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LUNAR OCCULTATION SUMMARY. II.

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ABSTRACT

Results of a second series of 196 two-color photoelectric lunar occultation observations made within the interval 1972 May to 1973 December are reported. Each observation has been employed to estimate the minimum magnitude difference between the observed object and possible undetected companions. The study contains the analyses of 143 disappearances and 53 reappearances. Eighteen of these events manifest some degree of multiplicity. Included in the study are 18 occultation events for Pleiades members.

Subject heading: occultations

I. INTRODUCTION

This paper contains a summary of the results of a continuing project in photoelectric lunar occultation observing. The purpose of the project is to exploit the high-resolution information available in the brief moments associated with each observable occultation event. In some cases it is possible to measure the diameter of the occulted star. Such objects in the present study will be discussed in a separate paper. In a greater number of cases it is possible to detect duplicity or multiplicity for the observed object. In all cases some estimates of the brightnesses of as yet undetected companions may be made.

II. OBSERVATIONS AND RESULTS

All observations were made at Erwin W. Fick Observatory employing the Mather 61 cm Cassegrain telescope. Predictions of the occultation events for this location were supplied by the U.S. Naval Observatory. A four-channel FM tape recorder is employed to record the time-varying output of two photomultiplier cells on two of the channels, and timing information is recorded on the other two. This study includes a relatively high proportion of reappearance observations. These have been made possible by employing a technique which makes use of the knowledge of our telescope tracking errors. That is, it has been found that the telescope drive has a four-minute periodic error of about 5 arc seconds amplitude. A similar setting error is present in declination. This is enough to cause the reappearing star to fall outside of the photometer aperture most of the time. Therefore, all telescope setting and offsetting from the last observed star to the predicted position of the reappearing object is performed as nearly as possible at 4 minute time increments before the predicted reappearances, and tabulated declination corrections are used. Employing this procedure results in about a 65% success rate for reappearance observations.

A summary of the observations is contained in Table 1. The Fick Observatory event number is in column (1). Magnitudes and spectral types of the occulted stars are given in columns (4) and (5). These values were obtained from the prediction list or from the Bright Star Catalog. UTC date and time of the observations appear in columns (6) and (7). Estimated timing errors (milliseconds) are shown in column (8). Labels *D* and *R* in column (9) identify, respectively, disappearance and reappearance events. The cell and filter combinations of the two channels are identified by the symbols in column (10) for which approximate effective wavelengths and optical bandwidths are tabulated in Table 2. (See Eitter and Beavers 1974 for additional details.) In those cases where no second star has been detected in the record, an estimate has been made of the minimum magnitude difference between the observed object and any possible as yet undetected companion. According to these results, any companions, if they exist, should differ in magnitude from the observed object by an amount exceeding the tabulated value or be oriented unfavorably for detection. Separate estimates have been made based upon that portion of the record where the primary star is not yet occulted (col. [11]) and for the portion of the record where the star has been hidden (col. [12]). The final column indicates which events have shown some evidence of duplicity or multiplicity of the objects and which events are occultations of Pleiades members. Cross listings of these events by DM and HD star numbers are contained in Tables 3 and 4, respectively.

III. MULTIPLE SYSTEMS

Within this set of 196 photoelectric observations there are 18 occultation events with evidence of some degree of multiplicity. These occultation records, with the timing information on separate parallel channels, provide measurements from which magnitudes for the separate components may be determined. In some cases this may be done in two colors. A summary of these results is presented in Table 5. The subscript 1 has been employed for quantities related to the brighter member of the pair or brightest in triple systems. Thus Δm_1 is the measured value of the magnitude difference between the brightest component in the record and the unocculted system. Similarly, Δm_2 is the corresponding value for the fainter member.

TABLE 1

SUMMARY OF OBSERVATIONS

1 Event No	2 DM No	3 SAO No	4 Mag	5 Sp	6 UT Date	7 Observed UTC Time	8 Δt msec	9 Type of Event	10 Colors Observed	11 Δm_*	12 Δm_0	13 Lunar Position Angle	14 Remarks
122	+18 1930	097781	5.9	dF0	72 May 18	01 54 39.644	8	D	ℬ	0.8	1.1	93.4	
									ℛ	0.5	0.5		
123	+18 1931	097783	8.0	K2	72 May 18	02 05 54.149	8	D	ℬ	1.1	1.3	129.8	
									ℛ	2.0	2.1		
124	+18 1939	097807	8.1	G0	72 May 18	03 26 51.161	19	D	ℬ	0.7	1.0	128.1	
									ℛ	1.0	1.0		
125	+13 2066	098473	8.7	K0	72 May 19	03 28 28.261	15	D	ℛ	0.8	1.4	151.8	
127	+13 2071	098502	8.5	F5	72 May 19	04 37 02.514	10	D	ℬ	1.0	1.2	114.6	
128	+08 2311	118077	8.1	F5	72 May 20	02 01 52.602	10	D	ℬ	1.4	1.4	167.4	
									ℛ	1.7	2.3		
129	+08 2316	118095	7.2	F2	72 May 20	03 09 22.857	5	D	ℬ	1.9	2.9	150.2	
									ℛ	1.9	2.3		
130b	+08 2319	118103	8.5	F5	72 May 20	03 45 12.889	10	D	ℬ	1.0	1.7	119.3	triple
									ℛ	0.6	0.6		
130a						03 45 13.034	10	D	ℬ	1.1	1.2		
									ℛ	1.0	1.0		
131	+03 2426	118536	7.9	K2	72 May 21	03 11 40.921	4	D	ℬ	1.7	2.3	111.1	
									ℛ	1.7	2.0		
132	+03 2428	118563	8.8	K0	72 May 21	04 51 21.852	6	D	ℬ	1.0	1.3	107.2	
									ℛ	0.8	1.0		
133	+02 2367	118558	7.6	MA	72 May 21	05 04 11.478	5	D	ℬv	1.2	1.5	181.3	
									ℛ	1.9	2.5		
134	-05 3434	138594	7.0	M3	72 June 19	04 45 44.292	8	D	ℛ	1.1	2.9	68.9	
135	-15 3705	158043	7.7	F2	72 June 21	04 47 58.159	4	D	ℬ	1.5	2.5	76.7	
									ℛ	1.3	1.6		
136	-23 12110	183241	9.3	K5	72 June 23	02 39 52.664	17	D	ℛ	0.3	0.3	121.3	
137	-22 10871	183246	9.0	K0	72 June 23	02 50 50.382	11	D	ℬ	0.1	0.1	80.6	
									ℛ	0.2	0.2		
138	-23 12158	183313	8.6	K2	72 June 23	05 56 45.538	17	D	ℛ	0.3	0.3	104.3	
139	-23 12159	183314	8.4	K0	72 June 23	06 02 53.968	25	D	ℛ	0.4	0.6	120.8	
140	-25 11295	184068	5.1	K5 III	72 June 24	03 06 21.450	3	D	ℬv	1.7	3.0	116.2	
									ℛ	1.3	3.7		
141	-18 5738	163779	5.1	M2 III	72 June 29	08 34 09.521	4	R	ℬv	1.7	2.4	240.0	
									ℛ	1.7	3.7		
142a	+19 0403	093062	5.66	A0 IV-V	72 July 6	08 07 21.197	4	R	red	1.4	2.6	217.4	double (triple?)
142b						08 07 21.226	6	R	red	0.7	1.3		
143	+19 0405	075531	7.8	G5	72 July 6	08 33 08.189	5	R	ℬ	1.0	1.9	249.0	
									ℛ	0.6	1.6		
144	+19 0409	075545	8.6	K0	72 July 6	09 11 38.822	15	R	ℬ	0.4	0.7	293.8	
									ℛ	0.5	0.5		
146	-25 11070	183766	7.9	K5	72 July 21	03 58 06.868	15	D	ℬ	0.7	0.7	174.5	
									ℛ	1.2	1.7		
147	-24 12296	183802	7.3	A0	72 July 21	04 50 28.144	9	D	ℬ	0.1	1.1	73.8	
									ℛ	0.6	1.0		
148a	-26 11990	185137	6.9	G5	72 Aug 19	02 34 23.913	4	D	ℬ	1.4	1.9	106.6	double
									ℛ	1.5	2.5		
148b						02 34 28.270	42	D	ℬ	0.4	0.4		
									ℛ	0.2	0.2		
149	-26 11994	185147	8.5	K5	72 Aug 19	02 50 29.65	25	D	ℛ	1.2	1.7	102.4	
150	-26 12012	185178	6.9	F0	72 Aug 19	03 53 28.217	5	D	ℬ	1.7	2.5	101.5	
									ℛ	0.9	1.8		
151	-26 12802	186276	8.8	G0	72 Aug 20	02 20 45.53	40	D	ℬ	1.1	1.1	35.8	
152	-26 12818	186299	9.1	G5	72 Aug 20	02 42 48.11	85	D	ℬ	0.2	0.2	71.1	
									ℛ	0.1	0.1		
153	-26 12814	186296	8.9		72 Aug 20	02 48 53.711	15	D	ℛ	0.8	1.0	36.4	
154	-26 12854	186347	8.4	K5	72 Aug 20	03 53 40.419	11	D	ℬ	0.1	0.3	130.4	
									ℛ	0.4	0.6		
155	-26 12858	186357	8.8	K5	72 Aug 20	03 56 28.448	25	D	ℛ	0.4	0.4	69.6	
156b	-26 12864	186372	9.0	A0	72 Aug 20	04 10 21.475	27	D	ℬ	1.1	1.1	84.4	double
156a						04 10 22.005	27	D	ℬ	0.4	0.4		
157	-26 12862	186362	7.5	G0	72 Aug 20	04 26 01.523	15	D	ℬ	0.4	1.7	23.1	
158	-26 12884	186403	7.3	A3	72 Aug 20	05 15 03.080	10	D	ℬ	0.6	1.0	21.8	
									ℛ	0.4	0.7		
159	-25 13614	187562	6.38	K0 III	72 Aug 21	01 41 47.020	6	D	ℬv	0.8	1.9	138.0	
									ℛ	1.1	2.0		
160	-24 14916	187572	9.0	A0	72 Aug 21	01 51 41.1	100	D	ℬb	0.9	0.9	70.0	
161	-25 13655	187599	5.73	K4 III	72 Aug 21	03 08 47.880	10	D	ℬv	1.2	2.5	147.1	
									ℛ	1.3	2.4		
162	-24 14948	187602	8.0	K5	72 Aug 21	03 26 58.170	15	D	ℬ	1.0	1.0	22.4	
									ℛ	1.4	1.4		
164	+21 0416	075773	7.8	K0	72 Aug 30	07 09 59.753	16	R	ℬ	0.7	0.7	234.2	
									ℛ	0.6	3.1		
165	+21 0419	075777	7.8	B9	72 Aug 30	07 36 1.902	4	R	ℬ	1.4	2.0	276.8	
									ℛ	0.5	0.8		

