BETA RAY ABSORPTION CURVE OF ONE PARTICLE OF FALLOUT PRODUCTS

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On determining the radioactive contamination in the air in Rio de Janeiro we obtained a particle of fallout products with an uncommon intensity. It was collected by the air-filtering method described by G. Kegel (An. Acad. Brasil Cien., 1956) in June 25, 1957. The present work consists only in the detremination of its beta ray absorption curve on passage through aluminum.

Experimental Procedure

The arrangement used is shown in Fig. 1 and represents an end window Geiger counter, the aluminum absorber and the filter with the particle. The thickness of the mica window was 1.4 mg/cm^2, and the aluminum sheets were calibrated in mg/cm^2. The filter was placed in such a way that the particle was on the counter axis of symetry. The whole sistem was protected with 5 cm lead wall to diminish the natural background.

Results of the Measurements

The form of beta ray absorption curves depends on the geometry of the counter-source arrangement. The measured curve represents the superposition of a divergent beam of rays and easily conceals the existence of groups of rays with different energies. For a point source situated along the axis of symmetry at a fixed

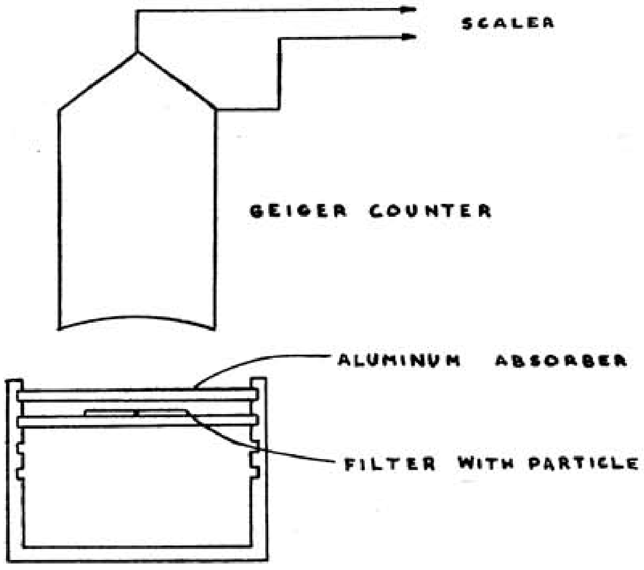

FIG. 1

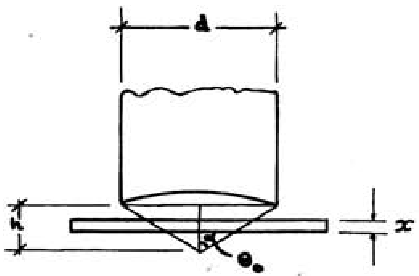

FIG. 2

distance from a cylindrical end window counter, the application of the Gross transform is possible. In this way the absorption curve for a parallel beam is obtained.

If φ (x) is the absorption curve for a parallel beam, J (x) the measured curve, x the thickness of the absorber, and θ_0 the maximum value of θ (Fig. 2), then one has

$$(1) \qquad J(x) = \int_0^{2\pi} d\varphi \int_0^{\theta_0} \varphi\,(x/\cos\theta)\,\sin\theta\, d\theta$$

This gives for φ (x) the equation

$$(2) \qquad \varphi\,(x) = f\,(x) + a\,\varphi\,(x/a)$$

where

$$(3a) \qquad f\,(x) = 1/2\left[J - xdJ/.dx\right]$$

and

$$(3b) \qquad a = \cos\theta_0$$

Since $a < 1$, we solve (3a) by the expansion

$$(4) \qquad \varphi\,(x) = \sum_0^{\infty} a^n \varphi_n\,(x)\ .$$

Substitution into (3a) and equaling terms with identical powers of a gives

$$(5) \qquad \varphi_n\,(x) = \varphi\,(x/a^n).$$

The final solution is therefore

$$(6) \qquad \varphi(x) = \sum_{0}^{\infty} a^{n} f(x/a^{n})$$

The first term coincides with the usual form of the transform.

It is frequently convenient to draw the absorption curve as log J (x). Then one has

$$(7) \qquad f(x) = 1/2. \left\{ J(x) \left[1 - x d\log J(x)/dx \right] \right\} .$$

The measurements were obtained for each aluminum sheet up to values not lower than 6000 counts. The background (measured without absorber) was 8.3% of the lowest counting.

The following table shows two kinds of measurements in relative intensity:

A) without applying the Gross transform

B) developing the Gross transform (expression 6) until the third term.

