Occultation Newsletter

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FROM THE PUBLISHER

For subscription purposes, this is the second issue of 1981.

O.N.'s price is $1/issue, or $4/year (4 issues) including first class surface mailing, and air mail to Mexico. Back issues also are priced at $1/issue. Please see the masthead for the ordering address. Air mail shipment of *O.N.* subscriptions is $1.80/yr. extra, outside the U.S.A., Canada, and Mexico.

IOTA membership, subscription included, is $7/year for residents of North America (including Mexico) and $9/year for others, to cover costs of overseas air mail. European and U. K. observers should join IOTA/ES, sending DM 12.-- to Hans J. Bode, Bartold-Knaust Str. 8, 3000 Hannover 91, German Federal Republic.

IOTA NEWS

David W. Dunham

I plan to attend the Astronomical League/A.L.P.O. Convention, "AstroCon 81," at Kutztown State College, Kutztown, PA, at least for the paper sessions on August 13 and 14, and workshops on the 15th. I plan to give a paper on recent IOTA work, during which I plan to show movies of the 1980 February 16 total solar eclipse which we made near the southern limit in India, and of the May 9th grazing occultation videotape discussed on p. 166. The paper may be given during the International Amateur-Professional Photoelectric Photometry (IAPPP) paper session the afternoon of the 14th. I have also requested a workshop on occultations the next day, probably to be held, totally or in part, concurrently with the IAPPP photometry workshop in the afternoon. An IOTA/National Capital Astronomers (the local Astronomical League affiliate, of which I am a member) display is also planned. Graham Blow, who has organized photoelectric occultation observations and is director of the very active Occultation Section of the Royal Astronomical Society of New Zealand, will be travelling in the U.S.A. at the time and plans to attend AstroCon 81. It should be a useful convention for occultation observers.

Unfortunately, tests of the relatively inexpensive occultation photometer described on p. 129 of the last issue are behind schedule. Those interested in assembling a copy of the photometer should write for information to Peter C. Chen, Department of Astronomy, University of Texas, Austin, TX 78712, U.S.A.

John Phelps reports that the IOTA treasury balance stands at about $2000, so that no membership or basic subscription price increase will be needed this year, in spite of general inflation and substantial postal rate increases. The only increase (last one on January 1) is the extra price paid by overseas non-IOTA *O.N.* subscribers for airmail delivery.

Some members have suggested that IOTA incorporate as a non-profit organization; some advantages of doing this are described below. Our inclination now is to incorporate, but before we do so, we will give you a chance to express your feelings about it, pro or con, by writing to me or to the IOTA address in Tinley Park, IL. More about this will be reported in the next issue. Many local astronomical societies smaller than IOTA have incorporated. The cost to incorporate in the State of Illinois is $75, plus a fee for a lawyer to prepare the necessary papers. We could incorporate in another state, and would especially consider doing so if one of you, or a friend, is a lawyer willing to do the paper work at little or no cost to IOTA. After incorporation, we will file an application with the Federal government as a non-profit organization to obtain tax-exempt status. This will permit us to do several things, including the following: We will be able to write proposals to obtain grants to purchase equipment or to hire part-time help to finish some of IOTA's long-languishing projects. Members can deduct their IOTA expenses from their reported income on federal tax returns. Besides membership dues, these expenses can include the cost of travel to observe grazes and other occultation events, the purchase of special equipment to be used for IOTA work, and part of your rent or mortgage payments according to the ratio of the number of square feet of your dwelling devoted to IOTA records and equipment, to the total number of square feet of your dwelling. We can obtain a reduced domestic bulk mailing rate. These things will not help foreign IOTA members directly, but even they will benefit from the increased IOTA services which can result from incorporation. Occultation observers in other countries might obtain similar benefits by forming their own national organization. Effectively, some already have done this by establishing occultation sections of larger incorporated national astronomical associations. Tax deductibility for travel alone would encourage more graze, and other occultation, expeditions, which should result in more observations.

This issue has been delayed by my work with eclipses and asteroid occultations. Besides work for the new 1981 events, I have completed preliminary calculations for all of the 1982 planetary/asteroidal occultations to meet a deadline for the *Handbook* of the Royal Astronomical Society of Canada. The usual articles about observed grazes and new double stars will be delayed until the next issue, which we plan to distribute within four to six weeks. Renewal notices are included for many with this issue, and prompt payment (before distribution of the next issue) is encouraged.

Working with Alan Fiala and Tom Van Flandern at USNO, I have developed software to compute automatically the latitudes and times of points at equal intervals of longitude in the northern and southern limits of total and annular eclipses, taking into account the lunar valleys and mountains according to Watts' data, as well as numerous other factors considered by Van Flandern in his analysis of occultation data. The path of the July 31st total eclipse was computed and plotted on fairly detailed, restricted maps of the U.S.S.R. Descriptions of sites just inside the path edges were sent to potential observers, who probably do not have access to topographic maps themselves. We hope that some observations will be made which will be useful for measuring the solar radius. Alan Fiala is taking video equipment to Bratsk, Siberia, where he hopes to record Bailey's beads from a site near the northern limit. Hans Bode is traveling to Tselinograd, where he plans to make observations near the southern limit. Our preliminary analysis of the Australian observations made near the edges of the path of annularity of last February's eclipse gives a solar radius exactly the same as that we determined from our 1980 February total eclipse timings in India. I am starting to analyze graze observations to try to improve knowledge of the lunar profile at small latitude librations, and will report on this work in the next issue.

David Herald reduced Astrographic Catalog data to obtain the positions of faint non-SAO stars in the field traversed by the partially eclipsed moon on July 17. I created a small special USNO "B" catalog from Herald's data and computed occultation predictions during the July eclipse, which I distributed to photoelectric observers, most of them in the U.S.A. Because the eclipse was only partial, only those with access to large telescopes had a reasonable chance to time the occultations of the non-SAO stars. Don Stockbauer reports that he and another observer successfully timed the graze of an 8.0-magnitude SAO star under clear skies during the eclipse in Mississippi.

Dr. Kubo reports that the International Lunar Occultation Centre plans to produce computer-generated maps of occultation limits for 1983 on, for various publications. The Royal Greenwich Observatory did this previously, and has distributed maps for 1982, the last year for which they produced the maps. Michael Kazmierczak modified his copy of the IOTA graze prediction program to generate path data on magnetic tape, which he then used to produce maps of graze paths crossing GA, SC, and NC, automatically.

Harold R. Povenmire, 215 Osage Dr., Indian Harbour Beach, FL 32937, U.S.A., has written a second edition of his *Graze Observers Handbook*, containing 180 pages and illustrated with 15 pictures and charts. In a few places, changes have been made from the original edition, and some new chapters have been added, including a short one on occultations by asteroids. A Foreword has been written by Dr. John O'Keefe. The first edition was reviewed in *Sky and Telescope, 51* (3), 189, and in *O.N. 1* (7) 63. IOTA members can obtain the new edition at a 10% discount ($8.10) by sending a check payable to the author at the above address.

A meeting of IOTA/European Section is planned to be held in Hannover, on Saturday, November 7th. Details may be obtained by writing Hans-Joachim Bode, Bartold-Knaust Str. 8, 3000 Hannover 91, German Federal Republic.

1977 TOTAL OCCULTATION TALLY

Joseph E. Carroll

The following two tables — one by country and one by individual — present the ordered counting of total occultations reported for the year 1977. In the individual lists, it appears that the first three entries derive from multiple observers. The leading lone observer, therefore, is Morrisby from Rhodesia, followed closely by Hays of the U.S.A.

The values again were computed as in 1975 and 1976 — via the formula: Value = Total + C × Reappearances, where C is the ratio of total disappearances to total reappearances minus 1. In 1977, 471 observers from 32 countries reported 9038 total occultations, of which 2135 were reappearances. That makes C = 2.2333, or reappearances are weighted over disappearances by the factor 3.2333.

In the table of individual observers, numerous blanks occur for names where none were available. In some of these cases (notably the Simosato and Sirahama observatories in Japan) the locations are the same. The repetition

1977 TOTAL OCCULTATION RANKING BY COUNTRY

Rank	Value	Total	R's	Country	# Obs.
1	4532.5	2824	765	United States	85
2	1928.2	1084	378	Japan	33
3	990.2	854	61	Australia	24
4	792.9	449	154	Rhodesia	3
5	749.2	575	78	England	34
6	748.4	380	165	Denmark	13
7	725.2	455	121	U.S.S.R.	70
8	664.1	519	65	New Zealand	31
9	422.3	266	70	South Africa	5
10	306.4	197	49	Argentina	3
11	258.1	180	35	Belgium	9
12	233.9	187	21	Germany	21
13	190.7	117	33	Philippines	4
14	159.3	128	14	Czechoslovakia	45
15	156.6	141	7	Netherlands	13
16	137.9	62	34	Canada	7
17	120.6	96	11	Portugal	5
18	114.4	101	6	Italy	12
19	113.0	84	13	Brazil	8
20	100.0	62	17	Spain	6
21	98.7	63	16	Switzerland	3
22	90.9	73	8	Austria	20
23	64.9	47	8	Norway	5
24	25.0	25	0	Jugoslavia	1
25	17.5	13	2	Finland	3
26	17.2	15	1	Namibia	1
27	16.2	14	1	Scotland	2
28	9.2	7	1	Israel	1
29	9.0	9	0	Chile	1
30	5.2	3	1	Sweden	1
31	5.0	5	0	Iraq	1
32	3.0	3	0	Mexico	1
Totals		9038	2135		471

is based upon differing observer codes in the Royal Greenwich Observatory tape data. [continued overleaf]

