$$\frac{d(\Delta J/J)}{d(\Delta H/H)} = -\frac{d(\Delta J/J)}{d(\Delta E/E)} = -12; \quad \frac{\Delta J}{J} = 12 \frac{\Delta E}{E}$$

due to the galactic-rotation effect the change in the

energy is of the order $\frac{\Delta E}{E} = \frac{1}{1-\beta} - 1 = 10^{-3}$;

so that the amplitude of the sidereal-time wave will be:

$$\frac{\Delta J}{J} \cdot F = 12 \frac{\Delta E}{E} \times 0.6 = 0.7 \text{ per cent.}$$

Adding to it the expected amplitude according to the calculations of Compton and Getting (± 0.18 per cent), we get as a result an amplitude of about ± 0.9 per cent, in good agreement with the experimental values.

It should be mentioned that for other counter arrangements, or for an ionization chamber—since the sidereal time wave depends largely on the magnetic effect—the amplitude is as likely to be smaller as larger. By coincidence apparatus the predominant part of the amplitude is proportional to the magnetic effect; for harder rays (greater filtering) the magnetic effect will be smaller, and in accordance with it, the amplitude of the sidereal time wave should also be smaller; this conclusion seems to be detectable also in our measurements, as the amplitude in the direction 64° was only ± 0.5 per cent (but the deflection in the north-south direction should also be taken into consideration in determining the value of F). In the case of the ionization chamber, the diurnal variation³, and hence the magnetic effect, is much smaller, so that here the effect calculated by Compton and Getting is predominant, and the sidereal time wave will have a much smaller amplitude.

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¹ Compton, A. H., and Getting, I. A., *Phys. Rev.*, **47**, 817 (1935).

² Barnóthy, J., and Forró, M., *Z. Phys.*, **104**, 534 (1937).

³ Hess, V. F., and Graziadei, H. Th., *Ter. Mag. Atm. Elec.* (March 1936).

The Continuous β -Ray Spectrum

QUANTUM mechanics deals with object systems composed of only a few particles out of the total number of particles in the universe. The particles of the local object system, which may be an atom or atomic nucleus, are supposed to be incapable of dropping into vacant energy levels in the background consisting of the unspecified particles of the universe. Also an unspecified particle of the background is supposed to be incapable of falling into one of the vacant levels of the local specified system. As Eddington¹ has pointed out, this means that quantum mechanics *postulates* that the levels of the background are all below the ground-level of the local object system, and further, that all the levels in the background are occupied by one particle, a neutral scalar particle in Eddington's theory, in each level in accordance with the exclusion principle. The *limit*

energy of the unspecified background particles corresponds to the *threshold* energy of the local specified system. The background forms a uniform isotropic 'comparison fluid' which is postulated by our statement of the quantum theory.

The disintegration β -particles are believed to arise from the transformation of a neutron into a proton and an electron inside the nucleus. In order to conserve spin and energy, since the β -particle spectrum is continuous, the existence of a neutrino has been assumed.

Let us suppose that a neutron in an upper energy level of the nucleus reverts to an unspecified particle of the background. To make room in the background for this particle, one of the unspecified background particles must be specified, and so it becomes a particle in the object system, that is, the nucleus. Let the background particle be specified as a proton in a lower energy level of the nucleus. The energy lost by the nucleus is now resident in the background and can be employed in raising an unspecified particle of the background to the limit energy (that is, the

Fig. 1

threshold energy of the object system), where it becomes specified as an electron and is endowed with kinetic energy equal to the energy change in the nucleus less the amount of energy required to raise the particle to the limit level.

Since the energy levels in the background just beneath the limit energy are practically continuous, for they have quantum numbers of the order of 10^{26} , the β -particle spectrum will be continuous. Since the electron comes from the background it will have the requisite spin. The process suggested above is shown diagrammatically in Fig. 1. It should be added that Eddington has shown² that the emission of an electron does not leave a vacant level in the background.

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¹ Eddington, "Relativity Theory of Protons and Electrons", p. 261 (Cambridge, 1936).

² Eddington, *ibid.*, p. 267.

Supraconductors of Small Dimensions

MENDELSSOHN¹ has suggested that the high threshold value of superconductive alloys and impure metals might be confined to regions of very small dimensions. In connexion with subsequent experiments², it was pointed out that for thermodynamical