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Warren M. Garrison, Herman R. Haymond and Roy D. Maxwell

March 15, 1949

Berkeley, California

A RAPID ELECTRICAL METHOD OF SEPARATING CARRIER-FREE RADIOACTIVITIES.

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Elements with similar chemical properties may be separated by electrical transference methods as shown by the work of Kendall and co-workers.[1,2,3] We have found a modification of their technique to be of value for rapid separations of carrier-free radioisotopes from other activities and from milligram amounts of non-isotopic carriers.

Our apparatus consists of a stack of filter papers moisented with electrolyte and placed between two platinum electrodes. In a typical separation, a sample of solution containing one or more carrier-free radio-elements and possibly other stable elements in milligram amounts was evaporated onto a circular filter paper and placed in the center of the stack which had been previously moistened with a suitable electrolyte. A direct current of 0.04 amperes/cm^2 for a half hour was sufficient to move ions through about 15 layers of filter paper. By a proper choice of complexing ions and pH, the desired activity could be moved to either one of the electrodes or retained at the initial position in the center of the stack. In some mixtures, one activity migrated to one of the electrodes, milligram amounts of non-isotopic elements to the other, while impurity activities remained at the initial position. Recovery of the desired fraction consisted simply of removing filter papers from the appropriate region of the stack. The activity was usually concentrated in less than five adjacent papers.

In each of the separations described below, 0.20 amperes were passed for one half hour through a stack of 30 filter papers, 2.6 cm in diameter.

(1) Separation of carrier-free radio-columbium from manganese dioxide precipitate: A solution of the precipitate in 5% oxalic acid was evaporated onto a filter

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paper and placed in the middle of the stack which had been saturated with 1 M ammonium oxalate solution. Under these conditions, columbium migrated to the anode region and manganous ions migrated to the cathode.

Another sample of precipitate was dissolved in concentrated hydrochloric acid and was placed in a stack saturated with 3N hydrochloric acid. The columbium activity remained on the original paper and the manganous ions migrated to the cathode.

(2) Separation of carrier-free radio-columbium and radio-zirconium from radio-yttrium and rare earth activities: A sample of solution was electrolyzed in a stack saturated with 1 M ammonium oxalate. Columbium and zirconium were recovered in the anode papers. Yttrium and rare earth activities (Eu, Nd, and Pr) remained on the original paper.

A second sample was electrolyzed in 3N hydrochloric acid. Columbium and zirconium did not migrate while yttrium and the rare earths were recovered in the cathode papers.

(3) Separation of carrier-free radio-arsenic from milligram amounts of copper hydroxide carrier: The precipitate was dissolved and electrolyzed in 3N hydrochloric acid. The arsenic activity remained in original position. Cupric ions migrated to the cathode.

The technique has also been used as a rapid preliminary test in establishing the chemical identity of carrier-free radio-isotopes. For example, an activity which is found to migrate in dilute hydrochloric acid cannot be columbium or zirconium.

Other applications of this type are obvious.

We are grateful to Dr. J. G. Hamilton for his interest in this problem.

(1) Kendall and Crittenden, Proc. Nat. Acad. Sci., 9, 75, (1923).
(2) Kendall and Clarke, ibid., 11, 393, (1925).
(3) Kendall and West, Jour. Am. Chem. Soc., 48, 2619, (1926).

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