UNIVERSITY OF CALIFORNIA

Radiation Laboratory

BERKELEY, CALIFORNIA

DISCLAIMER

Copy 2

UCRL-285

Administrative-General

UNCLASSIFIED

UNIVERSITY OF CALIFORNIA

Radiation Laboratory

Contract No. W-7405-eng-48

MASS SPECTROGRAPHIC ASSIGNMENT OF Cs^{131}

D. G. Karraker, F. L. Reynolds and D. H. Templeton

February 11, 1949

Berkeley, California

MASS SPECTROGRAPHIC ASSIGNMENT OF Cs^{131}

D. G. Karraker, F. L. Reynolds and D. H. Templeton

Department of Chemistry and Radiation Laboratory
University of California, Berkeley, California

Irradiation of normal barium with neutrons and deuterons produced a 12-day barium activity which decays by orbital electron capture to a 10-day cesium, which in turn captures an electron to form stable xenon[1-3]. Consideration of the known facts led to mass 131 as the most reasonable assignment for this decay chain.

We have confirmed this assignment by a mass-spectrographic technique. Barium nitrate which had been exposed to neutrons in the Oak Ridge pile was obtained from the Isotopes Division of the Atomic Energy Commission.

Two or three weeks after the neutron irradiation, carrier-free cesium was separated from about one gram of this barium nitrate as follows. Most of the barium was precipitated as the sulfate. Then cesium was isolated by elution from a Dowex-50 ion-exchange resin column. This active cesium plus about one microgram of inactive carrier was placed on the tungsten filament of the mass spectrograph[4] as the chloride. Heating the filament produced Cs^+ ions which were analyzed and caught on a photographic plate. The plate was tested for radioactivity by the transfer technique. In two different experiments the original plate showed an inactive line for Cs^{133}, the single stable isotope, and an active line at mass 131. One transfer exposure of 30 days duration, on which the transfer line was very dense, provided a sensitive test for other radioactive isotopes of cesium, but no other line was observed.

The correspondence of this line to the 10-day cesium is made certain by the chemical purification, by the relatively great difficulty of thermal ionization of other elements in this mass range, and by the following obser-

vations on a portion of the active cesium. A Geiger-counter decay curve was straight over 4 half-lives with slope corresponding to 9.8 ± 0.4 days. An aluminum absorption curve agreed well with that published by Katcoff[2].

The 12-day barium was not identified directly because of its low specific activity in the barium, which contains only 0.1% of the Ba^{130} isotope[5].

This confirmation of the $Ba^{131} \longrightarrow Cs^{131} \longrightarrow Xe^{131}$ chain also lends support to Katcoff's deductions[2] concerning the assignment of the long-lived barium to Ba^{133}.

This paper is based on work performed under the auspices of the Atomic Energy Commission.

References

(1) F. C. Yu, D. Gideon, and J. D. Kurbatov, Phys. Rev. 71, 382 (1947).

(2) S. Katcoff, Phys. Rev. 72, 1160 (1947).

(3) B. J. Finkle, Phys. Rev. 72, 1260 (1947).

(4) F. L. Reynolds, D. G. Karraker, and D. H. Templeton, Phys. Rev. 75, 313 (1949).

(5) A. O. Nier, Phys. Rev. 54, 275 (1938).

Appendix

Chemical Separation of Carrier-free Cesium

About one gram of irradiated barium nitrate was dissolved in water. A calculated amount of sulfuric acid was added to precipitate most of the barium. The supernatant solution was evaporated with hydrochloric acid to small volume, to destroy the nitrate. The residue was diluted to make it 0.1 M in HCl. This solution was then equilibrated with a small amount of Dowex-50 cation-exchange resin. This resin was placed at the top of a resin column containing already about 20 times as much resin. The cesium was then eluted with 6 M hydrochloric acid, at a rate of 1 drop per 7 to 8 minutes.

