Occultation Newsletter

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Edited and Published for I. O. T. A. by H. F. DaBoll at 6 N 106 White Oak Lane, Saint Charles, Illinois 60174, U. S. A.

INTERNATIONAL OCCULTATION TIMING ASSOCIATION AND OCCULTATION NEWSLETTER

IOTA is a dues-supported organization. With some exceptions noted in the accompanying article, "IOTA NEWS", observers will have to join IOTA to receive grazing occultation predictions on a regular basis. Privileges include a subscription to Occultation Newsletter, predictions for various special occultation events, and various special papers, when published, including a detailed zodiacal double star list, and an updated version of David Dunham's grazing occultation papers.

IOTA annual dues are $7 for residents of the U.S.A., Canada, and Mexico, and $9 for others, in U.S. funds.

The other items mentioned are also available to non-members: a subscription to Occultation Newsletter is still $2 per year, but only thru Vol. I, No. 9, with later issues priced higher; for a non-member, requests for graze data will be handled at $1.50 per graze; separate copies of the graze papers will be priced at $2.50. These prices are applicable towards IOTA membership, if the requester decides to join. Applications, requests, and orders should be directed to the IOTA Secretary (see "IOTA NEWS").

The $9 IOTA membership includes overseas airmail delivery of Occultation Newsletter. The basic price of a separate subscription includes first class surface mail delivery, with air mail available at the difference in cost to us: 12¢/year in U.S., Canada and Mexico; 96¢/year in the remainder of the Americas; and $1.36/year to all other countries. A new basic price will be announced in the next issue.

H. F. D.

ERRATUM

As indicated in handwritten notes included with all individually mailed copies of Vol. I, No. 4 sent prior to the mailing of this issue, there was an error in the formula on p. 30; it should read:

$$\text{VPS} = \text{seconds of arc per mile} = \frac{1}{1.158 \times \sqrt{\dfrac{\sin^2 D}{\sin^2 a} + \cos^2 D}}$$

IOTA NEWS

David W. Dunham

An organizing meeting for IOTA was held in Highland Park, Illinois, during July 26th. IOTA now has 79 paid members. At this point, we decided that formal incorporation and a constitution would be more trouble than they're worth; as the organization grows, we will reconsider these options. The following officers were established: President and Scientific Director, David W. Dunham, 2976 Linwood Ave., Apt.2, Cincinnati, OH 45208, phone 513,321-5536; Vice President and Publications Chairman, John D. Phelps, Jr., 8621 W. 167th Pl., Orland Park, IL 60462, phone 312,532-2968; Secretary, Berton L. Stevens, Jr., 4032 N. Ashland Ave., Chicago, IL 60613, phone 312,281-8258; Treasurer and Occultation Newsletter Editor, H. F. DaBoll, 6 N 106 White Oak Ln., St. Charles, IL 60174, phone 312,584-1162. All changes of address, requests for predictions of grazing occultations (including prediction non-receipt complaints and changed coordinates or travel radii) and other special events, and requests for IOTA application forms, should henceforth be sent to the IOTA Secretary, Berton Stevens. Any checks or money orders should be made payable to IOTA [Ed: If you prefer, you may use either International Occultation Timing Association, or Occultation Newsletter].

IOTA can best be run by a group of officers living in the same metropolitan area. For instance, virtually day-to-day communication will be necessary between the secretary and treasurer. It would be hard - probably impossible - to find three people in the same metropolitan area who were as competent and willing to do the work of IOTA as our current vice president, secretary, and treasurer. I urge all members to give them their wholehearted support. An additional advantage is the proximity to Cincinnati, so that all officers' graze travel areas overlap. A year from now, we plan to have more democratic procedures, and will consider nominations of officers from other geographical areas, provided a satisfactory working relationship with the other IOTA officers can be established.

It must be stressed that there continues to be no charge for occultation services not provided by IOTA, such as the Occultation Supplement and detailed total occultation predictions computed at the U. S. Naval Observatory and the total and graze (for Eastern Hemisphere observers) predictions computed at the Royal Greenwich Observatory. Approximate total occultation predictions for North America (only) are still available from Nicholas Esposito if you send him a self-addressed long envelope and postage (see "Special Occultation Predictions", Sky and Telescope, Jan. 1975, p. 60). See the section on grazes, p. 42, for more important information.

Grazing occultation predictions will continue to be distributed by the computers, all of whom are IOTA members. Postage for graze predictions is being paid by the U. S. Naval Observatory for observers in part of the northeastern U. S., the Middle East, and New Zealand. Jan Hers, contrary to what was said in the last issue, is paying postage for graze predictions for observers in Australia and southern Africa out of his own pocket, and says he will continue to do so, regardless of IOTA membership. For this, he has been given honorary IOTA membership, and will be sent some proportion of the dues paid by any IOTA members in the area he serves. Hans Bode recently sent a letter to his observers reiterating the O.G.O.-VIII observational criteria for the observers in Europe (excluding Norway, northern Sweden, Finland, and northern Russia) to whom he supplies graze predictions, so he is also an honorary IOTA member. Depending on finances, Bode says that a European version of IOTA may be necessary in the near future. A European occultation organization would have different needs from IOTA; if such a group is established, details will be published here as soon as we learn of them. Similarly, I doubt that Motonobu Tonomura would require IOTA membership for graze observers in Japan to receive predictions.

Joseph Senne has sent predictions for grazes through the end of September to observers in the Midwest, Hawaii, and Manitoba, while Richard Nolthenius has sent graze data for the rest of 1975 to observers in the southwestern U. S. and Baja California. Bob Bailey has sent predictions through at least September to some non-members in the south-central U. S. But observers in these areas will have to join IOTA, or possibly make other arrangements with their computors, in order to continue to receive graze predictions regularly.

OBSERVATIONS OF OCCULTATIONS DURING THE MAY 24-25 LUNAR ECLIPSE

David W. Dunham

I must apologize for the delay in distribution of predictions for this event. Due to my move to Cincinnati, I had many things to do which had to have precedence over my eclipse work. Occultation predictions giving the accurate eclipse circumstances had never been computed before (at least, not on such a scale) and many unexpected computer programming problems had to be worked out. The bulk of the detailed total occultation predictions were computed only 8 days before the event, and were received in St. Charles for distribution with the last issue the following Monday. As a result, some observers, mainly in South America, Canada (plagued by postal strikes), and U.S. college students with changed summer addresses, received the data after the eclipse. One of the latter, R. Nolthenius, did quite well without the data, by careful use of my star chart published in the May issue of <u>Sky and Telescope</u>. Detailed predictions of grazes of non-SAO stars suffered the worse delay, being mailed less than 2½ days before the eclipse. Few of these reached the observers in time and very few were observed - unfortunate considering the darkness of the eclipse and consequent favorability of some of the events, compared with the one very marginal graze of an SAO star in the United States. At least, the computer programs are now set up so that predictions for future eclipses can be more easily computed farther in advance; good progress has been made for the November eclipse.

Since events can be observed at both the eastern and western limbs of the moon, timings of lunar eclipse occultations have special value in studying the moon's shape (specifically, corrections to the reference sphere used by Watts for his limb data). The account, OCCULTATIONS DURING TOTALITY on p. 77 of the August issue of <u>Sky and Telescope</u>, is quite thorough and does not need to be repeated here. The workers at McDonald Observatory recorded eclipse occultations photoelectrically in two colors, but found the red trace to be useless due to the brightness of the eclipsed moon at those wavelengths. It is unfortunate that cloudy skies ruined the occultation timing plans of many observers in Latin America, where the eclipsed moon was high in the sky. The tally of eclipse occultation timings given here is similar to the yearly tallies, such as the one for 1974 on p. 39, but I have not tried to assign values. In the case of two observers with the same total, I have given the lower rank number to the one who timed the most reappearances, if this is known. Many of the observers listed here are from an eclipse occultation tally published in <u>Newsletter of the Northeast Florida Occultation Team (NEFOT)</u>. Another Florida observer, Tom Campbell, saw stars to 11th magnitude, but his short-wave radio failed and he got no timings. I am a little disappointed at the total number of occultation timings made during the eclipse, especially in relation to the number of photographs taken, most serving no useful purpose. I realize that many observers were clouded out, but I wish that occultation observers would concentrate more on occultations during eclipses; there are enough others taking photographs, conducting public viewing, etc. Some, especially those working two or more telescopes, were able to do fairly well at both occultations and other projects, such as photography. Good eclipses visible from a given place are not very common, as mentioned in the Future Eclipse Occultation section.

# indicates that the observations were made photoelectrically. Under Telescope, the aperture is given, and L (reflector) or C (Celestron). Another observer made reference to Margaret Stewart's timing of a reappearance, so all I know is that she made at least that timing, and probably others (hence, the "+"). I thank all observers who sent me eclipse occultation timing reports, and give my condolences to those who were clouded out - they missed a good eclipse.

