in form to Balmer decrements computed under the assumptions of Baker's and Menzel's (1938) cases A (complete escape of Lyman line radiation) and B (complete conversion of Lyman line radiation), may fall outside the range in form set by these limiting case decrements, especially as regards the $H\alpha/H\beta$ and $H\beta/H\gamma$.

The Fast CN Cycle. GEORGEANNE R. CAUGHLAN, *Montana State University*, and WILLIAM A. FOWLER, *California Institute of Technology*.—If temperatures in excess of 100 million degrees occur at the site of hydrogen burning through proton captures by carbon and nitrogen nuclei in a star, the probability is high (Caughlan, G. R., and Fowler, W. A., *Astrophys. J.* **136**, 453, 1962) that N^{13} will capture a proton in a time short compared to the 867 second β -decay mean lifetime of N^{13} . Thus, under proper temperature and density conditions, one should expect the fast CN cycle

to be active. We have investigated the mean lifetimes and relative equilibrium abundances of the nuclei of this cycle in the temperature range 50 million to 250 million degrees and the density range 0.1 to 10^4 g/cm³. There are substantial differences between the equilibrium abundances of the slow cycle (first line of reactions) and of the fast (combined) cycle. For a given density in the fast CN cycle, at low or at high temperatures in the range investigated, the final ratio of nitrogen to carbon abundances is large, but for an intermediate temperature a minimum of approximately 2 occurs in the nitrogen to carbon ratio. Accompanying this minimum in N/C is a maximum in the ratio of C^{13} to C^{12} that is greater than one for most density conditions. The results of this investigation and the effects of the fast CN cycle on the cosmic abundances of carbon and nitrogen will be the subject of a paper by the present authors in the near future.

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Analysis of Expansion Processes of a Homogeneous Stellar Gas. F. CERNUSCHI AND F. R. MARSICANO, *Facultad de Ingeniería, Buenos Aires*.—Some possible processes of expansion of a gaseous stellar mass are studied. It is assumed: (a) The spherical form and an uniform distribution of the

mass are maintained; (b) the perfect gas law is applicable; (c) the total mass is kept constant; (d) the evolution is adiabatic.

Naming R the external radius of the cloud; M the total mass; G the gravitational constant; γ the adiabatic exponent; ρ the initial pressure; ρ_0 the initial density; $C = \rho_0 \rho_0^{-\gamma}$; and applying the virial theorem [Walraven, T., and Ledoux, P., "Variable Stars," in *Handbuch der Physik* (Springer-Verlag, Berlin), Vol. **LI**, p. 353], we obtain

$$R\ddot{R} = -GMR^{-1} + 21CR^3(1-\gamma)(0.24)^\gamma M^{\gamma-1}. \quad (1)$$

By integrating this equation,

$$(\dot{R})^2 = A + 2GMR^{-1} + \frac{42C(0.24)^\gamma M^{\gamma-1} R^{3(1-\gamma)}}{3(1-\gamma)}, \quad (2)$$

where A is a constant. Equation (2) is used to analyze different types of processes of expansion.

If the radiation pressure is negligible ($\gamma = 5/3$) and if R_0 is the initial radius; $\dot{R}_0$ the initial velocity of expansion; T_0 the initial temperature; to get a limited expansion, it must be

$$R_0^2 > \frac{5.6 \times 10^{14} T_0 + 1.79 \times 10^6 (\dot{R}_0)^2}{\rho_0}. \quad (3)$$

When the corpuscular pressure is negligible in front of the radiation pressure, $\gamma = 4/3$ (Chandrasekhar, S., *Stellar Structure*) to have a limited expansion,

$$R_0^2 > \frac{15 \times 10^{14} T_0 + (\dot{R}_0)^2 1.79 \times 10^6}{\rho_0}. \quad (4)$$

The case when the pressure is between the two extremes ones is also studied.

If it is admitted that there also exists a uniform magnetic field proportional to $\rho^{1/2}$, it is shown that, in this case, a term proportional to $\log R$ must be added to the right-hand side of (2).

Color Anomalies and Metal Deficiencies in Solar-Type Disk Population Stars. PETER S. CONTI AND ARMIN J. DEUTSCH, *Mount Wilson and Palomar Observatories*.—Many solar-type stars of the disk population have spectral lines that are systematically weaker than those in the Hyades dwarfs of the same temperature. Small line-weakening has often been inferred from a photometric determination of, say, an ultraviolet color excess $\delta(U-B)$, a low m_1 index, or some other comparable color anomaly. The line weakening is, in turn, usually attributed to a small metal deficiency. But a direct calculation shows that the small metal deficiencies which have been spectroscopically established in some of these stars can directly weaken the lines by far too little to produce the color anomalies