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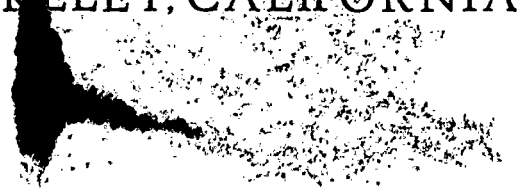

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CARRIER-FREE RADIOISOTOPES FROM CYCLOTRON TARGETS IV. PREPARATION AND ISOLATION OF Mn^{54} AND $Co^{56,57,58}$

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CARRIER-FREE RADIOISOTOPES FROM CYCLOTRON TARGETS IV. PREPARATION AND ISOLATION OF Mn^{54} AND $Co^{56,57,58}$[1]

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Carrier free radioisotopes of manganese and cobalt of useful half-life may be obtained only by cyclotron bombardment. The present paper describes chemical methods of isolating Mn^{54} and $Co^{56,57,58}$ from an iron target bombarded with 19 Mev deuterons in the 60-inch cyclotron at the Crocker Laboratory. At this energy Mn^{54} and $Co^{56,57,58}$ are produced in a thick target by the nuclear reactions[3]: $Fe^{56}(d,\alpha)Mn^{54}$, $Fe^{56}(d,2n)Co^{56}$, $Fe^{56}(d,n)Co^{57}$, $Fe^{57}(d,2n)Co^{57}$, $Fe^{57}(d,n)Co^{58}$. Other possible shorter-lived radioisotopes of manganese and cobalt were allowed to decay out prior to the separation.

The iron[4] target was silver soldered to a water cooled copper probe and bombarded for 2000 μa-hr at an average beam intensity of approximately 50 μa. The bombarded surface was dissolved off in 6 N HCl.

All but approximately 10 mg. of the target iron was extracted with ether. The aqueous phase was neutralized with NH_4OH, a few drops of bromine were added, and $Fe(OH)_3$ was precipitated with 15 N NH_4OH in excess. Under these conditions carrier free radio manganese was quantitatively carried, presumably in the

(1) This document is based on work performed under the auspices of the Atomic Energy Commission.

(2) Lieutenant Colonel, U. S. Army, now stationed at Walter Reed Hospital, Washington, D. C.

(3) G. T. Seaborg and I. Perlman, Rev. Mod. Phys. 20, 585 (1948).

(4) The iron was obtained from Johnson Mathey & Co. Manganese and cobalt were not detected by spectrographic analysis.

quadrivalent state. Over 98% of the radio cobalt remained in the supernatant[5]. The $Fe(OH)_3$ plus radio-manganese was reprecipitated twice with Br_2-NH_4OH in the presence of 1 mg of cobalt hold-back carrier. Three additional precipitations removed traces of carrier cobalt. The $Fe(OH)_3$ was washed, dissolved in 6 N HCl and iron was extracted with ether. The solution of carrier-free radio-manganese in 6 N HCl was evaporated to dryness after the addition of 5 ml of isotonic saline solution. Addition of 5 ml of distilled water gave an isotonic solution of carrier-free Mn^{54} for subsequent biological experiments.

The activity was identified by the 310 day half-life and by the 0.85 Mev gamma ray reported[6] for Mn^{54}. As further identification, a small amount of activity added to a solution containing carrier amounts of Mn, Fe and Co was quantitatively recovered in the Mn fraction from a chemical separation.[7]

The supernatant from the first $Fe(OH)_3$ precipitation containing carrier-free radio-cobalt, NH_4Cl and NH_4OH was evaporated to dryness and treated with 16 N HNO_3 to destroy ammonium salts. 12 N HCl was added to remove HNO_3 and the solution was evaporated to dryness on 40 mg of NaCl. The activity dissolved quantitatively in 5 ml of water.

The radio-cobalt showed the 72-day half-life of $Co^{56,58}$; after 200 days the longer period of Co^{57} was apparent. In addition, chemical separation with added Mn, Fe and Co carriers identified the activity as cobalt. Mass absorption measurements showed the 1.2 Mev beta reported[8] for Co^{56}. The combined gamma radiation had a half-thickness of approximately 10 gm/cm^2 in lead.

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(8) J. J. Livingood and G. T. Seaborg, Phys. Rev. 60, 913 (1941).

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