Occultations of the May 24-25 eclipse star field are still happening, and timings of any of them could be of value as additional data for a study of the moon's shape. If conditions are very good, timings of non-SAO stars not in the USNO total occultation predictions might be timed with the aid of the chart on p. 31 of the last issue. Since the moon will be waxing, disappearances will occur on the dark limb and accurate predictions will not be needed. It would be interesting to compare what can be done when the moon is crescent with the data obtained during the eclipse. Since eclipse occultations were observed only in the United States, the stars for which additional timings would be most valuable are the ones south of -20° 50' and between $16^h\ 01^m$ and $16^h\ 08^m$ (epoch 1950) on the chart. These will be occulted in the Northern Hemisphere for only a few more months. A preprint of a paper on lunar occultations of the astrophysically interesting multiple system β Scorpii prepared at USNO was used to determine the following 1975 dates and times of the May eclipse field passages: Aug. 15, 0^h-5^h U.T., moon 61% sunlit, Latin America and eastern and central North America (the 7.9-mag. star SAO 184141, discovered to be double during the eclipse, will be occulted again on Aug. 15 in eastern North America, a good opportunity for photoelectric observers to get more data about the binary; a dark-limb graze of the star will be visible near the southern limit, passing 40 miles north of Dallas, TX; along the AR-LA border; 40 miles north of Jackson, MS; and near Birmingham, AL, Atlanta, GA, and Columbia, SC; Sept. 11, 7^h-10^h U.T., 37% sunlit, New Zealand, central Pacific, possibly Japan and Australia; Oct. 8, 16^h-19^h U.T., 17% sunlit, Africa, Europe; and Nov. 5, 3^h-5^h U.T., 3% sunlit, central Pacific. In later months, waning-phase events will occur and the chart could be used to predict occultations of non-SAO stars, but none of the stars whose occultations were timed during the May eclipse will be occulted.

1975 MAY 24-25 ECLIPSE OCCULTATION TALLY

Rank	Observer	Telescope	Total	R's	Non SAO	Non BD
1	Richard Nolthenius, Dos Cabezos Mtns., AZ	15-cm L	18	7	13	3
2	David Dunham, Redford, TX	25-cm L	17	11	14	5
3	James Fox, Cottage Grove, MN	25-cm L	15	6	11	2
4	David Evans, McDonald Observatory, TX#	76-cm L	13	2		
5	John Cotton, Dallas, TX	25-cm L	12	4	10	1
6	James Brooks, Chatham, VA	32-cm L	10	6	6	3
7	Mickey Schmidt, Ira, TX		7	2	5	1
8	George Haysler, Austin, TX	32-cm L	7			
9	Danny Morrison, Celina, TX	20-cm C	6	3	6	0
10	Mike Reynolds, Jacksonville, FL	25-cm L	6			
11	Mike Kazmierczak, Jacksonville, FL		4			
12	Richard Sweetsir, Jacksonville, FL		4			
13	Joan Dunham, Redford, TX	15-cm L	3	1	1	0
14	Jeff Green, Redford, TX	15-cm L	3	1	1	0
15	Harold Carney, Jacksonville, FL		3			
16	Raymond Bryant, Bakersfield, CA	20-cm	3	1	0	0
17	Lee Hellig, Jacksonville, FL		3			
18	Gary Ringler, Cleveland, OH	11-cm L	2	1	2	0
19	James Van Nuland, San Jose, CA	20-cm L	2	1	1	0
20	Terry Boone, San Antonio, TX		2	1	0	0
21	Alvin Flesher, Baltimore, MD	15-cm L	2	1	0	0
22	John Oliver, Bronson, FL#	76-cm L	2	0	0	0
23	Margaret Stewart, Gold Run, CA		1+	1+		
24	Richard Wilds, Rock Creek, KS	10-cm L	1	1	1	1
25	David Scott, Panama City, FL	15-cm L	1	0	0	0
26	Alfred Webber, Chadds Ford, PA	25-cm L	1	0	0	0
27	Craig Conrad, Jacksonville, FL		1			
28	Wayne Green, Atlanta, GA		1			
29	Peter Reynolds, Jacksonville, FL		1			
30	Mike Roscoe, Jacksonville, FL		1			
31	Chuck Vaughn, Jacksonville, FL		1			
			150	49	71	13

1974 TOTAL OCCULTATION TALLY

David W. Dunham

The following tally of total occultations for 1974, in the same format as the 1973 tally published in the third issue (p. 22), has been compiled mainly from the forms that were distributed with the third issue and sent to me. This list is not as complete as the one for 1973. Unfortunately, no Czechoslovak observers could be listed. I have reports of their observations made during the first half of 1974 (they didn't do as well as during the first part of 1973), but left them in Texas in my late-May rush to move to Ohio. The Japanese make about 1000 occultation timings a year, many of them photoelectric, but there is usually at least a year's delay in reporting them. For these reasons, we will probably postpone future occultation tallies so that we can publish a more complete picture, perhaps waiting for the HMNAO observation tape sent to USNO. HMNAO is now including observer identification in their observation files.

Rank	Observer	Value	Total	R's	Non ZC
1	Robert Hays, Jr., Chicago, IL	421.83	220	100	147
2	N. Wieth-Knudsen, Tisvildeleje, Denmark	277.99	169	54	113
3	H. F. Cochran, Brownwood, TX	185.46	135	25	85
4	Jan Hers, Randburg, South Africa	149.24	123	13	68
5	Bill Fisher, Colfax, CA	145.66	73	36	28
6	H. F. DaBoll, St. Charles, IL	136.57	74	31	50
7	Robert L. Sandy, Kansas City, MO	117.44	69	24	19
8	Richard Nolthenius, Tucson, AZ	100.46	50	25	27
9	John Korintus, Palm Bay, FL	94.33	58	18	0
10	Nathaniel White, Flagstaff, AZ#	88.00	88	0	-0
11	Robert Bailey, Houston, TX	84.35	46	19	32
12	Clifford J. Bader, West Chester, PA	83.42	37	23	4
13	Guillermo Mallén, México City, México	78.44	30	24	-0
14	Douglas Hall, Leicester, England	75.18	55	10	34
15	Steve Vogt, McDonald Observatory, TX#	70.00	70	0	49
16	Luis Felipe Hurtado, San Fernando, Spain	64.20	42	11	7
17	David Dunham, Austin, TX	56.29	24	16	11
18	Thomas Whelan, Tikorangi, New Zealand	55.13	41	7	3
19	Alfred C. Webber, Chadds Ford, PA	54.05	48	3	12
20	Robert Germann, Wald, Switzerland	51.13	37	7	0
21	John Africano, McDonald Observatory, TX#	48.00	48	0	34
22	Thomas Campbell, Temple Terrace, FL	47.27	17	15	7
23	José Osório, Vila Nova De Gaia, Portugal	44.07	36	4	25
24	James H. Fox, Cottage Grove, MN	39.11	27	6	16
25	Cliff Turk, Pinelands, South Africa	37.05	31	3	11
26	P. Darnell, Rodovre, Denmark	37.02	35	1	21
27	Geoffrey Kirby, Weymouth, England	35.11	23	6	7
28	Mickey Schmidt, Ira, TX	34.04	30	2	1
29	Antonio Vazquez, San Fernando, Spain	33.09	23	5	8
30	Harald Marx, Münchingen, W. Germany	33.07	25	4	10
31	James Van Nuland, San Jose, CA	33.04	29	2	12
32	David Herald, Canberra, Australia	31.04	27	2	23
33	Keith Horne, San Diego, CA	29.11	17	6	16
34	B. Soulsby, Canberra, Australia	29.00	29	0	20
35	Klaus Kiebert, Fellbach-Schmiden, W. Germany	27.02	25	1	14
36	Lionel E. Hussey, Christchurch, New Zealand	24.09	14	5	9
37	David Evans, McDonald Observatory, TX#	22.00	22	0	15
38	Roy Caputo, Howard Beach, NY	20.09	10	5	1
39	Joel Dubin, Skokie, IL	20.04	16	2	10
40	Gary Ferland, McDonald Observatory, TX	20.00	20	0	19
41	George L. Fortier, Baie d'Urfe, Quebec, Canada	18.04	14	2	12
42	Ronald W. Cross, Christchurch, New Zealand	18.02	16	1	6
43	Karl Simmons, Jacksonville, FL	16.07	8	4	2
44	Joseph Zoda, Maple Park, IL	16.05	10	3	1
45	Richard Wilds, Topeka, KS	14.07	6	4	0
46	Don Stockbauer, Austin, TX	14.07	6	4	4
47	Daniel Green, Boone, NC	14.05	8	3	4
48	Robert Pike, Mississauga, Ontario, Canada	14.04	10	2	1
49	James E. Brooks, Chatham, VA	13.02	11	1	6
50	Steve Zvara, Whittier, CA	12.00	12	0	8
51	Tom Moffett, McDonald Observatory, TX#	12.00	12	0	10
52	Bart Benjamin, Peoria, IL	11.02	9	1	0
53	Michael L. Wilson, Milwaukee, WI	11.00	11	0	10
54	Alvin R. Flesher, Baltimore, MD	10.04	6	2	2
55	Alistar McDonald, Townsville, Q., Australia	10.02	8	1	8
56	Hank Geerlof, Calgary, Alberta, Canada	9.02	7	1	0
57	Jean Meeus, Erps-Kwerps, Belgium	9.00	9	-0	-0
58	John A. Church, Princeton Junction, NJ	7.02	5	1	4
59	Bruce Blundell, Manhasset, NY	7.02	5	1	3
60	Alain Porter, Narragansett, RI	6.00	6	0	2
61	Joan Dunham, Austin, TX	6.00	6	0	4
62	Willy Verhaegen, Wetteren, Belgium	5.00	5	0	1
63	Wayne Clark, St. Louis, MO	5.00	5	0	4
64	William Young, Arlington, VA	4.02	2	1	0
65	Roger Giller, Engadine, N.S.W., Australia	4.00	4	0	0
66	Victor Slabinski, Arlington, VA	3.00	3	0	1
67	Motonobu Tonomura, Shizuoka, Japan	2.00	2	0	2
68	William Dillon, Springfield, VA	2.00	2	0	1
69	Dan Rugar, Las Vegas, NV	1.00	1	-0	-0
70	William J. Westbrooke, San Francisco, CA	1.00	1	-0	-0
71	Larry Mills, Kansas City, MO	1.00	1	0	1
72	Terry Boone, Los Angeles, TX	1.00	1	0	0
73	Stan Harley, Creedmore, TX	1.00	1	0	1
74	Walter Bures, Omaha, NE	1.00	1	0	1

