Occultation Newsletter

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Edited and Published for IOTA by H. F. DaBoll, 6 N 106 White Oak Lane, St. Charles, IL 60174, U.S.A.

IOTA NEWS

David W. Dunham

Due to changes in computor region assignments for 1976, observers in the Middle East, the West Indies, and Mexico will now have to join the International Occultation Timing Association in order to continue receiving our USNO-format grazing occultation predictions.

IOTA Secretary Berton Stevens, Jr., has recently converted my partial occultation prediction program to run on his small IBM computer. He is now distributing detailed predictions for partial occultations, now in a form similar to the predictions for grazes of stars, of major and minor planets to IOTA members, and will henceforth supply them to non-members for $1.50 per event, like grazes of stars. During the summer, we have had trouble with predictions for these events, since the only working program was at the University of Texas at Austin. But now we should be able to compute the predictions further in advance, as we are doing for grazes of stars.

Stevens also has a computer program for computing the local circumstances for solar eclipses and will be supplying these to IOTA members.

Jan Hers informs me that he does not have to pay for graze prediction mailing expenses, as erroneously stated in the last issue, p. 37 (i.e., the statement in the 4th issue was correct, after all).

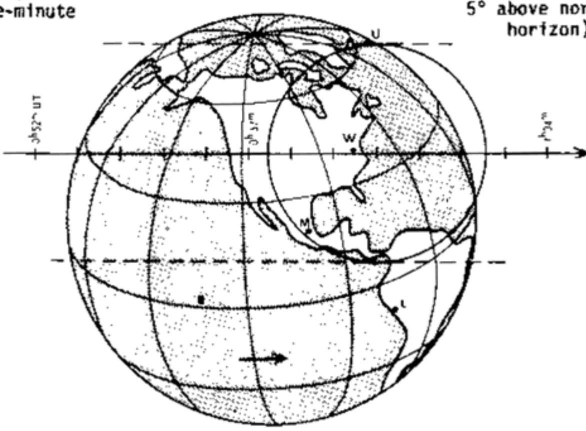
The National Amateur Astronomers will be hosting a national convention in Boulder, Colorado, 1977 August 10-13, and has invited IOTA to meet concurrently. We accepted the invitation. The moon will be a waning crescent at the time, and predictions for some grazes in Colorado and Wyoming during the meeting have been computed.

Gary Ringler (address: 2634 E. 126; Cleveland, Ohio 44120) has obtained about 30 P-28 photomultiplier tubes with full visual range, 900 to 1100 volts. As long as they last, he will send them to anyone who sends him payment for shipping (weight one pound, in a box about 18 cm long) from Cleveland. Mr. Ringler is working on plans for a power supply to use with these tubes.

OCCULTATION OF ϵ GEMINORUM BY MARS

David W. Dunham

This 3.2-magnitude star will be occulted by 1.2-mag. Mars during U.T. 1976 April 8, for North America and parts of Europe and South America. The figure below, reproduced from *Hemelkalender 1976* by permission of the author, Jean Meeus, shows the path of the center of the shadow of Mars across the earth, with its location indicated at one-minute intervals of U.T. The edge of the shadow at $1^h 00^m$ U.T. is shown by a circle, and dashed lines show the northern and southern limits. Eastern North America will be favored with night skies, since the sunset terminator will be at about 100° W. longitude when the occultation occurs, according to data published by Gordon Taylor on I.A.U. Circular No. 2782. The northern limit, uncertain by at least 100 km, is predicted to pass near Dublin, Ireland; Cardiff, U.K.; and Le Havre and Paris (altitude only 5° above northwestern horizon), France.



FROM THE PUBLISHER

Regretfully, it is necessary to raise the basic price of individual subscriptions to Occultation Newsletter. As promised, the old (50¢ per issue) price will be maintained for issues through Vol. I, No. 9. Later issues will be priced at $1.00 each, until further notice. If someone were to order a one-year subscription (four issues) starting with Vol. I, No. 7, the basic price would be figured as 3 @ $0.50 + 1 @ $1.00 = $2.50.

The basic price includes first class surface mail delivery, with air mail available at the difference in cost to us (we are assuming that the *difference* between surface and air rates will remain unchanged): 12¢/year in U.S., Canada, and Mexico; 96¢/year in the remainder of the Americas; and $1.36/year to all other countries.

Please note that the foregoing applies only to separate, individual subscriptions to the newsletter. IOTA memberships, including a subscription to the newsletter, remain priced at $7.00 for residents of the U.S., Canada, and Mexico, and $9.00 for others.

Back issues of Occultation Newsletter are still available at 50¢ each.

Please address all membership, subscription, and back issue requests to Berton L. Stevens, Jr., 4032 N. Ashland Ave., Chicago, IL 60613, U.S.A., but make checks and money orders payable to IOTA, or to International Occultation Timing Association, or to Occultation Newsletter.

ERRATUM

In Vol. I, No. 5, p. 42, column 3, line 43, for -2", read -2°. The sentence should read: "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."

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 issues. Not included are 103 new components discovered visually by Paul Couteau at Nice, France, except in two cases, where the star was also listed in the special double star list. However, a listing of these is being supplied to the grazing occultation computors and the new codes are included in U.S.N.O. version 75B. They will also be included in the planned comprehensive Zodiacal double star list. Bryan Siebuhr, Titusville, Florida, keypunched Couteau's data for our use.

Unfortunately, most observers planning to time the August 15th occultation of SAO 184141 were clouded out. However, Michael Reynolds was able to observe the disappearance using the 36-inch reflector at the Fernbank Science Center in Atlanta, Georgia, where he was attending the Astronomical League convention. He noted that the star took $0^s.4$ to disappear. Since the event was nearly grazing, with the predicted total occultation only 10 minutes, a careful analysis will be needed to see what additional information this adds to knowledge of the position of the secondary, discovered during the May 25th eclipse. Clouds prevented an observation of the reappearance. Mr. Reynolds hopes to use the same telescope to record the 1976 Feb. 22 occultation of the multiple star β Scorpii (see Van Flandern and Espenschied, p. 54).

Six of the stars listed here are from J. A. Pearce and G. Hill, "A Spectroscopic Investigation of the Pleiades", Publ. Dom. Astrophys. Obs., Victoria 14, 319. Under the method (M) column, S = spectroscopic analysis, and under the new double star code (N) column, J = one-line spectroscopic binary. Other codes used have been described in previous issues.

Volunteers to keypunch data are still needed, for the probable occultation doubles listed in Union Observatory Circular No. 95 (see p. 21, issue #3) and for some short lists needed for the photoelectric occultation index (see p. 45 of the last issue). Richard Nolthenius provided and keypunched the data relating to Arizona mentioned in the last issue.

Ten of the entries in the list were found by scanning all of the reports of occultations timed by astronomers from Cracow Observatory, Poland, published in Acta Astronomica. There were almost twenty other cases of "probably double", all of which involved known doubles, mostly visual ones. The non-spectroscopic companion of Z.C. 709 (τ Tauri) was noted by Banachiewicz during an Occultation on 1947 Sept. 7, as well as by Piotrowski in 1937. K. Kordylewski noted the non-spectroscopic companion of Z.C. 852 (125 Tauri) on 1953 November 29, which was "rediscovered" during a grazing occultation in California in 1966 August. Another graze observed in 1972 provided the best data about the star (see p. 36, issue #4). Unfortunately, position angles were seldom published in Acta Astronomica, so central occultations usually were assumed. Durations were published only during the last decade. If you have access to a large astronomical library and have some spare time, you might be able to find useful data in other publications, perhaps using the occultation (Sternbedeckung) sections of Astronomische Jahresbericht as a guide.

