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THE U^{227} COLLATERAL SERIES

W. W. Meinke, A. Ghiorso, and G. T. Seaborg

February 21, 1951

Berkeley, California

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THE U^{227} COLLATERAL SERIES

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February 21, 1951

ABSTRACT

Continuation of our investigations of the type which led to the observation and characterization of five artificial radioactive chains collateral to the natural radioactive families[1,2,3] has led to the partial identification of one additional chain, collateral to the actinium $(4n \pm 3)$ family.

Thorium nitrate was irradiated for one minute with 175-mev helium ions in the "jiffy probe" of the 184-inch Berkeley cyclotron. At the end of bombardment the target container was ejected from the probe by compressed air and blown into a pneumatic tube which carried the target some 100 yards to the Chemistry Building. Chemical separation was begun on the target 18 seconds after shutdown and counting of the separated sample was begun 1.4 minutes after shutdown. The chemical procedure consisted of solution of the thorium nitrate target in slightly acidic saturated ammonium nitrate solution. The tracer uranium was then extracted into diethyl ether and an aliquot of this ether solution ignited on a platinum plate to give a nearly weightless sample. The decay and energy of the alpha particles in the resulting samples were measured with an alpha particle pulse-analyser[4] equipped with a fast sample-changing mechanism.

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The 9.3 minute U^{228} and 58 minute U^{229} collateral series predominated in these uranium samples. Several of the more satisfactory runs, however, showed a third series decaying with the 1.4 minute half-life of the parent. Although the mass type has not yet been definitely identified through known daughters, general considerations with regard to the method of formation and half-life of the parent substance, and the energies of all the members of the series suggests a collateral branch of the (4n + 3) family:

$$_{92}U^{227} \xrightarrow{\alpha} {}_{90}Th^{223} \xrightarrow{\alpha} {}_{88}Ra^{219} \xrightarrow{\alpha} {}_{86}Em^{215} \xrightarrow{\alpha} {}_{84}Po^{211} \xrightarrow{\alpha} {}_{82}Pb^{207}$$

The measured alpha particle energies of the individual members of the U^{227} series, assigned according to alpha decay systematics in this region,[5] are shown in the accompanying table. Alpha energy and half-life values predicted[3] from these systematics are also given in the table. The values given for Po^{211} are the accepted values from the literature.[6,7]

Isotope	Type of radiation	Half-life	Energy of radiation (mev) Observed	Predicted
U^{227}	α	$1.4 \pm {}^{0.15}_{0.3}$ min	7.0 ± 0.1	7.0 - 7.2
Th^{223}	α	($\sim 10^{-1}$ sec, predicted)	7.5 ± 0.1	7.5 - 7.7
Ra^{219}	α	($\sim 10^{-3}$ sec, predicted)	7.8 ± 0.1	7.9 - 8.1
Em^{215}	α	($\sim 10^{-6}$ sec, predicted)	8.6 ± 0.15	8.6 - 8.8
Po^{211}	α	0.52 sec	7.434	
Pb^{207}	Stable			

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