(R/D=3.018) (# indicates most or all timings made photoelectrically)
(-0 means unknown)

The data for the 1974 list were keypunched, and the list produced, by Richard Nolthenius in Tucson, Arizona, using a copy of Don Stockbauer's program used to produce the 1973 list.

Robert Hays, Chicago, makes most of his observations with a 15-cm reflector, and some with a 12.5-cm Celestron, and not a 20-cm Celestron, as incorrectly reported in the write-up about the 1973 tally.

Keith Horne, using a 10-inch reflector primarily in San Diego, California, reports the following annual counts:

Year	1970	1971	1972
Total	19	500	202
R's	3	172	73
Non-ZC	8	386	179

He began observing in late 1970. He had less time for observing during the fall of 1972, when he went to college. For the same reason, he ranked only 48th in the 1973 list. But as far as I know, his total for the year 1971 is unsurpassed. 34% may not seem such a high percentage for R's until consideration is made of the morning fogs which frequently blanket the California coast and the fact that many unpredicted D's of non-SAO stars were timed. Keith obviously made an all-out effort in 1971, and his result is not likely to be beaten for a long time.

[Ed: 3 reports were received after the computer run was made. These have been inserted at the appropriate ranking, without re-computing the R/D ratio.]

FUTURE FIRST MAGNITUDE OCCULTATIONS

David W. Dunham

Using an approximate lunar theory supplied by USNO, Bruce Watson, Gulfport, MS, has computed a list of Besselian elements of all occultations of first magnitude stars occurring from 1960 to 2025. He used his data to compute the 1960 March 4 occultation of Aldebaran (the first occultation he observed) for Washington, DC, and got agreement to within 2 minutes of HMNAO's predicted time. A series of occultations of Spica is now in progress in the Southern Hemisphere; a few occultations of the star will be visible from North America next year. A long series of occultations of Aldebaran will begin in 1978.

OCCULTATIONS DURING FUTURE LUNAR ECLIPSES

David W. Dunham

Complete information about occultations during the 1975 November 18-19 total lunar eclipse will be published in the next (October) issue, and detailed predictions for occultations of all stars shown in the Paris Astrographic Catalog (to about photographic magnitude 12) will be distributed to observers in the favorable area of visibility, including Asia (but excluding Japan and the Philippines), Europe, Africa, eastern South America, eastern Canada, and the United States north and east of Maryland. Send David Dunham coordinates of your intended place of observation, if he doesn't already have them; observations should be made with the largest available telescope.

Most of the predictions will be computed during August. Unfortunately, the moon will be passing through a relatively star-poor area west of 13 Tauri and south of the Pleiades. No variable stars are predicted to be occulted, but the 15th-mag. asteroid 1686 De Sitter will be occulted during totality as seen from part of the Southern Hemisphere. Z.C. 510, 519, 520, and 528 will be occulted in the umbra, as will many SAO stars with numbers ranging from 93455 to 93552.

Occultations of the November eclipse star field are now in progress; timings would be useful for supplementing the eclipse observations for studies of the moon's shape. Some timings were made on July 5, when occultations by a 17% sunlit waning moon were observed in the United States. Hopefully, more were made in Australia and the Far East on August 2. Other 1975 passages by the waning moon through the field will occur as follows: August 29, 0^h-4^h U.T., eastern Canada, U.S. northeast of Pennsylvania, eastern South America, and western Europe (since the moon will be 58% sunlit, some observers using large telescopes may be able to observe reappearances of some non-SAO stars; predictions for such events will be available upon request to David Dunham); September 25, 7^h-11^h U.T., moon 80% sunlit, North America and the Pacific; and October 22, about 15^h U.T., 95% sunlit, west Pacific, east Asia, and Australia. Check your total occultation predictions, and try to get some timings. Tom Campbell, Temple Terrace, Florida, notes that his July 5 timing indicates the position of SAO 93485 may be in error.

The only umbral lunar eclipses during the two years following 1975 are small partials on 1976 May 13, 20^h U.T., magnitude 0.13, and on 1977 April 4, 5^h U.T., magnitude 0.20. The best events will be grazes at the south and north limbs, respectively, but even so, only occultations of SAO stars will be observable (hence, University of Texas predictions for fainter stars will be of no use). The next total lunar eclipse after this year will occur on 1978 March 24 in Asia and Australia. On 1979 Sept. 6, a total lunar eclipse will be visible from the Pacific Ocean, including western North America. However, the next total lunar eclipse favorably visible throughout North America, like the one on May 25th, will not occur until 1982 July 6. So when good lunar eclipses occur in your area, do your best to get some useful observations.

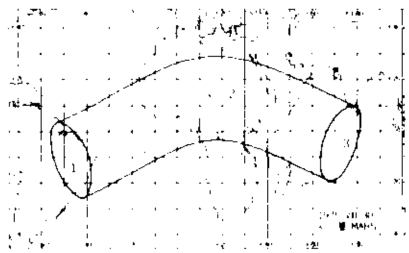
See the paper, "Occultations of Bright Stars by the Eclipsed Moon," by Konnen and Meeus in the publications list, p. 41.

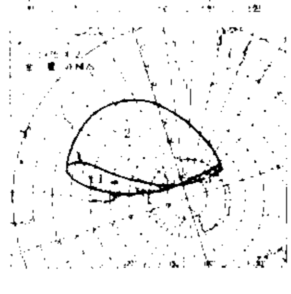
PLANETARY OCCULTATIONS

A letter from Francisco Diego relates that he and several other members of the Sociedad Astronomica de Mexico observed the partial occultation of Mercury on July 7th at the Mexican National Observatory at Tonanzintla, Puebla. Some photographs were obtained with the 1-meter, and other, telescopes. The planet never completely disappeared. An approximate timing of last contact was made, as well as timings of a distinct dimming and subsequent brightening of the planet due to a high lunar mountain. This is the first observation of a partial occultation of Mercury.

A number of total occultation (contact) timings have been received, and will be reported later.

Worthwhile events of Mars (August 30) and Venus (October 2) will be visible as shown in the maps, which are reprinted by permission from the Japanese Ephemeris 1975, published by the Hydrological Department of Japan.





MORE PUBLISHED PAPERS ABOUT OCCULTATIONS

Compiled by
David W. Dunham

Reprints of these papers usually are available from the authors. Some authors have sent me reprints of their articles. This helps considerably in preparing these compilations, and I encourage the practice.

P. Bartholdi, D. W. Dunham, D. S. Evans, E. C. Silverberg, and J. R. Wiant, "Occultations of the Pleiades: Reappearances Observed photoelectrically at McDonald Observatory", Astron. J. 80, 449. Twenty-two reappearances were recorded using the 272-cm telescope at a wavelength of 6943 Å during the Pleiades passages of 1971 September 10 and November 4, including 7 non-SAO stars. A possible companion of Alcyone was discussed on p. 36 of the last issue.

P. Bartholdi, "Photoelectric Observations of Occultations of the Pleiades and the Incidence of Duplicity in the cluster", Astron. J. 80, 445. Twenty-two disappearances were recorded using the 1-m Geneva telescope at Haute Provence Observatory, France, during a favorable Pleiades passage on 1972 March 19. A collation of all data, spectroscopic and visual as well as occultation, shows that some 40%-50% of the brighter Pleiades are double. A comparison with the diagnoses of duplicity and rotation by the Geneva photometry is almost perfect for duplicity and good for rotation.

J. Berezne, M. Combes, R. Laporte, J. Lecacheux, and L. Vapillon, "The Occultation of β Scorpii by Jupiter III. Discussion of the Photometric Results", Astron. & Astrophys. 40, 85. Accurate determination of the zero level of the stellar flux was the crucial measurement. Characteristic "plateaus" evident in the far portions of the light curves are shown to be due to the Jovian atmosphere, implying that the inversion method used in analysis of the Pioneer 10 radio occultation data needs to be revised.

