Critique of “Cold Fusion from a Chemist’s Point of View”

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The following critique of Dr. Edmund Storms’ recent observations and theory, “Cold Fusion from a Chemist’s Point of View,” can be called un-critical, in the sense that his arguments appear to be fully defensible, at least within a narrow focus. There is little to dispute within what Storms presents—but the problem, if there is one, goes to the validity of any underlying premise of simplification, which can be called “parsimony” or “Ockham’s razor.”

Specifically, having a single operational method or model which excludes all others, especially when based on a low probability kind of reaction (in the case of proton-proton fusion), limits the application of theory to a specific type of experiment where it has been seen, or limits it to a subset of all reactions where it applies. Thus, the theory may adequately explain only a small fraction of experimental results in the broader field. On the other hand, since the overwhelming assumption in physics is that there cannot be many similar-but-separate novel reactions with hydrogen—all of which lead to energy anomalies (yet none of them were appreciated prior to 1989)—Storms is on solid ground with his narrow focus. That search for simplicity is essentially what Ockham’s razor is all about; but as a guiding principle, it seldom stands up to close inspection.

Storms’ theory can be summarized as moving the locus of the thermal anomaly from the “lattice” (solid crystal interstices within a metal host) to “cracks” or fissures (larger geometry) not unlike fracto-fusion, and then further suggesting that protium fuses to deuterium directly and in a way similar to deuterium fusing into helium. If one had to choose a single hypothesis or theory amongst the many which have been floating around for over two decades, Storms’ would likely be at the top of the list (for many observers in the field), since it is “comfortable” and comes with the reputation of a pioneer experimenter who backs his conclusions with high quality lab work. Additionally, it is derivative and evolved from other models which have been circulating for years, and not too far removed from hot fusion in energy expectation, per fusion event. But is it exclusive?

Within the community of LENR experimenters, there will be the usual complaints—to the extent that one cannot easily rationalize the total lack of gamma radiation with real fusion, and other details. But that lack of hot fusion indicia is also the knock on deuterium LENR, so it is no great leap of faith to apply a similar theory to protium, when one is convinced of the former. But the transition from deuterium to hydrogen is almost too effortless, given the much lower probability (cross-section of the reaction). And, in recent years, there are newer and more robust experimental claims, especially with catalyzed nickel alloys—which are not amenable to a “real fusion” explanation. This gets us back to the issue of simplicity-of-explanation. There are good arguments in physics—for and against—“parsimony” as a guiding principle. This seems to be an appropriate time to air them in the context of Storms’ theory, compared to other compelling viewpoints which better match experimental results.

This past year, on the LENR forums and blogs, there has been resurgence in the belief that aside from deuterium reactions, the field is largely “non-fusion” and perhaps some of the thermal anomalies are “non-nuclear” to the extent that there is gain with absolutely none of the indicia of known nuclear reactions. A better descriptor of the “non-nuclear” sentiment is “quasi-nuclear” and/or “Millsean,” in deference to the work of Randell Mills. Mills proposed an ostensibly non-nuclear “redundant ground state” reaction for thermal gain very soon after Pons and Fleischmann’s 1989 announcement. Although Storms does not ignore alternative viewpoints, and gives mention to a few of them, he is clearly of the belief that thermal gain with both deuterium and protium involves real nuclear fusion, but without the known characteristics of fusion. He appears to be dubious of the suggestion that gainful quantum mechanical (QM) reactions can be involved which operate as a predecessor or enabling stage—which can then proceed to real fusion. Storms does acknowledge that any reaction must be novel to a substantial degree, since the traditional indicia of nuclear reactions are largely absent; so it is perhaps a bit disingenuous to limit novelty in such a way as to bolster only one’s own explanation.

For many years Storms was at the forefront of experimentation with palladium and deuterium, so it is not surprising that he bases much of his “chemist’s point of view” on the lessons learned there, and not surprising that he borrows from, and builds on, Pons and Fleischmann (P&F). His experimental background is combined with the mainstream perception that conservation of energy cannot be violated in ways which do not involve the nucleus. The ostensible alternatives would include not only Mills but an asymmetric Lamb shift, a dynamical Casimir effect and the zero point field, to name a few. It should be added that these alternatives can be understood to derive energy ultimately from the reduced mass of the proton (reduction of average mass) so they can be rationalized as “quasi-nuclear” if we accept the proposition that proton mass is an average and not quantized.

Along with a few others, Storms has championed the view that helium has been found commensurate with the excess heat which is seen in deuterium reactions. This claim, in particular, is highly contentious and seems to be losing ground—at least based on the number of cogent contrary opinions which turn up on blogs. When moving from palladium-deuterium to nickel-hydrogen, Storms is content to find the same kind of fusion reaction occurring in cavities or fissures which are called the nuclear active environment (NAE). He tends to rationalize evidence of gain from nanopowder, zeolites or other porous substrates as being the functional equivalent of the NAE, and many observers have no problem with that.

