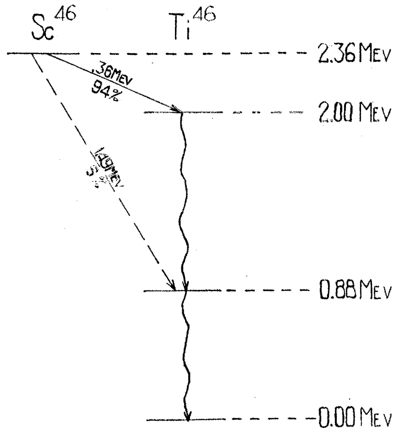

FIG. 1.

Mev beta-ray and a 1.25-Mev gamma-ray. Meitner was unable to find a beta-group with a 1.5-Mev end point and attributed Walke's result to scattering. Careful study has convinced us that the 1.49-Mev group cannot be due to scattering inherent in the geometry of our instrument or to secondary electrons from the source or backing. Further confirmation of this group is found in the fact that it decays with the same half-life as the 0.36-Mev group. The decay has been followed for about one half-life and is found to be approximately 85 days as reported by Walke.

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The $(4n+1)$ Radioactive Series: The Decay Products of U^{233}

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DURING 1944–1946 we studied the chain of decay products of U^{233}, the new isotope of uranium which was first separated and examined (1941–1942) by Seaborg, Gofman, and Stoughton.[1] These decay products, which constitute a substantial fraction of the entire missing, $4n+1$, radioactive series are listed, together with their radioactive properties, in Table I.

The radioactivity of the Tl^{209} has not yet actually been observed, its existence in the chain is inferred from the partial alpha-decay of Bi^{213}. The isotope Pb^{209} has been previously reported, as a result of its production by the (d, p),[2] (n, γ),[3] and (n, p)[3] reactions.

A number of the preceding members of this $(4n+1)$ radioactive series have been previously reported as follows:

$${}_{94}Pu^{241} \xrightarrow{\beta^-} {}_{95}Am^{241} \xrightarrow{\alpha} {}_{93}Np^{237} \xrightarrow{\alpha} {}_{91}Pa^{233} \xrightarrow{\beta^-} U^{233}.$$

TABLE I.

Isotope	Type of radiation	Half-life	Energy of radiation (Mev)
${}_{90}Th^{229}$	α	7×10^3 yr.	4.85
${}_{88}Ra^{225}$	β^-	14.8 days	~0.2
${}_{89}Ac^{225}$	α	10.0 days	5.80
${}_{87}Fr^{221}$	α	4.8 min.	6.30
${}_{85}At^{217}$	α	0.018 sec.	7.00
${}_{83}Bi^{213}$	β^- (96%) α (4%)	47 min.	~1.2 (β^-) 6.0 (α)
${}_{84}Po^{213}$	α	very short	8.30
(${}_{81}Tl^{209}$)	(β^-)	?	?
${}_{82}Pb^{209}$	β^-	3.3 hr.	0.7
${}_{83}Bi^{209}$	stable		

The 27.4-day Pa^{233} was first reported by Meitner, Strassmann, and Hahn,[4] and the doubts as to this isotopic assignment which later arose as a result of the discovery of fission were cleared up by the work of v. Grosse, Booth, and Dunning[5] and Seaborg, Gofman, and Kennedy.[6] The 2.25×10^6 year Np^{237} was first identified by Wahl and Seaborg,[7] while Pu^{241} and 500-year Am^{241} were first reported by Seaborg, James, and Morgan.[8] Also of interest are two previously reported beta-emitting radioactive isotopes, 23-minute Th^{233} [9] from the reaction Th^{232} (n, γ) and 7-day U^{237} [10, 11] from the reaction U^{238} $(n, 2n)$, which may be referred to as "collateral" members of the series.

As the name for the $(4n+1)$ radioactive decay family we suggest "neptunium" series or family; thus the longest-lived member would give its name to the family in a manner similar to the naming of the uranium and thorium decay series.

Another independent study of the decay products of U^{233} was carried on simultaneously by A. C. English, T. E. Cranshaw, P. Demers, J. A. Harvey, E. P. Hincks, J. V. Jelley, and A. N. May of the Division of Atomic Energy of the National Research Council of Canada, which has resulted in essentially similar findings.[12]

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