Determination of the Half-Life of Tc^{102}

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In the isotope tables a value of "less than 25 seconds" is given for the half-life of technetium-102, the parent substance of which is the 11.5-minute molybdenum, which is found in fission products.[1] In order to measure such a short half-life, a chemical method was designed to make it possible to effect a very rapid separation; the measurements were made with equipment especially designed by Fraenz for measuring short half-lives.[2]

The chemical method consisted of separating pure molybdenum from the fission products by the methods already described[3,4] and then dissolving the lead molybdate in a mixture of tartaric and hydrochloric acids. The tartaric acid forms a complex with the molybdenum and inhibits its precipitation by tetraphenylarsonium chloride. Previous precipitation of the technetium was carried out by adding perrhenate ion and an excess of tetraphenylarsonium chloride, filtering on a colloidal filter from which the solution was obtained ready for the precipitation of the technetium by the addition of a few drops of perrhenate ion. The solution thus obtained was passed through a Buchner funnel (of the type which can be dismantled, using a colloidal filter mounted on a vacuum filtering tube as shown in Fig. 1. In the absence of vacuum, the filter does not pass the liquid. A GM tube, connected to the measuring circuits, was mounted over the bowl as close to it as possible. At a given point, a few milligrams of rhenium were added to the liquid in the bowl, vacuum was applied; the bowl was removed after filtration had ceased and the measurements were started. With such a procedure, only 5 to 6 seconds elapse from the time at which rhenium is added to that at which the measurements are begun. The technetium precipitate does not account for the whole of the technetium present at the time the reagent is added, and it retains some of the molybdenum, but the major part of the latter is sepa-

