RUTHERFORD, THE "TRUE DISCOVERER OF RADON"

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In an earlier issue of this *Bulletin* (1), Marshall and Marshall provide strong evidence that Ernest Rutherford was the "true discoverer" of radon. They report (p 78) that "By 1903 they [Rutherford and Soddy] could claim that the "emanation" must be matter in the gaseous state." In fact, Rutherford was persuaded of the gaseous nature of emanation in 1901 as a result of research performed by his first graduate student, Harriet Brooks (2).

In an earlier paper of 1900 (3), Rutherford had suggested two possibilities for emanation: that it was "fine dust particles of the radio-active substance emitted by the thorium compounds" or "a vapour given off from thorium compounds." Once experiments showed that emanation was not a dust, Rutherford concluded that, "The emanation may possibly be a vapour of thorium."

It was in 1901 that Rutherford's view changed. Rutherford and Brooks jointly authored a paper titled "The New Gas from Radium." In their opening remarks, they comment (4):

> The term "emanation" was applied to the substance thus emitted, as there was no evidence at the time whether the material emission was a vapour of the substance, *a radioactive gas* (our emphasis), or particles of matter each containing a large number of molecules.

Thus Rutherford and Brooks had now added this third possibility that was absent from the 1900 paper. They then described their efforts to identify the nature of emanation. No appreciable volume of a gas could be isolated nor could any new spectral lines be identified. As a result, they concluded that the volume of any gas was small. They resorted to a gas interdiffusion apparatus as a means of not only confirming emanation to be a gas but also in order to obtain a rough value for its molecular weight. They reported (erroneously) that the gas had to have an atomic weight between 40 and 100. Nevertheless, the fact that the value was far less than that of thorium persuaded them that emanation was a previously unknown gas. They did not claim at the time that it was a new element, though this seems to be the implication left to the reader.

The title of the paper made a definitive claim of the gaseous nature of the substance; but, in their closing remarks, they were somewhat more diffident, stating (4):

> We must therefore conclude that the emanation is in reality a heavy radioactive vapour or gas.

However, in the final sentence, they came out more strongly for the gas option:

> … special experiments show that it diffuses rapidly, and is also gaseous in character.

Later in the year, Rutherford re-published the findings under his own name alone (5). This briefer account contained the comment, "In these experiments, I have been assisted by Miss H. T. Brooks, …" He then repeated the statement from the earlier paper, "We must therefore conclude that the emanation is in reality a heavy radioactive vapour or gas."

Thus we would courteously suggest 1901 as the year in which emanation was first identified by Rutherford–and Brooks–as a new gaseous element.

REFERENCES AND NOTES

1. J. L. Marshall and V. R. Marshall, "Ernest Rutherford, the 'True Discoverer' of Radon," *Bull. Hist. Chem*., **2003**, *28*, 76-83.
2. M. F. Rayner-Canham and G. W. Rayner-Canham, *Harriet Brooks—Pioneer Nuclear Scientist*, McGill-Queen's University Press, Montreal, 1992.
3. E. Rutherford, "A Radio-active Substance Emitted from Thorium Compounds," *Philos. Mag.*, **1900**, *49*, 1.
4. E. Rutherford and H. T. Brooks, "The New Gas from Radium," *Trans. R. Soc. Canada*, **1901**, Section III, 21.
5. E. Rutherford, "Emanations from Radio-active Substances," *Nature*, **1901**, *64*, 157.

RESPONSE TO RAYNER-CANHAM LETTER

Marlene Rayner-Canham includes an added dimension to the discovery process of radon in Rutherford's laboratory. The question is raised whether the actual discovery date should be earlier. We have found that identifying "the" discovery date of an element can be difficult, owing to uncertain criteria for the elements previous to modern times; this was briefly discussed in the beginning of our article. V. Karpenko (*Ambix*, **1980**, *27*, 77-102) discusses this matter more fully and cites E. Rancke-Madsen (*Centarus*, **1976**, *19*, 299), who suggests two criteria to be an "effective discoverer of an element," the first being the observation of a new substance recognized as being elemental (but may be in combination or may be impure), and the second being the announcement (publication or even professional lecture) of this discovery so that it has been noticed by persons outside the immediate circle. On this basis we would tend to adhere to the "official" dates given in our article. (As we have noted in our article, we had contacted IUPAC, which has no official standing regarding the "true discovery of elements" except for the recent artificial elements.) However, we completely agree that the first recognition of a new element may precede the "official" date. Notable examples include einsteinium (whose first detection in a nuclear detonation was kept secret for a period of time) and oxygen (which was discovered by Scheele probably even before his work in Uppsala, actually during his previous stay in Stockhom). The Rayner-Canhams' excellent comments remind us that the "discover" phenomenon is a dynamic and unfolding process, and they breathe additional insight into the discovery process of radon in the laboratory of Rutherford. December 6, 2003.

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The 10th Biennial Chemical History Study Tour

The 10th Biennial Chemical History Study Tour will take place from October 7 - 19, 2005. Our itinerary will take us to Prague, Vienna, and Northern Italy where we will explore the work of Czech Nobel Laureate Jaroslav Heyrovsky, visit a medieval silver mine and one of the world's oldest alchemy museums, examine the work of Austria's most famous chemist, Auer von Welsbach, at a museum dedicated to his work, visit Galileo's academic digs in Padua, view the magnificent architecture of Palladio, the model for many of our buildings in Washington, DC, etc. There will be an optional four days in Rome for those who wish where we will visit the University of Rome's Physics Museum crammed with Fermi memorabilia, and the Chemical Education Museum. For more details of the itinerary and pricing, please contact Mary Virginia Orna at mvorna@cnr.edu or write to her at the Department of Chemistry, College of New Rochelle, New Rochelle, NY 10805.