September 5, 2018

To: Dr. Charles Tracy, Head of Education, Institute of Physics
Cc: Dame Julia Higgins, President, Institute of Physics Council
Cc: Martin Andrew Whitaker, Chairman, Institute of Physics History of Physics Group

Dear Dr. Tracy,

On August 23, Manchi Chung at IOP advised me of your institution's intention to change the text on this Web page http://tap.iop.org/atoms/fission/527/page_47258.html as follows:

> The first artificial transmutation was achieved by Rutherford by bombarding nitrogen with alpha particles. Rutherford discovered the process and later its nature was fully elucidated by Patrick Blackett. (This experiment was also important in demonstrating that protons are found inside nuclei.) Ask your students to complete the following nuclear equation that summarises Rutherford's transmutation of nitrogen into oxygen:

I have already provided you with the historical references and facts. Nevertheless, the change you have made does not honestly or accurately depict this science history.

Because the myth of the attribution of this discovery has existed for at least 70 years, your experts have unknowingly learned the false history while they were students. Their textbooks depicted the incorrect history. Thus, it is entirely reasonable that they should have difficulty accurately assessing the matter.

Your experts need to perform a first-principles investigation of the four 1919 Rutherford "Collisions" papers and the 1925 Blackett paper, as I have done. As the U.S. Department of Energy chief historian has done. As the American Institute of Physics has done. As half a dozen experts at other preeminent institutions have already done.

In June 1919, Ernest Rutherford published his four "Collision of Alpha Particles with Light Atoms" papers in the *Philosophical Magazine and Journal of Science*. The most significant aspect of this work is that he established that a "hydrogen atom" (later known as a

proton) was emitted as a result of the bombardment of nitrogen with alpha particles. This provided conclusive evidence that scientists could deliberately make some kind of change to an atom. But in no way did Rutherford obtain evidence of a transmutation of one element to another, publish such results, let alone claim to discover artificial transmutation.

It was Blackett who, in 1925, published the results of his experiments in which he obtained the evidence of the first artificial transmutation, concluded and claimed it as such, and correctly identified the underlying transmutation process. In fact, Blackett *disconfirmed* rather than "*fully elucidated*" Rutherford's 1919 conclusion about the process.

In 1919, Rutherford incorrectly concluded that the underlying process was one of disintegration. Rutherford stated this at the end of his Collisions IV paper:

> From the results so far obtained, it is difficult to avoid the conclusion that the long-range atoms arising from collision of alpha particles with nitrogen are not nitrogen atoms but probably atoms of hydrogen, or atoms of mass 2. If this be the case, we must conclude that the nitrogen atom is disintegrated under the intense forces developed in a close collision with a swift alpha particle, and that the hydrogen atom which is liberated formed a constituent part of the nitrogen nucleus. [1]

In 1925 however, Blackett published his results that provided the first experimental evidence of a transmutation from one element to another and correctly concluded that the underlying process was one of *integration*. [2]

In 1920, Rutherford had incorrectly concluded that the residual nucleus of nitrogen bombarded by an alpha should be boron or carbon. Rutherford stated this in his Bakerian lecture, delivered June 3, 1920:

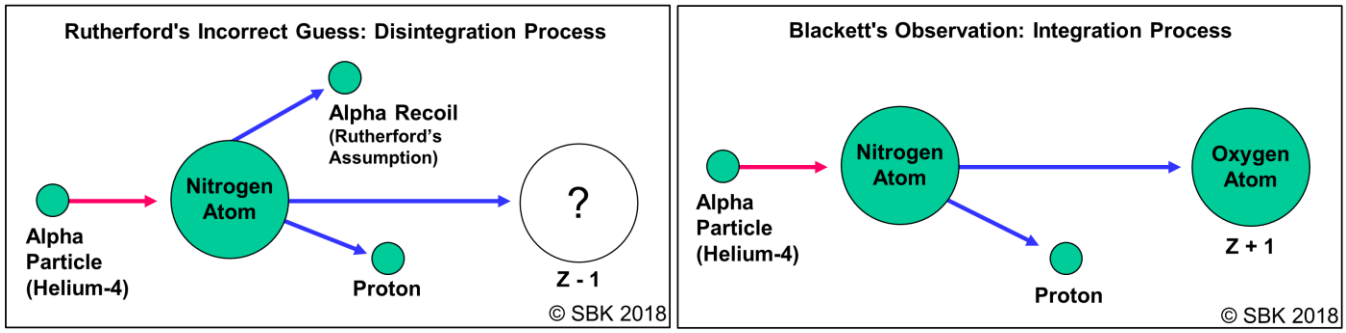
> The expulsion of a mass 3 carrying two charges from nitrogen, probably quite independent of the release of the H atom, lowers the nuclear charge by 2 and the mass by 3. The residual atom should thus be an isotope of boron of nuclear charge 5 and mass 11. If an electron escapes as well, there remains an isotope of carbon of mass 11. The expulsion of a mass 3 from oxygen gives rise to a mass 13 of nuclear charge 6, which should be an isotope of carbon. In case of the loss of an electron as well, there remains an isotope of nitrogen of mass 13. The data at present available are quite insufficient to distinguish between these alternatives. [3]

