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RADIATION FROM COLUMBIUM 95

J.E. HUDGENS, JR. and W.S. LYON

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Radiation from Columbium 95

J. E. Hudgens, Jr., and W. S. Lyon

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Nedzel[1] using the beta ray spectrometer in studying columbium 95 has reported one beta ray (0.154 mev.) and one gamma ray (0.77 mev.). In addition, he observed a conversion electron peak with energy of 0.224 mev. Levinger[2] further studied this peak and assigned it to a short lived columbium 95 isomer the gamma ray of which is completely converted, and which undergoes isometric transition to 35 day columbium 95. Using a beta ray spectrometer similar to that described by Deutsch et al[3] we have recently examined both the 35 day and the short lived nuclide of columbium 95.

From a hydrochloric acid solution containing columbium 95 and its parent zirconium 95, the zirconium was removed by repeated extractions with 0.5 M thenoyltrifluoacetone benzene solution. From the pure aqueous solution, active columbium was precipitated by the addition of 0.5 mg. of columbium carrier and evaporation in nitric acid. This material (~100 microcuries) was placed on a laminated formvar-polystyrene film (~50 micrograms/cm^2) and used as a source for the study of the beta spectrum in the beta ray spectrometer. From the data obtained, a plot of the counts per minute per unit momentum interval versus the current in amperes ($\frac{N}{I}$ vs. I) has been made (Figure 1). A conversion peak may be noted at 0.200 mev., and another at 0.735 mev. The Kurie plot (Figure 2) indicates one beta ray of energy 0.146 mev. is associated with the decay of the 35 day columbium 95 nuclide. Using values for intensities obtained by graphical integration under the counts per minute per unit momentum interval vs. coil current plot, we find that the short lived isomer is present to the extent of 1.4% in a solution in which zirconium 95 and columbium 95 are in equilibrium. The decay of a columbium source has been followed on a standard bell-type thin end window Geiger-Mueller counter equipped with continuous recorder. These data indicated the half life to be 90 hours which is identical with the value

reported by Steinberg[4].

After extrapolation of the Kurie plot and a recalculation and replotting of a theoretical $\frac{N}{I}$ vs. I curve, we have compared the areas under the continuous beta spectrum and the areas under the two conversion electron regions. We find for 35 day columbium 95 the ratio of the conversion electrons to the continuous beta particles is 2.4×10^{-3}.

A source for study of the gamma spectrum was prepared in a manner similar to that described above. The amount of active columbium taken was increased ~50 fold, and the precipitated columbium oxide was mounted in the spectrometer and data obtained using first a uranium and later a lead radiator. These data indicate the presence of one gamma ray of energy 0.758 mev., which is in good agreement with the energy value obtained from the converiion electron region in the beta spectrum.

A summary of the results obtained in this investigation is shown in Table I.

Table I

Energy Values for Columbium 95

	35 day Cb^{95}	90 hour Cb^{95}
β Max.	0.146 ±.01 mev.	
γ	0.758 ±.02 mev.	0.216 ±.01 mev. (100% converted)
$\frac{\text{Conv. electrons}}{\text{Continuous beta particles}}$	2.4×10^{-3}	1.4×10^{-2}

References

(1) Nedzel, V. A., PPR Vol. 9B, 7.15.7 (1947). (The Plutonium Project Report (PPR) contains a complete report of Project information, Vol. 9B being entitled Radiochemistry of the Fission Products. This volume is in the process of being declassified and prepared for publication as part of the National Nuclear Energy Series under auspices of the United States Atomic Energy Commission.)

(2) Levinger, J. S., PPR Vol. 9B, 7.15.11 (1946).

(3) Deutsch, M., Elliott, L. G., and Evans, R. D., Rev. Sci. Inst. 15, 178 (1944).

(4) Steinberg, E. P., PPR Vol. 9B, 7.15.10 (1946).

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Figure 1.

The beta and conversion electron spectra of Cb^{95} (counts per minute per unit momentum interval plotted against coil current in amperes).

