Anomalous Abundances of Atmospheric Xenon Isotopes. A. G. W. CAMERON, *Atomic Energy of Canada Limited, Chalk River, Ontario*.—Mass spectrometric analyses of xenon in cosmogenic gases extracted from various stone meteorites (principally by J. H. Reynolds) show the same relative isotopic abundances except for variations in Xe^{129} . These variations may be attributed to the decay of I^{129} with a half-life of 17 million years, and indicate that an interval of approximately 120 million years passed between the cessation of nucleogenesis in the material which formed the solar system and the freezing of xenon in the meteorite parent bodies. The relative abundances of *all* the isotopes in atmospheric xenon differ from those of meteoritic xenon. The largest differences occur for the isotopes Xe^{129} , Xe^{131} , Xe^{132} , Xe^{134} , and Xe^{136} , which are unshielded against formation by the decay of fission products. Kuroda has suggested that the atmospheric excess of these isotopes is due to spontaneous fission of Pu^{244} (80-million-year half-life) incorporated in the primitive earth. The present calculations support this view. The anomalous abundances of the shielded isotopes Xe^{124} , Xe^{126} , Xe^{128} and Xe^{130} appear to have been produced by a neutron-capture process. It is extremely unlikely that a sufficient number of neutrons can have been produced in the atmosphere to account for the anomalies. The order of magnitude of the anomalies can be accounted for if it is assumed that about 10% of the atmospheric xenon has come from the sun, where it has been subjected to the neutron flux associated with deuterium thermonuclear reactions. While one can expect that the earth's magnetic field will deflect away the gases of the solar wind, the high mass-to-charge ratio of the xenon ions may allow them to be captured into the atmosphere.

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Narrow-Band Photometry of Babcock's Magnetic Star HD 215441. ROBERT C. CAMERON, *NASA Theoretical Division, Silver Spring, Maryland*, AND CHARLES PERRY, *Berkeley Astronomical Department, University of California*.—The eighth-magnitude A0p star HD 215441 was discovered by Horace W. Babcock in 1959 to have by far the largest effective magnetic field known. In October, 1959 the intensity was $34\,400 \pm 266$ gauss. The star is unique in that its Zeeman pattern has been clearly resolved.

We observed Babcock's star photoelectrically on 14 of 17 consecutive nights in September, 1960 with the 20-inch reflector of the Palomar Observatory in narrow bands at 5500, 4700, 4100 (half-width 200 Å), and 3500 Å (half-width about 300 Å), during the course of a program of photoelectric narrow-band photometry of B. Strömgren. The respective ranges

of variation in the four wavelengths were approximately 0.18, 0.23, 0.23, and 0.27 mag. Pending final reduction, we tentatively note an increase in the range of variation from a value of 0.14 magnitudes, derived through broad-band photoelectric photometry (effective wavelength 4200 Å) during the period August, 1959–February, 1960 by T. Jarzebowski, Wroclaw Observatory. The six light-curves in *yellow*, *blue*, *violet*, *ultraviolet*, *v-b*, and *u-v* are approximately 180° out of phase with *b-y*. The ranges of *b-y*, *v-b*, and *u-v* are approximately 0.07, 0.07, and 0.10 mag., respectively.

Jarzebowski derived a period of 9.49 days. Combination of his epoch with ours yields a possible period of 9.475 days. A slight suggestion of short-period variation seems to be worth following up.

The star is unusually bright in the ultraviolet for its spectral class.

The remainder of this paper is based upon unpublished observational data of Strömgren. The anomalous location of several magnetic stars in his (*l,c*) classification, based on the strengths of *H*-beta and the Balmer discontinuity, respectively, is described in connection with the possibility of using narrow-band criteria for the discovery of magnetic stars.

Neutrino Emission Processes in Old Stars.

HONG-YEE CHIU, *The Institute for Advanced Study, Princeton, New Jersey*.—When created inside stars, neutrinos will escape, thus carrying energy away. This is due to the long mean free path *l* of neutrinos at normal densities ($l \gg 10^{13}$ cm, the maximum dimension of normal stars). Important neutrino emission processes are: (1) The URCA process (Gamow, G., and Shönberg, J., *Phys. Rev.* **59**, 539, 1941; Cameron, to be published; Chiu, to be published): $(Z, A) \rightarrow (Z+1, A) + e^- + \bar{\nu}$, and $(Z+1, A) + e^- \rightarrow (Z, A) + \nu$. (2) The neutrino bremsstrahlung process: $e^- + (Z, A) \rightarrow e^- + (Z, A) + \nu + \bar{\nu}$ [Pontecorvo, B. M., *JETP* **36**, 1615, 1959 (Translation: *Soviet Phys. JETP* **9**, 1148, 1959); Gandel'man, G. M., and Pinaev, V. S., *JETP* **37**, 1072, 1959 (Translation: *Soviet Phys. JETP* **37**, 764, 1959)]. (3) The photo-neutrino process: $e^- + \gamma \rightarrow e^- + \nu + \bar{\nu}$ (Chiu and Stabler, to be published). (4) The pair annihilation process: $e^- + e^+ \rightarrow \nu + \bar{\nu}$. (5) The blackbody radiation process: $\gamma + \gamma \rightarrow \nu + \bar{\nu}$ (Chiu and Stabler, to be published). Processes (4) and (5) are related, since at $T > 5 \times 10^8$ °K electron pairs will be created in thermal equilibrium with radiation. Anomalous rates of energy dissipation have been found for processes (4) and (5). A typical example: the relaxation for cooling for pure radiation at $T = 10^9$ °K is one year. The effect of neutrino emission on stellar evolution is to shorten the time of evolution in which the central temperature exceeds 5×10^8 °K. It can be proved