Von Neumann-Richtmyer Method for a Steady Shock. JOHN H. EVANS, *Wisconsin State University*.—When one attempts to solve the partial differential equations describing the flow of a compressible fluid, it is found that an analytic solution can be found for special cases only. Hence, one turns to numerical procedures.

To test the validity of the method of approximating solutions to differential equations by numerical procedures, we apply the method to equations which have known solutions for given conditions. The problem is that of fluid motion in a region where there is a single steady shock. The method is that of Von Neumann and Richtmyer (Richtmyer, R. D., *Difference Methods for Initial Value Problems*, Chap. X) which introduces frictional forces into the equations by use of a pseudoviscosity term.

The agreement of the numerical integration and the analytical solution is better than within 1%. It is hoped this will open a method for the more exact study of shock phenomena in astronomical situations.

Solar Evolution with Varying G. DILHAN EZER AND A. G. W. CAMERON, *Institute for Space Studies*.—Following an earlier study of solar evolutionary models, a new sequence of models was computed with the assumption that a scalar gravitational field is present in addition to the tensor field, so that the gravitational coupling coefficient G varies with time. A cosmological model was used in which G exceeded the present value by 14% 4.5×10^9 yr ago. The motivations for the study were suggestions by R. H. Dicke that varying G could result in an increased depletion of lithium in the outer convection zone of the sun, and that the time required for the sun to evolve off the main sequence would be considerably shortened. The evolutionary sequence of models was started as usual at the threshold of stability. The sun descended through the usual high-luminosity contraction phase onto the main sequence, and then its luminosity slowly decreased with time. At an age of 4.5×10^9 yr, the luminosity was approximately 20% too high; a downward adjustment of initial helium content from 0.24 to 0.22 would be required to produce the observed luminosity at this age. Contrary to the expectations of Dicke, the varying G sun has less lithium depletion than the constant G sun, and both take very nearly 10^{10} yr to exhaust the central hydrogen. The varying G sun burns a much larger fraction of its interior hydrogen into helium during this time. The most striking factor distinguishing between the two models is the finding that the flux of B^8 neutrinos is higher in the present sun in the varying G case by a factor 4 as compared

to the constant G case. The neutrino experiment of R. Davis may be able to distinguish between these cases.

The $\lambda 4226$ Line as a Spectrum-Luminosity Indicator in Late-Type Stars. J. D. FERNIE, *David Dunlap Observatory*.—Photoelectric measurements of the strength of Ca I $\lambda 4226$ have been made for 53 MK standard stars with spectral types between F0 and M2 and covering all luminosity classes. Measurements were made in a dual-channel photometer through two interference filters, one of bandpass 15 Å, the other of bandpass 150 Å, both centered at $\lambda 4226$. An index g has been defined as $g = 2.5 \log (I_w/I_n)$, where I_w and I_n are the intensities transmitted through the wide and narrow filters, respectively. The average probable error in g is 0.008 mag. per star.

The index is found to be useless for F stars, but for stars later than early G it becomes a good indicator of both spectral type and luminosity. For giants and supergiants the sensitivity of the index to absolute magnitude (taken as the change in M_V per 0.01 mag. change in g) is -0.25 mag. at K0 and -0.12 mag. at M0. The sensitivity to color index (change in $B-V$ per 0.01 mag. change in g) averages $+0.03$ mag. among dwarfs between G0 and M2 and -0.02 mag. among supergiants of type G0 and later.

Although only a few stars are available for comparison, no differences could be discerned between Miss Roman's "strong-(4226) line" and "weak-(4226) line" stars. The only high-velocity stars measured were 61 Cyg A and B. Both fit the relation for low-velocity stars.

It is found that when the g index is combined with Deeming's photoelectric index r (*Monthly Notices Roy. Astron. Soc.* 121, 52, 1960) measuring the strength of the Mg b triplet at $\lambda 5175$, a unique determination of both spectral type and luminosity class is possible. For 13 stars which Deeming and I have in common the individual photoelectric measures are used to predict the MK types. The average error in spectral type is about half a spectral subclass, while the luminosity class is predicted without error in each case. It is expected that a more refined calibration would allow a higher precision than that available from the MK system, especially in luminosity.

A General Relativity Effect in Radius for Minor Planet (1566) Icarus. MARY PARMENTER FRANCIS, *TRW Space Technology Laboratories*.—During the close approach of Icarus to earth in 1968, it may be possible to observe a general relativity