor	Recife, Pernambuco, Brazil	6	6
160	14.0	Claudio Lusso	Nichelino, Italy	10	0
161	14.0	Henry Eikel	New Orleans, LA, USA	10	3
162	13.3	Cathal Mooney	New Ross, CO. Wesford, Ireland	12	1
163	13.3	Pietro Maga	Torino, Italy	12	1
164	13.3	Luca Pietranera	Rome, Italy	12	1
165	13.3	Geoffrey W. Amery	Reading, Berks., England	12	1
166	13.3	Rob Steuenson	Driebergen, Netherlands	8	4
167	13.0	Nobuyuki Takeisi	Kamigusa, Tokyo, Japan	9	3
168	13.0	Ewald	Biesenthal, GDR	9	3

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Order	Value	Name	Location	T	R
169	12.7	Mark Gingrich	Oakland, CA, USA	10	2
170	12.3	Paolo Emilio di Numzio	Rome, Italy	7	4
171	12.3	Betsy Robinson	Memphis, TN, USA	7	4
172	12.3	David Pettitt	Carlisle, England	11	1
173	12.3	J. J. Trott	Wokinham, England	11	1
174	12.3	M. Felgentreu	Bernau, GDR	11	1
175	12.3	Michael Schmid	Markgrafneusied, Austria	7	4
176	12.3	Brian Taylor	S. Humberside, England	3	7
177	12.3	Kathy Burke	Mt. Pleasant, MI, USA	11	1
178	12.0	Robert Kurianowicz	Warszawa, Poland	8	3
179	12.0	Wayne E. Clark	Webster Groves, MO, USA	12	0
180	12.0	Greg Hayward	Sidney, NSW, Australia	8	3
181	12.0	H. Feijth	Goutum, Netherlands	8	3
182	12.0	Robert South	Malvern, Worcs., England	12	0
183	12.0	Robert Melvin	Creedmore, NC, USA	8	3
184	12.0	John D. Phelps, Jr.	New Burg, WI, USA	8	3
185	12.0	Leo Lipinski	New Orleans, LA, USA	8	3
186	12.0	Bob Schiffer	New Orleans, LA, USA	8	3
187	11.7	M. Matthews	Auckland, New Zealand	9	2
188	11.7	N. Reddemann	Prenzlau, GDR	9	2
189	11.7	Richard McWatter	Stratford, Canada	9	2
190	11.3	Clifford J. Bader	West Chester, PA, USA	6	4
191	11.3	Roger Laureys	Vliermaalroot, Belgium	10	1
192	11.3	V. N. Mazhorovski	Poltava, USSR	6	4
193	11.3	R. J. Harrow	Hertford, England	10	1
194	11.0	F. Ezequiel	Tapada, Lisoba, Portugal	11	0
195	11.0	Francisco Roldan	New Burg, WI, USA	7	3
196	11.0	John Edmonson	Pocahontas, MS, USA	7	3
197	10.7	Ryszard Drazkowski	Wkockawek, Poland	8	2
198	10.7	Don M. Stockbauer	Houson, TX, USA	8	2
199	10.7	Michael Tabb	Batheaston, England	8	2
200	10.7	Paul F. Heuper	Chester, VA, USA	8	2
201	10.3	Jimmy Duke	Collins, MS, USA	5	4
202	10.3	Isao Sato	Sakata, Yamagata, Japan	9	1
203	10.0	Dieter Schmidt	Hutzen, Netherlands	10	0
204	10.0	Jose Rufino	Lisbon, Portugal	10	0
205	10.0	Ivan Nikoloff	Erth Obs., Australia	10	0
206	10.0	Hans Einskau	Bodo, Norway	10	0
207	10.0	Renate Birnkraut	Wien, Austria	6	3
208	10.0	Mark Trueblood	Chester, VA, USA	6	3
209	10.0	Aris Penakis	New Burg, WI, USA	6	3
210	10.0	Forrest Francis	New Orleans, LA, USA	6	3
211	9.7	Jim Meadows	Memphis, TN, USA	7	2
212	9.7	Ralph Lowd	Patterson, CA, USA	7	2
213	9.7	Tom Smart	Stratford, Canada	7	2
214	9.3	L.E. St. George	Auckland, New Zealand	8	1
215	9.3	Brues A. Rodgers	Locust Valley, CA, USA	8	1
216	9.3	Viertel	Karl Marx Stadt, GDR	8	1
217	9.3	Rodr Victor Domingo	Caracas, Venezuela	8	1
218	9.3	Peter F. Raw	Phertlern, Australia	8	1
219	9.0	Jerzy Lukaszewicz	Warszawa, Poland	5	3
220	9.0	Xaver Willi	Oberehrendingen, Switzerland	9	0
221	9.0	Paolo Zanetti	Terni, Itali	5	3
222	8.7	Paul Maegraith	Adelaide, S. Austr., Australia	6	2
223	8.7	A. W. K. Thomas	Berkshire, England	6	2
224	8.7	Berthol Kronsteiner	Linz, Austria	6	2

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Order	Value	Name	Location	T	R
225	8.7	Jim Hahn	New Burg. WI, USA	6	2
226	8.7	Philip Bradley	Grand Cane, LA, USA	6	2
227	8.7	Tom Wilson	Grand Cane, LA, USA	6	2
228	8.7	John Mugford	Virgina, Australia	6	2
229	8.3	Vanni Guarnieri	Firenze, Italy	7	1
230	8.3	Stawomir Chorek	Betchatow, Poland	7	1
231	8.3	Robert Clyde	Streetsboro, OH, USA	7	1
232	8.3	J. D. Shanklin	Cambridge, England	7	1
233	8.3	Mike Swan	Wimborne Minster, England	7	1
234	8.0	N. R. Lomb	Sidney, N. S. W., Australia	8	0
235	8.0	Mark Taylor	Wakefield, England	8	0
236	8.0	Piero Bergano	Torino, Italy	8	0
237	8.0	Pauline Loader	Blenheim, B. Birch, New Zealand	8	0
238	8.0	Ralph Loader	Blenheim, New Zealand	8	0
239	8.0	Thomas Epps	Flagstaff, AZ, USA	4	3
240	8.0	Gerry Samolyk	Milwaukee, WI, USA	4	3
241	8.0	W. B. Albrecht	Pahala, HI, USA	8	0
242	7.7	Henk J. Bril	Drachten, Netherlands	5	2
243	7.7	Patrick Wils	Niel, Belgium	5	2
244	7.7	Emil J. Volcheck	Collegeville, PA, USA	5	2
245	7.7	Peter James	New Burg, WI, USA	5	2
246	7.7	Carl Grantham	New Orleans, LA, USA	5	2
247	7.7	Jimmy Rosamond	New Orleans, LA, USA	5	2
248	7.7	Gary Meibavm	New Orleans, USA	5	2
249	7.7	Jeff Lusher	Virgina, Australia	5	2
250	7.3	Dennis Goodman	Wellington, New Zealand	6	1
251	7.3	Rolf Strohm	Greenfield, CA, USA	6	1
252	7.3	Mark Strohm	Greenfield, CA, USA	6	1
253	7.3	Jari Rautianen	Helsinki, Finland	6	1
254	7.0	Ricardo Liuz	Reciefe, Pernambuco, Brazil	3	3
255	7.0	Victor J. Slabinski	Arlington, VA, USA	7	0
256	6.7	Carlos Schnabel	Barcelona, Spain	4	2
257	6.7	R. Vink	Huizen, Netherlands	4	2
258	6.7	Beat Rykart	Wald, Switzerland	4	2
259	6.7	Robert McCracken	Edgar, VA, USA	4	2
260	6.7	James K. Fanson	New Burg, WI, USA	4	2
261	6.7	P. McConnell	Michelago, Australia	4	2
262	6.7	Jose Pereira	Pombal, Portugal	4	2
263	6.3	Arkadiusz Krajewski	Warszawa, Poland	5	1
264	6.3	Benny J. Roberts	Jackson, MS, USA	5	1
265	6.3	L. J. De Lange	5, Netherlands, Bantega	1	0
266	6.3	Anthony Dip	Hialeah, FL, USA	5	1
267	6.3	R. Lefeber	S-Gravensande, Netherlands	5	1
268	6.3	Bill Cooke, Jr.	Patterson, CA, USA	5	1
269	6.3	Charles C. Heinzer	Patterson, CA, USA	5	1
270	6.3	John Thompson	Stratford, Canada	5	1
271	6.0	D. S. King	Sidney, N. S. W., Australia	6	0
272	6.0	A. W. Dodson	Otaki, New Zealand	6	0
273	6.0	John A. Church	Princeton Jct., NJ, USA	6	0
274	6.0	William M. Owen, Jr.	Altadena, CA, USA	6	0
275	6.0	Kazuyuki Yamada	Nisitama, Tokyo, Japan	6	0
276	6.0	Walter Brandli	Wald, Switzerland	6	0
277	6.0	Leif Kristensen	Aarhus, Denmark	6	0
278	6.0	Geoges Helmer	Nice, France	6	0
279	6.0	Bjorn M. Sorensen	Trondheim, Norway	6	0
280	6.0	Stefano Lista	Torino, Italy	6	0

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Order	Value	Name	Location	T	R
281	6.0	A. O. Pearson	Barnton, England	6	0
282	6.0	David Symonds	Delamere, Australia	6	0
283	6.0	F. C. Baker	Victoria, Australia	6	0
284	5.7	Beata Paluszkiewicz	Warszawa, Poland	3	2
285	5.7	T. V. Haymes	Maidenhead, England	3	2
286	5.7	Brian Ganier	Milwaukee, WI, USA	3	2
287	5.3	Joan Bixby Dunham	Silver Spring, MD, USA	4	1
288	5.3	William J. Westbrooke	San Francisco, CA, USA	4	1
289	5.3	Jonathan E. Dew	Bracknell, England	4	1
290	5.3	Robert Fingerhut	Patterson, CA, USA	4	1
291	5.3	Jack Peterson	Patterson, CA, USA	4	1
292	5.3	Christopher A. Pratt	Patterson, CA, USA	4	1
293	5.3	Ronald L. Hanson	Patterson, CA, USA	4	1
294	5.3	Kevin A. Medlock	Patterson, CA, USA	4	1
295	5.3	Patter Winter	Greenfield, CA, USA	4	1
296	5.3	Penny E. Pinschmidt	Greenfield, CA, USA	4	1
297	5.3	David Elliott	Pocahontas, MS, USA	4	1
298	5.3	Arthur Hall	Jannali, Australia	4	1
299	5.3	Peter Williams	Jannali, Australia	4	1
300	5.0	Dietmar Bohme	Nessa, GDR	5	0
301	5.0	Christian B. Luginbuhl	Flagstaff, AZ, USA	5	0
302	5.0	Mirsostaw Kubiak	Grudziadz, Poland	5	0
303	5.0	Daniel Sheber	Green Bay, WI, USA	5	0
304	5.0	Thomas O. Strickler	Berea, KY, USA	5	0
305	5.0	Ole Klinting	Ringstad, Denmark	5	0
306	5.0	Pierre Vingerhoets	Antwerpen, Belgium	5	0
307	5.0	A. De Boer	Utrecht, Netherlands	5	0
308	5.0	Michael Grunanger	Wein, Austria	5	0
309	5.0	Rudolf Typpelt	Wien, Austria	5	0
310	5.0	Nick Stoikidis	Larisa, Greece	5	0
311	5.0	G. Richardson	Plumsfead, South Africa	5	0
312	5.0	Yasuharu Suzuki	Kawaguti, Saitama, Japan	5	0

