$$-\frac{1}{\Sigma_H(u)}\nabla^2\phi_0 + \Sigma_H(u)\phi_0(u) = \int_0^u d\mu'\phi_0(u', x)e^{-(u-u')}\Sigma_H(u) + S_0;$$

(purely hydrogenous medium)

for an uncorrelated scattering kernel the corresponding equation is more complicated. However, even the above must usually be solved by a machine, and if a machine is to be employed, one might as well use the exact kernel rather than an approximate one. In those cases in which one can use the Selengut-Goertzel approximation analytically, the uncorrelated approximation appears preferable. (In some cases it might be best to use a combination of two-thirds uncorrelated scattering kernel and one-third Selengut-Goertzel scattering kernel, since this gives the correct asymptotic value for the age.)

The uncorrelated approximation can be applied easily to a more general medium containing a hydrogenous cross section Σ_H, an absorption cross section Σ_a, and an "infinitely heavy" scatterer with cross section Σ_0 and an average cosine theta of $\bar{\mu}$.

In this case one gets

$$\phi_0(x = 0, u) = \frac{m}{2}e^{-nu}[I_0(mu) + I_1(mu)]\sqrt{\frac{\Sigma_T - \bar{\mu}\Sigma_0}{\Sigma_H + \Sigma_a}} \qquad u \neq 0$$

$$m = \frac{1}{2}\left[1 - \frac{\frac{2}{3}\Sigma_H}{\Sigma_T - \bar{\mu}\Sigma_0} - \frac{\Sigma_a}{\Sigma_H + \Sigma_a}\right]$$

$$n = \frac{1}{2}\left[1 - \frac{\frac{2}{3}\Sigma_H}{\Sigma_T - \bar{\mu}\Sigma_0} + \frac{\Sigma_a}{\Sigma_H + \Sigma_a}\right]$$

$$\Sigma_T = \Sigma_H + \Sigma_a + \Sigma_0.$$

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The Age of Plutonium-Beryllium Neutrons in Light Water[1]

The disagreement between theoretically calculated and experimentally observed ages in hydrogenous media has led to a continuing interest in these measurements. Although many age experiments have been made using other than fission neutrons, it seems that a considerable amount of the work has been done with neutrons produced by polonium-beryllium sources which have several disadvantages (*1*) that can be avoided by the use of plutonium-beryllium sources.

Some measurements have been made in this Laboratory of the ages of plutonium-beryllium neutrons in light water to the indium (1.458 ev), rhodium (1.25 ev), and silver (5.18 ev) resonances.

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TABLE I

Neutron source	Neutron age (cm²)		
	Ag^{109} (5.18 ev)	In^{115}(1.458 ev)	Rh^{103}(1.25 ev)
Pu-Be	49.3	52.8 ± 2.5	53.7 ± 2.5
Po-Be		57.3 ± 2.0	

The sources were suspended by means of stainless steel wires in a cylindrical tank about 4 ft in diameter and 4 ft in height. The cadmium-covered indium foils were placed in lucite holders which were suspended above the source by an aluminum rod. The foils were irradiated separately in order to avoid shadowing effects and each irradiation lasted for at least six hours. The activities were corrected in the usual manner for background, flux depression by the cadmium covers (*2*), and finite size of the source and foils (*3*). Activations by neutrons of energies higher than the resonance energy of interest were assumed to be negligible (*4, 5*). The activation curves were plotted in the usual manner. The area under the exponential portion of the curve was obtained analytically and the remaining area evaluated by Simpson's rule. Preliminary results of these measurements are given in Table I.

The measurement of the age of the polonium-beryllium neutrons was made principally for the purpose of evaluating the dependability of the techniques used, and the result obtained appears to be in reasonable agreement with the average age found by other authors (*6*).

One of the disadvantages of the plutonium-beryllium source is its low specific activity and this, coupled with the low abundance of the 109-isotope, resulted in poor statistics for the case of silver. For this reason, no error is assigned to the age to the silver resonance (5.18 ev) as the value reported is considered to be only an indication of the true age.

A paper on these experiments is in preparation and will be submitted for publication at a later date.

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