In 1925 however, Blackett obtained the data and correctly concluded that the residual

nucleus was *oxygen:*

> In ejecting a proton from a nitrogen nucleus, the alpha particle is therefore itself bound to the nitrogen nucleus. The resulting new nucleus must have then mass 17 and, provided no electrons are gained or lost in the process, an atomic number of eight. ... It ought, therefore, to be an isotope of oxygen. [2]

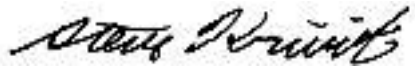
The facts leave very little room for opinions or any basis to perpetuate the myth. This diagram should be helpful:



This is the correct way to describe this science history on your Web page:

> The first artificial transmutation was achieved by Patrick Blackett by bombarding nitrogen with alpha particles. (A prior experiment by Rutherford was important in demonstrating that protons are found inside nuclei.) Ask your students to complete the following nuclear equation that summarises Blackett's transmutation of nitrogen into oxygen:

Sincerely,



Steven Krivit
Publisher and Senior Editor, *New Energy Times*

1. 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
2. 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.
3. Rutherford, Ernest (1965) "Nuclear Constitution of Atoms," [Bakerian Lecture], Proceedings of the Royal Society of London 97-A, 374-400, (1920); reprinted in The

Collected Papers of Lord Rutherford of Nelson O.M., F.R.S. Published under the Scientific Direction of Sir James Chadwick, F.R.S., Chadwick, James, ed., 3, George Allen and Unwin, p. 14-38

Subject:RE: Historical Inaccuracy on IOP Web Site
Date: Tue, 11 Sep 2018 16:13:24 +0000
From: Charles Tracy
To: Steven B. Krivit
CC: Manchi Chung

Dear Steven,

Thank you for your continued help with this question. We are keen to get this resolved satisfactorily.

Whilst we are keen to get the history correct, this is not a history resource. And, in the end, if we cannot resolve the words, we will simply take them out (better to say nothing than say something incorrect).

After consultation, my understanding is that Rutherford says he discovered the basic reaction (that an alpha particle came in and a proton comes out). But it was Blackett who showed that the nucleus invoked also changed [to balance A and Z of courser]. Also, the source we have checked (Rutherford by A.S,. Eve (Cambridge UP) [Eve was very close to Rutherford] and a 1933 article by Rutherford - Artificial Transmutation of the Elements http://adsabs.harvard.edu/full/1933JRASC..27..155R) stresses the importance of Blackett's work.

Does that match your view?

In which case, would this be acceptable:

Rutherford found that protons exist in the nucleus by bombarding nuclei with alpha particles. Patrick Blackett carried out further experiments and showed that the bombarded nucleus had transmuted. Ask your students to complete the following nuclear equation that summarises the transmutation of nitrogen into oxygen.

Best wishes,
Charles

Charles Tracy
Head of Education
Institute of Physics
76 Portland Place, London, W1B 1NT

www.iop.org

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Subject: Historical Correction on IOP Web Site
Date: Tue, 11 Sep 2018 11:42:03 -0700
From: Steven B. Krivit

To: Dr. Charles Tracy, Head of Education, Institute of Physics
Cc: Dame Julia Higgins, President, Institute of Physics Council
Cc: Andrew Whitaker, Chairman, Institute of Physics History of Physics Group

Dear Charles,

I greatly appreciate your willingness to work with me not only to make the IOP Web page "Episode 527: Nuclear Transmutation" accurate, but informative for students.

Yes, I concur that your current proposed revision is acceptable.

As to sources, however, I always try to use original sources. My sources are the four "Collisions" papers published by Rutherford in 1919 and the Blackett paper published in 1925. These are the indisputable scientific and historical references on this matter.

Arthur Eve's biography of his colleague Rutherford is not independent and it was written years after the fact, with the aid of Rutherford. The 1932 summary in *The McGill News* written by Rutherford is not a primary reference but a memoir and consists of his historical review of transmutation.

As an investigative science journalist, I have conducted hundreds of interviews with scientists. With all due respect to Sir Rutherford, my experience has taught me that scientists' versions of history — in which they were key participants — tends to be less reliable than their original published journal papers or historical retrospectives written by independent parties. I find that to be the case with this article in *The McGill News*.

Independent sources I used to confirm my own first-principles investigation of this history were Peter Galison, *Image and Logic* (1997, p. 118) and Milorad Mladjenović, *History of Early Nuclear Physics* (1992, pp.157-162).

Your current proposed revision would be more thoughtful if you recognized Blackett's discovery as you had done previously, when you believed it to have been Rutherford's ("The first artificial transmutation was achieved by Rutherford") and as you now do with Cockroft and Walton ("were the first.") By doing so, I think you would also make a better contribution to science history and education, as the

following organizations have now done: U.S. Department of Energy, American Institute of Physics, American Institute of Physics, Imperial College, Cambridge University, Oxford University Press, University of California Santa Barbara, Atomic Heritage Society, Brittanica.com, and the Royal Society.

