absorption, since the effect of scattering will be to increase the value of θ_m and thus increase the radioactivity produced. If each neutron is scattered several times, this secondary effect may cause an apparent *increase* in the strength of the beam by a factor as great as 2.

This secondary effect can be eliminated by using a sphere of detecting material instead of a sheet, and we have used this method to investigate the passage of fast neutrons through heavy water.

The beryllium-radon source was placed at the centre of a spherical flask containing the heavy water* (98·4 per cent); the whole was surrounded by a nickel cylinder which had the small spherical detectors stuck on its inner surface. After activation, the cylinder was slipped over a cylindrical aluminium counter for measurement. The following results were obtained.

Absorber	Detector	Absorption (per cent)	Effective cross-section
D_2O	Al ($_{27}Mg^{12}$)	11	$7 \cdot 0 \times 10^{-25}$
D_2O	Si ($_{28}Al^{13}$)	15	$9 \cdot 7 \times 10^{-25}$
D_2O	P ($_{31}Si^{14}$)	12	$7 \cdot 7 \times 10^{-25}$
H_2O	Al ($_{27}Mg^{12}$)	13	$8 \cdot 4 \times 10^{-25}$
H_2O	Si ($_{28}Al^{13}$)	13	$8 \cdot 4 \times 10^{-25}$
H_2O	P ($_{28}Si^{14}$)	11	$7 \cdot 0 \times 10^{-25}$

The reduction in the activity of the detectors excited by the neutron beam can be accounted for in two ways: either neutrons are removed by true absorption or, after being slowed up by a collision, the neutrons are less effective in exciting artificial radioactivity.

If true absorption were a significant factor in our experiments, one would expect a marked difference between the absorption in heavy and light water; since this is not found it seems probable that the observed reduction is due to the differential slowing up of the neutrons.

Owing to the smaller mass, the velocity of neutrons is reduced by a greater amount on collision with a proton than on collision with a diplon. The simplest interpretation of our results is that the velocity excitation curve for silicon, aluminium and phosphorus rises steeply as the velocity is increased and then remains fairly independent of velocity within the range of velocities used.

That the neutrons actually do suffer a greater decrease in velocity on colliding with protons is confirmed by independent experiments on the excitation of silver (Fermi effect). As Fermi showed, silver is much more strongly excited by neutrons which have been slowed up by collision with protons than by the same neutrons before they have been scattered. We found in agreement with the experiments of Herszfinkiel, Rotblat and Zyw[1] that although the activity induced in silver is increased by passing the neutrons through heavy water, the increase is only about one third of that produced by the same amount of ordinary water.

Thus the results of our experiments can be accounted for in an elementary way as being due to the large difference in mass between the diplon and the proton.

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* The 100 gm. of heavy water used was kindly lent to us for these experiments by the Imperial Chemical Industries, Limited.

[1] NATURE, **135**, 654, April 27, 1935.

Evidence on the Velocities of 'Slow' Neutrons

WE have searched in a number of ways for experimental evidence of the existence of neutrons of thermal energies, using a radon-beryllium source of fast neutrons and allowing them to diffuse through materials rich in hydrogen[1]. Until very recently we could find no such evidence, but repetition of one of our early trials, under much improved conditions, has strongly suggested the presence of such very slow neutrons.

Specimens of silver, rhodium and iodine (the last in an envelope of thin glass) were placed in turn within a long hollow paraffin wax cylinder the inner and outer radii of which were respectively 2·1 cm. and 3·7 cm. The cylinder fitted closely into a Dewar vessel which itself was surrounded by wax to a thickness of about 7 cm. The source was placed in a cavity in the outer wax. We observed the β-ray activity induced in each specimen with the whole apparatus at room temperature; the inner wax cylinder and the specimen were then cooled to the temperature of liquid oxygen (90° K.) and the observations repeated. The thermal capacity of the wax sufficed to prevent serious rise of temperature during irradiation. The specimens were allowed to regain room temperature before being presented to the counter.

The ratios of the activity induced with the wax cold to that with the wax at room temperature were found to be as follows: $1 \cdot 26 \pm 0 \cdot 04$ for silver (25 sec. period); $1 \cdot 29 \pm 0 \cdot 04$ for silver (150 sec.); $1 \cdot 23 \pm 0 \cdot 07$ for rhodium (44 sec.); but $0 \cdot 84 \pm 0 \cdot 06$ for iodine (25 min.). The change in the linear dimensions of the cylinder did not exceed 1 per cent. We conclude that an appreciable proportion of the neutrons concerned had energies comparable with those of thermal agitation, and were able to attain some measure of thermal equilibrium with the medium through which they were passing.

Fermi and his collaborators[2], using a rhodium detector in a medium of liquid hydrocarbons, have found no variation of the activity induced at 200° C. from that at room temperature. We tried with a silver detector in an oil bath up to 250° C., and found a decrease of about 20 per cent. The increase of volume of the oil due to the rise of temperature was, however, of similar order of magnitude; our result was thus inconclusive.

The difference between the behaviour of iodine and that of silver and rhodium would seem to indicate that iodine absorbs preferentially neutrons of velocities different from, and probably higher than, those which are most effective in the other cases. In this connexion we may mention that we find the absorption of 'slow' neutrons by a block of iodine to be greater for an iodine detector than for detectors either of silver or of rhodium.

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[1] Fermi and others, *Ricerca Scientifica*, October 1934.

[2] *ibid.*, December 1934.