D. W. Dunham, D. S. Evans, and S. S. Vogt, "Angular Diameters and Effective Temperatures of Red Giant Stars from Lunar Occultations with Special Reference to μ Geminorum", Astron. J. 80, 45. The observation was made photoelectrically in two colors with the McDonald 76-cm telescope. Due to an error, there was a sensible time constant in the system, which was modelled in the analysis to derive a diameter for μ Gem near $0''.013$. The calibration of effective temperature for normal M giants needs to be revised.

J. J. Eitter and W. I. Beavers, "Lunar Occultation Summary. I.", Astrophys. J. Suppl. Series 28, 405. A list of the results of 121 photoelectric records of 111 stars observed in two colors at the Erwin W. Fick Observatory, Ames, Iowa, is given, along with details for two previously unpublished new double stars.

T. L. Elliot, L. J. Wasserman, J. Veverka, C. Sagan, and W. Liller, "Occultation of β Scorpii by Jupiter V. The Emersion of β Scorpii C", Astron. J. 80, 323. A new method for using multicolor observations to remove noise due to the Jovian limb is presented, and the corrected occultation curve has been inverted to obtain an atmospheric refractivity profile. The proposed companion to β Sco C is not seen in the light curve, placing constraints on its color. Sharp spikes in the light curve are compared with those observed during the occultation of β Sco AB, and a simple model is developed. The widths of the narrowest spikes are shown to correspond closely to the angular diameters of the occulted stars.

J. M. Harwood, R. E. Nather, A. R. Walker, B. Warner, and P. A. T. Wild, "Photoelectric Observations of Lunar Occultations", Mon. Not. R. Astr. Soc. 170, 229. Photoelectric occultation data, including 58 timings, 5 diameters, and 3 new doubles, are listed. The diameters include 42 Librae (″0022 ± ″0003), SAO 186699 (″0032 ± ″0008), and 47 Capricorni (″0028 ± ″0006). These and interferometry results show that only a small modification needs to be made to Wesselink's V_0-system surface brightness to $(B-V)_0$ relationship.

J. Hers, "Improved Portable Electronic Clock". Mon. Not. Astron. Soc. S. Africa 33, 118. An accurate portable clock is essential for occultation field work in areas where reception of short-wave time signals is unreliable. This article tells how an inexpensive tuning fork clock movement can be used with an earlier electronic clock design published in Vol. 33, p. 33, to provide pulses correct to within 0ˢ1 over several hours. In a letter, Mr. Hers also notes that the clock in his recently purchased Passat automobile keeps a fairly constant rate of + 0ˢ17/day under a wide range of temperatures.

G. P. Konnen and J. Meeus, "Occultations of Bright Stars by the Eclipsed Moon", J. Brit. Astr. Ass. 85, 17. The authors show that stars within 1°79 of the ecliptic can be occulted by a part of the moon within the umbra during a lunar eclipse. But observers at different latitudes on the earth's surface can only see such occultations for part of their zone. For instance, Regulus, at ecliptic latitude + 0°46, will never be occulted in the umbra as seen from the north polar regions, and is more favorably observed in the Southern Hemisphere. Ten other stars brighter than 4.0-mag. within 1°79 of the ecliptic are listed, along with the approximate date the eclipse must occur for the star to be occulted. Series of eclipse occultations of Regulus, α Librae, β Scorpii, and ε Cancri (brightest Praesepe star) are described. As it usually seems to work out, all the really good events took place last century and won't happen again for a few centuries. At least, we can look forward to an occultation of 3.5-mag. δ Geminorum by a totally eclipsed moon on 1982 January 9.

T. Mori, "Precepts for Personal Equation and Accidental Error of Visual Observation of Occultation", an appendix to "Occultation Observations in 1973", Data Report of Hydrographic Observations, Series of Astronomy and Geodesy No. 9, Maritime Safety Agency, Tokyo, Japan, March, 1975. Almost 500 occultations, including 98 reappearances, have been observed both visually and photoelectrically at observatories of the Hydrographic Department in Japan for 1954-1973. The visual timing is recorded with a tapping key (microswitch) and ink-writing oscillograph, and the observer classifies his timing as good, fair, or poor. Comparison showed that the personal equations (reaction times) for good timings of stars brighter than 6th mag. was 0ˢ40 ± 0ˢ10; good timings of stars fainter than mag. 8.0, 0ˢ50 ± 0ˢ15; and poor timings of stars fainter than mag. 8.0, 1ˢ1 ± 0ˢ5. There was virtually no difference between the values for disappearance and reappearances in all categories.

L. V. Morrison, "Lunar Occultations of X-Ray Sources", I.A.U. Circ. No. 2731. The range of dates of occultations of 6 X-ray sources, including the Crab and Sco X-1, are listed, with an offer of detailed predictions.

R. E. Nather, J. Churms, and P. A. T. Wild, "Occultation Resolution of σ Scorpii", Publ. Astron. Soc. Pacific 86, 116. The 1972 July 21 occultation was recorded photoelectrically at Cape Town and at Sutherland, South Africa. The two observations showed that the star has a companion 0″49 from the primary in p.a. 268° with $\Delta m = 2.2$. Combination of this result with five visual observations dating back to 1860 where the companion was noted and timed indicates that the orbit has a semi-major axis of perhaps 0″5 and a period of approximately 300 years. The primary is also a spectroscopic binary, with a 33-day period.

M. R. Nelson, "The Angular Diameter of Mu Geminorum", Astrophys. J. 198, 127. The angular diameter of μ Geminorum was found to be ″0165 ± ″0014 from a photoelectric record obtained with the 1-m University of Illinois telescope at Prairie Observatory.

S. T. Ridgway and D. C. Wells, "Infrared Occultation Observations", Bull. Am. Astron. Soc. 7, 248. Lunar occultations of late type stars listed in the 2-micron survey and observed at a wavelength of about 10 microns can yield accurate stellar diameters. An observation of an immersion of RY Arietis yielded a very noise-free trace showing five fringes. This was done in the daytime with a 54-inch telescope at Kitt Peak.

Aa. Sandqvist, "Lunar Occultations of the Galactic Center Region in H I, OH and H_2CO Lines", Astron. & Astrophys. 33, 413. High resolution contour maps of the Sgr A complex and of the + 40 km/sec cloud nearby have been obtained during 11 occultations of the Galactic center observed with the 43-meter NRAO radio telescope at Green Bank, West Virginia. The main peak of Sgr A has a half-width of between 3″ and 22″. Within a few arc minutes are 3 secondary components, one polarized in the continuum at least 10% in an east-west direction and a foreground object with respect to the + 40 km/sec cloud, whose center is about 2' from Sgr A. The + 40 km/sec cloud may be a central component of the Galactic nucleus, containing Sgr A, rotating such that, at a distance of 10 pc from the center, it has a rotational velocity component of 50 km/sec and a flow of gas and dust into the Galactic center with a radial velocity of 50 km/sec.

A. M. Sinzi and Y. Harada, "Measurement of Double Stars by Occultation with Small Telescopes", Report of Hydrographic Researches No. 9. This result of photoelectric work done in Japan was read at the IAU Comm. 26 in Sydney, Aug. 1973. A preprint was used to include the data in the special zodiacal double star list. There is a discussion of the visual binary star orbit for ADS 2253 in light of the occultation data.

A. M. Sinzi and H. Suzuki, "Comparison of the Lunar Profiles of Watts and Weimer", Report of Hydrographic Researches No. 3. This showed that Weimer's center deviates 0″39 in p.a. 336° from Watts' center, while their adopted radii of the moon are practically identical. The discrepancy at the eastern and western limbs, and at different librations, are different.

(T. C. Van Flandern), "The Shrinking G", Newsweek, 41 (1975 July 7). One of several popular accounts of results published in more detail elsewhere (see below).

T. C. Van Flandern, "A Determination of the Rate of Change of G", Mon. Not. R. Astr. Soc. 170, 333. This is a continuation of work discussed on p. 10, issue 1 and p. 25, issue 3. The new result is (-65″ ± 18″)/century^2 for the secular acceleration of the moon's mean longitude, implying $(-8 \pm 5) \times 10^{-11}$/year for $\dot{G}/G$. There is a discussion of supporting evidence, including geophysical data indicating an expansion of the earth's radius and generally good agreement with recent determinations of the Hubble constant, which is related to $\dot{G}/G$. The observed rate is consistent with the Dirac and Hoyle-Narlikar cosmologies, and to a lesser degree, with the Brans-Dicke theory.

F. Willey, "Star-Crossed Venus", Newsweek, 24 (1975 July 21). José López Rega, Social Welfare Minister of Argentina and an astrologer, announced on the evening of July 7th that Venus was approaching Regulus in an attempt to occult it. "This only occurs every 21,000 years", he said. Actually, they missed by 0°4, a not-very-rare event. López Rega would have been more accurate if he had made his statement exactly 16 years earlier, when an occultation of the star by Venus did occur in the Eastern Hemisphere. Such events are indeed rare, but we're lucky in that they come in pairs, and there will be another one next century. López Rega was recently sent into exile. Remember the Chinese astrologers who failed to predict an eclipse a few millenia ago?

OCCULTATIONS OF STARS BY PLANETS

David W. Dunham

The following occultations not mentioned in the last issue are predicted to occur during the remainder of 1975:

Venus will occult the radio source 4C -06.34 on November 30, visible throughout the Western Hemisphere at times ranging from $15^h 20^m$ to $15^h 31^m$ U.T. The maximum duration of occultation is 7 minutes.