The following people achieved a value of less than 5:

4.7 (2 timings, 2 reappearances): Stefano Cau

4.3 (3 timings, 1 reappearance): Paulo Sergio Bretones, S. Stoustrup, A. T. Holmes, P. J. Made, Frank Vaccarella, Charles Leche, J. W. A. Chorley, G. Hughes, Stephan Lockart, Wayne Herbert, Geof Scott

4.0 (4 timings): Jose Osorio, Nazareth Rego, G. M. Ross, Ken Honda, E. A. Best, W. Rother, Paul Ahnert, W. Backwell, Don Miles

3.3 (2 timings, 1 reappearance): A. van der Drift, Maciej Bielicki, Tomasz Peszke, Knofel, J. Rendtel, K. Guhl, B. Wunderlich, Eric Limburg, Ilg Peter, Michael B. Houchen, Koeen Ghijs, C. Raurell, James Toeller, John Azstolos, Kunz Schmidt, Dan Purrington, Archie Estorinal, Chuck Nance, Donald R. Savat, Mikio Yamagata, Peter Jedicke;

3.0 (3 timings): Ambrosio J. Camponovo, K. P. Sims, Jean Meeus, Luiz Augusto da Silva, A. Wells, Rauno Hartikainen, Boschloo, Michael Gallagher, J. Parker, James E. Brooks, Virgil J. Tangney, Mark P. Herbstritt, C. Anton, Roy Sharp, G. Stanley, Andrea Moro, C. J. Devoy, Glenn L. R. Johnson, Charles A. Karbal, John Yeates, F. Seidel

2.3 (1 timing 1 reappearance): Andrew G. Allison

2.0 (2 timings): Steven Saunders, Pierson C. A. Barretto, E. C. Lins da Silva, Geraldo Falcao, Joao Rodrigues, H. J. Widdop, Matti Suhonen, Umbert Bragagnolo, Serafino Gargano, Luisa Bastos, Mike Bolen, Anne Connarty, Michael Handschuh, H. Pachali, Douglas Johnson, Loren Clifford, Douglas D. Cuthill, Carroll L. Evans, Tetuo Ohtuka, A. J. Elliott, R. Noack, W. Hohle, Deutsch, Jahn, Eberha Splettgerberr, Robert de Graef, Daniel Yvergneaux, Michael Boschat, Arne Foss, Gottfried Gerstbach, Gerhard Seitinger, Paolo Rizzi, Nathan Richman, Susumu Hosoi, Schmidt Eric, Keski, Petaja, Timo, Mika Suoranta

1.0 (1 timing) Loui Pagano, C. C. P. de Paula, Jeorge Luis, J. Olimpo, Pauli Heiskanen, Edgar Otto, Yoshiko Kimoto, A. Glading, L. Kendall, W. Kissling, C. Print, Dorota Schon, Joe Kovak, Richard W. Lasher, Joe Lawrence, Ronald S. Price, Bruce S. Rusnak, V. N. Sincheskul, K. Selie, Christopher Stephan, C. R. G. Turk, C. C. Brunt, H. S. Newby, D. M. Straub, H. Lorenz, A. Rudiger, Paul W. Gilgen, Volmer Hegvad, Dick Laurent, B. Poalvast, F. A. M. van der Plum, Karl Emil Egge, Wolfgang Schwabel, Enrico Stomeo, P. Lowe, J. A. Burger, Tom Arnold, Robert H. Nelson, Yuuko Igarasi, Sigezi Ito, D. Bratt, G. Kellock, Matti Turunen, Jouni Sarkioja, Veikko Makela, Rudolf Conrad, John Everard.

Number of Observers:	**460**
Total Observed Occultations	**7,398**
Total Observed Reappearances:	**2,209**

Constant C in the equation: $V = T + C*R$

$$C = (T/R) - 2 = 1.349$$

OCCULTATIONS IN THE LITERATURE

David W. Dunham

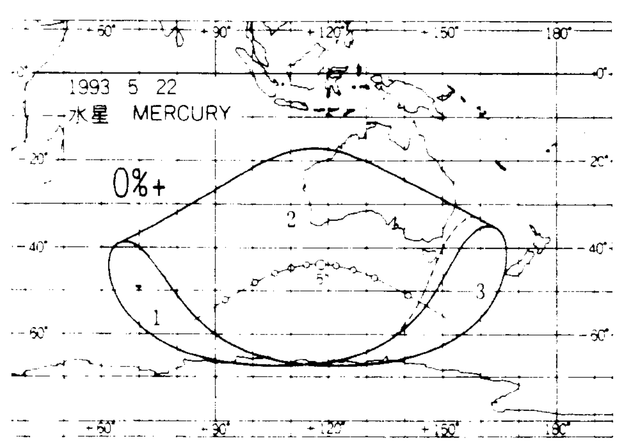
This is a continuation of the article with the same title on p. 175 of the last issue of ON. If you know of any articles which I have missed (I am sure there are some, my search is far from thorough), please contact me at the Greenbelt address in the masthead, or telephone me at 1-301-4744722, or send me an E-mail message to: nssdca::dunham (Decnet) or dunham@nssdca.gsfc.nasa.gov (Internet). Please include enough information to be able to make this listing.

"Multiplicity among Young Stars in Taurus", M. Simon et al., Astrophys. J. 384, p. 212 (Jan. 1992) [This used occultation data, according to R. Wilds, who drew my attention to this article].

"Occultations of Stars by Solar System Objects. IX. Occultations of Catalog Stars by Asteroids, Planets, and Major Satellites in 1992 and 1993", L. H. Wasserman, E. Bowell, and R. L. Millis, Astron. J. 103, 6, p. 2079 (June 1992).

"Triton Stellar Occultation Candidates: 1992-1994", S. W. McDonald and J. L. Elliot, Astron. J. 104, 2, p. 862 (August 1992).

"Occultation of a Compact Radio Source by Venus", R. P. Linfield, Astron. J. 104, 2, p. 880 (August 1992)



THE AUSTRALIAN OCCULTATION OF SAO 189263 BY CERES ON OCTOBER 307

David W. Dunham, David Herald, Steven Hutcheon, and Paul Maley

Since asteroidal occultations have been predicted, no occultations of (1) Ceres, by far the largest asteroid, have occurred that were easily observed visually, and only one occultation has been observed photoelectrically (Millis et al., 1987, Icarus 72, p. 507). However, on October 30, there will be an occultation of 8.8-mag. SAO 189263 by Ceres. An occultation as long as 49 seconds could occur with a 0.9-magnitude drop, which should be easy to detect visually unless the spectral type K5 star is a close double that would produce smaller separate drops. More information about the event is listed in ON 5, No. 6, p. 138-139. The path should cross Australia, as shown in the map at the end of this article, based on the PPM position for the star. Parallel paths at 0".1-interval shifts from the nominal prediction (measured perpendicular to the path) are shown. If the less accurate SAO catalog position is used instead, the center of the path will be shifted 0".26 to the northwest, as shown by the dashed line; astrometry performed a week or so before the occultation would improve the accuracy.

We are organizing observers across Australia to observe the occultation, and scan the space around Ceres for secondary occultations, in a coordinated manner. Three observers from the U.S.A. plan to travel to Australia to attempt observations. About 20 observers with portable equipment plan to travel west from Adelaide to bracket the entire possible path region west of that city. If you are interested in joining this effort, please contact either David Herald; P.O. Box 254; Woden, A.C.T. 2606; phone 61-62-319214; or Steven Hutcheon; 41 Campbell Rd.; Sheldon, Queensland 4157; phone 61-7-2064338; e-mail Internet: joyce@vk4kiv.qut.edu.au or

Decnet: AMES::"joyce@vk4kiv.qut.edu.au"; or Paul Maley at the address and telephone given at the end of the first paragraph of IOTA NEWS above.

About 3 hours after the Ceres occultation, there will be an occultation of 10th-mag. FAC 246779 by 8.5-mag. Juno that is predicted to cross Singapore and Australia approximately from Darwin to Sydney, a path almost perpendicular to the Ceres path. Due to the errors in FAC positions, the path location is quite uncertain, but it might also be improved with astrometry. With a predicted magnitude drop of 0.3, only photoelectric observers have a good chance for detecting this event. Photometry is planned to see if the star is red, since in this case, the occultation might also be detected with intensified video systems.

To see what other opportunities there might be, Dunham compared the ephemeris of Ceres with his combined catalog to search for possible occultations through April of the year 2000. The result is given in the table, with some notes about individual events below:

1993 Apr 10: Due to the small solar elongation, at best the altitude will be 10° with the Sun 10° down; an astrometric update is impossible, and weather prospects are very poor in the possible region.

