ART. II.—*Light of Comparison Stars for Vesta;* by EDWARD C. PICKERING.

IN Professor Harrington's important "Study of Vesta," which appeared in this Journal, III, xxvi, 461, the light of the planet was determined from comparisons with the two stars DM. +22° 2163 and 2164. The observations were made with the wedge photometer, and were accordingly differential, so that the resulting magnitudes of Vesta depend upon the assumed magnitudes of the stars, which were taken from the Durchmusterung. It therefore appeared desirable that the stars should be observed with the large meridian photometer of the Harvard College Observatory, with the object of providing means for the reduction of Professor Harrington's results to absolute measures. The meridian photometer has been described in the Monthly Notices of the R. Astron. Society, xlii, 365.

The following table exhibits the results respectively obtained for the two comparison stars. The first column contains the numbers of the series to which the observations belong, the second the dates, and the third the initials of the observers, E. C. Pickering and O. C. Wendell. The fourth and fifth columns contain residuals expressed in tenths of a magnitude. The mean results, from which these residuals are derived, when corrected for atmospheric absorption, are 9·06 for DM.+22° 2163 and 5·48 for DM.+22° 2164. The fifth observation of DM.+22° 2163 was rejected because it appeared that an error of 30° in reading the graduated circle of the photometer had probably occurred in one of the four comparisons which constitute a complete observation with the meridian photometer. The residual corresponding to the rejected observation is placed in brack-

ets. If the presumed error of 30° is left without correction, this residual would become −0·9 instead of −0·2. The separate reduction of the four comparisons gives the residuals —2·4, 0·0, −0·5, +0·1. Correcting the first reading by 30°, its residual is reduced to −0·3.

No. of Series.	Date, 1884.	Obs.	Residuals 2163	2164
249	March 16	P.	—0·1	0·0
251	March 18	W.	0·0	0·0
252	March 22	P.	0·0	−0·1
254	March 25	W.	+0·1	+0·1
255	March 31	P.	[−0·2]	−0·2
261	April 14	P.	+0·1	+0·2

The corrections to be applied to the DM. magnitudes of the stars appear from these observations to be +·28 for DM.+ 22° 2163 and+ ·18 for DM. +22° 2164. From these corrections may be derived the formula $M-m=\cdot 023m+\cdot 058$, in which M denotes the photometric magnitude of Vesta corresponding to the magnitude m given by Professor Harrington.

In the following table the first column is repeated from Professor Harrington's table in the article above mentioned. The second column contains the corresponding magnitudes of Vesta computed for mean opposition, after correction by the formula just obtained. By mean opposition is understood, as usual, the situation in which a planet is in exact opposition to the Sun, while both the planet and the Earth are at their mean distances from the Sun. The third column contains the residuals from the mean, 6·64, of the corrected magnitudes thus found. The last column contains the residuals showing the accordance of Professor Harrington's observations of the two comparison stars. Taking the differences between the two columns of his table headed 2164 and 2163, we have a series of quantities expressed in seconds of time, the mean of which is 20·6; it corresponds to the photometric difference in magnitude resulting from the observations made here with the meridian photometer. This photometric difference is 9·06−5·48 = 3·58. These data show that in Professor Harrington's observations one second of time may be expressed in terms of magnitude by ·174. The final column of the table here given accordingly contains the products by ·174 of the differences between Professor Harrington's columns 2164 and 2163, diminished by the photometric difference 3·58. If reduced to the equator, the quantity 174 becomes ·16, which furnishes a determination of the constant of reduction required by the particular wedge employed. The last line of the table contains the numerical means of the quantities in the last three columns. It may be observed that in the first and third lines of the table the large residuals in the third column are accompanied by large residuals in the final

column and are therefore partly attributable to errors of observation. In the seventh line from the end of Professor Harrington's table, 5·84 is assumed to be a misprint for 6·84.

Sidereal time of Observation. April, 1883. d.	h.	m.	Magn. of Vesta.	Residuals. Vesta.	Stars.
9	XII	17	7·21	+·57	−·24
13	XII	31	6·59	−·05	+·05
	XIV	57	6·17	−·47	−·26
	XV	24	6·39	−·25	−·19
15	XII	38	6·55	−·09	+·02
	XIII	19	6·43	−·21	+·07
	XV	43	6·32	−·32	−·14
16	X	3	6·73	+·09	·00
	XI	55	6·85	+·21	+·03
	XII	26	6·43	−·19	+·14
	XII	55	6·78	+·14	+·11
	XIII	24	6·69	+·05	−·14
	XIII	49	6·79	+·15	−·12
	XIV	18	6·79	+·15	+·05
17	IX	39	6·52	−·12	+·09
	X	11	6·47	−·17	+·12
	X	40	6·48	−·16	+·11
	XI	5	6·75	+·11	−·03
	XI	29	6·51	−·13	+·12
	XI	50	6·52	−·12	+·14
	XII	11	6·61	−·03	+·02
	XII	31	6·62	−·02	−·22
19	XII	41	6·67	+·03	−·02
23	XII	8	6·82	+·18	+·07
	XII	58	6·85	+·21	+·17
26	XI	55	6·91	+·27	−·02
28	XII	27	6·84	+·20	+·03
			6·64	±·17	±·10

The mean result for the magnitude of Vesta, 6·64, may be compared with the results formerly obtained at this Observatory and published in the Astronomische Nachrichten, cii, 151. The value obtained from observations on 12 nights in 1880 was 6·49, and from observations on 10 nights in 1881–2 was 6·45. The differences between these values and that derived from Professor Harrington's observations do not seem large, considering the fact that the two methods of observation were very dissimilar. In measuring large intervals of brightness with the wedge photometer systematic errors may perhaps result from irregularities in the tint of the glass and other causes. On the other hand, the small meridian photometer used in the observations of Vesta was not designed for measuring the light of objects fainter than the sixth magnitude, and even the brightest asteroids were seen in the instrument with some little difficulty.

The magnitude 6·51 found for Vesta in vol. xi of the Annals of this Observatory, page 294, was obtained by an indirect process, and its close agreement with the later results just mentioned is probably accidental.

Harvard College Observatory, Cambridge, Mass., May 19, 1884.