Disturbances in an instability zone might initiate oscillations which could lead to a flare outburst. Because of forthcoming space travel, proton flares are of particular interest. A statistical study of solar cycle 19, with peak years 1956–1961, showed that at least two-thirds of the proton flares followed within 10 days after solar perturbations. The perturbations occur on different dates each year and with various magnitudes. The possibility of such correlations occurring by chance alone is less than one in 1000, using a standard contingency table. The delay time after a perturbation may be longer or shorter than 10 days, and may depend upon active longitudes on the sun. There is a possibility that some centers of activity are related to repeated disturbances at a particular heliographic latitude and longitude. The proton flares of 12, 15, and 20 November 1960 and of 11, 12, 18, and 20 July 1961 show indications of three perturbations at approximately the same solar longitude within the two preceding solar rotations.

Doppler Line Broadening in the Atmospheres of K-Type Stars. WALTER K. BONSAK AND ROGER B. CULVER, *Perkins Observatory*.—Equivalent widths and half-widths have been measured for lines in the spectra of approximately 60 K stars, including all luminosity classes. Curves of growth have been constructed to allow determination of the effects of instrumental resolution, thermal motion, microturbulence, and macroturbulence on the observed widths of the lines in each star. The possible correlations of microturbulence and macroturbulence with temperature and luminosity have been investigated. The well-known increase of linewidth with luminosity among the K stars is due to macroturbulence rather than microturbulence.

The correlations of the widths of the Ca II emission and H α absorption with luminosity have been ascribed to chromospheric turbulence by some authors (e.g., Kraft, Preston, and Wolff, *Astrophys. J.* 140, 235, 1964). The present investigation indicates that the same phenomenon exists, but with reduced amplitude, in the deeper layers of the atmospheres which give rise to the weakest observable absorption lines.

Interstellar Absorption Determined from Measures of the Total H α Flux from the Orion Nebula. PETER B. BOYCE, *Lowell Observatory*.—The intensities of the first three Balmer lines in the Orion Nebula have been studied as a function of position in the nebula. Intensities of H α , H β , and

H γ have been determined for a few points by means of a photoelectric spectrometer at the University of Michigan. These intensities were put on an absolute scale by comparing to the standard stars, ϵ Ori, γ Gem, and β Ari, which were then compared to Vega. The scanner measures were made through a square aperture about one minute of arc on a side. Each position was observed several times on each of at least three nights. The mean error of one observation referred to the standard stars is about 3% for the weakest signals measured and less than 2% for the strongest.

Observations of H α and H β for many more points across the nebula were made at the Lowell Observatory using narrow-band interference filters. The H β filter has a half-intensity width of 60 Å and a peak transmission of 46%. The H α filter is particularly good, having a half-intensity width of 9 Å and a peak transmission of 75%. It is centered at 6570 Å and must be tilted 4 deg in order to be centered at H α . Filters centered at 4700 and 6300 Å were used to subtract the continuum. The filter measures were calibrated by fitting them to the scanner observations; thus, the filters were used for interpolation only.

Except for the east side of the nebula, which includes the dark bay, the intensities show a good degree of circular symmetry. The measured H α isophotes were extended using this assumption to eliminate the effect of the dark bay which is felt to be purely a local phenomenon. These extended isophotes were then integrated to give the total nebular radiation in H α .

Finally, this total flux in H α was compared to that predicted on the basis of the radio frequency observations. The difference between the two, which should be a measure of the total optical absorption is 0.5 mag. at H α . This amounts to a maximum total absorption at the wavelength of the V magnitude of 0.7 mag. which is considerably smaller than the absorption obtained by Johnson from infrared measures of stars.

The Heavy Element Abundances in the Solar Wind. JOHN C. BRANDT, *Kitt Peak National Observatory*.—Simple hydrodynamic and evaporative models of the solar wind predict a significant decrease for the abundance of heavy elements in the solar wind relative to the photospheric (and assumed coronal) values. The entire corona is replenished in a time equal to some weeks and hence the corona has a remarkably short response time to correct any imbalance in the inbound and outbound net fluxes of a particular element. Thus, the equation of continuity must be obeyed for each element.