Absorption of Slow Neutrons

THE absorption of slow neutrons is believed to take place in two ways: a general absorption of very slow neutrons (thermal energies) together with a highly specific absorption (rhodium, indium, silver, gold)[1] of faster neutrons. Further to investigate this phenomenon, experiments have been carried out on the absorption of neutrons with the apparatus shown in Fig. 1.

The radon beryllium source was placed in a block of lead at the bottom of a paraffin wax tube[2]. The top of the paraffin block was covered with a layer of boric acid 1½ cm. deep to absorb slow neutrons emerging from its surface. In these circumstances, the neutrons which emerge from the mouth of the tube are those which have been slowed down by repeated collisions with the paraffin wax. To detect the neutrons an ionisation chamber ½ cm. deep filled with boron trifluoride was used. Such a chamber has several advantages over a chamber lined with boron, since the kicks produced are twice as great and of uniform size, and so they are more readily distinguished from the background produced by the

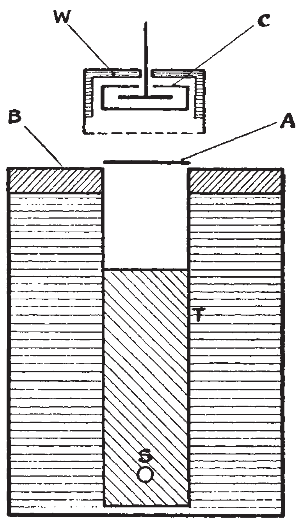

FIG. 1. *A*, absorber; *B*, layer of boric acid; *C*, ionisation chamber; *S*, source; *T*, paraffin tube; *W*, layer of paraffin wax.

γ-rays emitted by the radon source. The chamber was in a shallow cylindrical box of paraffin wax 2 cm. thick; the bottom of the box could be closed with a circular sheet of wax 2 cm. thick. Such a chamber will detect neutrons over a very wide velocity range, since neutrons which are not captured on their first passage through the gas may be scattered back by the top paraffin sheet. Such a neutron will have been considerably slowed down, and is therefore likely to be detected. When the chamber is completely surrounded by paraffin wax it is not very sensitive to the slowest neutrons, since a great many of these are reflected at the first paraffin surface.

One or more absorbing sheets were placed immediately over the mouth of the tube. The following results were obtained. The statistical error is about two per cent.

With the chamber surrounded by paraffin wax

Absorber	None	B	B	B/Cd	Cd	Cd/In	Cd/Ag	Cd/Au
Weight in mgm./cm.².	—	288	399	288/159	159	159/73	159/220	159/116
Number of neutrons recorded.	100	58	53½	58	68	66	68	68

With the chamber open at the bottom

Absorber	None	B	B/Cd	Cd	Cd/In	Cd/Ag	Cd/Au	In	Ag	Ag	Au
Weight in mgm./cm.².	—	220	220/159	159	159/73	159/200	159/116	73	220	126	116
Number of neutrons recorded.	100	17	13	23	20½	23	23	84½	91½	95	99

From these results one can estimate the width and position of the neutron absorption bands in terms of the absorption of boron. For convenience of expression, it is useful to assume that the reaction cross-section of boron is inversely proportional to the velocity of the reacting neutron. There are reasons for believing that this theory may be true[3], and even if it is not, absorption in boron will remain for some time a convenient practical method of isolating neutrons in a definite velocity range. With this notation the results obtained may be summarised as follows:

The absorption band of cadmium occurs in the energy range[4] 0–1½ e.v. and the results are consistent with a very narrow absorption band (0–0·1 e.v.). The absorption band of indium occurs in the same range and partly overlaps that of cadmium. No effect due to the specific absorption of gold or silver could be found, and it is therefore probably not in the range investigated.

This method of measurement is being extended to other elements and other velocities.

C. H. COLLIE.

Clarendon Laboratory,
Oxford.
March 5.

[1] Amaldi and Fermi, *Ric. Scient.*, **6**, 2, 9 (1935); Szilard, NATURE, **136**, 950 (1935); Frisch, Hevesy and McKay, NATURE, **137**, 149 (1936).
[2] Hopwood and Chalmers, NATURE, **135**, 341 (1935).
[3] Bohr, NATURE, **137**, 344 (1936).
[4] Frisch and Placzek, NATURE, **137**, 357 (1936).

Conservation of Energy and Momentum in Atomic Processes

ACCORDING to recent experiments by R. Shankland[1], the conservation principles are not obeyed in individual processes of interaction between matter and radiation. The general theoretical implications of the new results have been considered by Dirac[2], who concludes that they only require us to forgo quantum electrodynamics (in which radiation is represented in terms of light-quanta rather than in