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The First Observation of Nuclear Transmutation in a Protium System by R.T. Bush and R.D. Eagleton (1993, 1994)*

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It is a common sense that the research of the cold fusion phenomenon (CFP) started by the work by Fleischmann et al. in 1989 [Fleischmann 1989]. And the presumption of the pioneers that the deuterons in solids (especially in a palladium metal, in their case) will experience fusion reactions between them by assistance of solid environment has casted a large shadow over the history of the CF research (the research of the cold fusion phenomenon). Expressed more plainly, the CF research in deuterium systems has been the main stream and that in protium systems the narrow side stream. For a long period until very recent years, the latter has been put in a shadow for instance in bibliography and in open discussion.

Now, however, the situation changed very much and it is clear that the CFP is a phenomenon occurring in both deuterium and protium systems containing nuclear reactions in room-temperature solids with a lot of hydrogen isotopes [Kozima 1998 (Chapter 7)].

The first report of the CFP in a protium system is, as far as I know, the one by Mills and Kneizys appeared in the *Fusion Technology* in 1991 [Mills 1991]. The second will be that by R.T. Bush also published in *Fusion Technology* in 1992 [Bush 1992]. These papers reported the excess heat generation in protium systems. It is interesting to notice their interpretation of their results to explain the unexpected nuclear reactions (resulting in the observed enormous amount of the excess energy). The parallelism of the $d + d$ fusions supposed by Fleischmann et al. should be the $p + p$ reactions which were too far from their common sense in physics and they assumed specific mechanisms each other. Mills et al. assumed a specific mini-hydrogen (hydrogen atoms with fractional quantum numbers) and R.T. Bush assumed a direct fusion reaction of a proton and an alkaline nucleus (alkali-hydrogen fusion).

I have classified experimental data in direct and indirect evidences of nuclear reactions resulting in the CFP to make clear the importance of the experimental data [Kozima 1998, 2006]. The excess energy (heat) is classified in the indirect evidence of the nuclear reactions if its amount is too much to explain by known physical or chemical processes without nuclear reactions. Therefore, it was desirable to observe any direct evidence in protium systems to declare the existence of the CFP in them.

The first direct evidence of the nuclear reactions in protium systems was measured by R.T. Bush and R.D. Eagleton in 1993 [Bush 1993, 1994]. For the benefit of readers, we have uploaded the paper [Bush 1994] in the CFRL website next to the CFRL News. No. 89;
http://www.geocities.jp/hjrfq930/News/news.html

We have analyzed their data with our model (TNCF model) applicable to deuterium and also protium systems and given a semi-quantitative explanation of their observation of transmuted nuclei [Kozima 1996, 1998 (Sec. 9.1b), 2015].

It is important to know a history of the journalism around the CF research. It is well known that the *Fusion Technology*, the authorized international journal of the American Nuclear Society, played a very important role in the promotion of CF researches. The editor of the journal at that time was Prof. G.H. Miley and his judgment made publication of many papers on the CFP. The editor of the journal changed from Prof. Miley to another and the name of the journal changed to *Fusion Science and Technology* in 2001. After this change, it seems the character of the journal has become less scientific. A Comment by G.H. Miley at his retirement from the editor is posted at CFRL website: http://www.geocities.jp/hjrfq930/FTEssay/Essays/Miley.htm

Researches of the CFP in protium systems have been accelerated by the papers by Mills and R.T. Bush and many papers have presented at international conferences and published in international journals. In ICCF3 held in Nagoya, Japan in 1993, there are following pioneering papers in this genre by Notoya and Enyo [Notoya 1993], Ohmori and Enyo [Ohmori 1993] and Srinivasan et al. [Srinivasan 1993]. By the way, it should be noticed that a short essay ”Open Minded Attitudes to the Science” by Michio Enyo, one of the authors cited above, which is posted at a following page of the CFRL website:
http://www.geocities.jp/hjrfq930/FTEssay/Essays/Enyo.htm

From our present view, it is interesting to looking for a first person or people who observed the CFP in protium systems. In relation to this question, we find an episode told by opponents against the CFP.

