liminary results show that the inclusion of these effects brings the cooling time of the white dwarfs into better agreement with the ages of the clusters containing them.

Photometric Methods for Measuring the Metal Content of K Giants. GEORGE WALLERSTEIN, *Astronomy Department, University of Washington*, AND H. L. HELFER, *Department of Physics and Astronomy, University of Rochester*.—Correlations are presented between spectroscopically determined ratios of iron-to-hydrogen for K giants and various combinations of color indices. Good correlations are found with the ultraviolet excess of the U, B, V system, two-color differences of the six-color system, one narrow-band system, and one system that combines U, B, V , and six-color indices. Nevertheless, each system has its disadvantages, and it is suggested that a four-color system using the S-20 surface might provide the highest accuracy combined with the greatest efficiency of observing time.

The Effect of a Solar Wind Blast Wave on the Chromosphere. DONAT G. WENTZEL AND ALAN B. SOLINGER, *The University of Michigan*.—The enhanced solar wind following some solar flares is probably caused by coronal heating. The energy involved in the enhanced wind suggests that flare-induced coronal heating occurs over an area extending far beyond the flare area. The resulting disturbance of the underlying nonflaring chromosphere is computed on the assumption that the corona is heated suddenly. In this case, a shock moves downward from the heated region. The increase in the undisturbed chromospheric density ahead of the shock (ρ) tends to weaken the shock. In addition, magnetic fields may act as a guide for the shock. An increase in field strength along the shock's path constricts the area of the shock front (A) and tends to strengthen the shock. Both effects can be evaluated analytically, using Whitham's theory for shock propagation in inhomogeneous media (*J. Fluid Mech.* 4, 337, 1958), if both the shock and the chromosphere are considered to be isothermal. The change in Mach number (M) with ρ and A is given by

$$\left(1 + \frac{1}{M^2} + \frac{1}{M} + \frac{2}{M-1}\right) dM + \frac{d\rho}{\rho} + \frac{dA}{A} = 0.$$

For plane stratification or vertical magnetic fields ($dA=0$), the shock penetrates gas increasing in density by one to two orders of magnitude before attenuation becomes significant. Its effect may relate to the flare nimbus and to the disappearance of stria-

tion patterns. The strength of a shock entering the field of a sunspot ($dA/d\rho < 0$) is attenuated much less. Flaring over sunspot umbrae may be initiated by such a shock.

Temperature Models for the Outer Solar Atmosphere. MARVIN L. WHITE AND KOO SUN KIM, *Air Force Cambridge Research Laboratories and Lowell Technological Institute Research Foundation*.—A re-examination of "observed" electron densities in the solar corona and corona extended plus Explorer X data shows that an inverse square law for the density variation is a good approximation. Such a law implies a constantly expanding model for the solar corona. An analytical expression is obtained for the temperature profile using this model. Without adjusting any constants, one obtains a temperature of 3500°K at 0.00025 solar radii above the limb, a maximum temperature of 1.65×10^6 °K at 0.7 solar radii and 2.16×10^4 °K at the earth's orbital distance. This temperature distribution is compared with one based on modifications of the hydrostatic model of Pottasch; a close agreement is found. The consequences of this agreement are discussed.

Structural Parallels in Nondegenerate Cosmic Bodies. ALBERT G. WILSON, *Douglas Advanced Research Laboratories*.—Schwarzschild's exact solution of the Einstein field equations leads to the prediction of a bound to the ratio of the gravitational radius to the linear radius for all gravitating systems, namely,

$$2GM/c^2R < 1.$$

It is observed that this ratio for each of four species of *nondegenerate* cosmic body—main sequence stars, galaxies, clusters of galaxies, second-order clusters—is bounded and that the bound is closely the same for each species: $2GM/c^2R \leq 10^{-4.3}$. ($M/R = 10^{23.5}$ g/cm or 10^{39} with respect to the mass and radius of the hydrogen atom.) The ratio of the *observed* bound for nondegenerate bodies to the *Schwarzschild* bound is of the order of the ratio of atomic to nuclear dimensions.

Assuming the Schwarzschild bound governs totally degenerate matter, the upper limit to observed masses of stars may be explained as the result of the Schwarzschild limit forbidding a mass of greater than about 10^{34} g for a dense neutron fluid under initial conditions similar to those postulated in evolutionary cosmological models.

The $10^{-4.3}$ bound appears to play the limiting role for nondegenerate matter. The latter bound limits stellar matter under maximum nondegenerate density