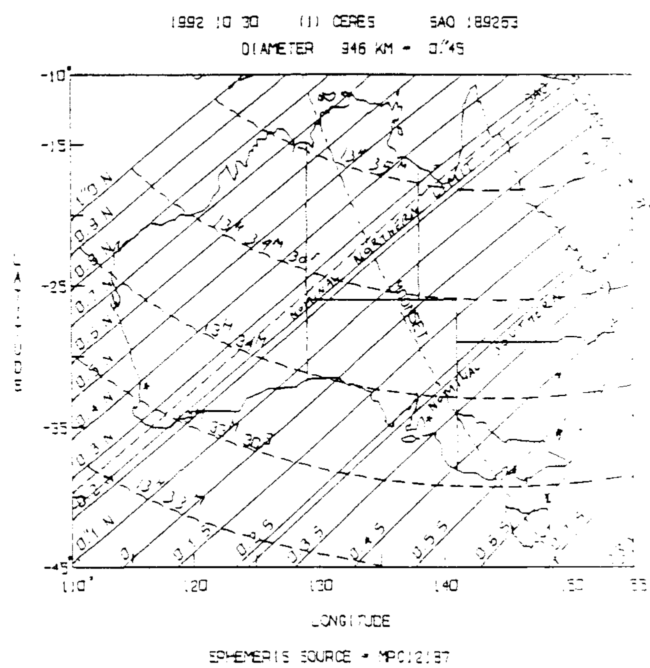
1994 Sep 11: This star, ZC 1195, is the brightest star that may be occulted. Hopefully, astrometry will be obtained to tell if the path will cross the Earth's surface, and chances for this happening in the Yukon are good, but perhaps with only the southern half of Ceres occulting the star, bad for a diameter/shape determination. Nevertheless, observers in the western U.S.A. and Canada should monitor this event for possible secondary occultations.

1997 Feb 11: Due to the small solar elongation, at best the altitude will be 9° when the Sun is 7° down; consequently, the event will probably not be observable, and astrometry will be impossible.

1997 Jul 22: This is the next good visual possibility after this year's Australian event. Central Chile (Santiago area) during the southern winter might not have as good prospects for clear skies as northern Argentina. There are many potential observers in eastern Brazil.

1999 Sep 1: A north shift would be needed for the path to reach Kerguelen Is., and even there, Ceres will be only 1° up and the Sun only 1° down. Both observation and astrometry appear to be impossible.

In conclusion, this year's occultation appears to offer the best possibility for measuring the size and shape of Pallas during the rest of this century, an event worth attempting by those with the means to do so. The 1997 July event also looks promising. The 1994 September occultation is very interesting, but unlikely to give a good size/shape result. Other events either have observational problems, or magnitude drops too small for visual observation and difficult for intensified video systems.



Map for 1992 Oct 30 (1) Ceres Occultation of SAO 189263

Date	Universal Time	Ceres m_v	Ceres Δ,AU	STAR SAO/BD	STAR m_v	STAR Sp	STAR R.A. (1950)	STAR Dec.	OCCULTATION Δm	OCCULTATION dur	OCCULTATION df	P	Possible Area	El Sun	MOON El	MOON %Snl	MOON Up
1992 Oct 30	13^h36^m	9.1	2.91	189263	8.8	K5	20^h22^m2	-29°11'	0.86	49^s	17	4	Australia	84°	28°	24+	w132°E
1993 Apr 10	4 16	9.2	3.86	128609	8.9	G5	0 6.3	-8 11	0.95	21	9	6	e. Nigeria; see notes	23	112	85-	all
1994 Sep 11	11 35	8.9	3.12	79805	6.7	B8	7 53.1	23 45	2.31	26	10	5	Yukon?s	52	129	39+	none
1996 Jun 10	2 35-46	7.3	1.79	159866	8.2	K2	16 17.6	-18 34	0.40	81	23	3	S.Afr.,cen.Arg.,s.Chile	167	124	32-	e 16W
1997 Feb 11	1 11	9.1	3.86	189468	9.0	K0	20 32.6	-24 4	0.82	21	9	6	sw.India; see notes	18	65	16+	none
1997 Jul 22	2 56-78	8.2	2.18	165639	7.9	G0	23 18.3	-19 16	0.94	134	41	3	Icel.,Brazil,cen.Chile	134	23	94+	all
1997 Aug 14	9 54-69	7.8	2.03	191707	9.1	K0	23 8.3	-21 52	0.29	80	24	3	Venez.,Peru,Antarctica	156	76	79+	w105W
1998 Jul 22	6 28	9.1	3.19	+13°605	10.0	G5	3 45.9	13 29	0.40	31	12	5	Canadian N.W. Territory	61	45	2+	none
1999 Sep 1	1 51	8.7	3.48	80867	8.8	F0	9 28.0	21 15	0.71	20	8	5	Kerguelen Is.; see note	21	95	71-	all
2000 Jan 11	21 56-65	8.1	2.13	119559	9.5	G0	12 41.3	9 20	0.28	82	25	3	Czechoslovakia, Russia	104	160	23+	none

LUNAR OCCULTATION PREDICTION AND SOFTWARE NEWS

David W. Dunham and Walter I. Nissen, Jr.

Occultation Visibility Subroutine (MAGLIM): The observability code (O-code) calculation of the IOTA/USNO lunar total occultation predictions has been improved to include Brad Schaefer's MAGLIM subroutine that uses astrophysical principles to compute and compare the brightness of the star's seeing disk with nearby background light. This was described briefly on p. 171 of the last issue of ON, and is documented well in an article that will appear in Icarus; a synopsis of the Icarus article will probably be published soon in Sky and Telescope. We had to make some changes to run on the USNO computer, and after several tests, we made a few adjustments to give better calculations in certain circumstances (these will be described in a future issue of ON after Schaefer's article is published). Since MAGLIM will not handle lunar eclipses, O-codes for lunar eclipse occultations are computed with the old O-code subroutine. Due to the complexity of the MAGLIM code, the run time to generate predictions increased by a little less than 30%. But the benefit is an over 40% reduction (for O-code 0) in the printed output, since the new code rejects many unobservable events that were allowed and printed by the old program. Comparing predictions generated with both the old and new versions, we are satisfied that the newly-rejected events are indeed unobservable. We calculated predictions using MAGLIM for Henk Bulder in the Netherlands for 1992, and his comparisons with his observations were valuable for refining the overall calibration factor. The new code accepts a few daytime events that were rejected previously. But the overall effect is a significant reduction in the size of the predictions, which will help with management of the predictions and postage costs.

Brad Schaefer doesn't like the O-code system, and would prefer that we give in its place directly the telescope aperture needed to see the event (the O-code system is based on telescope aperture, as explained in the O-code form that is sent to all new observers, and as published in H. Bulder's article in ON 5, #1, p. 18). We are keeping the O-code for now, mainly due to inertia (we have more important things, such as survival of the prediction system, to be concerned with now, and we think that most observers using the predictions have become familiar with the O-code), but we solicit comments about Schaefer's suggestion. Implementation of the aperture would cause a difficulty, since every space in the standard 132-character printed line is now used; also, there would be some increase in computation time. The aperture could be given in units of either cm or inches, with values over 10 given by letters of the alphabet, such as A = 10, B = 11, C = 12, etc., with larger apertures perhaps increasing by units of 5. Although most of the world is metric, inches would be better because of its coarser scale (9 inches is 2.54 times

9 cm), but the units could be left as an option to be selected by the observer. A system of letters for the larger apertures would be, like the present O-code system, not obviously related to the aperture.

In addition, MAGLIM has several factors, relating to station light pollution as well as average seeing and transparency; observer eyesight and experience; and telescopic light transmission and method of observation, for which default values had to be assumed. Observers were given an option to specify these factors, although variable input values for them might not be implemented.

OCC Versions 80M and 80N: David updated the XZ80L star catalog used for most of IOTA/USNO's occultation predictions by adding and changing double star codes described in Tony Murray's articles starting on page 184 of the last issue, and in ON 5, #5, p. 116, to create XZ80M. Also, the codes of a few doubles were updated based on photoelectric observations made at Kitt Peak National Observatory and reported in two issues of the Astronomical Journal; these will be described in the next issue. The only modification to the OCC program was the addition of unit 50 output, which is used as terminal screen output to monitor progress of OCC production runs; no changes were made to the OCC or ACLPPP empirical corrections. The resulting version 80M (OCC update and XZ catalog update XZ80M) were used to generate all of the IOTA/USNO grazing occultation and total occultation data for 1993. But Mitsuru Sôma found two errors in XZ80M: The declination of X01073, a star very close to the celestial equator, had the wrong sign (fortunately, the star will not be occulted from anywhere in the world during 1993) and the prefix for star number 22522 was "A" instead of "X", an error that occurred during a disconnection while David was editing the XZ80L dataset to create XZ80M. In addition, H. Povenmire reported that X02996 was much fainter than its catalog mag. of 8.2, since he could not see it during a favorable graze in late July. The B.D. gives its mag. as 9.2, which has now been used, although Povenmire thinks that the star was even fainter. W. Morgan pointed out a confusion in the double star code for X05389, which should be S, not M. These four corrections were made to the XZ80M data set to form the current version XZ80N.

Mitsuru Sôma at the National Observatory at Mitaka, Tokyo, has recently converted XZ80N from B1950 to J2000 for use with IOTA's new prediction and reduction software. Wayne Warren and Wolfgang Zimmermann have independently discovered some non-ASCII blanks that cause problems with PC use, and they will be corrected in a future version. Zimmermann identified some additional differences between XZ80JA and XZ80L, mostly involving Pleiades stars, that turned out to be caused by improved data that were incorporated into XZ80L.

Predictions for 1993: Predictions for 1993 for European observers (excluding the C.I.S.) were computed in mid August and brought to the European Symposium on Occultation Projects (ESOP) near Rome in late August for distribution, saving mailing costs, similar to the distribution of the 1992 predictions at the ESOP meeting in Hannover last year. This did not include the special lunar eclipse occultation predictions described below, which are much smaller than the main data and which will be mailed soon to European national coordinators for inclusion with their mailings to observers. The predictions for active (that is, those who have returned their verification forms) European observers not at ESOP will be mailed by IOTA/ES. Predictions were neither computed nor distributed, either directly or to national coordinators, for those who did not return their verification forms (this included several IOTA members). The 1993 predictions for North American observers will be mailed from Maryland, in September or October. The 1993 predictions for observers not in Europe and not in North America will be mailed by the International Lunar Occultation Center (ILOC) in Tokyo; a tape containing the print files for these predictions, and the corresponding address labels, has been prepared and will be sent to ILOC soon. The basic grazing occultation data sets for 1993 have all been generated; copies of these will be distributed soon to the graze computors for processing.

