liberated; or, *a fortiori*, to form a conclusion as to the possibility of chain reactions, contrary to the results of similar experiments[5].

The only suitable case for showing with certainty, by means of an ionization chamber, the production of neutrons, would be that in which, by the use of a sufficient quantity of uranium, the chain mechanism would give multiplication of neutrons, if such chain is realizable[6].

In conclusion, it results from these experiments with neutrons of polonium plus beryllium that the sum of the cross-sections $\sigma_e+\sigma_i+\sigma_r$ for the uranium nucleus is $(11{\cdot}2 \pm 1{\cdot}5)10^{-24}$ cm.^{2}. This value implies a mean path in uranium much shorter than that usually admitted; this suggests that smaller masses than those hitherto expected might be used to show chain fission.

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Possible Delay in the Emission of Neutrons from Uranium

ROBERTS[1] and others have reported the emission of delayed neutrons with a period of 12 sec. from uranium under neutron bombardment, but the effect seems to be a small one[2], the main body of neutrons being produced in a much shorter period. Green and Alvarez have shown that there is no delay exceeding 3×10^{-3} sec. in the actual production of fission, but it seemed possible that the neutrons might not be produced at the moment of fission but rather as the products of rapid disintegration of the primary fission particles.

Following on a conversation with Prof. N. Bohr, we have made experiments to see if there is any appreciable delay (approximately 0·01 sec.) in the emission of the bulk of the fission neutrons. For this purpose we have used the intermittent neutron source described by Moon and others[3]. In this device, neutrons emitted by the intermittent bombardment of a target of heavy ice with deuterons are detected on a cathode ray oscillograph, the time-scale of which is interrupted by marks produced by the intermittent beam of ions. For the present experiment, the detecting chamber was shielded with cadmium and placed nearer the source (about 2 metres instead of 5 metres), thus increasing the intensity and diminishing the lag due to the time of flight of any slow neutrons present. The period of intermittence was 0·005 sec. and delays exceeding 0·001 sec. could have been detected. Delays larger than 0·005 sec. would have resulted in an approximately uniform distribution of the fission particles over the time-scale. Experiments were made by surrounding the source with a considerable thickness (approximately 10 cm.) of uranium oxide (U_2O_5). Check experiments were made without the uranium, and also without the source but with the uranium.

Two complete sets of experiments were made, one with the source surrounded with wax inside the uranium, the other with it bare. The second experiment showed a slight positive effect corresponding to a cross-section of about 5×10^{-26} cm., about that found by Roberts, but this is of the order of the experimental error. We can, however, say that the effect is less than corresponds to a cross-section of 10^{-25} cm., so that it is unlikely that the bulk of the emission is due to effects having a delay of more than 10^{-3} sec. in the case of the primary neutrons from the D—D process. The experiment with the wax gave a negative result, and assuming that the number of 'slow' neutrons emitted from the source, which was surrounded by about 5 cm. wax, is a quarter that of the fast neutrons emitted under the same conditions, we should have detected a cross-section for the production of a delayed neutron of 5×10^{-25} cm. The value given by Anderson and others for fission is 2×10^{-24} cm., and according to Szilard about two neutrons are produced per fission.

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Evaluation of the Beta Upper Energy Limits with Simple Absorption Data

OF late, several methods have been suggested by different workers[1,2,3,4] for estimating the β upper energy limits of radio-elements (especially those produced in artificial disintegrations) from absorption measurements made with aluminium foils. One great drawback of these methods is that most of them are too empirical and without a theoretical basis, and are limited to cases of simple spectra.

A new method is now proposed, which enables one not only to obtain good results, but also to analyse complex spectra into simple ones, from the ordinary absorption data. It consists essentially in utilizing the absorption measurements to construct the Fermi and Konopinski-Uhlenbeck theoretical curves and deduce the upper limit by extrapolation.

As is well known, the Fermi and Konopinski-Uhlenbeck[5] curves have been used for magnetic spectrograph and cloud chamber data. Kurie, Richardson and Paxton[6] first pointed out a practical way of doing this, and many workers have applied it to several cases with success. To plot these curves, two quantities are required, namely, the number N of β-particles in successive small momentum (or energy) intervals, and the average momentum M (or average energy E) for each of those intervals, all along the distribution curve, chiefly in the high-energy portion. Certain simple considerations make it possible to derive these two factors N and M (or E) to a good approximation even from simple absorption measurements. In consequence, absorption data can be used to draw the Fermi and Konopinski-Uhlenbeck curves.

This new method has been applied with interesting results to radiorhodium and radiosilver obtained with slow neutron activation. The two periods of rhodium are supposed to be isomeric, while those of silver are not.