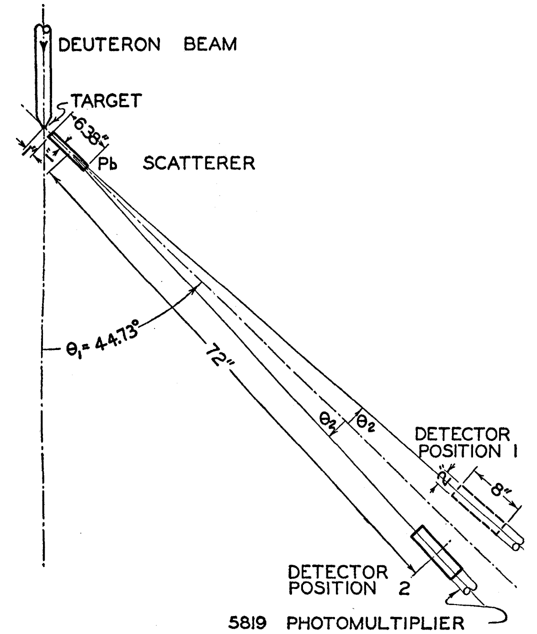

FIG. 1. Experimental arrangement.

For a given θ_1 this ratio may be solved for the polarization $P_1(\theta_1)$ if $P_2(\theta_2)$ is known.

θ_1 was 45° in center-of-mass coordinates, and the ratio R was measured for two angles $\theta_2=3.23°$ and 4.47°. At $\theta_2=4.47°$, $R=1.2\pm0.2$; and at $\theta_2=3.23°$, $R=1.5\pm0.2$. The value of $P_2(\theta_2)$ can be computed as in Schwinger's discussion, giving values of the polarization $P_1(45°)$ to be 30 percent from R at $\theta_2=4.47°$ and 40 percent ±20 percent from R at $\theta_2=3.23°$.

The chief uncertainty in the experimental data is due to the background count, and the experiment is being repeated to lower the uncertainties.

The neutrons were detected by a liquid xylene-terphenyl mixture coupled to a 5819 photomultiplier. The details of the experimental arrangement and the revised data will appear in a subsequent article.

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The Decay of Rubidium 87

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SINCE the discovery of natural radioactivity in rubidium by Thomson[1] in 1905, much work has been done in an attempt to evaluate its properties. Strassman and Walling,[2] evaluating the half-life from a determination of the ratio of Sr^{87} to Rb^{87} in a lepidolite sample of known geologic age, obtained the value $T_{\frac{1}{2}}=6.3\times10^{10}$ years. In addition many determinations of the half-life have been made by counting methods.[3-5] Recent results range from $5.8\pm1.0\times10^{10}$ years to $6.5\pm0.6\times10^{10}$ years. Most of the values obtained must be carefully evaluated, since in many of the cases thick sources or backings were used, and in some it was found necessary to make assumptions concerning the decay scheme.

Experiments giving information about the decay products have been in disagreement. By means of absorption measures, Hoffman[6] (1924) and Mühlhoff[7] (1930) found evidence of a weak beta-radiation accompanying a stronger one. Ollano[8] (1941) reported at least five electron lines lying over a continuous background. The absorption work of Eklund[3] (1945) indicated simple beta-decay. Haxel *et al.*[4] (1948) found up to 30 percent coincidences between the front and back sides of the source and attributed them to a beta-particle in coincidence with a 100-percent-converted gamma-ray. Curran *et al.*[5] (1951), using a proportional counter, obtained an energy spectrum of the beta-disintegration from which they concluded that the process is simple beta-dacay.

The present work was undertaken to re-evaluate the half-life and to provide further information about the decay scheme. In measuring the half-life of Rb^{87}, the cell counter described by Sawyer and Wiedenbeck[9] was used. A thin aluminized zapon film of about 0.025 mg/cm², upon which RbCl was vaporized, served as the cathode. The two sections were operated in parallel. With this arrangement the results are essentially independent of the decay scheme. Data were obtained for various source and backing thicknesses (Fig. 1). The specific activity extrapolated to zero thickness is 478 counts/g RbCl/sec; this, combined with Nier's value[10] for the isotopic abundance, gives $T_{\frac{1}{2}}=6.23\pm0.3\times10^{10}$ years. (Using Paul's[11] more recent value for this abundance, one obtains $T_{\frac{1}{2}}=6.29\times0.3\times10^{10}$ years.)

