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Research Article

How the Flawed Journal Review Process Impedes Paradigm Shifting Discoveries

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Abstract

The purpose of scientific journals is to review papers for scientific validity and to disseminate new theoretical and experimental results. This requires that the editors and reviewers be impartial. Our attempt to publish novel experimental results in a renowned physics journal shows that in some cases editors and reviewers are not impartial; they are biased and closed-minded. Although our subject matter was technical, its rejection was not: it was emotionally charged. It was an agenda-laden rejection of legitimate experiments that were conducted in US DoD and DoE laboratories. This paper describes the flawed journal review process, detailing our own case and citing others. Such behavior on the part of editors and reviewers has a stifling effect on innovation and the diffusion of knowledge.

Keywords: Discovery, Flawed journal review, Nuclear diagnostics, Review process, Scientific breakthrough, Scientific policy

1. Introduction

In 1989, Drs. Martin Fleischmann and Stanley Pons published a peer-reviewed claim that their palladium/deuterium (Pd/D) electrochemical cells were generating more excess heat than could be accounted for by conventional chemistry. [1] Over the ensuing years, researchers accumulated additional evidence that nuclear processes occur within metal

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lattices. Successful replications of these novel "Low Energy Nuclear Reaction" (LENR) results have been published in several peer-reviewed journals.

However, potential government sponsors have stated that these peer-reviewed publications are meaningless because the research was not published in either Nature or Science, as if these two were the only legitimate arbiters of scientific truth. Those journals are considered to be prestigious because of their high impact factors[a] of 36.280 for Nature [2] and 31.201 for Science [3] in 2011 [4]. By comparison, the Journal of the American Chemical Society, the flagship of the world's largest scientific society which has published successful cold fusion replications, had an impact factor of 9.907 in 2011 [5]. Replications have also been published in prestigious overseas journals such as the Japanese J. Applied Physics. This is published by the Japanese Applied Physics Society, and it is thus roughly equivalent to Science, published by the AAAS. We, and others, have attempted to publish papers in Nature, but our submissions were returned with the admonishment, "This subject area is of no interest to our readers." In fact, Nature has published a number of papers on experiments that failed to replicate the Fleischmann–Pons results, such as the one written by Lewis et al. [6], as well as negative commentaries on the field [7,8]. In light of criticisms of not having published our results in higher-tiered journals, we attempted to publish a LENR-based paper in a higher-tier physics journal. In this communication, we document and discuss the outcome of our experience as a case study to illustrate the larger problem.

Unfortunately, the problem of publishing controversial papers is hardly a new phenomenon. In their book entitled *Responsible Conduct of Research,* Shamoo and Resnick [9] stated:

> *History provides us with many examples of important theories that were resisted and ridiculed by [reviewers of] established researchers, such as Gregory Mendel's laws of inheritance, Barbara McLintock's gene jumping hypothesis, Peter Mitchell's chemiosmostic theory, and Alfred Wegener's continental drift hypothesis.*

Campanario [10] documented instances where 24 scientists encountered resistance by scientific journal editors or referees when they tried to publish manuscripts on discoveries that later earned them the Nobel Prize. Recently, Nature published an editorial on the subject of peer rejection [11]. Nature acknowledged that they had rejected papers on Cerenkov radiation; Hideki Yukawa's meson; the work on photosynthesis by Johann Deisenhofer, Robert Huber and Hartmut Michel; and the initial rejection (but eventual acceptance) of Stephen Hawking's black-hole radiation. The editorial concluded:

> *… rejected authors who are convinced of the groundbreaking value of their controversial conclusions should persist. A final rejection on the grounds of questionable significance may mean that one journal has closed its door on you, but that is no reason to be cowed into silence. Remember, as you seek a different home for your work, that you are in wonderful company.*

2. Our Rejection Experience

The journal wherein we submitted our observations publishes short, important papers from all branches of physics. Although its impact factor was 7.37 in 2011, it is considered to be among the most prestigious publications in any scientific discipline. In December 2009, we submitted a paper *comparing* fast neutron-induced triple tracks in a Solid State Nuclear Track Detector (CR-39) that we observed as a result of our LENR experiments with those generated by a DT fusion generator. Previously, we had published a paper in a "lower-tier" journal, *Naturwissenschaften* [12] discussing our first observation of energetic neutrons in a deuterated palladium lattice (Pd/D), in addition to three other papers using CR-39 to detect energetic particles [13–15].