NEW ZODIACAL SPECIAL DOUBLE STARS, 1975 SEPTEMBER 30

SAO	ZC	M	N	MG1	MAG2	SEP	PA	MAG3	SEP3	PA3	DATE, DISCOVERER, NOTES
75886	0486	V	T	5.4	7.9	0″.15	38°	8.4	0″.66	246°	1968.10, P. Couteau, Nice, France (3rd *)
76050		S	J	7.3	>9.3	.0001					1974, J. Pearce and G. Hill, Victoria, British Columbia
76073	0529	S	J	6.3	>8.3	.0004					1974, J. Pearce and G. Hill, Victoria, British Columbia
76137	0538	S	V	6.4	6.4	0.05					1974, J. Pearce and G. Hill, Victoria, British Columbia
76164	0543	T	K	7.3	7.3	0.1	80				1934 April 16, K. Kordylewski, Cracow, Poland
76175		S	X	8.7	>10.7	0.05					1974, J. Pearce and G. Hill, Victoria, British Columbia
76215	0556	S	X	5.7	>7.7	0.05					1974, J. Pearce and G. Hill, Victoria, British Columbia
76343	0584	S	J	6.2	>8.2	.00006					1974, J. Pearce and G. Hill, Victoria, British Columbia
76499		V	C	7.3	10.5	0.92	89				1971.84, P. Couteau, Nice, France
76721	0709	T	L	4.9	6.4	.0005		5.6	0.1	90	1937 Jan. 22, S. Piotrowski, Cracow, Poland
77606		V	Y	9.1	10.4	0.027	59	11.1	8.0	264	3rd * from I.D.S., not shown on p. 45 (Van Flandern)
78710	1035	T	X	7.6	7.6	0.12	90				1968 Nov. 9, M. Winiarski, Ft. Skala Observatory, Poland
79913	1216	T	X	8.5	8.5	0.08	280				1971 Oct. 12, M. Kurpinska, Ft. Skala Observatory, Poland
93436	0497	T	K	7.2	7.2	0.1	70				1929 Aug. 27, T. Banachiewicz, Cracow, Poland
95945		T	X	10.0	10.0	0.5	230				1975 Sept. 1, R. Binzel, Atchison, Kansas
96028		T	X	9.9	9.9	0.1	255				1975 Sept. 1, W. Morgan, Las Vegas, Nevada
97221	1175	T	X	5.8	5.8	0.1	90				1955 March 31, J. Kordylewski, Cracow, Poland
97468	1203	T	X	7.9	7.9	0.05	90				1973 April 10, M. Winiarski, Ft. Skala Observatory, Poland
109195	0051	T	K	8.0	8.0	0.1	60				1953 Dec. 14, R. Szafraniec, Cracow, Poland
118354	1546	T	K	8.0	8.0	0.1	104				1940 May 15, K. Kordylewski, Cracow, Poland
163563		P	V	9.6	10.2	0.088	190				1975 Sept. 16, G. Ferland, McDonald Observatory, Texas
164640	3189	T	X	7.8	7.8	0.1	70				1941 Oct. 28, T. Banachiewicz, Cracow, Poland
183445		V	A	8.7	9.0	0.6	205				A.D.S. 9621, corrects error on p. 45 (Van Flandern)
183952		G	X	8.6	9.8	0.022	0				1975 Sept. 11, R. Nolthenius, Cortaro, Arizona
184728		T	X	9.5	10.3	1.02	214				1975 Sept. 12, R. Nolthenius, Tucson, Arizona
185660	2547	G	X	5.1	6.9	0.02	172				1975 Sept. 13, H. Povenmire and M. Reynolds, Titusville, Florida
187071	2704	T	K	6.5	6.5	0.1	270				1925 May 12, J. Gadomski, Cracow, Poland

OCCULTATIONS DURING THE LUNAR ECLIPSE OF 1975 NOVEMBER 18-19

David W. Dunham

During the eclipse, the moon will occult numerous faint stars in an area just west of 13 Tauri and 6° south of the Pleiades. Accurate timings of the disappearances and reappearances can be used for detailed studies of the moon's size and shape, needed to improve all occultation and solar eclipse predictions and analyses. As events at the eastern and western limbs can be observed about equally well, eclipse observations have an advantage over Pleiades passages for this work. Some close binary pairs, not resolvable by other means, may be discovered, as was SAO 184141 during the May eclipse.

As totality will end soon after moonrise in the northeastern U. S., there will be few opportunities to see occultations of faint stars there. The reappearance of 8.3-magnitude Z.C. 528 might be observed as far west as Ohio and as far south as Virginia, but only in New England and Canada east of Ontario will North Americans have a good chance to see other events. In Newfoundland, Europe, Africa, and western Asia, conditions will be favorable for seeing numerous faint occultations, the moon being well above the horizon throughout totality.

Observations of occultations during the May 25th eclipse were much the easier to see, the deeper in the umbra they occurred (see p. 38 of the last issue and p. 77 of the August issue of Sky and Telescope). Light-gathering power is important for seeing events involving the fainter stars; the largest available aperture should be used. Occultations of stars at least as faint as magnitude 10 can be seen in the core of the umbra with a six-inch telescope, if the eclipse is as dark as the one in May and observing conditions are good.

Events can be viewed during the partial phases of the eclipse, but they are more difficult, due to glare from the uneclipsed part of the moon.

Two charts of the eclipse star field are given. The first is a relatively uncluttered view, showing the paths of the center of the moon for twelve locations, but no star names. The second chart identifies all of the stars shown. The Z.C. number is given for Z.C. stars, and the number is underlined. For example, 13 Tauri is Z.C. 531. A 3- or 4-digit number is given for non-Z.C. SAO stars. For stars north of declination +20°, add the number to 75000 to obtain the SAO number, and south of +20°, add it to 93000. For example, the star labelled "1044" near 3^h 36^m near the top of the chart is SAO 76044, while the one in the upper left corner just below the +20° line, "560", is SAO 93560. All Z.C. and SAO designations are greater than 400. The numbers for all other stars, all less than 300, are the star's number on one of the Paris Astrographic Catalog (A.C.) plates. Four A.C. plates were used, separated by dashed lines on the chart. The A.C. plate designations are given in the boxes in the corners of the chart, and should be prefixed to the star number. For example, star "78" near 3^h 38^m and +20° is 19332 78, the name given in the University of Texas predictions. Its symbol shows it has a B.D. number, which is +19° 575, according to the non-SAO B.D. cross reference list. The plate designation is the approximate epoch 1900 A.C. plate center. For example, 19332 is decl. +19°, R.A. 3^h 32^m. For reporting timings, the following numbers should be used, in this order of preference: Z.C., SAO, B.D., and A.C. These numbers are used in the University of Texas (or the equivalent Indiana University) total occultation predictions, which are enclosed for those in the region of visibility, except that A.C. numbers are given for non-SAO B.D. stars. the B.D. numbers and magnitudes of these stars are given in the B.D. cross reference table. The magnitudes given in the predictions for all non-SAO stars are photographic, which emphasize the bluer stars. When available, the B.D. magnitudes will give a better idea of the visual brightness of the stars, but for these fainter stars, magnitude 9.5 (never fainter) was usually assigned by the visual observers of the B.D. Observers may be able to time some unpredicted occultations of reddish stars not recorded in the A.C., and may have much difficulty with some of the faint predicted blue stars, but a quick comparison of the chart with the red (approximately visual response) Palomar Sky Survey print of the area showed no major discrepancies.

In order to use craters and maria shown on a lunar chart to see a reappearing star, subtract 255° from the predicted position angle to obtain the selenographic latitude of the emergence point. The pattern of faint stars in the field of view can sometimes be used to locate reappearances.

Z.C. 528 is the brightest star occulted during the eclipse in North America. Predictions for some cities are given in the table. The events will occur well into the umbra, just over halfway from the center to the edge. The reappearance will take place shortly after the end of totality, before the lunar glare will become so bright as to seriously hinder observation.

