fatally inconsistent. The pseudoscalar theory does not yet show a good agreement in the region of smaller angle. It was already found[3,4,6,7] that both scalar and pseudoscalar theories showed a rough agreement with experiment for the ratio of negative to positive mesons. In order to see whether the pseudoscalar theory is in good agreement with experiment or not, more exact experiments are required.

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The Radioactive Decay of Ca^{41}

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THE threshold of the $K^{41}(p, n)Ca^{41}$ reaction[1] indicates that Ca^{41} should decay by electron capture to K^{41}. The half-life of Ca^{41} has previously been listed as approximately 10 days;[2,3] however, several unsuccessful attempts to verify this result make it subject to doubt.[4,5]

We have observed x-rays resulting from the decay of Ca^{41} by using a proportional counter x-ray spectrometer of the type described by Bernstein *et al.*[6] X-rays from the source entered a high multiplication proportional counter through a thin Be window. Most of the x-rays were absorbed in the counter gas and produced pulses proportional to the x-ray energy. The pulse distribution was obtained with a sliding channel pulse-height analyzer. A homogeneous x-ray gave a single peak having a full width at half-maximum of about 20 percent. The resolution of the instrument permitted the K_α x-rays of adjacent elements to be distinguished.

The analyzer was calibrated with Fe^{55}, V^{49}, and A^{37} (Fig. 1).[7] Table I lists the energies of the characteristic x-rays in the vicinity of calcium and a few isotopes which emit these x-rays.

The calcium sample was listed as item No. 13A of the "Irradiated Units" in the AEC Isotopes catalog.[8] It had been irradiated in a neutron flux of about 10^{12} from June 13, 1949, to July 11, 1949. The measurements were made in July, 1950, more than a year after the irradiation. The sample contained some Ca^{45}, which emits β-particles with a 152-day half-life. The presence of the β-particles did not interfere with the observation of a 3-kev x-ray because most of the β-particles lost 12 to 15 kev in the counter, and consequently produced much larger pulses. The β-background at 3 kev was about 30 percent. X-rays produced by β-particles striking the counter walls, neighboring atoms of calcium, etc., were found to be negligible for such a weak source by taking measurements with P^{32} sources of various strengths.

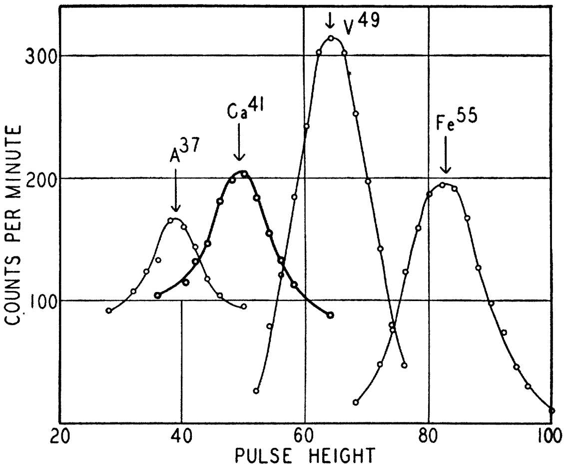

FIG. 1. X-rays from electron capture. The x-ray peaks are obtained by a proportional counter x-ray spectrometer. The relative amplitudes of the peaks have no significance.

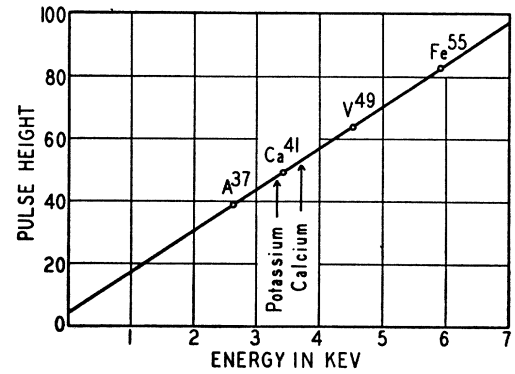

FIG. 2. Calibration curve of pulse-height analyzer. A plot of the K_α x-ray energy *vs* the analyzer setting at the peak shows the linearity of the analyzer. The peak from the calcium sample falls at a position which corresponds to a potassium K_α x-ray.

