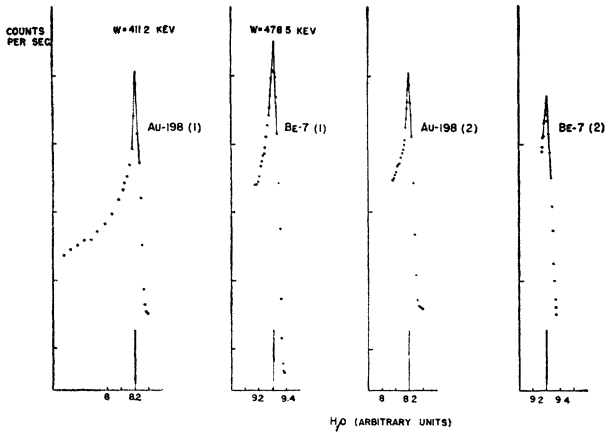

FIG. 1. Spectra of the photoelectrons ejected from a 50 mg/cm² uranium radiator by the gamma-rays of Au^{198} and Be^{7}. The ordinates representing the number of counts per second have been normalized to bring the lines to approximately the same height graphically; and are graduated in arbitrary units.

	Au(1)	Li(1)	Au(2)	Li(2)
Momentum	8.20	9.31	8.20	9.30

Taking for the gold line the value reported by DuMond:[6] 411.2 kev, we find for the energy of the excited state of Li^{7}: 478.5±0.5 kev. Elliott and Bell[3] reported the value of 478.5±1.5 kev for the energy of the excited state of Li^{7} reached $B^{10}(n, \alpha)Li^{7*}$. It appears from these results that if these two excited states are different they are not separated by more than 2 kev.

This work was assisted by the joint program of the ONR and AEC.

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TABLE I. Values of I_0/I_{90} for targets of various diameters.

I Diameter of D_2O Holder	II I_0/I_{90}	III I_0/I_{90} Corrected for geometry
12 mm	0.393	
	0.354	
	average 0.374±7 percent	0.350
9 mm	0.318	
	0.361	
	0.347	
	0.357	
	average 0.346±6 percent	0.321
6 mm	0.245	
	0.304	
	0.364	
	0.279	
	average 0.298±16 percent	0.271
4.5 mm	0.299	
	0.282	
	0.264	
	0.257	
	0.354	
	average 0.276±19 percent	0.248

holders were made of steel tubing 0.0125 cm-thick and 5 cm-long. The outer diameters were 4.5, 6, 9, and 12 mm respectively. Column II of Table I shows the values of I_0/I_{90} for the different targets obtained on different runs lasting 12–24 hours. In column III are the average values for a given diameter of the results in column II corrected for geometry.

Assuming a linear dependence on radius of I_0/I_{90}, the extrapolated value for zero radius is 0.17. This yields a value of a/b of 0.205±.05.

The value previously reported by us[4] was not corrected properly. The present value is in agreement with Lassen's[5] corrected value and with Meiner's value.

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The Angular Distribution of the Photo-Neutrons from Deuterium at 2.76 Mev

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THE apparatus and techniques used in the study of the photoneutrons from beryllium[1] have been used to study the photoneutrons produced in deuterium by 2.76-Mev γ-rays. The distribution is found to be of the form $I(\theta)=a+b\sin^2\theta$. The ratio a/b is best found by measurements made at 0° and 90°. The results are subject to two corrections, a geometrical one caused by the finite angles subtended by the source and counter at the target and a correction caused by neutrons being scattered inside the D_2O target. The former correction is readily estimated from the relative dimensions and spacings of the target, source and counter. The scattering correction may be estimated in a very rough manner.[1] However, because of the large effect of this correction on the a/b value for deuterium, an experimental study was made of the correction.