City	PH	Moon Alt.	U. T.		p.a.
Cincinnati, OH	R	7°	23^h	$04^m\!.3$	262°
Washington, DC	R	13	23	03.0	255
New York, NY	D	5	22	09.4	76
" " "	R	16	23	05.6	256
Boston, MA	D	8	22	11.0	74
" "	R	18	23	08.2	256
Montreal, Que.	D	8	22	16.4	68
" "	R	18	23	12.8	265

A southern-limit graze of 9.1-magnitude SAO 93540 will cross the Adirondack Mountains of New York (moon alt. 11°), the northwest tip of Vermont, and northern Maine. This occurs just before the end of totality, but unfortunately near the edge of the umbra.

13 Tauri (magnitude 5.5) will be occulted in southeastern Brazil, but the disappearance will occur in the penumbra 1.3 umbral radii from the center, making the event difficult to time accurately. Incidentally, an historically interesting graze of 13 Tauri by a 5% sunlit moon was observed near St. Hyacinthe, Quebec, on 1966 April 23. It was the first international graze expedition, the first one in Canada, and the first one well-observed and reported using a cable system. I timed 16 events during the graze, making it one of the best I've observed. I still have a few copies of the mimeographed report of the expedition, which will be sent to anyone requesting it, until the supply is exhausted.

6.4-magnitude Z.C. 517 is the brightest star occulted in the umbra, but only for some of the Russian Arctic regions. The 7th-magnitude double star B.D. +19° 554 will be occulted in South Africa south of a line passing through Johannesburg (Although this is one of the brighter stars occulted during the eclipse, it is not in the SAO, since it was not included in the Yale Catalog, where hard-to-measure close doubles were avoided. The A.C. positions agree well with the epoch 1950 positions of the stars listed in the AGK2 catalog, whose plates were taken about 30 years after the A.C. plates. Therefore, proper motion for the stars is apparently negligible.). Most other locations with the moon above the horizon will have an occultation of at least one 8th-magnitude star. The fifteenth-magnitude minor planet 1686 De Sitter will be occulted only as seen from Kerguelen Island and some smaller islands in the Indian Ocean south of latitude -40°.

In order to avoid the work of measuring a Palomar Sky Survey plate, as was done for the May eclipse, I used the measures of faint stars published in the Paris Astrographic Catalogs. All of the A.C. plates used were taken around 1900, so there is about three times as much error in the current positions due to neglect of proper motions as if a Palomar plate had been used. While in Austin, Texas, during mid-August, I used Rick Abbot's plate reduction program and Z.C. and SAO star positions to convert all measures into epoch 1950 right ascensions and declinations, computed the University of Texas total occultation predictions for most observers, and produced all of the computer plots. Due to the difference in computers, this would have been impossible, or much more difficult, to do in Cincinnati.

Most observers being sent the University of Texas (or Indiana) predictions either have (possibly enclosed) a copy of the explanation, "Univ. of Texas Total Occultation Predictions", or are receiving the very similar USNO predictions (the differences from USNO are explained at the end of the predictions). If you have neither, a copy of the explanation can be obtained upon request to IOTA, 4032 N. Ashland Ave., Chicago, IL 60613; please send a self-addressed (and stamped, if in U. S.) long envelope.

As explained above, the fainter stars are identified by A.C. plate designations and numbers. If there is a comment about the star in the A.C., a code indicating this is between the designation and the number. "A" indicates a less-accurate position due to an elongated (due to coma) image and "D" indicates difficulty in making good measurements due to an overlapping image of the star's close companion. Double stars have a double star code given after the star's number, "D" indicating the primary, "E" the secondary, and "M" signifying that a mean position for a very close pair was measured. Data about double stars from the Lick Observatory IDS (including IDS magnitudes) are listed in a table.

Many of the stars were measured on two or more of the A.C. plates. Most of the duplicates were removed by establishing the boundaries shown on the chart. However, I missed some, so you may see some of these (usually not double stars) as two stars which disappear at nearly the same time and P.A. Since these were only in certain parts of the charts, North Americans are the most affected, and Europeans and Indian Ocean islanders to a lesser extent. Stars which should be removed are shown in the list of duplicates. Also, due to a keypunching error, star 18328 242, mag. 12.3, is incorrectly given as 18328 244. The real 18328 244 is mag. 12.0. 18328 242 is only occulted in eastern Canada, the Arctic, and the northernmost parts of the Atlantic and of Scandinavia.

Detailed predictions of grazing occultations of Z.C. and SAO stars during the eclipse should already have been computed and distributed through the usual graze prediction channels. I can provide detailed predictions of grazes of non-SAO stars during the eclipse for those who send me a request (2976 Linwood Ave., Apt. 2, Cincinnati, OH 45208, U.S.A.) identifying the star, whether a northern or southern limit is needed, and the approximate U.T. Like predictions for submarginal grazes, these requests involve two mailings to the U. S. Naval Observatory to get complete data, so any requests must be sent promptly in order to take into account the mail transit times. Nearby grazes can be identified in the predictions by short occultations with large ACC values, or near misses, which are listed if the moon's limb misses the star by 2' (139 miles or 224 km at the moon's distance, which may be projected into a greater distance on the earth's surface). Under nearly grazing conditions, the university of Texas predictions are not very accurate, especially in computing the miss distances (listed under the contact angle column), which can be in error by 0′.5.

University of Texas (or Indiana) total occultation predictions will be computed upon request for other locations whose coordinates are specified, but again requests must be sent early, as the computations are actually done in Austin, Texas, or Bloomington, Indiana (where there is a CDC computer like the one at the University of Texas). Those planning to observe grazes of Z.C. and SAO stars may especially want predictions for locations other than their usual sites. For non-SAO graze requests, I will have University of Texas predictions computed for the point in the predicted limit closest to the requester's station.

Subscribers have my [the author's and the publisher's] permission to reproduce this eclipse occultation article, tables, and charts for local use. I hope that there will be time for some of this to be included in overseas publications so that the eclipse occultations may be more widely observed. Please send me a copy of any observations of the eclipse occultations; all successful observers who send me reports will be listed in an article about the event in issue number 7 or 8.

I gratefully acknowledge the help of Anne Herget, who keypunched the Paris A.C. data; Paul Herget and Conrad Bardwell, who supplied an accurate updated ephemeris for the minor planet 1686 De Sitter; and NSF grant MPS 74-23135 (photoelectric occultations) for computer time at the University of Texas. I also thank Frank Fekel and Wayne Warren for computing predictions for many observers, at the universities of Texas and Indiana, respectively.

Non-SAO B.D. Cross Reference List

A. C. Plate	No.	B.D. No.	B.D. Mag.
18328	32	+18° 493	9.5
18328	52	+18° 498	9.5
18328	58	+18° 501	9.5
18328	59	+18° 502	9.3
18328	61	+17° 572	9.2
18328	72	+17° 576	9.5
18328	91	+18° 508	9.5
18328	99	+17° 583	9.5
18328	160	+17° 566	9.5
18328	173	+17° 569	9.5
18328	174	+17° 570	9.5
18328	207	+17° 577	9.5
18328	209	+17° 578	9.5
18328 D	216 D	+17° 579 A	9.3
18328 D	217 E	+17° 579 B	
18328	220	+17° 580	9.5
18328	223	+17° 681	9.5
18328	228	+17° 582	9.3
18328	246	+17° 586	9.5
18328	251	+17° 588	9.3
18328	252	+17° 589	9.3
18328	253	+17° 590	9.5
18336	13	+18° 516	9.5
18336	19	+18° 518	9.3
18336	24	+17° 599	9.5
18336	127	+17° 594	9.5
18336	148	+17° 600	9.5
19324	58	+18° 488	9.5
19324	68	+19° 542	9.5
19324	83	+19° 545	9.5
19324	86	+19° 548	9.5
19324	90	+18° 490	9.5
19324	110	+18° 495	9.5
19324	120	+18° 500	9.5
19324	129	+19° 551	9.5
19324	220	+18° 491	9.5
19324	238	+18° 496	9.5
19324	242	+18° 497	9.5
19324	248	+18° 499	9.5
19324	256	+18° 504	9.5
19332	5	+19° 552	9.5
19332	10 E	+19° 554 B	8.2
19332	11 D	+19° 554 A	
19332	13	+19° 555	9.4
19332	17 E	+19° 556 B	-
19332	23	+19° 558	9.5
19332	24	+19° 559	9.5
19332	32	+18° 509	9.4
19332	38	+19° 563	9.5
19332	42	+18° 515	9.5
19332	54	+19° 565	9.5
19332	57	+19° 567	9.4
19332	58	+19° 566	9.5
19332	63	+19° 569	9.3
19332	68	+19° 570	9.5
19332	69	+19° 571	9.5
19332	75	+19° 573	9.5
19332 A	78	+19° 575	9.5
19332	79 M	+19° 576	9.2
19332	109	+18° 511	9.5
19332	110	+18° 510	9.5
19332	111	+18° 512	9.4
19332	140	+18° 519	9.5
19332	143	+18° 520	9.5