If you would like to better understand this history, I am enclosing a copy of a letter I wrote to the Royal Society which they published yesterday.

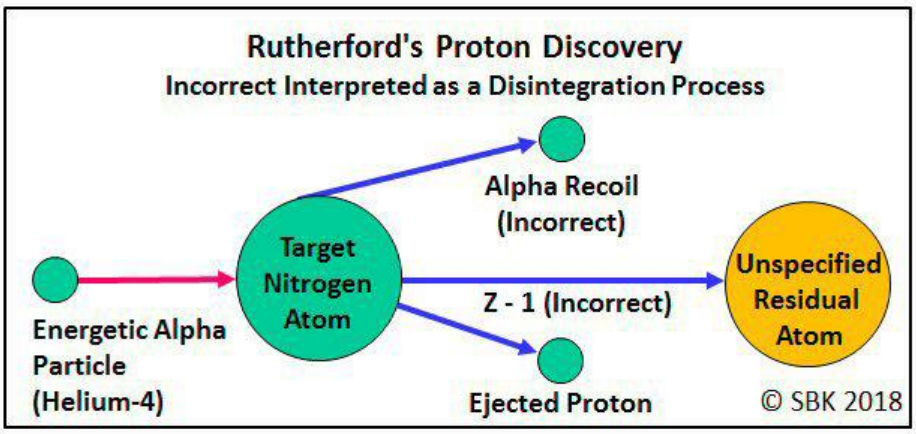
Most kind regards,
Steven

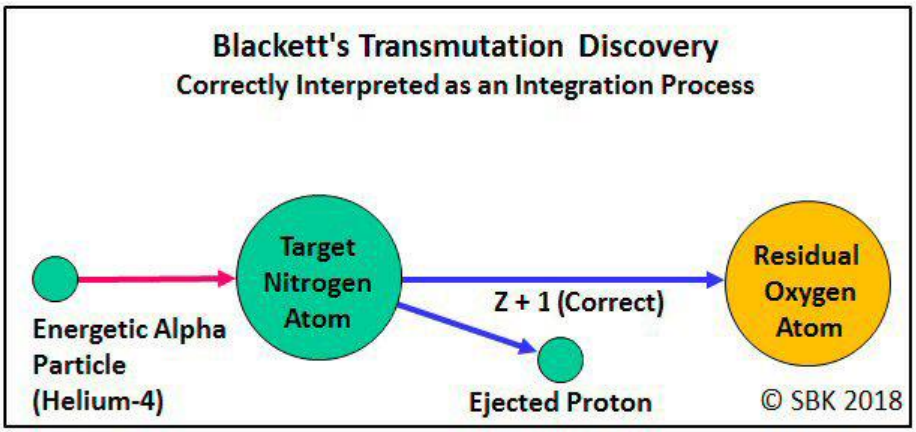
Subject: Historical Correction on IOP Web Site
Date: Tue, 11 Sep 2018 16:47:55 -0700
From: Steven B. Krivit

To: Dr. Charles Tracy, Head of Education, Institute of Physics
Cc: Dame Julia Higgins, President, Institute of Physics Council
Cc: Andrew Whitaker, Chairman, Institute of Physics History of Physics Group

Dear Charles,

These diagrams should help.





Most kind regards,
Steven

Subject: Historical Correction on IOP Web Site
Date: Fri, 28 Sep 2018 21:20:00 -0700
From: Steven B. Krivit

To: Dr. Charles Tracy, Head of Education, Institute of Physics
Cc: Dame Julia Higgins, President, Institute of Physics Council
Cc: Andrew Whitaker, Chairman, Institute of Physics History of Physics Group

Dear Charles,

I wish to thank you for working with me to correct the depiction of this important history. I appreciate the time and effort you contributed to this matter.

Most kind regards,
Steven

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Steven B. Krivit
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Author of Fusion Fiasco: Explorations in Nuclear Research, Vol. 2
Author of Lost History: Explorations in Nuclear Research, Vol. 3
Editor-in-Chief Wiley & Sons Nuclear Energy Encyclopedia: Science, Technology, and Applications
Co-editor of Low-Energy Nuclear Reactions and New Energy: Technologies Sourcebook Volume 2 (ACS Symposium Series)
Co-editor of Low-Energy Nuclear Reactions Sourcebook Volume 1 (ACS Symposium Series)
LENR Contributor to the Elsevier Reference Module in Chemistry, Molecular Sciences and Chemical Engineering
LENR Contributor to the Elsevier Encyclopedia of Electrochemical Power Sources

Subject: Re: Historical Correction on IOP Web Site
Date: Sat, 29 Sep 2018 08:02:23 +0000
From: Charles Tracy
To: Steven B. Krivit, Julia Higgins, Andrew Whitaker
CC: Manchi Chung

Dear Steven,

Thank you too. It was helpful to have the error highlighted and I'm glad that we have got it sorted out.

Best wishes
Charles

Charles Tracy
Head of Education

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76 Portland Place, London, W1B 1NT