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THE HALF-LIFE OF Po^{208}

D. H. Templeton

February 27, 1950

Berkeley, California

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	98

THE HALF-LIFE OF Po^{208}

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February 27, 1950

The properties of Po^{208} have been described in a previous paper[1] in which the half-life was reported as "about 3 years", based on decay during 10 months of a mixture of Po^{208} and Po^{210} (and a small amount of Po^{209} which was not then recognized). By that time the silver plates on which the polonium was deposited had tarnished so badly that two new samples of the same polonium were mounted on platinum for more careful decay measurements. These samples have now been observed for three years. In the mean time Kelley and Segrè[2] have reported the half-life of Po^{208} as 3.0 ± 0.2 years and have described Po^{209}.

Several alpha-counters of the ionization chamber type were used in the course of the measurements. Each time they were used they were standardized by means of a sample of Th^{230}. Cognizance was taken of the growth of daughters in the Th^{230} sample, but this amounts to only 0.05 percent in three years. Statistically significant differences were observed in the counting efficiencies of the various counters only on a few occasions when very discordant results revealed external disturbances or defective equipment. The activity due to Po^{210} in each sample was calculated from the pulse-analysis data obtained earlier when the activities due to Po^{208} and Po^{210} were about equal, combined with the value 138.3 days[3] for the half-life of Po^{210}. The contribution of Po^{209}

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[1] D. H. Templeton, J. J. Howland, and I. Perlman, Phys. Rev. 72, 758 (1947).

[2] E. L. Kelley and E. Segrè, Phys. Rev. 75, 999 (1949).

[3] W. H. Beamer and W. E. Easton, J. Chem. Phys. 17, 1298 (1949).

to each sample was derived from pulse analyses made at the end of the experiment, when it amounted to about 4 percent of the activity. Neglect of the decay of Po^{209} during the 3-yr. period causes no significant error if its half-life (estimated as 200 years[2]) is 100 years or more.

The logarithm of the derived counting rate of Po^{208} in each sample is plotted as a function of time in Figure 1. The best straight lines through these points, derived by the method of least squares with the points weighted inversely as the squares of their probable errors, had slopes corresponding to half-lives of 2.887 ± 0.015 and 2.921 ± 0.015 years.

Pulse analyses taken at the end of the experiment showed broad peaks typical of a moderately thick sample. Since the peaks observed when the samples were fresh were sharp, this was interpreted as evidence that the polonium had diffused somewhat into the platinum. Such diffusion lowers the counting rate because some particles must emerge nearly parallel to the surface of the sample, and must therefore penetrate a large amount of matter, even if the depth is small. A careful consideration of the data led to the conclusion that the average depth of the polonium was about 200 A and that the decrease in counting rate due to this cause was of the order of 0.7 percent.

If a correction of 0.03 years is made for the diffusion error, the final result for the half-life of Po^{208} is 2.93 ± 0.03 years. The probable error includes estimates of the reliability of the counting rates and of the corrections for diffusion and for the other polonium activities. It has been assumed that loss of polonium from the sample has not occurred.

This work was carried out under the auspices of the U. S. Atomic Energy Commission.

Fig. 1. The dashed curves represent the total activity of each sample; the points and solid lines represent the activity due to Po^{208}. The radius of each circle approximates twice the probable statistical error.

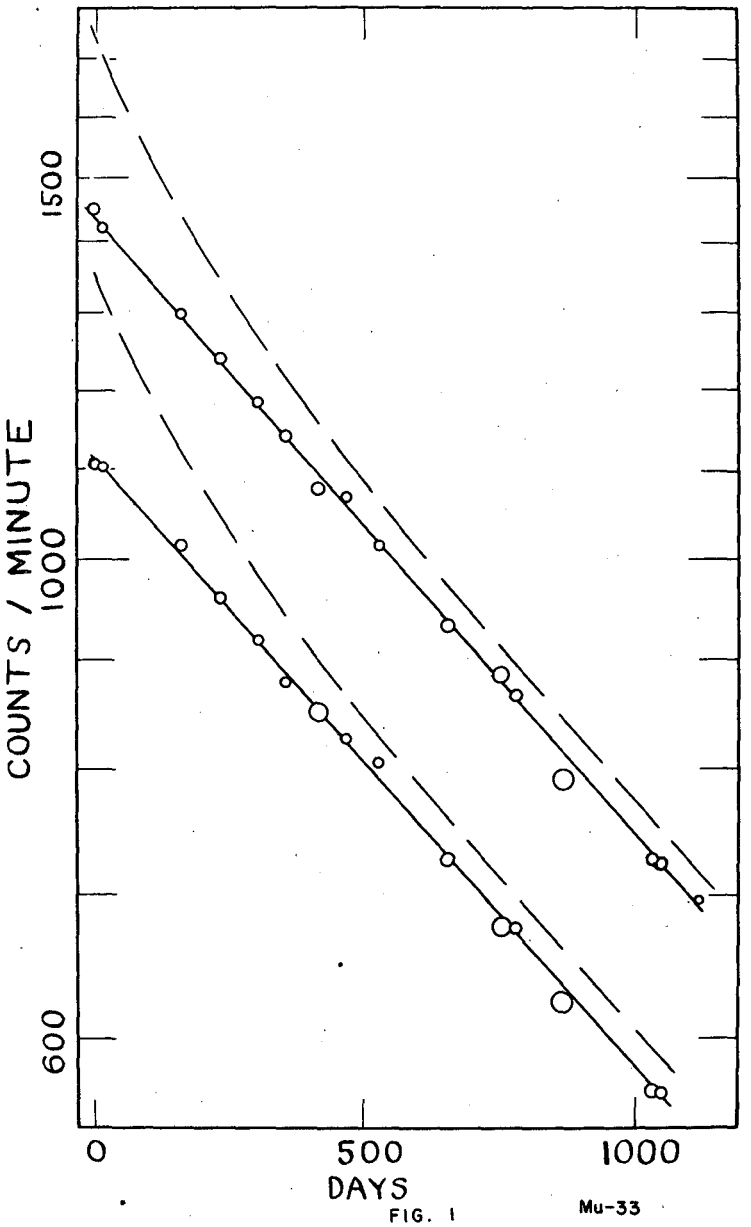

FIG. 1

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