Finally, an estimate may be made of how much these results are likely to be changed by the inclusion of other effects in the evolution of a cluster.

King, I. 1958, *A. J.* **63**, 118.

Spitzer, L. 1958, *Ap. J.* **127**, 17.

*University of Illinois Observatory,
Urbana, Ill.*

Kraft, Robert P., Camp, David C., Fernie, J. D., Fujita, Choko and Hughes, William T. Line profiles for the classical Cepheid SV Vulpeculae.

The classical cepheid SV Vul is of particular interest because of its long period, 45 days, and large spectral type variation, F7 Iab to Ko Iab. Curves of growth constructed at phases near maximum light, maximum radius, minimum light and minimum radius gave the damping and Doppler parameters needed to study the line profiles. Values of the ratio of scattering to total absorption, as well as the limb darkening, were assumed, and profiles were calculated for Milne-Eddington atmospheres using the IBM 650 program of M. H. Wrubel.

It was found impossible to fit the line profiles of $\lambda 4508$ of FeII unless some macroscopic motion, formally like rotation, was introduced. An excellent fit to the observed profiles was obtained on the assumption of pure scattering, a limb-darkening coefficient $B^{(0)}/B^{(1)} = 2/3$, and rotational velocities between 22 and 27 km/sec depending on phase. The profile of $\lambda 4508$ is widest at phases near minimum radius.

Using the position of the Cepheids on the H-R diagram given by Sandage (1958) and a set of reasonable evolutionary tracks, these rotational velocities were compared with the velocities to be expected if SV Vul had originally been a B1 main sequence star. The agreement was found to be poor. The "evolutionary" rotational velocity was only one-fourth of that obtained from the line profiles if the angular momentum was assumed to be conserved in shells. Similar results were obtained for the two non-variable supergiants β Aqr, Go Ib and 9 Peg, G5 Ib.

It is suggested that macroturbulent motions are responsible for the line profiles in SV Vul, β Aqr and 9 Peg. Evolution from the main sequence with angular momentum conserved in shells can explain the line profiles of A and F supergiants (Abt 1958). It is therefore possible that macroturbulence becomes increasingly important relative to rotation with advancing spectral type.

In SV Vul, the opacity and atmospheric density vary by large factors during the cycle. The energy bound up in turbulent motions reaches a maximum near minimum radius. Thus we can study the effects produced by changing turbulence in a supergiant atmosphere.

Abt, H. A. 1958, *Ap. J.* **127**, 658.

Sandage, A. R. 1958, *Ap. J.* **127**, 513.

*Goethe Link Observatory,
Indiana University,
Bloomington, Ind.*

Liller, William. Photoelectric spectrophotometry of the heads of three comets.

During 1957 the appearance of three naked-eye comets (Arend-Roland, Mrkos, and Encke) made possible a detailed study of their heads with photoelectric techniques. Comet Arend-Roland was observed from $\lambda 3400$ to $\lambda 6400$ on eight nights during a period extending approximately 2.5 months on either side of the time of perihelion passage. The C_2 bands were found to have reached a maximum brightness with respect to the underlying continuum approximately four weeks after closest approach to the sun, when the heliocentric distance to the comet was about 0.75 a.u. Beyond 1.2 a.u. from the sun, the intensity of the C_2 relative to the continuum appears to have remained a few per cent brighter after perihelion passage than before. On three nights the head of Comet Mrkos was scanned from $\lambda 3400$ to $\lambda 6400$, and on one of these nights the red and infrared spectrum from $\lambda 6400$ to $\lambda 12,000$ was also observed. The shorter wave length region is nearly identical in appearance to that of Comet Arend-Roland when at the same solar distance. In the infrared the $\Delta v = 0$ and $\Delta v = 1$ bands of the red system of CN at $\lambda 11,000$ and $\lambda 9200$, respectively, seem to have been observed for the first time. The $\Delta v = 2$ band of CN at $\lambda 8000$ was the only other emission feature observed. Spectral sweeps of Comet Encke from $\lambda 3400$ to $\lambda 6400$ were made on two nights, and the faintness of the continuum is particularly striking.

*University of Michigan Observatory,
Ann Arbor, Mich.*

Markowitz, Wm. and Hall, R. G. Changes in speed of rotation of the earth as determined by the moon and by atomic standards.

Variations in the speed of rotation of the earth have been obtained by comparing Universal Time with Ephemeris Time and with time based on atomic standards. Universal Time was deter-