A, the continuous beta spectrum of Cb^{95}. B is the conversion electron peak of the 90 hr. Cb^{95}, C is the conversion electron region of the 0.75 mev. gamma ray.

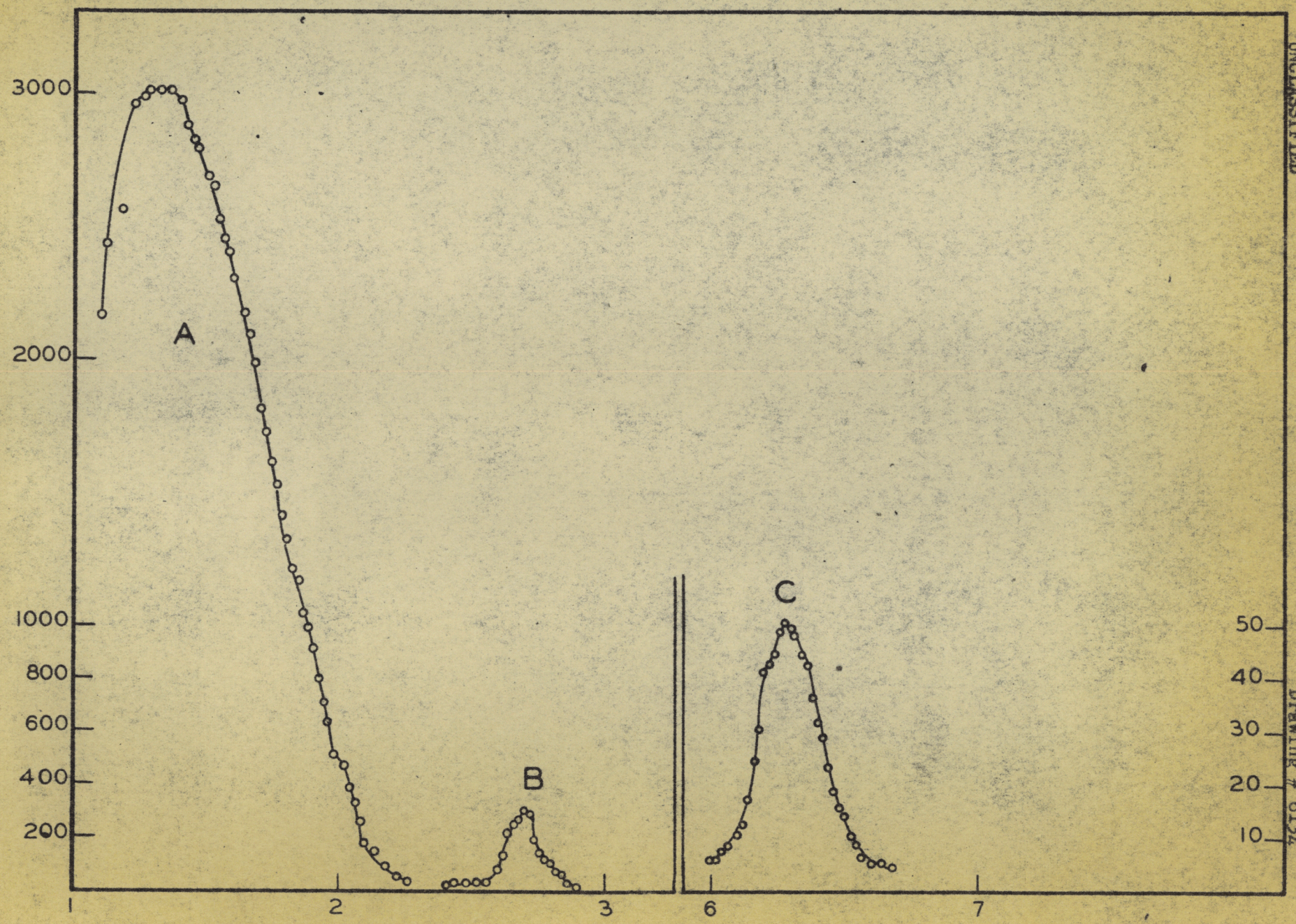

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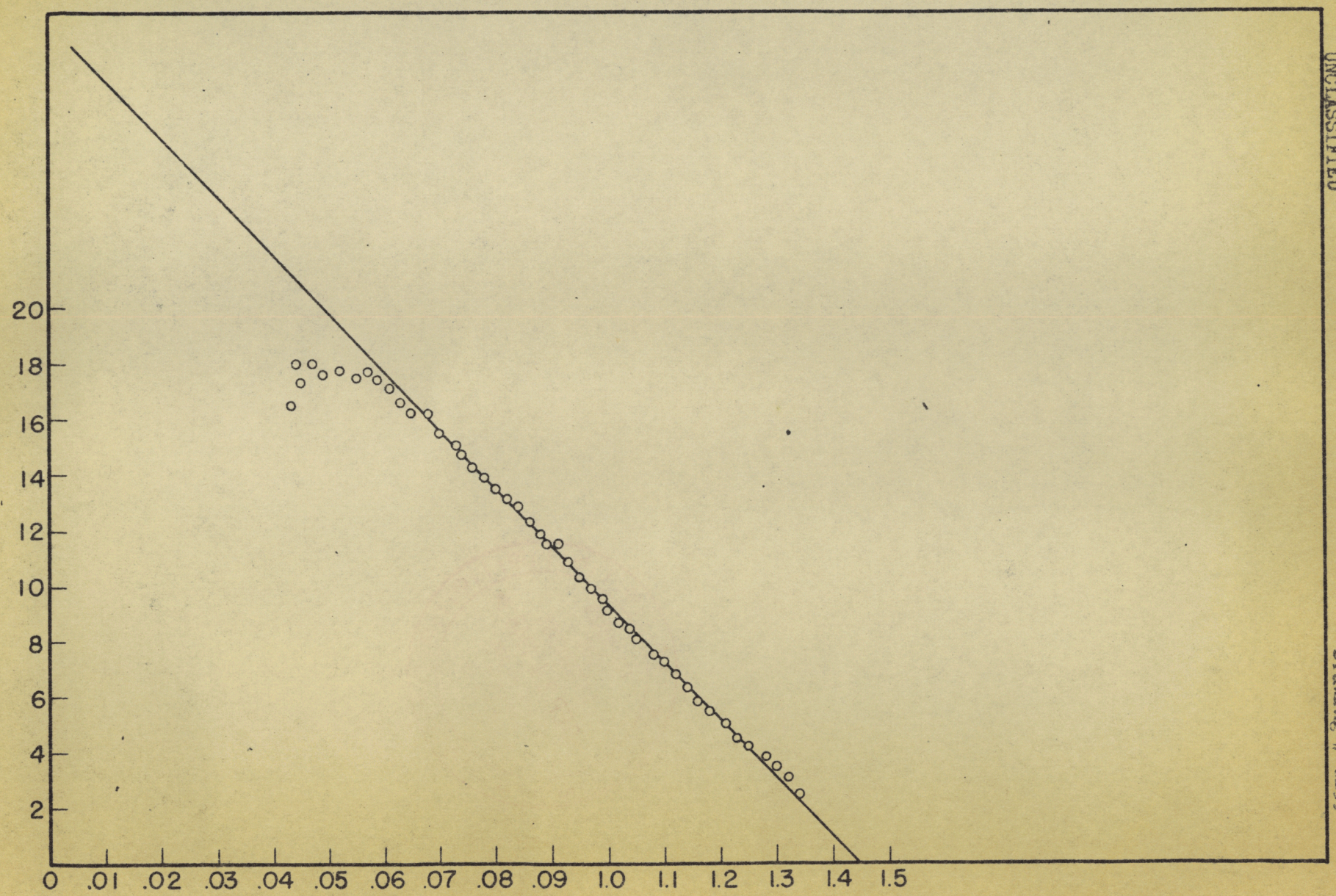
Figure 2.

Kurie plot of the beta spectrum of Cb^{95}, (Kurie plot, $\sqrt{N/FI^3}$ vs. energy E, where N is net counting rate, F is the Fermi function, and I is the coil current in amperes.)



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