Radioactive Halogens Produced by the Neutron Bombardment of Uranium and Thorium

We have looked for radioactive iodine in uranium and thorium after bombardment by deuteron-deuteron neutrons. Under the conditions of our experiments we did not find the iodine of 2.5-hour half-life recently reported[1] as a product of the uranium fission. However, the results indicate two radioactive iodine isotopes, of half-lives about 45 minutes and 12 hours, respectively, from both uranium and thorium, and also a radioactive bromine of about 40-minutes half-life from uranium.

Uranium in the form of uranium nitrate or ammonium uranate was irradiated with neutrons, with paraffin surrounding the uranium but not between the uranium and the neutron source. After two-hour irradiation the uranium salt was dissolved in dilute nitric acid, a small amount of iodine added and extracted with carbon tetrachloride. After thorough washing, the extracts were reduced with bisulfite and the iodide precipitated as silver iodide. This precipitate showed an activity the logarithmic decay curve of which fell rapidly at the start, then flattened out into a straight line of slope corresponding to about a 12-hour half-life. Analysis of the curve indicated that the initial rapid fall was due to a substance of about 45-minute half-life. In another experiment the iodide solution was divided into halves, one of which was precipitated immediately, the other standing for five hours. Small amounts of cesium, barium, and lanthanum nitrates were added to the second portion, a rapid stream of argon bubbled through for five minutes, and the iodide then precipitated with silver nitrate. The activity of the second precipitate agreed with the first to about 10 percent, and both decayed with a 12-hour half-life. We believe this to show that the long-lived substance is an iodine, and not the daughter of the 45-minute substance. It is to be observed that an I^{130} of 13-hour half-life has been reported.[2]

It has been shown[3] that the minute amounts of radioactive substance produced in artificial disintegrations behave in distribution processes quantitatively the same as if accompanied by larger amounts of "carrier." Thus the chemical behavior of the activities reported above did not exclude bromine, or even chlorine. To investigate these possibilities we added bromide to the iodide solution, separated the iodide by nitrite oxidation and extraction, then the bromide by permanganate oxidation and extraction. The iodide precipitate gave the composite decay curve previously obtained, the bromide precipitate was feebly active. When this experiment was repeated with bromine carrier in the initial extraction from the uranium solution the bromide precipitate showed a strong activity decaying with a 40-minute half-life; no longer-lived substance was found. The iodide precipitate was only feebly active, which we attribute to oxidation of the iodine by bromine to iodate which would not be extracted. When a small amount of iodate was added to the uranium solution after the bromine extraction, reduced, oxidized to iodine and extracted, the iodide gave the composite decay curve previously obtained. We believe that the completeness of the chemical separations precludes the possibility that the bromide activity was iodine contamination, likewise that the 45-minute iodine could be bromine contamination.

Similar, but less complete experiments have been performed with thorium. As in the case of uranium, two iodines, chemically separable from bromine were found. We do not have good evidence for a bromine from thorium, but it is not excluded by our results.

The activities obtained from the uranium when 100 to 400 g portions of uranium nitrate were irradiated were of the order of several thousand counts per minute. Comparable amounts of thorium gave activities of a few hundred counts per minute. Control experiments on unirradiated uranium and thorium gave zero activity in the halide precipitates.

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The Dispersion of Water for Electromagnetic Waves

Up to the present time no conclusive evidence of dispersion of water for electric waves has been found by observers in the region of wave-lengths of 50 to 100 cm or more. Drake, Pierce and Dow[1] working in the region from $\lambda=391.8$ to 2547 cm found the refractive index to be 8.925 for water of low conductivity at 22°C. Other observers working in the same region found values of refractive index which were in good agreement. No definite dispersion was observed. Some observers working in the region below 50 cm have found a variation of the index of refraction of water with wave-length. However, Knerr[2] points out that the lack of precision in the methods used by these observers does not allow definite conclusions to be drawn about the dispersion in this region. From his own observations, Knerr quotes a value for the refractive index of 8.80 for water at 22°C with no conclusive evidence of dispersion in the region of $\lambda=6.48$ to 20.44 cm.

The refractive index of water has been investigated using the method of standing waves inside a copper pipe with a concentrically placed wire. Actual dispersion of water was detected from wave-lengths of a meter to one-half meter by making simultaneous observations of waves of the first and second harmonics of a continuous wave oscillator. It was observed that with air in the pipe the two waves traveled with the same velocity since it was impossible to resolve the nodes of the standing waves; while with water in the pipe the wave of the second harmonic traveled with a velocity greater than that of the first. After the tenth node it was found that the positions of the nodes of standing waves could be separated, and actual measurements of wave-length were made for each harmonic. The observed values are: for $\lambda=52.84$ cm, $n=8.799$ and for