RNK	VALUE	OBSERVER	LOCATION	TOTAL	REAP
1	624.9		JAPAN, SIRAHAMA	357	120
2	523.1	WEITH-KNUDSEN, ET AL	DENMARK, TISVILDELEJE	206	142
3	507.7	J AFRICANO ET AL	U.S.A., MCDONALD OBS. TEXAS	367	63
4	433.3	A MORRISBY	RHODESIA, SALISBURY	219	96
5	399.6	R HAYS JR.	U.S.A., CHICAGO, ILLINOIS	192	93
6	340.5	DAVID HERALD	AUSTRALIA, CANBERRA	240	45
7	318.6	T TAKEMURA	JAPAN, KURASIKI	169	67
8	265.2	JAN HERS	S. AFRICA, RANDBURG	129	61
9	259.8	J VINCENT	RHODESIA, SALISBURY	137	55
10	254.3	JAMES L. FERREIRA	U.S.A., FREMONT, CALIF.	136	53
11	236.2	ROBERT CLYDE	U.S.A., STREETSBORO, OHIO	100	61
12	231.7	WALT MORGAN	U.S.A., LAS VEGAS, NEVADA	91	63
13	219.6	RICHARD NOLTHENIUS	U.S.A., SAN DIEGO, CALIF.	166	24
14	194.4	ROBERT H. SANDY	U.S.A., KANSAS CITY, MISSOURI	114	36
15	193.4	DON M. STOCKBAUER	U.S.A., VICTORIA, TEXAS	113	36
16	170.4	ROBERT LASCH	U.S.A., GREEN VALLEY ARIZONA	99	32
17	160.6	JOHN S. KORINTUS	U.S.A., PALM BAY, FLORIDA	107	24
18	159.7	B. SINCHESKUL	U.S.S.R., POLTAVA	86	33
19	148.0	P ANDERSON	AUSTRALIA, BRISBANE	148	0
20	144.2	J RODRIGUEZ	ARGENTINA, CORDOBA OBSERVATORY	104	18
21	141.5		JAPAN, SIRAHAMA	79	28
22	134.4		JAPAN, SIMOSATO	54	36
23	133.3		JAPAN, SIRAHAMA	73	27
24	131.0	K BLACKWELL	ENGLAND, WESTHAM, SUSSEX	93	17
25	126.7	BEN HUDGENS	U.S.A., CLINTON, MISSISSIPPI	82	20
26	123.6	AMBROSIO JUAN CAMPONOVO	ARGENTINA, BUENOS AIRES	70	24
27	122.0	STEVE J. ZVARA	U.S.A., WHITTIER, CALIFORNIA	55	30
28	121.2	OSCAR G. DE LAS ALAS	PHILIPPINES, MANILA	52	31
29	117.7	M BECH	DENMARK, COPENHAGEN	73	20
30	117.6	JEAN BOURGEOIS	BELGIUM, MONTIGNY LE TILLEUL	64	24
31	117.3	DOUGLAS HALL	ENGLAND, LEICESTER	57	27
32	117.1	E HALBACH	U.S.A., MILWAUKEE, WIS.	59	26
33	114.8		U.S.A., MORONGO VALLEY, CALIF.	50	29
34	112.2	DAVID D. BROWN	CANADA, MONTREAL	43	31
35	100.0	GEORGE WINGATE	NEW ZEALAND, AUCKLAND	62	17
36	99.7	A HILTON	RHODESIA, SALISBURY	93	3
37	95.8		JAPAN, SIMOSATO	40	25
38	87.0		JAPAN, KURASIKI OBS.	58	13
39	84.6	ALFREDINA DO CAMPO	PORTUGAL, LISBON OBSERVATORY	60	11
40	83.2	MICHAEL C. ASHLEY	AUSTRALIA, CANBERRA	72	5
41	83.0	JAMES H. VAN NULAND	U.S.A., SAN JOSE, CALIF.	83	0
42	82.2	JOSEPH E. CARROLL	U.S.A., MINNETONKA, MINNESOTA	42	18
43	82.0	CLIFFORD J. BADER	U.S.A., WEST CHESTER, PA.	44	17
44	81.0	PAUL ASMUS	U.S.A., AURORA, COLORADO	52	13
45	78.7	LIONEL E. HUSSEY	NEW ZEALAND, CHRISTCHURCH	34	20
46	78.2	GLEN ROWE	NEW ZEALAND, AUCKLAND	76	1
47	72.8		U.S.A., DENVER, COLORADO	46	12
48	71.7	H. F. COCHRAN	U.S.A., BROWNWOOD, TEXAS	65	3
49	69.9	G MARSHALL	S. AFRICA, JOHANNESBURG	61	4
50	67.7	PAUL J. NEWMAN	U.S.A., GARLAND, TEXAS	23	20
51	66.2	ROGER LAUREYS	BELGIUM, DIEPENBEEK	64	1
52	65.2		AUSTRALIA, CANBERRA	54	5
53	63.7	A. ZHITETSKI	U.S.S.R., KIEV	28	16
54	63.0	F ZEHNDER	SWITZERLAND, BIRMENSTORF	34	13
55	61.5	JUAN D. SILVESTRE	PHILIPPINES, MANILA	57	2
56	60.0	J SMITH	U.S.A., WACO, TEXAS	60	0
57	59.5	H. F. DABOLL	U.S.A., ST. CHARLES, IL.	26	15
58	56.8	O. KVARATSKHELYA	U.S.S.R., ABASTUMANI OBS.	30	12
59	54.9	Y KIMOTO	JAPAN, TOKYO	46	4
60	54.8		SPAIN, SAN FERNANDO OBS.	28	12
61	53.2	V. MAZUR	U.S.S.R., KIEV	42	5
62	52.5	ALFRED C. WEBBER	U.S.A., CHADDS FORD, PA.	48	2
63	51.0	B SOULSBY	AUSTRALIA, CANBERRA	51	0
64	49.1	HANS-JOACHIM BODE	GERMANY, HANNOVER	29	9
65	46.5	MARK GINGRICH	U.S.A., OAKLAND, CHABOT OBS.	42	2
66	46.5	RICHARD BINZEL	U.S.A., MACALESTER COLLEGE, MN	42	2
67	44.8	K KENMOTU	JAPAN, SIMOSATO	18	12
68	44.0	J VAN DER MEULEN	NETHERLANDS, WOGNUM	44	0
69	43.9		S. AFRICA, JOHANNESBURG	35	4
70	43.2	MAURICE STOKER	NEW ZEALAND, AUCKLAND	32	5
71	39.9	GERRY ALLCOTT	NEW ZEALAND, AUCKLAND	31	4
72	39.6	V. MAZHOROVSKI	U.S.S.R., POLTAVA	15	11
73	39.3	A. OSIPOV	U.S.S.R., KIEV	17	10
74	39.0	H. WILLIAMS	NEW ZEALAND, AUCKLAND	39	0
75	38.7	JORGE POLMAN	BRAZIL, RECIFE	32	3
76	38.6	EDUARDO VALENTIN PRZYBYL	ARGENTINA, RAFAELA	23	7
77	38.5	A MACDONALD	AUSTRALIA, TOWNSVILLE	34	2
78	37.7	GRAHAM L. BLOW	NEW ZEALAND, AUCKLAND	31	3
79	36.7	H ABE	JAPAN, OSYAMANBE	30	3
80	36.6	M. ESHMATOV	U.S.S.R., TASHKENT	12	11
81	36.6	TOM BUTLER	U.S.A., TROY, MISSOURI	21	7
82	35.5	D PETTITT	ENGLAND, CARLISLE	31	2
83	35.5	G MORSE	ENGLAND, MAIDENHEAD	31	2
84	34.6	ROBERT N. BOLSTER	U.S.A., ALEXANDRIA, VA.	19	7
85	34.2	DAVID BROCK	NEW ZEALAND, AUCKLAND	32	1
86	34.2		NEW ZEALAND, GISBORNE	32	1
87	33.7	G HEWICK	ENGLAND, LEICESTER	27	3
88	33.0		AUSTRALIA, BRISBANE	33	0
89	32.9	HARALD MARX	GERMANY, KORNTAL-MUNCHINGEN	24	4
90	32.7	ROBERT GERMANN	SWITZERLAND, WALD	26	3
91	32.7	J POGODA	CZECHOSLOVAKIA, OLOMOUC	26	3
92	32.6	JOSEPH ZODA	U.S.A., MAPLE PARK, ILL.	17	7
93	32.4	O MIDTSKOGEN	NORWAY, TRANBY	19	6
94	31.4		U.S.A., LAKE PARK, FLA.	18	6
95	31.2	GEOFFREY W. AMERY	ENGLAND, READING	29	1
96	31.0	D. STANKEVICH	U.S.S.R., KHARKOV	31	0
97	31.0	J MORGAN	ENGLAND, CAMBRIDGE OBS.	31	0
98	30.2	H PACHALI	GERMANY, BERLIN NEUKOLLN	28	1
99	30.2		ENGLAND, BRACKNELL	19	5
100	30.2	ROGER H. GILLER	AUSTRALIA, ENGADINE	28	1
101	30.0	BRUCE RUSNAK	U.S.A., ST. PAUL, MINNESOTA	30	0
102	29.6		JAPAN, SIMOSATO	14	7
103	29.2	CHET PATTON III	U.S.A., BUCHANAN, MICHIGAN	18	5
104	29.2	L PAZZI	S. AFRICA, NIGEL, TVL.	27	1
105	27.9		U.S.A., DUBLIN, CALIFORNIA	19	4
106	27.6	RONALD W. CROSS	NEW ZEALAND, CHRISTCHURCH	12	7
107	26.9	J. A. BARRATA ARAUJO	BRAZIL, RECIFE	9	8
108	26.7	NOEL MUNFORD	NEW ZEALAND, PALMERSTON NOR.	20	3
109	26.6	T HIRAIWA	JAPAN, KURASIKI	11	7
110	26.4	J DOMMANGET	BELGIUM, BRUSSELS, R. OBS.	13	6
111	26.2	JAMES H. FOX	U.S.A., WEST ST. PAUL, MINN.	24	1
112	26.2	F CERCHIO	ITALY, RIVALBA, NR. TURIN	24	1
113	26.0	M THOMAS	NEW ZEALAND, DUNEDIN	26	0
114	26.0	W. H. ROBERTSON	AUSTRALIA, SYDNEY OBSERVATORY	26	0
115	25.4		JAPAN, KURASIKI	12	6
116	25.2		NEW ZEALAND, AUCKLAND	23	1
117	25.0	V PROTIC-BENISEK	YUGOSLAVIA., BELGRADE OBS.	25	0
118	24.5	J RYDER	AUSTRALIA, BRISBANE	20	2
119	24.2	KLAUS KLEBERT	GERMANY, STUTTGART SWABIAN	22	1
120	24.0	EZEQUIEL CABRITA	PORTUGAL, LISBON OBSERVATORY	24	0
121	23.9	W MELLOR	ENGLAND, SHEFFIELD	15	4
122	23.7	A SALAZAR	SPAIN, SAN FERNANDO OBS.	17	3
123	23.5	D EVALS	ENGLAND, BIRMINGHAM	19	2
124	23.2		U.S.A., ROCKLEDGE, FLORIDA	21	1
125	23.2		NORWAY, LANGENESBYGDA	21	1
126	23.2	CARL GRUNNET	DENMARK, VIRUM	21	1
127	23.0		AUSTRALIA, CHINCHILLA	23	0
128	22.9	WILLIAM J. WESTBROOKE	U.S.A., SAN FRANCISCO, CALIF.	14	4
129	22.9	E KARKOSCHKA	GERMANY, STUTTGART	14	4
130	22.2	A. POROSHIN	U.S.S.R., GORKI	20	1
131	22.2	A MCCONNELL	U.S.A., RIDGECREST, CALIFORNIA	20	1
132	22.0		AUSTRALIA, LAVINGTON	22	0
133	21.9		ITALY, TURIN	13	4
134	21.9	ROLAND BONINSEGNA	BELGIUM, CHARLEROI(MARCINELLE)	13	4
135	21.7	V. SINCHESKUL	U.S.S.R., POLTAVA	15	3
136	21.2		ENGLAND, HARROGATE	19	1
137	21.0		U.S.A., ENGLEWOOD, FORIDA	21	0
138	21.0	J BAGULEY	ENGLAND, DERBY	21	0
139	20.7	H TOMIOKA	JAPAN, HITACHI	14	3
140	20.5	R MIDDLETON	ENGLAND, COLCHESTER	16	2
141	20.2	OCENAS	CZECH., BANSKA BYSTRICA	9	5
142	20.0	F ROSSET	ITALY, UDINE	20	0
143	19.9		AUSTRIA, ST LEONHARD(POLTEN)	11	4
144	19.5		ENGLAND, EASTHAM	15	2
145	19.4		NETHERLANDS, ZOETERMEER	6	6
146	19.2	V TANGNEY	U.S.A., MILWAUKEE, WIS.	8	5
147	19.0		AUSTRALIA, PERTH OBSERVATORY	19	0
148	18.5	M FRASER	ENGLAND, LEICESTER	14	2
149	18.2	H LUFT	U.S.A., OAKLAND GARDENS, N.Y.	16	1
150	18.2	C KAPRAL	U.S.A., PARLIN NEW JERSEY	16	1
151	18.2		NETHERLANDS, STREEFKERK	16	1
152	18.2	O KLINTING	DENMARK, RINGSTED	16	1
153	18.0	JAMES PERILLAT	U.S.A., OAKLAND, CHABOT OBS.	18	0
154	18.0	R BOSCHLOO	NETHERLANDS, LAREN	18	0
155	18.0		JAPAN, TIBA	18	0
156	18.0	O CHAVES	BRAZIL, RIO DE JANEIRO	18	0
157	18.0	B BRIDGE	AUSTRALIA, BRISBANE	18	0
158	17.2	E SAWYER	NAMIBIA, WINDHOEK	15	1
159	17.2	N WATANABE	JAPAN, SIMOSATO	6	5
160	17.0	J MEDSKER	U.S.A., BUCHANAN, MICHIGAN	17	0
161	17.0	A VAN DER DRIFT	NETHERLANDS, SOESTDIJK	17	0
162	16.9	E NISIMURA	JAPAN, TOKYO	8	4
163	16.5		U.S.A., URBANA,ILLINOIS UNIV.	12	2
164	16.5		AUSTRIA, VIENNA	12	2
165	16.2	A. YUSHCHUK	U.S.S.R., KIEV	5	5
166	16.2	L BRUNDLE	ENGLAND, HAYWARDS HEATH	14	1
167	15.5	V. PHEDOSENKO	U.S.S.R., KOMSOMOLSK-NA-AMUR	11	2
168	15.5	JOSE OSORJO	SPAIN, MADRID	11	2
169	15.5	MATTI SUHONEN	FINLAND, HELSINKI	11	2
170	15.2		U.S.A., CHICAGO, ILLINOIS	13	1
171	15.0	BARRY MENZIES	NEW ZEALAND, AUCKLAND	15	0
172	15.0	V RASMUSSEN	DENMARK, KOLDING	15	0
173	14.2		SCOTLAND, DUNDEE, MILLS OBS.	12	1
174	14.2		ITALY, ROME	12	1
175	14.2	C BRUNT	ENGLAND, CAMBRIDGE OBS.	12	1
176	14.2		ENGLAND, WIMBORNE	12	1
177	14.0		U.S.A., SOLON, OHIO	14	0
178	14.0	H KRUMM	S. AFRICA, LANGEBAAN	14	0
179	14.0	J. VAN CAMP	BELGIUM, URANIA OBS.	14	0
180	14.0	MARK TAYLOR	AUSTRALIA, CANBERRA	14	0
181	13.7	C CANNON JR	U.S.A., SAN FRANCISCO, CALIF.	7	3
182	13.7	M KAWADA	JAPAN, TOKYO	7	3
183	13.5		JAPAN, TOKYO	9	2
184	13.5		ENGLAND, BIRMINGHAM	9	2
185	13.2	MARTIN KNITSCH	GERMANY, HANNOVER	11	1
186	13.0	V. GOLUBEV	U.S.S.R., GORNOTAEZHNI, SIBERIA	13	0
187	13.0	A WELLS	ENGLAND, BIRMINGHAM	13	0
188	12.5	A. MOROZOV	U.S.S.R., TOMSK	8	2
189	12.2		U.S.A., SAN FRANCISCO UNIV.	10	1
190	12.0	CHRISTOPHER STEPHAN	U.S.A., STREETSBORO, OHIO	12	0
191	12.0		GERMANY, SCHMIDEN/STUTTGART	12	0
192	12.0	P DARNELL	DENMARK, COPENHAGEN	12	0
193	12.0		DENMARK, COPENHAGEN	12	0
194	11.5	N TABEISI	JAPAN, TOKYO	7	2
195	11.5		JAPAN, TOKYO	7	2
196	11.5		ENGLAND, WALES, DYSERTH	7	2
197	11.5	KARL E. MCNAMARA	CANADA, MONTREAL	7	2
198	11.2	VICTOR J. SLABINSKI	U.S.A., ARLINGTON, VIRGINIA	9	1
199	11.0	ROBERT R. BAILEY	U.S.A., HOUSTON, TEXAS	11	0
200	11.0	E OTTO	GERMANY, EILENBURG	11	0
201	10.5		BRAZIL, RECIFE	6	2
202	10.2	V. TKACHENKO	U.S.S.R., KHERSON	8	1
203	10.2	G KELLOCK	AUSTRALIA, CANBERRA	8	1
204	10.0		U.S.A., MCMINNVILLE, TENNESSEE	10	0
205	10.0	D SCHMIDT	NETHERLANDS, HUIZEN	10	0
206	9.7	G SAMOLYK	U.S.A., MILWAUKEE, WIS.	3	3
207	9.5	D SCOTT	U.S.A., PANAMA CITY, FLORIDA	5	2
208	9.2	G. HERDMAN	NEW ZEALAND, AUCKLAND	7	1
209	9.2	M ALON	ISRAEL, YAVNE	7	1
210	9.2	WEYRICH	GERMANY, EILENBURG	7	1
211	9.2	W CAUNTER	ENGLAND, TOTNES DEVON	7	1
212	9.0	P. PAVLENKO	U.S.S.R., KHARKOV	9	0

Looking over the 1975, 76, 77 lists shows that Hays of the U.S.A., Sirahama Observatory of Japan, and Take-