An investigation was then carried out to determine whether or not there are coincidences between beta-particles and conversion electrons. The counter mentioned above was modified by insulating the source from the rest of the counter and placing wire screens on both sides of the source, between the source and the cell counters. The screens were placed about 2 cm from the source, thus enabling a negative screen potential to discriminate against low energy electrons coming from the source. The two cell counters were

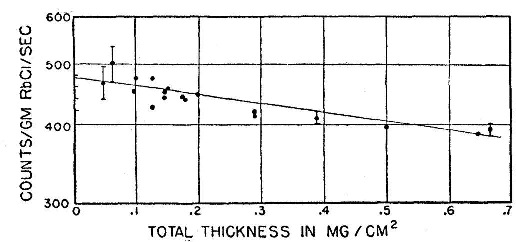

FIG. 1. Counting rate *versus* total source-plus-backing thickness. A zero-thickness activity of 478 counts per g RbCl per sec was obtained.

operated in coincidence, and a third cell counter was placed in anticoincidence to eliminate cosmic-ray effects. Coincidences which occur when the screen is at a negative potential arise either from a two-particle disintegration in which each particle has sufficient energy to traverse the 2 cm of counter gas between the source and the screen, or else from a single particle disintegration in which the particle is scattered from the sensitive region of one counter into the sensitive region of the other counter. When the screens are positive with respect to the source, there is superimposed on the above effect those real coincidences which arise from low energy particles which cannot traverse the 2 cm of counter gas, as well as coincidences due to a single particle which is scattered from one side of the source to the other in the region between the two screens.

Preliminary work was carried out with a group of single beta-emitters having different upper energies. These included Ni^{63}(50 kev), S^{35}(169 kev), Ca^{45}(260 kev), and P^{32}(1.7 Mev). The coincidence curves for these elements varied slightly with the energy of the emitted radiation. Changing the source activity by a factor of 100 and the resolving time of the coincidence circuit from 8 to 30 microseconds had no effect on the shape of the curves. Decreasing the gas pressure in the counter lowered the curves on the screen positive side (by reducing gas scattering), and it raised the curves on the screen-negative side (by increasing the mean free path).

Curves were taken for Rb^{87} sources of varying thicknesses. The Curve obtained for the thinnest source, 0.04 mg/cm², most closely resembled the curves for S^{35} and Ca^{45}. Figure 2 shows the curves

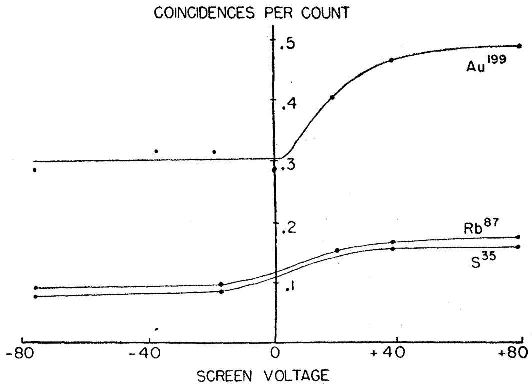

FIG. 2. Coincidence curves for Au^{199}, Rb^{87}, and S^{35}, plotted as a function of screen voltage.

for S^{35} and Rb^{87}, as well as the curve for Au^{199}, all obtained with a total source plus backing thickness of about 0.1 mg/cm^2. The close agreement of Rb^{87} with S^{35} is apparent. Au^{199}, which emits beta-radiation followed approximately 40 percent of the time by conversion electrons,[12] has a much higher coincidence rate.

On the basis of these results, it seems safe to conclude that the disintegration of Rb^{87} consists of a simple beta-decay.

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* AEC Predoctoral Fellow.

