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Cold Fusion: Fact or Fantasy?

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When Professors Martin Fleischmann and Stanley Pons made their initial announcement about cold fusion in 1989, the scientific community was unusually open toward incredible discoveries. A few years earlier a team of scientists had announced the discovery of high temperature superconductors. Alex Muller and Georg Bednorz were considered outsiders in the area of superconductor research, their laboratory had no reputation in the field, and they provided no theoretical explanations. These facts, combined with previous failed attempts by dedicated superconductor researchers, caused the announcement to be received with skepticism. However, within a few short weeks nearly every replication of the experiment was successful and improvements had been made (Nowotny & Felt, 1997). In an almost parallel set of circumstances, Fleischmann and Pons, neither of whom were specialists in the field of nuclear physics, announced their extraordinary results with no theoretical underpinning. But at this point the stories diverge. Most of the efforts to replicate their experiment failed and the furor died almost as quickly as it started (Simon, 2002).

One possible explanation for this turn of events is that cold fusion is not real. In this case, the positive results obtained by numerous researchers (LENR-CANR Library, n.d.) over the past 20 years would have to be due to some combination of measurement error, misinterpretation of results, or even confirmation bias, which is ". . . the inclination to recruit and give weight to evidence that is consistent with the hypothesis in question, rather than search for inconsistent evidence that could falsify the hypothesis" (Risen & Gilobich, 2007). While this may not seem likely due to the volume of published positive results, it should be noted that there are countless null experiments that have remained unpublished. Several null results were published shortly after the announcement when interest in cold fusion was widespread (Browne, 1989), but the vast majority of null results after the initial announcement have fallen victim to the "file drawer effect," a phenomenon that causes less emphasis to be placed on papers that prove the status quo. The research behind these papers is simply stored in a file drawer and it never reaches publication status. In an effort to combat this effect, we are belatedly publishing pertinent null results in this issue of the *Journal.*

The other possible explanation is that cold fusion is real but difficult to reproduce for reasons that are yet to be fully understood. Fleischmann and Pons did not provide a complete specification for the experiment. Subsequent efforts to discover this specification have not resulted in the usual narrowing of experimental parameters accompanied by increased reproducibility and strength of effect. Instead, the cold fusion parameter space has exploded into an assortment of loosely related methods and phenomena. In contrast to the original experiment, which involved electrolysis of heavy water with a Pd cathode, cold fusion experiments now include light water electrolysis, a variety of cathode materials, gas-loaded metals, ultrasound cavitation, exploding wires, high-temperature plasmas, etc. (Storms, 2007). This diversity can be optimistically interpreted as evidence that the phenomenon is robust and rather reproducible. But it also can be a symptom of confirmation bias: evidence of cold fusion is found in any sufficiently complicated experiment.

It is quite difficult to judge which of these two scenarios is true. The field of cold fusion suffers greatly from the Experimenter's Regress—a term coined by Harry Collins (1981). Experimenter's regress has two pertinent consequences in this situation. First, "it is impossible to know by objective criteria alone whether one or another experiment has been performed competently. Thus, rather than providing an unambiguous way out of controversial affairs, experiments can only serve to reinforce the apparent conflict" (Saulson, 2001). This aspect of experimenter's regress does not allow conclusions to be drawn about the positive results from cold fusion experiments, nor about the null results. One is unable to determine the merit of an experiment if the expected outcome is not known. If cold fusion is real, then the experiments with positive results should be lauded as well performed. However, if cold fusion is nothing but the result of measurement errors, then the null experiments were obviously correctly performed. Because of the controversial nature of the claims, the results cannot be interpreted objectively. Additionally, experimenter's regress, combined with confirmation bias, leads a person into a feedback loop where they assume that the results obtained are the correct ones since it is difficult to determine otherwise. This further polarizes the two sides as experimenters with positive results become more convinced of the veracity of cold fusion and experimenters with null results become more convinced of the fantasy of cold fusion.

All doubts could be put to rest by the development of a commercial energy source based on cold fusion. But before this development can begin, a robust demonstration experiment is required to convince scientists, engineers, and investors. A cold fusion cell that produced enough power to run itself would certainly suffice. Several researchers have claimed such large quantities of excess heat; a self-sustaining device should be possible even with the inefficiency of converting heat to electricity. But no such device exists.

A cold fusion experiment that reproducibly produced strong, unambiguous evidence of nuclear reactions would be the next best thing. Martin Fleischmann lamented the lack of such an experiment in his opening remarks at the Seventh

International Conference on Cold Fusion (ICCF-7) in 1998. Apparently, this situation has not changed in the ensuing decade. Some cold fusion researchers will claim to have such experiments in hand but the world has not yet seen the expected consequences, namely large-scale investment and research in cold fusion. Possibly some researchers are keeping their success a secret. Solving the world's energy problems would certainly bring both fame and fortune.

It should therefore come as no surprise that the mainstream scientific community still does not accept cold fusion as a means of creating nuclear reactions. This situation will persist until a robust demonstration experiment is developed and publicized. If no such experiment ever appears, cold fusion will slowly fade away and become nothing more than a footnote in the history of science.

About the Authors: Marissa and Scott Little work at EarthTech International, a company dedicated to investigating new energy ideas. We have spent countless hours on cold fusion experiments, with a great deal of emphasis on accurate calorimetric measurements (Little et al., 2008). Despite this effort, we have never seen a successful cold fusion experiment. We are still dedicated to this field and watch for new announcements with anticipation. Unfortunately, the null results obtained in our laboratory have fostered the undeserved reputation that we are trying to disprove cold fusion. Nothing could be further from the truth. This reputation has lessened the interests of other scientists in being open and cooperative with us. However, our laboratory remains open and we remain optimistic that someday we will have the opportunity to make measurements on an experiment that irrefutably demonstrates the phenomenon known as cold fusion.

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