Letters to the Editor

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NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 364.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Capture of Slow Neutrons

IT is known that some nuclei have very large capture cross-sections for slow neutrons. This fact may be explained from the point of view of wave mechanics, which also leads to the consequence that the capture cross-section should decrease with $1/v$ with increasing velocity of the neutrons, so long as the capture probability is constant over the velocity region concerned.

There is, however, a number of experiments which cannot be reconciled with the idea of the validity of the $1/v$ law for all the elements investigated. The influence of temperature[1] and the absorption coefficients of different elements[2,3] have been found to depend on the element used as indicator for the neutrons, and evidence has been obtained for the existence of selective absorption regions[3,4,5], which are different for different elements.

Therefore we have to assume that the capture probability will in general be a complicated function of neutron velocity, depending upon special features of the nuclear model. One would, however, expect a simpler state of affairs in those collisions where the capture of the neutron is immediately followed by the emission of an α-particle, as for example with ^{10}B, because in this case the energy levels of the intermediate excited ^{11}B-nucleus should be very much broadened, on account of its very short life-time; in this case we should therefore expect the capture probability to be fairly constant for low velocities, in any event for the velocity range concerned in the type of experiments described below. One may, therefore, with suitable precautions, try to determine the velocity of neutrons by using the absorption in boron and applying the $1/v$ law.

We have carried out combined absorption experiments with boron and cadmium, using a boron chamber as indicator, which permit an analysis along these lines. Cadmium is known to absorb slow neutrons strongly but to transmit, even in fairly thick layers, a certain part of the neutrons emerging from a paraffin block[6]. Our experiments seem to show that cadmium, though a very efficient absorber for neutrons of thermal energies, becomes almost transparent for neutrons of energies not higher than one volt.

In discussing the absorption in boron, the possibility that the ^{11}B-isotope may contribute to the absorption in a way which deviates from the $1/v$ law must be considered. While this possibility cannot in general be excluded, a detailed discussion, based on the negative result of the search for β-rays under neutron bombardment[7], such as would be expected[8] from ^{12}B, shows that the ^{11}B-absorption cannot be of importance in our measurements.

The surprising sharpness of resonance in cadmium seems to agree with general views on neutron capture and nuclear constitution, recently developed by Bohr[9]. Experiments to investigate along the same lines other cases of selective capture are in progress.

Note added in proof: Experiments on the absorption of a rotating cadmium disk, just published by Rasetti *et al.*[10], indicate a slight variation of the capture probability of cadmium within the thermal energy range. This fact seems to support our conclusions. From these results and our experiments together, we may now deduce that the capture probability in cadmium has a maximum between 1 and 0·03 volt.

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[1] Moon and Tillman, NATURE, **136**, 66 (1935).
[2] Ridenour and Yost, *Phys. Rev.*, **48**, 383 (1935).
[3] Amaldi and Fermi, *Ric. Scient.*, VI, **2**, n. 9–10 (1935).
[4] Szilard, NATURE, **136**, 950 (1935).
[5] Frisch, Hevesy and McKay, NATURE, **137**, 149 (1936).
[6] Dunning *et al.*, *Phys. Rev.*, **48**, 265 (1935).
[7] Amaldi *et al.*, *Ric. Scient.*, VI, **2**, n. 1 (1935).
[8] Crane *et al.*, *Phys. Rev.*, **47**, 887 (1935).
[9] Bohr, NATURE, [**137**, 344 (1936)].
[10] *Phys. Rev.*, **49**, 104 (1936).

Masses of some Light Atoms measured by means of a New Mass-Spectrograph

SINCE my last letter on this subject[1], I have designed and constructed my third mass-spectrograph which embodies second-order focusing. The dispersion, from 4 mm. to 6 mm. for one per cent difference of mass, was calibrated by means of the twin lines of bromine, which were found to have a difference of 1·9983 ± 0·0015 units. The D, H_2 doublet can now be obtained perfectly resolved, and as the lines are not seriously curved it is not difficult to estimate their separation to 0·005 mm. so that an accuracy of 1 in 10^5 is theoretically possible. Unfortunately, the differences in mass deduced from individual doublets show variations greater than this. These appear to depend on the condition of the discharge and are probably due to the uneven illumination of the front slit causing lateral structure in the lines themselves, which may not be quite the same for particles so different as an atom and a molecule. It is hoped to get rid of this technical difficulty as the work proceeds.

The four doublets linking H, D, He, C and O have been again measured with the following results:

Doublet	Number of doublets measured	Difference of packing fraction	Difference of mass
D, H_2	53	$7{\cdot}5_4 \pm 0{\cdot}2$	0·00152
He, D_2	12	$63{\cdot}5 \pm 0{\cdot}2$	0·02551
C^{++}, D_3	10	$70{\cdot}3 \pm 0{\cdot}3$	0·04236
O, CH_4	14	$22{\cdot}4_8 \pm 0{\cdot}15$	0·03601