RNK	VALUE	OBSERVER	LOCATION	TOTAL	REAP
213	9.0	A PENNEL	NEW ZEALAND, DUNEDIN	9	0
214	9.0		NETHERLANDS, LEEUWARDEN	9	0
215	9.0		JAPAN, NISITAMA	9	0
216	9.0	T HAYMES	ENGLAND, MAIDENHEAD	9	0
217	9.0		ENGLAND, SALFORD	9	0
218	9.0	E. OTTO	CZECH., EILENBURG	9	0
219	9.0	M LOOCKS-VASQUEZ	CHILE, VALPARAISO	9	0
220	9.0		AUSTRALIA, PERTH OBSERVATORY	9	0
221	9.0		AUSTRALIA, SYDNEY OBSERVATORY	9	0
222	8.5	PAT HARVEY	U.S.A., HACIENDA HEIGHTS, CAL.	4	2
223	8.2	A. RAKHIMOV ABDUMALIK	U.S.S.R., TASHKENT	6	1
224	8.2		JAPAN, TOKYO	6	1
225	8.2	K SILBER	AUSTRIA, GMUNDEN	6	1
226	8.0	JOHN A. CHURCH	U.S.A., PRINCETON JUNC., N.J.	8	0
227	8.0	JOSE OSORIO	PORTUGAL, PORTO UNIV. OBS.	8	0
228	8.0		JAPAN, TOKYO	8	0
229	8.0		ITALY, TURIN	8	0
230	8.0		AUSTRIA, GRAZ	8	0
231	7.5	M MORROW	U.S.A., HAWAII, OAHU EWA BEACH	3	2
232	7.2	JAMES E. BROOKS	U.S.A., CHATHAM, VIGINIA	5	1
233	7.2	H POVENMIRE	U.S.A., SATELLITE BEACH, FLA.	5	1
234	7.2	D HOUGH	U.S.A., SOUTH PLAINFIELD	5	1
235	7.2		DENMARK, VIBY, JUTLAND	5	1
236	7.0	B. M. LEWIS	NEW ZEALAND, WE., CARTER OBS.	7	0
237	7.0	E BEET	ENGLAND, ASHAMPSTEAD	7	0
238	7.0		ENGLAND, SHEERNESS	7	0
239	7.0	J OLESEN	DENMARK, RONNE BORNHOLM	7	0
240	6.5	A. ZAPOROZHETS	U.S.S.R., ODESSA	2	2
241	6.5	ZIMNIKOVAL	CZECH., BANSKA BYSTRICA	2	2
242	6.2	A. SHAPOVALOV	U.S.S.R., KHERSON	4	1
243	6.0	S. IEMAYLOV	U.S.S.R., KHARKOV	6	0
244	6.0	G DELAHUNTY	U.S.A., GARDEN CITY, N.Y.	6	0
245	6.0		U.S.A., MILWAUKEE, WIS.	6	0
246	6.0	WAYNE CLARK	U.S.A., ST. LOUIS, MISSOURI	6	0
247	6.0		JAPAN, YOKOHAMA	6	0
248	6.0	H KRUGER	GERMANY, HANNOVER	6	0
249	6.0	E AHNERT	GERMANY, SONNEBERG OBS.	6	0
250	6.0	S PATTINSON	ENGLAND, SOUTH CROYDON	6	0
251	6.0	L MORRISON	ENGLAND, WESTHAM, SUSSEX	6	0
252	6.0	V HAUT	CZECHOSLOVAKIA, CHEB	6	0
253	6.0		BRAZIL, RIO DE JANEIRO	6	0
254	6.0	JEAN MEEUS	BELGIUM, ERPS-KWERPS	6	0
255	6.0	K. P. SIMS	AUSTRALIA, SYDNEY OBSERVATORY	6	0
256	6.0	N BUTTERWORTH	AUSTRALIA, TOWNSVILLE	6	0
257	5.2	V. ILIN	U.S.S.R., KAZAN	3	1
258	5.2	I. BLAGOVESHCHENSKI	U.S.S.R., ULYANOVSK	3	1
259	5.2	ROGER ERIKSSON	SWEDEN, LUND	3	1
260	5.2	G. PATTERSON	NEW ZEALAND, CHRISTCHURCH	3	1
261	5.2	F PAVLAS	CZECHOSLOVAKIA, HOLESOV	3	1
262	5.2	M. MULLER	CZECH., EILENBURG	3	1
263	5.2		AUSTRIA, VIENNA	3	1
264	5.0	V. LAZAREV	U.S.S.R., TOMSK	5	0
265	5.0	A. ZAPOROZHETS	U.S.S.R., KIEV	5	0
266	5.0	CESARIO E. TAGANAS	PHILIPPINES, MANILA	5	0
267	5.0	N BRYNILDSEN	NORWAY, HORTEN	5	0
268	5.0	E. HANHAM	NEW ZEALAND, AUCKLAND	5	0
269	5.0		NEW ZEALAND, DUNEDIN	5	0
270	5.0		NETHERLANDS, GRONINGEN, KAPTEYN	5	0
271	5.0	G OLTHUIS	NETHERLANDS, UITHOORN	5	0
272	5.0		ITALY, MILAN	5	0
273	5.0		ITALY, ANCONA	5	0
274	5.0	M ABDULAHAD	IRAQ, BASRAH	5	0
275	5.0	R PICKARD	ENGLAND, HADLOW, KENT	5	0
276	5.0		ENGLAND, PLUCKLEY	5	0
277	5.0	K. W. FABRIN	DENMARK, AALBORG	5	0
278	5.0	E PEDERSEN	DENMARK, HORSENS, JUTLAND	5	0
279	5.0	J BOCEK	CZECH., JINDRICHOV HRADEC	5	0
280	5.0		BRAZIL, RIO DE JANEIRO	5	0
281	5.0		AUSTRIA, VIENNA	5	0
282	4.2		JAPAN, TOKYO	2	1
283	4.2	E. WEYRICH	CZECH., EILENBURG	2	1
284	4.2	ANDRE COULOMBE	CANADA, QUEBEC	2	1
285	4.0	V. KOSTROV	U.S.S.R., GORKI	4	0
286	4.0	V. UTKIN	U.S.S.R., GORKI	4	0
287	4.0	D. GALYCH	U.S.S.R., LVOV	4	0
288	4.0	R WOOD	U.S.A., COCOA, FLORIDA	4	0
289	4.0		U.S.A., COCOA, FLORIDA	4	0
290	4.0		U.S.A., OAKLAND, CHABOT OBS.	4	0
291	4.0	M HERBSTRITT	U.S.A., ST. MARYS, PA.	4	0
292	4.0	SIDNEY HENDRICKSON	U.S.A., COLUMBUS, OHIO	4	0
293	4.0	B. A. SINTON	NEW ZEALAND, GISBORNE	4	0
294	4.0		NETHERLANDS, HILVERSUM	4	0
295	4.0		JAPAN, TOKYO	4	0
296	4.0		ITALY, UDINE	4	0
297	4.0		ENGLAND, EASTBOURNE	4	0
298	4.0		ENGLAND, EASTBOURNE	4	0
299	4.0	P. DRABEK	CZECHOSLOVAKIA, GOTTWALDOV	4	0
300	4.0	S KOCHAN	CZECH., ZIAR-NAD-HRONOM	4	0
301	4.0	C REID	CANADA, SELKIRK, MANITOBA	4	0
302	4.0	I MAGALHAES	BRAZIL, RECIFE	4	0
303	4.0	P.C.A. BARETTO	BRAZIL, RECIFE	4	0
304	4.0	DANIELLE BOURGEOIS	BELGIUM, MONTIGNY LE TILLEUL	4	0
305	4.0	G KANATSCHNIG	AUSTRIA, GMUNDEN	4	0
306	4.0		AUSTRIA, VIENNA	4	0
307	4.0	G READING	AUSTRALIA, GEELONG	4	0
308	4.0	T. L. MORGAN	AUSTRALIA, SYDNEY OBSERVATORY	4	0
309	3.2	O. BOGDANOV	U.S.S.R., RIZAN	1	1
310	3.2	A. SLITSCHENKO	U.S.S.R., KIEV	1	1
311	3.2	G. MOSKALEVA	U.S.S.R., KIEV	1	1
312	3.2	HOWARD D. THOMAS	U.S.A., COULEE DAM, WASH.	1	1
313	3.2	B SORENSEN	NORWAY, TRONDHEIM	1	1
314	3.2	CHROMEK	CZECH., BANSKA BYSTRICA OBS.	1	1
315	3.0	V. SHERSTNEVA	U.S.S.R., GORKI	3	0
316	3.0	V. KONEV	U.S.S.R., ULYANOVSK	3	0
317	3.0	W ALBRECHT	U.S.A., MILWAUKEE, WIS.	3	0
318	3.0	J KISIEL	U.S.A., PALOS OBSERVATORY	3	0
319	3.0		U.S.A., SATELLITE BEACH, FLA.	3	0
320	3.0	THOMAS H. CAMPBELL JR	U.S.A., TEMPLE TERRACE, FLA	3	0
321	3.0	BEAT RYKART	SWITZERLAND, AATHAL	3	0
322	3.0	M DE PASCUAL MARTINEZ	SPAIN, MADRID OBSERVATORY	3	0
323	3.0	NAZARETH REGO	PORTUGAL, PORTO UNIV. OBS.	3	0
324	3.0	D YGLOPAZ	PHILIPPINES, MANILA	3	0
325	3.0	ROSA TYSON	NEW ZEALAND, AUCKLAND	3	0
326	3.0		NETHERLANDS, VUGHT	3	0
327	3.0	F DIEGO	MEXICO, MEXICO D.F.	3	0
328	3.0		JAPAN, YOKOHAMA	3	0
329	3.0		JAPAN, TOKYO	3	0
330	3.0		ITALY, MILAN	3	0
331	3.0		ITALY, ANCONA	3	0
332	3.0		GERMANY, RUDOLSTADT	3	0
333	3.0	E SPLITTGERBER	GERMANY, SONNEBERG OBS.	3	0
334	3.0	A HOUSKA	CZECHOSLOVAKIA, TURNOV	3	0
335	3.0	P NAJSER	CZECH., PRAGUE PEOPLE'S OBS.	3	0
336	3.0	SOJKA	CZECH., PRAGUE PEOPLE'S OBS.	3	0
337	3.0	SUCHAN	CZECH., PRAHA	3	0
338	3.0	FIEDLEROVA	CZECH., PRAHA	3	0
339	3.0	VOLF	CZECH., PRAHA	3	0
340	3.0		CANADA, VICT. DOMINION OBS	3	0
341	3.0		AUSTRIA, ST. POLTEN	3	0
342	3.0		AUSTRIA, VIENNA	3	0
343	3.0		AUSTRIA, VIENNA	3	0
344	3.0	E LUMLEY	AUSTRALIA, SYDNEY	3	0
345	3.0		AUSTRALIA, GEELONG	3	0
346	2.0	A. EPHIMOV	U.S.S.R., RIZAN	2	0
347	2.0	V. A. VOROTNIKOV	U.S.S.R., ENISEICK123	2	0
348	2.0	A. KHOLODNI	U.S.S.R., GORKI	2	0
349	2.0	I. MUSIKHIN	U.S.S.R., GORKI	2	0
350	2.0	V. KHAREVICH	U.S.S.R., ENISEISK	2	0
351	2.0	N. KRASNIKOV	U.S.S.R., KAZAN	2	0
352	2.0	O. ORLOVSKI	U.S.S.R., KRASNOYARSK	2	0
353	2.0	P. VELESHCHUK	U.S.S.R., KIEV	2	0
354	2.0	M. PYSHNENKO	U.S.S.R., KHABAROVSK	2	0
355	2.0	V. VELMUSHKIN	U.S.S.R., KHERSON	2	0
356	2.0	P. KOSYARUM	U.S.S.R., CHERKASSI	2	0
357	2.0	V. MIKHNO	U.S.S.R., CHERKASSI	2	0
358	2.0	R ROYER	U.S.A., WRIGHTWOOD, FORD OBS.	2	0
359	2.0		U.S.A., BALTIMORE, MARYLAND	2	0
360	2.0		U.S.A., COCOA, FLORIDA	2	0
361	2.0	P MURN	U.S.A., MILWAUKEE, WIS.	2	0
362	2.0		SPAIN, MADRID OBSERVATORY	2	0
363	2.0	R EBERST	SCOTLAND, EDINBURGH	2	0
364	2.0	R GLEDHILL	NEW ZEALAND, DUNEDIN	2	0
365	2.0	G. COULING	NEW ZEALAND, WELLINGTON	2	0
366	2.0		NETHERLANDS, GOUTUM	2	0
367	2.0	H BETLEM	NETHERLANDS, LEIDEN	2	0
368	2.0		JAPAN, TOKYO	2	0
369	2.0		JAPAN, TOKYO	2	0
370	2.0		ITALY, BOLOGNA	2	0
371	2.0		ITALY, ANCONA	2	0
372	2.0	MULLER	GERMANY, EILENBURG	2	0
373	2.0	WOLFGANG BEISKER	GERMANY, HANNOVER	2	0
374	2.0		GERMANY, WIEL-DER-STADT	2	0
375	2.0	V HEGVAD	DENMARK, COPENHAGEN	2	0
376	2.0	M. MATYSEK	CZECHOSLOVAKIA, GOTTWALDOV	2	0
377	2.0	V TALKNER	CZECH., JINDRICHOV HRADEC	2	0
378	2.0	M. VACLARIK	CZECH., POLICE-NAD-METUJI	2	0
379	2.0	J PAVLOUSEK	CZECH., PRAGUE PEOPLE'S OBS.	2	0
380	2.0	MUDRA	CZECH., PRAGUE PEOPLE'S OBS.	2	0
381	2.0	B MALECEK	CZECH., VALASSKE MEZIRICI	2	0
382	2.0	PRIBYL	CZECH., PRAHA	2	0
383	2.0	BUBENICEK	CZECH., PRAHA	2	0
384	2.0	PLECHAC	CZECH., PRAHA	2	0
385	2.0	W JUTTING	CANADA, MONTREAL	2	0
386	2.0		AUSTRIA, LINZ	2	0
387	2.0		AUSTRIA, VIENNA	2	0
388	1.0	A. BELYAKOV	U.S.S.R., KALININ	1	0
389	1.0	A. D. TARABAKIN	U.S.S.R., KALININ	1	0
390	1.0	A. KANTOROV	U.S.S.R., TOMSK	1	0
391	1.0	A. KIRICHENKO	U.S.S.R., UZHGOROD	1	0
392	1.0	V. KIRDATOVSKI	U.S.S.R., KHARKOV	1	0
393	1.0	I. ZHDANCHUK	U.S.S.R., CHERNIGOV	1	0
394	1.0	T. POLIZHUK	U.S.S.R., CHERKASSI	1	0
395	1.0	A.T. MAILBAEV	U.S.S.R., KAZAN	1	0
396	1.0	V. KAZAKOV	U.S.S.R., GORKI	1	0
397	1.0	E. XHARITONOVA	U.S.S.R., GORKI	1	0
398	1.0	A. VINOGRADOV	U.S.S.R., GORKI	1	0
399	1.0	C. VETOSHCHKIN	U.S.S.R., GORKI	1	0
400	1.0	M KAZMIERCZAK	U.S.A., ATLANTIC BEACH, FLA.	1	0
401	1.0	KARL SIMMONS	U.S.A., JACKSONVILLE, FLORIDA	1	0
402	1.0	JERRY SEARCY	U.S.A., LAS VEGAS, NEVADA	1	0
403	1.0	G WEDEMEYER	U.S.A., MILWAUKEE, WIS.	1	0
404	1.0	R JAMES	U.S.A., MILWAUKEE, WIS.	1	0
405	1.0	I DE PALDO QUIROS	SPAIN, MADRID OBSERVATORY	1	0
406	1.0	A FOSS	NORWAY, ASKER	1	0
407	1.0	TRIXIE STEWART	NEW ZEALAND, AUCKLAND	1	0
408	1.0	W KOHLBACH	GERMANY, HANNOVER	1	0
409	1.0	ILMO KUKKONEN	FINLAND, HELSINKI	1	0
410	1.0	J SHANKLIN	ENGLAND, CAMBRIDGE OBS.	1	0
411	1.0	G TAYLOR	ENGLAND, NEAR HERSTMONCEUX	1	0
412	1.0	KRAL	CZECHOSLOVAKIA, GOTTWALDOV	1	0
413	1.0	METELKA	CZECHOSLOVAKIA, UHERSKY BROD	1	0
414	1.0	SPURNY	CZECHOSLOVAKIA, KUNZAK	1	0
415	1.0	KRAJCIR	CZECHOSLOVAKIA, HLOHOVEC	1	0
416	1.0	J VACEK	CZECH., POLICE-NAD-METUJI	1	0
417	1.0	KREJCI	CZECH., PRAGUE PEOPLE'S OBS.	1	0
418	1.0	ROSKOVA	CZECH., PRAGUE PEOPLE'S OBS.	1	0
419	1.0	SOBRA	CZECH., PRAGUE PEOPLE'S OBS.	1	0
420	1.0	LEV	CZECH., PRAGUE PEOPLE'S OBS.	1	0
421	1.0	NETOPICK	CZECH., PRAGUE PEOPLE'S OBS.	1	0
422	1.0	H.J. WIDDOP	CANADA, QUEBEC	1	0
423	1.0	W JASCHEK	AUSTRIA, VIENNA, KUFFNER OBS	1	0
424	1.0	P REINHARD	AUSTRIA, VIENNA	1	0

mura of Japan are the only consistent top ten leaders.

In the countries list, the U.S.A. tops the list by virtue of its large number of observers. It is interesting that this list divides quickly into: the top three, four countries in the 700's, and everyone else considerably lower. One can examine these in a different way, however — by ranking according to value per observer. Here, we find that Rhodesia tops the list by far, with a value of 264.3 per observer. Then comes Argentina at 102.1 and South Africa at 84.5. Japan, Denmark, and the U.S. follow in the 50's, the Philippines and Australia in the 40's, Switzerland at 32.9, and then everyone else. Czechoslovakia, fourteenth in the main ranking, drops to thirty-first, by virtue of its large number of observers. The reason for the change of ranking becomes obvious from the data. Many observatories evidently are used by students, resulting in one observation per observer (Are these the result of some class assignment?). Rhodesia, on the other hand, has an apparently dedicated trio.

The compilations, of course, have not been solely my doing, though I'll take responsibility for the errors. The project was started at the impetus of Dave Dunham, who consistently urged its completion. Tom Van Flandern supplied the USNO tapes which included RGO data. He also forwarded the Czech and Russian publications. I want particularly to express my appreciation to Honeywell, Inc. for its continuing support and encouragement of these tallies and of the asteroid occultation predictions. Finally, thanks are due to H. F. DaBoll who was able to fit the tables and text into their proper place in the newsletter.

I wish to apologize for taking so long to complete these lists. Dave Dunham first requested that I do this in early 1980. The information received, however, consisted of magnetic tapes containing observations for multiple years, the observation forms filled out by many observers and mailed to Dave, and the publications of two countries; Czechoslovakia and Russia. The first problem was reading the tapes. As anyone who tries this can attest, no computer seems to be able to produce a tape readable easily by another computer. It took literally six months of part-time effort and the combined talents of Honeywell's software people to devise a solution which now runs beautifully.

The next delay was caused by the devotion of my efforts to the asteroid occultation prediction task. This involved breaking up Dave's program into two (now three) programs so as to respond efficiently to the needs of that area.

Upon returning to the tally problem, the second major difficulty was encountered — no or little correlation among the three data bases. The tapes had only codes for names and locations, the slips filled out by observers had no codes and neither did the publications of Russia or Czechoslovakia. A partial name/code list was found on one tape and a third tape provided location/codes. The name/code list was, however, old and many codes were not included. The occultation tapes themselves (from RGO via USNO) contained data from 1975 thru 1979. These showed dramatically that it indeed takes about four years for the data to be properly submitted and collated before a tally like this can claim to have even a minimum of accuracy. I can estimate that another 400 observations from 1977 can be expected to appear on future tapes.

The data compilation resulting in these two tables, therefore, contain a considerable amount of detective work, guesswork, and just plain arbitrariness! Please excuse me for whatever errors are thus produced. If you'll let me know of the grosser errors, I'll attempt a revision.

USING THE IOTA/ILOC OCCULTATION REPORT FORMS

David W. Dunham

Yoshio Kubo, Director of the International Lunar Occultation Centre, has given me some guidelines for including additional information on their report forms in a letter dated May 15th. No change in the current forms is needed, but the information below should be added to the four-page description, *Use of form for recording occultation observations*, which has been distributed with the forms.

Column 39, Personal equation (PE), A: An additional code can be used: U (Unsubtracted), The following value of the personal equation has *not* been subtracted from the observed time. This was suggested by Robert Clyde, Streetsboro, OH, and was an often-used option on the previous ("U. of Texas ed. 2") IOTA graze report forms.

Column 56 (back of form) is devoted to other phenomena relating to gradual events other than those listed for Column 35 (which should be left blank if Column 56 is used). For Column 56, use the following code numbers:

1 Start of disappearance at dark limb
2 End of disappearance at dark limb
3 Start of disappearance at sunlit feature
4 End of disappearance at sunlit feature
5 Start of disappearance at the umbra during lunar eclipse
6 End of reappearance at the umbra during lunar eclipse
7 Partial blink (Star doesn't completely disappear)
8 Faint flash (Star doesn't achieve full brilliance)

These events no longer need to be written in the comments area, as was specified in the original instructions, since they now are listed on separate lines. Remember that a blink is a disappearance followed immediately (by 0s5 or less, so that the events can not be timed separately) by a reappearance, while a flash is the opposite sequence, a reappearance followed immediately by a disappearance (star "flashes" out in a deep lunar valley bottom).

Column 57 (back of form) is devoted to D/B/U. Enter D (dark limb), B (bright limb, sunlit feature or penumbra), U (umbra), or T (at terminator, considered as B). The "D/B" column on the left side of the back of the IOTA/ILOC forms, 81 Feb Edition, should no longer be used.

New IOTA/ILOC forms, 81 June Edition, have been produced, along with revised instructions, to include the above changes. However, the 81 Feb Edition of the forms can and should be used until the supply of them is exhausted, keeping in mind the above information. It is important that the ILOC and IOTA/ILOC forms be used, rather than any other forms, use of which will cause considerable delays in putting the data into computer-readable form for computing residuals and for analysis. It is a major undertaking just to get the current system of keypunching and reduction operational at the I.L.O.C., so we should help them as much as possible by using the new forms

I have been rather dismayed at the number of mistakes on, and misunderstandings about, the new forms which observers have sent me so far. Be sure to read the instructions carefully. At least for the first few forms you complete, I recommend using pencil, since it is much harder to correct forms written in ink.

As an example, I have partially completed a form for a hypothetical graze report reproduced above. This can serve as a guide for correctly filling out the forms. Two observers are included in the heading, although only the first six timings by observer "a" are listed. Several minutes before the graze, a total occultation disappearance of the star SAO 098016 was timed with a stopwatch. It was suspected that the star disappeared in steps due to previously unknown duplicity, so an uncertain timing of the suspected secondary star, estimated to have occurred half a second after the primary disappeared, is given on the second line. The third line gives the time observation of the graze began, with timing by tape recording a mechanical clicker (equivalent to a tone generator) or voiced calls, and WWV shortwave time signals. The first event was a gradual disappearance, with start and end of fade separately timed. The next graze event was a faint flash, entered on the sixth line, the last line shown. I will describe how some of the information should be completed below, referring to the example and pointing out some common mistakes.

PLACE NAME: Give the name of the village, or other prominent landmark, closest to the point of observation. Give the name of the city in which you live only if you observed from home or if it is closer to your observation site than any other village.

ADDRESS: Give your complete address, including street, post office box, or rural route number, city, state or province, postal code, and country. Also, include your name if you are not the only observer listed on the back of the form, or if you are not the graze expedition leader specified on

IOTA/ILOC (mainly GRAZING) OCCULTATION OBSERVATIONS

NOT REAL DATA EXAMPLE ONLY

PLACE NAME CONOWINGO DAM, MARYLAND, USA

Copy has been sent to circled place(s): (IOTA) (ILOC) Other______

ADDRESS P.O. BOX 488, SILVER SPRING, MARYLAND 20907, U.S.A.