TABLE 1—*Continued*

1 Event No	2 DM No		3 SAO No	4 Mag	5 Sp	6 UT Date	7 Observed UTC	Time	8 Δt msec	9 Type of Event	10 Colors Observed	11 Δm_*	12 Δm_0	13 Lunar Position Angle	14 Remarks
166	+21	0422	075795	9.1	F0	72 Aug 30	07 50	23.329	13	R	B	0.5	0.7	189.7	
167	+21	0427	075804	8.5	F8	72 Aug 30	08 52	37.495	15	R	B	0.7	0.7	244.1	
168	-25	13305	187073	8.1	B9	72 Sept 17	00 58	36.202	9	D	B	1.2	1.2	86.2	
169	-25	13318	187103	9.2	A2	72 Sept 17	02 14	24.711	17	D	B	0.4	1.4	133.1	
170a	-25	13320	187106	8.0	A0	72 Sept 17	02 19	06.018	24	D	B	1.5	1.9	136.4	double
											R	1.5	2.0		
170b							02 19	11.113	14	D	B	1.9	2.4		
											R	2.0	2.5		
171	-25	13331	187114	9.0	G5	72 Sept 17	03 02	40.108	32	D	B	0.3	0.3	12.4	
172	-25	13352	187142	8.9	K0	72 Sept 17	03 19	55.450	18	D	B	0.4	0.6	80.8	
											R	1.1	1.4		
173	-25	13351	187139	8.4	K0	72 Sept 17	03 30	24.588	12	D	B	1.1	2.2	38.0	
											R	1.6	2.2		
174	-25	13364	187165	9.0	K0	72 Sept 17	03 50	27.702	13	D	R	0.4	0.9	88.1	
175	-25	13368	187172	8.6	K0	72 Sept 17	04 03	54.944	8	D	R	0.7	1.9	70.4	
176	-19	5809	163545	6.9	K0	72 Sept 19	00 59	40.498	5	D	B*v*	1.0	2.1	100.5	
											R	1.9	2.2		
177	-19	5813	163568	7.6	F5	72 Sept 19	01 55	18.683	6	D	B*v*	2.2	2.2	68.9	
											R	1.5	2.1		
178	-19	5815	163578	9.0	A2	72 Sept 19	02 47	51.282	25	D	B	0.6	0.9	13.3	
179	-19	5830	163625	6.74	A3	72 Sept 19	04 33	34.055	4	D	B*b*	1.6	2.3	46.1	
											R	1.2	1.6		
180	-19	5831	163626	5.94	A2	72 Sept 19	04 34	28.478	4	D	B*b*	1.1	2.7	46.0	
											R	1.2	2.4		
181	+22	0549	076168	8.7	G0	72 Sept 27	03 12	16.712	18	R	B	0.5	0.5	222.9	P
182	+22	0565	076222	8.5	A3	72 Sept 27	04 06	22.204	10	R	B	1.5	1.5	213.0	P
183	+22	0563	076215	5.44	B8 V	72 Sept 27	04 09	01.711	12	R	B	0.6	0.6	253.7	P
184	+22	0567	076230	8.9	K5	72 Sept 27	04 14	11.611	12	R	R	0.5	0.5	206.3	
185	+23	0597	076360	9.0	F5	72 Sept 27	08 35	48.25	50	R	B	0.6	0.9	197.4	
186	+24	1040	077770	8.3	K0	72 Sept 29	05 13	46.628	11	R	B	0.7	1.0	237.8	
											R	0.2	1.2		
187	+24	1049	077790	7.6	G5	72 Sept 29	05 36	54.362	6	R	B	0.8	2.1	242.9	
188	+25	1060	077807	9.0	F5	72 Sept 29	05 49	47.903	22	R	B	0.2	0.5	300.0	
189	+25	1065	077816	8.8	B2	72 Sept 29	06 05	14.457	8	R	B	1.0	1.2	304.2	
190	+24	1052	077823	8.6	K0	72 Sept 29	06 18	23.987	20	R	B	0.2	0.4	271.0	
											R	0.4	0.6		
191	+24	1055	077833	8.7	K5	72 Sept 29	06 20	31.797	12	R	B	0.6	1.0	231.6	
											R	0.8	1.2		
192	+24	1065	077859	9.4	A0	72 Sept 29	06 57	23.12	50	R	B	0.1	0.3	275.7	
193	+24	1071	077873	9.0	A0	72 Sept 29	07 05	17.069	11	R	B	0.5	0.7	224.7	
194	+24	1079	077910	8.6	K0	72 Sept 29	07 38	11.748	12	R	B	0.1	0.1	204.1	
											R	0.2	0.3		
195	+24	1078	077901	9.3	G0	72 Sept 29	07 41	34.269	19	R	B	0.1	0.1	236.3	
196	+25	1097	077907	8.9	M	72 Sept 29	07 51	51.328	17	R	B	0.3	0.9	290.2	
197	+25	1099	077913	8.5	K0	72 Sept 29	07 58	09.008	12	R	B	0.7	0.7	293.5	
											R	0.7	1.0		
198	+24	1080	077912	8.9	K7	72 Sept 29	08 00	44.465	9	R	B	0.1	0.1	268.5	
											R	0.7	0.7		
199	+25	1105	077925	8.5	F8	72 Sept 29	08 07	28.544	9	R	B	1.0	1.4	314.9	
											R	0.2	0.4		
200	+24	1029	077965	8.9	K0	72 Sept 29	08 58	02.005	37	R	B	0.7	1.0	206.6	
201	+24	1109	078007	9.0	A0	72 Sept 29	10 03	32.744	13	R	B	1.0	1.0	253.8	
202	+25	1139	078055	9.3	A3	72 Sept 29	11 10	03.71	30	R	B	0.4	0.5	291.6	
203a	+23	1589	079040	8.8	A2	72 Sept 30	08 02	36.495	10	R	B	2.5	2.5	323.8	double
											R	1.0	1.0		
203b							08 02	36.912	23	R	B	0.1	0.4		
204	+23	1590	079041	9.0	M0	72 Sept 30	08 04	36.325	12	R	R	0.3	0.7	320.4	
205	+22	1569	079056	8.1	G0	72 Sept 30	08 22	30.211	11	R	B	1.2	1.2	199.5	
											R	0.8	0.8		
206	+22	1577	079070	6.5	S3	72 Sept 30	09 05	47.587	11	R	R	2.0	2.0	222.9	
207	+23	1604	079072	9.0	A7	72 Sept 30	09 15	58.531	10	R	B	1.0	1.2	249.2	
208	+23	1605	079077	9.2	G0	72 Sept 30	09 19	07.139	6	R	B	0.9	1.1	287.6	
											R	0.1	0.6		
209	-17	6123	163978	9.2	G0	72 Oct 17	00 50	28.920	32	D	B	0.6	0.7	103.4	
210	-16	5725	163977	9.2	K0	72 Oct 17	01 25	02.974	18	D	B	0.6	0.7	7.9	
											R	0.3	0.5		
211	-16	5739	164005	8.6	A0	72 Oct 17	02 14	59.325	7	D	B	1.4	1.4	79.2	
212	-16	5741	164013	6.0	A3	72 Oct 17	02 39	31.112	3	D	B*b*	1.6	3.4	65.8	
											R	1.7	2.2		
213	-16	5734	163997	8.0	A2	72 Oct 17	02 47	53.35	120	D	B	0.3	1.0	353.6	
214	-16	5753	164030	8.8	K0	72 Oct 17	03 43	51.400	11	D	B	0.7	1.0	42.0	
											R	1.0	1.0		
215	-16	5754	164031	9.0	G5	72 Oct 17	03 55	31.746	10	D	B	1.2	1.2	24.8	
											R	0.5	0.7		
216	-16	5759	164056	8.8	G5	72 Oct 17	04 27	48.641	10	D	B	1.1	1.4	93.8	
											R	0.7	1.3		
217	-16	5769	167082	7.8	G5	72 Oct 17	05 47	33.957	17	D	R	0.4	0.7	99.7	
218	+23	1494	078733	8.2	F5	72 Oct 27	07 33	43.596	43	R	B	0.3	0.3	307.1	possible double?
											R	0.4	0.4		
220	+23	1503	078767	8.6	K7	72 Oct 27	08 19	06.462	25	R	R	0.4	0.7	346.1	