STARS OCCULTED IN UMBRA DURING LUNAR ECLIPSE OF 1975 NOVEMBER 18-19

DUPLICATES

Remove star since it is	the same as
18328 48	19324 112
18328 50	19324 113
18328 262*	18336 120
18336 116	18328 257
18336 118 M	18328 259 D and 260 E
18336 121	18328 263
18336 123	18328 265
19324 101 M	SAO 93470 and 93471

*This star was removed before most of the predictions were computed.

DOUBLE STARS

B.D. Number	Star	Double Designation	Magnitudes Primary	Magnitudes Secondary	Separation	P.A.
	Z.C. 506	STF 399	7.9	9.4	20"2	147°
	SAO 93455	ADS 2572	9.1	11.2	7.1	283
	SAO 93470 SAO 93471	ADS 2584	8.9	10.3	2.5	173
BD +19° 556 {	SAO 93498 19332 17 E	BDS 1771	9.6	10.3	28	65
BD +17° 579 {	18328 D 216 D 18328 D 217 E	ADS 2624	10.2	11.8	3.9	132
	18328 259 D 18328 260 E	HJ 3249	11.5	12.4	6.9	99
BD +19° 554 {	19332 11 D 19332 10 E	ADS 2618	8.1	8.2	7.4	185
	19332 65 D 19332 64 E	BRT 2312	10.8	11.0	3.0	354
BD +19° 576	19332 79 M	ADS 2684	10.2	10.5	1.2	150
	19332 98 M is not double; "M" is result of early misidentification with BRT 2311.					
	19332 102 19332 101	BRT 2311	10.8	11.4	2.0	339

When both components are listed, the upper one is the primary.

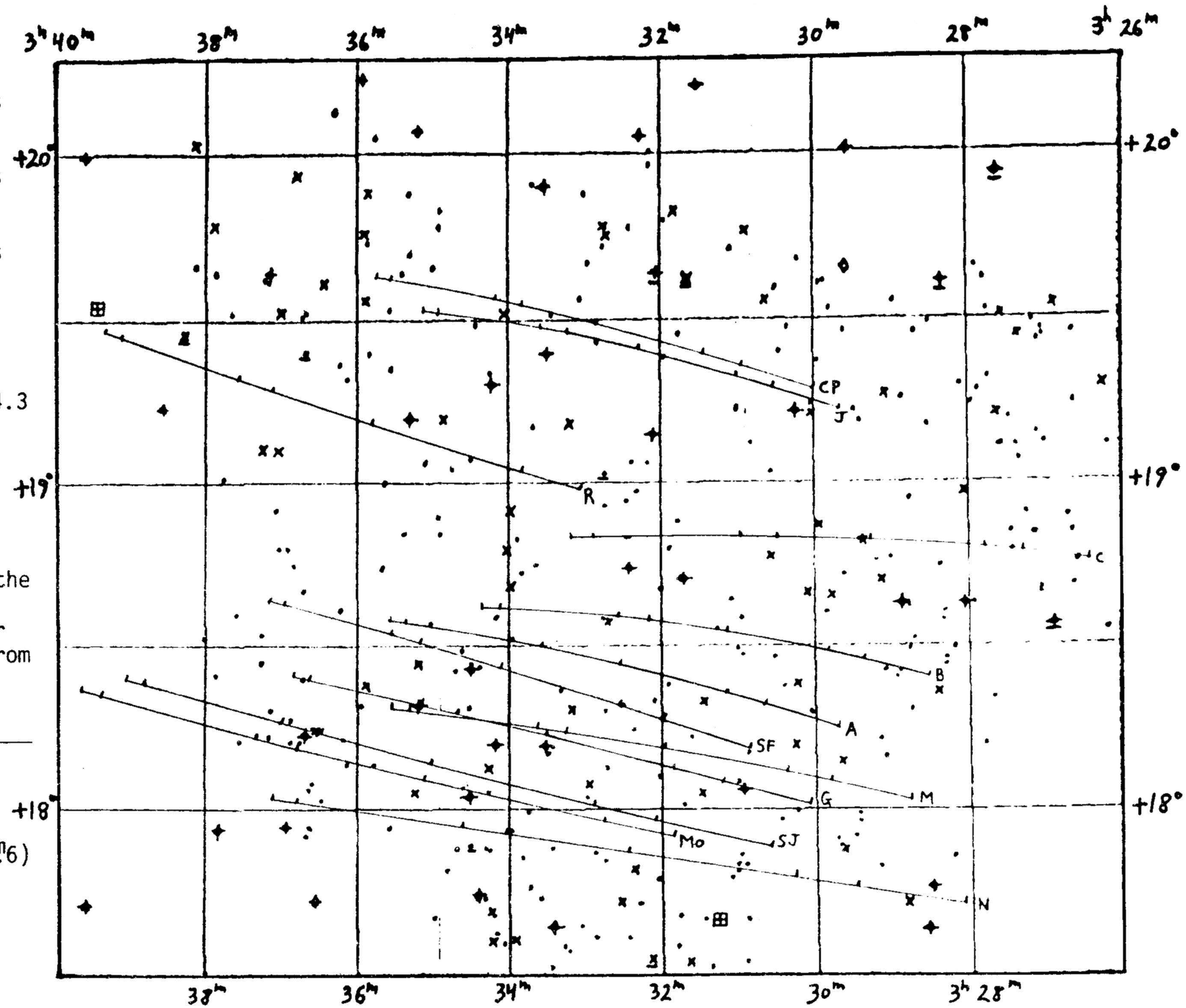
- ⊞ Z.C. and SAO stars Mag. 5.5-6.5
- ✦ Z.C. and SAO stars Mag. 7-9
- × Non-SAO B.D. stars Mag. about 10
- • Non-B.D. stars Mag. about 11
- ◆ De Sitter, Mag. 14.3

Underlined stars are double

Marks are given along the plotted tracks for the center of the moon, for the following times, from right to left:

U.T.	Contact
20^h00^m	
20 38.6	I
21 00	
22 00	(II at $22^h02^m.6$)
22 44.1	III
23 00	
0 00	
0 08.2	IV