TABLE I. K_α x-rays and some radioactive isotopes decaying by electron capture.

Radioactive isotope	Characteristic x-ray	K_α x-ray energy
A^{37}	17 chlorine	2.625 kev
K^{40}	18 argon	2.96
Ca^{41}	19 potassium	3.316
	20 calcium	3.694
	21 scandium	4.092
V^{49}	22 titanium	4.512
Fe^{55}	25 manganese	5.898

The x-ray emitted by the irradiated calcium had an energy of 3.40±0.15 kev (Fig. 2). This apparently is a potassium K_α x-ray (3.31 kev), which indicates that some isotope of calcium is decaying by electron capture. Examination of the isotope tables shows that Ca^{41} is the only reasonable choice, as none of the other calcium isotopes can be associated with electron capture.

It appears, therefore, that Ca^{41} decays by electron capture and has a half-life of the order of several months. At present a sample of enriched Ca^{40} is being irradiated in the Brookhaven reactor. It will be used for a more precise measurement of the half-life of Ca^{41}.

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Magnetic Analysis of the $B(\alpha, p)C$ Reaction

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THE two most recent reports on the $B(\alpha, p)C$ reaction by Perkin[1] and Creagan[2] have given the following Q values: 4.07, 0.85, 0.31, 0.07, −0.31, −1.57, −1.76, and 4.08, 3.35, 0.65, 0.15, −0.57 Mev, respectively. Use of a separated isotope target by Creagan identified the 0.85 group as belonging to B^{11}, the others to B^{10}.

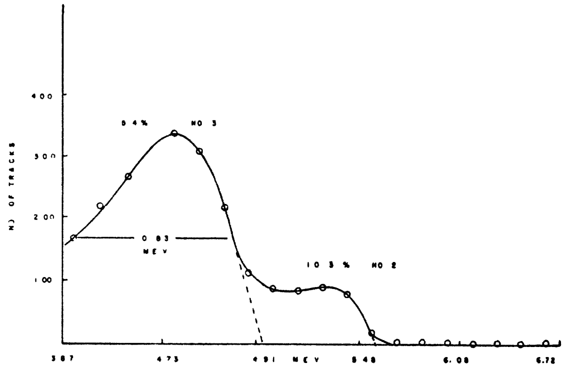

FIG. 1. High energy proton groups. The ratio of peak No. 3 to the background is approximately 170.

In this investigation a semicircular focusing magnetic spectrograph was used to analyze the protons produced by a polonium alpha-particle source. The source and target were $1\frac{13}{32}\times\frac{1}{16}$ in. with a separation of $\frac{1}{8}$ in. between them. This "poor" geometry was necessary to give an appreciable proton intensity and resulted in a broad line for each group (Fig. 1). However, Q may be determined from the value of the high energy cutoff, since, for observation in the direction of the alpha-beam, the most energetic protons are those formed on the surface of the target nearest the source by alphas striking the target normally. Adding the energy loss in the target to the cutoff value gives the total proton energy.

NTA plates, inclined at an angle to the proton beam, were employed as the detector. They were covered with an 8-mg/cm^2 layer of collodion to screen off stray Po alpha-tracks. This layer was soaked off with a 9 to 1 acetone-water solution before developing. By counting only tracks of the right direction and length, the effect of background radiation and particles scattered in the chamber was eliminated. This enabled one to make long exposures without accumulating appreciable background. The actual exposure times ranged from 37 to 199 hr. The targets were either of pressed boron powder or B_2O_3 evaporated onto a tin foil, and varied in thickness from 1.1 to 2.2 cm of air. This air equivalent was determined by measuring in the spectrometer the energy loss of Po alphas in passing through the target. The magnet used had a maximum usable radius of 26 cm at a field of 18,200 gauss. Current regulation was achieved by a circuit of the type described by Lawson and Tyler.[3]

The energy of each proton group was determined by comparing its radius of curvature with that of the Po 5.300-Mev line. Thus for protons of energy 4–6 Mev (groups 2 and 3 below), the effect of small inhomogeneities in the field are greatly reduced.

