Book Review

Nuclear Transmutation: The Reality of Cold Fusion

Tadahiko Mizuno. (1998). Jed Rothwell, Translator. Concord, NH: Infinite Energy Press. 150 pp.; $32.95 cloth.

In submitting this review of a book on a controversial subject, a few words of introduction are desirable.

1. Research in the last 9 years has led to the conclusion that a number of nuclear reactions can be made to take place in metals saturated with hydrogen (H) or deuterium (D). The happenings seem to be associated with free neutrons in the metal. Fusion of Ds also may contribute because there is plenty of Helium formed. *Low-temperature nuclear reactions in solids* is the current title for the field.
2. The impression in the United States and the United Kingdom that a mistake was made and that there is no nuclear activity in H- (or D-) saturated metals is not the impression held in, for example, Japan, Russia, and Italy, among others. In those countries, there are active groups researching the field (although, of course, the established professors in nuclear science still will deny its existence).
3. The original 1989 discovery of a heat associated with nuclear products is the tip of the iceberg. Transmutation in H- and D-loaded metals has been multiply established (and this book under review is devoted to it). Still more astonishing, there is evidence for the occurrence of nuclear reactions in certain biological systems.

If I can write these things with complete confidence, why is there no government funding, whereas hot fusion (with no success after 40 years) continues to be supported (worldwide) to the extent of $1 billion per year? The reasons are three:

1. The conclusions of the new researches are so far away from expectations in present textbooks that anyone who has not done the experiments (i.e., seen the tritium being produced, etc.) or studied the voluminous literature will find the claims unacceptable. At my university, my coworkers and I were reviled and harassed for 3 to 4 years although our results had been published in refereed papers. But such situations always occur prior to paradigm shifts. Thus, people claimed—incredibly—that sometimes large stones fall out of the sky. Meteors were recognized only in this century.
2. Large numbers of prestigious scientists have announced that the idea of nuclear reactions in solids in the cold is absurd. Planck (1901) said the Quantum Theory would not be a part of physics until his opponents died off.
3. However, there is also an objective reason for lack of support: The phenomena are difficult to reproduce. Between 1989 and 1994, my coworkers and I carried out approximately 100 experiments in the field, of which only about 25 worked. Many experimenters in the field would think this a favorable fraction. The reason for the difficulty seems to be due to the internal damage to the metal crystal, which occurs when H or D diffuses through it. Thus, when critics ask for a demonstration, it is only a one in four chance that one can satisfy them. The consequence is

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that those who have seen the phenomenon beg off requests to demonstrate it.

Nonreproducible? Yes. Repeatable? Yes. All the main results have been done again and again all over the world. There are more than 2,000 publications.

Tadahiko Mizuno is on the faculty of the University of Hokkaido (one of the 11 Imperial Universities) in Japan. He is, formally, a nuclear engineer, but he has published in electrochemistry and in the field of H in metals. This experience (and the equipment available to him) is an ideal background for research into transmutation in H- or D-saturated metals. In the following, I describe a book that recently has been published in Japanese. It is fortunate that one of the U.S. pioneers in this field, Jed Rothwell, married to a Japanese woman, promptly translated the book into excellent English.

Dr. Mizuno, a Japanese academic at an Imperial University, has become well-known for his work on what is misleadingly called "cold fusion," that is, research on Low Energy Nuclear Reactions (LENR). Although there is evidence for D + D fusion, many of the observations are best fitted by other types of nuclear reaction.

The book is a very personal account of Mizuno's struggles to achieve success in this difficult area, totally against the opinions of his Japanese colleagues. He was thereby forced, to a large extent, to buy his own apparatus and equipment.

The book has seven chapters. The first two are preliminary and describe the field. Chapter 3 reports successful work on neutron production resulting in the characteristic energy spectrum, which points to the presence of some D + D fusion (the origin of the term cold fusion). In the fourth chapter, there is a description of the finding of tritium. (This gave me much joy, because it was I who had suffered at the hands of the journalist who had written, in 1990, an article in *Science* accusing me and my coworker of fraud in respect to our 1989 claims to have produced tritium in the cold.)

The fifth chapter concentrates on that part of Mizuno's work whereby he became famous in the field—the detection of anomalous nuclear heat in proton conductors. In the book, this is followed by a description of his work on transmutation, a field in which Mizuno (in parallel to independent work of his colleagues, Enyo and Omori) has generated more results than any other groups, although George Miley at the University of Illinois seems to be rapidly catching up on them.

Perhaps, for the future, the seventh chapter is the most interesting. It presents a theory due to the Italian physicist, Conte, as to how all this can occur against the apparent wisdom of the classical nuclear physicists. The theory presented is so simple that it is worth stating here. It relies on the rapid acceleration of protons across the interfacial region of electrodes. The idea is that protons or deuterons collide with electrons on the metal surface, and that a small fraction of the H isotopes has a velocity such that they fuse to neutrons. Thereafter—neutrons having been produced—all the other phenomena (in particular, the production of an astounding number of new elements in the region near the surface) are, of course, in principle, explicable, because the neutrons know nothing of repulsion due to coulomb fields and can wander around, entering under other nuclei without limit.