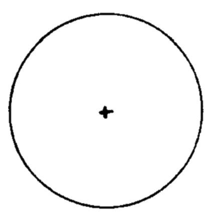
Key continued on following page



STAR FIELD FOR LUNAR ECLIPSE OF 1975 NOVEMBER 18-19. COORDINATES ARE EPOCH 1950.0
David W. Dunham

Key continued from preceding page

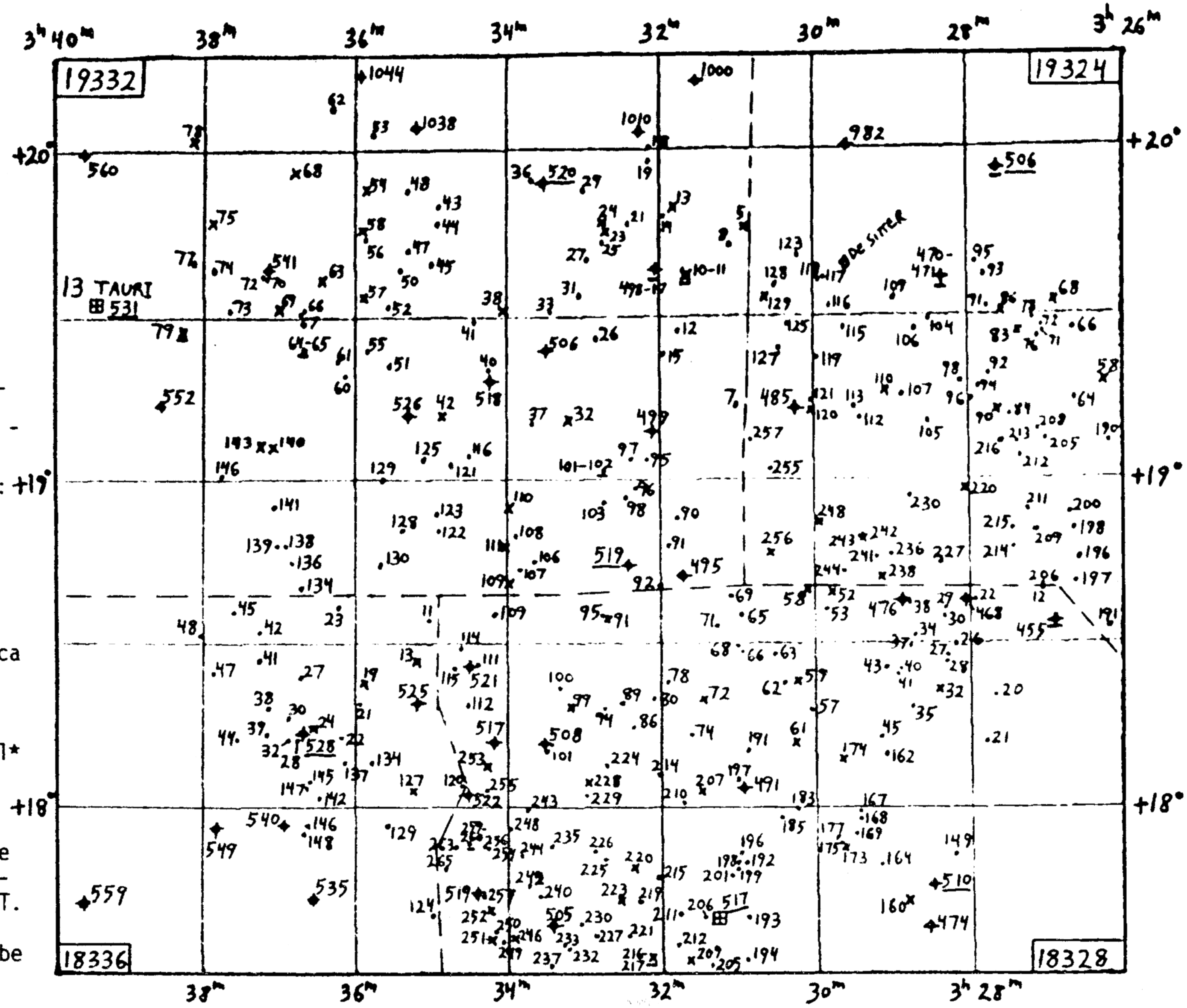
Moon's approximate apparent disk



On the chart on the preceding page, letters to the right of the tracks show the locations for which they are computed:

A=Athens, Greece
B=Basrah, Iraq
C=Colombo, Sri Lanka
CP=Cape, S. Africa
G=Greenwich, England
J=Johannesburg, S. Africa
Mo=Montreal, Quebec*
M=Moscow, U.S.S.R.
N=North Pole
R=Rio de Janeiro, Brazil*
SF=San Fernando, Spain
SJ=St. John's, Nfld.

*For Montreal and Rio de Janeiro, the first plotted time mark is for U.T. $20^h38^m.6$ (I), since at 20^h00^m, the moon would be at least 12° below the horizon.



STAR FIELD FOR LUNAR ECLIPSE OF 1975 NOVEMBER 18-19. COORDINATES ARE EPOCH 1950.0
David W. Dunham

A VERY TARDY STAR

Robert Hays, Jr. has mentioned to us a possible large star position discrepancy, which he has also called to the attention of the U.S.N.O. On 1975 April 19, disappearances of mag. 7.1 Z.C. 1190 and nearby mag. 8.4 Z 07912 (SAO 097334) were predicted to occur about 37^s apart at his station. Z.C. 1190 disappeared right on schedule (P.A. 79°), but Z 07912 (P.A. 157°) was about *three minutes late!*

Occultations of Z 07912 are still occurring. For instance, for observers in midwestern U.S., a well placed reappearance is predicted for October 27th. Please report timings through the usual channels, but in addition, your editor (see top of p.47) would appreciate receiving notes from successful observers of this event. Please include predicted time and position angle, and observed time. Results, including names of observers, will appear in an early future issue.

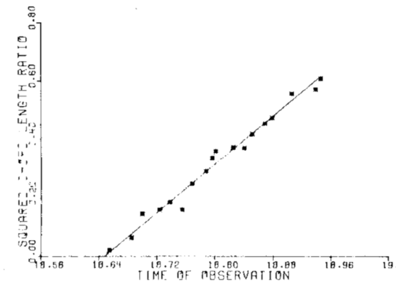
TIMING SOLAR ECLIPSE CONTACTS

William J. Westbrooke

An eclipse of the sun is really an occultation of the sun. However, while much attention is devoted to methods of timing occultations, little or no attention is given to methods of timing the contacts of a solar eclipse. When such timings are made, they are usually obtained by timing, with a stopwatch, the first or last appearance of a notch in the solar limb. However, what is really wanted is the moment of limb tangency, as with two coins touching, edge to edge. The stopwatch method can never give that.

An excellent method of timing eclipse contacts was devised by Minnaert and described by Mulders in a 1938 paper (Publ. Astron. Soc. Pacific 50, 267). The method is easy for the amateur to use, since it only involves making timed sequential measurements of the distance between the cusps of the notch in the solar limb about every thirty seconds for some fifteen minutes around the time of contact. Photographs can also be used.

When analyzing the results, one may proceed in the following way. Having found the maximum distance between the cusps (all such distances being chords of the solar disk) one may divide all the chord length measurements by that maximum value, and then square those ratios. A graph of squared chord length ratio will show the observations falling along a straight line which appears to be an average of all the observations through the points on the graph. The place where that line intersects the time axis is then taken as being the time of contact. The method can be used by any well equipped amateur astronomer, or by any science museum with a coelostat display; the coelostat at the California Academy of Sciences was used in timing the solar eclipse of July 1972. The accompanying figure was drawn by a computer, but it shows the form of diagram required. The contact time shown is $18^h38^m52^s2$ U.T. on July 10, 1972. The observations were made at Berkeley, California, by eyepiece projection.



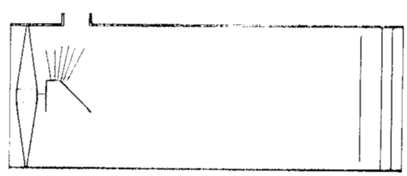
One may think of performing such an analysis with an electronic computer. However, those are not commonly available, and so it seems best to describe a manual method of obtaining results, such as that described above.