Pioneers in this unknown field of the cold fusion phenomenon (CFP), have

experienced unexperienced facts and they had to work by a trial-and-error approach. In doing so, they made many mistakes caused by mismatching between their presumption based on the common sense they had and the fact they observed in their experiment. This is a normal process in pioneering works in science even if the discrepancy in the CFP was rather enormous. The two books by G. Taubes [Taubes 1992] and J.R. Huizenga [Huizenga 1992] cited many examples of these mistakes performed in the early days of the CF research and gave negative influence against the CFP to people who did not investigate concrete facts.

An episode about the control experiment by F. Pons is taken up by both opponents in their books as if the heat measurement by Fleischmann et al. is incredible. We can read their paragraphs telling the episode below. Paragraphs from Huizenga* and from Taubes** are given with underlines in corresponding parts.

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[Huizenga 1992, pp. 31 – 32] (The underlines in the following sentences are added at citation.)

"*Furth, in an excellent review paper on nuclear fusion, discussed progress toward achievement of practical fusion power. He was the token nuclear physicist speaking at the Dallas ACS session. In his talk, Furth discussed also the extremely small probabilities of fusing hydrogen isotopes at room temperature and the large effective electron mass that would be required to account for the University of Utah claims. Furth concluded that many additional experiments needed to be performed before nuclear physicists would believe the University of Utah's reported data. One of the crucial experiments he suggested was to compare light water (H_2O) and heavy water (D_2O) water under the same electrolytic conditions. Pons replied that he was preparing to do this. On the other hand, based on the discussion following Pons' lecture at Dallas it appeared that Pons and Fleischmann had already performed this control experiment. When Pons was asked why he had not reported results of control experiments with light water substituted for heavy water, he replied "A baseline reaction run with light water is not necessarily a good baseline reaction." When asked to elaborate, Pons intimated he had performed the experiment with light water and had seen fusion, saying "We do not get the expected baseline experiment. . . We do not get the total blank experiment we expected*" (*Science* 244, p. 285)."

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[Taubes 1992, pp. 260 – 261] (The underlines in the following sentences are added at

citation.)

"*The collaboration, however, was undone by Pons's feelings of persecution and then by the local lawyers. First, Linford had a run-in with Pons, sparked by a slight Pons felt he had suffered at the congressional hearings. Harold Furth of Princeton had called Linford before the hearings to learn exactly what Pons had said about his light water controls in his Los Alamos seminar. Linford, who had a videotape of the seminar, found the point at which Pons answered the question about light water – that he had seen heat and then discontinued the experiment – and played it for Furth over the telephone. In Washington, Furth had apparently confronted Pons with what he had said in Los Alamos, suggesting it was proof cold fusion did not exist. Pons had not taken it well. Now Linford stopped by the Utah lab as Pons and Fleischmann were showing the Texas A&M people around; then he slipped away for a few minutes with Pons*."

The citation of this episode by Huizenga and Taubes shows their clear intention to show how incredible is the excess heat measurements by CF researchers and to denunciate the discovery of the CFP. However, regrettably to them, the history of the CF research in these 25 years have shown reality of the CFP and occurrence of unexpected events in hydrated and deuterated solids revealing a realm of new physics unknown before.

It is possible to explore a new field in deuterium system and another in protium system separately as several people have tried for many years. On the other hand, it is possible to look for a new clue to explain the CFP in protium and in deuterium systems simultaneously. Our trial has belonged in the latter and given fairly good qualitative and sometimes semi-quantitative explanations for the experimental data sets. The analysis of the data by Bush and Eagleton given above [Kozima 1996, 2015] is an example and many examples are given in my books [Kozima 1998, 2006] and papers, especially papers given recently [Kozima 2014a, 2014b, 2014c]. We hope these trials using the TNCF model are useful to promote investigations in this field.

References

[Bush 1992] R.T. Bush, "A Light Water Excess Heat Reaction suggests that 'Cold Fusion' may be 'Alkali-Hydrogen Fusion'," *Fusion Technol.* 22. 301 – 322 (1992). ISSN 0748-1896

[Bush 1993] R.T. Bush and D.R. Eagleton, "Experiment Supporting the Transmission Resonance Model for Cold Fusion in Light Water: I. Correlation of Isotopic and Elemental Evidence with Excess Heat," *Proc. ICCF3*, pp. 405 – 408 (1993). ISBN