Coordinator Address Updates: Pierre Vingerhoets, the occultation prediction coordinator for Belgium and France, moved recently; his new address is: Diksmuidelaan 334 b2; B-2600 Berchem, Belgium; telephone 32-3-3226972 (home), 32-15-415911 (office) and 32-15-418780 (office fax). Portugal now has a coordinator: A. Sr. Joaquim Soares Garcia; Rua de Sao Bruno 25; Caxias; 2780 Oeiras, Portugal. Bohumil Malecek's address is now Namesti Generala Piky 9; 301 58 Plzen, Czechoslovakia.

Eberhard Bredner, the prediction coordinator for Germany - West and for European countries without other coordinators listed above or in ON 5, #5, p. 109, has moved to the address given at the end of this issue; his new telephone number is 49-2388-3658 (with answering machine) and fax is 49-2381-36770.

Lunar Eclipse Occultation Predictions: In addition to the 1993 IOTA/USNO total lunar occultation predictions, special predictions of numerous occultations of faint stars, including chronologically-ordered abbreviated output, will be distributed to those on the IOTA/USNO active mailing list for the total lunar eclipses of 1992 December 9-10, 1993 June 4, and 1993 November 29. The umbra of the partial eclipse of 1992 June 15 was unusually dark, apparently due to material remaining in the upper atmosphere from the Pinatubo eruptions, so the upcoming total eclipses could be unusually favorable for timing occultations of faint stars. A good impression of the shadow is provided by R. Royer's photo at the bottom left of p. 65 of the 1992 October issue of Astronomy. It matches the intensified CCD images that David videorecorded of three occultations during the eclipse; the limb was faintly visible on the left side of Royer's photo (where disappearances occurred), but not on the right side. Due to the darkness of the June eclipse umbra and the consequent promise for the upcoming total eclipses, we decided to generate these predictions before USNO's computer was removed, and distribute them with the 1993 total occultation predictions, contrary to what was stated in the last issue. Also, with two of us working on the predictions, and with additional help from Wayne Warren, we believe that we can accomplish the job. The Q-catalog prepared for these predictions is based on Space Telescope Guide Star (GS) Catalog data, including stars to mag. 14.0 in the regions that will be traversed by the eclipsed Moon, provided by Douglas Mink, Center for Astrophysics, Cambridge, Mass., and merged with the XZ and K catalogs by David. The DM numbers of non-XZ and non-K GS stars were added to the 1992 December eclipse field, and the magnitudes were compared with the True Visual Magnitude Atlas and corrected, when necessary, for all three eclipse fields. DM numbers of non-XZ and non-K stars in the 1993 eclipse fields will be published in a future issue of ON. As noted above, the eclipse occultation predictions will only be computed and distributed to those on IOTA/USNO's active total occultation prediction mailing list; IOTA members who are not in the active mailing list and who want these predictions might contact either Hans Bode in Hannover (address in lower left corner of front page or lower right part of back page) or David in early November (when we expect to have Costa's version of the EVANS program operational on our PC's), giving accurate coordinates. Italians can get these predictions directly from Claudio Costa. A map of the star field for the 1992 December eclipse, the densest of the three fields with over 4000 stars, will be published in the next ON.

OCCRED to Replace Accurate Functions of OCC: Mitsuru Sôma has modified his OCCRED program to generate lccard data needed by the ACLPPP program, in the same format that USNO's OCC program now produces them. There are errors in a couple of the computed values, but we are confident that Sôma can fix these problems soon, probably before September 30, which will provide continuity in the generation of these data sets crucial to the overall graze prediction process. Sôma can communicate results quickly by E-mail, as David has been able to do with many of the computors; we hope to transport his program to run on powerful PC's in the U.S.A. and Germany. Sôma's heights differ from OCC's values by about 0.2", usually, but sometimes the differences are 0.5", due to different application of empirical corrections. But since Soma's results are based on more recent analyses using better star catalogs, they should either now be, or soon will be, superior to USNO's OCC results. Sôma and Al Fiala at USNO are also working to duplicate OCC's solar eclipse output needed for Bailey's bead analysis and accurate eclipse path edge calculation.

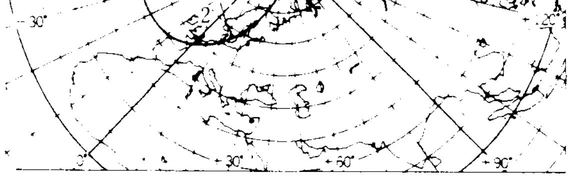
Migration/Replacement of other USNO Occultation Software: After September 30, USNO's mainframe computer will be turned off and removed (USNO's expensive contract with IBM to use and maintain the VM/CMS operating system expires then, so it is not just a question of the hardware). Until then, efforts to inventory and download the remaining programs and data sets on the USNO mainframe will have precedence over prediction requests. Previously, we mentioned that Wayne Warren and David were able to run the EVANS and OCC programs on an IBM 3081 scientific mainframe computer at Goddard Space Flight Center. Unfortunately, that depended on use of the CMS operating system (same as on USNO's mainframe) which was removed from the Goddard computer last January. With help from Wayne Warren, we hope to develop a capability to make update prediction runs using the MVS system on the computer at Goddard in October, but that will not be suitable for the main prediction runs for 1994. Fortunately, Claudio Costa in Italy has gotten his PC version of EVANS to work; comparisons with USNO's data are good, but some more work is needed to identify the cause of, and correct, some error messages that sometimes occur. As noted above, Bode and David plan to start using it in November, and sometime early in 1993, we will distribute it to national coordinators. For use of Costa's EVANS, we recommend either a 486DX or 386 PC with math coprocessor, with 80 megabytes of hard-disk storage (the EVANS program and its two large input files will require about 50 megabytes). We need to coordinate these efforts, especially the maintaining of station coordinates and assignment of station codes, with ILOC. At first, we will do this job, but procedures will be established so that the national coordinates can be responsible for the files pertaining to their country. After the national coordinators are established, later in 1993 we may create a version of EVANS that would not use the large Watts limb correction data set, so that it could be more easily copied and provided to users of smaller machines.

The formatted Besselian elements file (befile) needed by Costa's EVANS program has been generated for 1993, and supplied to Costa. Unlike the binary befiles created to the USNO EVANS program for several previous years, neither the binary nor the formatted befile for 1993 contains predictions for lunar occultations of minor planets, which we have found to be observable only very rarely; perhaps for 1994, we will correct this deficiency. We hope to create a befile for 1994 at USNO that will include the stars (XZ and K), major planets, and galactic-nebular objects. Wolfgang Zimmermann is working on FK5/J2000-based PC software to generate the befiles.

At ESOP-XI, David had long discussions with Eberhard Riedel about his new grazing occultation prediction system, which we plan to use operationally for the 1994 IOTA graze predictions. Riedel plans to produce the hemispheric grazing occultation supplements for 1993.

Predictions for 1994: Although we are collecting the verification forms for 1994, we make no promise to provide these predictions. We will send the forms that we receive either to ILOC or to your regional or national prediction coordinator, whichever is most appropriate, when the alternative prediction capabilities mentioned below are realized.

Other Occultation Software: Gordon Taylor's Lunar Occultation Package (LOP), including its cost and how to obtain it, was described on p. 174 of the last issue. IOTA recently obtained a copy, still using the SAO catalog zodiacal subset. We find that it does the basic job, giving the times (accurate to 5 seconds or so, since limb corrections are not used), p.a.'s, cusp angles, and altitudes above the horizon (but not Sun altitude) of all events within a specified time interval, which can be selected to be from sunset to moonset, or moonrise to sunrise. There is no automatic event rejection, even for events below the horizon. The program is very slow on a 286 machine without coprocessor. IOTA had planned to act as the North American distributer for LOP, but when we saw the registration forms and payments required by the British Astronomical Association (BAA), we declined. So readers interested in obtaining it should send a payment in British pounds to the BAA Computing Section c/o R. Harrold; see p. 174 of the last issue. Also, O. Montenbruck and T. Pfleger have written a book, translated by S. Dunlop and titled Astronomy on the Personal Computer, that includes a diskette with several programs written in Pascal (so you need a Pascal compiler), including an OCCULT program. Unfortunately, OCCULT does not compute the cusp angle, or any way to determine it, and the user needs to type in the star catalog file. We hope to review OCCULT in the next issue of ON.



A SIMPLE TIME INSERTION TECHNIQUE

Cliff Bader

After acquiring a video camera through the IOTA group purchase, I tried in vain to devise a simple method of video time insertion. Finally, it occurred to me that there are options other than an on-screen display. The baseband video spectrum extends from very low frequencies to a few megahertz, and there is plenty of room for a time-signal carrier which can be recovered by a radio receiver connected to the VCR along with the television set. In contrast to time signals on the VCR audio channel, those on the carrier are not lost during frame-freeze analysis of an occultation.

The technique involves the use of a low amplitude (about 10 millivolt) radio frequency carrier superimposed on the camera output by simple resistive addition. I use a frequency of approximately 165 kilohertz; this frequency is midway between successive horizontal sweep frequency harmonics, is in a fairly quite portion of the video spectrum, and can be received with modern all-band radios which cover the longwave (European) broadcast band. Higher frequencies are usable, but are less faithfully reproduced by the VCR and seem to be noisier. The carrier and associated modulation sidebands cause no video interference if the amplitude is kept low and the frequency is carefully chosen.

The time information format can (and must) be very simple. Since events can be timed to the nearest second using the audio channel of the VCR, the modulation need only provide undifferentiated second markers, and the event time can be fixed by counting frames to or from the nearest marker.

While it is not possible to use radio time signals to modulate the carrier, more reliable operation can be realized through the use of a local time reference (such as a crystal oscillator and frequency divider chain). The local second-marker beeps can be set to coincide with the radio time signal by auditory comparison, or by oscilloscope if one is available. Either method works well, even under poor radio conditions. Coincidence can be established to within about 10 milliseconds by ear, and to within a millisecond using an oscilloscope triggered by the local source and displaying the receiver audio output.

It is not necessary that the local reference be extremely accurate, provided that the drift rate is known and predictable. The drift rate can be established by monitoring against radio signals over a period of an hour or so, and an appropriate correction can be applied. The oscillator can be protected from rapid temperature changes by enclosing it in a styrofoam box.

Various techniques can be used to modulate the carrier with the time information. My original experiments used laboratory equipment which was easily configured for frequency-shift keying of the carrier by the second markers. This technique performs well, but a receiver with a beat-frequency oscillator (BFO) for code or single-sideband reception is needed for playback. I have since tried amplitude modulation using an audio beep generated by the time reference, with good results. This type of signal can be detected by any receiver which covers the longwave band.