One may also think of applying the Minnaert chord measurement method to observations made throughout the eclipse. However, in that case, the graph of plain squared chord length versus time seems to form a parabola, but is actually best fitted with at least a fourth power polynomial in time. The determination of contact times from observations made throughout an eclipse was investigated by me and was described in a paper read at the San Diego meeting of the American Astronomical Society.

AN ANTI-GLARE MASK

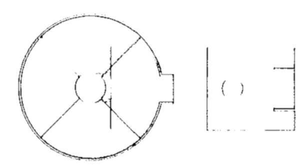
F. John Howell

Here is a trick that may be of interest to other observers, who probably have watched a star gradually "approach" the lunar limb, only to lose it in the glare, especially when the moon is nearly full. I discovered some years ago that this glare is often *in the telescope tube*, and is due to the moonlight illuminating the edge of the diagonal mirror *holder*, because most of the cone of light from the main mirror is being held outside the field of view, and therefore, this concentrated beam or cone of light strikes the diagonal tube (normally painted flat black) holding the diagonal mirror. Just look inside the tube and see for yourself, sometime.



Although painted flat black, the diagonal mirror holder appears a bright white with the moonlight on it, and is glaring right into the eyepiece. The end of the tube is quite brightly lit up with this glare.

How can this glare be minimized? I used a piece of flat black stiff paper to mask the glare. The intercepting mask just slides onto two struts of the spider, and is adjusted to allow only the light from the diagonal mirror to pass. In fact, I use it as a "stop" - not using the full area of the diagonal - the hole being only about 1" diameter - whereas the diagonal minor axis of my old 10" f/8 was 2¼" wide. It was quite effective. Remove it and see the star disappear in the glare!



The problem may not be as severe if a small holder supports the diagonal mirror. My holder was a piece of copper pipe about 3" long, so it had quite a large area lit up.

PLANETARY OCCULTATIONS

Conducted by Mike Reynolds

Recent Observations

7 July 1975 - Occultation of Mercury by a 3% sunlit waning moon. Observations of the daylight (or near daylight) occultation were widespread. In Denmark, N. P. Wieth-Knudsen observed and timed 1st, 2nd, and 4th contacts of the total occultation. W. Odom and R. Nolthenius timed 1st and 2nd contacts from Tucson, Arizona, at an extremely low moon altitude. D. Seidenschwarz, C. Sherrod, and B. Valentine timed 1st, 2nd, and 3rd contacts (an observation of 3rd contact only after it had occurred) from North Little Rock, Arkansas. From Chicago, Illinois, R. Hays observed 1st contact and observed and timed 2nd contact with ease. D. Dunham, Cincinnati, Ohio, attempted the occultation, but haze and clouds interfered. G. Haysler and J. Dunham, Austin, Texas, attempted the total, with timings of the 1st and 2nd contacts. P. Newman timed 2nd contact from near Pleasant Valley, Texas. B. Comsa observed the total and timed 3rd contact. He described the occultation as "really fantastic". In Jacksonville, Florida, M. Roscoe and R. Sweetsir attempted the occultation, but clouds hindered their observations. J. Korintus, Palm Bay, Florida, observed and timed 1st and 2nd contacts with his 12½" reflector.

Five Jacksonville, Florida observers, L. Heilig, M. Kazmierczak, C. Vaughn, D. Reynolds, and M. Reynolds, attempted the partial occultation from Ft. Lauderdale, Florida. The conditions for the event, as Mercury and the moon rose, were perfect, considering Florida's rainy season. Because of the difficulty of the event, the observers split into two groups. The spectacular pair was followed with no difficulty until about 30 minutes after sunrise, when an inversion layer formed (fog layer forming due to heat and high humidity). All observers lost the pair, until 5 minutes before the predicted occultation, when orange Mercury was found. Due to the team split, three of the five stations saw a spectacular partial occultation of Mercury, as it disappeared behind nothing! The moon was never seen near the time of the partial. In fact, Mercury was lost right after a possible 2nd contact (It could have been a true contact, or it could have been due to poor visibility). This expedition complemented that of the Sociedad Astronomica de Mexico, which was the first to observe a partial occultation of the planet Mercury (see p. 40 of issue #5).

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1976 LUNAR OCCULTATIONS OF MINOR PLANETS

David W. Dunham

Ceres (mag. 7.0) will be occulted by an 80% sunlit waxing moon around 2^h U.T. of January 13, as seen from a wide area of Latin America. The northern limit crosses El Salvador, Southern Honduras, passes near Guadeloupe in the Lesser Antilles (unfortunately, only a miss will occur in the Greater Antilles), and nearly crosses the Atlantic Ocean to a point off northwestern Africa. The southern limit passes near Arequipa, Peru; La Paz, Bolivia; and north of Rio de Janeiro, Brazil.

A 98% sunlit waning moon will occult Juno (mag. 8.8) around 22^h U.T. of February 16, visible from much of Africa and the Indian Ocean. The northern limit passes the vicinity of the Strait of Gibraltar (detailed calculations will be needed to see if it is in Spain, Morocco, or actually threads the strait), northern Algeria, central Tunisia, northern Libya, northern Egypt, southwestern Arabia, and the northern Indian Ocean to the sunrise point west of Sumatra. The southern limit passes south of Liberia, enters Africa just north of the equator, passes over southern Lake Tanganyika, the northern tip of Lake Nyasa, central Malagasy Rep., and goes south of Reunion and Mauritius Islands.

The approximate predictions for these events were supplied by Dr. Sinzi of the Japanese Maritime Safety Agency. Accurate total occultation predictions can be obtained upon request to David Dunham; 2976 Linwood Ave., Apt. 2; Cincinnati, OH 45208, while detailed limit predictions are available from Berton Stevens (see IOTA News, p. 47).

MORE PUBLISHED PAPERS ABOUT OCCULTATIONS

Compiled by
David W. Dunham and
Wayne H. Warren, Jr.

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

Chr. de Vegt, "On the Angular Diameter of TX Piscium from Lunar Occultations", Astron. & Astrophys. 34, 457. A reappearance of this carbon star (Z.C. 3501) from behind the 91% sunlit moon was observed photoelectrically on 1973 Aug 18 with the 60-cm refractor of the Hamburg Observatory. An angular diameter of 0".009 ± 0".001 for a disk fully darkened at the limb is determined, in agreement with a previous determination by Lasker at Cerro Tololo Obs. Small deviations from the theoretical curve are most likely due to noise (seeing, etc.) rather than to lunar limb irregularities. It is mentioned that occultations are being recorded photoelectrically in two colors on a regular basis with the 1.5-m telescope of the Vienna Observatory.

J. Hers, "Four More Grazing Occultations", Mon. Not. Astron. Soc. S. Africa 34, 83. Report on grazes of Z.C. 709, SAO 186294, SAO 162079, and Z.C. 709 again. An important part of this paper is the postscript added by Mr. Hers commenting on observing techniques using tape recorders. He suggests that observers not wait for events to occur before making recorded comments, since this often results in blank records which are useless. A preferable procedure is to make a continuous record of what is observed throughout the period. A description of the star's approach to the limb, how far from the limb it appears to be, the locations of bright peaks and their appearance is often very valuable during later reductions. Continually comment on whether or not the star is visible; if an event is missed - let it pass - but note the time when you first realized that it had occurred. Do not merely leave a blank record. If the star disappears or reappears due to clouds - comment on it; more importantly - note when the moon reappears from behind a cloud if the star is found to be gone. This may lead to a fairly accurate time of disappearance. Also, play back all tapes within 24 hours so that it is probable that taped remarks will still be recalled. After a few days obscure details are likely to be forgotten.

V. K. Kapahi, M. N. Joshi, and N. V. G. Sarma, "Ooty Occultations of 76 Radio Sources", Astron. J. 79, 515. Positional and structural information (many sources are double) derived from lunar occultations observed with the Ooty radio telescope at 327 MHz is presented. Optical counterparts for only 16 were identified.