TELESCOPES and POSITIONS

	Type	Aperture	Focal length	Mounting	Drive	Longitude ° ' "	E/W	Latitude ° ' "	N/S	*Acc "	Height m	Geodetic datum
a	R,(N),C,O( )	25 cm	142 cm	(E),A	D,(M)	76 16 10.2	(W)	39 42 46.7	(N)	±0.3	128.	NAD 27
b	R,N,(C),O( )	13 cm	127 cm	(E),A	D,(M)	↓ ↓ 12.4	(W)	↓ 42 41.3	(N)	↓	125.	↓
c	R,N,C,O( )	cm	cm	E,A	D,M		E/W		N/S			

No.	Yr	Mth	Day	Hr	Min	Seconds	Ct	Decl	No.	Station	Tel	Obs	Rec	Ph	MR	MT	PE A	PE B	Accur	Ce	S/N	X	Sky St	Sky Tr	C	Temp	G	T	O	R
1	81	05	10	01	06	17.1	S	09	8016					1	S	R	5	4	2	1		B	1	1	2	20		a	a	
2			↓		06	17.6	S	09	8016					1	E	1	E		3	2		F	↓		↓			↓		
3					27	50.	R		1310						T		E		1.0	1							8			
4					30	12.9	↓								K	T	U	3	1								6			
5					30	14.0								1	T			4	2								6			
6			↓		30	17.2									K	T	↓	4	2	↓					↓		6	↓		

* Map name or # DELTA, PENNSYLVANIA-MARYLAND Year 1974 Publisher U.S.G.S. Scale 1:24,000 * 81 June Edition

PLEASE RETURN THIS FORM TO: David W. Dunham, IOTA, P. O. Box 488, Silver Spring, Maryland 20907, U. S. A. and International Lunar Occultation Centre, Astronomical Division, Hydrographic Department, Tsukiji-5, Chuo-ku, Tokyo, 104 Japan

MORE FORMS REQUIRED? ~~YES~~ / NO

Graze Expedition Leader DAVID DUNHAM

OBSERVERS and RECORDERS

a DAVID W DUNHAM b JOAN B. DUNHAM c ______

d ______ e ______ f ______

No.	*eyepiece power	*time station call letters	COMMENTS	ot Ph	D/B/U
1	117	WWV			D
2	↓	↓	PROBABLE COMPANION; NO DOUBLE STAR CODE IN USNO PREDICTIONS. EVENT PA = 69°, CA -54°, MOON ALT. = 33°, MAG. DROP ABOUT 1.0		↓
3					
4				1	
5					
6	↓	↓		8	↓

* P.A. graze 18°.8 *Mag. 4.2 % Snl 41+ C.A. 4N # Sta 2 # Tm 18 Sky St 1 Ap cm 13 Shift 0".25 W.A. 2° Lat. Lib. +0°.1 *

the back of the form.

TELESCOPES and POSITIONS, Type: A Newtonian reflector was used at station "a," so "N" is circled. At station "b," a five-inch Celestron was used. Since it is a Schmidt-Cassegrain design, "C" has been circled, and the aperture and focal length converted to the nearest centimeter. "C" might also be used for a Maksutov telescope, although, since the design is slightly different, in this case, "O" could be circled and "Maksutov" written within the parentheses.

Height: This should be in meters above sea level. Multiply elevations in feet by 0.3048 to obtain values in meters. Unless the site has been surveyed accurately, the height should be given only to the nearest whole meter.

Geodetic datum: This is *not* mean sea level, used for vertical control. The geodetic datum is the horizontal control surveying system on which the map is based. For nearly all of North America, it is the North American Datum 1927 (NAD 27), while for most of Europe, it is the European Datum (ED, also called Potsdam 1950). There should be a statement about the geodetic datum somewhere in the margin of the map. If there is no such statement, the publisher of the topographic map should be contacted to find out what it is. Note that the geodetic datum usually does not have the same name as the rectangular grid system which is printed on many topographic maps.

Star Name: Do not write "Z.C."; "R" is the code to be used for Z.C. stars (which have no prefixed letter under the column "USNO REF NO" in the U.S. Naval Observatory total occultation predictions). R is used because Robertson published the currently-used Zodiacal Catalog in 1940. Whenever possible, avoid use of Durchmusterung (BD, SD, or CD) numbers since there is an ambiguity between BD and CD in the -22° zone and there are not enough columns provided for CD numbers. The columns reserved for the declination zone can be used for the star number if the catalog does not have declination zones and if the number requires more than four digits, as is the case for SAO and USNO "X" numbers. Since SAO numbers have up to six digits, a leading zero has been written in column 18 for SAO 098016.

Station, Tel, Obs, Rec (columns 24-34): *Always* leave these columns blank on graze reports since the ILOC needs to assign them. Instead, enter the appropriate telescope, observer, and recorder (if any) letters in the T, O, and R columns (S1, S2, and S3) on the far right side of the form. For total occultations observed at your usual observation site, you can put the USNO station code (such as, SA187) under Station (columns 24-28), but columns 29-34 should be left blank until you are notified by ILOC of the numbers to be used in those columns, which will probably not be the same as the similar numbers assigned by H.M.N.A.O.

Ph, phenomenon, column 35: Leave this blank if you enter 8 or 9 in the graze column G (73) or if you use column 56 on the back for the gradual phenomena described above.

MR, method of recording, Columns 36 and 37: Leave column 37 blank, not column 36, in case only one code letter is used. I think that this has confused some observers because it is exactly the opposite of the convention required for numbers, which must be written in the right-most columns, unless their positions are fixed by decimal points. Be careful to follow the directions when completing these, and the next few, columns; notice my examples. "E" has been used for the event on line 2, "eye and ear," since the possible secondary disappearance was not specifically timed, but only estimated to have occurred 0^{s}5 after the primary disappeared. Code P should be used for any automatic (non-visual) method of recording occultation times, such as videotape as well as photoelectric.

On the back of the form, the probable duplicity of SAO 098016 is noted in the comments for event number 2. The event position angle, cusp angle, and moon altitude are given, since these are useful for estimating the possible double star parameters.

At the bottom of the back of the form, "+" (waxing) or "-" (waning) or "E" (lunar eclipse) should be given after the % sunlit, and "N" (north), "S" (south), or "U" (umbral distance during eclipse) should be given after the cusp angle value in degrees. The Watts angle should be a value near the center of the region of observed events, which may be offset a degree or more (especially if the graze is near the terminator, with half the events not observed because they were against sunlit features) from central graze. The latitude libration value can also be taken from the predicted profile.

There is no provision on the new form for the observing condition code. For the time being, we plan to abandon it, but in case we later find it useful, for example, for continuity with previously-reported grazes, you might write "O.C.C." and give its value in the upper left corner (above OBSERVERS and RECORDERS) of the back side of the form, or even for some individual events in the comments section.

If you want to get some practice in completing the forms, I have a large backlog of graze reports which need to be transcribed to the new forms for processing by the ILOC. These include most of the 1978 and 1979 graze reports written onto the old IOTA forms which were never processed by H.M.N.A.O., and have been returned to me since they no longer have the manpower to do the job. Don Stockbauer and Robert Clyde have volunteered to do this work, but they could use some help in order to complete the job in a reasonable amount of time. It is most important to get the data in machine-readable form so that reduction profiles can be generated automatically and comprehensive analyses can be performed. Transcription to the new forms is the first necessary step in this process.

OCCULTATION OF NUNKI BY VENUS, OUR LAST CHANCE TO SEE THE CENTRAL FLASH

David W. Dunham

The rare occultation of 2.1-magnitude Nunki (Z.C. 2750 = SAO 187448 = σ Sagittarii) was discussed in *O.N.* 2 (10) 122; the usual planetary occultation information about the event was included in the tables on pages 116 and 117 of the same issue. The rarity of such an event is emphasized by G. P. Können and J. van Maanen in their article, "Planetary Occultations of Bright Stars," in *J. Brit. astron. Assoc.*

91 (2) 148, 1981 February issue. They calculate that occultations of first-magnitude stars by planets occur only once in every 190 years, on the average, whereas mutual planetary occultations occur with a mean frequency of once every 40 years (we are now near the middle of an unusual 247-year period of no mutual planetary occultations). Only 3 first-magnitude stars are available, since Aldebaran can not be occulted by any of the planets, at least not until about 6000 A.D. (Venus), according to Jean Meeus in *J.B.A.A. 70*, p. 182 (1960). Können and van Maanen found that 23 stars brighter than magnitude 3.5 can be occulted by the planets, and they list 14 occultations of these stars which happen between 1900 and 2100. Only four of these occur during the next 70 years, all by Venus: Nunki on 1981 November 17; 2.9-mag. λ Sagittarii on 1984 Nov. 19; 3.0-mag. π Sagittarii, 2035 Feb. 17; and 1.3-mag. Regulus, 2044 Oct. 1. The 2044 occultation of Regulus will be a good event, similar to the one in 1959, but few of us reading this will be able to travel to see it in a dark sky, which will occur around 120° east longitude. The central lines for the 1984 and 2035 events miss the Earth's surface. The southern limit of the 1984 occultation crosses Canada.

Until 2044, only the occultation of Nunki on Tuesday, 1981 November 17, provides a central occultation of a bright star visible under good conditions in areas with a high probability of clear skies. The Middle East is favored, with the event occurring at high altitude in a dark sky. In most parts of Europe, daylight, strong twilight, or low altitude may hinder observation. At the time of the occultation, the sunset terminator crosses easternmost Holland, the German Federal Republic, the Adriatic Sea, and the southern Italian peninsula; this will be shown on a regional map to be published in the next issue. The disappearance of Nunki behind Venus' dark limb in a dark sky will be a spectacular once-in-a-lifetime event for observers in central and southeastern Europe, the Middle East, eastern Africa, and the western Indian Ocean.

Observations of the occultation, especially photometric observations, made from several widely separated locations will have special scientific value. Perhaps the most important result will be astrometric. By accurately measuring the position of Venus with respect to the star, it should be possible to link accurate radio astrometric results (such as from very long baseline interferometry) to the stellar fundamental FK4 system. In the radio reference frame, the orbit of Venus has been established accurately by tracking of the Pioneer Venus orbiter, which has been linked with quasi-stellar radio sources. Since Nunki is an FK4 star, the radio system can be linked with the FK4 system, especially in right ascension, through astrometry determined from

[continued on next page]

VARIABLE ZODIACAL STARS LISTED IN THE SAO CATALOG, by David Herald

Some time ago I prepared a comprehensive list of stars listed in the General Catalogue of Variable Stars, and its supplements, that can be occulted by the moon, and have a maximum magnitude of 10.6 at least. Eventually it is hoped to have the data included with the normal occultation predictions, considerably improving the coverage of the predicted data for variable stars which currently is very poor. In the interim, and to avoid problems of finding a star far fainter than predicted, the following tabulation gives the SAO numbers of all ecliptic variables (listed in the SAO) which have a magnitude range of 0.5 or more, together with the magnitude range, and its type; L for long-period, etc., as distinct from E, for eclipsing-type variables. The stars are listed in Right Ascension order, rather than pure numeric order, to facilitate comparison with occultation predictions.

0^h to 6^h		6^h to 12^h		12^h to 18^h		18^h to 24^h	
109778	1.0 E	77963	0.6 L	119203	1.7 L	186237	1.2 L
109789	7.1 L	78024	1.4 L	138594	0.5 L	186452	1.2 L
109934	7.7 L	78066	3.1 L	138666	5.8 L	161257	1.7 L
92853	1.0 L	78092	0.8 L	138725	1.1 L	161376	1.0 L
93115	3.8 L	78094	0.6 L	119433	0.8 L	186718	2.2 E
76297	2.0 L	78098	1.4 L	139236	0.8 L	161444	1.2 L
76418	4.5 E	78120	0.6 E	139335	1.2 L	161502	0.6 E
94036	0.6 L	78135	0.6 L	157936	1.3 E	161571	0.7 L
76680	0.8 E	95862	0.8 L	139350	6.5 L	161754	0.5 L
76788	2.0 L	79031	0.5 L	139403	6.9 L	187233	1.1 L
94173	5.7 L	79070	8.0 L	158092	0.5 L	187294	0.9 E
77084	0.6 E	96912	2.8 E	139594	1.1 L	161870	1.0 L
94604	0.5 L	97083	0.6 L	158210	0.5 E	187349	0.8 L
77299	1.8 L	79635	6.5 L	158369	0.8 E	161972	0.7 L
77330	1.0 E	79717	7.0 L	158394	5.1 L	187547	4.4 L
94779	0.7 L	97596?	0.9 E	158406	0.7 L	187624	0.7 L
77516	2.1 L	97631	1.0 L	158411	0.5 L	162339	2.5 L
94837	0.5 L	80035	1.5 L	158473	0.9 L	162394	6.1 L
77730	7.8 L	97753	6.4 L	158607	0.7 L	162777	1.8 L
77756	1.9 L	97768	1.3 L	158665	0.6 E	163080	1.2 E
		97854	0.7 E	158719	6.0 L	188715	0.5 E
		97942	6.5 L	183401	5.5 L	188923	2. L
		80312	1.5 L	183578	1.0 E	163323	5.3 L
		98075	2.6 E	159561	5.2 E	164150	2.0 L
		98230	1.6 L	184232	1.4 E	164193	6.4 L
		80524	2.9 L	159918	0.8 L	164218	0.7 L
		98266	1.1 L	184415	0.9 L	164320	1.3 E
		80608	1.4 L	159981	5.7 L	164343	5.9 L
		98769	6.9 L	184551	2.0 L	164507	1.1 L
		99413	0.7 E	160116	0.8 E	164558	0.6 E
		118649?	0.6 E	184796	1.7 L	164829	0.6 E
		138245	0.5 E	185020	1.0 L	146035	0.5 E
				160299	6.6 L	146043	0.5 L
				185643	0.7 L	165212	1.6 L
				185745	1.0 E	146384	1.0 L
				185755	1.0 L	128374	0.8 L
				185899	0.5 L	146923	0.6 E

the occultation. Nunki is much easier to observe astrometrically than 13th-magnitude quasi-stellar sources. The current uncertainties of a few tenths of an arc second between the two reference systems might be reduced to only 0″.01, the accuracy claimed from the analysis of the 1959 Regulus-Venus occultation observations by G. de Vaucouleurs and D. Menzel, *Nature 188,* p. 30 (1960 Oct. 1), and Gordon Taylor, *Royal Observatory Bulletin* No. 72 (1963).

Information about Venus' atmosphere can be derived from photometric occultation data. Although this can not compete for accuracy with space probe data, data for several locations around the planet can be obtained nearly simultaneously at the time of the occultation. If Nunki is a close binary, the observations will reveal the duplicity, and the star's diameter might be measured for comparison with the intensity interferometer results.

The most interesting aspect of this occultation will be the possibility of observing the central flash, the focusing of Nunki's light by the entire circumference of Venus' atmosphere when the star is directly behind the planet's center. The phenomenon probably will be visible, to some extent, from a band about 150 km wide, which is about twice my estimate of the uncertainty with which we can predict the location of the central line. The observable path would be considerably narrower, and harder to predict (substantially decreasing the probability of success for a given observer), for occultations of stars fainter than magnitude 3.5, and as noted above, there are no possibilities for stars brighter than this until 2044. The only observation of the central flash to date was obtained by the Kuiper Airborne Observatory during the occultation of ϵ Geminorum by Mars on 1976 April 8. Formulae for the central flash phenomenon are given by J. Elliot *et al.* in *Astrophys. J. 217* (2) 671, issue of 1977 Oct. 15, where they discuss their Martian occultation results. The central flash appears to the observer as a ring of light around the planet at the time of central occultation. The intensity of the ring will vary rapidly with time, and also with position angle around the limb due to the ellipticity of the atmospheric layer focusing the star's light. During the occultation of Nunki, the central flash will probably be visible for less than 10 seconds.

From the 1959 occultation, de Vaucoulears and Menzel determined Venus' occultation radius to be 6165 km, which is 55 km above the cloud tops. For the occultation by Mars in 1976, Elliot *et al.* determined that the layer producing the central flash was about 4 1/2 scale heights below the half-intensity immersion and emersion layers. Applying this to the 1959 data implies that the Venusian central flash should be produced by an atmospheric layer about 30 km above the cloud tops or 100 km above the solid surface of Venus. This layer is high enough that it should be quite stable and free of dust, aerosols, and turbulence in amounts which could cause significant absorption or scattering. From the Pioneer Venus probes, A. Seiff *et al., J. Geophys. Res. 85* (A13) 7903, special issue of 1980 Dec. 30, find the pressure at this level to be only 2×10^{-4} bars. The maximum brightness of the central flash is limited by Nunki's angular diameter, which subtends about 380 meters at Venus. This gives an enhancement by a factor of 54 times Nunki's unocculted intensity, which when spread around Venus' 85″.7 circumference results in light equivalent to a 3.6-magnitude star for each arc second around the limb. In practice, the flash will not be this bright due to a further attenuation caused by the ellipticity of the atmosphere. According to the data in Seiff *et al.*'s tables, the flattening at 100 km is only about 0.5 km. Elliot *et al.* show that the central flash maximum focus zone has a width 4 times the ellipticity, which is 2 km, which would be covered in only 0^s.11 of time and would be mag. 4.4 per arc second around the limb. It is doubtful that anybody will be so lucky to be that close to the central line, but since the intensity drops off inversely with distance from the center, the phenomenon should be visible over a considerable distance. At a distance of 67 km, which is 0″.15 at Venus, the intensity will be mag. 9.0 per arc second along the limb and the duration will be 7^s.5. Since this is the expected maximum path prediction error, if there are 3 observers, it would be logical to station one at the center and the other two 67 km to the north and south. In this case, the worst that could happen would be for the path to pass exactly between two of the observers, in which case, the distance would be 0″.075, giving a brightness of 8.3 mag. per arc second of limb for 3^s.8. If the miss distance were 0″.05, the brightness would be mag. 7.8 per arc sec. for 2^s.5. Of course, the more observers that can be deployed, the greater the chances that at least one of them will see a very bright central flash. Remember that the intensity will probably not be uniform around the circumference of Venus, so that the intensity at some position angles on the dark side will likely be several tenths of a magnitude brighter than the values quoted above.