The method used is similar to the one of Graham and Halban[2] and Meiners.[3] Since the scattering effect should become smaller and smaller as the size of the D_2O target decreased a set of D_2O targets of varying diameters was used. The cylindrical D_2O

28.7-Hour Ba^{135}

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WITH electromagnetically enriched Ba^{132}, Ba^{134}, Ba^{135}, and Ba^{136} ** now available, the previously reported 28.7-hour barium activity[1–3] has been investigated. It had been postulated that this activity was a metastable state of Ba^{135} although assignments to other mass numbers were not entirely ruled out.[3] It is the purpose of this letter to confirm the mass assignment of the 28.7-hour activity to Ba^{135}. As the degree of enrichment of the respective barium isotopes is not yet available, this mass assignment has been made on the basis of the specific activities per milligram of barium in the enriched barium samples after bombardments with deuterons and fast neutrons.

Bombardment of enriched $Ba^{134}(NO_3)_2$ with 10-Mev deuterons yielded the 28.7-hour activity in the barium fraction. Characteristic radiaions were 0.28-Mev negatively charged particles, barium x-rays, and a 0.30-Mev gamma-ray in agreement with the measurements previously reported.[1–3]

The bombardment of $Ba^{134}(NO_3)_2$ with 10-Mev deuterons produced more of the 28.7-hour activity than similar bombardments of the nitrates of the enriched Ba^{132}, Ba^{135}, Ba^{136}, and normal barium. The same chemical procedures were used in extracting barium fractions. The bombardment time was the same in each case. Decays were followed on a Wulf electrometer.

The resulting specific activities in terms of the time-off intensity of the 28.7-hour activity per milligram of bombarded barium were in the ratios 1.00:0.73:0.54:0.03:0.05 for the samples enriched in Ba^{134}, Ba^{132}, Ba^{135}, and Ba^{136}, and natural barium, respectively. Similar bombardments of the enriched barium isotopes in carbonate form with fast neutrons from Li+d produced the 28.7-hour activity with specific activities in the ratios 1.00:0.42:0.42:0.09:0.04 for the samples enriched in Ba^{135}, Ba^{132}, Ba^{134}, and Ba^{136}, and natural barium. Bombardments of Hilger CsCl with 10-Mev deuterons yielded the well-known 38.5-hour activity[4] of Ba^{133} in the barium fraction but no 28.7-hour activity, precluding assignment of the 28.7-hour activity to Ba^{133} or Ba^{134} as a result of the reaction $Cs^{133}(d, 2n)$ or $Cs^{133}(d, n)$. Bombardment of Hilger CsCl with 20-Mev alpha-particles did not produce the 28.7-hour activity in the barium fraction, ruling out assignment to Ba^{136} as a result of the reaction $Cs^{133}(\alpha, p)$.

On the basis of these data the 28.7-hour activity in barium is assigned to an isomeric state of Ba^{135} as a result of the reactions $Ba^{134}(d, p)$ and $Ba^{135}(n', n)$. Calculations of the cross sections for the reactions will be communicated when the isotopic analyses of the enriched barium isotopes are available.

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** Supplied by the Y-12 plant, Carbide and Carbon Chemicals Corporation, through the Isotope Division, AEC, Oak Ridge, Tennessee.

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Upper Limit for the Lifetime of the 411-Kev Excited State of Hg^{198}

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THE β-γ-coincidences arising from the Au^{198}—Hg^{198} β-disintegration have been examined with a coincidence circuit of short resolving time in an effort to measure the mean life of the 411-kev γ-emitting state of Hg^{198}. Using the method of delayed coincidences and resolving times $2\tau_0$ less than 10^{-8} sec., the mean life is found too short to detect, in contradiction to MacIntyre's recent result[1] for the same measurement.

The coincidence unit employs anthracene—1P21 scintillation counters operated with electrode voltages so high (~2000 v) that their output pulses do not require amplification. The pulses are equalized in Type 6AK5 pentodes and led along 95-ohm matched coaxial cable to a 50-ohm shorted coaxial cable clipper which determines their length, and thence to a 1N34 diode coincidence mixer. The pulses from either counter can be delayed by accurately known amounts by lengthening the appropriate signal cable. Checks have been made to see that the extra lengths of cable used to delay the pulses do not cause any loss of coincidences through attenuation. The selection of pulse heights and determination of counting rates in the individual counters is accomplished by feeding the individual counter pulses by separate cables into two ordinary linear amplifiers equipped with amplitude discriminators. The output pulses of these amplifiers are fed into a relatively slow (~2 μsec.) triple coincidence circuit with the unselected fast coincidence pulses, and the desired coincidence rate is counted at the triple coincidence output. In this way only those fast coincidences are recorded which correspond to pulses larger than a fixed size from the individual counters, and the difficulties of very fast pulse height discrimination are avoided.