Venus will occult 6.3-mag. 2 Librae (Z.C. 2060) in southeastern Europe and northern Africa on December 13. D at Athens will be at $3^h 17^m$ U.T. in P.A. 59°, with the R four minutes later in P.A. 339°.

Mars will occult 8.9-mag. SAO 77081 in western Europe on December 23. D at Greenwich will be at $5^h 10^m$ U.T. in P.A. 239°, with the R 16 minutes later in P.A. 117°.

John Van Allen, Santo Domingo, Dominican Republic, wrote recently, "Since mail here is slow, feel free to phone collect if an event arises unexpectedly." Sometimes they do, such as refinements to predictions of occultations of stars by minor planets. An extreme case is the Eros-κ Geminorum event, which was nailed down only 4 hours before it occurred. IOTA can't afford long distance telephone calls or telegrams, but we will telephone observers such as Mr. Van Allen if they are willing to accept collect calls for "unexpected" events. The next time you communicate with one of the IOTA officers, you might mention if you are willing to accept such collect calls, and we will do it, if the need arises. If you are willing, you might also spread the word of "panic" events to others in your state or area, but we do not plan to set up a formal "telephone tree" due to the problems that occur when people aren't home. If we receive a prediction for a special event more than about ten days in advance, and can't include it in Occultation Newsletter in time to warn readers, we will make a special mailing to all subscribers in the area of visibility.

GRAZES AS SPORTING EVENTS

Richard Nolthenius

When I first began observing grazing occultations with my high school astronomy club, grazing appealed to me as a social event as much as a scientific one. Most of our favorables seemed to fall on weekends, and we'd usually drive out to the Mojave Desert to set up our graze line. Afterwards we'd hold a "post-graze wrap-up", then cook dinner and camp out under the clear, dark skies. The next day might call for some local sight-seeing and exploration before reluctantly heading back to Los Angeles.

During these years we found it was fun to consider grazing as more a sporting event than just an expedition to collect rather dry scientific data, and terminology from the professional sports crept more and more into our graze terminology. Thus, January 1st thru December 31st wasn't just a year; it was a "season", during which observers were on the "graze circuit", the circuit being divided into "home grazes" (usually sub-marginals which wouldn't normally warrant an expedition, but happen to pass thru your home town) and "away grazes". Major grazes were always the most fun: we'd assemble our regular "team", headed by "team co-captains" Bob Fischer and me, then maybe hold a "free agent draft" of the local surrounding suburbs' talent. At the graze site, some light-duty road would become our "field". If there were two different areas of the profile needing coverage, we'd go into our "double-wing offense". If equipment was short, we might have two observers at one position "double-teaming the limb". A look at the final "score" would show the team "shooting percentage from the field" (number of timings made divided by total timings estimated possible, usually about 85% for us). After the season was over, you could look back at the team and individual won-lost records, winning and losing streaks, shut-outs, 10-graze winners, 20-graze winners - maybe even a 30-graze winner - and make a comparison with previous seasons. You could also see how many grazes your team put into the "10 highest scoring grazes" list (or the "Top Dozen", which Dunham has recently compiled).

Bob Fischer, the rest of our team, and I are all many years out of high school, and most of my grazes are now solo efforts. However, I still find myself thinking of grazing as a sport, and it still helps to make it more fun. Who knows? Maybe, years from now, the all-time leader in career graze victories will have his name immortalized in the *Guinness Sports Record Book*, right alongside Hank Aaron!

GRAZES OBSERVED IN 1974-5 REPORTED TO IOTA

David W. Dunham

Observers should still send graze observation reports to me, but prediction requests should be sent to Berton Stevens, Jr.; see p. 37. If possible, a copy of the graze report should also be sent to H. M. Nautical Almanac Office, Royal Greenwich Observatory, Herstmonceux Castle, Hailsham, Sussex BN27 1RP, England; this will save me some duplication and postage costs, and speed up the reduction and analysis at HMNAO. Always indicate on your report to whom copies are being sent.

On p. 28 of the last issue, a fee of $1.50 per graze prediction is mentioned; this applies only to those who are not IOTA members, and only to the detailed "USNO-style INT4" predictions computed by the various computors (regions where there is no fee due to postage being paid from other sources are mentioned on p. 37). Paid IOTA members receive as many graze predictions as they want, at no charge per event, for a year; predictions through the end of 1976 will be sent to anyone who joins during 1975. Any non-member who pays for five predictions in a year is entitled to IOTA membership and can receive as many additional predictions for a year as he wants, at no charge.

Observers should start to receive the computer-produced predicted profiles (see p. 46) during late August or September. Starting with the predictions for the last quarter of 1975, manually-drawn profiles should no longer be necessary. Many thanks are in order for the profile plotters who drew and distributed profiles manually during the last 11 years. Now they can devote their efforts toward making more observations, other projects such as those mentioned in the double star section on p. 45, or just relax a little.

The prediction for the July 1 graze of Z.C. 29 was very accurate (the position source was Z.C.), but the observers had set up too far south due to a south shift of the shadow of 1".2 predicted by AGK3, which turned out to be wrong. The star's position in the Yale catalog was subsequently computed and "predicted" that the shadow would have gone about 0".8 to the north, in the opposite direction to the AGK3 prediction! If the calculation had been done beforehand, we could have deduced correctly that the Z.C. position for the star, being in the middle, would give the best prediction. Due to this experience, I have decided to add another service to the star position shift request guidelines detailed in O.G.O.-VIII: If the star's position source is Z.C. or G.C., if its declination is north of -2°, and if at least 7 stations are planned for the graze, I will compute both the AGK3 and Yale shifts for the star upon request of the expedition leader. As usual, if no significant (i.e., less than 0".5) shift is predicted, I won't reply, unless the expedition leader sends me a self-addressed (and stamped, if U.S. stamps are available) card or envelope, in which case, I'll reply in any case. Requests should be received at least two weeks in advance. I would like to turn these shift calculations over to someone else who has access to the Yale catalog at a local university; anyone who does have such access should at least try to compute his own graze shifts. The Yale catalogs are available on magnetic tape, and could be cross-referenced with the USNO's SZ occultation prediction tape to make a list of current position differences which could easily be used to compute graze shifts, as was done for the AGK3. Anyone with access to a computer, and with at least a modest programming knowledge, including magnetic tape use, who would be interested in doing this work should contact me.

The need for a comprehensive and up-to-date "Grazing Occultation Manual" is becoming critical. It will be my next big occultation project, and should be ready sometime this autumn. The comprehensive zodiacal double star catalog work will consequently be delayed, probably until next year.

Getting predictions for submarginal grazes has usually been a slow process which can involve as many a 7 consecutive mailings. In several instances, predictions were not received in time, even when the initial request was made 2 months in advance. There is a way, described as follows, to speed up the process and eliminate some of the mailings. Treat the "graze nearby" message in the USNO predictions as an exact limit-line prediction. Send the coordinates of a point in this line (either one point very close to the intended observation site, or 2 or 3 points so that the true curvature of the limit can be accounted for) to your computor, and ask him to get profile data for that (or those) point(s) using ALTERNATIVE TO LIB3 (which specifies the format for keypunching the data manually and sending the card to USNO to compute the profile data). If you have access to a keypunch machine, you can punch the card yourself (a copy of ALTERNATIVE TO LIB3, telling how, is obtainable from me by sending a stamped, self-addressed envelope) and send it direct to USNO. The profile data they return refines the prediction (the HEIGHT may be as much as 1"), including limb corrections. If you are not a profile plotter, this data must be sent to one to finish the job, or the profile card data sent to a computor to produce the profile, when the profile printing computer program is operational (soon).

The "E" in the % Snl column indicates that the observation was made during a lunar eclipse; the value is the percent of the moon's diameter not in the umbra (0 for totality). "U" in the CA column indicates that the value is the percentage distance from the center of the umbra (0) to its edge (100). For the graze of Z 15367, Nolthenius used a smaller telescope than I did and had somewhat less favorable eclipse conditions, whereas he was able to observe the graze better than I did. His 1000-meter-higher elevation above sea level was probably largely responsible. "E00184" refers to the non-BD star which I've assigned the index number 184 on the eclipse chart in the last issue. As far as I know, it is the faintest predicted graze ever observed, and using only a 10-cm telescope! An unpredicted graze of a non-BD star was observed during the December 1963 eclipse at Wooster, Ohio.

The most successfully-observed graze during the 2nd quarter was the one of Z.C. 755 on April 16, observed by four expeditions in Texas, reported in the last issue. The most successful expedition during the quarter, and in the current list, is the one for Z.C. 1320 on April 20 organized by DaBoll. They would have gotten even more timings if a strong wind hadn't been blowing. Povenmire's report for Z.C. 633 on March 19 brings the total for that graze to 152, only one short of the #4 position. The data from Albuquerque will be valuable for filling in parts of the profile which were not well-observed in Texas or Nevada, but will probably not put the graze in the #3 position (see issue #2 for a list of the dozen best-observed grazes). The only double graze reported was observed in Canada during 1974 Nov. 4. The observers didn't have to move between the grazes, except to stimulate circulation to prevent frostbite.