A more basic problem is that early researchers in palladium-deuterium "cold fusion" were using hydrogen as a control. If hydrogen was used as a control to show a baseline of no-gain 20 years ago, but now is shown in experiments to have higher gain than deuterium when catalyzed by nickel, this presents a curious dilemma and it is one that has not really been adequately addressed. Skeptics remind us of a cinematic court room scene where a witness who has changed his story is asked by the prosecutor: "Were you lying then, or are you lying now?" But in fact, this scenario of higher gain with protium and nickel is fully explainable under other theories than that of Storms—but the details which explain it will also make the hybridized modus operandi more complex than can be accommodated by any single theory of operation. Thus, we have another hit on Ockham (parsimony).

There are dozens of hypotheses and less-developed theories for LENR, and most of them have some backing from real data. One of the major competing theories comes from Widom and Larsen (W-L). It involves weak-force dynamics (beta decay) but relies on an invented particle, the "ultra low momentum" neutron, which is somehow different from the well-known ultra cold neutron. Storms has been vocal in opposition to this theory. The implication of W-L for deuterium fusion is that helium is more a relic of contamination of the experiment than of nuclear ash, so it is not surprising that Storms should be personally offended. He has essentially staked a large part of his reputation on the helium yields in reactions involving palladium and deuterium. Yet the W-L theory has been embraced by several high profile parties, including researchers at NASA. Ironically, proton fusion—as it happens in the solar environs—also depends on a rare predecessor beta decay event (of the transient helium-2 nucleus). Storms does not adequately explain how beta decay is avoided in his version of proton fusion when it is obligatory in the solar model. Curiously, another recent finding from Storms and Scanlan seems to be explained by a mechanism involving accelerated nuclear decay (of long-lived elements like potassium-40). Therefore, nothing has been set in stone on the theoretical front, even after 22 years.

In fact, a useful hypothesis/theory that appeared in 1990 to explain the P&F effect, called the "binuclear atom," is being reexamined since it seems to be more applicable to protons than deuterons. It is one of several older ideas which are largely uncredited today, but vestiges have been incorporated into hybrid concepts. In the binuclear atom, protons become bound as pairs, held together by electron charge, but not as a molecule. The two protons, despite Coulomb repulsion, become bound by 30 eV, which is close enough to Mills' theory to raise eyebrows (with its Rydberg multiple at 27.2 eV). Mills has been previously interpreted (by a few LENR proponents) to offer a way for ground-state orbital reduction to lead further—to real fusion at high levels of redundancy (in ground state)—although Mills has never claimed to see this in any experiment. In the end, as far as theory goes, it is not clear who deserves credit for a number of overlapping details—if in fact it is determined that protons will only fuse from lower energy states involving electron abnormalities as the prime ingredient.

Of the dozens of past hypotheses and partial explanations, there are at least seven workable concepts to explain thermal anomalies in hydrogen in metal matrices at low energy input. Kozima has made exhaustive attempts to include more, as has Gluck and others, and this listing is not intended to be complete. It overlooks many contributions, such as multi-body reaction concepts and exotic but unproved particles, based on the perception of extremely low likelihood. Here are viable candidates which are not mutually exclusive.

- The original theory of P&F—restricted to palladium and deuterium, involving fusion to helium or tritium caused by coherent electron effects. Later internal (virtual) pressurization due to overvoltage was mentioned—such as was presumed to exist in the interstices of the proton conductor.
- The original "hydrino" (fractional hydrogen) mechanism of Mills, now expanded or differentiated by Miley and others as inverted Rydberg hydrogen, or as a deep Dirac layer.
- The W-L beta decay mechanism, which is similar to a Focardi/Rossi/Brillouin mechanism. This mechanism involves the transmutation of nickel into copper or other metals following the adsorption of a cold virtual neutron. This theory can also explain helium ash.
- The Storms mechanism, which is evolved from P&F and from "fractofusion."
- Accelerated nuclear decay.
- A nanomagnetism mechanism, which is "quasi-fusion" (quantum chromodynamics, QCD, reversible-proton-fusion) and a strong force modality. The key "leap of faith" is magnon "radiation" from protons which interact magnetically with host nuclei like nickel. This is QM-based and consequently can have incidental trace radioactivity and transmutation.
- Any combination or permutation of the above—since none of them is mutually exclusive by nature. Not included are multi-body hypotheses, dark energy, or other exotic inventions—or generalized zero-point energy (unless it relates to a real effect, like the Casimir).

This listing, or any like it, is *not* what mainstream or even non-skeptical theorists want to accept: that there could be several overlapping mechanisms for gain in hydrogen-loaded nanocavities. Such a suggestion is anti-Ockham—but in fact, all of QM and especially QCD is anti-Ockham. Essentially we must ask: Why not interacting mechanisms? After all, most of the universe is composed of hydrogen, and there is no logical reason that quantum interactions of sub-nuclear hydrogen (quarks and pions, etc.) should be simple —just because the atom itself seems deceptively simple at first glance or to those who are put-off by QM. When broken down to quarks, gluons, goldstone bosons and color change, etc., simplicity disappears at the femtometer strata, and science is just now coming into possession of tools that peer into these dimensions.