The resolution curve of the coincidence unit was measured by observing the coincidence rate as a function of delay of the pulses from each counter in turn. Results have been recorded for Co^{60} γ-γ-coincidences, Cs^{134} γ-γ-coincidences, and Au^{198} β-γ-coincidences at two different resolving times, $2\tau_0=9\times10^{-9}$ sec. and $2\tau_0=5.5\times10^{-9}$ sec. To clarify the diagrams, only the Cs^{134} and Au^{198} results at the shorter resolving time are shown. (The Co^{60} results are indistinguishable from those for Cs^{134}.) Figure 1 shows the resolution curves observed for Cs^{134} γ-γ- and Au^{198} β-γ-coincidences. The two curves are identical within experimental error and both are highly symmetrical. If the Hg^{198} 411-kev excited state had a mean life τ long enough to be detectable in this experiment, the right-hand (β-pulse delay) portion of the Au^{198} resolution curve would have a tail falling off as $\exp(-T/\tau)$, where T is the delay time.[2] No such tendency is visible in Fig. 1. The slight shifts (~4×10^{-10} sec.) of the maxima of the curves of Fig. 1 with respect to each other and to the zero of time represent fixed delays due to differences in transit time of the electrons in the photomultiplier tubes at slightly different electrode voltages. As a check on this explanation, the voltage on one photo-multiplier was lowered by 30 percent: the resolution curve then moved, without change of shape, in the direction corresponding to a lag of 3.4×10^{-9} sec. in the pulses from that tube. A resolution curve was plotted for β-α-coincidences from ThC(β)ThC'(α)ThD to

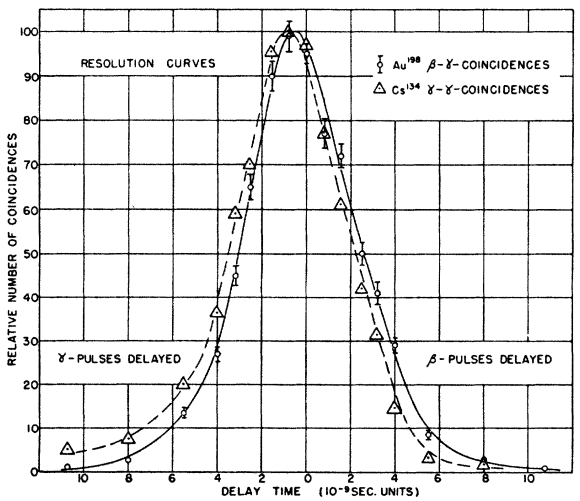

FIG. 1. Resolution curves of the coincidence unit for Au^{198} β-γ-coincidences and Cs^{134} γ-γ-coincidences.

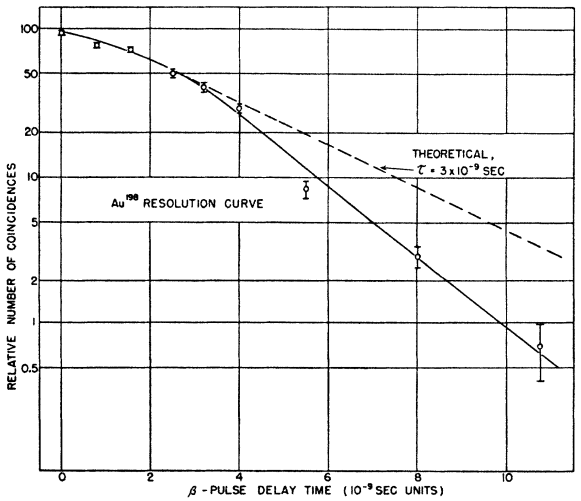

FIG. 2. β-pulse delay portion of Au^{198} resolution curve plotted on a logarithmic scale.