Epilogue – CFP as a Typical Complexity in Hydrated Solids

Science is a human endeavor which began late in the history of civilization. Its activity resides in a thin surface layer of our brain, supported by fundamental, old and instinctive activities in deep in the brain. Reason is one of the characteristics of human beings, together with others such as righteousness and sensibility. Rationalism, an essential part of science, is a subtle activity governed by emotional movements deep in the brain. Pascal's words express it briefly; "Man is but a reed, the weakest in nature, but he is a thinking reed." (B. Pascal, *Pensées*, 347)

Scandalous events which occurred in connection with the discovery of the cold fusion phenomenon (CFP) were results induced into the scientific world by an underlying old world, as described in greaqt detail by G. Taubes. However, it is shortsighted to conclude that the essence of CFP is fraud from the tragicomedy played by actors controlled by secular desire and a lack of knowledge. It is similar to the fact that I. Newton's controversy with G.W. Leibniz about the discovery of differential calculus does not spoil his accomplishments.

Consider an example of confusion, which tends to occur during a crisis concerning a new paradigm. The DOE Report of 1989 and the subsequent book by Huizenga, chair of the committee that presented the Report, did not have the foresight to look beyond the limits imposed by the established scientific world. Opponents of CFP were similarly behaved after the Report, and several scientific papers that denied the

possibility of Fleischmann's hypothesis were published.

On the other hand, proponents were mired in established scientific theory the same as opponents. They adhered to an old frame of reference and used questionable assumptions to change reaction probabilities of *d-d* fusion in order to reconcile several uncertain tiny parts of a vast number of facts. These trials remind us of the Lorenz contraction devised to reconcile the result of the Michelson-Morley experiment with classical mechanics instead of the revolutionary assumption proposed by Einstein of the constancy of the speed of light for every reference frame.

If we consider the whole experimental data sets as results of a common cause about which we do not yet understand, it is clear that Fleischmann's hypothesis contradicts not only the experimental facts cited, but also other diverse facts discovered one by one since 1989. The merit of CFP is in its revolutionary capability of generating nuclides that, in free space, are only generated with reactions between high-energy particles.

The first step to approach a difficult problem is traditionally phenomenological. According to this common practice, we used a model to investigate CFP based on experimental facts that are not understood. We used a frame of reference established in nuclear physics and solid-state physics at that time (1993). When the model seemed successful, the next step was to check its capabilities to deal with as many facts as possible. The results of this work were successful. This gave us confidence that the fundamental premises of the TNCF model are effective and the trapped neutrons may reflect at least some of the reality behind the experimental facts of CFP.

By investigation of existing knowledge from the point of view suggested by the success of the TNCF model, it became clear that there are many riddles in the solid-state physics of transition-metal hydrides and also in the nuclear physics of excited states of neutrons around the zero level (or the evaporation level). Together with this knowledge of riddles in traditional branches of physics, new facts of the CFP gave us direction to develop new physics of neutrons in solids. Tentative estimation of neutron bands below zero mediated by interstitial hydrogen isotopes and coherent accumulation of neutrons at surface/boundary regions gave us hope to clarify the riddle of the CFP which is unbelievable from the traditional point of view in physics. In our opinion, the fundamental physics of the CFP may be explained by continuing research along this passway.

Another important phase of CFP is complexity. As was explained in Section 2.12, it is shown by experimental facts that one characteristic of the CFP is complexity. This is already expected from the structure of materials in which the CFP occurs. The fact revealed in Section 2.12 confirmed our expectation and made the image of the CFP clearer. Our research on the CFP must consider this fact.

Science is fundamentally autonomous and not necessarily related with practical applications. In any period of history, reason is the guiding principle of the evolution of a society even if it is merely an ideal which cannot be fully ralized. Science should esteem itself as an activity of reason, but it is not independent of application, as a matter of fact. However, we recollect an episode told about M. Faraday and his discovery of electromagnetic induction. It is said that a man asked him about the future applications of the electromagnetic induction which

was displayed in public, as if his discovery was useless. Faraday replied to the man “what can you say about the future of a newborn baby?” It is desirable that the CFP is correctly understood by many people and they achieve satisfaction in their investigations using materials on hand.

The CFP is a phenomenon which includes diverse events which are applicable to various materials. Application, however, is also restricted by the characteristics of the phenomenon. The characteristics of CFP pointed out in this book should be seriously considered in regard to applications.

Hideo Kozima

January 2006
Yatsu, Shizuoka, Japan