other end by a carbon-strip resistance thermometer detector (C).[7] Normal sound at a frequency of 1000 cycles was generated in the vapor by the transmitter (M). The temperature was now set at about 1.7°K and allowed to rise slowly beyond the λ-point. A series of second-sound resonances at 1000 cycles was detected by C, the output of which was amplified, rectified, and recorded on a recording potentiometer. The length of the liquid column remained substantially constant during this temperature sweep, and a resonance peak occurred whenever the velocity was such that the liquid column was an integral number of half-wave lengths. As was to be expected, we found that the resonances came successively closer together and finally disappeared at the λ-point. This allowed calculation of the velocity of second sound at a series of temperatures, and the results are in substantial agreement with our previous measurements and also those of Peshkov.

It appears possible that this method of generating second sound might be useful for extending the velocity measurements to lower temperatures, inasmuch as the heat generated in the liquid is much smaller than in the case of generation by a resistance heater.

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Formation and Properties of Radioactive Lithium*

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THE short-lived Li^8 (half-life about 1 sec.) was first produced[1] by the (d, p) reaction on Li^7. Knol and Veldkamp[2] found evidence for the formation of this activity by neutron irradiation of lithium. Bethe[3] concluded that the activity found by Knol and Veldkamp was really He^6 formed by the reaction $Li^6(n, p)He^6$ because He^6 was known to have approximately the same half-life as Li^8 and formation of the latter by an (n, γ) reaction would be unlikely for such a light element. Rumbaugh[4] looked for the capture reaction in Li^7 also, but was unable to find it and fixed the upper limit for the cross section at about 10^{-3} barn. As this value of the cross section was smaller than that necessary to give the results observed by Knol and Veldkamp, it appeared as though the reaction they had observed was really the $Li(n, p)$ reaction. Recently Poole and Paul[5] reported that Li^8 is formed by the (n, γ) reaction with a cross section about 10^{-3} barn. In view of the uncertainty concerning this reaction, it seems well to publish some results which were obtained using the deuterium-moderated pile at the Argonne Laboratory during the spring of 1945.

Several grams of Li_2O were placed in a lusteroid tube and irradiated for several seconds inside the pile shield. The sample was transferred from the pile through an aluminum tube to a position where a G.M. counter was placed just outside the tube. A short life of intensity sufficient to block the scaler for about 10 sec. was observed in spite of the 1 g/cm² absorber equivalent of the aluminum tube. Figure 1 shows the decay over many half-lives of this activity

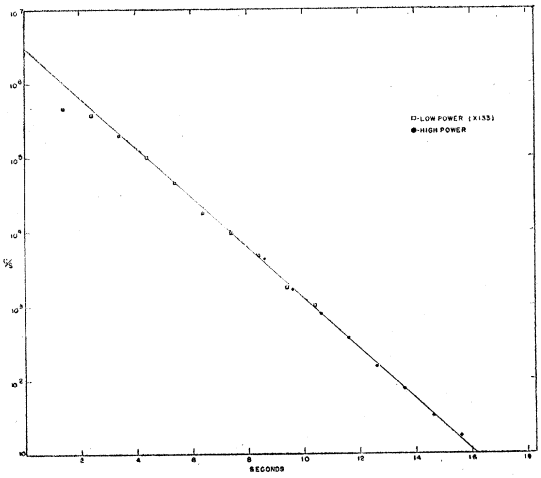

FIG. 1. Decay curve of irradiated sample.

made up of runs at two power levels. The half-life of 0.89 ± 0.02 sec. agrees with the previous value[1] of 0.88 ± 0.1 sec. for Li^8 obtained from the (d, p) reaction.

When the sample is covered with Cd the activity drops to 2 percent of its no-Cd value, thus showing that the activation is thermal. A rough absorption curve in Al was obtained and its end point (about 6 g/cm²) indicates an energy of at least 11 Mev. The cross section was estimated by measuring the value of nv with a standard gold foil, calculating the geometrical counter efficiency, and correcting the absorption curve to zero absorber, the last correction being difficult to make accurately. The value obtained was 0.049 barn which is surprisingly high, being at least ten times greater than Rumbaugh's upper limit and 50 times greater than an estimated upper limit of Wigner's.[6] The cross section was measured more accurately by irradiating LiF, comparing the relative amounts of 0.89-sec. Li^8 and 12-sec. F^{20} and assuming $\sigma(F) = 0.01$ barn. Here it is necessary to measure an absorption curve for F and also to correct the F activation to zero absorber. The value resulting from this method is 0.033 ± 0.005 barn (kT value) a much more accurate value than the above result. We considered the possibility that the Li^8 might be formed from the high H^3 bombardment of Li, resulting from the

$Li(n, \alpha)H^3$ reaction. This was investigated by measuring the Li^8 activation as a function of thickness of Li sample for small thicknesses (less than H^3 range). The results showed a definite linear relationship between Li^8 produced and thickness of sample, thus disproving any H^3 effect which would result in a quadratic increase of activation.

In order to rule out the possibility that the activity was He^6, the energy of the short-lived β-activity obtained from Li was also measured by allowing the higher energy β's from the sample to enter a cloud chamber in a 500-gauss magnetic field. Only the high energy β's were measured and the highest of these were in the range 10–11 Mev. No effort was made to determine the end point more carefully, for the occurrence of β's above 10 Mev shows that the activity cannot be He^6 (which has a 6-Mev end point).

The isotopic assignment of the activity to Li^8 was substantiated recently (November 1946) by the use of enriched isotopes. A sample containing only 0.1 percent Li^6 instead of the normal 8 percent was irradiated and the amount of the short-lived activity produced was determined. The amount produced was very closely the same as that produced from an equal sample of normal Li, showing that the activity was that of Li^8. If the activity had been formed in Li^6, the 80-fold change in its abundance would have given a much different result.

The results reported here show quite definitely that the 0.89-sec. activity is Li^8 formed by the $Li^7(n, \gamma)$ reaction. The cross section we observe is much larger than that of Poole and Paul. A possible explanation is that they used In for a cross-section comparison and any resonance neutrons present would lower the apparent value of the Li cross section.

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