The column was 2 mm in diameter and 5 cm long, with a void volume of a few drops. Each drop of eluate was caught on a separate glass plate and was evaporated to dryness. A plot of the activity on these plates in one experiment is shown in Fig. 1. Drops 15, 16, and 17 were taken as the sample for the mass spectrograph in this case. Other experiments showed that barium would appear after 150 or 200 drops.

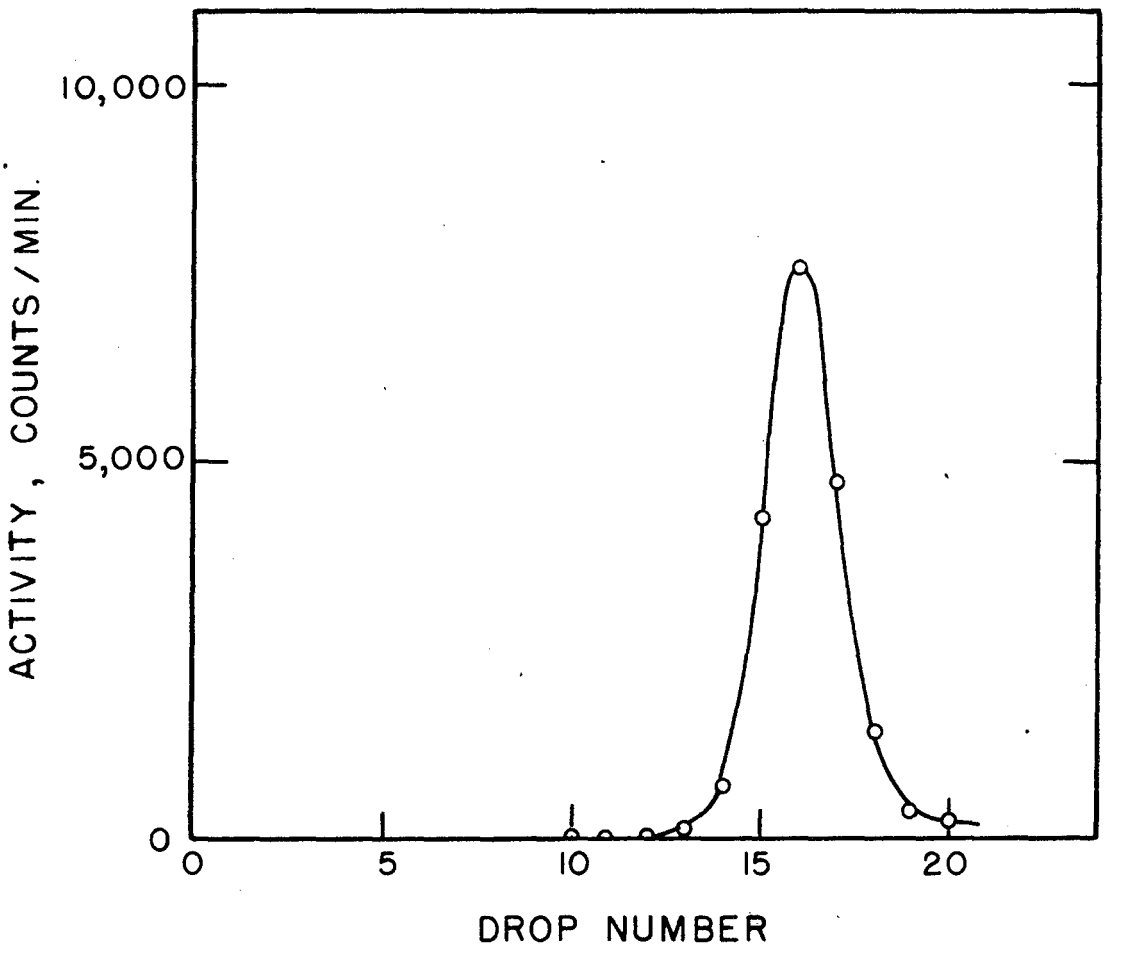

FIG. 1

PLOT OF ACTIVITY PER DROP OF ELUATE