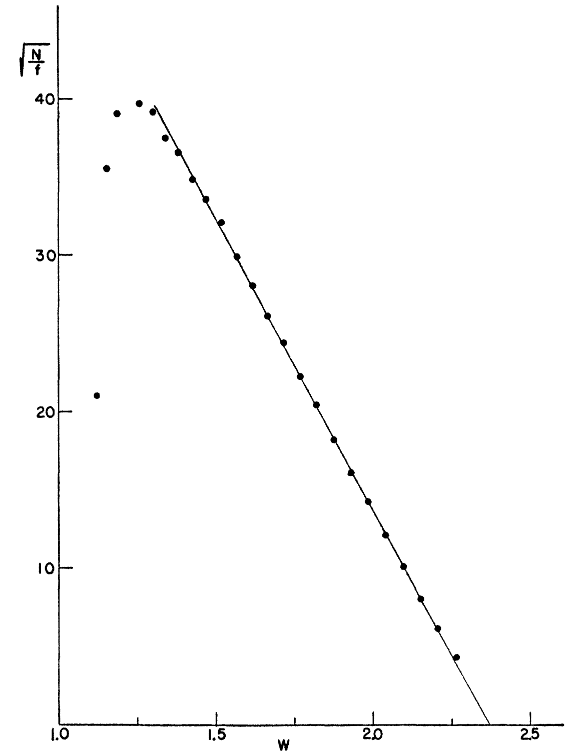

FIG. 1. Fermi plot of beta-ray spectrum of As^{77}.

the exception of $_{37}Rb^{85}$ and $_{30}Zn^{67}$ which show $f_{5/2}$ orbits. For example $_{33}As^{75}$ has a spin of 3/2 and it is presumed that the odd proton is in a $p_{3/2}$ orbit. On these grounds it is supposed that $_{33}As^{77}$ will likewise have a configuration $p_{3/2}$. In the region from 38 to 50, $p_{1/2}$ and $g_{9/2}$ configurations have nearly the same energy. For example $_{32}Ge^{73}$ has a $g_{9/2}$ orbit and spin of 9/2. If one assumes that As^{77} is a $p_{3/2}$ configuration, these experiments show that the ground state of $_{34}Se^{77}$ is $p_{1/2}$ rather than $g_{9/2}$. This follows since no internal conversion line is seen and the ft-value indicates an allowed transition. The evidence on the spin of Se^{77} is confusing.[10] There is conflicting evidence showing a spin of 1/2 or one of 7/2. The present experiments lend support to the view that in Se^{77} the $p_{1/2}$ state lies lower than the $g_{9/2}$ state.

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The Neutron Capture Cross Section of Am^{241}

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THE 16-hr Am^{242} (Am^{242m}) produced by neutron capture in Am^{241} decays by β-emission to Cm^{242}, by orbital electron-capture to Pu^{242}, and by an isomeric transition to a long-lived ground state (Am^{242} g.s.). Presumably Am^{242} g.s. may also be formed directly. Although a tentative decay scheme of Am^{242m} has recently been published,[1] the relative amounts formed of the various end products are not known accurately.

In a series of irradiations in the NRX pile we have measured the amount of curium produced and, for two of the samples, the amount of americium destroyed.

The samples of Am^{241} for irradiation were deposited on disks of aluminum by evaporation in vacuum from a tantalum filament. Thus, thin deposits were obtained, so that the amount of Am^{241} before and after the irradiation, and the amount of Cm^{242} formed, could be measured accurately by α-pulse analysis, using a low geometry proportional α-counter[2] and a 30-channel pulse analyzer. Since the α-activity of Cm^{242} after the heavier irradiations was about 100 times as great as that of the Am^{241}, accurate estimations of the latter could be achieved in only very thin sources. A typical α-pulse analysis is shown in Fig. 1.

The amount of Am^{241} destroyed was measured with any precision for only the two most heavily irradiated samples (Nos. 3 and 7), since only these would give results of sufficient accuracy. In all cases the Cm^{242} produced was measured and compared with the initial Am^{241} activity.