The map shows the central occultation path, and offset paths at 0″.2 intervals to 2″.0 north and south, across eastern Africa computed from standard ephemeris and FK4 data. I have obtained an improved ephemeris of Venus, based largely on the Pioneer Venus orbiter tracking data, from E. M. Standish of the Jet Propulsion Laboratory. Also, Thomas E. Corbin, Transit Circle Division, U. S. Naval Observatory, has provided the latest accurately-reduced positions of Nunki from the Southern Reference Star program and given me advice on applying various corrections to reduce these to an inertial system somewhat better defined than even the FK4. Using all these data, I computed a new path, which is shown by the line at about 0″.17 north. Shading extending ±0″.15 from this line defines the most probable zone of visibility of the central flash. The only land crossed by the path in reasonable darkness is in Ethiopia and northern Somalia. The chances are very small that anyone farther west, in strong twilight or daylight, will be able to see the central flash. Perhaps the main uncertainty in the path results from the uncertainty in the absolute right ascension of Venus, which had to be determined mainly by optical transit data. The J.P.L. and Astronomical Ephemeris right ascensions disagree by 0″.4. As noted above, a major goal of the observations is to resolve this discrepancy. The central flash should be a more precisely measureable phenomenon than either immersion or emersion, which especially nighttime visual observers may find difficult to time due to their gradual nature over several seconds. Timings accurate to 0^s.5, which should be achievable visually for the central flash, will give a determination accurate to 0″.02, while a 0^s.1 timing error would result in 0″.004. The central flash will also probe a deeper layer of Venus' atmosphere and will be produced by a large fraction of the circumference, not just essentially single points probed by the disappearance and reappearance of Nunki. Photometric observations of the central flash can probably yield data on extinction of the Venusian atmosphere, as the 1976 observations of the occultation by Mars did for that planet.

Hans-Joachim Bode, director of the European section of I.O.T.A., Bartold-Knaust Str. 8, 3000 Hannover 91, German Federal Republic, and I are making plans for an expedition to Somalia to bracket the central flash zone. We hope to use CCD arrays and sensitive video equipment to try to record the phenomena with 8-inch telescopes. Visual observations are also planned, and anyone else interested in joining us on this once-in-a-lifetime occultation opportunity should contact either Hans Bode or me at P. O. Box 488, Silver Spring, MD 20907, U.S.A.. We probably will gather in Berbera, the largest city in northern Somalia, where some Americans are stationed, and on the northern edge of the possible central flash zone. We probably will deploy from there to other towns across the 140-km-wide path on Nov. 17, perhaps with the help of a small rented airplane. I have obtained 1:250,000-scale maps of the area with the help of Alan Fiala, U.S.N.O. The area is a desert, and weather satellite photoes taken during the past 3 years show a high probability of clear skies. The infamous refugee camps are mostly in the southern part of Somalia, and mainly close to the border with Ethiopia, which we plan to avoid as much as possible; weather prospects are slightly better closer to the coast. Since logistic details have yet to be worked out, it is hard to estimate costs now. Hans Bode informs me that round-trip air fare from Germany to Kenya is about $900, while discount fares (should be easy to get in mid-November) from the eastern U.S.A. to Germany and back are about $600. About November 8, there will be a national meeting of German amateur astronomers which some traveling to the occultation may wish to attend. If you don't want to travel to Somalia, you might consider other places where astronomical and weather prospects for observing this rare occultation are good, such as Saudi Arabia, Egypt, Israel, or, perhaps, Turkey or Greece. Observations from more different latitudes will give better coverage. Gordon Taylor is seeking others interested in traveling to east Africa for the occultation combined with a holiday tour; see the bottom of p. 122 of *O.N. 2* (10), 1981 January, for details.

MORE ASTEROIDAL OCCULTATIONS DURING 1981

Andrew Lowe and David W. Dunham

Lowe has made a computer comparison of the SAO catalog with asteroid ephemerides generated with Keplerian formulae using the precision osculating orbital elements published in the Leningrad *Ephemerides of Minor Planets for 1981*. Although planetary perturbations were neglected, accurate calculations by Dunham using numerically-integrated ephemerides showed Lowe's selection to be quite good. Of his claimed occultations, all in fact were occultations, and out of a similarly long list of close misses, one appulse was actually an occultation. The searches were restricted to minor planets with *TRIAD* diameters between 100 and 200 km which might not have been included in Gordon Taylor's work. The results are presented in two tables in the same format as those for the main list of 1981 planetary occultations in *O.N. 2* (10) 116-120. The occultation by Mercury was not found by us, but rather by Steven Albers, who informed *Sky and Telescope*, which notified Dunham. We include it here for completeness.

Most events occur at relatively small elongations from the Sun, so that the durations are rather short, but most may occur in areas with potential observers. Three of the occultations occur at very favorable elongations, and some of the others involve rather bright stars. The first two events will occur before this issue is distributed, but advance information about them has been sent to IOTA coordinators in the possible areas. Regional maps and finder charts will be distributed, or published here, along with the maps and charts for the other 1981 events, as appropriate. Unfortunately, the plotter was not functioning well when some of the regional maps were drawn, putting bumps or small waves on some curves drawn at certain angles. The bumps should be ignored; the smooth part of the line is correct. Sometimes, the problem was so bad that the lines appear almost as stair steps. You can receive local circumstances for these additional appulses by sending a self-addressed stamped (for those in the U.S.A.) envelope to Joseph Carroll, 4216 Queen's Way, Minnetonka, MN 55343; see p. 131 of the last issue. Notes about some of the events are given below.

Oct. 23: The nominal prediction was computed using an ephemeris generated from orbital elements determined at the Institute of Theoretical Astronomy (I. T.A.) in Leningrad. Orbital elements by Paul Herget published in *M.P.C. 4373* (1978) will probably give a better prediction, which is $0''.51$ north of, and 3.4 minutes later than, the I.T.A. prediction used for my regional map and Sôma's world map. Data for the Herget element prediction are given in the tables.

Nov. 9, Mercury: SAO 139620's magnitude is given incorrectly as 5.8 in the SAO catalog. At its true magnitude of 9.1, the occultation will be very difficult to see due to the combination of low altitude and twilight. The possibility for seeing anything exists only for those in a narrow band a few degrees of longitude wide roughly along the eastern side of the Appalachian Mountains.

Nov. 22: This occultation was not discovered by us, but was found by Gordon Taylor, who has already distributed predictions for it. The star is the *secondary* of the double star A.D.S. 6308. The magnitude of the primary is 8.7 and its spectral type is A5. The secondary, 1.0-magnitude fainter than the primary, is $4''.3$ from the primary in p.a. 108°. The primary will not be occulted, with its occultation shadow missing the earth's surface by 760 km ($0''.51$) over the Indian Ocean at $5^h\ 45^m$ U.T. in daylight. These calculations are based on an ephemeris computed from orbital elements by Paul Herget, which probably give a better prediction than that derived from the orbital elements published in the Leningrad *Ephemerides of Minor Planets for 1981* (*E.M.P.81*), which is very similar to Gordon Taylor's prediction. The *E.M.P.81* ephemeris runs $3''.88$ west and $9^m.6$ earlier than Herget's ephemeris, which produces occultations of both components from the earth's surface. In this case, the path for the primary star occultation will cross northern and western Europe, and northwestern Africa from 5h 18m U.T. to 5h 38m, a path just a little east of the secondary star track produced by Herget's elements. The *E.M. P.81* path for the secondary star crosses the southeastern U.S.A., the Caribbean, and northwestern South America from 5h 28m U.T. to 5h 44m. Although the Herget ephemeris is probably the better one, an astrometric check is needed to be sure; some information about the discrepancy probably can be determined from analysis of observations of the asteroid made during the past few years. Dunham plans to include the results of such an analysis in the next issue. The calculated diameter of the primary star is 0.08 milliarcseconds = 116 m at Siegena's distance, so it would take only 21 milliarcseconds to be covered if centrally occulted. Since this is only 0.4 fringes, the pattern will be modified only slightly for photoelectric observers. The magnitude drop in case of an occultation of the primary star will be 3.1.

1981 DATE	UNIVERSAL TIME	PLANET NAME	PLANET m_v	PLANET Δ,AU	STAR SAO No	STAR m_v	STAR Sp	STAR R.A.(1950)	STAR Dec.	OCCULTATION Δm	OCCULTATION Dur	OCCULTATION df	OCCULTATION P	OCCULTATION Possible Area	El SUN	MOON El	MOON %Snl	MOON Up
Jun 22	22h38m	Aemilia	13.7	3.16	99321	6.8	K0	10h48m5	11°51'	7.0	5s12	33		Brazil	68°	174°	74-	E 10°w
Jul 4	17 5-21	Ino	11.7	1.81	141877	9.0	K0	17 44.8	-5 2	2.8	14	22	16	Indonesia, S. Africa	156	123	11+	W 40 e
Aug 3	17 23-29	Ligura	14.1	3.23	182518	9.3	K0	14 22.0	-22 17	4.8	11	25	30	S. Africa?n.	90	47	14+	W 50 e
Aug 15	1 21-48	Athamantis	10.6	1.41	143526	9.4	F8	19 30.7	-7 14	1.5	17	34	18	Mediterranean, n. S. America	148	26	100+	all
Sep 1	21 34	Prokne	12.2	2.46	140438	9.5	A0	15 15.1	-0 13	2.8	7	11	18	eastern Brazil	69	31	11+	W 15 w
Sep 5	19 50	Polyxo	13.7	3.74	98550	8.8	K0	9 21.6	12 44	4.9	3	9	39	Queensland	24	106	43+	none
Sep 30	23 44	Eleonora	11.3	2.84	116606	9.2	A0	8 15.8	9 19	2.3	5	11	26	Mauritius?n	64	96	8+	none
Oct 20	20 40	Lumen	13.6	2.83	185954	9.6	B9	17 52.9	-28 43	4.1	4	11	35	e. Brazil, n.w. Africa	62	142	42-	none
Oct 23	15 45	Aquitania	11.7	2.44	160897	9.0	A2	17 51.6	-18 59	2.8	3	8	30	Arabia, Pakistan	58	105	16-	none
Oct 25	17 34	Lampetia	12.5	2.41	160426	9.2	K2	17 14.3	-12 6	3.3	3	7	30	S. Africa?n.	48	70	4-	none
Nov 9	11 5	Mercury	-0.6	1.14	139620	9.1	K5	13 52.5	-9 20	0.0	99	4	0	e. N. America	17	162	91+	none
Nov 9	14 34	Prokne	12.2	2.87	160482	6.6	F0	17 18.1	-10 39	5.6	4	7	21	s. Indian Ocean	35	115	92+	all
Nov 22	5 30-43	Siegena	11.7	2.05	135010	9.7		7 40.1	-3 54	2.2	37	51	15	Norway,U.K., Canary&C.VerdeIs.	118	78	17-	all
Nov 23	1 29	Lumen	13.6	3.09	187448	2.1	B3	18 52.2	-26 22	11.6	3	9	38	Japan?s., Brit. Columbia?s.	42	81	11-	W154 w
Dec 3	12 55	Thia	12.6	2.72	182607	8.8	M2	14 27.6	-21 17	3.9	3	7	31	w. Ontario; cen. or s.w. USA?s.	30	105	38+	none
Dec 8	17 23-29	Aoeona	13.3	2.64	165680	8.5	K2	23 22.5	-17 54	4.8	8	18	28	s.e. Africa, southern India	88	54	90+	all
Dec 15	8 26	Aquitania	11.9	2.90	188659	9.2	F2	19 49.7	-21 28	2.8	3	7	35	New Zealand (North Island)?s.	33	158	79-	none
Dec 27	2 9-29	Ninina	13.6	2.32	98120	7.7	A0	8 44.5	11 21	5.9	12	32	31	S. Africa, Caribbean, e.USA?n.	144	151	0+	none

1981 DATE	MINOR PLANET No.	Name	km-diam.	-"	RSOI	Type	MOTION °/Day	PA	STAR SAO No	DM No.	D	STELLAR DIAMETER M"	M	Time	df	S	COMPARISON DATA AGK3 No	Shift	Time	APPARENT R.A.	APPARENT Dec.
Jun 22	159	Aemilia	141	0.06	634	C	0.294	113	99321	+12°2266		0.93	2123	76	6.1	Z	N11°1261	0".36	0m.1	10h50m.1	11°41'
Jul 4	173	Ino	169	0.13	783	C	0.219	252	141877	-04 4351		0.26	343	29	1.3	S				17 46.5	-5 3
Aug 3	356	Ligura	157	0.07	857	C	0.147	99	182518	-21 3895		0.23	535	37	1.5	S				14 23.8	-22 26
Aug 15	230	Athamantis	116	0.11	375	S	0.161	252	143526	-7 4984		0.10	102	15	0.4	S				19 32.4	-7 10
Sep 1	194	Prokne	195	0.11	803	C	0.392	118	140438	+00 3334		0.05	84	3	0.3	S	S 0 2001	-0.74	-0.4	15 16.7	-0 20
Sep 5	308	Polyxo	139	0.05	602	U	0.388	107	98550	+13 2083		0.56	1527	35	4.0	X	N12 1133	0.61	0.7	9 23.3	12 36
Sep 30	354	Eleonora	156	0.08	641	U	0.358	101	116606	+09 1928		0.05	111	4	0.3	S	N 9 1061	-0.56	-0.2	8 17.5	9 14
Oct 20	141	Lumen	117	0.06	410	C	0.365	81	185954	-2813855		0.02	49	2	0.1	X				17 54.8	-28 43
Oct 23	387	Aquitania	120	0.07	355	S	0.507	103	160897	-18 4675		0.06	104	3	0.3	X				17 53.4	-18 59
Oct 25	393	Lampetia	117	0.07	308	C	0.585	95	160426	-11 4332		0.30	522	12	1.7	S				17 16.0	-12 8
Nov 9		Mercury	4880	5.88	15548		1.421	113	139620	-08 3661		0.53	437	9	2.1	P				13 54.1	-9 29
Nov 9	194	Prokne	195	0.09	749	C	0.532	101	160482	-10 4477		0.22	456	10	1.4	P		-0.79	0.2	17 19.8	-10 41
Nov 22	386	Siegena	203	0.14	993	C	0.090	188	135010	-03 2023	B					G				7 41.7	-3 59
Nov 23	141	Lumen	117	0.05	398	C	0.434	78	187448	-2613595	Y	0.85	1907	47	5.5	F				18 54.1	-26 19
Dec 3	405	Thia	126	0.06	352	C	0.597	106	182607	-20 4039		0.76	1503	31	4.6	X				14 29.3	-21 25
Dec 8	145	Aoeona	137	0.07	576	C	0.222	45	165680	-18 6304		0.42	803	45	2.5	S				23 24.1	-17 44
Dec 15	387	Aquitania	120	0.06	361	S	0.539	88	188659	-21 5554		0.04	94	2	0.3	X				19 51.5	-21 23
Dec 27	357	Ninina	110	0.07	470	C	0.135	301	98120	+11 1913	A	0.11	183	19	0.6	X	N11 1034	-0.34	0.4	8 46.2	11 14

Nov. 23: The star is Nunki (σ Sagittarii = Z.C. 2750) which remarkably is occulted by Venus only six days earlier; see page 161. This appulse is actually a close miss, so that a south shift is needed for the event to be visible in the possible area. But at least secondary occultations are possible. The appulse occurs in the daytime, and at rather low altitude, in Japan. The elongation and low declination will prevent astrometry from the Northern Hemisphere to improve the prediction. The predicted magnitude drop is the greatest I have seen for a predicted occultation. The star probably can be found easiest in daylight or bright twilight by offsetting from Venus. Nunki's right ascension will be 22m3 less than Venus', and Nunki will be 41' south of Venus in declination, at

the time of closest approach by Lumen. Unfortunately, the shadow for Nunki's 9.5-magnitude visual companion will pass even farther (by $2\overset{\prime\prime}{.}2$ in the sky) north, with closest approach $8\overset{m}{.}0$ earlier than for the primary.

Dec. 8: The nominal prediction was computed using an ephemeris generated from orbital elements determined at the Institute of Theoretical Astronomy (I.T.A.) in Leningrad. Orbital elements by Paul Herget published in *M.P.C. No. 4368* (1978) may give a better prediction, which is $0\overset{\prime\prime}{.}8$ south of, and 2.2 minutes earlier than, the I.T.A. prediction used for my regional map and Sôma's world map. Data for the Herget element prediction are given in the tables.

Dec. 15: (387) Aquitania again; see Oct. 23 note. Herget's prediction for this event is $0\overset{\prime\prime}{.}85$ north and 2.8 minutes later than the I.T.A. prediction used for my regional map and Sôma's world map. Data for the Herget element prediction are in the tables.

Dec. 27: SAO 98120 is the southern (primary) component of the double star A.D.S. 6995. The secondary, only 0.1 magnitude fainter, is $12\overset{\prime\prime}{.}5$ away in position angle 354° and has a separate SAO number (98119). SAO 98119 will not be occulted by Ninina from anywhere on the Earth's surface.

THE GRAZE OF IOTA AQUARII

David W. Dunham

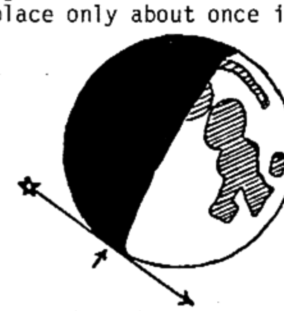
A grazing occultation of the 4th-magnitude star Iota Aquarii (Z.C. 3237) took place on U.T. 1980 November 16. It was the most favorable graze to pass near several large cities along the east coast of the USA during the past few years. The time was convenient and the path passed right over Washington, DC. Of course, it rained or was cloudy along the entire path; only one observer in a Rhode Island expedition may have seen the first disappearance in a break in the clouds (he was unsure). Nevertheless, the graze generated much interest, and was favorable enough that some interest might be generated among the general public. I prepared the paper, printed below, and sent copies to the local major daily newspapers, and to amateurs in other cities suggesting that they make local modifications and do the same. You might consider preparing a similar article when a very favorable graze next passes over your metropolitan area. The Washington newspapers did not publish anything about the event; their science writers were in California for the Voyager Saturn flyby that week. Paul Teicher did manage to get a shortened version of the paper published in a Long Island, NY, newspaper. It might also be useful to contact the electronic media. I did this locally so late that the long-range weather forecast already was pessimistic, but radio station WTOP did interview me on the air by telephone. Since that station was the one we selected for the secondary time reference, the announcer asked me about that, which gave me the opportunity to explain how members of the public could make useful observations. The map showing the path, traced from a 1:250,000-scale topographic map plot, is not reproduced here. On 1981 January 14-15, a graze of Z.C. 444 followed a nearly identical path across the Washington area, but we did not publicize it since binoculars would not be sufficient to see it. In spite of a pessimistic weather forecast, which discouraged many, the skies cleared a few hours before the graze, which was timed by several observers, some of whom successfully used WTOP for a secondary time reference (I made the WTOP - WWV master tape).

