The Balmer gradient is steeper than expected for either a pure recombination, or a thermal-collisional spectrum with $T \geq 8000^\circ\text{K}$. The electron temperatures indicated by $[O\text{ III}]$ and $[N\text{ II}]$ lines show that the ionization is not due to collisions of thermal electrons. The strength of $[O\text{ I}]$ and $[N\text{ I}]$, and also the absence of the Bowen fluorescent lines of $O\text{ III}$ indicate there is a substantial amount of neutral gas mixed in with the ionized gas, and therefore that the ionization mechanism is not completely ultraviolet light. Thus, a considerable part of the ionization is probably due to fast protons. The fastest protons would have to have energy about 25 MeV for their ranges to be large enough to excite the entire nucleus if they come from a single source, but the high-ionization lines (such as $Fe\text{ X}$) that would be expected to result from these fast protons are not observed. The observed velocities of the gas correspond to energies ranging up to 25 keV for protons, sufficient to produce $Ne\text{ V}$ and $Fe\text{ VII}$, which are in fact observed. Thus it is likely that frequent collisions between high-velocity clouds produce part of the energy, and ultraviolet synchrotron radiation may be responsible for the rest.

Near-Infrared Classification of A and F Stars.

SIDNEY B. PARSONS, *University of California, Berkeley*.—Luminosity classes, particularly of the more luminous A and F stars, can be determined accurately by visual inspection of 200 Å/mm spectra in the region 7600–8800 Å. The strength, sharpness, and number of lines resolved of the Paschen series all provide effective criteria, while lines of $O\text{ I}$, $N\text{ I}$, and $Ca\text{ II}$ are much stronger in supergiants than in main sequence stars. Because the $O\text{ I } 7774$ absorption is considerably stronger in Ia supergiants than in type Ib stars, in the spectral range A0–G0, it should still be visible at 850 Å/mm in the former but not in the latter. In this way, then, it should be possible to carry out surveys for A and F stars of type Ia, and with a 6° prism on a 36-in. Schmidt camera one can reach the 12th infrared magnitude.

The strength of $\lambda 8543$ ($Ca\text{ II} + P15$) is directly proportional to absolute magnitude for a given spectral type and allows M_v to be determined within 0^m.7 if the spectral type is known independently. However, a plot of the strength of $\lambda 8543$ vs that of $\lambda 8598$ (P14) separates stars according to both spectral and luminosity types. Measurements of about 30 standard stars indicate an accuracy of better than one magnitude in M_v and 1½ subclasses in spectral type for this method, which can be combined with two-color photometry to provide the reddening and the true distance of the star.

Spectroscopic Absolute Magnitudes of Early-Type Stars from Hydrogen Absorption—a Revision.

R. M. PETRIE, *Dominion Astrophysical Observatory*.—Equivalent widths of $H\gamma$ in spectra of 166 early-type stars are used for a new derivation of the calibration of absolute magnitude. Calibrating stars are members of the galactic clusters the Pleiades, the α Persei cluster, and NGC 2244; the associations I Orionis and h and χ Persei; and six visual binary systems. Spectral types included are O6 to A3; the range in absolute magnitude is from -7.3 to $+2.3$.

Cluster sequences are used to determine the shape of the curve and spectral-type corrections. The zero point is fixed from nearby A stars, from visual binaries, and from eclipsing binaries. The new calibration is given in graphical and tabular forms.

Distance moduli of three clusters and five associations determined from the calibration agree closely with those given by the photometric distance scale. Absolute magnitudes with the new calibration average about 0.7 mag. brighter than the original calibration, and are on the average 0.2 mag. fainter than the revised calibration of MK classes for B stars.

Interpretations of the Infrared Limb-Darkening of Venus.

JAMES B. POLLACK, *Harvard College Observatory*, AND CARL SAGAN, *Harvard College Observatory and Smithsonian Astrophysical Observatory*.—The limb-darkening laws predicted for several models of the atmosphere and clouds of Venus are compared with limb-darkening observations in the 8–13 μ interval. Model A attributes the limb darkening to pure molecular absorption by the atmosphere above the Cytherean cloud layer, Model B to multiple scattering by cloud particles of arbitrary albedo and altitude distribution. In each model, the temperature regime is considered specified, alternatively by convective and by radiative equilibrium. In Model A, limb darkening arises from the increase of temperature with atmospheric depth. In Model B, both the $T-\tau$ relation and the dependence of emissivity on the angle of emergence contribute to the limb darkening. Each model can be made to agree with observation, with an appropriate specification of atmospheric and cloud parameters. If, in Model B, a cloud layer with a relatively sharp upper boundary is assumed, then the observational data imply a very high albedo for single scattering. In this case, the cloud temperature will be substantially higher than the measured blackbody temperature, due to the reflectivity of the clouds, and the clouds make a major addition to the atmospheric greenhouse effect.