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Transmission of X-Rays through Calcite near the Bragg Angle

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RECENTLY Campbell[1] has reconsidered the problem of the transmission of x-ray radiation through a crystal when set at the Bragg angle. This same problem has also been investigated experimentally by Bragg, Bosanquet, and James[2] and Borrmann.[3,4] When a monochromatic beam of x-rays falls on a thin crystal, as this crystal is rotated through the Bragg angle, part of the incident beam is reflected and part of it is transmitted straight through. Bragg, using a rocksalt crystal, has observed that this transmitted intensity at a wavelength of about 0.5A will decrease at the Bragg angle, whereas Campbell at about 1.5A has measured an increase in this intensity for various crystals.

We have measured the transmitted intensity at the Bragg angle for single crystals of calcite using monochromatic radiation from 0.7A to 2.3A. A double crystal spectrometer served as a monochromator. When working at the wavelength of a strong emission line, sufficient intensity was available to use the $(1, +1)$ position at the peak of the line. When using the continuum from a W target, because of intensity limitation, the $(1, -1)$ position was used to obtain limited monochromatization. The crystal under investigation was mounted on the axis of an Allison-type spectrometer and could be rotated by a synchronous motor drive at an angular speed of 27 sec/min. Crystals with the reflecting planes parallel to the surface using both external and internal reflections were investigated. In some cases crystals were cut with planes perpendicular to the surface. An indication of the perfection of the crystal was obtained from the width of the $(1, -1)$ diffraction pattern which in all cases was a symmetrical curve.[5] The intensity was measured with an argon filled Geiger counter and a General Radio counting rate meter, the output of which was recorded with an Esterline-Angus recording milliameter.

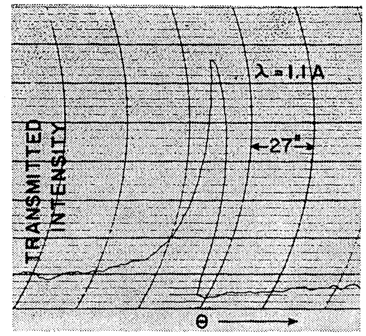

FIG. 1. Transmission curve for a calcite crystal.

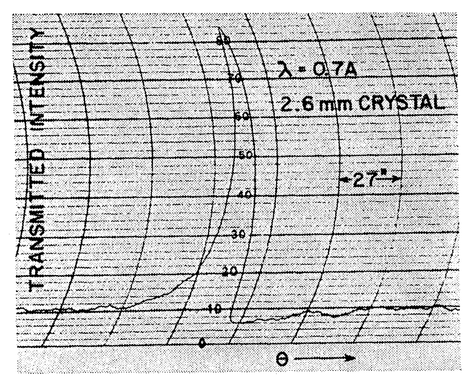

FIG. 2. Transmission curve for a 2.6-mm calcite crystal.

The results of both Bragg and Campbell were confirmed using the peaks of Mo $K\alpha 1$ and Cu $K\alpha 1$. The expected decrease in the transmitted intensity was observed at the short wavelength and the expected increase was observed at the longer wavelength. By using Cr $K\alpha$ radiation a large increase in transmitted intensity at the Bragg angle was also observed. With the spectrometer set to pass radiation of about 1.1A, the transmitted intensity was found to show a dip on the long wavelength side of the Bragg angle and a substantial increase at the Bragg angle as shown in Fig. 1. The absorption on the two sides of the Bragg angle was not the same.

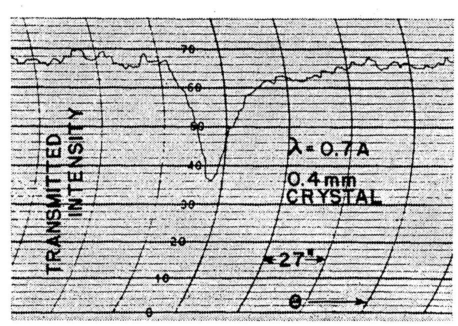

FIG. 3. Transmission curve for a 0.4-mm calcite crystal.