The method of connecting the receiver for playback varies, depending on its antenna system. Typically, a signal of less than 50 microvolts is needed for good reception, and minimal coupling to the VCR is required. My Sony ICF-PRO80 receiver uses an internal ferrite rod for longwave reception, but connection of the VCR to the shortwave antenna terminal provides sufficient feedthrough of the signal. In some cases it may be necessary to wind a ferrite rod with wire and connect it in series with a resistor across the VCR video output; bringing the rod near the receiver internal rod will provide the needed coupling.

With the VCR running at normal speed, the receiver can be tuned for optimum time signal reception. During frame freeze operation, the second-marker beep will have a more or less choppy sound, depending on where in the frame the beep begins or ends. Using an oscilloscope triggered by the vertical synchronization pulses and displaying the receiver audio output, the start or stop time relative to frame start can be determined to within one or two milliseconds.

I have designed a simple, low cost time insertion circuit based on the above principles; it uses three CMOS small-scale integrated circuits and a 32.768 kilohertz watch crystal. I will be happy to furnish interested parties with the schematic diagram and parts procurement information. As noted, an oscilloscope is needed for optimum time resolution but is not an absolute necessity. The required bandwidth and sweep capabilities are modest, virtually any low cost scope can be used.

One interesting phenomenon which I noticed during my experiments concerns how different VCRs freeze frames. If I interpret my observations correctly, my 4-head Magnavox repeats the first field of the frame, skipping the second field, and my three-head Panasonic alternates between the last fields of two successive frames. This is a particularly interesting result, since by playing the tape on both machines it is possible to identify on which individual frame the event occurred. Does anyone have definitive information on how the process works for various VCRs?

I can be reached at the following address: C. J. Bader, 1209 Gateway Lane, West Chester, PA 19380 USA

Note: ON readers may find useful material in the National Institute of Standards Special Publication 432, which details the NIST time and frequency services. Of particular interest is the Automated Computer Time Service, which uses echoes from the user's computer to establish telephone line delay time to about 1 millisecond and sets the local clock. The publication can be ordered from:
NIST, Mail Station 847, 325 Broadway, Boulder, CO 80303-3328 USA

TWO EXERCISES WITH LUNAR LIMB PROFILES

Dietmar Buettner

Two exercises are presented in this article demonstrating possibilities is using occultation data.

I. Identification of Lunar Features from Graze Profiles: Looking at grazing occultation profiles, an observer may ask which object at the lunar surface could produce any prominent peak or valley in a given profile. A direct examination of the lunar limb with a telescope usually fails because the appropriate limb point is not visible or cannot be identified with a lunar map. Most lunar maps are drawn for zero libration and do not show the features for the Moon's back side.

The author tried to resolve the problem mathematically. From the Watts angle, WA, of the peak or valley, and from the libration in longitude and latitude, one can calculate the selenographic coordinates of the point at the Moon's edge as follows: First, the "apparent" selenographic coordinates at the libration-affected visible lunar disk are computed from the WA. Then the libration is used to perform a coordinate transformation of the point to the true selenographic system. With the selenographic coordinates, one can try to find the object on a lunar map. This method, of course, has the uncertainty that a feature apparently at the lunar limb is not necessarily exactly 90° away from the centre of the apparent lunar disk, but could be a bit on the Earth-facing side or the far side of the limb. For instance, objects with a height of 1, 2, or 3 km can be seen as limb features when they are 1.9°, 2.7°, or 3.4° away from the edge. Thus, the coordinate transformations may be in error by these amounts.

The author tested the usefulness of this using real profiles from ACLPPP. The lunar maps used were the charts of the libration zones in an excellent Lunar atlas by the Czechoslovakian author Antonin Rukl.

The results were surprising. There are many cases where the peaks/valleys in the profile can clearly be related to lunar features. For instance, the peak at WA 16.6° (1990 April 1 graze of X08701, l=+5.39°, b=-3.80°) is doubtless the northern wall of crater Pascal. Such clear identifications are possible mostly for large features (craters, mountains, etc.) and in relatively smooth regions, such as the northern polar region. In some cases an identification is quite impossible, especially where there are many small features in a rugged area.

One thing to note about this method is that applying it to the WA of the beginning and end of the graze profile can give the region at the Moon's surface where the graze occurs.

II. Reconstruction of Lunar Limb Profiles from Total Occultations: In evaluating grazing occultations it is common to compare the observations with the predicted profile in order to derive the shift value and to see how well the observations fit to the ACLPPP profile. In the case of total occultations, the practice is somewhat different. From the residual (O-C), the observer can estimate only whether there were any serious errors such as bad timing or wrong star identifications, etc. However, using several parallel observations of the same occultation made at different locations, more information can be derived. Parallel observations have the advantage that errors in the star's and the Moon's positions are constant for all observations and affect the residual with the same value and the same sense for all points within a few degrees of position angle. A well suited source for data on parallel observations are the "Reports of Lunar Occultation Observations" published annually by the ILOC. Besides the date, time, and star identification, they contain the reduction results of the residual (O-C), limb correction (WH) and position angle (K) for all observations reported to the ILOC having a residual of less than 2". Using all observations of the same occultation one can draw three

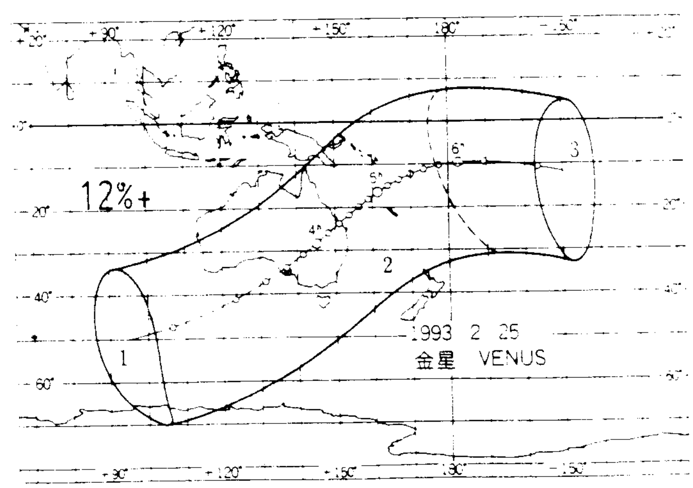
diagrams as functions of the position angle K:
1. WH over K: Gives the profile as derived from Watts' charts of limb corrections with respect to the mean lunar radius.
2. (O-C)+WH over K: Gives the observed profile with respect to the theoretical smooth lunar limb (zero height in Watts' charts).
3. (O-C) over K: Gives the summary error of the observation, the profile, and the positions of the star and the Moon with respect to the theoretical profile.

As the ILOC residual expresses the distance of the star from the limb according to Watts' charts [ed question: Plus corrections?], the distance from the smooth lunar limb can be derived by removing the limb correction with (O-C)+WH.

In reconstructing the lunar profile from total occultations the diagram 1 is needed. The observed profile from diagram 2 may be compared with the predicted profile from diagram 1. Observations of a grazing occultation are often all made from locations near one another, but observations of a total are made from locations which may be very widely separated. This introduces an error that distorts the profiles derived from total occultations as the topocentric librations differ from the observations of the total. Each observer is then presented with a different outline of the lunar disk. The maximum difference between geocentric and topocentric libration is nearly equal to the equatorial horizontal parallax of the Moon (about 1°). If all observing locations are within a few 100 km, which is often the case, then the topocentric librations may only differ by a few 0.1°, and the resulting profile distortion should be only tenths of an arc second. Another uncertainty results from the fact that the observations do not necessarily cover the highest peaks and deepest valleys of the profile.

Some diagrams were drawn applying these considerations to observations made by the author in 1983. As expected, the diagrams 1 'WH over K' look like predicted profiles for grazing occultations. The diagrams 2 '(O-C)+WH versus K' are similar to the 'WH against K'. General trends as well as large peaks or deep valleys can be found at the same place and in the same sense in both diagrams of the same occultations. However, the '(O-C)+WH versus K' show more scattering in the points as compared with observed graze profiles. Apart from the resemblance between the two diagrams, there may be a systematic offset between the two resulting from errors in the star's and/or the Moon's position, just like the shift for a grazing occultation.

<u>Conclusion:</u> It has been shown that the observer can diagram some relations using real occultation data. Most important for the observer might be renewing the necessity to do as many observations as possible. This is necessary for a detailed resolution of the lunar limb profile and for the mutual confirmation of observations. Parallel observations of the same occultation are suitable for this. A visual examination of the reduction results is often a useful addition to pure numerical analysis results since it shows general trends and may help in detecting spurious errors in single observations. These conclusions are known from grazing occultations and are valid for total occultations as well. For more information, see the author's article "Parallel Observations of Lunar Occultations" in <u>ON</u> <u>4</u> (8) p 212-214.



VIDEO TIPS AND VCR Q & A

Tom Campbell

Noise reduction (cont.) In last November's issue of ON, page 114, I described a noise suppression technique to reduce short-wave radio time signal interference caused by power inverters. I use one in the field during grazes to power my 110V AC 9" video monitor. RFI noise can be further suppressed by wrapping a few turns of the AC cord around an iron toroid choke core (Radio Shack # 273-104) close to the power inverter.

Ni-Cad batteries Ni-cad batteries such as camcorder batteries perform better if not re-charged until they reach the point where the low battery indicator flashes. If they are charged most of the time while in a partially discharged state, they develop "memory". That means if a 1 hour battery is recharged after each 20 minutes of use, it will soon develop a 20 to 30 minute capacity instead of one hour! Home video use of the camera rarely lasts more than 20 minutes at any one time. Remove the battery back after each taping, store it in its plastic case, but do not recharge it unless the low battery indicator was flashing. Better to have two battery packs so one can be charging while the other is being used. To prepare the ni-cad battery pack for a graze, playback one of your old tapes until the low battery light flashes. Then fully recharge the battery pack. Don Stockbauer bought a larger double capacity battery for his Sony Camcorder for an extra margin of power in the field and to guarantee recording rate linearity.

The Sony 8mm auto power adapter. I bought one and I was sorry I did! The RFI it generates (from its electronic DC to DC convertor) seriously degrades HF time signal reception! Better to use the battery pack. In fact it is better to use battery power in all your field equipment if it is possible to do so to eliminate sources of RFI. This adapter works fine for family videos in remote areas.