C. L. Morbey and J. M. Fletcher, "A Simultaneous Two-Channel System for Lunar Occultation Observations", Publ. Domin. Astrophys. Obs. 14, No. 11. A block diagram of the equipment, and a circuit modification diagram for the Nova 1200 computer, is shown. Results for two double stars are given, as well as a diameter of 0".0056 ± 0".0005 for SAO 79641 observed on 1971 May 3.

P. Murdin, "Multicolour Photometry of an Occultation of Europa by Io", Mon. Not. R. Astr. Soc. 172, 385 (1975). Color changes across the disk of Jupiter's satellite II (Europa) have been detected by simultaneous photometry through UBV filters (wide-band) and a 20-Å wide narrow-band filter during an occultation of this moon by satellite I (Io). The light curves show structure due to surface brightness non-uniformities across the disk of Europa, and these are most pronounced in the ultraviolet. Light curves are shown for uniform and non-uniform models, and brightness contour maps are presented.

G. Swarup, Gopal-Krishna, and N. V. G. Sarma, "Occultation Observations of the Galactic Center Region at 327 MHz", IAU Symposium No. 60 Galactic Radio Astronomy, edited by F. J. Kerr and S. C. Simonson III (D. Reidel Publishing Co., Dordrecht, Holland), p. 499. Two occultations of the galactic center region have been observed at 327 MHz with the Ooty radio telescope. Observations of the thermal sources Sgr B2, G0.9+0.1 and G1.1-0.1 have been used to estimate their electron densities and temperatures. A new extended non-thermal source about 7' south of G1.1-0.1 has been found and may be a supernova remnant. A brightness contour diagram having a resolution of approximately 25 X 6' is presented for the background radio emission near the sources Sgr A and Sgr B2.

T. C. Van Flandern and P. Espenschied, "Lunar Occultations of Beta Scorpii in 1975 and 1976", Astrophys. J. 200, 61. Northern and southern limits of occultations of this star during the current series are shown on two world maps. β Sco. is known to be quadruple, and evidence for three additional components is presented. The May 1971 occultation of β Sco. by Jupiter and Io raised important questions about all objects involved, making the current series especially significant. High-speed (preferably multi-color) photoelectric photometry should yield: (i) the magnitude and position of B with respect to A (very important for the interpretation of the Jupiter occultation data), and the possible duplicity of B; (ii) the mag., color indices, and relative position of the probable companion to C, to see if it is double or an ultraviolet dwarf (if so, it would be the first known); and (iii) the detection of any other now-unknown components. Observations in a graze path could have special value, since data at a variety of position angles could be obtained; at least two-color data would be needed to disentangle possible effects of limb irregularities. The next five observable occultations are listed below:

Date	U.T.	% Snl	Night Land Area
75 Oct 8	17^h	17+	S. and E. Africa
75 Nov 5	3	3+	Marquesas Is., Pitcairn I.
75 Dec 29	19	9-	New Guinea, Caroline Is., Guam, Austrl. (C. York)
76 Jan 26	2	27-	N. and E. Africa, S. Arabia
76 Feb 22	7	50-	E. USA, W. Indies, S. Amer. (N. coast)

Detailed predictions are available from the authors, U.S. Naval Observatory, Washington, DC 20390. U.S.A.

R. S. Wolff, H. Kestenbaum, W. Ku, and R. Novick, "Lunar Occultation of the Crab Nebula in Low-Energy X-Rays", I.A.U. Circ. No. 2731. Preliminary results of a low-energy (1.5 to 20 KeV) rocket observation of the lunar occultation of the Crab Nebula on 1974 Nov. 3 (at emersion, P.A. 255°) show that 80% of the flux between the western limb of the nebula and the pulsar is contained within an angular range of 36". When combined with the observations on 1974 Aug. 13, the results show an elongation of the X-ray emission along the direction of the magnetic field of the nebula.

GRAZES OBSERVED IN 1975 REPORTED TO IOTA

David W. Dunham

An important error was recently discovered in the computer profile printing program: the VPC is incorrectly computed for all northern-limit grazes for latitude librations between -5.0 and +5.0. The problem is worse for values between 0 and +5, where the program indicates that observers should be much farther south than they actually should be. At least, this is a failure on the side of safety; seeing a short total occultation is better than seeing no occultation. Profile plotters can correct the profiles by using the HEIGHT value printed and the guidelines described in the 1974 October notice for plotters. The graze computors are being sent the appropriate program correction with this newsletter, so they will soon be able to recompute any erroneous profiles they have distributed. Fortunately, most dark-limb grazes this month are southern-limits.

The data for nearly all graze profiles during the past couple of years have been computed with U.S.N.O.'s version 72C. They are now using a new lunar ephemeris version called version 75A or 75B, which can differ from 72C by as much as 0."3 in declination. The difference will have to be studied so that appropriate changes can be made to the "72C" empirical corrections built into the profile printing program and used by the manual plotters. These will be sent to the graze computors soon; the difference in versions is less than the errors in most star positions.

A format for keypunching graze observations has been established, and has been sent to all computors and to a few others who have access to keypunch machines (see p. 45 of the last issue). In order to speed up analyses of graze observations, as many observers as possible should keypunch their observations and send me the punched cards, as well as the written report. The format will be supplied upon request to me. Also, all graze observations made since 1970 need to be keypunched (Ronald Abileah has keypunched most of the earlier observations in a form which can be converted to the present form); if you can do this for your own and/or others' data (which can be supplied by me for the purpose) it would be greatly appreciated. New report forms to make the keypunching a little easier will be designed and distributed within a few months. Since the keypunch format is already nearly identical to the current "University of Texas" forms, the latter should be used until your supply of them is exhausted. The new forms will be designed so that data for three stations can be reported on one page, to reduce mailing and duplicating costs.

For those who have access to the appropriate catalogs, I will provide a working example of the calculation of a grazing occultation shift, upon request.

IOTA has decided that graze predictions will be provided on the same yearly basis as Occultation Newsletter and other services, in the interests of keeping memberships up-to-date (i.e., to avoid possible lapses and the need for reinstatement). Consequently, those who joined in June, 1975 will receive predictions through the 2nd quarter (i.e., through June) 1976, but will have to renew their IOTA membership in order to receive another year's predictions. Many of the computors probably will have computed the graze predictions for the 2nd half of 1976 by January or February, so some members may wish to renew their memberships early in order to receive those predictions well in advance.

Some observers need to be reminded that the observing condition code on the graze station report form is a carefully defined function of the star's visibility during the event, as described in a page distributed with the graze report form explanation, and is not just a general rating of atmospheric seeing or transparency. A "9" rating is possible only for relatively bright stars under the most ideal conditions, yet some reports with condition code "9" have also expressed much difficulty in observing the event. Such obviously inconsistent ratings are now being ignored.

When reducing graze tapes to obtain accurate timings using a stopwatch, care must be taken not to introduce additional reaction times. First, play through the tape, counting the seconds (remember to count *zero* at the time mark beginning the minute), to determine the integral seconds of each event (if conditions were poor, the observational accuracy may not be any better than a second, in which case, no further work is needed; this is also usually sufficient for reporting interruptions due to clouds, adjusting telescope, etc.). Then, use a stopwatch (one with a 10-second sweep can be read easily to high accuracy) to determine the tenths of a second. Move your hand with the stopwatch in rhythm with the seconds beats many seconds before the event to be timed, then try to start the watch at an exact second. A few seconds before the event, see if the stopwatch hand passes over the integer second marks exactly in time with the seconds beats, and note any offset, so that a correction can be applied later, if necessary. This comparison should be made just before and just after the event, since the recorder will often play back at a slightly different rate than that at which it recorded the graze. Keep the stopwatch running, and note the tenths of a second when the event call (or buzz, beep, or click) occurs. Don't stop the stopwatch at the event, since that introduces a reaction time. In case of more than a couple of events in quick succession, I find it useful always to start the stopwatch at a particular second several seconds before the first event, and mark (preferably with a non-permanent felt marking pen) the position of the end of the stopwatch hand on the crystal, using preliminary "first run" times. The tenths of seconds of all events can then be refined with the help of these reference marks. Usually, at least three runs are needed, to have confidence in the tenths of seconds. Take advantage of auxiliary or casual times on the tape (e.g., the missing 29th second beat or the common change in tone at the 45th second with WWV or WWVH, or even observer comments or static before the event) to reduce the time needed to play the tape to reach the event. Of course, a personal equation still needs to be used with the tape time of the event, and 0.s1-accuracy is not possible if the recording is very poor, with most seconds beats not audible and/or tape rate highly variable.

