$\mathbf{NM}/$ LETTERS TO THE EDITOR

TRANSLATION OF AN HISTORIC PAPER

On a New, Strongly Radioactive Substance, Contained in Pitchblende: By M. P. Curie, Mme P. Curie

and M. G. Bémont; Presented by M. Becquerel*

Ed Note: In his letter to the Editor in 1967 (J. Nucl. Med. 8:76, 1967) Abraham A. Sherman expressed his interest in using the Journal of Nuclear Medicine as a vehicle for reproducing some of the original outstanding papers of historical interest to nuclear medicine and nuclear physics. Published here is his translation of the original report on radium by the Curies and Bémont.

Two of us (M. and Mme P. Curie) have shown that, by chemical purification procedures, it is possible to extract a strongly radioactive substance from pitchblende. This substance is very close to bismuth in its analytical properties. We have expressed the opinion that pitchblende contains, perhaps, a new element for which we have proposed the name PO-LONIUM. (M. and Mme P. Curie, *Compt. Rend.* **127,** 1898, p. 175).

The research which we are now pursuing is actually in accord with the first results obtained, but in our present work we have encountered a second, strongly radioactive substance which is entirely different from the first one in its chemical properties. In fact, polonium is precipitated in acid solution by hydrogen sulfide; its salts are soluble in acids, and water precipitates them from these solutions; polonium is completely precipitated by ammonia.

The new radioactive substance which we found has nearly all the properties of barium except: it is not precipitated by hydrogen sulfide, ammonium sulfide nor by ammonia; the sulfate is insoluble in water and in acids; the carbonate is insoluble in water; the chloride, although very soluble in water, is insoluble in concentrated hydrochloric acid and in alcohol. Finally, this substance gives the easily recognized spectrum of barium.

We believe, nevertheless, that this substance, although it seems to be for the most part barium, also contains a new element which gives to it its radioactivity and besides, is very close to barium in its chemical properties.

Here are the reasons which favor this viewpoint:

1st: Barium and its compounds are not ordinarily radioactive; however, one of us has shown that radioactivity seems to be an atomic property which persists in all the chemical and physical states of a material. (Mme. P. Curie, *Compt. Rend.*, **126**, 1897, p. 1,101). From this viewpoint the radioactivity of our substance is not due to barium but must be attributed to another element.

2nd: The first yields of our substance, in the form of the hydrated chloride, had a level of radioactivity 60 times higher than that of metallic uranium. (The intensity of radioactivity was measured by the degree of conductivity of the air between the parallel metal plates of our apparatus.) By dissolving these chlorides in water and then by precipitating part of them by alcohol, the part precipitated is found to be much more active than the part which remains dissolved. By using this principle, one can carry out a series of fractionations which results in chlorides which are increasingly radioactive. We have obtained chlorides having an activity 900 times greater than that of uranium. Our progress has been halted by the lack of enough material to work with, but judging from the course of events in performing our operations, it is possible to predict that the activity would be greatly augmented if we were able to continue. These facts could be explained by the presence of a radioactive element whose chloride would be less soluble in alcoholized water than barium chloride.

3rd: M. Demarçay studied the spectrum of our material and we cannot thank him enough for this kindness. The results of his examination are given in a special report following our report. M. Demarçay found a line in the spectrum which does not seem to belong to any other known element. This line which is barely visible, using the chloride 60 times more active than uranium, becomes very prominent with the chloride which was enriched by fractionation up to the activity of 900 times uranium. The intensity of this spectral line thus increases at the same time as does the radioactivity, and this is, we think, a very important reason to attribute the radioactive emanation to our substance.

The various reasons which we have enumerated prompt us to believe that the new radioactive sub-

^{*} Originally published in *Comptes Rendus* of the Sessions of the Academy of Sciences, Paris, 127, July-December, 1898, pp. 1,215–1,217. The work was done at the Municipal School of Industrial Physics and Chemistry.

stance represents a new element, to which we propose to give the name RADIUM.

We have determined the atomic weight of our active barium in proportion to the chlorine in the anhydrous chloride. We have found numbers which differ very little from those obtained in a like manner using inactive barium; however, the numbers for active barium are always a little heavier, but the difference is of the order of magnitude of the experimental error.

The new radioactive substance contains, of course, a very high proportion of barium; in spite of this the radioactivity is considerable. The radioactivity of radium must therefore be enormous.

Uranium, thorium, polonium, radium and their compounds cause air to conduct electricity and act photographically on sensitive plates. From these two standpoints, polonium and radium are considerably more active than uranium and thorium. On photographic plates one obtains good exposures with radium and polonium in one-half minute; it takes several hours of exposure to obtain the same results with uranium or thorium.

The rays emitted by the compounds of polonium and radium cause barium platinocyanide to fluoresce; their action from this standpoint is analogous to Röntgen rays but considerably weaker. To perform the experiment, one places on the active substance, a very thin sheet of aluminum upon which is spread a thin layer of barium platinocyanide; in the dark, the platinocyanide appears faintly luminous.

A source of light is thus achieved, and although, in truth, it is a very feeble light, it functions without any source of energy. This is a contradiction of the principle of Carnot, or at least it appears to be.

Uranium and thorium do not give off light under these conditions, their action probably being too weak.

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INCREASE IN PBI CAUSED BY LT₃

I am concerned that the literature should contain the statement that the administration of LT_3 increases the PBI. In the article by Dr. Cuarón entitled "Determination of Serum Thyroxin by Saturation Analysis of Thyroxin-Binding Protein" (J. Nucl. Med. 10:532, 1969) there is a statement and a figure to support that statement which must be challenged.

On page 536 there appears, "Daily administration of 100 μ g of L triiodothyronine for 10 days increased the PBI concentration in the serum from every subject studied but had quite a different effect on T₄ iodine level". Figure 3 on page 537 graphically illustrates these findings.

It should be noted that this finding is entirely different from many other reports in the literature and textbooks. These indicate that the PBI is reduced in euthyroid individuals receiving L triiodo-thyronine. Indeed, this is the basis of the T_3 suppression test. It would be a great disservice if this error (from whatever cause) should remain in the literature unchallenged.

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THE AUTHOR'S REPLY

I do appreciate the observations made by Dr. Jackson concerning our paper on serum thyroxine estimation. His comment has in itself the accreditation of rightness.

The fact that T_3 administration decreases thyroid function in euthyroid subjects but fails to do so in thyrotoxic patients is well known. Last June we sent to the *Journal of Nuclear Medicine* a paper designed to study the effect of T_3 medication on T_4 concentration in sera from euthyroid and thyrotoxic individuals and to assess the value of this procedure in the diagnosis of borderline thyrotoxicosis in iodinecontaminated patients. A clear-cut distinction between both groups was obtained, mainly when the inhibition of serum thyroxine concentration was described as a percent fraction of the basal pretreatment value.

In regard to his pertinent observation, the only obvious explanation for the unusual increase of protein-bound iodine concentration in sera from those subjects receiving T_3 medication is a presumable contamination of the hormone we were using at that time with other iodinated compounds.

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