Mo	Dy	Star Number	Mag	% Snl	CA	Location	# Sta	# Tm	C C	cm	Organizer	St	WA	b
1974														
4	19	3501	5.3	7-	N	Kawasaki, Japan	5	10		5	Toshio Hirose			
9	21	2290	2.5	28+	12S	Gila Bend, AZ	6	10	9	15	Richard Nolthenius			
11	4	0989	6.6	79-	N	Wimborne, Alberta	2	2		15	John Howell			
11	4	0995	4.1	79-	3S	Wimborne, Alberta	7	15		9	John Howell	2N	186	34
11	20	3045	6.0	36+	S	Brisbane, Austrl.	1	8	3	20	Gregg Thompson			
1975														
3	19	0633	5.3	32+	14N	Lauderdale L., FL	8	23		15	Harold Povenmire	3N	15	5
4	15	0651	5.9	14+	N	Kaizuka, Japan	3	3		5	Toshio Hirose			
4	18	Z06591	8.7	37+	13N	Fellsmere, FL	1	2	6	25	Harold Povenmire			
4	20	1320	6.8	60+	12N	Rochester, IL	6	37	B	20	Homer DaBoll	2N	12	68
5	5	Z24101	8.3	30-	2N	Cocoa, FL	1	2		32	Robert Wood			
5	15	1176	7.4	25+	7N	Inyokern, CA	6	15	6	20	James McMahon	4N	11	62
5	17	Z08726	8.6	35+	6N	Cullom, IL	3	17	5	20	John Phelps	0	9	70
5	19	1528	6.6	58+	12N	Tucson, AZ	1	3	8	15	R. Nolthenius	6N	11	72
5	20	1655	6.7	70+	5N	Burton, NE	1	1	6	15	Robert Sandy	C2S	5	72
5	20	1655	6.7	70+	3N	Beason, IL	1	1	3	20	Homer DaBoll	C3N	3	72
5	25	Z15367	9.1	40E	92U	Dos Cabezas Mtn,AZ	1	4	4	15	R. Nolthenius	3S	195	03
5	25	Z15367	9.1	28E	83U	Redford, TX	1	1	2	25	David Dunham	2S	195	03
5	25	-20°4406	9.5	0E	80U	Celina, TX	1	6		20	Danny Morrison			
5	25	E00184	11.	0E	18U	Rock Creek, KS	1	1	3	10	Richard Wilds			
6	1	3272	5.8	56-	8N	Corkscrew, FL	1	12	8	20	Thomas Campbell	5S	351	-62
6	14	Z01384	7.4	23+	4N	Carrizo, AZ	1	8	8	15	R. Nolthenius	10N	8	73
6	16	1605	6.2	43+	4N	Trappe, PA	5	14		20	Alfred Webber			
6	16	1605	6.2	43+	4N	Collegeville, PA	1	3	7	10	Clifford Bader	N		
6	16	1617	8.0	45+	1N	Cedar Rapids, IA	1	2	6	20	Frank Olsen		1	73
6	16	1617	8.0	45+	0N	Grand Ridge, IL	2	3	4	20	Homer DaBoll	C13N	1	73
6	16	1617	8.0	45+	-1N	Anna, OH	2	1	4	15	Rick Binzel		0	73
6	26	3002	6.3	92-	S	Christchurch, N.Z.	1	0	7	11	Ronald Cross	CN	179	-6
6	30	3455	6.4	63-	1N	Maplewood, IN	9	8	8	15	Homer DaBoll	4S	359	-55
7	1	0029	7.2	53-	6N	Elkhorn, WI	4	7	8	15	Homer DaBoll	1S	355	-48
7	4	0400	8.4	25-	2N	Guasti, CA	1	1	9	25	Keith Horne		0	-49
7	7	Mercury	0.4	3-	2S	Tonantzintla, Mex.	1	2		15	Francisco Diego			
7	14	Z11360	8.2	30+	3S	Hampshire, IL	1	2	1	20	Homer DaBoll	2N	179	67
7	18	2310	4.6	81+	S	Melfort, Rhodesia	4	21	9	13	Arthur Morrisby			
7	19	2457	6.3	88+	S	Salisbury, Rhod.	3	10	9	13	Arthur Morrisby			
7	30	0230	7.4	59-	6N	Topeka, KS	1	4	7	10	Richard Wilds	2N	355	-31
7	30	0230	7.4	59-	5N	Spring Valley, IL	1	3	4	20	Homer DaBoll	2N	356	-31
8	3	Z04069	8.0	21-	2N	Lake City, MN	1	5	5	20	James Fox	CO	0	26
8	3	Z04142	9.3	20-	2N	Red Rock, AZ	1	2	6	15	R. Nolthenius	15N	357	27
8	3	Z04162	8.3	20-	-2S	Colfax, CA	1	5	4	32	William Fisher			
8	4	0915	4.7	12-	2S	Woodbine, GA	8	47	9		Michael Reynolds			

Besides the two grazes listed here, Toshio Hirose, a member of the Japanese "Lunar Occultation Observations Group", also recently sent reports of 3 grazes observed in Japan in 1973. On 1973 Nov. 20, 70 timings were made from 21 stations in the Tokyo area during a graze of 5.8-mag. Z.C. 1713.

If the 1"2 south shift predicted by AGK3 were applied to the prediction for the graze of Z.C. 1655 on May 20 at Burton, NE, the shift would change to C1ON, more in line with what we expect of the northern Cassini region.

Through Harold Povenmire's efforts, a graze of 7.2-mag. Z 10338 was recorded on videotape with a large telescope in Florida on May 19. Even the disappearance of the star's 8.9-mag. secondary was timed to 0^{s}01. As far as I know, this is the first time that more than 2 events during a graze have been recorded to better than human timing accuracy. It will be interesting to see Povenmire's report of the graze. Unfortunately, due to classification restrictions, the pictures can't be published.

Richard Nolthenius may have set a not-enviable record during the June 14 graze by having to pay over $64 per event to get his car engine rebuilt after it more-or-less disintegrated on his way home. Brian Cuthbertson complained about the $25 per event (he got two) he had to pay to replace his gas tank, damaged when he missed a driveway while turning around after a graze in 1972. Fortunately, he had no mishap during the graze of Merope in 1973 when he timed his record 22 events. Can anyone beat Nolthenius' cost-per-event record, not counting the trivial cases where no events are obtained? I hope not. The only consolation in such cases is that the data is priceless, since no amount of money can replace a lost observation, at least as long as backwards time travel is impossible.

[A "stop the presses" note has been received from D.W.D. which provided several additional entries for the graze list, as well as a comment that the last entry (Z.C. 915, Reynolds) is the most successful graze in the list, and is a new double (see the New Double Stars section).]

ANOTHER IDEA FOR OBSERVING REAPPEARANCES

A device for observing reappearances, depending on principles very similar to those by Walter Fellows and Robert L. Sandy (see Occultation Newsletter 1, 18 and 34) was described in the Danish journal Nordisk Astronomisk Tidsskrift (recently joined with others in the common Scandinavian Astronomisk Tidsskrift) as early as N.A.T. 15, 110 (1934) by the late Danish engineer and amateur astronomer, Arthur Nielsen, in a small paper called "Et Enkelt Positions-Okular" ("A Simple Positional Eyepiece"), which, I think, deserves not to be passed over and forgotten.

Nielsen applies an eyepiece (even one of the Huygenian type will do) with a field great enough for holding the entire lunar disk with abundant free field around. The major part of the field is covered with a red translucent screen in the plane of the diaphragm, and leaving free only a segment great enough as to show the lunar limb with the lunar disk centered in the field (mostly covered by the red screen), even when the moon is at apogee. A "position thread" perpendicular to the chord separating the segment and the screen (t, Fig. 1, which, however, shows also other threads, i_{1-5}, not applied by Nielsen, but mentioned below), and fixed to the diaphragm, will show the point of reappearance, when set upon the proper position angle by rotation of the entire eyepiece around the optical axis. The eyepiece is equipped with an index pointing to a position circle (in a plane perpendicular to the optical axis and centered upon it), the "90°-point" of which is adjusted by the diurnal motion of a star along the position thread.

Fig. 1

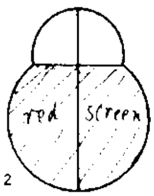


Fig. 2

In connection with the 92.4-mm reflector, 1:7.5, which was my main instrument from 1947 to the summer of 1971, I applied a version of the Nielsenian device with a diaphragm cut as shown in Fig. 2, which is to be taken as in the scale [2.66:1] when to be applied to my focal length (698.3 mm). The center of the large circular cutout is at the optical axis of the principal mirror (as deflected by the Newtonian secondary), while the optical axis of the eyepiece coincides with the center of the small circular cutout, i.e.: the optical axis of the eyepiece is placed eccentrically with respect to the optical axis of the telescope, but can be rotated parallel to, and around it. The large circular cutout is covered, as far as the common chord of the two circles, by a piece of translucent red (cellophane) paper (from the finery of the Christmas tree), and through the centers of the two circular cutouts is placed a "pointing micrometer wire", the position angle of which can be read at the position circle of the telescope. Different eyepieces can be used in connection with that "pointing diaphragm"; ordinarily I used nothing better than a simple Keplerian single-lens eyepiece (!!!), of which the full illuminated field of view just coincides with the small circular cutout, thus acting as an ordinary diaphragm for that eyepiece, while almost the entire large cutout is within the "vignetted penumbra" of the field of view, thus (besides the effect of the red screen) decreasing, in a most simple manner, the brightness of the illuminated disk of the moon, which is to be placed concentrically within the large circular cutout. Having previously set to the appropriate position angle, the pointing wire and the center of the small circular cutout indicate where to look for the reappearing star.