Video frames and fields NTSC (USA) video has 30 frames per second and 525 horizontal scan lines. PAL (European) and the video formats used by other countries are similar in principal but differ in frame rates and the number of horizontal lines. Here I will discuss just some of the NTSC format.

Each frame has two fields. Each field has 262.5 lines and the field rate is 60 per second. A frame consists of two interlaced scanned fields, the odd lines are scanned and then the even lines are scanned which eliminates annoying flicker to the human eye. Motion picture projectors for years have used a technique to eliminate flicker. The projector frame rate is 24 frames per second but there are actually 48 fields per second on the movie screen. A rotating shutter projects each frame twice on the screen. Many of today's VCR companies loosely call a video field a "frame" since some VCRs are capable of single still field playback. Many of the low light level ccd cameras update the video information 60 times a second (field rate) and it is possible to get 1/60 (0.0167) second video time resolution.

But don't you lose picture resolution with still field "frame" playback? Not noticeably because there are still 525 scan lines on the video monitor. The video head drum is rotating over the same video field track on the tape. Both the even and odd pickup heads, on opposite sides of the drum, are scanning the same still video field track.

How is the audio recorded on video tape? VCRs all have a separate linear sound track with its own recording/playback head at a fixed position separate from the rotating video head drum. Some models have hi fi sound which is mixed with the video on the helical scanned video tracks. But the hi fi models too have linear audio soundtracks for non-hi fi sound.

What is the control track? All VCRs and camcorders have a third track for control sometimes called a sync track. It is a linear track that gets 30 magnetic beeps or pulses/second, frame rate. Some models have 60 pulses/second, field rate. The control head and linear audio head are shared in the same small package. The purpose is to maintain proper playback picture alignment (tracking) and constant audio head to rotating video head distance for sound sync with the picture information. The control track serves the same purpose as sprocket holes do for motion picture film. The video recording device has a reasonably accurate frequency standard built in for the sync track magnetic pulses. The playback video capstan motor speed is electronically controlled until the sync track pulses are passing by the control head at the proper rate (30 or 60 per sec.).

Is the camera frame rate alone good enough for video time reduction? No. You might first think that reduced timings can be derived by counting frames starting from a frame where the time may somehow be known. Recording frame rates are close but not accurate enough for occultation time reductions. The same is true for playback rates and those may be different than the recording rates especially if a different playback machine is used. The observed frame rate error has been +/- one or two frames per minute when the battery is good. Somewhat worse when the battery is low. Use a video time insertion device such as the Model IV, by Peter Manly, to get an accurate time display for each occultation recording. The latter has a crystal controlled clock which has been closely adjusted to the NIST time standard. But, for inserting time on a copy (dubbing) from a non time inserted original video tape you will soon notice on the monitor that the playback of the recorded time signals will drift out of sync with the inserted (dubbed) time display. This is because playback rate can be faster or slower than the original recording rate. You have to stop (freeze) the time display by triggering the clock stop off of a played back known time minute marker. Then you calculate the playback rate error and apply corrections to the inserted (dubbed) time display.

What other time corrections must be applied to video occultations?

RADIO PROPAGATION DELAY - First calculate the great circle distance from the time signal radio station to the observing site in kilometers and divide by 299.8 kilometers/millisecond. The answer will be the propagation time delay of the time signal in milliseconds accurate to about +/- one millisecond. Sky hop uncertainties account for the small error which is well within the duration of a single frame. For example, the great circle distance from WWVH, Hawaii to Sawdust, Fl. is 7412.3 kilometers. The propagation delay = 24.7 milliseconds which is added to the reduced video times. The equation for the great circle distance in kilometers, D, is:

$$D = 111 \arccos[\sin(phi)\sin(phis) + \cos(phi)\cos(phis)\cos(long-longs)],$$

where phi = observing site latitude,
phis = radio station latitude,
long = observing site longitude,
longs = radio station longitude,
The arc cosine, which is the great-circle angular distance, is in degrees. This assumes a spherical Earth, but for this calculation, the Earth's oblateness is negligible. The coordinates of some of the more important time stations are given below:

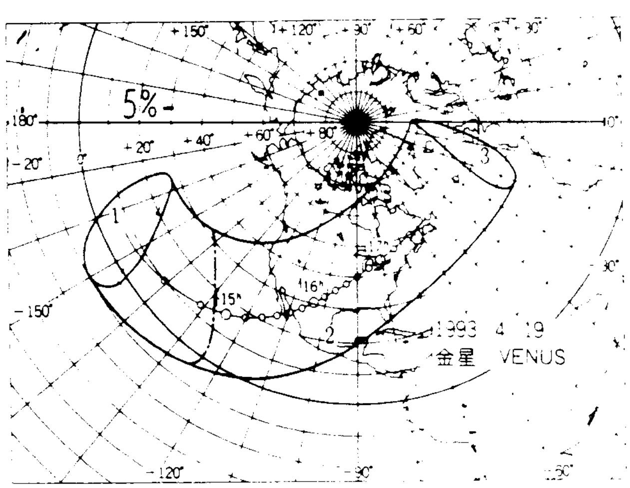
Station	Latitude	Longitude
CHU	45° 18'N	75° 45' W
DCF77	50 01 N	9 00 E
JJY	36 11 N	139 51 E
MSF	52 22 N	1 11 W
RWM	55 48 N	38 18 E
WWV	40 41 N	105 02 W
WWVB	40 40 N	105 03 W
WWVH	21 59 N	159 46 W

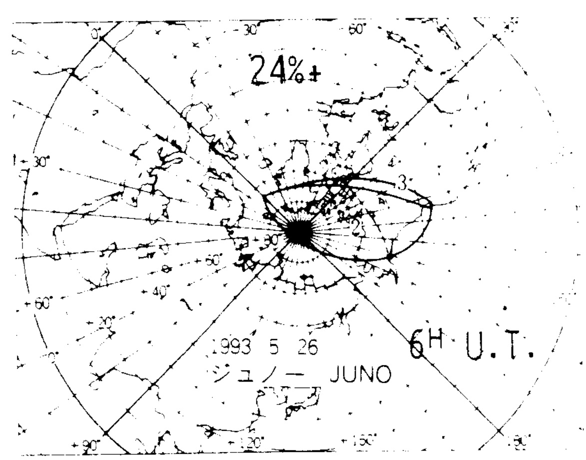
TIME DELAY OF SOUND - If your field clock uses an acoustic coupled (microphone) device to trigger off of the time signal minute tone, the distance from the time signal speaker to the microphone must be known. Sound travels about

1.1 feet per millisecond.

CLOCK TRIGGER DELAY - This is the delay of the audio clock triggering device electronics. The device has to first sample several tone cycles in order to distinguish tone from the background noise prior to generating a trigger. This time delay is usually fixed and given in the owners manual.

The Vtact Prototype, VCR Time signal Audio conditioner and Clock Trigger, as first described on p. 178 of the last issue, that I have recently developed has been extensively used and tested by Don Stockbauer. Don has used the device in conjunction with the Model IV video time inserter, by Peter Manly, to reduce his and David Dunham's large backlog of archived video taped occultations. He has also used the audio pre-amplifier/automatic level control feature, with a built in condenser microphone, for live occultation video recordings. He said, "after using the VTACT, you will want to leave your mixer and microphone in your closet." The device will DX weak voice announcements and DX minute tone markers out of weak audio time signals and bring the volume up to full audio line input level for the VCR soundtrack. It will trigger the clock/time inserter on the very first try some 94% of the time regardless of the input volume level. As long as time signals can be heard, the device will work. Certain transient audio noise conditions cause 6% of the triggers to be either missed or occur pre-maturely. Don will give his full test report in a future ON. I am currently working on a small design change in order to make the device work close to 100% reliability on the first try clock triggers. Production models should be available by September for an attractive fee of only $175 per finished, tested and ready to use unit. The unit will not be available as a kit because of the complexity of its circuitry, some 150 plus electronic components. However, fully detailed drawings, printed circuit foil patterns and a parts list are in the owners manual and anybody with electronics knowledge can make one. You do not have to have a time insertion device to use the VTACT. The Pre-Amp/microphone feature with automatic volume control alone is well worth the cost for a good clean time signal on the VCR soundtrack.





VIDEOGRAPHIC OCCULTATION OBSERVATION TOWARD A BETTER ACCURACY

J. Bourgeois and M. Bousmar

Video recording of an occultation is a nice way for improving the accuracy of occultation observations. Recent black and white CCD surveillance cameras are affordable, lightweight, and very sensitive. With our Philips NXA/1011/01 we are able to observe occultations of stars down to 10th magnitude with a 25cm telescope. However, care is needed to obtain the accuracy such a system could allow. Here are some suggestions concerning the date-time inserter with a radio time signal and concerning a way to analyze the data.

Synchronization In the EIA standard, 60 interlaced semi-images are recorded every second, while there are 50 in the CCIR European standard. The record contains 30 and 25 full images per second, respectively. We deduce that an accuracy of 0.033 and 0.04 seconds should be obtainable in timing an occultation. This is true if we synchronize the time inserter accurately with a radio time signal. Simple time synchronizers were described by P. Manly (ON 4 (12) p. 291) and J. Bourgeois (ON 5 (5) p. 113).

Unfortunately, such synchronizers do not control the phase between the reference time signal and the video time base. The time signal may fall anywhere between the start and the end of a full image. We can do better, however, if we center a full image around the time pulses. In this way, we obtain accuracies better than 0.017 and 0.02 seconds.

One of us (M. Bousmar) modified a circuit suggested by Philips to synchronize the CCD camera to the main frequency, so that it could be triggered by the radio time signal from DCF77 (Mainflingen, Germany). This circuit might be used with any other reference time signal. Figure 1 shows his camera synchronization circuit. In this figure, SAA1043 is a synch-generator wherein a phase-locked loop synchronizes the output pulse (pin 20) with a comparison pulse derived from the reference time signal. To obtain this comparison pulse, the reference time signal (each second) is fed to a HEF4538 monostable, which serves for a precise time adjustment. A strap in front of the monostable allows it to synchronize on a low-to-high or on a high-to-low transition. In this design, a HD6301V microprocessor is then used to generate the comparison pulses (pin 9) each 20 ms (European standard) in synchrony with the external time signal. The second monostable is used to obtain the correct field synchronization. The SAA1043 delivers, on pin 26, a composite synchronization signal, used to synchronize the camera.