TABLE 1—*Continued*

1 Event No	2 DM No	3 SAO No	4 Mag	5 Sp	6 UT Date	7 Observed UTC	Time	8 Δt msec	9 Type of Event	10 Colors Observed	11 Δm_*	12 Δm_0	13 Lunar Position Angle	14 Remarks
219	+23 1518	078816	5.62	gK5	72 Oct 27	10 05	23.818	4	R	B v	2.5	2.5	339.2	
										R	3.1	3.1		
221	+23 1513	078802	8.3	G5	72 Oct 27	10 09	55.617	8	R	B	2.2	2.2	275.1	
										R	1.0	1.0		
222	+22 1645	079294	3.52	F0 IV	72 Nov 24	05 19	14.958	6	R	B v	0.4	3.0	326.3	
										R	0.3	2.3		
223	+21 1588	079359	8.7	G5	72 Nov 24	07 26	39.06	50	R	B	0.7	0.7	300.0	
224b	+21 1602	079403	5.18	F5 IV-V	72 Nov 24	09 37	01.566	8	R	B v	0.7	1.2	303.6	double
										R	1.2	1.2		
224a						09 37	01.721	6	R	B v	2.2	3.0		
										R	2.3	3.1		
225	+12 0164	092379	8.9	K0	72 Dec 16	00 13	34.278	10	D	B	1.2	1.2	76.5	
										R	1.0	1.0		
226	+13 0199	092375	8.6	G0	72 Dec 16	00 35	59.542	10	D	B	0.9	1.1	6.1	
227	+13 0202	092390	8.7	K0	72 Dec 16	01 17	17.639	12	D	B	0.5	0.5	11.4	
										R	0.7	0.7		
228	+13 0207	092420	9.1	G5	72 Dec 16	02 37	17.031	13	D	B	0.8	0.8	99.9	
										R	0.5	0.7		
229	+13 0216	092452	8.6	G5	72 Dec 16	05 04	11.302	12	D	B	1.3	1.9	80.1	
										R	1.0	1.0		
230	+14 0227	092473	8.9	F8	72 Dec 16	06 27	04.82	80	D	B	0.7	0.7	64.3	
231	+14 0226	092471	7.5	MB	72 Dec 16	06 54	17.354	13	D	B v	0.5	1.0	3.3	
										R	1.5	2.0		
232	+14 0230	092483	8.9		72 Dec 16	07 04	34.819	22	D	B	0.7	0.7	19.2	
233a	+14 0232	092486	8.3		72 Dec 16	07 20	38.882	35	D	B	0.9	0.9	4.6	double
233b						07 20	41.240	25	D	B	0.4	0.6		
234	-25 11485	184336	2.93	B1 III	73 Jan 1	13 20	04.577	6	R	B b	0.2	1.9	288.2	
235	-04 5716	146210	5.03	K2 III	73 Jan 9	02 13	42.621	6	D	B v	1.7	3.3	2.3	
										R	1.1	2.6		
236	+20 0477	075652	8.6	A5	73 Jan 14	00 52	13.074	9	D	B	1.4	2.1	9.5	
										R	0.9	0.9		
237	+20 0482	075667	9.1	G5	73 Jan 14	01 20	51.675	14	D	B	1.0	1.0	88.4	
238b	+20 0484	075673	5.55	A2 V	73 Jan 14	01 44	41.228	4	D	B v	1.9	2.1	79.4	double
										R	1.8	2.0		
238a			5.25	A2 V		01 44	43.754	2	D	B v	2.7	4.1		
										R	2,3	3.0		
239a	+21 0397	075671	6.7	A3	73 Jan 14	02 08	31.799	6	D	B b	2.4	2.4	7.9	double
										R	1.6	1.8		
239b						02 08	32.822	8	D	B b	2.2	2.2		
										R	1.6	1.6		
240	+20 0485	075675	8.7	F0	73 Jan 14	02 10	50.435	9	D	B	1.7	1.7	49.4	
241	+20 0496	075715	7.4	K0	73 Jan 14	04 41	20.812	6	D	B	1.3	1.9	124.5	
										R	1.9	1.9		
242	+21 0407	075717	8.5	K2	73 Jan 14	04 47	08.982	8	D	B	0.8	1.2	71.6	
										R	1.9	1.9		
243	+21 0408	075728	9.1	K7	73 Jan 14	05 20	36.763	16	D	R	1.2	1.4	55.5	
244	+21 0416	075773	7.8	K0	73 Jan 14	07 32	03.136	20	D	R	0.6	1.9	77.5	
245	+23 0594	076358	7.8	B9	73 Jan 15	00 07	40.337	6	D	B	2.1	2.5	34.5	
246a	+23 0609	076425	5.56	F5 + A	73 Jan 15	03 05	13.153	3	D	B b	1.5	2.1	101.0	double
										R	1.9	2.2		
246b						03 05	13.215	2	D	B b	2.1	2.5		
										R	0.6	1.7		
247	+23 0606	076417	8.9	K2	73 Jan 15	03 06	18.756	19	D	R	0.7	0.7	29.7	
248	+24 0788	077039	9.2	F2	73 Jan 16	05 00	14.23	90	D	B	0.5	1.3	97.6	
249b	+25 0800	077038	8.9	A3	73 Jan 16	05 02	07.49	60	D	B	0.2	0.5	70.1	double?
										R	—	—		
249a						05 02	07.97	39	D	B	1.2	1.2		
										R	0.6	0.7		
250	+25 0808	077062	8.4	K0	73 Jan 16	06 29	09.008	17	D	B	0.6	0.6	27.7	
251	+24 0807	077077	9.1	F5	73 Jan 16	06 38	55.949	28	D	B	0.4	0.4	86.8	
252	+24 0818	077112	8.8	B9	73 Jan 16	08 05	11.663	14	D	B	1.5	1.5	86.4	
253	+25 0818	077113	8.5	A2	73 Jan 16	08 16	22.102	15	D	B	0.1	0.1	47.3	
254	+15 0255	092616	9.3		73 Feb 9	01 39	56.670	13	D	B	1.3	1.3	9.1	
255	+15 0266	092639	8.5	F2	73 Feb 9	02 53	09.452	8	D	B	2.2	2.6	61.1	
										R	1.7	1.9		
256	+15 0268	092645	7.9	F0	73 Feb 9	03 07	13.677	3	D	B	1.8	2.8	54.9	
										R	1.4	2.1		
257	+15 0273	092663	8.2	K0	73 Feb 9	04 20	37.852	9	D	B	0.6	2.9	89.6	
										R	0.4	2.9		
258	+19 0398	093043	8.8	G5	73 Feb 10	00 15	14.985	8	D	B	1.3	1.9	66.7	
										R	1.2	1.2		
259	+19 0399	093046	9.0	F	73 Feb 10	00 16	38.739	7	D	B	1.0	1.7	108.1	double?
										R	0.6	0.9		
260	+19 0400	093051	9.0		73 Feb 10	00 30	15.855	9	D	B	0.0	0.6	117.5	double?
										R	1.4	1.4		
261b	+19 0403	093062	5.66	A0 IV-V	73 Feb 10	01 35	37.206	15	D	B b	1.3	1.3	152.7	double (triple?)
										R	0.1	0.3		
261a						01 35	37.381	11	D	B b	2.0	3.5		
										R	1.1	2.3		