TABLE

Absorber Thickness	*Relative Intensity* A	B
mg / cm²	%	%
0	100	100
3.4	82.8	80.6
6.8	72.1	70.0
16.0	57.6	54.6
19.5	54.9	51.7

Absorber Thickness	*Relative Intensity* A	B
mg / cm²	%	%
27.6	49.3	48.1
35.6	45.6	45.0
42.4	43.8	43.3
52.4	42.2	41.6
63.4	40.7	40.2
82.6	39.3	38.3
108.3	37.9	36.0
138.6	33.8	32.5
184.6	30.0	29.0
220.3	27.2	24.7
275.6	23.0	20.7
350.0	17.6	15.3
444.5	12.7	10.9
566.1	7.90	6.67
625.0	6.00	5.80
726.3	3.80	3.56
869.4	2.10	2.08
1.089.7	0.99	0.86

These data may then be represented as in Figures 3 and 4, where the ordinates are the relative intensities plotted on a logarithmic scale.

In Fig. 3 we have the absorption curve given directly by the measurement with the scaler (and expressed in percent of the maximum count), Fig. 4 represents that curve on which the Gross transform was applied. For this purpose we got the value of "*a*" in Fig. 2; that is:

$$a = \cos\theta_0 = 2h / \sqrt{4h^2 + d^2}$$

From our data we find

$a = 0.506$

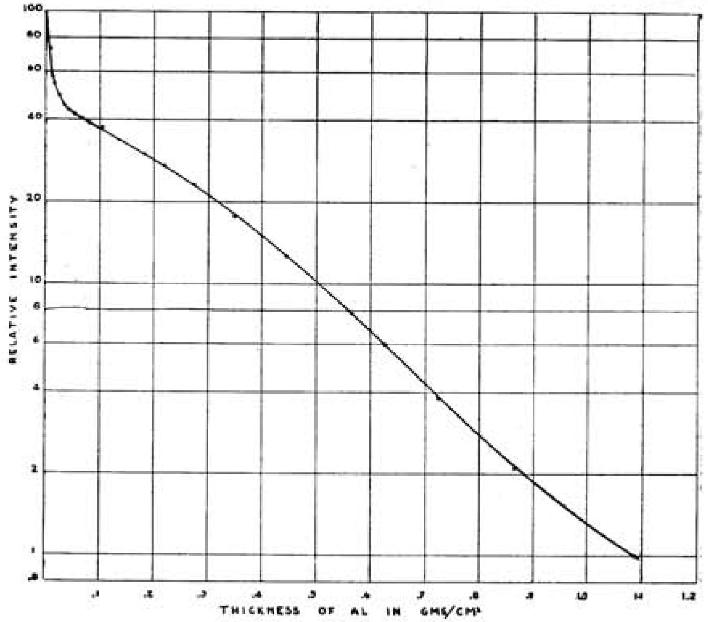

FIG. 3

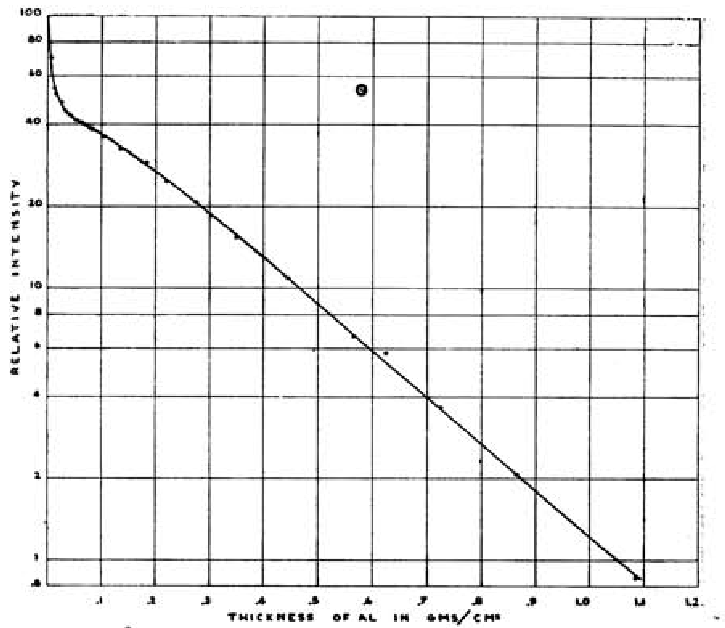

FIG. 4

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