PARTIAL ECLIPSE OF THE *SUN*, NOVEMBER 10, 1920,

OBSERVED AT THE U. S. NAVAL OBSERVATORY, WASHINGTON, D. C.
BY ELEANOR A. LAMSON.
[Communicated by Rear Admiral J. A. HOOGEWERFF, U. S. Navy, Superintendent.]

The results of the visual observations of first and last contact made at the U. S. Naval Observatory are as follows:

Observer	First Contact G. M. T.	Last Contact G. M. T.	Instrument
	h m s	h m s	
HALL	2 0 22	4 9 5	12-inch equatorial
HAMMOND	2 0 20	4 8 59	5-inch equatorial
HILL	2 0 19	4 8 56	5-inch equatorial
BURTON	[2 0 29]*	4 9 9	5-inch equatorial
BOWER	.....	4 9 7	5-inch equatorial
	h m s	h m s	
Mean	2 0 20	4 9 3	

*Noted as poor by observer.

Computed times of contract { First 2h 0m 22s; Last 4 9 31

Several photographs of the eclipse were also made near the time of last contact with the 40-foot photoheliograph by G. H. PETERS assisted by C. B. WATTS, the sidereal time being carefully noted at the instant of each exposure. To determine the instant the *Moon* moved off the *Sun's* disc, *i. e.*, the time of last contact, the following scheme was used, based upon suggestions made by A. NEWTON of the *Nautical Almanac Office*.

The geocentric right ascension and declination of the *Sun* and *Moon* were computed for three times, two minutes apart, grouped about the approximate time of second contact based upon the elements of the eclipse found in the *American Ephemeris*, 1920. These positions were reduced to Washington and the distance between the centers of the two bodies computed, from which one obtained the rate per second of the increase of the line of centers as the *Moon* moved off the *Sun's* disc.

The length of the common chord on the photographic plate was measured for each partial phase and reduced to arc. The distance between centers was then obtained by solving the triangles comprised between the radii, the semi-chord and the line of centers. Having the rate of change of line of centers, as mentioned in the preceding paragraph, it is easy to compute the instant when the two bodies are in contact for each exposure. The following results were obtained for last contact based on these plate measures.

Plate	Observed Time of Exposure G. M. T.	Length of Chord	Time of Last Contact G. M. T.
	h m s	″	h m s
I	4 6 52.9	336.0	4 9 17
II	4 7 23.8	299.4	4 9 18
III	4 7 53.8	[234.3]*	[4 9 4]
IV	4 8 27.8	213.3	4 9 26
V	4 9 1.9	[73.4]†	[4 9 9]
			h m s
		Mean	4 9 20

*Distortion on plate. †Questionable on plate.

PROPER-MOTIONS OF CERTAIN LONG PERIOD VARIABLE STARS,

BY ANNE S. YOUNG AND LOUISE F. JENKINS.

PLATES

A series of photographs of the fields around faint variable stars was made with the 24-inch reflector of the Yerkes Observatory by Mr. PARKHURST and MR. JORDAN during the years 1902 — 1908. In every case the image of the variable was at or near the center of the plate, and although such reflector plates might not be well adapted to a general study of proper-motions, yet because of their favorable position on the plates it seemed worth while to attempt to determine the proper-motions of some of these variables. Plates selected from this series were therefore duplicated for us at the Yerkes Observatory under the direction of MR. PARKHURST, the hour-angle, aperture, and exposure time of the second plate corresponding to that of the first, and the magnitude of the variable being as nearly the same as possible upon the two plates. The usual length of exposure was one hour,

the aperture used was 18 inches unless otherwise noted. The scale of the plates is 87″.38 to the millimeter.

Measures

These plates were measured at Mount Holyoke College in a Gaertner machine which has two screws at right angles to each other. The pitch of both screws is 0.5mm to a revolution; one division of the screw heads corresponds to 0.001mm.