TABLE 1—*Continued*

1 Event No	2 DM No	3 SAO No	4 Mag	5 Sp	6 UT Date	7 Observed UTC	7 Observed Time	8 Δt msec	9 Type of Event	10 Colors Observed	11 Δm_*	12 Δm_0	13 Lunar Position Angle	14 Remarks
262	+19 0405	075531	7.8	G5	73 Feb 10	01 36	13.647	4	D	B	2.3	2.7	95.2	
										R	2.3	2.5		
263	+19 0409	075545	8.6	K0	73 Feb 10	02 40	41.759	8	D	B	1.7	1.7	39.3	
										R	1.3	1.7		
264	+20 0457	075554	9.2	G0	73 Feb 10	03 17	00.369	14	D	B	0.4	0.4	37.9	
										R	0.8	0.8		
265	+20 0458	075558	8.0	A0	73 Feb 10	03 26	33.804	7	D	B	1.9	3.2	28.4	
										R	1.8	2.1		
266	+23 0497	076106	9.0	G5	73 Feb 11	02 09	51.821	16	D	B	0.9	0.9	39.3	P
267	+23 0496	076103	8.1	A5	73 Feb 11	02 19	53.790	6	D	B	2.4	2.8	21.2	P
										R	1.5	1.5		
268	+22 0537	076130	8.8	F5	73 Feb 11	02 39	11.060	9	D	B	1.5	1.5	122.1	P
										R	1.0	1.0		
269	+23 0506	076128	9.0	K0	73 Feb 11	02 40	34.016	30	D	R	0.7	0.7	50.3	P
270	+23 0509	076135	8.9	F5	73 Feb 11	03 08	33.540	25	D	B	1.3	1.4	15.7	P
271	+23 0524	076175	8.0	A0	73 Feb 11	03 35	07.341	6	D	B	2.2	2.4	53.0	P
										R	1.6	1.6		
272	+23 0542	076202	7.7	K0	73 Feb 11	04 03	41.811	6	D	B	1.9	2.6	61.1	P
										R	2.7	2.9		
273	+23 0539	076198	7.7	A0	73 Feb 11	04 05	33.516	6	D	B	2.0	2.5	42.8	P
										R	1.3	1.9		
274	+23 0535	076189	6.9	F5	73 Feb 11	04 09	32.543	9	D	B*b*	0.0	0.9	25.5	P
										R	0.6	2.1		
275	+22 0563	076215	5.44	B8 V	73 Feb 11	04 21	43.014	21	D	B*b*	1.9	4.1	104.0	P
										R	2.1	3.6		
276	+22 0568	076233	8.8	F8	73 Feb 11	04 46	46.994	19	D	B	0.4	0.4	109.4	P
277	+22 0565	076222	8.5	A3	73 Feb 11	04 49	16.569	9	D	B	1.7	1.9	151.7	P
										R	1.0	1.3		
278	+22 0570	076238	9.1	F8	73 Feb 11	04 57	45.946	15	D	B	0.6	0.6	116.7	P
279	+22 0567	076230	8.9	K2	73 Feb 11	05 00	57.645	27	D	R	0.7	1.0	150.6	
280	+22 0573	076243	8.1	A2	73 Feb 11	05 04	35.025	6	D	B	1.7	2.1	126.9	P
										R	1.4	1.4		
281	+23 0563	076244	6.16	B9 V	73 Feb 11	05 10	10.996	4	D	B*b*	2.7	3.6	41.0	P
										R	2.6	3.3		
282	+22 0579	076265	9.0	A3	73 Feb 11	05 35	50.339	35	D	B	0.5	0.5	108.6	
283	+07 2232	118084	8.6	F8	73 Ap 13	02 04	50.219	10	D	B	1.7	1.7	155.3	
										R	1.2	1.2		
284	+07 2235	118110	8.5	K2	73 Ap 13	03 43	46.918	8	D	B	1.8	1.8	121.6	
										R	1.6	1.9		
285	+07 2243	118124	8.8	F0	73 Ap 13	04 38	47.844	14	D	B	0.9	0.9	98.7	
286	+07 2245	118132	8.7	B9	73 Ap 13	05 12	51.793	7	D	B	2.2	2.8	85.2	
										R	1.4	1.4		
287	+06 2265	118135	6.8	K0	73 Ap 13	06 19	01.082	14	D	B	0.6	2.1	188.0	
										R	1.3	1.9		
289	+06 2268	118151	7.8	K0	73 Ap 13	06 51	42.114	5	D	B	1.7	2.0	119.8	
										R	2.1	2.3		
288	+02 2367	118558	7.2	MA	73 Ap 14	01 40	05.374	4	D	B	0.7	0.9	66.0	
										R	2.5	3.1		
290	+02 2366	118557	8.6	K0	73 Ap 14	01 54	16.391	8	D	B	1.1	1.1	143.2	
										R	1.0	1.0		
291	+09 2251	117951	8.7	G5	73 May 10	02 07	00.134	11	D	B	0.4	0.9	94.2	
										R	1.0	1.0		
292	+08 2275	117942	8.3	G5	73 May 10	02 13	48.284	11	D	B	1.4	2.1	169.8	
										R	1.3	1.7		
293	-02 3360	138238	5.07	K4 III	73 May 12	03 42	45.337	4	D	B*v*	1.4	2.4	125.0	
										R	1.6	2.6		
294	-20 4093	182873	6.11	gK5	73 Aug 6	02 24	32.588	5	D	B*v*	1.0	3.1	111.8	
										R	1.5	4.2		
295	-23 12450	183673	8.7	M0	73 Aug 7	03 06	31.075	6	D	R	1.3	1.7	84.4	
296	-23 12458	183686	5.06	gK4	73 Aug 7	03 29	37.423	4	D	B*v*	0.6	4.0	102.9	
										R	0.8	3.8		
297	+23 0729	076717	7.7	F5	73 Aug 22	09 10	08.986	7	R	B	1.4	2.1	289.1	
										R	1.4	1.4		
298	+23 0733	076727	6.08	dF6	73 Aug 22	09 41	50.350	7	R	B*b*	1.3	1.3	295.8	
										R	0.3	0.3		
299	+23 0738	076731	8.4	G0	73 Aug 22	10 18	37.007	12	R	B	0.9	0.9	283.0	
										R	0.7	0.7		
300	-23 14760	187353	8.6	K0	73 Sept 7	03 14	37.365	12	D	B	0.5	1.1	59.1	
301	-04 5716	146210	5.03	K2 III	73 Oct 9	04 42	42.789	3	D	B*v*	1.5	4.0	61.9	
										R	1.7	4.7		
302	+22 0621	076406	8.2	F5	73 Oct 15	05 01	00.603	8	R	B	0.1	0.1	219.1	
										R	0.9	1.0		
303	+22 0637	076475	7.6		73 Oct 15	08 43	22.394	10	R	B*b*	1.8	1.9	287.0	
										R	1.5	1.5		
304	+22 0637	076476	7.6	A3	73 Oct 15	08 43	24.320	8	R	B*b*	1.7	1.7	287.2	double
										R	0.4	0.4		
305	+20 1753	079226	8.4	K2	73 Oct 18	08 17	44.843	16	R	R	1.2	1.2	261.4	
306	+20 1775	079328	5.06	gM0	73 Oct 18	11 09	27.691	4	R	B*v*	2.2	2.9	345.6	
										R	2.6	3.1		