[a] The impact factor of a journal is a measure of the frequency with which the "average article" in a journal has been cited in a particular year or period.

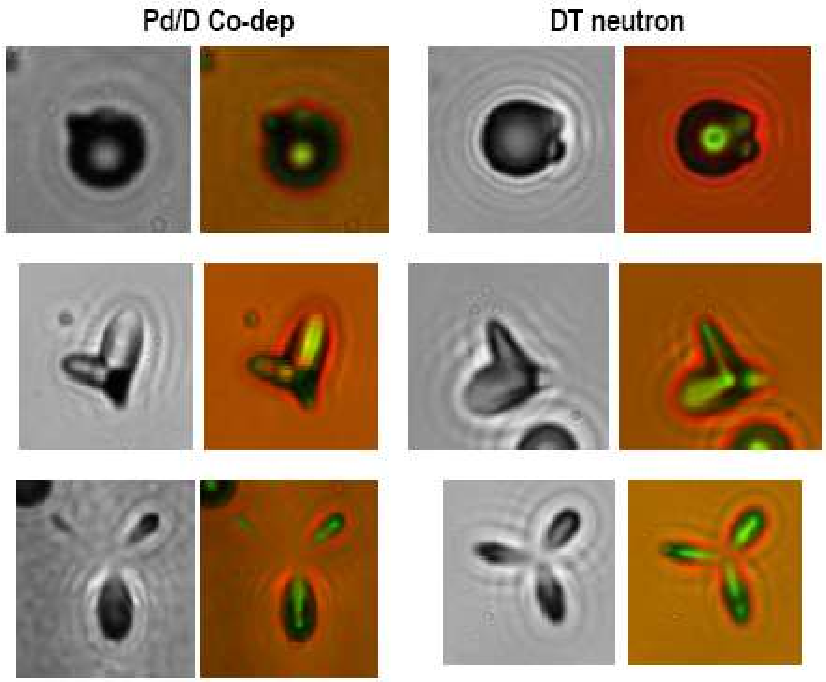


Figure 1. Comparison of DT fusion induced tracks. Palladium deuterium co-deposition tracks are in the two left columns and DoE accelerator driven DT fusion neutron generator tracks are in the right two columns. The black and white pictures are CR-39 microphotographs. The false color photographs are a composite of two microphotographs, one focused at the bottom of the track with one focused on the surface. This allows both the extent of the track and its "origin" to be more clearly observed. Triple tracks are caused by a nearly 10 MeV neutron striking a carbon atom in the CR-39, shattering it into three energetic alpha particles that create an ionization trail in the CR-39. The CR-39 is etched for several hours, enlarging the trail until it is visible with a microscope as a track. *If you cannot tell the difference, there is no difference.*

2.1. Our claim: solid-state nuclear track detector — CR-39 and neutron detection

Our submission described our experiments with CR-39 neutron detection. CR-39 is a solid-state nuclear track detector (SSNTD) that is commonly used to detect neutrons and charged particles in inertial confinement fusion (ICF) *aka* "laser fusion" [16]. When an energetic, charged particle traverses a solid-state nuclear track detector it creates an ionization track [17,18]. When the detector is etched, the tracks are enlarged until they are visible with the aid of a microscope. However, neutrons only leave tracks under certain conditions. The neutron must either elastically scatter off or undergo an inelastic nuclear reaction with, the hydrogen, carbon, or oxygen atoms within the CR-39 [19].

