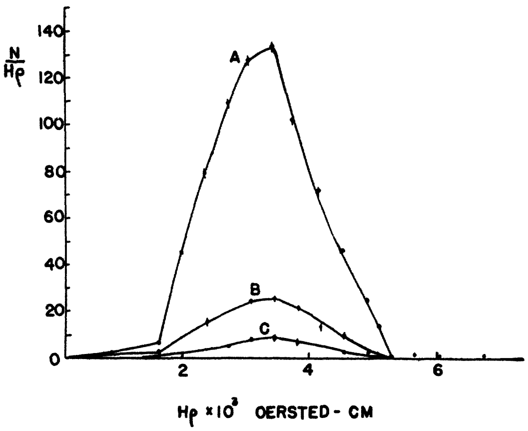

FIG. 1. Momentum distribution of the Compton recoils of the γ-rays from Sc^{48}.

by an amount less than the statistical probable error of the points on the curve of Fig. 1.

The end point of the Compton electron spectrum of Fig. 1 corresponds to a γ-ray energy of $1.35\pm.03$ Mev. It is probable, therefore, that one mode of disintegration of Sc^{48} would consist in the emission of a negative electron spectrum of maximum energy 0.640 Mev followed by a γ-ray of quantum energy $1.35\pm.03$ Mev, a more precise value than that of Walke's absorption method. In addition to information which this result gives with regard to the disintegration energy of Sc^{48}, an excitation level in the Ti^{48} residual nucleus is established at $1.35\pm.03$ Mev. Pollard[6] has reported a level at 1.1 Mev in the Ti^{48} nucleus. The absence of the electrons of a converted γ-ray in the case of Smith's experiment might be attributed to a low internal conversion coefficient arising from the energy of the γ-ray and a small spin difference between the level at 1.35 Mev and the ground state of Ti^{48}. The presence of this γ-ray indicates that the existence of the weak β-ray spectrum of high maximum energy reported by Walke[1] is possible and of maximum energy about 1.99 Mev.

It is a pleasure to thank Professor A. L. Hughes and the cyclotron group of Washington University, St. Louis, Missouri, for the preparation of the radioactive material. Their effective cooperation made possible this work. Experiments of a similar nature are in progress.

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The Diffusion Length of C Neutrons in Water

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THE diffusion length l of C neutrons in water, which is the average distance C neutrons will diffuse in water before being absorbed, has been obtained previously in two different ways. It has been computed either from the data given by Amaldi and Fermi[1] for paraffin or with the help of the equations

$$l=\lambda(n/3)^{\frac{1}{2}} \quad \text{and} \quad n\lambda=\bar{v}\tau,$$

where λ is the mean free path for scattering of C neutrons, n the average number of collisions a C neutron makes before being absorbed, and τ the mean lifetime of slow neutrons (all quantities measured for water). The average velocity $\bar{v}$ of thermal neutrons, is assumed to be 2.2×10^5 cm/sec.

Recent computations[2] have given $l=2.5$ cm, as deduced essentially from the early work of Amaldi and Fermi, and $l=2.22$ cm as deduced from the work of several authors on λ and τ.[3]

It seemed to us desirable to determine l in a somewhat more direct manner. For a point source of C neutrons, or at some distance from a spherical source, the density N of C neutrons in water at a distance R from the center of the source, should be given by the diffusion equation

$$NR=\text{const.}\times e^{-(R/l)}, \tag{1}$$

if the scattering is assumed to be isotropic.[4] Using this equation, we have measured l, with the help of a "virtual" source of C neutrons in the following way.

Inside a large water tank, at a distance of 6.35 cm from a 90 mg Ra-α-Be source, a graphite sphere of 1″ diameter was suspended. The relative slow neutron density N_1 was then measured as a function of the distance R from the center of the sphere on the far side from the Ra-α-Be

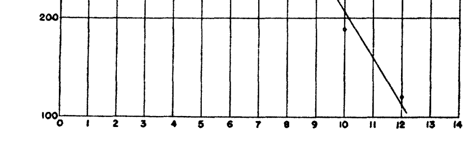

FIG. 1. N = number of counts per minute due to "C neutron source." The root-mean-square error of RN increases from about 5 percent for small values of R to about 30 percent for the larger values of R.

source. As a detector for the slow neutrons we used a small ionization chamber $\frac{1}{4}$″ in diameter, and $1\frac{1}{2}$″ high, lined with boron carbide and connected to a linear amplifier. A similar series of measurements was carried out with Cd (0.5 mm thick) covering the sphere, the slow-neutron density in this case being N_2. $N=N_1-N_2$ should then vary according to the diffusion Eq. (1) for C neutrons.

In Fig. 1 NR has been plotted on a semilog scale as a function of R. From the slope of the straight line fitted to the experimental points we obtain a value $l=3.1$ cm.

A correction, taking account of the fact that our source is not quite spherically symmetrical and that our detector has a finite size, should reduce this value slightly. A round value $l=3$ cm with a probable error of 10 percent may be concluded from our results. This is somewhat larger, but barely outside the respective limits of error, than the value computed from the work of Amaldi and Fermi for paraffin.

According to a calculation kindly carried out by Dr. P. Morrison, the diffusion Eq. (1) will not be appreciably affected by assuming a slight deviation from isotropic scattering for C neutrons in water.

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