Moon to Graze Bright Star in Washington Saturday Night, Nov. 15

About 8:40 p.m. Saturday evening, November 15th, those living in a narrow zone passing across the Washington area may be able to see the bright star Iota Aquarii (Iota in the constellation Aquarius) disappear and flash back into view several times as it appears to skip along a rugged mountain range near the moon's south pole.

This rare grazing eclipse, technically called a "grazing occultation," or simply a "graze," can be seen with a small telescope or even a pair of binoculars. If binoculars are used, they should be mounted on a camera tripod or steadily held against something, such as a fence post.

A graze of a star bright enough to see with binoculars occurs at a particular place only about once in every 50 years, while one such event visible somewhere from the Washington metropolitan area might occur about every ten years. The graze will be visible only within the 2½ mile wide band shown on the map. South of the southern line on the map, the moon will miss Iota Aquarii altogether, with no eclipse occurring. North of the northern line, a short "ordinary" eclipse of the star can be seen. There, Iota Aquarii will disappear at about 8:35 p.m., and will not reappear until several minutes later.



The diagram above shows the moon as it will appear at the time of the graze of Iota Aquarii on Saturday evening, Nov. 15. The darker areas on the moon's bright side are the maria, ancient seas of frozen lava which form "the man in the moon" figure at full moon. The long arrow shows the motion of the star relative to the moon as seen by observers in the predicted graze zone shown on the map. The star at the base (upper left side) of the long arrow shows Iota Aquarii's location a half hour before the graze. The short arrow indicates where the graze will occur.

The moon will be near first quarter, with 54% of its apparent disk illuminated by the sun. The rest of the disk will be faintly lit by "earthshine," which is sunlight reflected from the earth. If you know where to look, Iota Aquarii can be found easily with the unaided eye from a location with a relatively dark sky. During a graze, the moon provides an easy reference for finding the star, but also produces so much glare that at least binoculars are needed to see the star.

The graze of Iota Aquarii will occur entirely on the dark side a short distance from the moon's southern cusp (normally called a "horn" when the moon is crescent).

The moon, which will be high above the southwestern horizon, will seem to drift from right to left in relation to the stars of Aquarius. Hence, relative to the moon, Iota will seem to move from left to right, as shown in the chart. The graze will be about five minutes in duration, beginning just before 8:41 p.m.

If the successive disappearances and reappearances of a star during a graze are timed to an accuracy of one second or better by observers at several locations across the predicted path, the moon's position in relation to the star can be measured to high accuracy. These data are valuable for studying the shape and motion of the moon. Lasers are used to measure the moon's distance precisely, but observations of grazes are needed to examine the small north-and-south variations in the moon's motion and to orient the lunar orbit relative to the stars. The two types of observation complement each other to give a better description of the moon's orbit and of the basic stellar reference system used by astronomers. Graze observations are analyzed at the U.S. Naval Observatory, Washington, and at the Royal Greenwich Observatory in England [Ed: currently, substitute ILOC for RGO].

The lunar profile can be approximately predicted using photographs of the moon which have been measured carefully at the U. S. Naval Observatory. But the profile can be traced more accurately with extensive graze observations than it can be deduced from photographs.

Recently, solar physicists have postulated small variations in the sun's diameter which can influence the earth's climate. Astronomers have found that careful observations of total solar eclipses provide a powerful method for monitoring the solar diameter. But in order to use these solar eclipse observations, a good knowledge of the lunar profile is needed. Grazes of stars help provide the details of the lunar profile.

Anyone within the graze zone who has a tape recorder and binoculars could make observations of scientific value. The more observers who record a graze from different locations spread across the zone, the more accurately the lunar profile is traced. To observe, place the recorder close to where you watch the graze, so that your voice can be recorded. Fresh batteries should be used. Small tape recorders need to be protected from the cold, to prevent the motor grease from freezing. For example, the machine can be kept under your coat, perhaps hung from the neck with a loop of twine. Start recording about 8:38 p.m. and be sure that you have at least ten minutes of tape. Each time the star disappears, call out "off" or "on," respectively. If the star is eclipsed briefly by a small hill, so that it reappears immediately after it disappears, we call the event a "blink." Similarly, a "flash" occurs if the star appears momentarily in a lunar valley. Also, you should record WTOP at 1500 kilohertz using an AM radio nearby (a car radio could be used). Check beforehand to be sure that both your voice and WTOP are clearly recorded. WTOP is used to provide a time reference for your observations; if a shortwave radio is available, it would be better to use WWV at 10.0 megahertz. We will make a master recording of WTOP along with WWV to calibrate everyone's WTOP recording. Ordinary telephone time is not accurate enough for this type of observation, but the time available from the U. S. Naval Observatory, phone area 202, 254-4950, is accurate enough.

In addition, the place of observation must be known to an accuracy of ten feet with respect to nearby road intersections, railroad tracks, creeks, or large buildings. If you do make a successful recording, telephone David Dunham at 585-0989 or write to him at P.O. Box 488, Silver Spring, MD 20907 to report the necessary details of the observation.

If you do not live in the predicted zone, but are interested in seeing the graze, you might visit a friend who does live in the zone, or just try to observe from any accurately identifiable position within the zone. Members of the local astronomy club, the National Capital Astronomers, plan an expedition to observe the graze from several locations across the path. If you want more information about the graze, or want to join our expedition, call David Dunham at 585-0989 or at 589-1545, ext. 358.

When the light of Iota Aquarii is spread out into its different colors with a spectroscope, evidence for two stars very close to each other is revealed. During the graze, the second star, which has never before been directly observed by itself, might be seen briefly after a disappearance or just before the reappearance of the main star. Or the second star may simply cause some of the disappearances or reappearances to appear gradual, lasting a few or several tenths of a second, rather than instantaneous, as they normally appear. A small telescope may be needed to observe such "step" or "gradual" events, but if they are seen, try to note both the beginning and the end of each event in your recording.

The path for the Iota Aquarii graze extends across the United States from southern Texas to Massachusetts. It passes near Lafayette, LA; north of Atlanta, GA; near Roanoke and Charlottesville, VA; south of Wilmington, DE, and Camden, NJ; over Long Island, NY; over New London and Groton, CT; south of Providence, RI; and north of Plymouth, MA. Other expeditions by amateur astronomers are planned in most of these areas; if the weather cooperates, it could become the best-observed graze yet.

VIDEO RECORD OF MULTIPLE EVENTS DURING GRAZING OCCULTATION OF δ CANCRI REVEALS DIFFRACTION PHENOMENA

David W. Dunham, Alan D. Fiala, and Joan B. Dunham

In spite of a pessimistic weather forecast, clear skies prevailed near Conowingo Dam, Maryland, on UT 1981 May 10 (May 9 local date, Astronomy Day), permitting observation of the graze of 4.2-magnitude δ Cancri (Ascellus Australis = Z.C. 1310) from 16 of 18 stations spread over a distance of 2.4 miles perpendicular to the predicted limit. A miss occurred at the two northernmost stations, but multiple events were seen at nearly all of the other stations. Analysis of the data is still in progress for the graze, important because the latitude libration was $+0^{\circ}.07$, well within the range for solar eclipses.

At one of the stations, we attached an R.C.A. 12-volt TC 2055 Ultracon low light level video camera to an 8-inch Celestron loaned to us by Mark Trueblood. The camera was small enough (2 pounds) so that no special counterbalancing was needed; this was even the case when we tested the unit with a 5-inch Celestron a few nights before the graze. The video equipment was loaned to the U. S. Naval Observatory by Robert Flory, a senior engineer at R.C.A.'s David Sarnoff Laboratory in Princeton, NJ, originally to record the annular eclipse in Tasmania last February, prevented by clouds. The camera output was fed to a half-inch Panasonic portable VHS video recorder-player. There was not enough time to secure a source of AC power for the telescope drive; the video equipment was all battery-powered. We found that the star drifted across the monitor screen in 50 seconds, so that manual adjustments, during which the star remained in view, were made slightly more often.

Playback of the videotape after the graze showed 14 events (occultations by seven lunar features) in a period of 62 seconds, luckily one of the highest numbers in the expedition. After helping with the setting up of the equipment, Joan moved to a site approximately 70 feet to the north (measured perpendicular to the limit), where she timed ten events visually; the shadows of the tops of two lunar hills passed between the stations. David timed eight events at his site 500 feet farther north. His first disappearance was gradual, lasting 1.4 seconds, followed a few seconds later by a faint flash of about seventh magnitude. The graze was very easy to see since the 41%-sunlit waxing moon was at an altitude of 47° and the cusp angle of central graze was 4°N.

Playback of the videotape at tenth speed (three frames per second) shows that the recorded events are gradual, some lasting 15 frames or more with undulations as the distance from the star to the edge of the moon varies. For each of these frames, we plan to estimate the brightness of the star relative to its unocculted intensity, and from that compute the distance to the lunar limb from the calculated Fresnel diffraction pattern. In this way, we can trace the limb at 30-meter intervals, the amount of lunar motion between frames. Relative times will be accurate to the frame interval of 1/30 second. We did not make any provision for absolute timing other than recording WWV on the audio channel of the video tape, from which we can determine U.T.C. to $0^{s}.1$. We are searching for a practical means for obtaining U.T.C. to an accuracy comparable to the frame interval, although such accuracy is not needed for graze observations considering the present state of the art.

We plan to make a movie copy of the video record for showing at meetings. The equipment proved to be very practical for field use. It should be possible to record grazes (or total occultations, lunar or asteroidal) of seventh-magnitude, or fainter, stars using a 14-inch Celestron, one of which is owned by our area astronomical society, the National Capital Astronomers. For recording total occultations, photoelectric equipment, such as that designed for amateur use by the University of Texas mentioned on p. 155, will give better time resolution. But video equipment is much more practical for recording grazes and reappearances, since accurate tracking is not needed. The automatic timing of reappearances, eliminating the uncertain estimates of personal equations, could be especially valuable since few of these events are timed photoelectrically.

The advent of automatic recording methods does not decrease the need for, or value of, visual observation of grazing occultations. To be sure, most of the information about the δ Cancri graze profile will be derived from the data of the 15 visual observers. Visual timing accuracies for grazes are more than adequate for our studies to improve the lunar profile, for solar eclipse analyses, and for astrometric studies; continuing substantial prediction errors constantly reaffirm this. Automatic records of grazes will be useful for assessing the smoothness of the lunar limb at the scale of Fresnel diffraction, since a perfectly smooth lunar limb is usually assumed for analysis of photoelectric total occultation data. Also, automatic records of grazes of close double stars, with two or more contacts observed, can give separations and position angles, not just projected separations, to considerably better accuracy than visual observation. For individuals or societies who would be interested in recording grazes and/or total occultations (especially reappearances) with video equipment, a camera like the one we used can be purchased from a video equipment store for about $1200. A video recorder and other needed accessories typically cost a similar amount. The TC 2055 Ultracon has a light range of 1:660,000 and a fast response which minimizes the image decay time.

As far as I know, this was the first time that multiple events were recorded during a graze with video equipment. In 1973, Joan photographed grazes of Alcyone (η Tauri = Z.C. 552, mag. 3.0) and Tejat (μ Geminorum = Z.C. 976, mag. 3.2) with 35-mm recording film pushed to ASA 4000. A motorized back for the camera, attached to a 60-mm refractor, permitted 1/4-second exposures at 1/2-second intervals. Four and six events, respectively, were photographed, but the timing was not as accurate as could be done visually. Video records have been made of three grazes of first-magnitude stars, but in each case, only one disappearance and one reappearance occurred. The first was on 1976 August 29, when Spica was recorded with a 48-inch Air Force satellite tracking telescope at Malabar, FL. The site was several miles north of the southern limit, so it is not surprising that only one 12-minute occultation occurred. Harold Povenmire reported that Spica's individual components were seen due to the high time resolution; the observation was mentioned in *O.N. 1* (10) 94. Portable equipment was used for the other two events, Regulus on 1980 June 18 in New Orleans, LA, *O.N. 2* (9) 101, and Aldebaran on 1981 February 12 in the German Federal Republic, communicated by Hans Bode. Dr. J. Dommanget has been determining accurate times of total occultations, including rather faint stars, with video equipment at the Belgian Royal Observatory during the last few years. He notes that the video method is the only one now capable of recording reappearances and disappearances equally. Not knowing the exact position of emersion causes longer reaction times for visual observers, while photoelectric observers need larger diaphragms for reappearances. Dommanget has published an article about his method, "Observation des occultations à l'aide d'une caméra de télévision," in *Communications of the Belgian Royal Observatory*, Series B, No. 104 (1978), and in *Ciel et Terre 94* (5), 1978. The variations, or "undulations" noted above in our δ Cancri record, are too large to be caused by the diffraction pattern fringes. Probably they are caused by small lunar hills near the point of contact, which cause the distance to vary on the steep part (major drop) of the diffraction curve.

ASTEROIDAL OCCULTATION UPDATES

David W. Dunham

Finder charts and regional maps are published elsewhere in this issue for several potentially favorable asteroidal occultations for North Americans. This material for the occultation by (18) Melpomene on August 7 was sent to photoelectric observers in the western U.S.A. since the small magnitude drop virtually precludes visual observation and this issue will be too late for that event. World maps for all asteroidal occultations through 1981 Oct. 5 were published in the last issue.

For the August 7th event, Arnold Klemola obtained a plate connecting the objects on June 30 at Lick Observatory. This shows a 0".42 north shift with the event 2m2 earlier than the nominal prediction, indicating a path crossing southwestern British Columbia, the Hawaiian Islands, and the southeastern parts of New South Wales and Victoria. Further astrometry is planned to refine the prediction. Long-focal-length direct photographs of Melpomene, similar to the ones of (9) Metis taken by Chinese astronomers discussed in the last issue, might show the satellite suspected from the 1978 December 11 secondary extinction recorded at Fernbank Science Center in Atlanta, GA.

Klemola will also attempt at least preliminary astrometry for the occultation by (70) Panopaea on Aug. 26, and perhaps also (89) Julia on Aug. 12. Astrometrists in the eastern U.S.A. will give priority to the occultations by Julia; (105) Artemis on Aug. 27; (230) Athamantis on Aug. 15 (moonlight will hinder, and possibly prevent, last-minute astrometry); and (409) Aspasia on Aug. 20, in that order. Gordon Taylor plans astrometry at the Royal Greenwich Observatory for all events potentially visible from Europe.

The Asteroid Intercept Radio Network has been disbanded due primarily to the infrequency of events and partly to lack of interest of amateur astronomers in this method of shift dissemination in most areas. For future events, we will rely mainly on the recorded message phone numbers used for the ill-fated June 5th occultation, 312,259-2376 in Chicago, IL, and 501,771-0978 in Little Rock, AR. In the case of an unusually favorable event, as indicated by the astrometry, we will try to have a message broadcast on WWV. Since *Sky and Telescope* is published more frequently than *O.N.*, asteroidal occultation news and finder charts often appear there first, so be sure to check *Sky and Telescope*.

I recently have made additions to my computer programs so that most of the labels on my regional planetary occultation maps now are written automatically by the plotter. This eliminates the need for me to add most of the labels manually, but sometimes makes the labels hard to read, when they are printed on top of each other, or over crowded national boundary areas. I check the maps to see whether difficult area can be figured out from adjacent labels, and sometimes add manual labels for clarity. A minor error, which soon will be corrected, caused many of the labels on the charts in this issue to be plotted at a slight tilt with respect to the curves along which they were supposed to be plotted.

The occultation by (48) Doris on March 19 seemed to be relatively unfavorable, but as far as I know, it was the only asteroidal occultation to be observed, from Washington and British Columbia, since the last issue was distributed. The path was accurately predicted from measurements of a plate taken the night before with the 61-inch U. S. Naval Observatory telescope at Flagstaff, AZ, with reductions using faint reference stars tied to Perth 70 positions with a plate taken earlier at Lick Observatory by Klemola. More information about this event, and other asteroidal occultation attempts, will be published in the next issue. The discovery of a probable third satellite of Neptune during the May 24th appulse with KMN 29, with confirming photoelectric observations by University of Arizona astronomers at the Catalina and Mt. Lemmon Observatories, will also be described in the next issue.

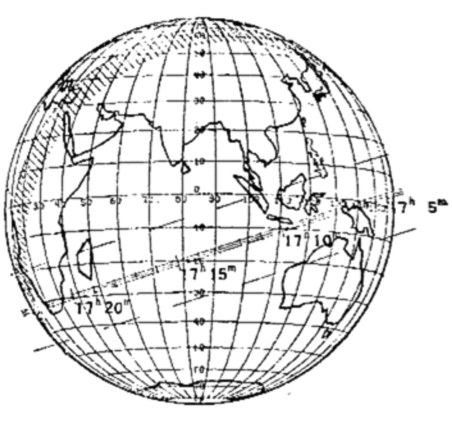
On p. 152 of the last issue, for the occultation by Metis on June 14, the label above the dashed line should be "Z.C.", not "AGK3". A special notice was sent to about 60 observers in the possible area of visibility, and astrometry by Klemola indicated only a small north shift. The only observations received so far are negative ones from the Purple Mountain and Yunnan Observatories in China, and from Dushanbe in the southern U.S.S.R., all south of the path indicated by Klemola's astrometry.