The most easily identified neutron interaction is a "triple track" that occurs when a neutron with over 9.6 MeV shatters a carbon atom in the detector resulting in a three pronged star [19–23]. Figure 1 shows representative triple tracks observed in CR-39 detectors that were used in Pd/D co-deposition experiments as well as their corresponding accelerator-driven DT fusion neutron generated triple track. The tracks are clearly indistinguishable.

2.2. The reviews

When the paper was first internally reviewed by the Journal, we were told that the paper was too long and that we needed to shorten it. However, we could include additional material in an electronic supplement. We complied with this request and resubmitted the paper along with the names of three potential referees, one of whom was a CR-39 expert.

2.2.1. *Reviewer A*

Our paper was rejected in February 2010 after being reviewed by three referees. The editor commented:

> *Referee A sent but a short report of no value to either of us. He or she did go over your manuscript and offered emendations in electronic form. We enclosed the marked manuscript in case it will be of use to you elsewhere.*

The emendations made by the referee clearly showed that he/she was knowledgeable on the use of CR-39 and interpreting the tracks. We had discussed the origins of asymmetric triple tracks, suggesting,

> *They could also be due to reactions of the type $^{12}C(n,\alpha)^{9}Be$ or $^{16}O(n,\ \alpha)^{13}C$. The track caused by these reactions typically has one prong with a larger cone angle than the other which are attributed to the alpha particle and the recoiling residual nucleus, respectively.*

To this Referee A commented,

> *This is due to the fact that cone angle decreases with increasing ionization rate. The ^{9}Be recoil has a higher ionization rate and thus a smaller cone angle.*

We asked the Journal's editor if we could have Referee A's comments. The editor steadfastly refused to send them to us. It is unheard of for editors to deny referee's comments to authors. In contrast, this editor had no qualms sending us the reports of the other two referees.

2.2.2. *Reviewer B: Authors should be glad they're not dead*

Referee B's report stated:

> *The authors claim to produce a source that emits approximately a few Hz, perhaps 10 Hz, 14 MeV DT neutrons. This is a formidable source. The rate of 2.5 MeV DD neutron source should be considerably (many order of magnitudes) stronger. Such a strong source of 2.5 and 14 MeV neutrons should be easily detectable with live electronical [sic] neutron detector. The fact that the authors did not make an attempt to measure these neutrons with the more reliable neutron detectors speaks volume of the less than adequate research effort.*
>
> *The authors are the best living evidence that this high intensity neutron source did not exist. We note from the outset that a full body neutron dose of 500 REM (5 Sv) will cause severe radiation sickness. A slightly larger dose will cause death within a few weeks. Such a full body dose is produced by 10^{10} 2.5 MeV DD neutrons or 2×10^{9} 14 MeV DT neutrons.*
>
> *The authors reported a "DT fusion flux of 1.25–2.5 n/cm^2/s" which leads to a full body dose of 2×10^{7} secondary DT neutrons per hour. The flux of the primary DD fusion will thus be many orders of magnitude above and beyond the lethal dose. A person spending one hour (in fact considerably less than one hour) in the vicinity of the apparatus will suffer severe radiation sickness and will die shortly afterward.*

The author should be thankful for not discovering DT fusion and in any case there is no place for such a low quality research in the pages of …[this Journal]… or for that matter in any scientific publication that adheres to a minimum standard of quality.

2.2.2.1 Our response to Reviewer B: No lethal neutron flux reported

The Journal did not give us the opportunity to refute the comments made by reviewer B. We will take that opportunity now. Reviewer B erroneously states the DD fusion rate should be many orders of magnitude greater than the DT fusion rate. In fact, the fusion cross-section over a wide variety of ion energies is 100 times greater for DT fusion than DD fusion [16]. The referee advocated the 'dead graduate student' argument first publicized by John Huizenga [24], the head of the 1989 ERAB panel charged with investigating cold fusion claims. In the submitted paper we measured the integrated DT neutron flux as 1.25–2.5 n/cm^2/s. The CR-39 detectors are 4 cm^2 in area. So the total number of neutrons per hour, at most, is 3.6×10^4 and not 2×10^7, as the referee stated. It is not clear how the referee calculated over 500 times our reported value.

