DISCUSSION

Following the papers on instability in binary systems, Dr S. Gaposchkin described a classification scheme that he had devised to describe the eclipsing binaries having emission lines, gas streams, or thick atmospheres. Such stars Gaposchkin calls the 'camouflaged eclipsing variables', and divides them into five groups:

(1) Typical members are UX Mon and SX Cas: the spectral type of the brighter star is B or A, that of the fainter is G or later. The minima are of equal depth. Balmer emission is present.

(2) Prototypes are β Lyr and υ Sgr: only one component can be seen distinctly, but two minima are present in the light curve. The spectroscopic behaviour is most complicated.

(3) Prototypes are RT And and YY Gem: the spectral class is G or later. Ca II emission is present. The depths of the minima are roughly equal, and the dimensions of the components are about the same.

(4) The prototype is DN Ori: both components are so well camouflaged that no definite velocity variation has been observed.

(5) Prototypes are V444 Cyg or UX UMa: the bright lines are strong, and their displacements and intensities do not vary in a simple manner with phase.

Dr Z. Kopal, in commenting upon the communication by Dr Wood, emphasized a need for caution in attributing every photometric irregularity of an eclipsing system to the effects of dynamical instability. Kopal felt that, in particular, considerable reserve should still be exercised in associating the secular loss of mass, which probably occurs at the point of instability of an expanding sub-giant, with the changes of period as are often exhibited by such systems. Numerical integrations of the trajectories of such gas streams reveal that the principal effect of these mass motions is to transfer material gradually from one component to the other. The formation of an outer ring of gas encircling the whole system is another possibility. Kopal stated that it is only under very extreme (and unlikely) conditions that any mass can be lost to the system as a whole, and it is only such a loss that could produce an observable lengthening of the period.

Kopal said that under very general conditions the surfaces of zero velocity remain closed about the system, and no secular loss of mass by the system as a whole can be expected as a result of gravitational forces.

Kopal concluded that if the orbital periods of eclipsing systems fluctuate (often varying in jumps rather than continuously), then the real cause of the perturbations of their semi-major axes must be sought elsewhere. Similarly, if ejection of matter with velocities exceeding that of escape is established spectroscopically (photometric observations alone cannot decide this point), an understanding of that phenomenon would have to await consideration of other effects.

Dr Struve, in response to Kopal's remarks, stated that if anything is certain in the spectroscopic study of eclipsing binaries, it is that gas streams do exist in

these systems! He also called attention to the fact, as a matter of historical record, that it was Wood, in a 1950 paper, who pointed out the possibility that material might be lost to eclipsing systems through Jacobian surfaces.

Kopal, in reply, said that he did not intend to question the reality of gas streams, so beautifully demonstrated by Struve's observations. He hoped that Struve would agree, however, that the significance of these streams for photometric observations in *continuous* radiation (as opposed to discrete frequencies) is still largely hypothetical. Kopal felt, in particular, that gas streams capable of producing continuous emission that would amount to an appreciable fraction of the total light of an eclipsing system would appear to be of inordinately large mass.

Kopal stated also that, in the interests of historical accuracy, we should perhaps recall that the first investigator who realized the relevance of the Jacobian surfaces of zero velocity for an eclipsing system appears to have been K. Walter, in the case of R Canis Majoris. The authority for this statement was H. N. Russell, in his Harvard Centennial Symposium lecture of 1946.

Dr W. A. Hiltner called attention to the fact that the loss of mass by binaries can actually be observed in the case of the Wolf-Rayet systems. Kopal agreed, but pointed out that it is in precisely these binaries, in which a loss of mass is best established, that no period increases at all have been observed.