Note added 1981 July 29 (addition to the "Using the IOTA/ILOC Occultation Report Forms" article, p. 159)

Don Stockbauer points out that the forms still contain no explicit provisions for "resumed observing, status changed" for the case where, during the graze, the star disappears or reappears during an interruption of observation. For now, in this situation, enter "8" in the graze column 73, and state in the comments that the star disappeared or reappeared while not observing. Also, do this in the case where the star already has disappeared by the time that effective observation has begun, as is often the case with waning-phase grazes when the first disappearance is on the sunlit limb. I have asked the ILOC whether a special graze column 73 code can be designated for this purpose, which would eliminate the need for a comment, and will report their response in a future issue.

The figures on this and the following pages are an extension of the "Planetary Occultation Predictions" article. The world maps are produced by Mitsuru Sôma. The regional maps are produced by David Dunham. Finder charts are prepared by several volunteers.

SAO 99321 by Aemilia 1981 Jun 22

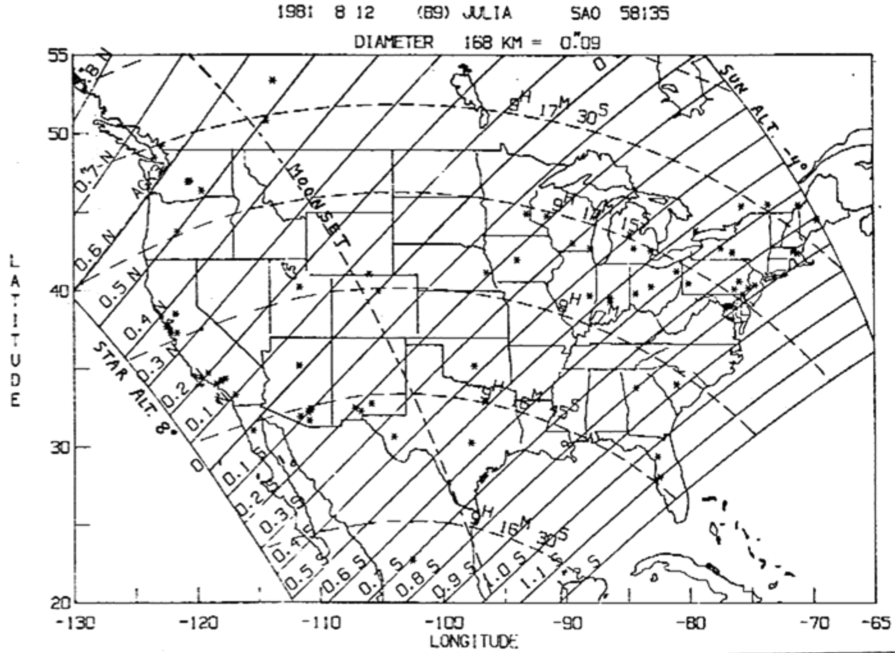


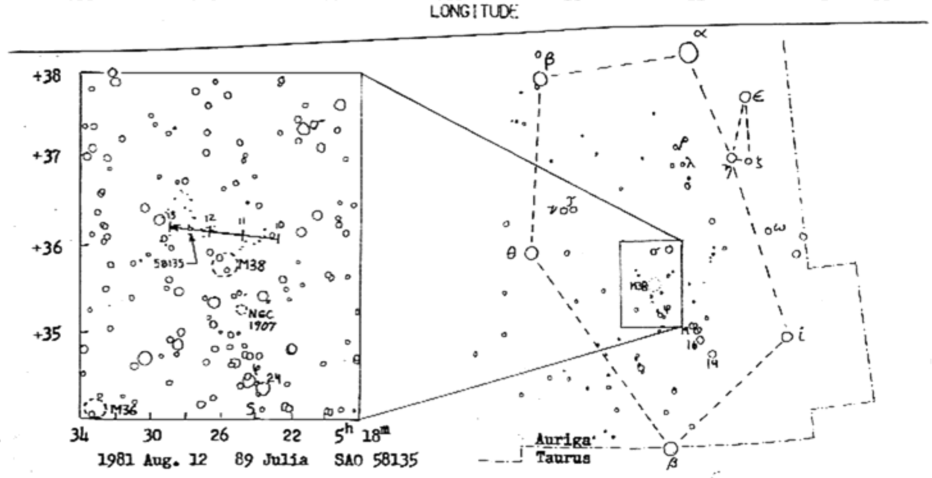
SAO 141877 by Ino 1981 Jul 4

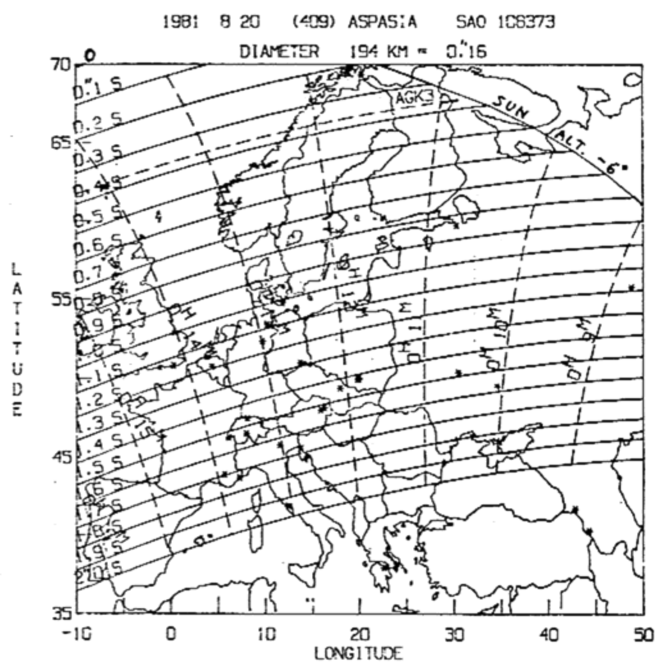
SAO 182518 by Ligura 1981 Aug 3

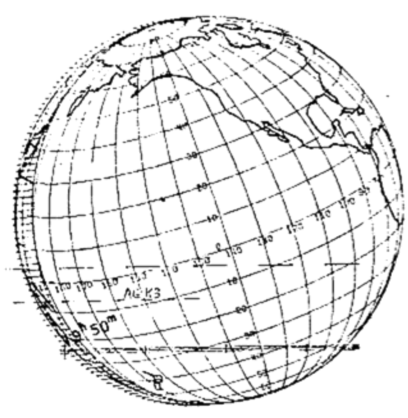
SAO 143526 by Athamantis'81 Aug 15

SAO 140438 by Prokne 1981 Sep 1

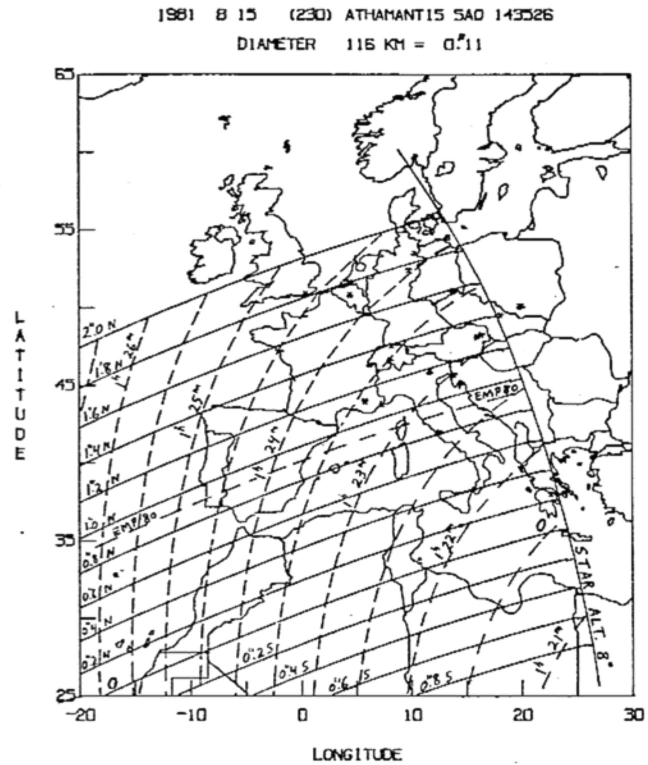




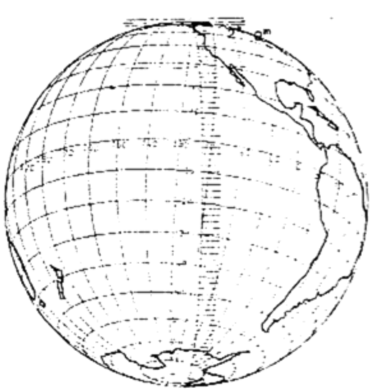




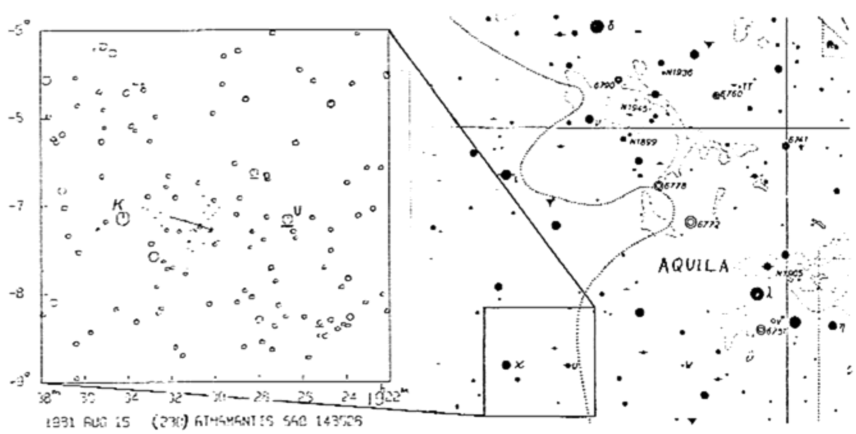
SA098550 by Polyxo 1981 Sep 5