That single lens, with a focal length of 20 mm, gave 35X with my old objective mirror. For ordinary disappearances at the dark limb (where the red screen is still useful) I used a higher power (70X) eyepiece, of more delicate construction. For occultations at the bright limb, and for reappearances near full moon, I used 175X (except for events near the horizon, when I was content with 70X), utilising axis [Watts] angle and lunar map (a most successful technique, which I learned from the mimeographed papers by Dr. Dunham). When using the higher powers, I couldn't see the entire large circular cutout, but still used the entire arrangement (which in my Danish I am calling what in English might be translated as: "my lunar oc(c)ultation-lar"), as in addition to the advantage of the red screen, I found it useful for restricting the area in which to search for faint stars about to disappear.

With the 305-mm reflector 1:6, which has been my main instrument since the summer of 1971, I have returned to an arrangement more like the original Nielsenian, but with other details because the image formation by such a focal ratio will not be satisfactory over a field scarcely supassing the lunar disk. The diaphragm (19 mm - even surpassing the moon a little at perigee) of my "weakest" eyepiece for that instrument (25 mm, 72X), is equipped with a thread system as shown in full in Fig. 1. Besides the "t-thread", it includes the perpendicularly arranged "i-threads", with known intervals (about 6'). The red translucent screen can be inserted or removed through a slit perpendicular to the optical axis, and must thus be a little out of the focal plane to keep free of the threads, but that doesn't matter. With the red screen removed, and the t-thread in position angle zero, the thread system can be applied to observing position differences by transits over the t-thread, and estimating declination differences by the i-threads. With the screen inserted and applied simply according to Nielsen, the reappearance would take place very near to the edge of the field, but you can displace it by any fraction of an "i-interval" wanted (mostly 0.8 "i-interval" = about 5') towards the center of the field and the edge of the red screen, by displacing any lunar feature at any intersection of an "i-thread" and the "t-thread" by the corresponding fraction of the "i-interval" along the "t-thread".

In cases where higher magnifications are required, as described above (180X, occultations at the bright limb at "reasonable" altitudes, - 136X, occultations near full moon or bright-limb occultations at low altitudes), the corresponding eyepieces are only applicable with my filar micrometer, which is then applied with half of its field covered with a removable red screen (inserted by the eyepiece holder, fixed by friction, - and separated from the threads by the diaphragm!!!).

A few more remarks:

A further accommodation is afforded by the "i-threads" when the dark limb is visible: the point of reappearance is more agreeably defined as that where the tangent of the limb is parallel to the "i-threads" instead of being near the intersection with the "t-thread".

When the moon is so little sunlit that the dark limb disappears in twilight approaching daylight, it is preferable to work with the red screen removed.

The 92.4-mm reflector with its observing arrangement, and upon the same mounting as the 305-mm, is still applied for the "easiest" occultations (with the highest observability code) alternately with the larger one, when the sequence of occultations runs with very short intervals, as either telescope can be set upon the proper position angle in advance.

To be seen clearly at these low magnifications, the threads must not be too fine. They are most easily made of the single fibres obtained by unravelling silk threads, which I steal from my wife's sewing materials.

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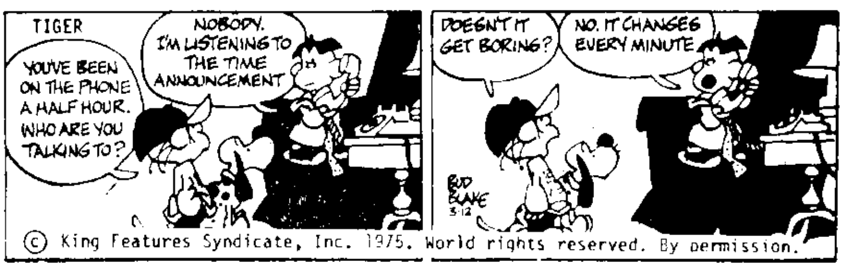

NEW DOUBLE STARS

David W. Dunham

The table lists additions and corrections to the special double star list of 1974 May 9 not listed in previous issue. Most components indicated were discovered with high-speed photoelectric recordings of occultations, and most of these were taken from a list of SAO numbers and comments supplied by Nathaniel White at Lowell Observatory, Flagstaff, Arizona. Since no details were supplied, I have only given the combined magnitude in the MG1 column. Dates were inferred mainly from comparison with observations made at McDonald Observatory, which showed no indication of duplicity for some of Dr. White's suspected doubles. Similarly, he observed the SAO 77606 event discovered to be possibly double at McDonald, and mentioned no evidence of this. However, since only 1^s or 2^s of data is recorded per event at both observatories, it is possible that components observed at one would be missed at the other. Detailed comparison of common records could resolve some of the questionable duplicities.

The BD numbers of non-SAO stars discovered to be double are given at the end of the list.

SAO 184141, the brightest star occulted in the United States during the May eclipse, was first noticed to be double by the author at Redford, Texas, where the disappearance occurred one minute before it happened at McDonald Observatory. The separation and p.a. are not well determined, since the p.a. of disappearance differed by only 18° at McDonald and Bronson, Florida. As mentioned in the article about the eclipse, the star will be occulted again on August 15, at a much more southerly p.a. which should be favorable for observing the secondary and improving the duplicity information.

SAO 184336, σ Scorpii, is discussed more in Nather et al's article abstracted in the publications list, p. 41. The star is a one-line spectroscopic binary, so that the close spectroscopic companion must be fainter than mag. 5.3.

Two stars whose duplicity was noticed during occultations are Z.C. 2172, observed photoelectrically by Dr. White to have a vector separation of 0".005, and visually by David Herald in Australia, who noted quick step events during a graze of Z.C. 2267 on March 3. Spectroscopic and parallax data indicate orbit radii of 0".1 and 0".0002, respectively, so the occultation results indicate possible errors in these data, or, less likely, third components.

The preliminary version of the list of visual doubles in the zodiac, prepared with computer programs which matched the USNO SZ-data with the Lick Observatory IDS (Index to Double Stars) catalog, done mainly by Don Stockbauer, was completed in early June amd copies were sent to the graze prediction computors. It contains nearly 2000 entries; checking the data, converting the special list to the same format, and adding other data, such as spectroscopic binaries not listed in Batten's orbit catalog, will take longer than expected. Since my job at Cincinnati does not involve occultations, and I have other tasks to do relating to my Ph. D. dissertation on the motions of the satellites of Uranus (NASA wants to launch a Mariner spacecraft to Jupiter and Uranus in 1979), I will need help in order to have any "final" comprehensive zodiacal double star list ready for IOTA to publish even sometime early in 1976. Another project which could use a little outside labor is the index of photoelectric occultation observations mentioned in O.G.O.-VIII. Mainly, volunteers are sought to keypunch data; anyone with a little typing experience who could use a keypunch machine after hours at their place of work or at a sympathetic local data processing firm could help. Others who could gain access to large astronomical libraries at local universities could do other jobs looking up and checking certain data. One job could be done easily by someone in the southwestern United States (the closer to Arizona, the better) with detailed USNO predictions for his site for 1974 and 1975 (preferably with O-code 3 or lower). Best of all would be some fairly local help where, for instance, small computing jobs which would take too long to explain, or involve bulky data difficult to send by mail, could be done in or near Cincinnati. Another useful project would be the preparation of a set of variable star data, which could be used to predict the approximate magnitudes, at given times, for zodiacal variables.