A special feature of the book is the vividness and personal character of the writing. It is rare that a scientist writes up his work with such a detailed description of just what happens at the key points. The author is great at describing the euphoria of the key moments. One is the discovery of the spectrum for neutrons that can only come from a D – D fusion reaction. There are minute details of the experiments, but they are given in such a way that even nonscientists can interact with the action and be thrilled by it.

"2.08 KeV! That is platinum," said Kurokawa, pointing out the peak on the screen. "9.46, 11.16, 12.96. These are all platinum. They are weak. You've got peaks at 6.4 and 8.0 KeV. It's gradually becoming clearer. This would be iron and copper, wouldn't it?" These are excerpts from the wealth of detail as to what was said when the new elements were seen from transmutation in the cold. The ratio of the tritium to the neutrons of 10^6 is another vital discovery (or confirmation of results obtained in my own lab), proving for the first time that a new nuclear reaction was being observed here, because it is well-known that in the normal high-temperature D + D reactions, the concentration of tritium and neutrons should be nearer to unity, not 10^6!

Mizuno is impartial and reasonable in his allocation of credit. For example, he brings out the fact that in the international conference on transmutation on "Cold Fusion" (occurring in Maui in December 1992), the Russians were already there with papers on cold transmutation. Mizuno himself gives a beautiful and exciting description of the observation of iron within a gold cathode by Ohmori. He notes the absolute negativity

of Ohromi at first; his observation of excess heat; and his persuasion and gradual conviction that nuclear reactions were occurring by his repeated observation of iron atoms in gold after electrolysis, with the isotopic ratio of the iron being radically changed from that which is normally observed in natural iron.

Mizuno describes the horror of the interruption of the First International Conference on Transmutation at Texas A&M University, when a professor from the inorganic group insulted those standing outside the lecture theater of the meeting, calling out to them that they were all "gooks." He is also scathing in his revelation that the Second International Conference on Cold Fusion, intended for Texas A&M University, was refused by members of the Chemistry Department there who (in 1996!) still described the field as "either a joke or fraud."

By the time Mizuno arrived for the 1996 Texas A&M Conference in College Station, he had observed a whole slew of nuclear products coming from his interactions of deuterons with palladium.

The book is extremely valuable historically, because it describes the gradual development of ideas in the field of LENR. For example, he points out the contributions made by George Miley and his team at the University of Illinois in establishing that endothermic reactions must also occur among the stream of reactions that arises within the palladium in the course of achieving transmutation. He documents several contributions made by the well-known metallurgist Richard Orianai of the University of Minnesota.

Chapter 7 is a wonderfully simple presentation of his theory. I say "wonderfully simple" because there are many papers in the literature describing theories of LENR; and they are distinguished not only by the varied nature of the ideas presented, but also by their complexity. Thus, when protons and deuterons approach the surface of a charged metal in solution—an electrode—they undergo an extraordinary acceleration because of the force field of 100 million volts per centimeter, occurring over distances in the order of 1 nanometer near the metal surface. Thus, Conte's idea can be expressed formally by the surface reaction:

$d + e^- = 2n$ + neutrinos

d = deuteron

e = the electron in the surface

n = the neutron

Mizuno also explains a concept well-known to electrochemists: that inside a metal, the pressure of hydrogen molecules in voids may rise to extraordinary degrees. Thus, in the interior of the sun (where fusion reactions are the source of the energy produced), the pressure of hydrogen is more than 10^{11} Atmospheres. It is possible to show that when the electrode exceeds a certain potential, the effective pressure of hydrogen inside the palladium is greater than that! This may provide another mechanism for fusion.

So, as Mizuno makes clear, it is a matter of the battering ram (the methodology of the billion-dollar support by the U.S. department of Energy of techniques to achieve fusion) or of the key in the lock, which is a fitting way to do describe the cold fusion field.

LENRs have been established in metals, not only in palladium but also in titanium, tantalum, and other transition metals in which the concentration of protons can be high. But there are other possibilities in which the evidence is tenuous but very exciting, and that is the evidence for nuclear reactions occurring in biological organisms.

May the original promise that was hinted at by Fleischmann, Pons, and Hawkins (1989) be achieved: clean nuclear heat with helium as the only byproduct? Are we seeing the beginnings of a possibility (claimed in one case from research at Texas A&M in 1992) of making any metal we want in the cold by nuclear transformation? Will we see the day when noble metals such as expensive platinum—so vital for use as a catalyst in the chemical industry—will be produced from cheap metals for less than one tenth the cost of obtaining them from ores in the ground?

To say that this book is worthwhile would be an understatement. It is a gem and, historically, will be treasured when one looks back (in 2020, say) upon the very turbulent birth of a new field in science. The fluency and relaxed accuracy of the translation depends upon the happy accident that the translator is a significant figure in the field.

References

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