bulence of 12 km/sec. Since $I(K_2) \simeq \epsilon B t \simeq 0.04 B$ (6000°K), we have that $T(\text{chromo}) \simeq 10\,000^\circ\text{K}$ for an electron density of 2×10^{11} ($\epsilon \simeq 10^{-3}$).

Recent Measurements of Stellar Rotational Velocities. ARNE SLETTEBAK, *Perkins Observatory*.—Rotational velocities for 77 A-type stars near the north galactic pole have been estimated from visual inspection of spectrograms and from measured half-intensity linewidths of Mg II 4481, in collaboration with Robert Wright. The spectrograms, with dispersion 40 Å/mm, were taken with the Perkins 72-in. telescope of the Ohio State and Ohio Wesleyan Universities at the Lowell Observatory. Mean rotational velocities for 44 normal stars are somewhat smaller than for stars of corresponding spectral types near the sun, but the differences are probably not significant. The 22 metallic-line stars included in the sample have a mean rotational velocity which is nearly identical with that for metallic-line stars in the solar neighborhood.

Rotational velocities were also estimated from half-intensity linewidth measurements of He I 4471 for 45 B0–B6 stars and from visual estimates of line broadening in the spectra of 20 B7–A0 stars in the Scorpio–Centaurus association. The B0–B6 stars in the denser Upper Scorpius portion of the association apparently rotate somewhat more slowly than field stars of corresponding type but faster than the B0–B6 stars in the Centaurus–Lupus part of the association. The late B-type stars measured, all of which are in the Upper Scorpius region, rotate with a mean $v \sin i$ which is considerably higher than the value for field stars of corresponding spectral type.

Use of an Infrared ImageTube for High-Dispersion Planetary Spectroscopy. HARLAN J. SMITH, *The University of Texas*, LOUISE GRAY, *The University of Texas and Jet Propulsion Laboratory*, EDWIN S. BARKER, *The University of Texas* and RONALD A. SCHORN, *Jet Propulsion Laboratory*.—An infrared two-stage RCA image intensifier system developed and supplied by the Carnegie Image Tube Committee has been applied to the coude spectrograph (160-cm camera) of the McDonald 82-in. Struve reflector. The S-1 photocathode permits useful astronomical photographic spectroscopy out to at least 12 300 Å. The relatively limited resolution attained with the tube and transfer lens—about 12 to 15 line pairs per millimeter—was compensated through the use of high dispersion permitted by the sensitive cathode. At 3.2 Å/mm, spectra of Venus and Mercury in the 10 300 to 12 000 Å region require exposures ranging from about 3 to 300 min.

CO₂ bands observed for Venus and Mars include

the three (203-043) bands and the two (103-023) bands, located at 10 361, 10 487, 10 626, 12 030, and 12 177 Å, respectively. The latter two bands are of particular interest because in recent years photographic plates have not been sensitive beyond $\sim 11\,500$ Å. (To our knowledge the bands beyond 12 000 Å were last photographed in 1947, by Herzberg and Kuiper, at quite low dispersion.) Measured equivalent widths for the lines in the carbon dioxide bands have been used to derive rotational temperatures ranging from 200° to 270°K for the atmosphere of Venus; the mean value from 10 plates is 235°K.

Small Nebulae Associated with Wolf-Rayet Stars. LINDSEY F. SMITH, *University of California, Los Angeles*.—We now know of six Wolf-Rayet (WR) stars that are situated at the center of curvature of an arc or arcs of nebulosity. All of these are WN stars; none are believed to be binary systems.

Total masses have been derived for three of the nebulae from (a) total fluxes obtained from 11-cm observations with the 210-ft radio telescope of the Australian National Radio Astronomical Observatory, (b) electron densities derived from spectra of the $\lambda 3727$ doublet, (c) photometric distances for the central WR stars. Similar data are given by Johnson and Hogg (*Astrophys. J.* **142**, 1033, 1965) for two other nebulae, and their mass estimates have been revised in accord with the new photometric distances for the stars concerned. The derived masses range from 7 to 700 solar masses.

The conclusions drawn by Johnson and Hogg are confirmed: (1) that the nebulae are in the form of extremely thin shells, and (2) that this characteristic shape may arise from a situation in which the interstellar matter is swept up by matter ejected from the WR star.

Assuming that the nebulae are formed in this way, and assuming continuous ejection, the ages of the nebulae may be calculated for a range of values of the assumed rate of mass loss and velocity of ejection. The derived ages lie in the range 10^4 to 10^6 yr for rates of mass loss between 10^{-4} and 10^{-6} solar masses per year. There is a monotonic relationship between the derived ages of the nebulae and their observed masses, in the sense that the more massive nebulae are older. This is reasonable since the formation, persistence and total mass of such a nebula will depend on the density of the interstellar medium in which the star is situated. The absence of nebulae associated with WC stars therefore implies either that the WC stars do not eject matter, or that they are situated in regions of low density of the interstellar gas. The latter explanation is favored.