rays, and the interesting research on the general nuclear photo-effect reported by Bothe and Gentner[2], suggest to us that a neutron or neutrons may be liberated from a lead nucleus by a cosmic ray photon, presumably accompanying a kind of disintegration into heavy particles (general Chadwick and Goldhaber's effect).

A recent report by Fünfer[3] on the existence of slow neutrons in the atmosphere corresponds probably with the existence of the natural kicks in our experiment, which is, however, not sufficiently sensitive to decide the matter.

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Electron Diffraction Studies of Oxides formed on Iron

THAT iron oxidized at high temperatures forms a scale composed of three layers, namely, ferrous oxide (below 575° C., does not form), magnetic oxide and ferric oxide is generally known. I have examined oxide films formed on a clean surface of iron exposed to air at various pressures and temperatures, using the electron diffraction reflection method, and have been able to ascertain the condition for the formation of these oxides.

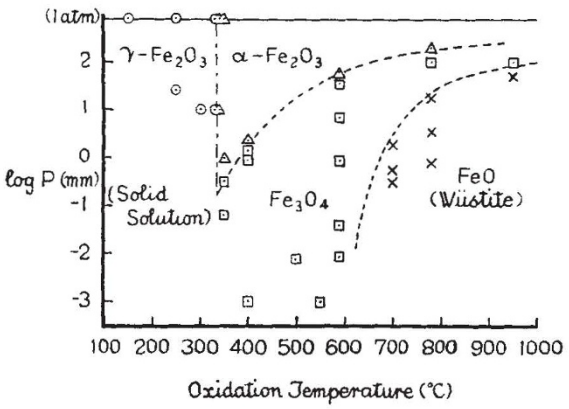

Fig. 1.

The iron specimens, after being etched to remove any polishing effects, were heated to definite temperatures in a highly evacuated tube and then oxidized by introducing air at definite pressures. After an appropriate period of oxidation, the tube was again evacuated as quickly as possible and in the meanwhile cooled in two or three minutes to room temperature. The space lattices of oxides were determined by electron diffraction photographs. The regions where the various oxides are formed are shown in Fig. 1. The duration of exposure has no effect on the resulting oxide except in a few cases.

The facts that lower oxides are formed at higher temperatures under reduced pressures and that prolonged exposure does not elevate the degree of oxidation but is manifested only in the increase of scale thickness are interesting phenomena indeed. These phenomena lead us to the suggestion that iron atoms migrate more vigorously towards the surface with rising temperature and check any further oxidation of the lower oxides.

Only the oxide of the structure of Fe_3O_4 type is obtainable below 340° C., and considering other parts of the diagram this oxide was concluded to be γ-Fe_2O_3. The invisible films[1] of passive iron and of the iron polished in air and the oxide film[2] formed in air below 200° C. were recently concluded to be γ-Fe_2O_3. These two cases are included within the γ-Fe_2O_3 region of the diagram.

In other investigations[3], the transition point between γ-Fe_2O_3 and α-Fe_2O_3 was indistinct; but in this work it was ascertained that the point lies almost at 340° C., and in the immediate vicinity of this temperature both oxides are formed in almost amorphous state. The ordinarily impossible transition from α-Fe_2O_3 to γ-Fe_2O_3 was verified to be possible by maintaining the temperature of this nearly amorphous α-Fe_2O_3 at 330° C.

Specimens heated at 200° C. and 250° C. for a short while produced an extra ring corresponding to 3·4 A., besides the diffused γ-Fe_2O_3 pattern, which disappeared on further heating. It is hoped that better identification may be arrived at for this unknown primary oxide from a different angle.

Experimental details and technique will be reported in the *Scientific Papers* of this Institute.

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β-Decay as due to a Neutrino Shower

ACCORDING to the Fermi theory of β-decay, the β-curve representing the number of electrons with a given energy lying in the interval of the transition energy of the nucleus, is governed by a statistical factor which may, however, be deduced in a simple manner as shown by Uhlenbeck and Goudsmit. Experimental curves indicate the existence of a marked asymmetry about half the transition energy of the nucleus, while the statistical factor in the Fermi theory is practically symmetrical.

If we imagine the final process to consist of a shower of neutrinos (the number in the shower depending on the transition energy of the nucleus), with intermediate stages, the asymmetry can receive a simple explanation. Indeed, following the basic transformation pictured by Fermi and assuming the Jordan formulation that a high-energy electron makes a transition to a lower energy state with the emission of two neutrinos tho total energy of which is equal to the transition energy of the electron, we can follow the shower production in a way analogous to Heisenberg's theory. The transformations in the β-decay would be

$$N \rightarrow P + e + n, \qquad \text{(Fermi)}$$
$$\left.\begin{aligned} e &\rightarrow e^{\mathrm{i}} + n^{\mathrm{i}} + n^{\mathrm{ii}}, \\ e^{\mathrm{i}} &\rightarrow e^{\mathrm{ii}} + n^{\mathrm{iii}} + n^{\mathrm{iv}} \end{aligned}\right\} \qquad \text{(Jordan)}$$

resulting in

$$N \rightarrow P + e^{\mathrm{ii}} + n + n^{\mathrm{i}} + n^{\mathrm{ii}} + n^{\mathrm{iii}} + n^{\mathrm{iv}},$$