Results (See Table I):

$Q\sim 3.8$ Mev. Evidence was found for a high energy proton group, but the intensity was too low to give an accurate value.

$Q_2=0.75$ Mev. Using an enriched B^{10} target confirmed the assigning of this group to B^{11}. Five determinations gave a mean deviation of 0.01 Mev. Using mass values from Mattauch's[4] tables, this gives the mass of C^{14} as 14.007824 amu.

$Q_3=0.24$ Mev. Six determinations gave a mean deviation of 0.02 Mev. This larger uncertainty is due to the fact that groups 2 and 3 were not completely resolved, and thus the high energy cutoff of group 3 was partially masked.

TABLE I. Summary of Q values found in this work.

Q Values	
B^{10}	B^{11}
~ 3.8 Mev 0.24 ± 0.02 -0.22	0.75 ± 0.01

$Q_4=-0.22$ Mev. This group was observed only for the run where the protons were observed at 90° to the alpha-beam.

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The L to K Capture Ratio and Disintegration Energy of Sn^{113}

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THE decay scheme of Sn^{113} based on the work of Barnes[1] and of Lawson and Cork[2] is given by the latter to consist of orbital capture to an excited state of In^{113} which then reaches its ground state by successive 85-kev and 390-kev transitions. The properties of the latter transition were found to be: half-life 104 minutes, $\alpha=2.3\pm 0.3$ or 0.7 ± 0.1,[3] $\alpha_K/\alpha_L=5.4$. Later Coleman and Poole[4] failed to find the 85-kev gamma-ray.

In order to examine the possibility of direct transitions to the 390-kev state and to the ground state, we have made the following measurements on this activity. (a) With a counter of known beta- and gamma-ray sensitivity, α for the 390-kev transition was found to be 0.35 ± 0.1. The 85-kev gamma-ray, if present, was found to have an intensity of less than one percent of the 390-kev gamma-ray. (b) With a low energy compensated magnetic lens spectrometer,[5] a very thin electroplated source, and two thin Nylon windows (36 and 18 μg/cm^2) the intensity of the K Auger electrons relative to the total conversion electrons of the 390-kev transition was found to be 0.61 ± 0.01. The thinness of the source is indicated by the almost complete absence of low energy tail on the 20-kev Auger line. The transparency of the counter window is indicated by the fact that the thinner window increased the 20-kev Auger-line intensity by only 3.8 percent. Correction for window loss is included in the above ratio. The conversion electrons of the 85-kev transition, if present, were found to have an intensity less than one percent of the conversion electrons of the 390-kev transition. All other measurements, where made, were in agreement with previous values.

According to Weisskopf[6] a half-life of 105 minutes for a 390-kev transition is consistent with a magnetic 2^4-pole radiation; therefore the spin of In^{113*} is probably $\frac{1}{2}$. Using a value of $\alpha_K=0.45$, as found in Rose's tables,[7] together with the measured value of α_K/α_L, the theoretical conversion coefficient is 0.53. Although the accuracy of our value is not sufficient to show that the theoretical value is wrong, it is apparent that the previous value was considerably too high. In the following argument the conversion coefficient will be assumed to be 0.53.

From the values of α_K/α_L, α, the Auger coefficient (one minus the fluorescence yield), and the Auger-conversion electron ratio, it can be shown that a negligible number of transitions direct to the ground state can occur and that more than normal L capture occurs. The chief uncertainty in the ratio of L capture to K capture as determined above is the Auger coefficient for indium. The theory of Massey and Burhop[8] gives 0.216, while the experimental results for $Z>40$ almost all give larger values than theory.[8–10] It is therefore assumed that the most probable value of the Auger coefficient for indium is 0.25 and that 0.20 and 0.30 represent outside limits. Using these values the most probable ratio of L capture to K capture is 0.81 with extreme values of 0.31 and 1.43. The ratio normally expected is only 0.115.[11]

Using the theoretical results of Marshak[12] and Rose and Jackson,[11] it can be shown that the orbital capture to the 390-kev