For each field a set of standard stars was selected, usually within 8′ of the center, and so distributed that the sums of the x and y coördinates were very nearly zero. As each pair of plates was examined in the stereocomparator at the Yerkes Observatory before it was sent to us, no star of large proper-motion was included among these standards. The balancing of distances made least squares solutions unnecessary and simplified greatly the reduction of the measures.

The early plate was oriented in the machine by *A. G.* stars or by the mean of star trails, weighted according to their distance from the center. The second plate was oriented to correspond to the first. Each plate was measured in both direct and reversed positions, and each pair of plates was measured and reduced independently by each observer. The average probable error of a single setting, determined from measures of three plates, was ±0″.074 in x, ±0″.093 in y.

Results

Results are given in the tables which follow. The plates for the stars in Table 1 were considered good and at a later time the measures of these will be published so that they may be available for use in the determining of more accurate proper-motions in the future. Proper-motions for stars in Table 2 were for various reasons considered less reliable and these measures will probably not be published. The columns of these tables contain the designation of the star, the right ascension and declination as given by Graff[1], the date of the early plate, the number of years in the interval between the two plates, the number of standard stars, the mean of the two determinations of the annual proper-motions in right ascension and declination, and the residuals in units of 0″.001. In right ascension the proper-motion is given in both arc and time.

The probable errors of the annual proper-motions found were computed for several plates from least squares solutions and ranged from ±0″.003 to ±0″.005.

For two of the stars in Table 1 proper-motions

[1] Ortsverzeichnis von 580 Veränd. Sternen, *Astron. Abhand.* der Hamburger Sternwarte in Bergedorf, Bd. 1, Nr. 3.

Table 1

Star	R. A. (1900)	Decl. (1900)	Ep.	Int.	No. Stars	μ_α	μ_δ	Resid. in α	Resid. in δ
	h m s	° ′ ″		y		″ s	″		
RR Andromedæ	0 45 56.86	+33 49 58.3	07.85	9.21	21	+.030 .0024	−.052	1	5
Y Andromedæ	1 33 45.16	+38 50 7.4	07.85	11.24	24	−.019 .0016	+.009	2	1
T Camelop.	4 30 20.77	+65 56 44.4	07.87	11.26	29	+.011 .0018	−.011	4	0
V Orionis	5 0 47.02	+ 3 57 59.5	07.76	11.32	20	+.018 .0012	+.022	1	0
Y Monoc.	6 51 19.04	+11 22 22.2	08.24	8.98	20	−.019 .0013	−.024	1	1
**R Geminorum*	7 1 20.12	+22 51 28.2	05.00	14.15	28	−.021 .0015	+.006	1	4
T Geminorum	7 43 18.04	+23 59 0.6	08.24	10.03	25	+.023 .0017	−.017	7	3
U Cancri	8 30 2.70	+19 14 25.8	08.24	10.02	22	+.019 .0013	−.001	8	3
S Hydræ	8 48 21.17	+ 3 26 46.2	08.31	8.98	25	−.024 .0016	+.028	7	2
T Hydræ	8 50 47.94	− 8 45 35.1	08.26	9.99	25	−.021 .0014	+.001	7	1
T Virginis	12 9 28.80	− 5 28 47.8	08.02	10.19	19	−.006 .0004	−.009	6	2
S Sagittarii	19 13 34.85	−19 12 21.1	07.61	12.03	26	−.006 .0004	−.012	6	8
**χ Cygni*	19 46 43.44	+32 39 40.6	04.54	15.11	37	−.017 .0014	−.034	5	6
Z Cygni	19 58 37.47	+49 45 51.5	07.49	12.00	31	−.002 .0002	−.018	8	0
W Capricorni	20 8 36.26	−22 16 51.0	07.73	11.94	22	+.001 .0001	−.027	5	1
T Delphini	20 40 43.27	+16 2 6.2	07.81	9.81	22	+.000 .0000	+.023	5	6
RR Aquarii	21 9 49.10	− 3 18 37.0	07.66	12.00	19	+.022 .0014	+.047	10	7

*Aperture 12 inches.