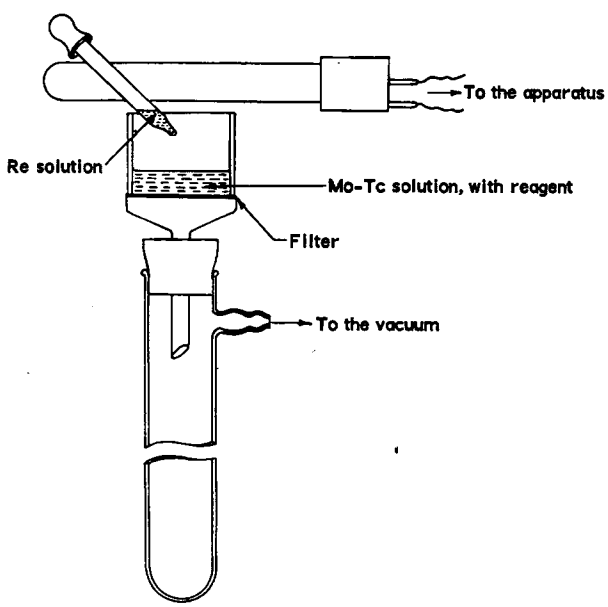

Figure 1

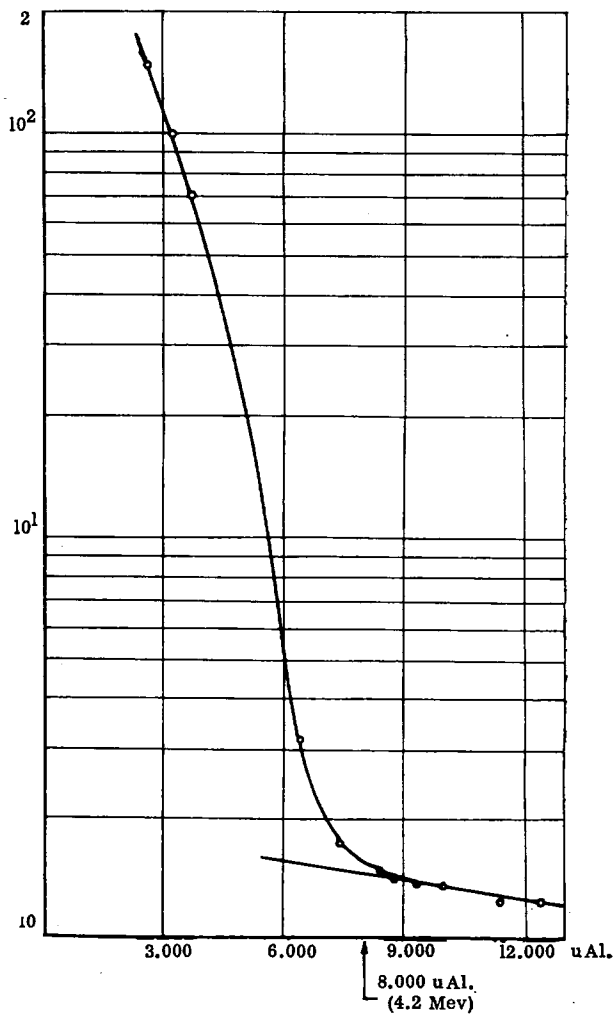

Figure 2. Absorption Mo fission: Eman. Tc^{102}

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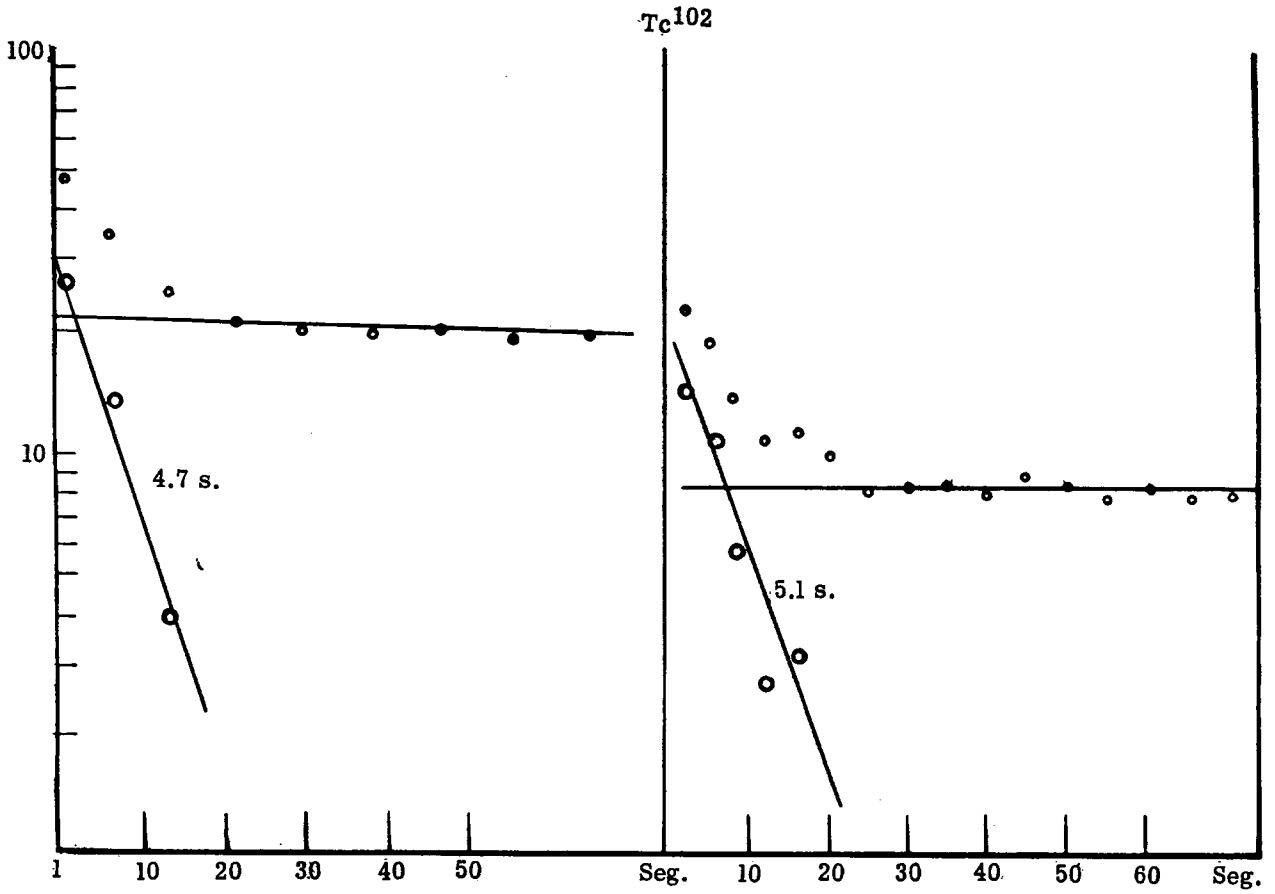

Figure 3

rated, and since it settles at the bottom of the tube, it influences the measurements very little by reason of the distance which separates it from the counter.

Figure 3 shows the decay curves of the technetium fraction. The average of the values found for the short half-life observed is 5 ± 1 seconds. The tails correspond to the absorbed technetium-101 and molybdenum-102.

For the determination of the energy of technetium-102, the molybdenum absorption curve from the fission products was drawn. The beta radiation of the molybdenum-technetium-101 series is almost completely stopped by an aluminum plate 3000 microns thick. If the gamma radiation corresponding to the series of 101 isobars also is subtracted, a half-life of approximately 11.5 minutes is then observed, corresponding to molybdenum-102. With a greater Al thickness, the hard betas due to 5-second technetium are partly absorbed as shown in Fig. 2. Total absorption of the beta particles is obtained with 8000 ± 500 microns Al, which corresponds to a maximum energy of 4.2 ± 0.3 Mev. This value is in good agreement with other figures published earlier.[5,6]

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