Calcium Clouds in the Milky Way.

GENTLEMEN,—

In the spectrum photographs of Nova Aquilæ obtained here in June last, I find a very narrow and rather faint absorption-line superposed upon the bright emission-band He, and on one plate which extends further towards the ultra-violet there is a

similar line separated from it by a distance equal to the interval between the H and K lines of calcium. These lines coincide almost with the centres of the H and K lines in the spectrum of Arcturus, which is impressed on the plates for comparison. Measures of the line near H give the following results, when corrected, for the small displacement of the Arcturus lines towards red due to the Earth's orbital motion and Arcturus's radial motion:—

1918 June 16	3968·4
19	3968·3
20	3968·5
23	3968·2
Mean ..	3968·35

Obviously, this is the calcium line H practically undisplaced in the star. Comparing it with Rowland's value of H, the displacement amounts to −0·28 Å., indicating an approaching velocity of 21 km./sec., or, subtracting the Earth's orbital motion in the direction of the Nova, −14 km./sec. with respect to the Sun. But, if the Sun is moving in the direction of R.A. 18^h, Dec. +30°, at −20 km./sec., the component of the solar motion in the direction of the Nova is −17 km./sec.

It appears from this that the calcium vapour giving these narrow lines in the Nova spectrum is, within the limits of accuracy of the measures, practically stationary in the line of sight with respect to the sidereal system, and probably has no connection with the star.

This much I deduced before referring to any previous work on the subject. On looking up the literature, I find that Hartmann was led to a similar conclusion with reference to Nova Persei and δ Orionis, the latter being a binary star showing fine H and K lines, which did not share in the displacements due to the orbital motion of the star. The H and K lines in Nova Persei were measured by Campbell and Wright, who gave values of radial velocity ranging between +4·2 and +7·7 km./sec. The component of the solar motion in the direction of Nova Persei I estimate as +4 km./sec. (Hartmann gives it as +8·7 km./sec.). Again, in Nova Geminorum No. 2, Adams and Kohlschutter found a radial velocity of +10 km./sec. Here the component of solar motion is +9 km./sec. In all three Novæ, therefore, if my measures are to be trusted, we have a close approach to a zero velocity for the calcium vapour.

But if these Novæ, situated in widely different parts of the Milky Way, show calcium vapour stationary in the line of sight with respect to the sidereal system, the probability seems great that the calcium has no connection with the Novæ, but forms clouds of absorbing material distributed over the Milky Way

region; and that these are really at rest with reference to the system of stars, not merely at rest in the line of sight.

Recent measures of the H and K lines in binaries seem to me to add cumulative evidence in support of the hypothesis of stationary calcium clouds. In the following table I give the velocities found in six binary stars in which special attention has been given to the measurement of the fine H and K lines :—

Star.	Radial velocity from H and K.	Component of solar motion.
σ Aquilæ	−12·6	−17
β Scorpii	− 8·5	−10·5
o Persei	+12·4	+ 6·8
δ Orionis	+17·2	+17
VV Orionis	+16·7	+17
ϵ Orionis	+15·6	+17

These are taken from the *Publications of the Allegheny Observatory*, vols. ii. and iii., the authors being Messrs. Schlesinger, Daniel, and Jordan. In the last column I give my estimate of the component of solar motion in the direction of the star. Considering the order of accuracy to be expected in such measures, it seems to me that the agreement between columns 2 and 3 is rather striking. Also the fact has to be borne in mind that in these early-type binaries the H and K lines due to the external calcium may in some cases be superposed on faint calcium lines due to the star itself, which would naturally cause discrepancies, for the star line would partake of the displacements due to the orbital motion; so that the combined line might in some cases show a slightly variable velocity, which seems actually to be the case.

In the Novæ the conditions are most favourable for detecting the stationary calcium, for here there is no possibility of confusion between the H line due to the star and the H line of the external cloud, owing to the enormous displacement of the absorption-lines in Novæ. Also the wide emission-band ϵ of hydrogen covers the position of H, and affords an admirable background for showing the fine absorption-line. It would seem almost worth while, indeed, to make a new determination of the solar motion by combining the results of measures of H and K in all the recent bright Novæ, assuming the calcium to be stationary.

The spectra in which I measured the H line in Nova Aquilæ were obtained with a 6-inch prismatic camera and two 45° prisms; they have a dispersion of 5·8 Å. per mm. at H, and by a special arrangement of the apparatus—to be described elsewhere—a comparison-spectrum of Arcturus is impressed on the plates, accurately aligned with the Nova spectrum. With this dispersion a very high degree of accuracy might have been attained in the measures had the apparatus been situated in Kashmir instead of

Kodaikanal, where the definition unfortunately was of the very worst. Probably much better measures have been secured elsewhere, and it will be interesting to see if they confirm my result here given.

I am, Gentlemen,
Yours faithfully,
J. EVERSHED.

Kodaikanal,
1918, Nov. 29.