

occurrence how much the oval section has turned out of its original position. Meanwhile we can only say that the shower is to be expected before 6 A.M. on Thursday, probably some hours earlier, and possibly, but not probably, so much earlier that the beginning of the shower may be seen from our side of the Earth before dawn on Wednesday morning. It is, however, more likely to come during the daytime or evening of Wednesday, in which case it will not be seen in England, or after 10.30 P.M. on Wednesday evening, in which case it will be visible if the weather permit."

Variable Velocities of Stars in the Line of Sight.

It will be remembered that last year Professor Campbell, of the Lick Observatory, announced that the stars η Pegasi, σ Leonis, χ Draconis, ζ Geminorum, ι Pegasi, and θ Draconis showed variation in radial velocity. Almost at once confirmation was given by Prof. Belopolsky, of the Pulkova Observatory, for the cases η Pegasi and ζ Geminorum.

In the October number of the 'Astrophysical Journal,' which has just appeared, Professor Campbell announces variable velocities in the case of no less than seven stars— α Aurigæ, ϵ Libræ, h Draconis, λ Andromedæ, ϵ Ursæ Minoris, ω Draconis, and α Ursæ Minoris. He devotes a special note to Capella, giving results derived from photographs obtained in 1896-97. The spectrum is described as composite; in one photograph it is of essentially normal solar type, in others there appear signs of a second component, whose spectrum contains the H_γ line and the prominent iron lines. The two spectra are superposed, the lines of similar origin being sometimes coincident, sometimes relatively shifted, so that they appear to be ill-defined or double. The period of the binary system is as yet not determined.

A second special note deals with the case of Polaris. Professor Campbell found about a year ago, from six photographs taken between Sept. 8 and Dec. 8 in 1896, that the velocity appeared to be constant, -19.6 kilometres per second. In August 1899 another photograph was obtained of the same spectrum to test the current work of the spectrograph, and a velocity -13.1 kilometres per second was deduced. Variability was suspected, and after 14 more photographs had been secured, variability was established and a period of $3^d 23^h$ was found. "The velocity at present seems to be included between -8.6 and -14.6 , having an extreme range of only 6 kilometres per second." To reconcile the present velocities with those determined for 1896, Professor Campbell does not hesitate to state that he has no doubt that the velocity of the binary system is changing under the influence of an additional disturbing force; in fact he regards Polaris as at

least a triple system. This, however, is a conclusion which seems hardly justified by the evidence given in the note; for, in face of the statement that the recent photographs of Polaris were taken in order to test the current results of the spectrograph, it is obviously necessary to show by comparison of results, in the case of a star whose velocity may be relied on as constant, that the current results are consistent with the earlier.

Prof. Frost's short note, in the same number of the 'Astrophysical Journal,' summarizing the results obtained at the Yerkes Observatory, tend to corroborate the existence of a variation of velocity in the case of Polaris, and also to emphasize the need for the further evidence above referred to; for whilst he gets practically the same range of variation (viz. 7 kilometres per second as compared with Campbell's 6 kilometres per second), the absolute values of the velocity fall midway between Campbell's values for 1899 and those for 1896.

It will be evident from these brief notes that the determination of radial velocities has entered upon more certain courses. The beautiful samples of stellar spectra that have quite recently been received at the Royal Astronomical Society from the Lick Observatory are evidence of the splendid material which Prof. Campbell is securing for his determinations. But the surest test of accuracy is to be found in the corroboration of his results afforded by independent workers, and in this connection I am glad to be able to confirm from my own observations Prof. Campbell's discovery that Capella is a spectroscopic binary; for, before his note reached us in this country, I presented a short preliminary note to the Royal Astronomical Society at its last meeting to announce the discovery of the binary nature of the star as one of the first results obtained with the new four-prism spectroscope attached to the 25-inch equatorial of the Cambridge Observatory. I feel sure that Prof. Campbell will agree that there is enough work for at least two workers in deciphering the complexities of the spectrum of this new binary.

H. F. NEWALL.

The Crossley Reflector.*

THE reflecting telescope has been so little used in this country, since the time of Henry Draper, that a few notes on the photographic efficiency of the Crossley reflector may be of interest to American readers.

* [This instructive article by Prof. Keeler is taken from the 'Publications of the Astronomical Society of the Pacific,' vol. xi. no. 70. It will be remembered that this 3-foot mirror, originally made by Calver, was used by Dr. Common to obtain the photographs for which he received the Gold Medal of the R.A.S. in 1884. It was afterwards acquired by Mr. Crossley, who presented it in 1895, after it had undergone some alteration, to the Lick Observatory, where it was the cause of some dissension. See this magazine, vol. xx. pp. 296, 299.—Eds.]