An integrated neutron radiation dose of 6 Gy is considered lethal [25]. This is equivalent to 6000 REM.[b] For neutrons with energies between 10 and 30 MeV, the integrated number of neutrons per square centimeter equivalent to a dose of 1 REM is 1.4×10^7 n/cm^2 [26]. For the entire Pd/D co-deposition experiment (typically two weeks), the total number of neutrons per square centimeter is 3.024×10^6 n/cm^2. This is equivalent to a total dose of 0.216 REM, which is far below the lethal limit for neutron exposure. Even if we use the referee's erroneous value of 2×10^7 n/cm^2/hr, a neutron dose over a two-week period of 480 REM is still far below the lethal limit of 6000 REM.

2.2.3. *Reviewer C*

Referee C commented:

The authors report the observation of "triple tracks" in a relatively new type of detector material, which is claimed to be proof for DT fusion events within the material.

At some points in the paper it becomes clear that the observed tracks in the detectors are "indicative" or "consistent with" DT fusion reactions. Such phrases, along with controversy discussions about the method that can be found in literature, make clear that the used method is far from being a solid proof for such reactions. They try to argue with heaps of supplementary material does not replace the need to establish the new method in peer-refereed journals. On the other hand, I am wondering why particles, be it alphas or neutrons, cannot be detected with conventional, well established, detection methods, at least in order to show the applicability of the new detection method relative to something else. In the end, I am not convinced that the observed "tracks" or "bubbles" are a unique signature of 3 alpha breakup of ^{12}C*, such as claimed by the authors.*

All these are technical details, (which the general …[this Journal]… reader will have no chance to comprehend from the present manuscript,) whereas the biggest question to this paper is what the reader is supposed to conclude from it. Multiple times the authors assume the source for the claimed detected neutrons to be DT fusion. However, quite artificially, the source for this DT fusion is left open until the conclusion. Even there,

[b] A gray (Gy) is a unit of absorbed dose, specific energy (imparted) and of kerma. One Gy is equivalent to 100 RAD (Radiation Absorbed Dose). REM is damage produced by 1 RAD in body tissue where REM = $Q \times$ RAD. Q is the quality factor which accounts for the difference in the amount of biological damage caused by the different types of radiation. For gamma and beta radiation, 1 RAD = 1 REM. For neutrons, 1 RAD = 10 REM.

one finds speaking of "hot" fusion DD reactions - without mention what hot means. Presumably, it means the energy necessary to actually fuse to deuterium nuclei. Unfortunately, the authors do not give any hint where this necessary energy would come from.

It is quite simple: in order to get fusion you have to overcome a Coulomb barrier. The authors themselves admit in the conclusion that the mechanism for the DD reaction is "not yet fully understood". Not surprising, since nothing I read explains where the necessary energy would come from. Instead, even more reactions are mentioned in the end (Oppenheimer-Phillips stripping) which now shall account for the observed tracks - without explanation. After that some mentioning of oscillations of atoms within the material, again with absolutely no firm connection to the observations. I am left with the impression that nobody has a clue where the energetic tritons (intermediate reaction products) would come from.

2.2.3.1 Our Response to Reviewer C: CR-39 was the appropriate method

Again the Journal did not give us the opportunity to refute the comments made by reviewer C. We will take that opportunity now. CR-39 is not a new detector material. Cartwright et al [17] were the first to demonstrate that CR-39 could be used to detect nuclear particles in 1978. There are hundreds of papers in the literature describing the use and development of CR-39 for neutron dosimetry. Countries involved in this research include Italy [27], Egypt [28,29], India [30], Japan [31], Hungary [20] , as well as the United States [16,17,19,32]. Landauer uses CR-39 in their Neutrak® dosimeter for neutron detection [33]. In the supplementary material that we provided to the Journal, we discussed the use of CR-39 in neutron detection. In the text of the submitted manuscript, we wrote:

