$$b' = \{(\alpha^2+4a^2)^{\frac{1}{2}}+\alpha\}/2$$

and

$$\alpha=(b^2+c^2-a^2)/b$$

Good coincidence was found between the experiments and this formula. Therefore, the counting ratio of of the circular source of radius c and the point source of equal intensity was easily shown as

$$R=\frac{\textit{Counts of a circular source}}{\textit{Counts of a point source}}=\frac{2\int_0^c f(c)\cdot c\cdot \mathrm{d}c}{f(0)\cdot c^2}$$

Two examples of this ratio are shown in Table 1 which shows that the counts with a circular source of larger radius deviate greatly from those with a point source; care must be taken on the absolute counting of a β-ray source with planar extension.

Table 1.

	R				
b \ c	0	4	8	12	16
9	1.000	0.968	0.868	0.708	0.541
34	1.000	0.981	0.935	0.888	0.827

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2. Absolute β-ray Counting. (II)

Analysis of Specific Activities

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In order to measure an absolute number of β-particles from samples, the effect of the self-absorption and self-backscattering should be eliminated. Usually, a curve of specific activity *versus* thickness of samples shows a maximum point. Considering that it was due to the self-absorption and self-backscattering of β-rays, we analysed this curve and obtained satisfactory result.

Silver discs of various thicknesses and of same diameter (21 mm.) were activated by slow neutrons in a paraffin pile. The thickness of samples varied from 218.0 mg./cm^2. to 10.2 mg./cm^2. Silver monitors of the same diameter were used. Samples and monitors were irradiated during five minutes, and four minutes later β-activities produced in samples and monitors were observed for seven minutes by a 2π-type β-counter respectively. Since, in the present case, β-activities of Ag^{110} with a half life shorter than 30 sec.

could be neglected, only those of Ag^{108} with 2.3 minutes half-life were measured. A distance between an effective volume of the counter and an upper surface of a sample was chosen always as 7.3 mm. Thus, we obtained a curve of specific activity *versus* thickness of samples.

In order to know the effect of the absorption of neutrons in samples, we covered samples by silver discs of various thicknesses. Thus we obtained the following experimental expression:

$$I=\tfrac{1}{2}I_0(e^{-kx}+e^{-k(x_0-x)}) \tag{1}$$

where x_0 was a thickness of a sample, I was the intensity of activities at the depth of x, I_0 was that without absorption, and k was an absorption coefficient of neutrons and, in our case, was found to be 0.00202 (mg./cm^2.)$^{-1}$.

The self-absorption of β-rays in a sample was obtained by the ordinary external absorption experiment. The result was expressed by

$$I=I_0e^{-ax}, \tag{2}$$

where a was an absorption coefficient of β-rays and found to be 0.0112 (mg./cm^2.)$^{-1}$.

Finally, we put silver discs of various thicknesses beneath the thinnest sample as backings. By a simple assumption, this curve of backscattering was expressed by the form

$$I=I_0\left\{1+\beta(1-e^{-2ax})\right\}, \tag{3}$$

where a was the same as in Eq. (2), and β was a constant. This expression showed a good agreement with the experiment with $\beta=0.367$.

From Eqs. (1), (2) and (3), we obtained the expression for a curve of specific activity *versus* thickness of samples as follows:

$$S=\frac{I}{x_0}=\frac{1}{x_0}\frac{1}{2}\int_0^{x_0}(e^{-kx}+e^{-k(x_0-x)})\,e^{-ax}\left\{1+\beta(1-e^{-2a(x_0-x)})\right\}dx, \tag{4}$$

where S was specific activity.

Eq. (4) was found to agree with the experiment within an error of 3 percent.

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3. On the Ammonia Proportional Counter

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We have investigated the properties of an ammonia proportional counter.

Ammonia gas was supplied by heating commercial aqueous ammonia and sufficiently dehydrated in the potassium hydroxide drying vessel for about 24 hours.