An emergent "nanomagnetism" theory is one of the few theories which can account for non-chemical anomalous endotherm, which has been seen in some hydride systems—and is perhaps more of a shocking anomaly than excess heat. Endotherm, in this specialized case, means that when a large amount of outside heat is put into the system, a substantial fraction of that heat seems to physically disappear, as if there was a magic internal heat sink—far surpassing any chemical explanation. Celani, Technova, Ahern and others have seen this physical feature—but have not pursued it. Its appearance in experiments designed for excess heat is emblematic of the problem of systemic over-simplicity and a single blanket theory.

Another anti-Ockham complication to more complete theoretical understanding of LENR is the dynamical Casimir effect (DCE) which was introduced by Schwinger in a simpler form in 1992: "Casimir Energy for Dielectrics." Although Schwinger was a proponent of cold fusion, it is not clear to what extent he was promoting DCE as an alternative explanation for gain (or as a predecessor condition for nuclear reactions). It should be noted that Storms' NAE can have Casimir geometry, but this is not an important part of his theory. Schwinger simply did not have enough pieces of the puzzle then, but was suggesting the idea that electron tunneling and QM effects, such as the Lamb shift, can account for some or all excess energy. A later nuclear event would then be incidental or a time reversal of cause-effect. The Lamb shift, superparamagnetism and the DCE can be interleaved and together portend both anomalous heating *and* anomalous cooling so long as asymmetry enters the picture. All one needs to see the "counter-effect" of endotherm is the correct material in the correct geometry—somewhat in the same way that the Casimir force can be either attractive or repulsive. The explanation of internal thermal loss is a surprise to many observers, but is yet also another strike against Ockham.

To clarify, the Lamb shift is a small difference between two energy levels of the hydrogen atom in quantum electrodynamics (QED) and can be perceived to go either way (energetically: endotherm or exotherm). It is basically a spin-flip, and is tiny in each instance, but lattice phonons move at terahertz frequencies and higher, so the "transaction rate" for tiny incremental gain or loss in contained hydrogen, due to the Lamb shift, is substantial if asymmetric; it is the same with the dynamical Casimir effect of virtual photons, and the two fit like hand-in-glove. All one needs to realize either anomaly over time is to impose asymmetry in a lasting way. Magnets are good at that, and the so-called Letts-Cravens effect of magnetic field boosting in LENR becomes yet another nail in Ockham's coffin.

In the end, a contributory source of anomalous heat from DCE, zero-point energy or from the Lamb shift or other QM modality is not descriptive of the complete physics, since it is a "proximate cause," and not an ultimate cause. However, if we dispense with "parsimony," in the sense of overly-simplistic solutions, it can be appreciated that the ultimate cause of any anomaly will be conversion of a percentage of proton mass into energy. Proton mass can be understood not as quantized but as an average value around the value of 938.27 MeV, with the capability to supply as much as several keV of "overage" from the high end of the distribution. This would be due to color change in quark binding and could couple via magnons to other atoms magnetically. In fact, over the years, different values for hydrogen mass have been reported over time and in a cosmological context.

The irony of suggesting many routes to gain in protium also suggests a simpler kind of mass-to-energy transfer. A heavier fraction of protons can in principle supply energy via a number of bosonic coupling routes without permanent change or transmutation. Magnons, in QCD, are the quantum of spin and can transfer small amounts of mass-energy as "spin waves" to cause spin flips or simple core heating in elements with magnetic susceptibility. This is similar to the way that an electromagnetic core heats up. Magnon transfer can happen whenever quark color change happens with a proton (which is often in confined systems—where hydrogen is captured in Casimir cavities). The beauty of this route, on paper, is that it is open to falsifiability—once current measurement techniques improve. Already, there is new information coming out about large changes in proton physical properties associated with the Lamb shift—which indicate what will happen soon with mass variation (in a metaphorical or actual way).

Unfortunately QCD and cavity-QED were not well appreciated by early theorists, and are not considered by Storms other than passing mention. Quarks account for a small part of proton mass—far less than half, and the percentage is not certain (which itself indicates innate variability). If the non-quark mass of protons is substantial and variable, to the extent that there will be a statistical surplus in a distribution, then some mass is extractable. It is a mistake for any theory to neglect QCD in favor of parsimony, since the most prevalent nuclear reaction in the universe, by far, is reversible fusion—that is: proton fusion which will always involve quantum color change. A direct mass-to-energy conversion methodology from this kind of reversible fusion fits the facts of LENR as well as any alternative, and it is counterproductive to ignore the implications—in pursuit of Ockham or simple answers.

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