TABLE 1—*Continued*

1 Event No	2 DM No		3 SAO No	4 Mag	5 Sp	6 UT Date	7 Observed UTC Time		8 Δt msec	9 Type of Event	10 Colors Observed	11 Δm_*	12 Δm_0	13 Lunar Position Angle	14 Remarks
307	-22	4950	187591	8.6	A2	73 Nov 1	00 47	25.583	7	D	$\mathscr{B}$	1.6	1.6	78.5	
308	+21	1399	078798	9.1	A3	73 Nov 14	04 52	29.052	12	R	$\mathscr{B}$	0.7	0.7	288.1	
309	-04	5728	146239	6.4	G0	73 Dec 3	00 03	03.790	3	D	$\mathscr{B}b$	2.8	4.4	52.4	no double
											$\mathscr{R}$	2.5	3.7		
310	-04	5733	146252	7.7	A0	73 Dec 3	00 59	07.404	4	D	$\mathscr{B}b$	2.4	2.9	81.3	
											$\mathscr{R}$	1.6	1.9		
311	-04	5738	146262	9.1	K0	73 Dec 3	01 37	50.444	8	D	$\mathscr{B}$	1.3	1.9	70.1	
											$\mathscr{R}$	0.9	1.1		
312	-04	5740	146270	9.1	K2	73 Dec 3	01 43	36.311	19	D	$\mathscr{B}$	0.4	0.4	106.9	
313	-04	5743	146274	9.3	F8	73 Dec 3	02 01	43.4	100	D	$\mathscr{B}$	0.2	0.2	124.2	
314	+15	0292	092750	7.7	F2	73 Dec 7	00 30	20.869	5	D	$\mathscr{R}$	2.3	2.3	14.3	
315	+15	0298	092764	9.2		73 Dec 7	01 14	09.153	13	D	$\mathscr{R}$	1.2	1.2	39.0	
316	+16	0239	092792	8.4	F5	73 Dec 7	03 10	18.433	6	D	$\mathscr{B}$	1.5	1.5	78.4	
											$\mathscr{R}$	2.3	2.3		
317	+16	0241	092796	8.3	F2	73 Dec 7	03 32	20.293	6	D	$\mathscr{B}$	1.1	1.1	42.1	
											$\mathscr{R}$	1.7	1.7		
318	+16	0247	092810	6.36	F3	73 Dec 7	05 04	45.654	2	D	$\mathscr{B}b$	2.0	2.9	68.2	
											$\mathscr{R}$	2.5	3.0		
319	+20	0514	075755	6.7	K2	73 Dec 8	05 01	38.018	8	D	$\mathscr{B}v$	1.3	1.3	76.8	
											$\mathscr{R}$	1.1	1.4		
320	+20	0527	075810	4.94	A0	73 Dec 8	07 58	52.970	11	D	$\mathscr{B}b$	1.4	1.7	69.4	

Note: P in column 14 denotes Pleiades member.

Where possible ambiguity exists the assignments of Δm_1 and Δm_2 have been made using the blue cell channel results. The measured projected separations of the stars along a line perpendicular to the advancing lunar limb are given. The angle which this projection makes with celestial north (ψ) has been called *lunar position angle*. This is so it will not be confused with *position angle* employed by visual binary observers. Relationships between these quantities are shown in Figure 1. In all cases we have employed the predicted rate of motion for the lunar limb, and we have assumed zero slope of the Moon's limb at the point of contact. As discussed by Evans (1971), this leads to greater uncertainty in the calculated values of the projected separations, but it was felt that for these cases the slope calculations were not warranted. Estimates of the errors of the projected separations and directions do not include this consequence of assuming zero slope. The sequence description employs the indices 1 and 2, or 1, 2, and 3 to denote the order in which the Moon's limb passes the separate components. Specific details of these events are given below.

a) *Event 130, BD +08 2319.*—Figure 2 contains both the $\mathscr{B}$ and $\mathscr{R}$ records for this occultation, which we judge to be of a definite double and probably triple object. The object has been previously referred to as a probable double in the unpublished Special Zodiacal Double Star List.

TABLE 2

System Bandwidth and Effective Wavelength

Filter-Cell Combination	λ (Å)	Δλ (Å)
$\mathscr{R}$	7200	1660
$\mathscr{B}$	4800	1840
$\mathscr{B}b$	4450	980
$\mathscr{B}v$	5500	980
Blue	4400	2840
Red	5900	2880

b) *Events 142 and 261, BD +19 0403, ADS 2062.*—These two separate occultation observations of the same star provide convincing evidence of the duplicity of this object, as has been reported by de Vegt and Gehlich (1976) at Hamburg (see Fig. 3). The common-proper-motion companion is too faint and too distant to contribute to the occultation records. Combining the two Fick observations with the Hamburg observations does not produce a well-defined orbit because of the intervals between the observations and the fact that there has been definite orbital motion between the measurements. It does appear that the period of the system may be on the order of 6 years, with a clockwise motion of the secondary more likely. The existence of a third member of the system appears highly probable, as its presence has now been suspected on four of six of the reported observations.

c) *Event 148, CD −26 11990, ADS 10388.*—Occultation secondary appears to be the visual secondary for this system. Separation and magnitude differences are consistent with visual measurements of magnitude 9.7 and 1".7 distance at $\theta = 66°$ for this secondary.

d) *Event 156, CD −26 12864, ADS 11100.*—Our occultation result is in reasonable agreement with extrapolated visual values of $\rho = 0''.2$ and $\theta = 67°$, and reconcilable with visual brightness determinations if we reverse our labels 1 and 2. As expected for so faint a blue system, the $\mathscr{R}$ Record is too noisy to detect the second object. The reported visual magnitudes of 9.5 and 9.8 and the present $\mathscr{B}$ results suggest that the stars are nearly the same color.

e) *Event 169, CD −25 13318; and Event 170 CD, −25 13320, ADS 11539.*—These stars are the two brightest components of a visual quadruple system. Our event 169 is the occultation of the C component,

TABLE 3
DM Cross Listing

Star DM	Event	Star DM	Event	Star DM	Event	Star DM	Event	Star DM	Event
-26 11990	148	-18 5738	141	+13 2071	127	+21 1399	308	+23 1605	208
-26 11994	149	-17 6123	209	+14 226	231	+21 1588	233	+24 788	248
-26 12012	150	-16 5725	210	+14 227	230	+21 1602	224	+24 807	251
-26 12802	151	-16 5734	213	+14 230	232	+22 537	268	+24 818	252
-26 12814	153	-16 5739	211	+14 232	233	+22 547	181	+24 1040	186
-26 12818	152	-16 5741	212	+15 255	254	+22 563	183,275	+24 1045	187
-26 12854	154	-16 5753	214	+15 266	255	+22 565	182,277	+24 1052	190
-26 12858	155	-16 5754	215	+15 268	256	+22 567	184,279	+24 1055	191
-26 12862	157	-16 5759	216	+15 273	257	+22 568	276	+24 1065	192
-26 12864	156	-16 5769	217	+15 292	314	+22 570	278	+24 1071	193
-26 12884	158	-15 3706	135	+15 298	315	+22 573	280	+24 1078	195
-25 11070	146	-05 3424	134	+16 239	316	+22 579	282	+24 1079	194
-25 11295	140	-04 5716	235,301	+16 241	317	+22 621	302	+24 1080	198
-25 11485	234	-04 5728	309	+16 247	318	+22 637	303,304	+24 1092	200
-25 13305	168	-04 5733	310	+18 1930	122	+22 1567	205	+24 1109	201
-25 13318	169	-04 5738	311	+18 1931	123	+22 1577	206	+25 800	249
-25 13320	170	-04 5740	312	+18 1939	124	+22 1645	222	+25 808	250
-25 13331	171	-04 5743	313	+19 399	259	+23 496	267	+25 818	253
-25 13351	173	-02 3360	293	+19 400	260	+23 497	266		
-25 13352	172	+02 2366	290	+19 403	142,261	+23 506	269		
-25 13364	174	+02 2367	133,288	+19 405	143,262	+23 509	270		
-25 13368	175	+03 2426	131	+19 409	144,263	+23 524	271		
-25 13614	159	+03 2428	132	+20 457	264	+23 535	274		
-25 13655	161	+06 2265	287	+20 458	265	+23 539	273		
-24 12296	147	+06 2268	289	+20 477	236	+23 542	272		
-24 14916	160	+07 2232	283	+20 482	237	+23 563	281		
-24 14948	162	+07 2235	284	+20 484	238	+23 594	245		
-23 12110	136	+07 2243	285	+20 485	240	+23 597	185		
-23 12158	138	+07 2245	286	+20 496	241	+23 606	247		
-23 12159	139	+08 2275	292	+20 514	319	+23 609	246		
-23 12450	295	+08 2311	128	+20 527	320	+23 729	297		
-23 14760	300	+08 2316	129	+20 1753	305	+23 733	298		
-22 4950	307	+08 2319	130	+20 1775	306	+23 738	299		
-22 10871	137	+09 2251	291	+21 397	239	+23 1494	218		
-20 4093	294	+12 164	225	+21 407	242	+23 1503	220		
-19 5809	176	+13 199	226	+21 408	243	+23 1513	221		
-19 5813	177	+13 202	227	+21 416	164,244	+23 1518	219		
-19 5815	178	+13 207	228	+21 419	165	+23 1589	203		
-19 5830	179	+13 216	229	+21 422	166	+23 1590	204		
-19 5831	180	+13 2066	125	+21 427	167	+23 1604	207		

