tion. However, preliminary estimates indicate that it maybe of importance in the convective regions of the red giant evolution.

Late Phases of Evolution of a $1.1M_{\odot}$ Star Composed of ^{12}C . G. S. KUTTER AND M. P. SAVEDOFF, *The University of Rochester*.—The late phases of evolution of a $1.1 M_{\odot}$ star, consisting of ^{12}C , are followed. The initial stellar radius exceeds Chandrasekhar's (1939) white dwarf radius by a factor of 60.

Nuclear reactions, neutrino losses, and relativistic degeneracy of the electrons are included. Nine hundred ninety-five models have been computed by using an adaptation of the Henyey method.

During the first 190 000 yr the star contracts. The temperature rises throughout the star except in the core where, after $\log T_c$ has risen to 8.64, cooling results due to neutrino losses. The continuing temperature rise in the outer layers produces a temperature inversion (cf. Vila, S. C. *Astrophys. J.* **146**, 437, 1966) and ignites the carbon (i.e., $\epsilon_n > \epsilon_e$) in an e -degenerate shell at $M_r/M_* = 0.64$ and $\log T = 8.76$, $\log \rho = 6.03$.

The subsequent evolution is dominated by the nuclear reactions. It occurs on a time scale short relative to the diffusion time (about 1000 yr), but long relative to the free fall time (about 10 sec).

Within 130 yr of ignition, the nuclear shell-burning reverses the contraction and 29.4 yr later the total rate of nuclear energy release reaches its maximum, equaling $3 \times 10^8 L_{\odot}$. A convective zone develops that extends to $M_r/M_* = 0.96$.

As the e degeneracy in the shell-burning region is removed, the star expands (maximum expansion velocity = 34 cm/sec), cools, and reduces the burning rate and convection. Four hundred years after ignition, the energy loss by ν emission again dominates the energy balance throughout the star. The core contracts, but the radius still grows until it is 3.4 times larger than at the point of minimum contraction. Within about 10^6 yr of the starting model, the star reaches a white dwarf configuration.

The addition of a H-He envelope to this ^{12}C model and the possibility that these light elements are carried inward by convection may lead to an explosive situation producing mass-ejection.

H II Regions in Finite H I Clouds. BARRY M. LASKER, *The University of Michigan*.—As not all H II regions are in infinite H I clouds, we consider the evolution of an H II region in a finite H I cloud whose boundary is taken to be a contact discontinuity with a high-temperature intercloud medium. In the most interesting case a shock driven by an ionization front reaches the boundary whence a

weak shock is transmitted to the intercloud medium and a strong—nearly cavitating—rarefaction wave is reflected. Differential expansion in the H I shell results.

The thickness of the shell is determined not by the separation of the shock from the ionization front but by the nearly free expansion of the initially shocked H I shell. For a wide range of parameters the velocity jump through the rarefaction wave is in the order of 7 km/sec. Compared to a shell in an infinite H I cloud, this one is therefore thicker and has a higher velocity; however, its smaller mass and consequent faintness makes it a difficult 21-cm observational problem.

After the rarefaction wave crosses the H I shell, it interacts with the ionization front, resulting in a rarefaction wave transmitted into the H II region and a shock reflected into the H I shell; the velocity in both regions increases by about 7 km/sec. The splitting of velocity profiles implied by this expansion velocity is seldom if at all observed, probably because the flow is less symmetrical and more disorganized than hypothesized here; however, this expansion appears relevant to the large velocities observed in the recombination lines.

Ultrashort Period Stellar Oscillations: Preliminary Results. G. M. LAWRENCE, J. P. OSTRICKER, AND J. E. HESSER, *Princeton University Observatory*.—A *UBV* 1P21 photometer, digital data-recording techniques, and modern autocorrelation analysis techniques have been used to investigate the power spectra of a number of stellar objects in the lower left-hand portion of the H-R diagram. The method is capable of detecting periodic fluctuations in apparent magnitude in many objects which might have Fourier components in the range of 2 sec to 5–15 min, the exact period range depending upon the length of the observing run. Periodic signals which are very small in comparison to the fluctuations in the noise level are easily isolated and appear as peaks in the power spectra.

Observations of nova DQ Herculis (1934) have confirmed the 71-sec period found by M. F. Walker's (*Astrophys. J.* **123**, 68, 1956; **134**, 171, 1961) careful application of standard techniques. A number of white dwarfs from the list of O. J. Eggen and J. L. Greenstein (*Astrophys. J.* **141**, 83, 1956) have been observed and each star has given null results of high accuracy for periods of less than 10 min. Observations of central stars of planetary nebulae, 3C273, other old novae, and the star, with the appearance of an old nova, associated with Sco XR-1, are reported.

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