TABLE 2

Star	R. A. (1900)	Decl. (1900)	Ep.	Int.	No. Stars	μ_α	μ_δ	Resid. in α	Resid. in δ
	h m s	° ′ ″		y		″ s	″		
S Arietis	1 59 15.42	+12 2 51.3	07.86	9.21	17	−.089 .0060	−.019	2	1
R Ceti	2 20 55.44	− 0 37 47.0	07.90	11.98	21	−.013 .0009	+.018	6	3
V Geminorum	7 17 32.72	+13 17 34.0	08.30	8.98	23	−.022 .0016	−.033	7	10
RU Herculis	16 6 2.74	+25 19 55.6	04.44	15.05	16	+.004 .0003	−.005	1	9
S Scorpii	16 11 42.65	−22 38 46.6	08.26	10.24	22	−.030 .0022	+.021	10	6
W Ophiuchi	16 16 1.11	− 7 27 42.6	07.51	12.03	22	+.023 .0015	+.020	15	1
†*RS Herculis*	17 17 30.86	+23 1 6.2	07.59	10.04	14	−.002 .0002	+.042	4	3
SY Cygni	19 42 43.54	+32 27 33.5	07.59	12.29	29	−.012 .0010	+.028	12	9
Z Aquilæ	20 9 51.41	− 6 27 20.5	07.46	12.12	23	+.022 .0015	−.006	6	3
S Pegasi	23 15 29.05	+ 8 22 19.6	07.82	11.83	14	−.055 .0037	−.036	8	3

†Measured by MISS FARNSWORTH instead of MISS JENKINS.

TABLE 3

Star	Field	Mag.	R. A. (1900)	Decl. (1900)	Ep.	Int.	μ_α	μ_δ
		M	h m s	° ′ ″		y	″ s	″
*.....	*W Androm.*	14	2 9 53.3	+43 36 2	02.03	15.75	+.05 .005	−.22
*.....	*W Androm.*	13	2 11 49.1	+43 47 40	02.03	15.01	+.46 .042	−.10
*HAGEN 46	*W Androm.*	11.8	2 10 43.2	+43 52 44	02.03	15.01	−.02 .002	−.12
HAGEN 34	*V Orionis*	12.1	5 0 44.7	+ 4 11 55	07.76	11.32	+.40 .027	+.12
B.D. +31° 3767	*SY Cygni*	9.2	19 42 27.8	+31 46 54	07.59	12.30	+.45 .036	−.42
**B.D.* + 8° 5037	*S Pegasi*	8.7	23 12 55.3	+ 8 31 55	07.82	11.83	+.42 .028	−.11
*.....	*U Puppis*	14.5	7 57 51.2	−12 48 23	08.26	11.88	+.20 .014	−.36

*MISS YOUNG'S measures.

have already been published as follows: —

Star	μ_α	μ_δ	Authority
	s	″	
R Geminorum	−0.008	+0.04	*A. G. Berlin A*, p. 224
χ Cygni	−0.0060	−0.054	Boss, *Prelim. Gen. Cat.*
	−0.001	−0.04	TUCKER, *Lick Obs. Bull.* No. 323.

Our results for *χ Cygni* are in good agreement with PROFESSOR TUCKER'S values based upon the 1900 position in the *Preliminary General Catalogue* and a meridian circle observation made at the Lick Observatory in 1919.

Table 3 gives similar data for seven stars whose proper-motions are so large as to be evident in the stereocomparator, and are the only ones found in the examination of 60 fields. Images of these stars, because of their distance from the center of the plate, were elongated and sometimes even cometary, so that the positions given, computed from the measures, are for identification only. The proper-motions were determined by a comparison with a group of neighboring stars whose images were of similar shape, so that the percentage of error in these is probably small.

The last star on the list, *B. D.* +8° 5037, is No. 11591 of the *A. G.* Zone 5° — 8°.

In conclusion we wish to express our thanks to Dr. Alice Farnsworth, who took most of the plates of the second series, and to PROFESSORS PARKHURST and FROST of the Yerkes Observatory for their many helpful suggestions as well as for their kindness in loaning the plates used in this investigation.

Mount Holyoke College,
November, 1920,