the cosmical time scale. Since then all modern cosmogonists, it seems to me, have constructed systems designed primarily to account for the maintenance of solar and cosmical energy on the scale demanded by this natural, but perhaps unwarranted, assumption.

Although I have no desire to trespass in the controversies concerning the nature of cosmical radiation, I may say that Millikan's views have always had a singular attraction to me because of the very difficulties to which he refers of finding a satisfactory kinetic picture of the instantaneous conversion of, say, 56 separate hydrogen atoms into one iron atom. This, to a chemist, a reaction of the 56th order, seems bizarre: for has not Sir Joseph Larmor educated us to regard a reaction even of the third order as difficult to form any kinetic picture of? But I like to think of these 56 atoms (or shall we say 55?) holding a committee meeting in the spacious regions of zero temperature and concentration, with infinite time ahead of them, and nothing to disturb them arriving at a decision (or possibly only awaiting a chairman) to rush into one another's arms and flash to us the birth of an iron atom.

FREDERICK SODDY.

131 Banbury Road,
Oxford.

Change of Density of Ethyl Ether with Temperature.

IN connexion with my former studies on ethyl ether, made in the Physical Laboratory of the Technical Institute at Warsaw, I have made a study of the dependence of the density of ethyl ether upon temperature in the interval between − 120° C. and + 35° C., using the method described by H. Kamerlingh Onnes and J. D. A. Boks (*Comm.*, Leyden, No. 170 b).

The dilatometer and the control tube were made of fused quartz, carefully calibrated and provided each with a closely fitting quartz stopper. The dilatometer was placed in a deep glass Dewar vessel, so as to permit the observation of the level of liquid in the dilatometer. The temperature was determined by two platinum resistance thermometers placed at different depths.

There was great difficulty in selecting the cooling liquid. The specially purified petrol ether which is commonly used for this purpose permits of lowering the temperature to − 150° C., but even at − 70° C. it

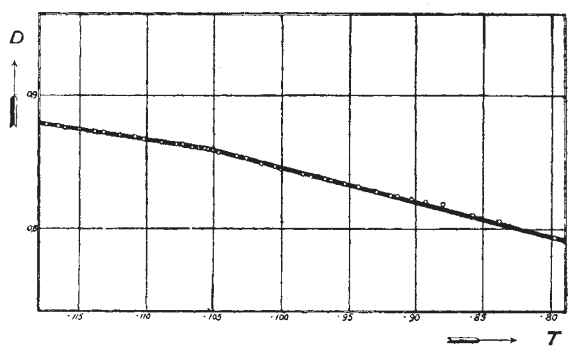

FIG. 1.

becomes so markedly disturbed as to make the observation of the levels of the liquid both in the dilatometer and the control tube quite impossible. After several attempts I found that a mixture of chemically pure ethyl ether and ethyl alcohol remains clear down to − 120° C. Probably this is due to the fact that ethyl alcohol absorbs the last traces of moisture in the cooling liquid, which would otherwise cause it to become disturbed at low temperatures.

The density of ethyl ether as a function of temperature in the neighbourhood of the point − 105·4° C. is represented on the accompanying graph (Fig. 1). The shape of the curve shows that the density of very carefully purified ethyl ether increases with the lowering of temperature from the value 0·6964 at 35° up to 0·8595 at − 105·4° C. With further lowering of temperature the density of ethyl ether still increases, but the rate of increase is markedly lower. According to former studies made in this laboratory, there appears also at this temperature a change of the value of the dielectric constant and of the specific heat of ethyl ether (J. Mazur, NATURE, **126**, 649; 1930: M. Wolfke and J. Mazur, NATURE, **126**, 684; 1930). Thus at the previously found transition point − 105·4° C. the density curve shows also a distinct change of character. At − 117·2° C. (freezing-point) the density has the value 0·8654.

J. MAZUR.

Technical Institute, Warsaw,
Jan. 6.

Crystal Structure of Martensite.

IT was first shown by W. L. Fink and E. D. Campbell (*Trans. Am. Soc. Steel Treat.*, **9**, 717; 1926), and independently by N. Seljakow, J. Kurdumoff, and N. Goodtzow (NATURE, **119**, 494; 1927), that quenched carbon steels contain a phase with a tetragonal crystal structure, which might be considered as a deformation of the body-centred cubic structure of α-iron. This has been confirmed by other investigators, and our present knowledge of the tetragonal martensite may be briefly summarised as follows. The axial ratio increases from about 1·03 at 0·8

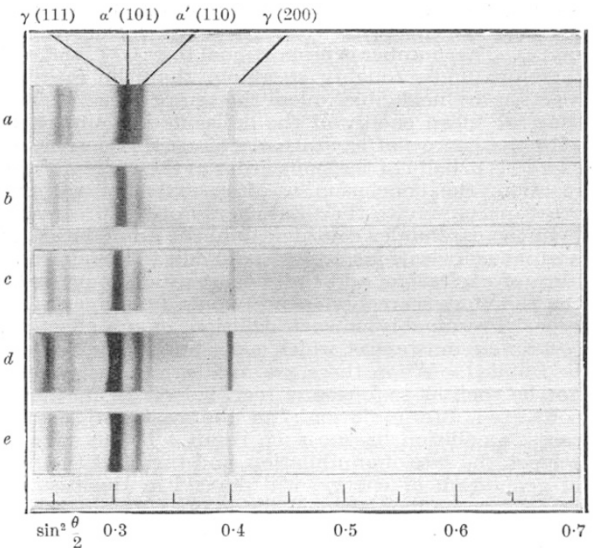

FIG. 1.—X-ray photograms of quenched carbon steels. The two lines γ (111) and α′ (101) are separated in the original films. *a*, 0·80 per cent carbon; *b*, 1·04 per cent carbon; *c*, 1·20 per cent carbon; *d*, 1·35 per cent carbon; *e*, 1·35 per cent carbon, after forty-eight hours in liquid air.

per cent carbon to 1·06 at 1·4 per cent carbon. At lower contents of carbon the interference doublets corresponding to the tetragonal lattice are not resolved, but in photograms of very rapidly cooled specimens the α-Fe-lines are slightly displaced in such a way as to indicate a tetragonal deformation. The higher the carbon content and the higher the axial ratio, the larger is also the volume of the unit cell.

It is thus evident that there is a correlation between carbon content and lattice dimensions, and it must be considered as an established fact that the tetragonal martensite has a homogeneity range of considerable