The measurement of the residual Am^{241} was complicated by the formation of Pu^{238} from the decay of Cm^{242}. The α-particles of Pu^{238} are almost identical in energy with those of Am^{241}; and, therefore, a correction for Pu^{238} has to be made.

A comparison of the Cm^{242} produced with the Am^{241} destroyed gives a value for f, the ratio of the partial cross section of Am^{241} for Cm^{242} production to the total cross section σ_1 for Am^{241} destruction. No knowledge of the neutron flux during the irradiation is required for this estimation of f. Samples 3 and 7 gave values of f equal to 0.66 and 0.62, respectively. The amounts of Am^{241} destroyed were 18 and 25 percent for these two samples, while the Pu^{238} corrections were 15 and 30 percent of the Am^{241} disintegration rates, respectively. Weighing these two results equally gives a value of 0.64 for f. The various errors which may accumulate are difficult to assess, but we feel that this value is correct within ± 10 percent.

By measuring the Cm^{242} produced in all the samples, we obtain a value for the partial cross section of Am^{241} for curium production, i.e., $f\sigma_1$, using the known integrated neutron flux for each sample. This was obtained from the pile operating log and the absolute neutron flux distribution in the pile.[3] The values of the partial cross section are given in Table I. The mean value is 568 barns. The deviations from the mean are within the over-all experimental error, and the absence of any trend toward lower values at high irradiation levels demonstrates that there is no appreciable neutron destruction of Cm^{242}.

This value of $f\sigma_1$, combined with the value of f obtained above, gives for σ_1, the total cross section for Am^{241} destruction, a value of 887 barns.

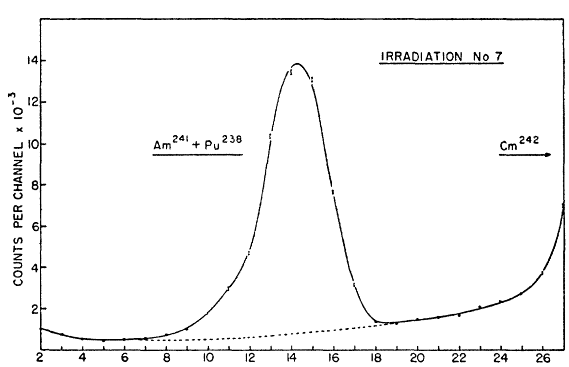

FIG. 1. α-pulse analysis of an irradiated sample showing the resolution obtained between the $Am^{241}+Pu^{238}$ α-group and a Cm^{242} α-group of about 80-fold greater intensity.

TABLE I. Evaluation of the partial cross section for the production of Cm^{242}. (Mean value $f\sigma_1 = 568$ barns.)

Sample No.	Integrated flux $\int(\rho v)dt$ (10^{20} neutrons/cm^2)	$f\sigma_1 \int(\rho v)dt$ from Cm^{242} production	$f\sigma_1$ (barns)	Percent deviation from mean
7	3.24	0.180	555	−2.1
3	2.12	0.123	580	+2.2
6	1.27	0.071	560	−1.3
5	0.365	0.0212	580	+2.1
4	0.162	0.00911	562	−0.9

If no Am^{242} g.s. is formed directly, that is, without intermediate formation of 16-hr Am^{242m}, then f will be identical with b, the β-branching ratio of Am^{242m}. A value of about 0.6 for b has been reported;[1] that is, b and f are approximately equal. This suggests that little, if any, Am^{242} g.s. is formed directly.

It is a pleasure to acknowledge our debt to Mr. Philip B. Aitken for the design of equipment used in the handling of large α-activities.

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Odd-Even Effect in Neutron Capture Gamma-Ray Spectra

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ADDITIONAL evidence has been obtained showing the dependence of the shapes of the neutron capture gamma-ray spectra on the odd-even character of the compound nuclei formed after neutron capture. The D_2O-soaked plate method[1,2] has been applied to two groups of three adjacent elements, namely, the group manganese, iron, and cobalt and the group silver, cadmium, and indium. The spectra are shown in Fig. 1. The spectra of iron and cadmium have been reported previously.[2]

