

americium became available in milligram amounts by neutron irradiation of plutonium.⁶ The isolation of the americium from the plutonium required tedious chemical procedures. The curium was produced in smaller amounts by the irradiation of americium with neutrons.^{2,6}

The intense radioactivity of the americium and curium source materials presented the third major difficulty. This radioactivity necessitated not only the design and development of advanced techniques and equipment⁷ for its safe handling, but also made it necessary to attain enormous separation factors in the isolation of the new element from the target material in order to be able to detect the small amounts of radioactivity due to it. Furthermore, this high degree of separation had to be carried out in good yield in a short length of time.

Essentially three chemical steps were developed to solve these chemical problems. The conversion of the americium to a hexapositive oxidation state⁸ was used in the rapid removal of the bulk of the bombarded americium. An ion exchange method involving the separation of the actinide elements as a group from the rare earth fission products by elution with concentrated HCl⁹ from a cation exchange column was exploited for the rapid separation of the tripositive actinide elements. An ion exchange method involving elution from a cation exchange resin at elevated temperature with ammonium citrate solution was used in the rapid separation of the tripositive actinide elements from each other. These steps had been worked out adequately by December, 1949 and the first successful experiment was done on December 19, 1949, as recently reported in a preliminary fashion.¹⁰ Three successful

⁶Ghiorso, James, Morgan, and Seaborg, Phys. Rev. (in press), May 1, 1950.

⁷Nelson Garden and co-workers, unpublished work.

⁸Asprey, Stephanou, and Penneman, J. Am. Chem. Soc. 72, 1425 (1950).

⁹K. Street, Jr. and G. T. Seaborg, J. Am. Chem. Soc. (to be published).

¹⁰Thompson, Ghiorso, and Seaborg, Phys. Rev. 77, 838 (1950).