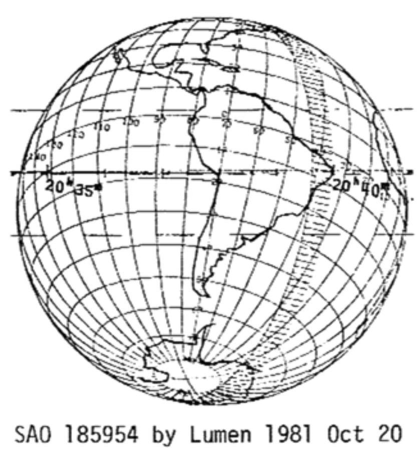
SAO 116606 by Eleonora 1981 Sep 30



SAO 187124 by Thisbe 1981 Oct 7



SAO 58448 by Eunomia 1981 Oct 12

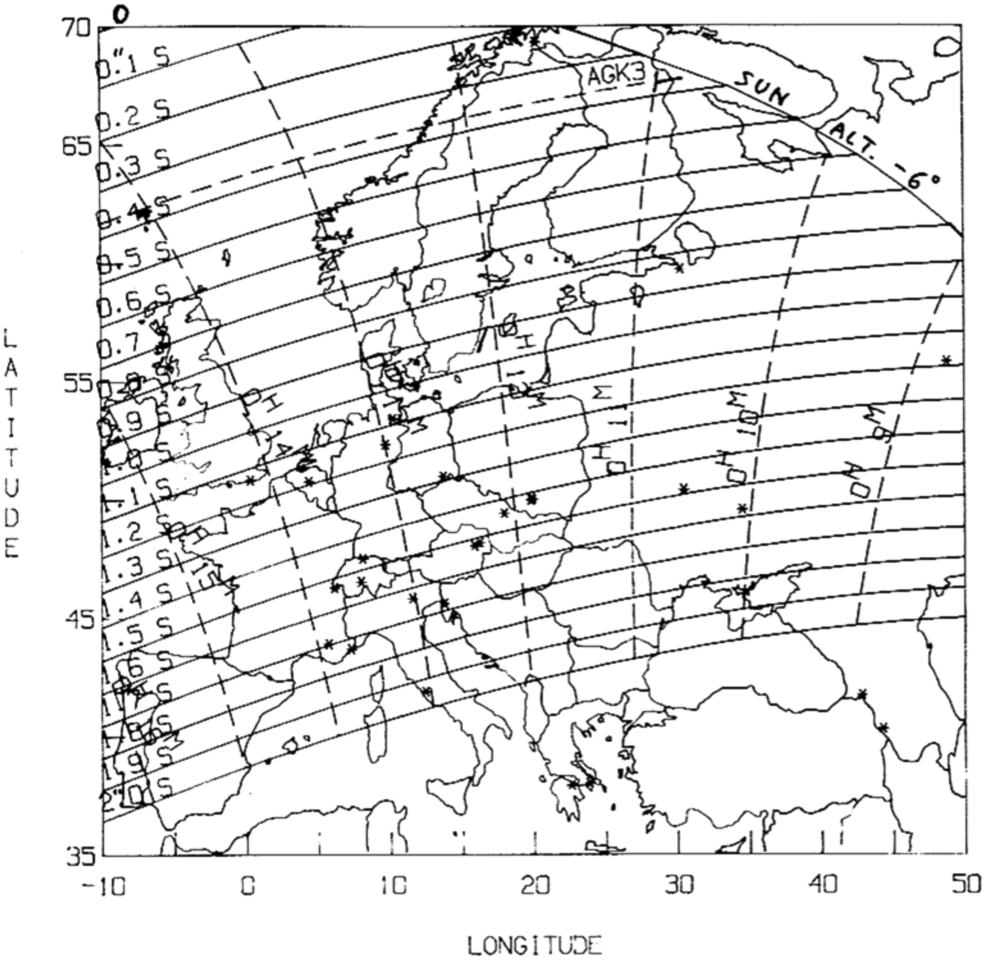


SAO 185954 by Lumen 1981 Oct 20

SAO 160897 by Aquitania '81 Oct 23

1981 8 20 (409) ASPASIA SAO 108373

DIAMETER 194 KM = 0."16

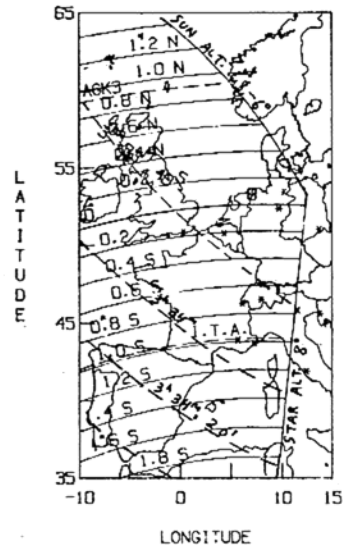


1981 8 27

(105) ARTEMIS

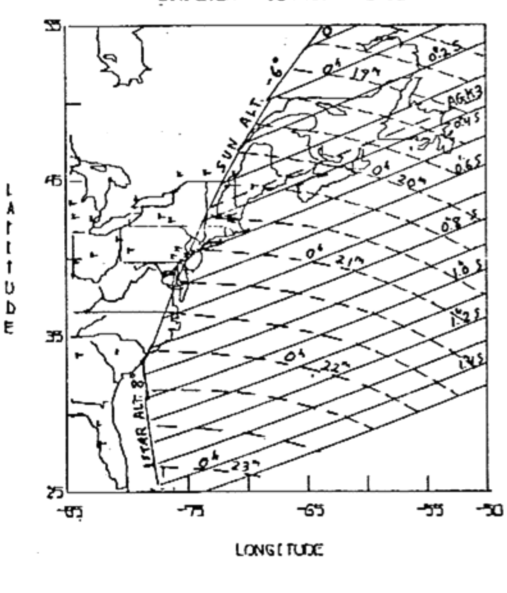
SAO 126198

DIAMETER 129 KM = 0."14



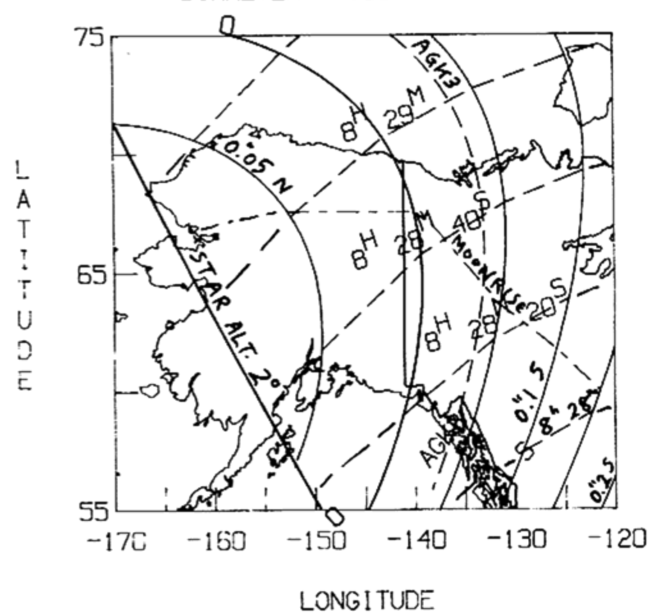
1981 8 20 (409) ASPASIA SAO 108373

DIAMETER 194 KM = 0."16

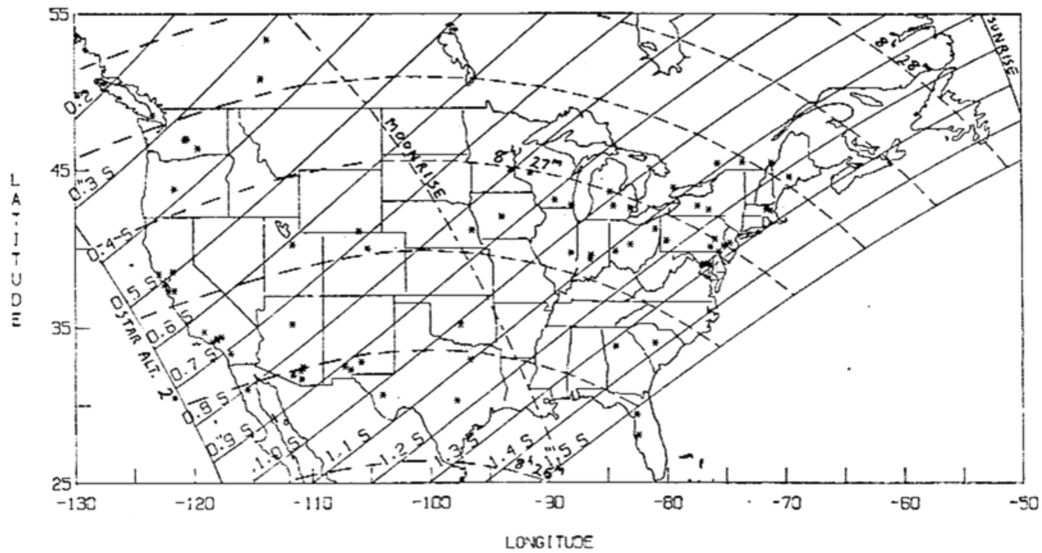


1981 8 26 (70) PANOPAEA SAO 77350

DIAMETER 153 KM = 0."07

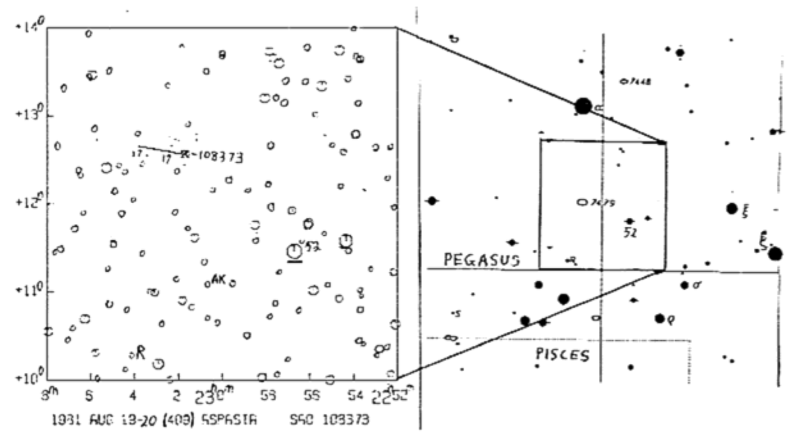


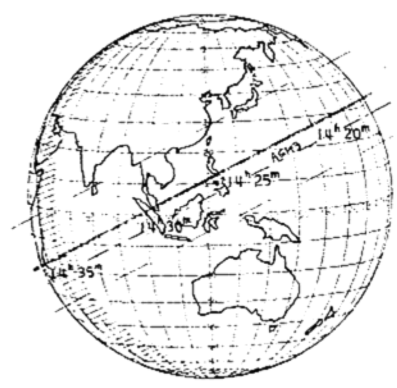
1981 8 26 (70) PANOPAEA SAO 77350
DIAMETER 153 KM = 0".07



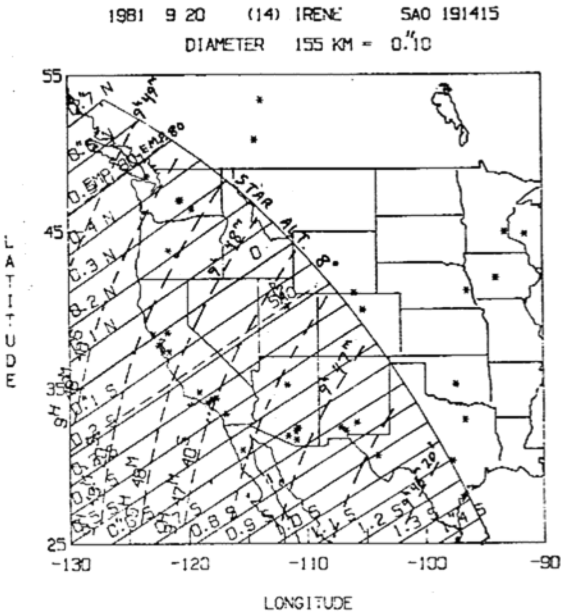
1981 8 27 (105) ARTEMIS SAO 126198
DIAMETER 129 KM = 0".14

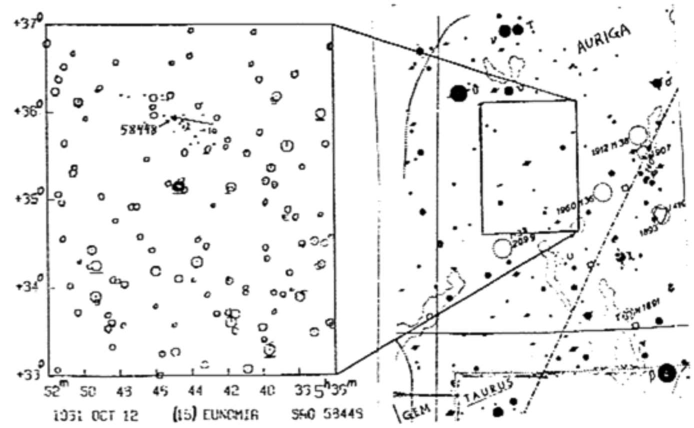
SAO 160426 by Lampetia 1981 Oct 25

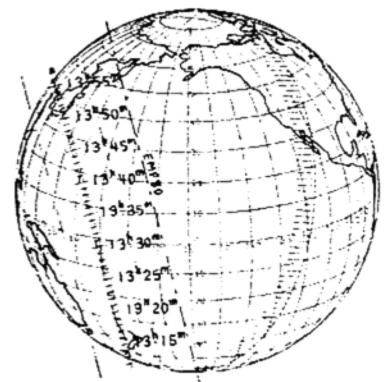




SAO 109524 by Freia 1981 Oct 27



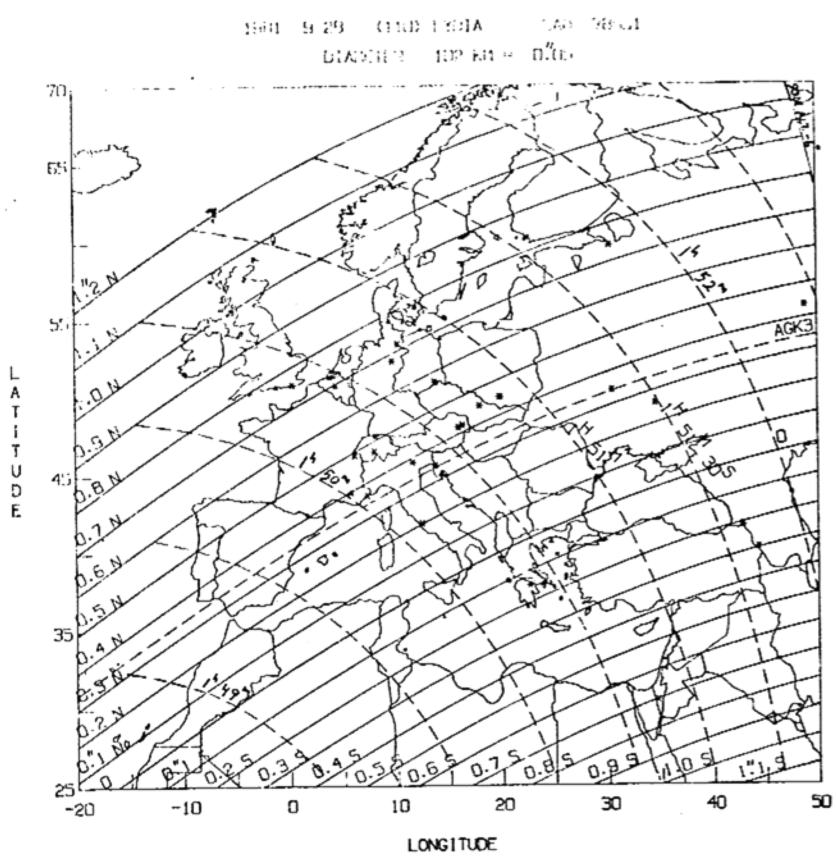


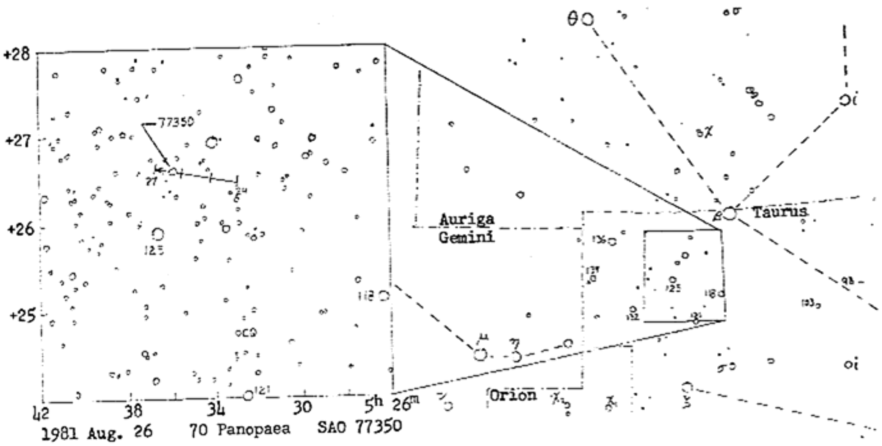


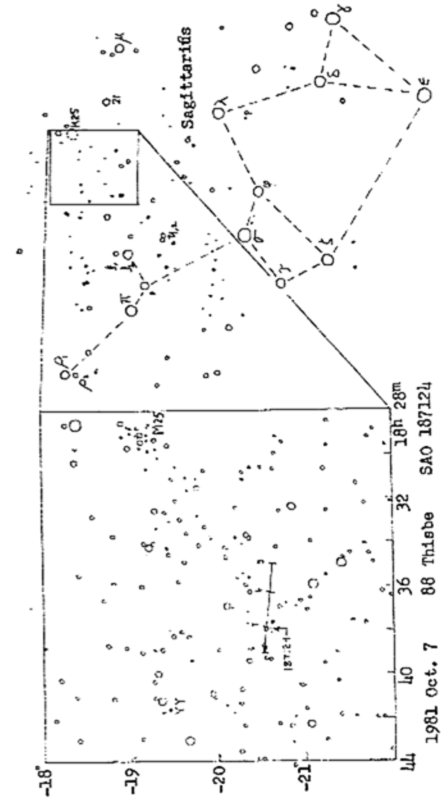
DM +17 1058 by Papagena 1981 Nov 1

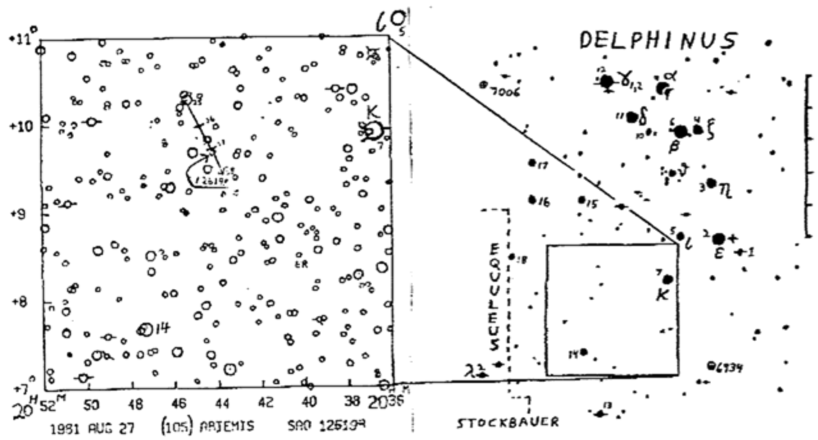
SAO 162511 by Thisbe 1981 Nov 2

SAO 118858 by Hebe 1981 Nov 7



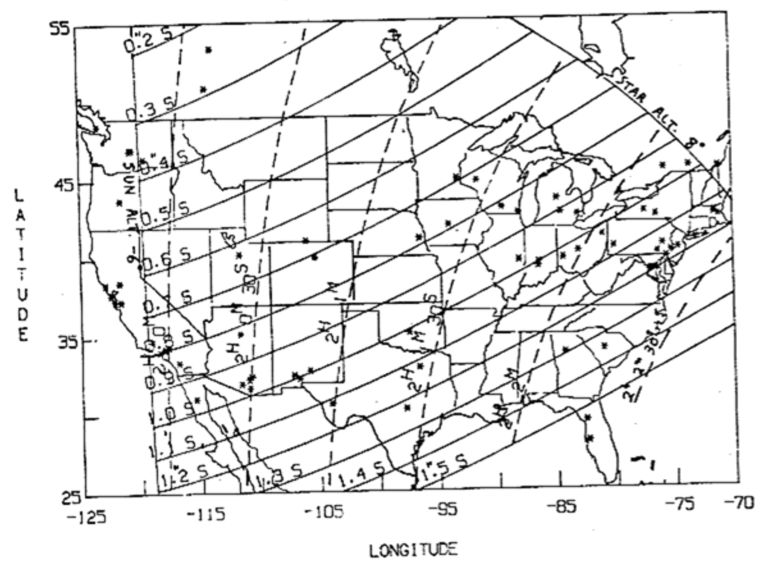


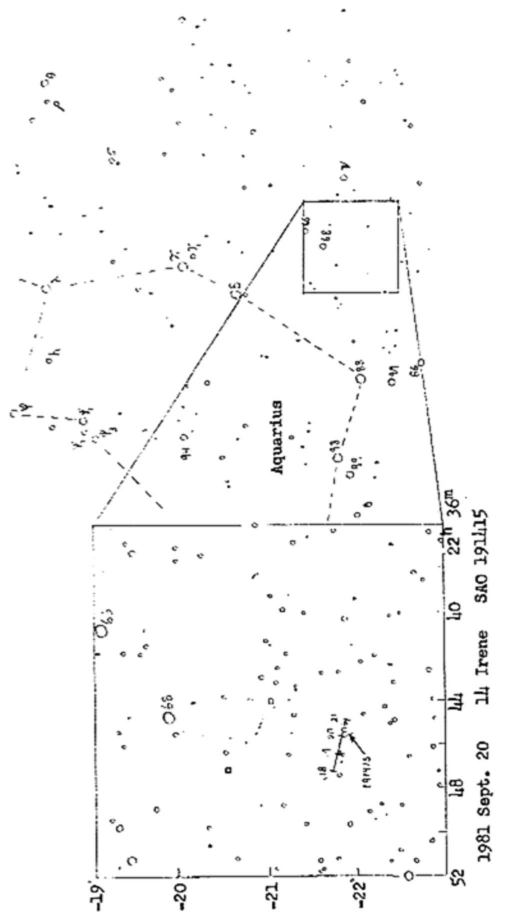


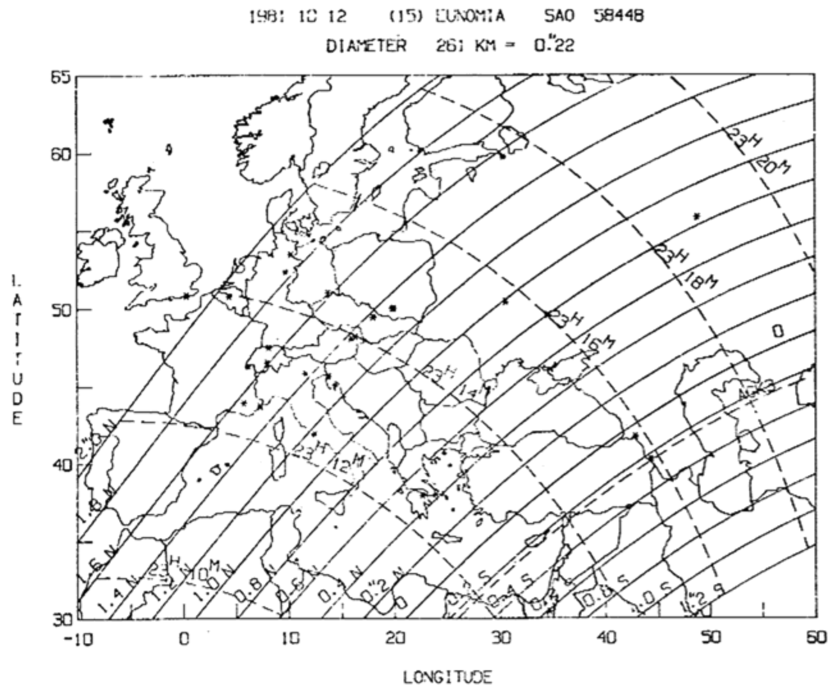


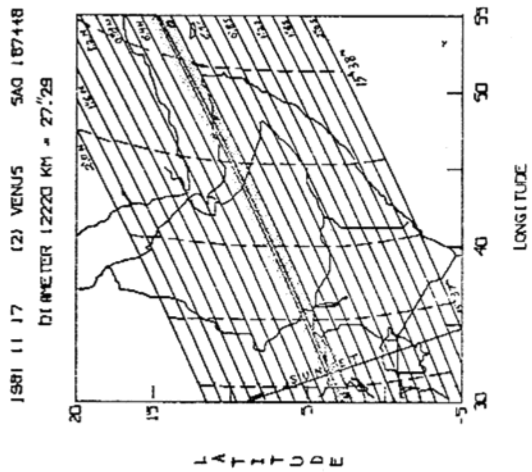
1981 10 7 (88) THISBE SAO 187124

DIAMETER 214 KM = 0.″14









DM +02 2269 by Arethusa '81 Oct 12

SAO 139620 by Mercury 1981 Nov 9

Nunki by Venus 1981 Nov 17