The Form of Nuclear Levels

RECENT experimental work has proved the existence of selective absorption for neutrons the kinetic energy of which amounts to a few volts by certain nuclei[1–5]. Bohr[6] assumes that in these cases the kinetic energy of the captured neutron is equal to the difference between the energy of a level of the newly-formed nucleus and the mass defect for a neutron with zero velocity. This provides an ideal compensation method for the determination of the distance[7], breadth[5,7] and form of nuclear levels. The total energy of the level, which amounts in all these cases to some millions of volts, does not interfere with the determinations in question, since only the kinetic energy of the absorbed neutrons is measured.

When working with the cadmium filtered radiation of a source of slow neutrons, we observed big deviations from the exponential law for the absorption of resonance neutrons of rhodium (45 sec.) by rhodium and of resonance neutrons of iodine by iodine. In the accompanying table, μ means the mass absorption coefficient for the total absorption, μ' the mass absorption coefficient for each additional absorbing sheet :

	Detector Rh (45 sec.), absorber Rh					Detector I, absorber I				
Absorber gm./cm.²	0·01	0·02	0·04	0·08	0·18	0·2	0·5	0·8	1·8	3·1
Absorption per cent	16	24	31	44	52	27	45	53	58	62
μ	17	14	9	7	4	1·6	1·2	1·0	0·5	0·3
μ'	17	10	5	5	1·6	1·6	0·9	0·5	0·1	0·07

Since the cross-sections of boron for radiation filtered by 0·2 gm./cm.² of rhodium and detected by rhodium (45 sec.) or filtered by 3 gm./cm.² of iodine and detected by iodine, were identical with the cross-sections for the unfiltered radiations, the observed deviations cannot be explained by the existence of a second level for selective neutron absorption, as in the case of silver[1,7]. We think the explanation lies in the self-reversal of the nuclear line. When both the absorption coefficient and the intensity of emission have a maximum for exactly the same energy, the middle of the line will be totally extinguished after passage through a sufficient layer of the absorber, that which penetrates consisting only of the weakly absorbable tails. By determining the absorption coefficient for each additional layer of the absorber, the whole range of values for the absorption coefficient between the middle of the line and the tails is obtained. We are thus able to determine the form of the nuclear levels. A detailed analysis and a comparison with the theoretical results of Breit and Wigner[8] will be given later. Qualitatively, the intensity distribution in the line is already obtained by plotting μ against A'/μ', A' being the fraction of the total radiation which is absorbed by each sheet. Fig. 1 shows the result for rhodium (45 sec.) plotted in this way. The real form of the line shows somewhat bigger differences of intensity. The half-value breadth amounts, as was shown by other experiments, to about 0·25 volt.

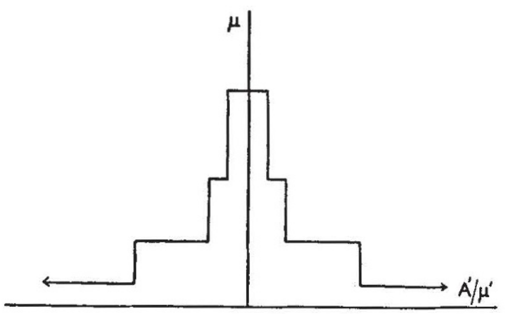

FIG. 1.

Errata : There was a mistake in the calculations for μ_B and the energies of the levels iodine and bromine (18 min.) in our letter in NATURE of May 30, p. 905. The correct values are : Iodine, $\mu_B = 0{\cdot}7$, energy $= 75 \pm 15$ volts. Bromine (18 min.) $\mu_B = 0{\cdot}35$, energy $= 300 \pm 80$ volts. The results for silver and rhodium are correct.

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June 6.

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The Crystal Photo-effect and Rectifying Action in the Bulk of the Crystal

ATTEMPTS have been made to discover how far a rectifying action is connected with the crystal photo-electric effect (Dember effect). A. and A. Joffé have already suggested[1] asymmetry of the photo-electric current due to the illumination of one electrode.

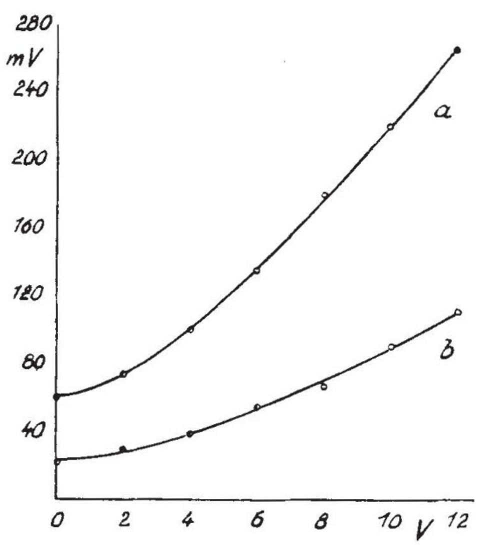

FIG. 1.