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Rutherford Memorial Lecture, 1963 The industrial development of nuclear power

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Steven B. Krivit

10 September 2018

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On the Transmutation of Nitrogen to Oxygen

[Steven B. Krivit](#), Publisher and Senior Editor New Energy Times

This letter serves to correct a historical inaccuracy in this sentence in this article: "... in the third decade Rutherford achieved this transformation by firing α -particles into nitrogen gas and observing that occasionally hydrogen nuclei endowed with very high velocity were produced—the α -particle had entered into the nitrogen nucleus to form a compound unstable nucleus which instantly broke up with the emission of a fast proton, leaving behind an isotope of oxygen, having a mass of 17."

In the process of writing my book *Lost History* [1] (<http://stevenbkrivit.com/lost-history>), I stumbled on the fact that for more than half a century, extensive confusion has existed about the first confirmed artificial transmutation of chemical elements. This discovery has often and mistakenly been attributed to Sir Ernest Rutherford who, in 1919, published a series of four papers titled "Collisions of Alpha Particles With Light Atoms," parts I, II, III and IV, published in the *Philosophical Magazine*. [2-5]

With the benefit of hindsight, we can certainly understand that Rutherford's experiment would have caused the transmutation of nitrogen to oxygen and that the fundamental reaction mechanism was an integration process; the capture of the impinging alpha particle by the target nitrogen nucleus. However, Rutherford did not obtain or observe evidence for these two concepts. He therefore, of course, did not make such claims in his 1919 papers. Nor was that his objective.

Rutherford's intent, as he wrote to his colleague Niels Bohr in 1917, was to better understand "the character and distribution of forces near the nucleus" and to shatter the nucleus to better understand its structure and constituent particles. He also wanted to ascertain the origin of what he then called the swift hydrogen atom, or the positive electron, in previously reported experiments. He correctly intuited that this particle was "a unit of which all atoms are composed." [6]

Ernest Marsden, a research assistant in Rutherford's laboratory, had preceded Rutherford in similar experiments but Marsden thought that the origin of this swift hydrogen atom was the radioactive source used in the experiments for its emission of energetic alpha particles. Rutherford definitively showed that this swift hydrogen atom was coming not from the radioactive source but from the interaction with the nitrogen particle and that it was indeed a fundamental particle which, the following year, he named the proton.

These were notable accomplishments, but that is the limit of his 1919 discovery. Rutherford did not discuss in his four papers the nature of the residual nucleus after impact by the alpha particle and he incorrectly presumed that the impinging alpha particle knocked out (what we now know as) a proton in a disintegration process. The research and discoveries of Patrick Blackett, another recent graduate and research fellow working in Rutherford's lab, shed light on these matters.

From 1921 to 1924, Blackett used the Wilson cloud chamber to take 23,000 photographs of 400,000 particle tracks. Among these, eight telltale sets of tracks revealed to Blackett that the alpha particle bombarding the nitrogen nucleus was, in fact, captured by the nitrogen nucleus which then nearly immediately ejected a proton, leaving behind the residual nucleus of a larger atom, that of oxygen. This also revealed that the fundamental nuclear process was one of integration, not disintegration. Blackett published this data and his conclusion in his 1925 paper. [7]

1. Krivit, Steven B. (2016) Lost History: Explorations in Nuclear Research, Vol. 3, Pacific Oaks Press
2. Rutherford, Ernest (June 1919) "Collisions of Alpha Particles With Light Atoms: I. Hydrogen," Philosophical Magazine, Series 6, 37, p. 537-61
3. Rutherford, Ernest (June 1919) "Collisions of Alpha Particles With Light Atoms: II. Velocity of the Hydrogen Atom," Philosophical Magazine, Series 6, 37, p. 562-71
4. Rutherford, Ernest (June 1919) "Collisions of Alpha Particles With Light Atoms: III. Nitrogen and Oxygen Atoms," Philosophical Magazine, Series 6, 37, p. 571-80
5. Rutherford, Ernest (June 1919) "Collisions of Alpha Particles With Light Atoms: IV. An Anomalous Effect in Nitrogen," Philosophical Magazine, Series 6, 37, p. 581-87
6. Trenn, Thaddeus (March 1974) "The Justification of Transmutation: Speculations of Ramsay and Experiments of Rutherford," Ambix, 21(1), p. 53-77
7. Blackett, Patrick Maynard Stewart (Feb. 2, 1925) "The Ejection of Protons From Nitrogen Nuclei, Photographed by the Wilson Method," Journal of the Chemical Society Transactions. Series A, 107(742), p. 349-60

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