Magnetosphere of the Moon. THOMAS GOLD, *Cornell University*.—The flow of solar plasma in the vicinity of the moon is considered and the magnetic configuration is deduced which will be set up by the interaction of the flow with the moon. It is shown that this configuration will tend to hold off solar plasma and prevent it striking the moon. A small magnetization of the moon will result. Variations in this magnetization will be measurable and will allow deductions to be made concerning the conductivity of the moon's interior.

An Attempt to Observe 21-cm Line Emission from Intergalactic Hydrogen. S. J. GOLDSTEIN, JR., *Harvard College Observatory*.—In an expanding universe containing a uniform distribution of optically thin neutral hydrogen atoms, the brightness temperature of the sky has a step in its spectrum at 1420.4 Mc. The amplitude of this step is proportional to the density of neutral hydrogen; for a Hubble parameter 100 km/sec/Mpc, a density of 10^{-4} atoms/cm³ gives a step of 1.7°K, if the gas is in thermal equilibrium. Field (*Astrophys. J.* **135**, 684, 1962) has attempted to observe 21-cm absorption in the spectrum of Cyg A. Observing emission has the advantage that the measurement is independent of the spectra of sources and that the observed brightness temperature can be expressed as a density without knowledge of the excitation temperature of the gas.

A horn antenna with half-power beamwidths of 24×27 deg, directed at the celestial north pole, fed one input of a switched maser radiometer. A coaxial resistor immersed in liquid nitrogen fed the other input. The difference in available power of these sources was measured at 2.0-Mc intervals with 1.0-Mc bandwidth over a 16-Mc range centered at 1420.4 Mc. The system noise temperature was 190°K including 110°K from the antenna and feed line. Test spectra of the temperature difference between two coaxial resistors clamped together in an aluminum block at room temperature show a maximum variation of 0.4°K at the switch terminals (0.6°K in brightness temperature). Observations of the north pole show an increase in brightness temperature of 2°K at the center frequency with respect to the adjoining frequencies. I conclude that a step as large as 1.1°K is not present, if the random motions of the intergalactic gas have a standard deviation of 400 km/sec or less. Hence, subject to the same condition, the average density of optically thin neutral hydrogen atoms in the intergalactic space observed is less than 7×10^{-5} atoms/cm³.

This research was supported by the National Science Foundation.

Evolution of Massive Stars after Helium Burning. CHUSHIRO HAYASHI AND ROBERT C. CAMERON, *Kyoto University and Goddard Space Flight Center*.—Our model of a star of 15.6 solar masses, with age-zero composition, $X=0.90$, $Y=0.08$, and $Z=0.02$, has been modified to include an outer convection zone for the carbon-burning phase, whose onset was treated in our Paper III (*Astrophys. J.* **136**, 166, 1962).

The following general expectations of Paper III have been confirmed: (1) the stellar radius is now considerably reduced, (2) the parameters describing the interior were already essentially correct, and (3) the red-supergiant branch in clusters such as η and χ Persei is accounted for by carbon burning and later evolutionary phases.

For the early stages of carbon burning, we find $E \approx 15.5$, with the bottom of the outer convection zone so deep ($q \approx 0.27$) as to cause mixing of previous hydrogen-burning products. Detailed computations have also been made for the contraction phase (lifetime: 0.5×10^5 yr) which precedes carbon burning.

The carbon-burning lifetime proper has an upper limit of 2.3×10^5 yr. The total lifetime from central helium exhaustion to iron decomposition (supernova explosion) has been carefully estimated to be nearly 11×10^5 yr, agreeing well with the preliminary estimate of Paper III and with star-count ratios in the appropriate regions of the H-R diagrams of η and χ Persei and NGC 330.

The inclusion of neutrino loss, due to the $(\bar{\nu}e)(\bar{\nu}e)$ interaction, as proposed by Feynman and Gell-Mann, and computed by Chiu *et al.*, shortens drastically the above-mentioned lifetimes and destroys the observational agreement mentioned. Assuming, and later verifying, nondegeneracy of the core, we find that, when neutrino effects are considered, the lifetime as a red supergiant becomes essentially that of carbon burning (now reduced to only 0.8×10^5 yr, at most), since, for example, the neon- and oxygen-burning lifetimes are reduced by factors of 10^3 and 10^4 , respectively.

The observational data of η and χ Persei therefore strongly suggest that the $(\bar{\nu}e)(\bar{\nu}e)$ interaction is forbidden.

UBV Photometry of DH Cephei. ARNOLD M. HEISER, *Dyer Observatory*.—DH Cephei is a spectroscopic binary located in the galactic cluster NGC 7380 and consists of two early O stars. The spectroscopic observations (Pearce, J. A., *Astron. J.* **54**, 135, 1949) indicated an inclination of 62 deg and prediction of an eclipse amounting to 0.1 mag. at primary minimum. *UBV* observations of this suspected eclipsing variable have been obtained and