TABLE 4

HD Cross Listing

Star HD	Event	Star HD	Event	Star HD	Event	Star HD	Event
8067	226	23851	184,279	87423	129	176610	307
8111	225	23912	278	87635	130	176704	161
8186	227	23923	281	87669	284	176752	162
8510	228	23924	280	87996	286	194213	176
8942	229	24088	282	88048	287	194473	177
9202	231	24899	245	88331	289	194549	178
11016	255	24922	185	94031	131	195093	179
11054	256	25322	302	94252	133,288	195094	180
11320	257	25555/6	246	94350	132	196777	141
12315	314	26128	303	99998	293	199059	210
12848	316	29745	297	105266	134	199295	213
12898	317	29859	298	118411	135	199366	211
13201	318	29969	299	130157	294	199443	212
16656	258	34670	252	134500	136	199615	215
16657	259	34682	253	135389	138	199616	214
16811	142,261	40241	187	135409	139	199884	216
16883	143,262	40833	193	139576	295	200213	217
17024	144,263	41115	197	140672	146	214376	235,301
17160	265	41221	199	141091	147	214810	309
18283	236	41526	200	143787	140	214982	310
18484	239	41766	201	147165	234	215078	311
18519	238b	48913	218	155363	148	215113	312
18520	238a	49824	308	155431	149	215142	313
18562	240	49838	221	155685	150	241688	249
19018	241	49968	219	165290	151	241689	248
19549	319	53230	203	165485	152	242052	250
19665	164,244	53532	205	165815	154	242218	251
19751	165	53791	206	165896	157	249569	186
20150	320	55972	305	165952	156	249870	188
23157	267	56986	222	166194	158	250028	189
23158	266	57423	306	171878	168	250094	190
23289	268	58728	224	172178	169	250176	191
23326	270	70569	122	172193	170	250423	192
23464	181	70593	123	172295	171	250833	195
23512	271	71053	124	172491	173	250915	194
23609	274	79954	125	172531	172	250941	198
23643	273	80392	127	172733	175	252584	202
23654	272	85270	292	174355	300	264152	220
23753	183,275	87143	128	176246	159		
23791	182,277	87261	283	176365	160		

TABLE 5

EVENTS INDICATING MULTIPLICITY

Event	Star	SP	m_v	Filter-Cell Comb.	Δm_1	Δm_2	Δm_3	Projected Separation a_{12}	Projected Separation a_{13}	Lunar Position Angle	Sequence
130	+08 2319	F5	8.5	$\mathscr{B}$	0.88 ± 0.13	0.97 ± 0.15	2.0 ± 0.4	0.063 ± 0.009	0.270 ± 0.013	119	3, 2, 1
				$\mathscr{R}$	0.64 ± 0.20	1.35 ± 0.25	2.0 ± 0.5				
142	+19 0403	A0	5.66	Red	0.62 ± 0.14	0.97 ± 0.33	...	0.016 ± 0.005	0.119 ± 0.009	217	1, 2, 3
261	+19 0403	A0	5.66	$\mathscr{B}b$	0.62 ± 0.09	1.21 ± 0.24	...	0.013 ± 0.002	...	153	2, 1
148	−26 11990	G5	6.9	$\mathscr{B}$	0.08 ± 0.04	2.84 ± 0.19	...	1.372 ± 0.014	...	107	1, 2
				$\mathscr{R}$	0.06 ± 0.07	3.27 ± 0.24					
156	−26 12864	A0	9.0	$\mathscr{B}$	0.75 ± 0.41	0.83 ± 0.49	...	0.189 ± 0.014	...	84	2, 1
170	−25 13320	A0	8.0	$\mathscr{B}$	0.68 ± 0.22	0.88 ± 0.35	...	0.812 ± 0.006	...	136	1, 2
				$\mathscr{R}$	1.85 ± 0.39	0.25 ± 0.19					
203	+23 1589	A2	8.8	$\mathscr{B}$	0.13 ± 0.09	2.43 ± 0.47	...	0.137 ± 0.011	...	324	1, 2
				$\mathscr{R}$	0.61 ± 0.22	1.18 ± 0.45					
218	+23 1494	F5	8.2	$\mathscr{B}$	0.74 ± 0.34	0.81 ± 0.34	...	0.034 ± 0.007	...	307	1, 2
				$\mathscr{R}$	0.50 ± 0.54	1.25 ± 0.77					
224	+21 1602	F5	5.18	$\mathscr{B}v$	0.16 ± 0.07	2.26 ± 0.14	...	0.047 ± 0.006	...	304	2, 1
				$\mathscr{R}$	0.22 ± 0.03	2.23 ± 0.16					
233	+14 0232	...	8.3	$\mathscr{B}$	0.28 ± 0.09	1.53 ± 0.25	...	0.486 ± 0.012	...	5	1, 2
238	+20 0484	A2	5.55	$\mathscr{B}v$	0.58 ± 0.03	1.00 ± 0.07	...	1.043 ± 0.012	...	79	2, 1
				$\mathscr{R}$	0.55 ± 0.03	1.00 ± 0.07					
239	+21 0397	A3	6.7	$\mathscr{B}b$	0.66 ± 0.05	0.85 ± 0.03	...	0.193 ± 0.002	...	8	1, 2
				$\mathscr{R}$	0.75 ± 0.07	0.75 ± 0.09					
246	+23 0609	F5 + A	5.56	$\mathscr{B}b$	0.76 ± 0.16	0.77 ± 0.13	...	0.025 ± 0.002	...	101	1, 2
				$\mathscr{R}$	0.22 ± 0.16	1.96 ± 0.42					
249	+25 0800	A3	8.9	$\mathscr{B}$	0.45 ± 0.43	1.39 ± 0.77	...	0.19 ± 0.04	...	70	2, 1
259	+19 0399	F	9.0	$\mathscr{B}$	0.30 ± 0.26	1.86 ± 0.83	...	0.133 ± 0.016	...	108	2, 1
260	+19 0400	...	9.0	$\mathscr{B}$	0.16 ± 0.24	2.26 ± 0.5	...	0.27 ± 0.03	...	118	1, 2
				$\mathscr{R}$	0.14 ± 0.11	2.32 ± 0.38					
303 and 304	+22 0637	...	7.6	$\mathscr{B}b$	0.70 ± 0.09	0.79 ± 0.07	...	0.712 ± 0.007	...	287	1, 2
				$\mathscr{R}$	0.63 ± 0.21	0.89 ± 0.20					