NEW ZODIACAL SPECIAL DOUBLE STARS, 1975 AUGUST 3

SAO or BD	Z.C.	M	N	MG1	MAG2	SEP	PA	MAG3	SEP3	PA3	DATE, DISCOVERER, NOTES
76613	0664	P	K	5.4							1974 Feb. 2, N. White, Flagstaff, AZ
77532		P	K	8.3							1974 Mar. 30, N. White, Flagstaff, AZ
77556	0876	P	K	8.2							1974 Mar. 30, N. White, Flagstaff, AZ
77606		P	K	9.0	10.3	0.027	59				1974 Mar. 30, G. Ferland, McDonald Observatory, TX
77614		P	K	8.2							1974 Mar. 30, N. White, Flagstaff, AZ
77911	0915	G	V	5.5	5.5	0.02	178				1975 Aug. 4, M. Reynolds & H. Povenmire, Woodbine, GA
92859		P	K	8.1							1975 Jan. 21, N. White, Flagstaff, AZ
93284	0455	T	K	6.8	6.8	0.03	299				1975 Aug. 1, D. Dunham, Cincinnati, OH
93560		P	K	8.4							1975 Feb. 19, N. White, Flagstaff, AZ
96058	1034	P	K	7.9							1975 Feb. 22, N. White, Flagstaff, AZ
96791		P	K	7.9							1975 March, N. White, Flagstaff, AZ
96794		P	L	8.1							1975 March, N. White, Flagstaff, AZ
97106		P	K	8.6							1974 May 25, N. White, Flagstaff, AZ
97207		P	K	8.7							1975 Feb. 23, N. White, Flagstaff, AZ
97223		P	Y	8.4				12.6	19.0	262	1975 Feb. 23, N. White, Flagstaff, AZ (2nd*; ADS 6349)
97483		G	T	8.0	8.8	0.1	75	9.6	10.0	51	1974 Sept. 12, S. Hale, Tucson, AZ (2nd*; ADS 6519)
97653	1238	P	U	6.1							1974 Feb. 6, N. White, Flagstaff, AZ
97913	1281	T	X	7.2	7.2	0.1	60				1975 May 17, L. Nadeau, E. Boston, MA
98146		P	K	8.0							1975 Feb. 24, N. White, Flagstaff, AZ
98178		P	K	8.0							1975 April 20, N. White, Flagstaff, AZ
98696	1425	P	X	7.7	7.7	0.006					1971 May 3, C. Morbey, Victoria, British Columbia
128380		T	V	8.9	9.0	0.44	229				1975 June 3, R. Nolthenius, Tucson, AZ
128410		P	K	8.9							1974 Jan., N. White, Flagstaff, AZ
138445	1713	P	X	5.8							1974 July, N. White, Flagstaff, AZ
138613		G	X	8.2	8.5	0.2	219				1968 Nov. 16, H. Povenmire, Indian Town, FL
138692		P	V	9.5	10.1	.318	124				1975 May 21, J. Africano, McDonald Observatory, TX
159317	2214	T	Y	7.0	7.0	0.03	60	8.5	11.1	281	1975 July 18, W. Fisher, Colfax, CA (2nd*; ADS 9681)
164717	3208	P	T	7.0	8.8	0.02	90	7.5	0.1	129	1972 Oct. 18, C. Morbey, Victoria, B.C. (2nd*; 3rd* visual)
183445		P	V	8.7	9.0	.064	128				1972 July 20, R. Nather, Sutherland, South Africa
184141		P	V	8.3	9.2	.076	160				1975 May 25, D. Evans, McD. Obs., TX and J. Oliver, Bronson, FL
184336	2349	P	L	3.3	5.3+	.0005		5.5	0.49	268	1972 July 21, R. Nather, Sutherland, South Africa
186579		P	V	10.0	10.3	.030	98				1973 Oct. 3, R. Nather, Sutherland, South Africa
186715	This star should be removed from the SAO; it is the same as SAO 186717 = Z.C. 2661. A note in Yale Vol. 14 confirms this equality.										
+17°1640		P	K	9.5	11.2	.218	238				1975 May 16, J. Africano, McDonald Observatory, TX
-20°4410		T	X	10.5	11.3	0.5	321				1975 May 25, D. Dunham, Redford, TX
-21°4282		T	X	9.9	10.8	1.3	331				1975 May 25, R. Nolthenius, Dos Cabezas Mountains, AZ

THE AUTOMATIC COMPUTER LUNAR PROFILE PLOTTING PROGRAM (ACLPPP)

Berton Stevens, Jr.

1. Objectives of program.

The ACLPPP is meant to be the final step in automating graze predictions. It also for the first time incorporates a large amount of Cassini data and other corrections into the final profiles. Manual plotters either did not have the data, or often neglected them or applied them incorrectly.

A final version of the ACLPPP will probably be released in about a year, allowing us to incorporate any suggestions that you may bring to our attention, and to add a few minor features not currently available. Most observers probably won't receive ACLPPP-produced profiles before September.

2. General comments on the profiles.

The profiles from the ACLPPP are for the point on the limit closest to the observer. The Watts angle of central graze, position angle of the graze, and cusp angle are all shifted from the longitude and latitude printed on the profile to the latitude and longitude of the closest point in the limit. The time of central graze is not shifted, and should not be used for precise timing.

The horizontal spacing is designed for 10 characters per inch, and one inch corresponds to one degree of Watts angle. The vertical spacing is 6 lines per inch. Nine lines (1.5 inches) is the basic "unit distance", corresponding to up to 16 miles on the Earth's surface (though it will usually be 1 or 2 miles).

3. Description of Computer-generated profiles.

The ALCPPP was designed to make the profiles self-explanatory, but a description of the profile plot is in order.

The first two lines are the scale of the Watts angle. The scale is one degree of Watts angle per inch (ten spaces). The values are printed in one degree intervals from the central graze point.

The next line indicates the time from central graze in one minute intervals. Vertical bars ("I") are generated for each minute through the plot. Negative indicates "before" and positive "after" central graze.

Horizontal bars are generated every 9 lines from the "PREDICTED LIMIT". The number of miles from the limit is indicated on the right hand side of the plot. The number of seconds of arc (lunar graze height) is indicated on the left side. In either case, a negative value is south of the limit, and a positive value is north of the limit. [Note added by D. Dunham: It must be stressed that, due to prediction uncertainties, expeditions involving 2 or more stations should spread out vertically at least 1".0 of lunar graze height (which is always more than a mile distance perpendicular to the limit), no matter how narrow the predicted multiple events range might be]

The central graze line is marked with "CENTRAL GRAZE" vertically in place of the vertical bar ("I") on the central graze line.

The plot initially looks very bewildering until you draw lines through the various points on the plot. It will then look like any normal profile except that it is even more exaggerated than the manual profile in the vertical direction.

The following symbols are used in the plot:

The grid:
- I = vertical bar
- - = horizontal bar
- + = intersection of vertical and horizontal bars

The limbs and terminators:
- D = dark limb of moon
- B = bright limb of moon
- T = terminator
- W = "worst" terminator, and mean limb arc where two-mile-high mountain peaks can be sunlit. Areas enclosed by W's will usually be sunlit at the south limb, where where high mountains are common, and will usually be dark at the relatively smooth north limb. T's and W's below the mean limb are important and only have significance when the moon is more than 50% sunlit.

Actual limb points:
- * = "good" limb correction, typically ± 0".15
- 1 = "fair" limb correction, typically ± 0".3
- 2 = meaningless limb correction, usually in the Cassini region
- 3 = "good" limb correction from observed data, typically ± 0".4
- 4 = "poor" limb correction from observed data, typically ± 1".0
- 5 = "good" limb correction with an empirical correction applied
- 6 = "fair" limb correction with an empirical correction applied
- 7 = "meaningless" limb correction plus an empirical correction
- P = shifted actual limb of primary star of a multiple star
- S = shifted actual limb of secondary star of a multiple star
- R = shifted actual limb of tertiary star of a multiple star

It is recommended that the following groups be connected together. A different color pen for each group makes the profile nore easily readable:

B and T (encloses bright area of moon)

D (encloses mean limb)

W (encloses area between bright area and worst terminator where sunlit peaks may exist)

*,1,2,3,4,5,6,7 (encloses the actual limb for mean star position)

P (encloses the actual limb for primary of a star not at mean position)

S (encloses the actual limb for a secondary of a star)

R (encloses the actual limb for a tertiary of a star)

After the profile is printed, other information of use is printed.

The date and time of central graze at the standard longitude and latitude is printed along with the lunar librations in latitude and longitude.

The star number in the Z or ZC catalog is printed with the version of USNO's profile prediction program which generated the plot data.

The type of limit along with the VPC (vertical profile correction) is printed as is the Watts angle of central graze at the point on the limit closest to the observer. The graze height from USNO and the cusp angle at the closest point is printed. HPS and VPS (the horizontal and vertical profile scale respectively) are printed, as is the distance to the closest point on the limit. The computor's name is indicated by the heading "PLOTTED BY". The observer is indicated by "PROFILE FOR", which gives the observer's name, city, and state.

The empirical corrections applied are indicated, according to the notes from DWD (= D. W. Dunham) of the dates specified. The date and star number that observed data is taken from is printed, mostly for reference and in case the star position is in error. These data are usually, but not always, from observations of Cassini-region grazes, although the word CASSINI is always printed.

If the star is multiple, the type (double, triple...) is printed with the double star code. If the code is H,I,M,O,Q, or R, then the primary star is not at the position used to compute the graze, and non-zero values appear for the shift of the primary. Any other code causes the shift to be 0.0 for the primary, since it is at the position used to compute the graze limit.

The magnitude, separation, position angle, the vertical and horizontal shift in the profile for each component are listed. For the vertical shift, the shift in seconds of arc, and in miles, are printed, and for the horizontal shift, the shift is in seconds of time. The program also prints out the limit for each component that doesn't fall on the predicted limit. Each limit is indicated on the far right hand side of the plot and by a short horizontal bar on each side of the plot on the same line.

4. Final comments.

The program will standardize the quality of profile plots and make a wealth of information available without increasing the workload, and in fact, eliminating all the work of manual profile plotting.

If you have any comments, or spot any errors, please inform me. My address and phone are listed on p. 37. For emergency assistance, in the evening, you might also need this number: 312,477-6006.