To create an autonomous system, Bousmar added an inserter around a teletext circuit, allowing insertion of date, time, and comments on the video image. A menu gives options to show on the monitor the camera signal only, the camera signal with date and time, or with date, time, and comments. Although this sophistication is very convenient, it will not be discussed here for it does not concern accuracy. If you are interested, you may ask Bousmar for details on this circuitry. Otherwise, a commercial time inserter and the synchronizing circuit shown in Figure 1 is all you need to get the best from your record. Comments on available time inserters have been published in earlier ON's; see the references above; ON 5 (7), p. 178; and Cliff Bader's article above.

How to Read the Record: As an occultation light curve is usually traced in a few milliseconds, the image integration (33 msec for the EIA standard and 40 msec for CCIR) is too slow to see it. We may thus consider the event to be sudden in the majority of cases. When analyzing your record, you will often see an image where the star is disappearing or reappearing at a lower level than the previous or following one. It does not necessarily mean that you caught the instant when the light was partially off! Consider what happens:

In the case of a disappearance, we usually consider the time indicated by the time inserter on the first image where the star is not there to be the time of disappearance. It is correct if we declare the timing accuracy to be 0.03 or 0.04 sec. If we use the synchronization circuit described here, we need to be more accurate. If Figure 2, where only the 50MHz standard is considered, shows the disappearance or reappearance events as time progresses. The star's brightness in the last image/first image in which the star is detected depends on the instant the event occurred relative to the beginning of each camera frame. For a disappearance, if we estimate the decrease in brightness, we might correct the inserted time (Tinserter) read on the following image, where the star is no longer visible. The corrected timing (Tdis) is the inserted time minus a correction, or Tdis = Tinserter - Tcor

50 Hz standard:

Mag decrease	Tcor
1.5 mag	0.05 sec
0.8 mag	0.04 sec
0.5 mag	0.03 sec
0.0 mag	0.02 sec

[Ed note - Henk Bulder points out that these values assume a geometrical occultation and are consequently not correct due to the effects of Fresnel diffraction, which increase as one approaches a grazing situation.] Similarly, for reappearances, we would correct the timing by taking the first image where the start is visible (Tinserter) and adding a correction as follows: Tdis = Tinserter + Tcor

Mag decrease	Tcor
1.5 mag	-0.02 sec
0.8 mag	-0.01 sec
0.5 mag	0.0 sec
0.0 mag	+0.02 sec

[Ed note - why the 0.02 offset? Also, see note above.]

It is obvious that a good signal-to-noise ratio is necessary to estimate correctly the difference in the star's brightness. In such cases, we might indicate an accuracy of 0.01 sec, which is a very nice improvement. In other cases, the accuracy would only be 0.02 sec. These are, of course, only one component in the overall accuracy of our observations. We must also take account of the errors in our geodetic position in our report to ILOC.

<u>Conclusion:</u> With a good video time base synchronization and a careful analysis of our records we are able to push the video timing accuracies to the limits. Here is a good opportunity to make more accurate observations.

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SOME GOFFIN 1993 EVENTS ERRONEOUS

David P. Werner and David W. Dunham

This is a warning to regional coordinators who are distributing copies of Edwin Goffin's asteroidal occultation predictions for 1993. If the star designation begins with "Lick2", the star's declination is probably wrong, by at least several arc minutes, and no occultation will occur. These stars are from the Lick Voyager-Saturn catalog, which straddles the celestial equator in Virgo. Apparently, a program bug caused bad values of the declinations of these stars to be calculated when Goffin created his J2000 version of this catalog. The other catalogs converted by Goffin seem to be alright. We discovered this error while comparing Goffin's charts with the True Visual Magnitude Atlas; apparently all of the faint stars on the charts for "Lick2" stars have bad declinations. We will not include these events in the 1993 Asteroidal Occultation Supplement for North American observers that we plan to distribute with the next issue.

Figure 1 (Bourgeois and Bousmar)

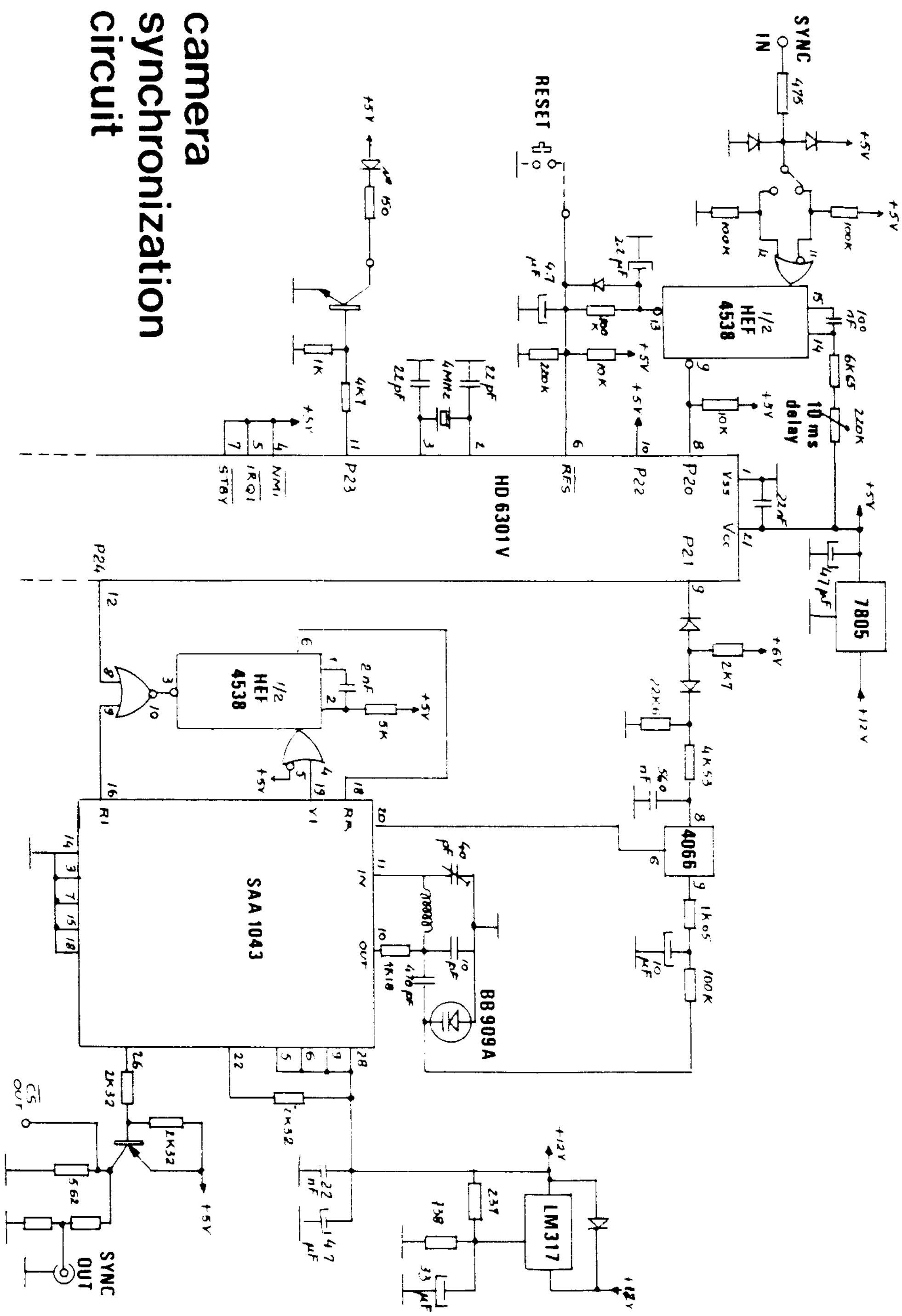
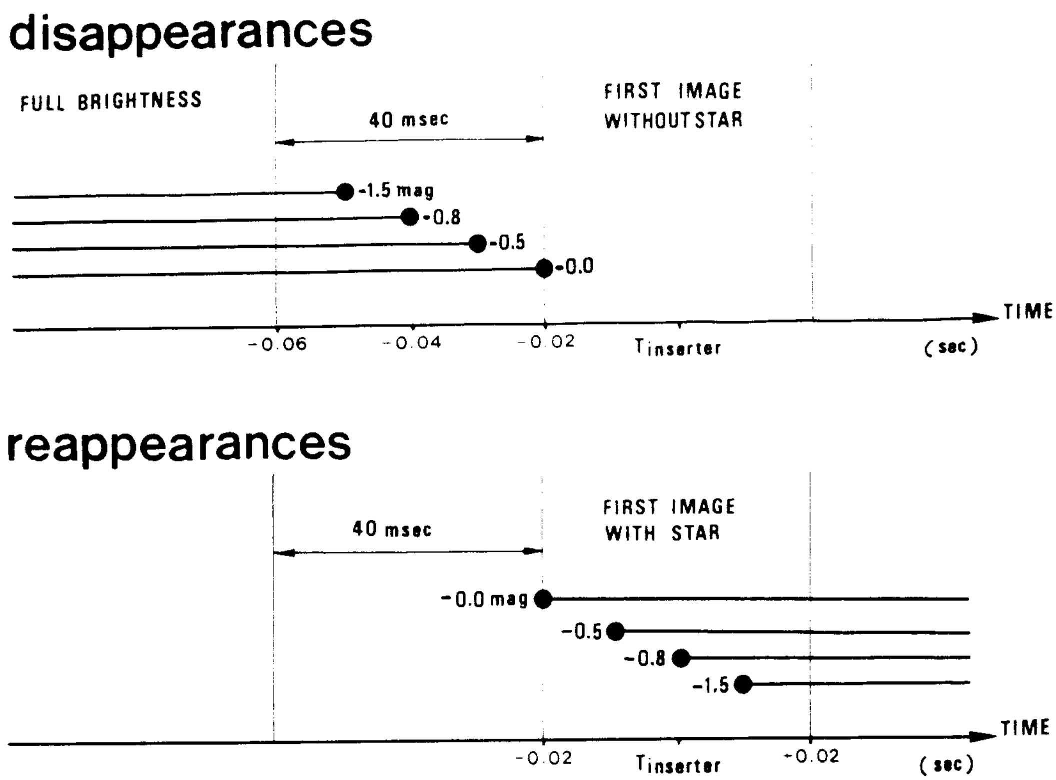
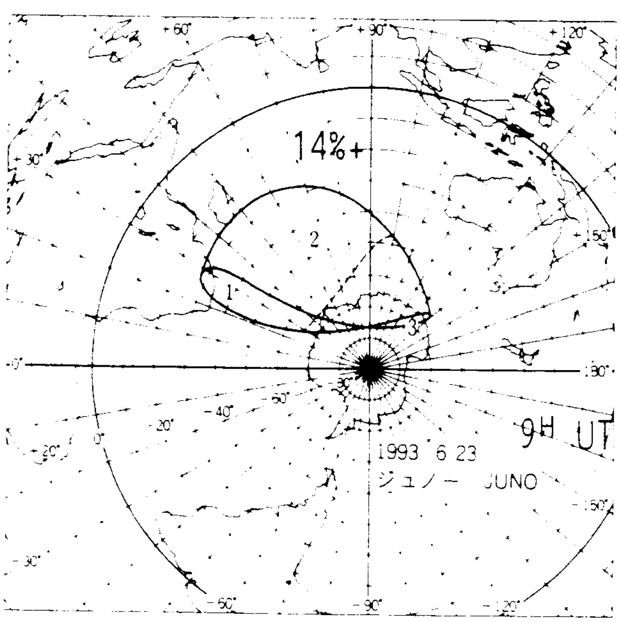
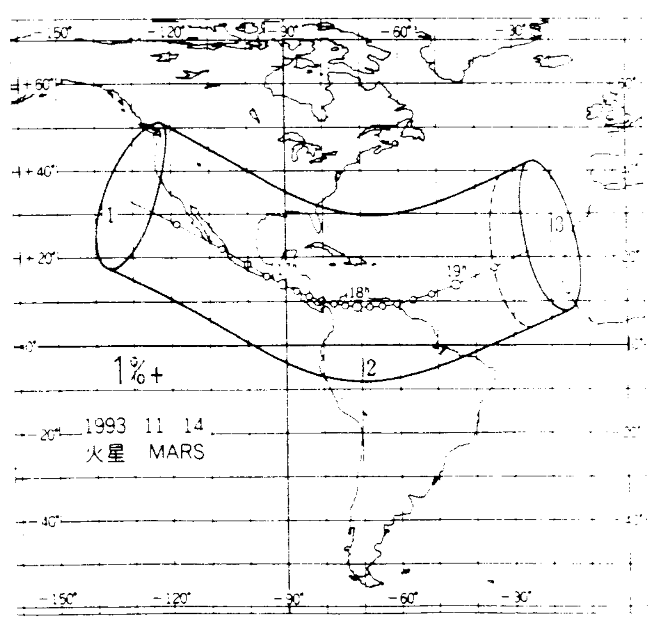


