has also been found by Ruben and Libby[1]. The exact figures obtained are contained in the accompanying table. The errors given are probable errors and not standard deviations.

Thickness of filter	Fraction transmitted through filter	Fraction transmitted through boron absorber	Absorption coefficient
0	1	$0 \cdot 60 \pm 0 \cdot 02$	$0 \cdot 77 \pm 0 \cdot 07$
B 0·96 gm./cm.^{2}	0·25	$0 \cdot 57 \pm 0 \cdot 04$	$0 \cdot 83 \pm 0 \cdot 12$
I 0·5 ,,	0·5	$0 \cdot 75 \pm 0 \cdot 04$	$0 \cdot 38 \pm 0 \cdot 1$
I 1·2 ,,	0·25	$0 \cdot 84 \pm 0 \cdot 05$	$0 \cdot 2 \ \pm 0 \cdot 1$

The first and second columns give respectively the thickness of filter used and the fraction of the intensity transmitted by them, B representing a boron filter and I an iodine one. The last two columns give data for the absorption in boron of the beam of neutrons emerging from the filter. They give respectively the fraction of the intensity transmitted through a boron absorber of 0·30 gm./cm.^{2}, and the absorption coefficient deduced from this fraction (not corrected for scattering).

These results show that whereas from the boron absorptions one can say that at least 85 per cent of the activity is due to neutrons having a uniform absorption coefficient of 0·77, the iodine filtration experiment shows that some 50 per cent of the neutrons have an absorption coefficient of almost half this, 0·38.

It has also been found that when both an iodine and a boron filter are used simultaneously, the activity produced in the detector depends on the order in which the filters are placed. The ratio of the activity produced when the boron filter (0·77 gm./cm.^{2}) was followed by the iodine filter (0·84 gm./cm.^{2}) to that produced when the iodine filter preceded the boron filter is $0 \cdot 78 \pm 0 \cdot 03$.

The first experiment has been repeated using a bromine detector in place of the iodine as the absorption regions of these elements overlap to some extent[2], but no change was observed in the boron absorption coefficient of the neutrons on passage through the iodine filter. Nor was any effect observed when an arsenic filter and an arsenic detector were used instead of iodine in this experiment, although iodine and arsenic detectors show nearly equal boron absorption coefficients for slow neutrons[3,4].

In all these experiments, the source of slow neutrons used was a (Rn + Be) source placed at the centre of a wax cube of side 10 cm. The sides of the cube were screened with cadmium sheets, and the absorbers and detectors were placed against the sides of the cube.

The results of these experiments do not seem to be at all explicable unless it is assumed that the passage through one or the other of the filters has resulted in a change in energy of a considerable fraction of the neutrons detected. The results could be interpreted as being due to slowing down of the higher energy neutrons by boron into the iodine resonance region. Alternatively, the effect could be due to an increase in energy of some of the neutrons on passage through the iodine, this latter being possible if some of the iodine nuclei exist in a metastable state of long life.

Further experiments are in progress, however, and a fuller account will be published elsewhere.

J. L. MICHIELS.

Imperial College of Science and Technology,
London, S.W.7.
July 20.

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Scattering of Yukawa Particles by Protons

I HAVE computed the electrical interaction between the heavy electrons as introduced by Yukawa[1] and recently discussed by Kemmer, Fröhlich, Stueckelberg and others[2], using the Dirac-Proca[3] equations for particles of spin one. It was thought that such a calculation would furnish polarization effects analogous to, and yet, because of the different spin, different from the effect found by Mott[4] for the scattering of electrons. The method used was the usual Born-Dirac calculus of perturbation.

It was found that in contrast to electrons, Yukawa particles show a polarization effect even in the first approximation. This effect, perhaps not wholly unexpected due to the similarity of the Proca equations with the Maxwell equations, is caused solely by the transversal wave field; it is proportional to the square of the cosine of the angle between the plane of polarization and the plane laid through the primary and the scattered ray. The second approximation also contains polarization terms, but they are of the form similar to those found by Mott in the case of the electron.

A detailed report of the calculations will be published in the *Physical Review*.

OTTO LAPORTE.

University of Michigan,
Ann Arbor, Michigan.
July 12.

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Direct Proof of the Effect of Temperature on the Conduction Electrons of a Metal

IT has been recognized for some time that the structure of the K-, L-, etc., emission spectra of the metals in the soft X-ray region (about 10–500 A.) can lead to direct information about the level system occupied by the conduction-electrons[1]. For the radiation of a metal in this region consists wholly (or, in other cases, at least partly) of a band which represents transitions of the conduction-electrons themselves into an inner shell which has been ionized by electron-impact in the X-ray tube; and since the inner level is relatively sharp, the structure of the conduction electron level system is clearly reflected in the emitted radiation. The most characteristic feature is the sharp edge which forms the short wave-length end of such a band; this evidently corresponds to the sharp 'surface' to which the conduction-electrons of the metal fill up the continuum of possible levels. But, theoretically, this surface is only sharp at the absolute zero of temperature. As is well known, the conduction-electrons are subject to Fermi-Dirac statistics and this has the result that at a temperature T, the surface is slightly diffused.

If $N(E)dE$ is the number of levels having energy between E and $E + dE$ and if $N(E)$ is assumed approximately equal to a constant N_0 in a small energy-range near the surface, then the number of *occupied* levels with energies between E and $E + dE$ at a temperature T is given by

$$n(E)dE = \frac{N_0}{1 + e^{\Delta E/kt}} \ dE \quad \cdots \cdots \quad (1)$$