a field of view 6' on a side and is equipped with a filter which limits the spectral range to $H\alpha$ and the $[NII]$ lines. Motions greater than 1.5 km/sec can be detected. Pictures of bright rim structures in NGC 6611, IC 1396, and NGC 7000 have been obtained.

On Second Helium Ionization as a Cause of Cepheid Instability. JOHN P. COX, *Cornell University, Ithaca, New York*.—Exact numerical solutions of the complete eighth-order system of linearized nonadiabatic pulsation equations have been obtained for simplified Cepheid envelope models in radiative equilibrium with a polytropic structure, using the IBM 704 computer at the Smithsonian Astrophysical Observatory, Cambridge, Massachusetts. The principal purpose of the investigation was to test the hypothesis that second helium ionization, occurring at a critical depth in a stellar envelope, is the ultimate source of Cepheid instability. In the pulsation equations, radiative transfer was assumed and second helium ionization was taken explicitly into account. Reasonable values were assigned to the real and imaginary parts of the complex pulsation frequency because interiors were not available to fix these values. It was found, however, that the solutions in the outer regions (the regions of greatest interest for the Cepheid problem) were not very sensitive to the precise values of these constants. The negative dissipation in the envelopes was calculated and the positive dissipation in the interiors was estimated in an approximate way. For population I Cepheid envelope models with reasonable helium abundances and radii near the empirical values, the negative dissipation in the envelopes approximately balances the positive dissipation in the interiors, thus rendering the actual sign of the total dissipation uncertain. Second helium ionization in the envelopes is therefore at least a significant factor in determining the over-all pulsational stability of the star and may conceivably be capable of producing incipient instability. A definite minimum in the calculated total dissipation (for the whole star) occurred for each of two (L, M) pairs as the equilibrium radius was varied across the Cepheid domain. Assuming pulsations to occur at these minima permits one to derive a theoretical period-luminosity relation. The computed curve has a 3 or 4% greater slope than the empirical curve and is displaced, for given luminosity, toward longer periods by about 30% for a helium/hydrogen ratio (by numbers) equal to 0.10 and by about 60% for a helium/hydrogen ratio equal to 0.15. Efforts have been initiated to test some of the predictions of the linearized theory by use of the nonlinear, nonadiabatic code developed by A. N. Cox *et al.* at the Los Alamos Scientific Laboratory, Los Alamos, New Mexico.

$H\beta$ Photometry of the Pleiades. D. L. CRAWFORD AND J. C. GOLSON, *Kitt Peak National Observatory, Tucson, Arizona*.—Photoelectric measures of the $H\beta$ line intensity have been obtained for the Pleiades members earlier in spectral type than G0. These measures show a good correlation with absolute magnitude. The rms deviation of the 19 B-type members, about the least-squares best-fit curve, is ± 1.9 mag. A comparison is made with the Hyades moving cluster as a check on the calibration. The present calibration for the late B-type stars fits the previous one for the Scorpius–Centaurus association (Hardie and Crawford, *Astrophys. J.*, in press) to within the observational error.

The Penumbra Filaments as Convection Rolls. ROBERT E. DANIELSON, *Princeton University Observatory, Princeton, New Jersey*.—Linearized equations describing the onset of convection in a horizontal layer of conducting fluid in the presence of a magnetic field have been derived by Chandrasekhar (*Phil. Mag.* 43, 501, 1952). From these equations growth rates of convection cells (of various sizes and shapes) have been calculated as a function of the magnetic field and the Rayleigh number for two cases: (1) a vertical magnetic field and (2) a horizontal magnetic field.

The penumbral filaments are long narrow structures having a width of 300 km or less and a length of 5000 km or more. Their lifetime is roughly five times that of the granulation. It is proposed that most of these filaments can be explained as convection rolls (i.e., long narrow convection cells) with the axis of the roll parallel to the horizontal component of the sunspot magnetic field.

The growth rate of convection cells in a magnetic field of 10 gauss or less (corresponding to the granulation) is compared with the growth rate of convection rolls in a magnetic field of 1000 gauss (corresponding to the penumbral filaments). The growth rate of the rolls is less than, but comparable to, the growth rates of the cells if the effective Rayleigh number in the penumbra is equal to the effective Rayleigh number in the granulation. The growth rate of the rolls will be five times less than the growth rate of the cells if the effective Rayleigh number in the penumbra is only a factor of 2 or 3 smaller than in the granulation. Hence it appears that both the lifetime and shape of the penumbral filaments can be accounted for by convection rolls.

Local Doppler Effects in the Photosphere. JOHN W. EVANS AND HORST MAUTER, *Sacramento Peak Observatory, Sunspot, New Mexico*.—High-resolution spectrograms taken under conditions of good seeing at Sacramento Peak show the charac-