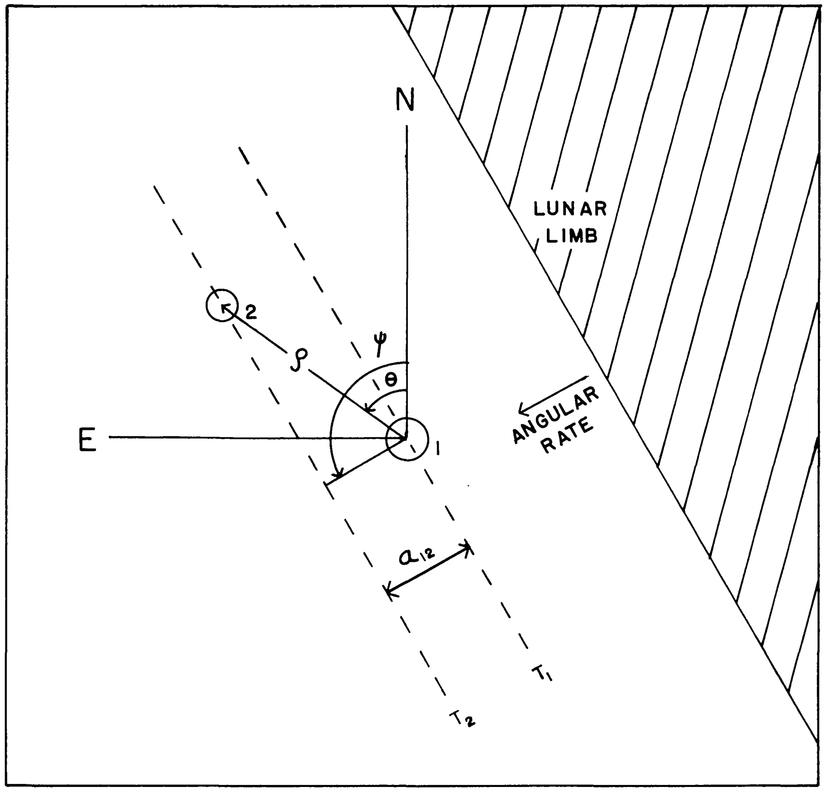

FIG. 1.—Occultation geometry

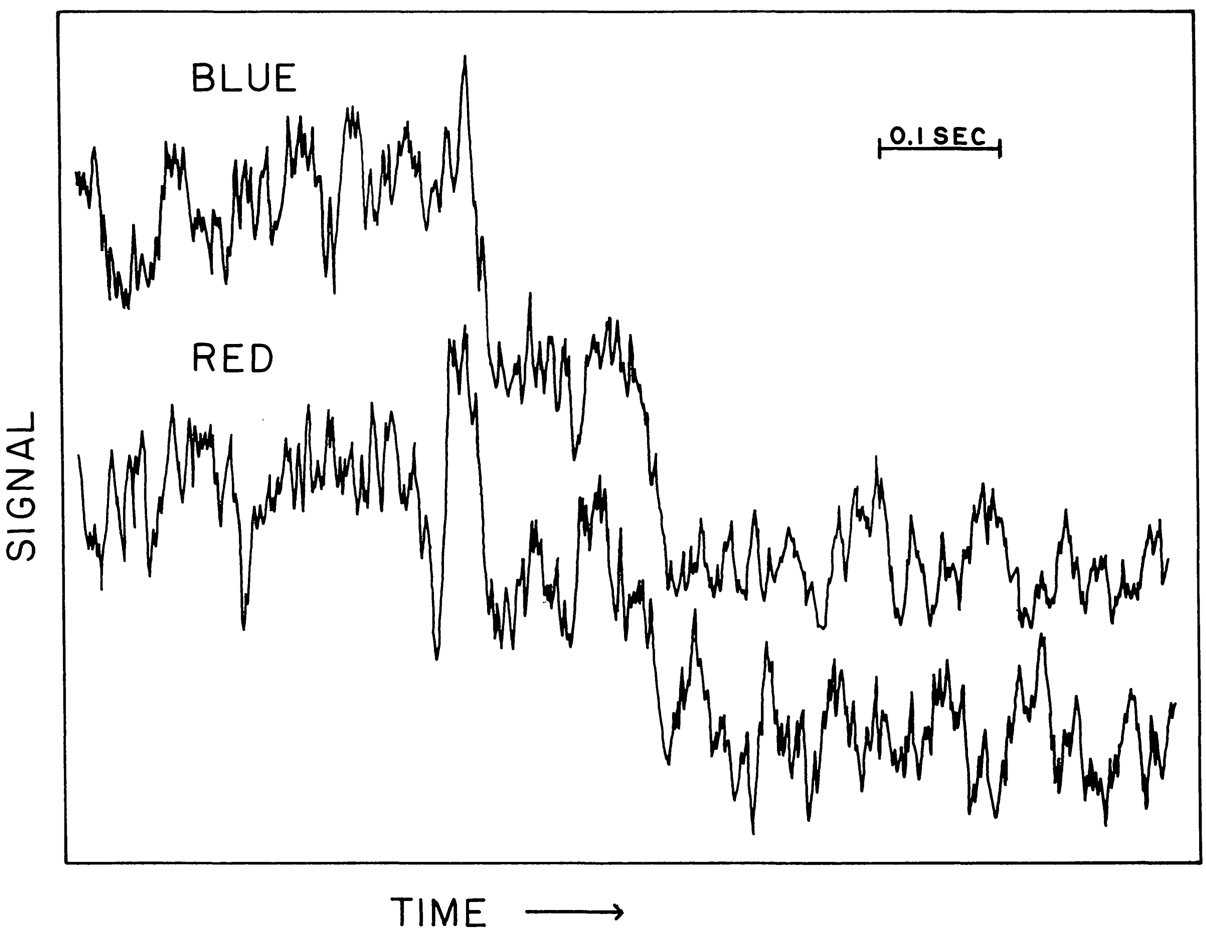

FIG. 2.—Occultation records for event 130, BD +08 2319

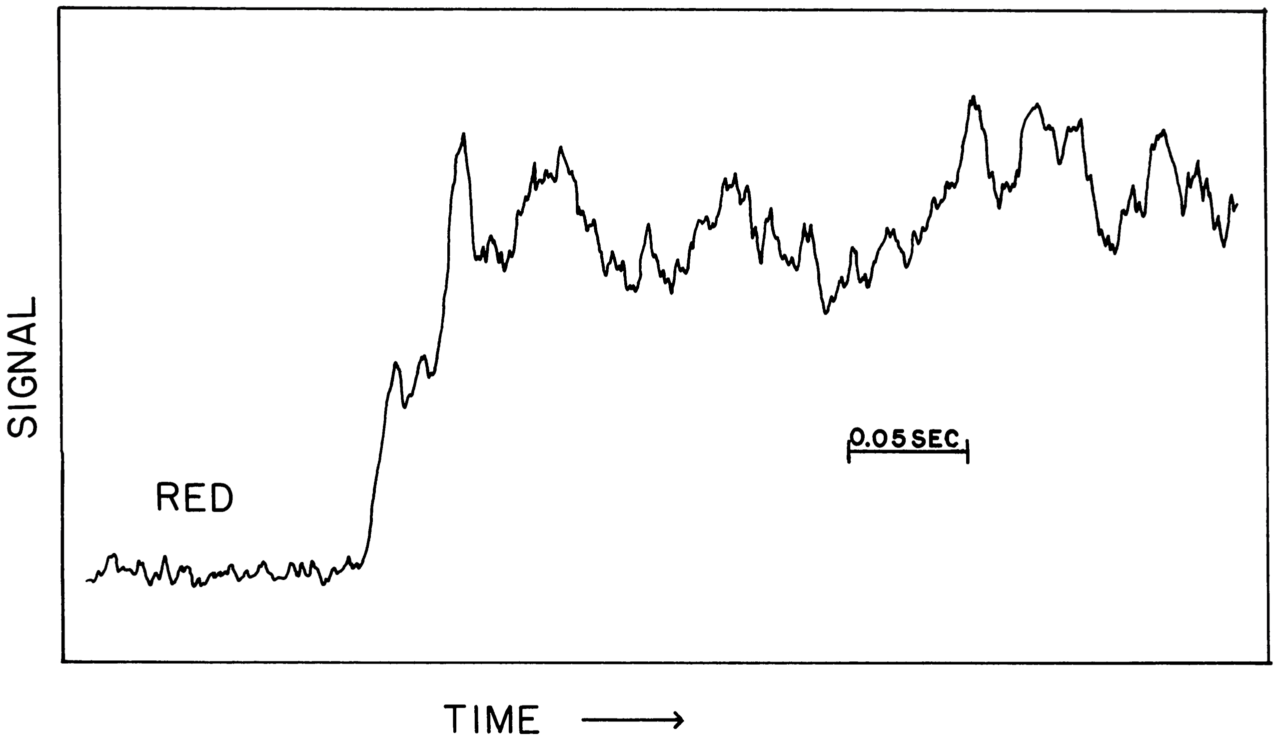

FIG. 3.—Occultation record for event 142, BD +19 0103

and we detect no occultation duplicity of this member. The projected separation of AC is determined to be 47″.59 ± 0.007 along a lunar position angle 136°. This agrees well with visual determinations of $\rho = 53''$, $\theta = 286°$. Event 170 is an occultation of component A of the visual system. Our detected duplicity is apparently visual pair AB. The occultation result is in good agreement with visual results for this system if we keep our designations 1 and 2 despite the fact that our records are not entirely clear as to which is the brighter member.