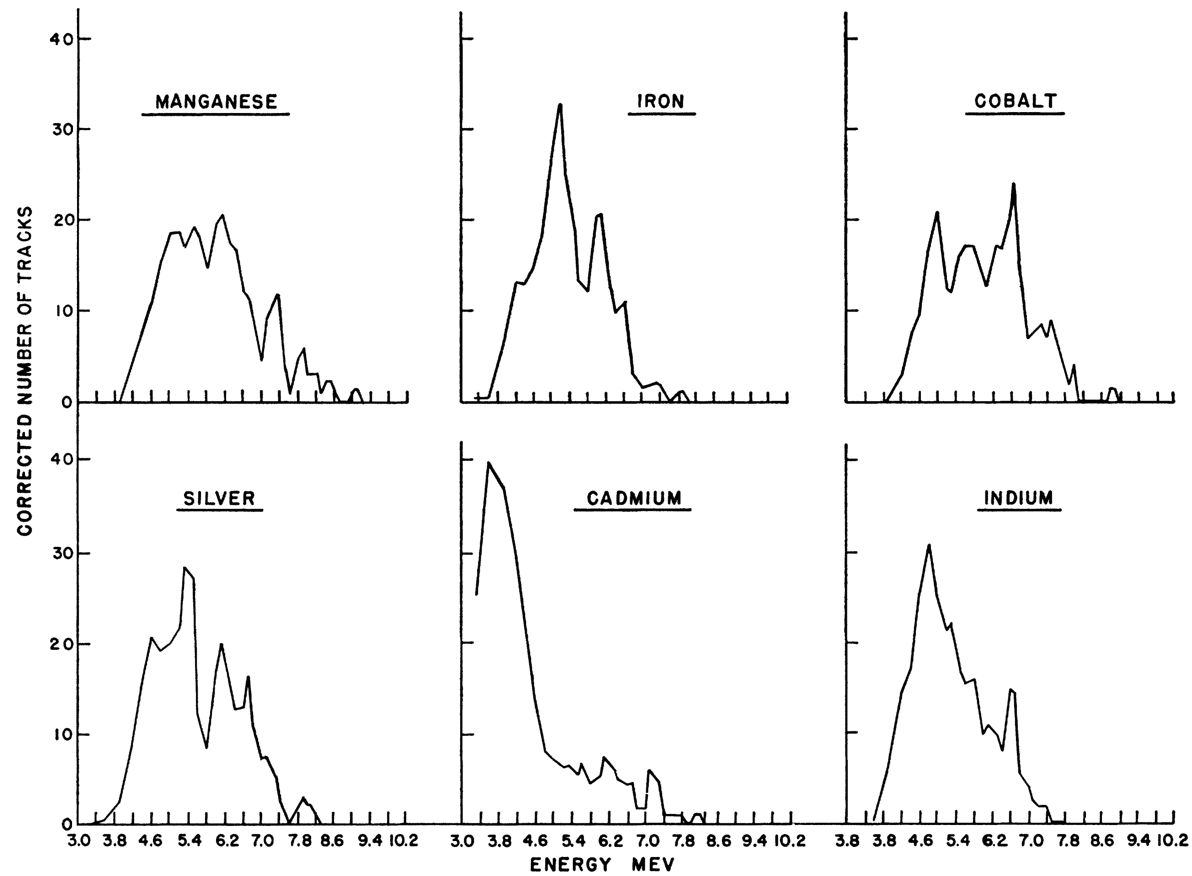

FIG. 1. Neutron capture gamma-ray spectra.

The manganese spectrum arises from the compound nucleus Mn^{56}, an odd-odd nucleus. The iron spectrum arises almost entirely from Fe^{56}, an even-odd nucleus. The cobalt spectrum arises from Co^{60}, an odd-odd nucleus.

The silver spectrum arises from Ag^{108} and Ag^{110}, both odd-odd nuclei. The cadmium spectrum is emitted by Cd^{114}, an even-even nucleus. The indium spectrum is emitted mainly by In^{116}, an odd-odd nucleus.

The evidence shown indicates that in elements of nearly the same Z, the mode of decay from the highly excited state formed on thermal neutron capture is different in nuclei of differing odd-even types. This would indicate a possible dependence of level spacings on odd-even characteristics of nuclei.

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