4-946443-12-6
[Bush 1994] R.T. Bush and D.R. Eagleton, "Evidence for Electrolytically Induced Transmutation and Radioactivity Correlated with Excess Heat in Electrolytic Cells with Light Water Rubidium Salt Electrolytes," *Trans. Fusion Technol*. 26, 344 – 354 (1994). ISSN 0748-1896
[Fleischmann 1989] M. Fleischmann, S. Pons and M. Hawkins, "Electrochemically induced Nuclear Fusion of Deuterium," *J. Electroanal. Chem*. 261, pp. 301 – 308 (1989).
[Fleischmann 1991] M. Fleischmann, "Present Status of Research in Cold Fusion," *Proc. ICCF2*, pp. 475 – 488 (1991). ISBN 88-7794-045-X.
[Huizenga 1992] J. R. Huizenga, *Cold Fusion*: *The Scientific Fiasco of the Century*, University of Rochester Press, 1992. ISBN 1-878822-07-1
[Kozima 1996] H. Kozima, K. Hiroe, M. Nomura, M. Ohta, "Elemental Transmutation in Biological and Chemical Systems," *Cold Fusion* 16, 30 – 32 (1996). ISSN 1074-5610. This paper is republished as [Kozima 2015].
[Kozima 1998] H. Kozima, *Discovery of the Cold Fusion Phenomenon* (Ohtake Shuppan Inc., 1998). ISBN 4-87186-044-2. Cf. Chapter 7, "*Cold Fusion occurs in Hydrated Materials, Too*." Sections 9.1a and 9.1b (Facts), and Sections 11.11a and 11.11b (Explanation). The "References" in this book is posted at the Cold Fusion Research Laboratory (CFRL) Website;
http://www.geocities.jp/hjrfq930/Books/bookse/bookse.html
[Kozima 2006] H. Kozima, *The Science of the Cold Fusion Phenomenon*, Elsevier Science, 2006. ISBN-10: 0-08-045110-1.
[Kozima 2014a] H. Kozima and K. Kaki, "Atomic Nucleus and Neutron — Nuclear Physics Revisited with the Viewpoint of the Cold Fusion Phenomenon," *Proc. JCF14,:14-5*, pp. 47 - 76 (2014). ISSN 2187-2260
[Kozima 2014b] H. Kozima, "Nuclear Transmutations (NTs) in Cold Fusion Phenomenon (CFP) and Nuclear Physics" *Proc. JCF14,: 14-15*, pp. 168 – 202 (2014). ISSN 2187-2260
[Kozima 2014c] H. Kozima, "Cold Fusion Phenomenon – What is It?" *Proc. JCF14,: 14-16*, pp. 203 – 230 (2014). ISSN 2187-2260
[Kozima 2015] H. Kozima, K. Hiroe, M. Nomura, M. Ohta, "Elemental Transmutation in Biological and Chemical Systems," *Reports of CFRL* (*Cold Fusion Research Laboratory*) 15-1, 1 – 6 (January, 2015). This paper is posted at CFRL Website:
http://www.geocities.jp/hjrfq930/Papers/paperr/paperr.html
[Mills 1991] R.O. Mills and S.P. Kneizys, "Excess Heat Production by the Electrolysis

of an Aqueous Potassium Carbonate Electrolyte and the Implications for Cold Fusion," *Fusion Technol.* 20, 65 – 81 (1991). ISSN 0748-1896

[Notoya 1993] R. Notoya and M. Enyo, "Excess Heat Generation in Electrolysis of Potassium Carbonate Solution with Nickel Electrode," *Proc. ICCF3,* pp. 427 – 430 (1993). ISBN 4-946443-12-6

[Ohmori 1993] T. Ohmori and M. Enyo, "Excess Heat Produced during Electrolysis of H_2O on Ni, Au, Ag and Sn Electrodes in Alkaline Media," *Proc. ICCF3,* pp. 421 – 426 (1993). ISBN 4-946443-12-6

[Srinivasan 1993] M. Srinivasan et al., "Tritium and Excess Heat Generation during Electrolysis of Aqueous Solutions of Alkali Salts with Nickel Cathodes," *Proc. ICCF3*, pp. 123 – 138 (1993). ISBN 4-946443-12-6

[Taubes 1992] G. Taubes, *Bad Science – The Short Life and Weird Times of Cold Fusion* –, Random House, New York, 1993. ISBN 0-394-58456-2