Inertial confinement fusion (ICF) experiments with DT targets generate 14.1 MeV neutrons and routinely observe three outgoing particle tracks from a single point in SSNTDs. This is diagnostic of the $^{12}C(n,n')3\alpha$ carbon breakup reaction in the detector with an energy threshold $\geq$ 9.6 MeV [20–23]. Furthermore, these features, which are characteristic of the carbon breakup reaction, make it easy to differentiate this reaction from neutron recoils, charged particle tracks and background events.

Therefore, CR-39 is an established technique for identifying tracks resulting from $\geq$ 9.6 MeV neutrons.

The referee asked, "why the particles, be it alphas or neutrons, cannot be detected with conventional, well established detection methods?" Presumably he/she is referring to real-time measurements. Detection of neutrons is non-trivial. Because neutrons have no charge, there is no direct method to detect them. Consequently, indirect methods must be used in which the neutrons are allowed to interact with other atomic nuclei. The response of that interaction is then measured. The most common means of detecting neutrons in real-time are based upon either neutron capture or elastic scattering. In neutron capture, the target nucleus captures the neutron to create an unstable nucleus that spontaneously loses energy by emitting either ionizing particles or gamma/X-rays. These radioactive decay products are then detected. However, the cross-section for neutron capture is very low at high neutron energies. As a result, this method requires the use of moderators to slow the neutrons down so that capture can occur. A detector based upon neutron capture will generally be unable to determine the energy of the neutrons. In the elastic scattering method, the neutron scatters off nuclei causing the struck nucleus to recoil. The recoiling nucleus can ionize and excite additional atoms through collisions producing detectable electrical charges and/or scintillation light. These types of detectors do not require a moderator so that the energy of the neutrons can be determined. However, these detectors also respond to gamma/X-rays and require a peak shape discriminator.

Other problems with real-time neutron detectors are that they are often temperature sensitive and subject to low-level electronic noise from the local environment causing false signals. Typically long acquisition times are used to improve the signal to noise ratio. If neutron production is sporadic and/or at a low level, the resultant signal may be averaged away. There is also a problem with the solid angle of detection. Neutrons are emitted from a source in all directions. In our experiments, we reported a maximum DT fusion flux of 2.5 n/cm^2/s. In 4π, this flux is 0.2 n/cm^2/s. It would be very difficult to measure such a low flux using real-time detectors. The CR-39 detectors used in these experiments were able to detect this low flux because they are integrating detectors, meaning events are recorded accumulatively. Nothing is averaged away. Also, these detectors were placed in direct contact with the cathode, which nearly eliminates solid angle detection issues. Thus, CR-39 was the correct choice to detect energetic neutrons in these experiments.

The referee's comment about using conventional, well-established methods to detect the alphas from the carbon break-up reaction shows that he/she does not understand the problem. We stated a $\geq$9.6 MeV neutron could cause a carbon atom to shatter into three alpha particles. The carbon atom that shatters to form the triple track in the CR-39 detector is part of the molecular structure of the detector. The resultant alpha particles have energies on the order of 1 MeV. These experiments were conducted in aqueous media. Linear energy transfer (LET) curves show that, in water, 1 MeV alphas have a range of 5.9 μm in water and 4.7 μm in CR-39. Consequently a real-time particle detector would only be able to detect alpha particles that were generated at the surface of the plastic detector. Alphas formed from the carbon break-up reaction occurring deeper inside the detector would not be able to get out. In the submitted manuscript, we indicated that we observed 5–10 triple tracks on both the front and back surfaces of the CR-39 detector. This translates into 15–30 alpha particles generated on the entire surface of the detector (4 cm ^{2}). For a two-week experiment, this translates into a maximum alpha flux from the carbon breakup of 6.2 $\times 10^{-6}$ α/cm^2/s. Real-time particle detectors cannot detect this low alpha flux *in-situ*. Therefore, CR-39 is the only detector capable of detecting these alphas.