The graze list is short this time, due to the relatively short time since the publication of the last issue. Since complete details are not yet available for the September 13 graze, it is not known whether it or the August 11 graze is the most successful. Mr. Cross writes concerning his expedition in New Zealand: "After organising 21 graze attempts spread over the last 12 years, we have recorded our first *completely* successful graze, all others being clouded out to some extent."

Mo	Dy	Star Number	Mag	% Snl	CA	Location	# Sta	# Tm	C C	cm	Organizer	St	WA	b
1975														
7	1	0029	7.2	53-	6N	New Berlin, WI	10	12	7	9	Raymond Zit	1S	355	-48
7	16	1986	7.0	57+		Buderim,Q,Austrl	1	2		15	Paul Mead			
8	11	1815	4.8	20+	8S	Christchurch,N.Z	12	68	7	6	Ronald Cross			
8	12	Z12596	7.9	28+	7S	Burlington, IL	5	28	8	20	Homer DaBoll	5N	174	46
8	15	2327	6.7	61+	13S	Port Lavaca, TX	1	2	8	25	Don Stockbauer	4S	166	-3
8	17	2614	6.2	80+	16S	Jollyville, TX	2	13	5	6	George Haysler	3S	165	-31
9	10	2120	6.8	24+	9S	San Angelo, TX	2	21	8	15	Wade Eichhorn	4S	170	18
9	10	2120	6.8	24+	9S	Milford, TX	1	8			Paul Newman			
9	11	Z15186	8.3	35+	12S	Cortaro, AZ	1	3	7	15	Richard Nolthenius	4N	167	-1
9	13	2547	4.9	55+	10S	Titusville, FL	18	50			Harold Povenmire	3S	170	

STILL MORE PUBLISHED PAPERS ABOUT OCCULTATIONS

[Late developments make it practical to include these additional reviews, which are a continuation of the article on pp. 54 and 55.]

J. L. Africano, C. L. Cobb, D. W. Dunham, D. S. Evans, F. C. Fekel, and S. S. Vogt, "Photoelectric Measurements of Lunar Occultations VII: Further Observational Results", Astron. J. 80, 689. Timings of 397 disappearances observed photoelectrically at McDonald Observatory with 76-cm and 91-cm reflectors are listed. The list includes a clear case of distortion of a trace by lunar limb irregularities (apparently the first such case), two new stellar diameter determinations (″0030 ± ″0010 for ϵ^2 Sagittarii and ″0095 ± ″0020 for 45 Arietis), and 36 cases, most new discoveries, involving probable duplicity.

V. A. Andrianov, M. R. Fedyanin, and G. S. Tyuterev, "The Photoelectric Observations of Lunar Occultations of Stars at the Astronomical Observatory of the Tomsk University", Astron. Tsirk. No. 830, p.6 (in Russian). Occultations of stars to magnitude 6.9 are being timed to 0^{s}001 photoelectrically using a 13-cm refractor.

V. R. Eshleman, "Jupiter's Atmosphere: Problems and Potential of Radio Occultation", Science 189, 876. Temperature-pressure profiles derived from Pioneer data are mutually consistent but differ from the results of other investigations, apparently due to both geometrical and equipment source errors. Nevertheless, the occultation technique, when optimally instrumented and carefully interpreted, retains its potential for high accuracy and resolution.

Z. Klimek, "Occultations of Stars and Planets by the Moon Observed at the Cracow Astronomical Observatory in the Year 1973", Acta Astronomica 24, 411. 126 timings are reported, including 10 involving Saturn, and the rest involving stars, including four photoelectric timings. A possible new double is noted. Several other photoelectric timings were made in 1972, including many Pleiades stars in March and a reappearance of 19 (TX) Piscium in August.

A. Kliore, D. L. Cain, G. Fjeldbo, B. L. Seidel, and S. I. Rasool, "Preliminary Results on the Atmospheres of Io and Jupiter from the Pioneer 10 S-Band Occultation Experiment", Science 183, 323. Height profiles of the electron density of Io's ionosphere and of Jupiter's atmospheric temperature are shown. The electron density measurements imply a surface atmospheric pressure of about 10^{-9} bar for Io, at most 1/100th of the upper limit set by photoelectric observations of the occultation of β Scorpii C in 1971. For Jupiter, the signal was lost about 100 km below the ionospheric peak for the planet.

A. Kliore, G. Fjeldbo, B. L. Seidel, T. T. Sesplaukis, D. W. Sweetnam, and P. M. Woiceshyn, "Atmosphere of Jupiter from the Pioneer 11 S-Band Occultation Experiment: Preliminary Results", Science 188, 474. Results from Pioneers 10 and 11 were combined to give 71,610 ± 6 km and 66,958 ± 4 km for the equatorial and polar radii, respectively (oblateness = 0.06496 ± 0.0001), at the 1-mbar level. The 160-mbar level was about 130 km lower. Measurements showed a number of layers in a range of about 3000 km in the ionosphere, with a topside temperature of 750° K.

R. Zappala, E. Becklin, K. Matthews, and G. Neugebauer, "Angular Diameter of IRC+10011 at 2.2, 10, and 20 microns", Astrophys. J. 192, 109. At 2.2 μ, most of the radiation came from this long-period variable, but at 10 and 20 μ, most was from an optically thick dust region 0″1 in diameter.

MEASURING OBSERVER REACTION TIME

Victor J. Slabinski

An observer's reaction time can easily be measured to 0.01 sec with an electronic stopwatch which displays the elapsed time continuously via light-emitting diodes. A suitable unit is the timer incorporated in the HP-55 pocket calculator.

For the measurement, the "seconds" portion of the elapsed-time display is covered by a finger or opaque tape, so that the observer can only see the tens digit of the seconds display. The watch is started, and the observer presses the button to stop the watch when the tens digit changes from 0 to 1. The fractional-second portion of the stopped display will show the time since the tens digit changed to 1, that is, the observer's reaction time in seconds.

The writer and another occultation observer found their reaction times and standard deviations to be as follows:

Walter I. Nissen, Jr.	^{s}26 ± ^{s}03
VJS	^{s}26 ± ^{s}04

[Editor: Readers are urged to accept this technique only for what it is - an excellent way of determining reaction times to an electronic display - and not to use the figures as values of personal equation to be applied to timing occultations of stars. Some years ago, John D. Phelps, Jr. and the editor conducted similar measurements, using a stopwatch with a three-second sweep dial. The dial was covered with opaque tape except for a small window. We attempted to stop the hand as soon as it appeared in the window. Results agreed very closely with those of Nissen and Slabinski. They did not agree with other experiments, using a two-pen recorder and an artificial star. Reaction times are considerably longer for events which are harder to see. For a discussion of reaction times directly applicable to occultations of stars, see the review of the paper by Mori, on p. 41 of Vol. I, No. 5.]

NEW BOOK RECEIVED

Graze Observer's Handbook, Harold R. Povenmire, 1975, Vantage Press. 134 pages. $4.95.

David Dunham's review of this book will appear in an early issue of Occultation Newsletter.