suggests that the chromosphere is composed of spicules with sheath-like structure down to this level.

Turbulence velocities at lower levels were measured on weak lines and were corrected for self-absorption effect. The velocity increases slowly starting from 3 km/sec at zero height up to about 10 km/sec at 1000 km.

Velocities at higher levels were measured for apparently individual spicules on H and K lines of Ca II. Linewidths for those spicules vary appreciably from spicule to spicule, suggesting that even among what seem to be individual spicules are included groups of spicules. If we interpret the smallest observed velocity as the actual velocities within an individual spicule, the turbulence velocity inside each spicule would come out to be about 7 km/sec even at the height of several thousand kilometers. Relative velocities between the spicules are relatively big, and if we include all velocities, the turbulence velocity increases upwards with the height in accordance with Redman and Suemoto's result.

Microstructure in Solar Fraunhofer Lines.

RICHARD G. TESKE, *The McMath-Hulbert Observatory of The University of Michigan*.—A photometric study of high-resolution spectra of the Ni λ 5176 and Fe λ 5180 solar absorption lines, taken with the vacuum spectrograph, has been carried out. The object of the study was to describe the point-to-point variations of central intensity, half-intensity width, and equivalent width of these lines along the solar surface.

There is a marked tendency for the three variables under study to vary in phase with position along the spectrograph slit, which was placed at the center of the solar disk. The observed correlation is one in which a decrease in half-width is correlated with a deepening of the lines and with a decrease in equivalent width, and conversely. These lines are formed mainly in the cooler photospheric elements. One possible interpretation of the observed result requires that the hotter, unresolved granular elements participate in a more organized motion than do the cooler intergranular elements.

Adiabatic Exponents of a Mixture of Radiation and Electrons. S. TSURUTA, *Institute for Space Studies and Columbia University*, AND H. Y. CHIU, *Institute for Space Studies and Yale University*.—We have computed the three adiabatic exponents Γ_1 , Γ_2 , and Γ_3 for a mixture of radiation and electron gas in the temperature range $T=0.5 \times 10^9$ °K $\rightarrow 10^{10}$ °K. The definition of the Γ 's are as follows:

$$\begin{aligned}\Gamma_1 &= -(V/P)(dP/dV)_{ad}, \\ \Gamma_2/(1-\Gamma_2) &= -(T/P)(dP/dT)_{ad}, \\ \Gamma_3-1 &= -(V/T)(dT/dV)_{ad},\end{aligned}$$

where the subscript "ad" means the derivatives are evaluated in an adiabatic process, P is the pressure, V the volume, and T the temperature. It is expected that catastrophic collapse of a star (to become a supernova) will occur in the above temperature range, and this calculation will be useful in numerical integration of presupernova stars. It is found that in a wide temperature and density range $\Gamma_1 < \frac{4}{3}$, and consequently no star can exist in this temperature and density regime for reasons of stability. Results are discussed.

Computer Programs for Preparing Early-Type Model Atmospheres and Computing the Theoretical Spectra from Models.

ANNE B. UNDERHILL, *Dominion Astrophysical Observatory*.—A program has been prepared for an IBM 709/7090 computer which will construct an early-type model atmosphere given an assumed $T-\tau$ relationship and an estimate of the radiation pressure gradient at each level in the model. The further parameters that must be specified are X , the relative abundance of hydrogen by weight, Y , the relative abundance of helium by weight, and g , the acceleration of gravity. The temperatures that are encountered must fall in the range 8000 to 120 000 deg. The opacity is assumed to be due to H , H^- , He , He^+ , and to electron scattering. The structure of the model is found by solving the equation of hydrostatic equilibrium. The radiation field transmitted by the model is found by solving the Milne-Eddington transfer equation. Data are output so one can examine in detail the properties of the model and study the variation of the net integrated flux with depth.

A companion program has been developed which permits one to compute the radiation field in lines or in the continuous spectrum, given a model atmosphere of early spectral type. The program will work for any wavelengths between 228 and 33 000 Å. Two options are given for the shape of the line absorption coefficient: (i) the function $H(a,v)$ which represents the effects of Doppler broadening and damping, and (ii) the function $T(\beta,\gamma)$ which represents the Stark broadening of hydrogen-like lines according to the approximate formulas of Griem. Options are given for taking into account any number of blending lines and of computing the profiles of lines in spectra I to VI. One may adopt pure absorption or coherent, isotropic scattering as the process of line formation.

Some examples are given of the results that may be obtained from these programs.

Perspective Secular Acceleration of Barnard's Star.

PETER VAN DE KAMP, *Sprout Observatory*.—Barnard's star, the second-nearest star, has the largest known secular perspective acceleration in proper motion, due to the large values of parallax (545), radial velocity (−108 km/sec) and proper motion