f) *Event 203, BD +23 1589*.—The object is definitely double, apparently previously unreported as such. Based upon its spectral classification and the two-color occultation results, it is an A star with a red companion.

g) *Event 218, BD +23 1494*.—Both $\mathscr{B}$ and $\mathscr{R}$ records imply that this is a probable double with very small projected separation. The primary appears to be redder than the secondary.

h) *Event 224, BD +21 1602, ADS 6089*.—This event is an occultation of the A component of a known visual triple. The same star is listed as a spectroscopic binary in the Special Zodiacal Double Star List with a probable separation of about 0″.001. Our observation of a companion at a projected separation of 0″.047 apparently is of a fainter, previously undetected member of the system.

i) *Event 233, BD +14 232*.—Although the $\mathscr{R}$ record is too noisy, the $\mathscr{B}$ record reveals a second occultation after the main event. An occultation of this object has been reported previously (Dunham *et al.* 1973*a*) where no duplicity was detected.

j) *Event 238, BD +20 484, ADS 2257*.—Pair AB of the visual triple system produces two occultations clearly separated in time. The two stars appear to be of similar color. There is good agreement between these results and those reported by others (Dunham *et al.* 1973*b*) for the same system.

k) *Event 239, BD +21 397, ADS 2253*.—Listed by Aitkin as a visual binary consisting of a pair of 7.5 mag A3 stars, the occultation records suggest a slight difference in brightness, with the fainter member slightly redder than the brighter member. If we combine this measurement with that reported by de Vegt and Gehlich (1976), it is possible to estimate ρ and θ for this pair if we assume negligible orbital motion in the 11 month interval. One obtains either $\rho =$ 0″.43 ± 0″.02, $\theta = 72° \pm 1°$, or $\rho =$ 0″.38 ± 0″.02, $\theta = 309° \pm 1°$. The former set of values is appropriate if the Hamburg event featured the occultation of the brighter member first, while the second set is applicable if the fainter member were occulted first. It is to remove such ambiguities that we specify the observed sequence of events in the last column of Table 5.

l) *Event 246, BD +23 0609, ADS 2965*.—Good records were obtained in both $\mathscr{B}b$ and $\mathscr{R}$ channels for this object. They imply duplicity of visual component A. Other observers (Dunham *et al.* 1973*c*) have reported observing this same event. Combining their result with ours, we obtain $\rho = 0.033'' \pm 0.002$, $\theta = 142° \pm 3°$ for this pair. The large position angle difference between these two observations helps reduce the uncertainties in both parameters in this case. It is difficult to reconcile either of the above observations with the values of 0″.095 projected separation and 214°

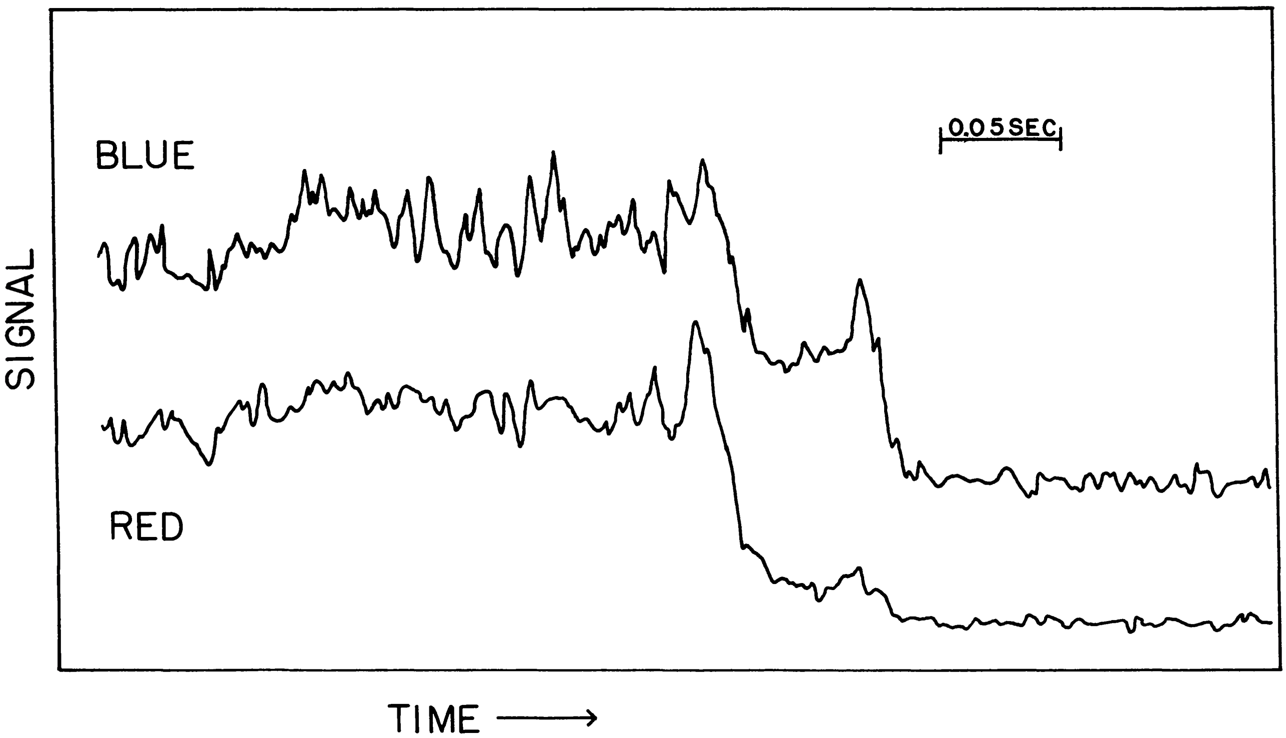

FIG. 4.—Occultation records for event 246, BD +23 0609

lunar position angle reported in the Special Zodiacal Double Star List. The stars appear to be comparable in brightness in the blue record. However, the red record shows a considerable difference in the pair. Therefore, the fainter member is considerably bluer than the brighter (see Fig. 4). This is consistent with Dunham's results where blue-sensitive equipment was used and $\Delta m = 0.04 \pm 0.06$ was obtained.

m) *Event 249, BD +25 0800.*—This appears to be a possible double star. Our $\mathscr{R}$ record is too noisy to use.

n) *Event 259, BD +19 0399.*—$\mathscr{B}$ record contains evidence of a possible companion.

o) *Event 260, BD +19 0400.*—Consistent evidence of possible duplicity is present in both $\mathscr{B}$ and $\mathscr{R}$ records for this faint object.

p) *Events 303 and 304, BD +22 0637, ADS 3019.*—With a visual separation of $5''.2$ at 187° for this system, the occultation-projected separations yield a consistent value for this rather unfavorable orientation of the lunar limb. At this event the limb was nearly parallel to the line between the visual pair.

q) *Event 309, BD −04 5728.*—Although there are unpublished reports of occultation duplicity of this system, we detect none despite rather favorable signal levels and lunar position angle.

r) *Event 319, BD +20 0514.*—The $\mathscr{R}$ record shows a hint of duplicity which is not substantiated in the $\mathscr{B}v$ channel record.

s) *Event 267.*—The same event observed at Tonantzintla by McGraw, Dunham, Evans, and Moffat (1974) showed definite duplicity. Our records show no features during the occultation which we would normally use to identify suspected doubles. However, upon reexamination of the occultation records we see that in both colors the decrease in light during the disappearance is anomalously slow. That is, the length of the time for the disappearance is nearly twice what would be expected from the predicted angular rate. Although no feature during the light decrease can be identified as the pause in the curve due to a second object, it is possible that noise prevents its detection in both colors.

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REFERENCES

de Vegt, C., and Gehlich, V. K. 1976, *Astr. Ap.*, **48**, 245.
Dunham, David W., Evans, David S., McGraw, J. T., Sandmann, W. H., and Wells, D. C., 1973*a*, *A.J.*, **78**, 487 (see #2676).
———. 1973*b*, *A.J.*, **78**, 487–488 (see #2656 and #2696).
———. 1973*c*, *A.J.*, **78**, 487 (see #2699).
Eitter, J. J., and Beavers, W. I. 1974, *Ap. J. Suppl.*, **28**, 410.
Evans, David S. 1971, *A.J.*, **76**, 1109.
McGraw, J. T., Dunham, D. W., Evans, D. S., and Moffett, T. J. 1974, *A.J.*, **79**, 1299.

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