Figure 2 (Bourgeois and Bousmar)



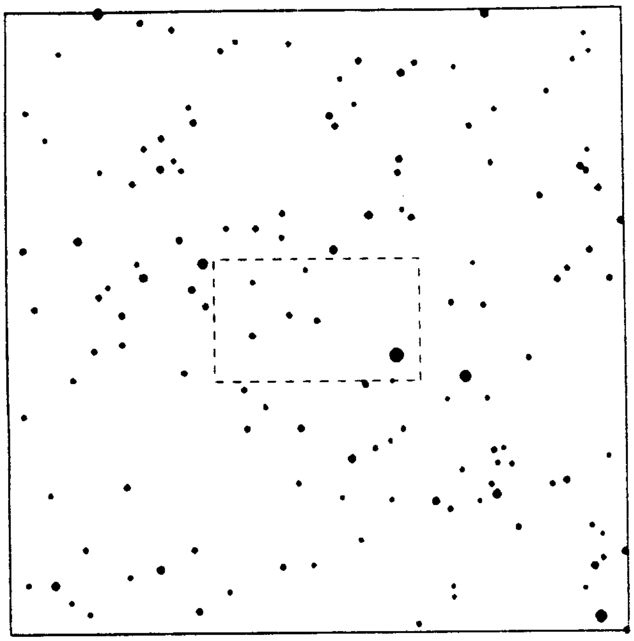


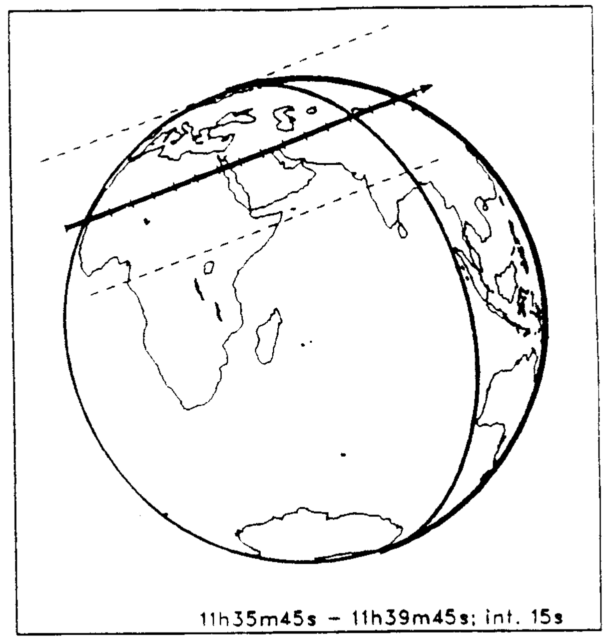


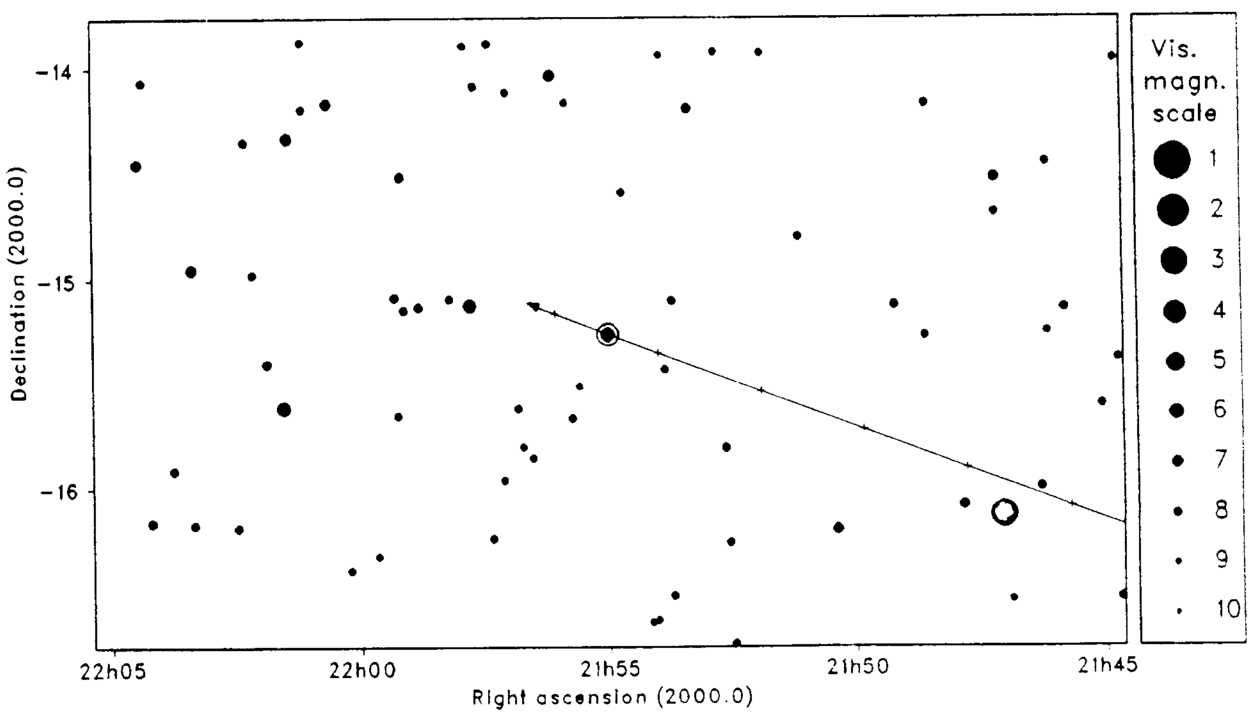
21 Lutetia – PPM 531390

1992 dec 29 11h38.6m U.T.

Minor planet :			Star :	Source cat. PPM
V. mag. = 12.04	Diam. = 99.0 km = 0.05″		α = 21h55m00.302s	δ = −15°15′29.50″
μ = 80.23″/h	π = 3.41″	Ref. = MPC15523	V. mag. = 7.0	Ph. mag. =
Δm = 5.9	Max. dur. = 2.4 s		Sun : 47°	Moon : 15° , 26%







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 <u>ON</u> 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
Secretary-Treasurer	Craig and Terri McManus
VP for Grazing Occultation Services	Joe Senne
VP for Planetary Occ'n Services	Joseph Carroll
VP for Lunar Occultation Services	Walter Morgan
<u>ON</u> Editor	Joan Bixby Dunham
IOTA/European Section President	Hans-Joachim Bode
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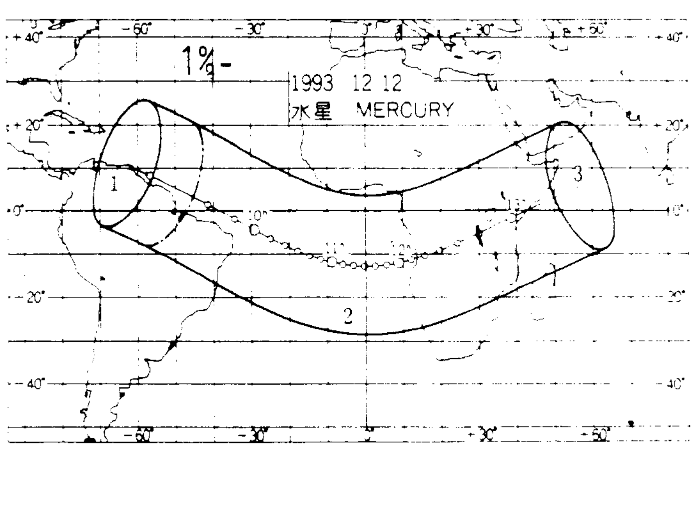
IOTA/ES Research & Development	Wolfgang Beisker
IOTA/ES Public Relations	Eberhard Riedel

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. When updates become available for asteroidal occultations in the central U.S.A., the information can also be obtained from either 708-259-2376 (Chicago) or 713-488-6871 (Houston); note that the area code given for the Chicago number on p. 77 of the January issue of <u>Sky and Telescope</u> is wrong.

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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