3. Discussion

The journal required us to provide a mechanism by which the triple tracks were formed. Yet, the purpose of the paper was only to compare DT fusion tracks from a DoE accelerator with tracks generated by Pd/D co-deposition. Granted, we mentioned that energetic tritons and 2.45 MeV neutrons had been previously detected in the Pd/D system [34]. One source for these tritons and neutrons are conventional hot fusion reactions. The energetic triton can react with another deuterium inside the Pd lattice producing a 14.1 MeV neutron as a secondary reaction. We noted the process of forming energetic tritons was unknown, but theories were under development. There was no difference in the tracks, meaning that they are one and the same, resulting from the same reaction: a $>$9.6 MeV neutron that shattered a carbon atom in the detector into three alpha particles.

The submitted paper was intended to stimulate interest in the phenomenon, leading to further investigation. Yet, neither referees B nor C commented on the data presented in the paper (Fig. 1). Instead, the reviewers relied upon their erroneous calculations of the neutron flux and integrated dose. They castigated the research with uninformed comments regarding the diagnostic used, although CR-39 is commonly used for both alpha particle and neutron detection. Unfortunately, given the nature of the review process, we had no opportunity to address erroneous or fallacious reviewer comments. One would have thought that the journal's editors would have found something awry, given the difference between the comments by reviewer A and those by reviewers B and C, as well as the vehemence of the latter two reviews. These responses, as well as the actions of the editors, were unprofessional.

Even more disturbing was the lack of curiosity and the unwarranted, surprisingly emotional responses by two of the reviewers. We reported on the unexpected observation of DT fusion neutrons in a palladium lattice. We explained how the detector worked, and displayed equivalent tracks from a known DT fusion source. Two of the reviewers ignored the data and denigrated the work while the journal editors blindly accepted these flawed evaluations.

Reviewers B and C clearly demonstrated their unfamiliarity with, and ignorance of, neutron detection and solid-state nuclear track detectors. This contrasts with reviewer A whose comments upon our paper in the emendated manuscript clearly indicated that he/she was familiar with CR-39 and understood its use.

Previously published physics papers have discussed CR-39 as an energetic particle diagnostic. Kinoshita [35] employed CR-39 in high-energy physics experiments. Clark [36] used CR-39 for studying proton transport in magnetized plasmas. Li et al. [37] also used it for diagnosing laser plasma interactions. Contrary to Reviewer B, CR-39 has been in use for decades. The fact that the editor selected and then stood with reviewers who were ignorant of standard practices in fast neutron detection indicates editorial failure, as it is incumbent upon editors to select competent reviewers.

The journal refused to provide us with the report of reviewer A as it was of "no value to either of us". It is unheard of for an editor to refuse to provide all responses to the authors, regardless of whether the editor thinks the responses have merit or will do the authors any good. This is unethical. The attitude of both the editor and Reviewers B and C demonstrate an unwillingness to examine observations contrary to accepted beliefs.

Shamoo and Resnick [9] further commented upon how the review of controversial data should be handled:

> *To provide objective and reliable assessments of controversial research, journal editors and review panel leaders should be willing to do what it takes to "open the doors" to new and novel work. If they close these doors, then they are exerting a form of censorship that is not especially helpful to science or society. What it takes to open the door to controversial research may vary from case to case, but we suggest that editors and review panel leaders should always try to understand controversial research within its context. For instance, if an editor recognizes that a paper is likely to be controversial, then he or she should not automatically reject the paper based on the one negative review; before rejecting it, he or she should seek other reviews and give the paper a sympathetic reading.*

It would appear that the editors of the Journal in question inverted Shamoo's suggestion: upon receiving *one positive review* they sought negative reviews in order to reject the paper. Again, this suggests an *a priori* agenda against the subject. Shamoo and Resnick [9] also recognize this as problematic:

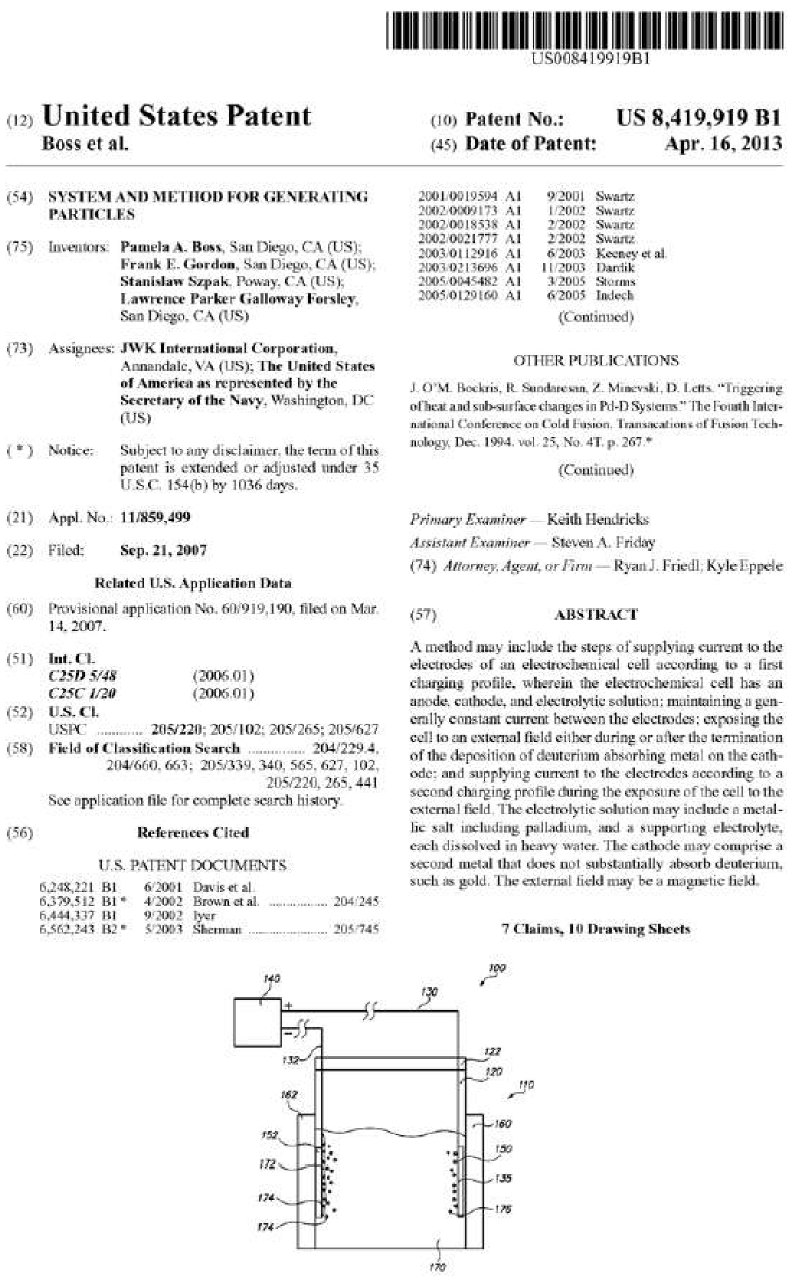
> *As a result of this controversy, it has been difficult to conduct peer-reviewed work on cold fusion, because mainstream physics journals select reviewers with strong biases against cold fusion.*

4. Conclusions

One immediate and long lasting effect of journals refusing to publish papers on as yet controversial observations is the elimination of a field of research and the diminution of scientists and engineers working in it. Without peer-reviewed publications, university faculty are precluded from funding as well as students, as no student will pursue an unrecognized field where jobs do not exist. Scientists are unable to find funds or management support. Entrepreneurs are limited because it is not likely that corporate angels or venture capitalists will risk funds on a technology, which is denigrated by leading scientists and subject to ridicule. In 1991, Nobel Laureate Julian Schwinger [38] aptly summarized the problem when he wrote:

> *"The pressure for conformity is enormous. I have experienced it in editors' rejection of submitted papers, based on venomous criticism of anonymous referees. The replacement of impartial reviewing by censorship will be the death of science."*

Indeed, this whole situation is a "Catch-22" [39]; a situation named for the war novel in which a pilot who claims he is crazy so he wouldn't have to fly missions, but by refusing to fly missions he proved he was sane! Our Catch-22 is that both DoE and DoD have unequivocally stated that until "first-tier" journals, like Science and Nature, publish papers in this field, they will not fund programs. But, editors of these journals have stated they would not publish papers without DoE acceptance of the phenomena: *a Catch-22.*



US008419919B1

(12) **United States Patent**
Boss et al.

(10) **Patent No.:** **US 8,419,919 B1**
(45) **Date of Patent:** **Apr. 16, 2013**

(54) **SYSTEM AND METHOD FOR GENERATING PARTICLES**

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 1036 days.

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(52) **U.S. Cl.**
USPC **205/220**; 205/102; 205/265; 205/627

(58) **Field of Classification Search** 204/229.4, 204/660, 663; 205/339, 340, 565, 627, 102, 205/220, 265, 441
See application file for complete search history.

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(57) **ABSTRACT**

A method may include the steps of supplying current to the electrodes of an electrochemical cell according to a first charging profile, wherein the electrochemical cell has an anode, cathode, and electrolytic solution; maintaining a generally constant current between the electrodes; exposing the cell to an external field either during or after the termination of the deposition of deuterium absorbing metal on the cathode; and supplying current to the electrodes according to a second charging profile during the exposure of the cell to the external field. The electrolytic solution may include a metallic salt including palladium, and a supporting electrolyte, each dissolved in heavy water. The cathode may comprise a second metal that does not substantially absorb deuterium, such as gold. The external field may be a magnetic field.

7 Claims, 10 Drawing Sheets

Figure 2. US Patent 8,419,919.

4.1. Prestigious journals publish fraudulent results

Prestigious journals are not infallible. There have been many disputes in the history of science; Nature and Science have not always been on the winning side. It is not reasonable for government agencies to require publication in these journals as proof that a phenomenon is real. Nature and several other high tier journals have also accepted papers that were later retracted. The most egregious failure of the editors and reviewers to deal with fraudulent physics papers was that of then Bell Laboratory's researcher, Jan Hendrik Schoen [40]. Schoen [41] published 36 papers, all of which were retracted, including seven from Nature, nine from Science and six from the Physical Review journal. In this case, there was a "rush to judgment" to publish the expected. As noted above, they have also failed to publish the unexpected, as they did when they rejected 24 papers that later won the Nobel prize [10].

4.2. The end of knowledge?

The impact of impeded discovery was recently featured in the cover story of the The Economist magazine, "The Great Innovation Debate" [42]. They noted, "If the rate at which we innovate, and spread that innovation, slows down, so too, other things being equal, will be our growth rate." One of the ways in which scientific discoveries become innovative technologies is through patents. Over six years ago the method producing the results cited in this paper were submitted to the US Patent Office. Normally, patents are granted in less than half that time. Because of the difficulty in publishing our results neither the US Patent Office nor other US agencies gave credence to these results, until now. US Patent 8,419,919, "System and Method for Generating Particles" was issued on April 16, 2013 (Fig. 2).

The journal review process prevents conscientious scientists from reaching beyond what is known or expected, ignoring the fact that most scientific and technical breakthroughs arise from the unexpected. These are the paradigm shifts that make progress in our technological civilization possible. Government agencies that refuse to fund research because the results have not been published in specific journals put their nations at risk of technological surprise. The dysfunctional research funding and review processes we have described here has dire consequences.

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