"The 2004 Cold Fusion Report"

by Steven B. Krivit and Nadine Winocur, Psy.D.

<u>March 22, 2004</u>

Published by New Energy Times
11664 National Blvd., Suite 142
Los Angeles, CA 90064

This report is dedicated to the memory of

Steven's father,

Lawrence Robert Krivit. M.D.

Healer, Inventor, Visionary

Massachusetts Institute of Technology graduate, 1952
Medical College of Virginia graduate, 1958

Contents

Preface

The investigation behind this report arose from Steven's naive curiosity. Throughout most of 1989, he had sworn off television. Although he learned of the initial announcement of cold fusion over the radio and from his local community newspaper, the news of cold fusion's demise apparently was carried mainly on television and in larger newspapers. Consequently, he missed the fact that cold fusion had been "disproved."

By 1999, curious as to why, after many years, he had heard no news of cold fusion, Steven began searching for answers. His investigative journey brought him into contact with dozens of cold fusion scientists from around the world. Many initially were reluctant to speak with him, because they previously had been burned by articles that maligned their words or character. Yet they found in Steven an unbiased listener who was willing to spend the time required to understand the information and to convey the facts accurately.

Steven's investigation heightened in 2003, when scientists whom he video-interviewed at the 10th International Conference on Cold Fusion presented him with many pieces of information which, when combined with previously gathered data, formed a coherent story. Nadine joined in at this point to help download the information in Steven's head and put it into writing.

By publicizing this report, they hope that not only will cold fusion scientists receive appropriate acknowledgement and funding for their work but also the world will benefit from these scientific achievements.

Exhibits

Quotes That Tell the Story

"This sort of dwindling band of true believers each year gets together and talks about the wonderful progress that's been made. None of the rest of us can ever see that."

Dr. Robert L. Park, director of public information for the American Physical Society, private interview, Nov. 12, 2003

"Many people see only what they want to see. At some point in the history of any new idea, the problem no longer involves logic but is psychological."

Dr. Edmund Storms, radiochemist formerly with the Los Alamos National Laboratory, Nov. 11, 2003

"Showing a greater fondness for their own opinions than for truth, they sought to deny and disprove the new things which, if they had cared to look for themselves, their own senses would have demonstrated to them."

Galileo Galilei, 1615

"It's all very well to theorize how fusion might take place in a palladium cathode … One could also theorize about how pigs could fly if they had wings, but pigs don't have wings."

Professor Steven E. Koonin, provost, professor of theoretical physics, California Institute of Technology (American Physical Society Annual meeting), Baltimore, Md., May 2, 1989

"There is one point on which all true believers in cold fusion agree. Their results are not reproducible. To most scientists, this implies that cold fusion results are not believable, but true believers suggest that this unpredictability makes them more interesting!"

Douglas R.O. Morrison, physicist with the CERN, "Ask the Experts," (Scientific American) Oct. 21, 1999

"We demonstrate nuclear emissions with reproducibility close to 100 percent."

Dr. Andrei Lipson, condensed matter physicist, Russian Academy of Sciences, Nov. 10, 2003

"We replicated the Mitsubishi experiment three times, and each time transmuted praseodymium from cesium. So our reproducibility on this experiment is 100 percent so far."

> Dr. Akito Takahashi, professor, chair of nuclear instrumentation, Department of Nuclear Engineering, Graduate School of Engineering, Osaka University, Japan, Sept. 18, 2003

"My perception of the cold fusion crowd is that they are elderly people who at least know something of physics and instrumentation .... if this stuff could be real, wouldn't it be an incredible boon to the world?"

> Eric Krieg, skeptic and founder, Philadelphia Association of Critical Thinkers, Oct. 9, 2003

"When a distinguished but elderly scientist states that something is possible, he is almost certainly right. When he states that something is impossible, he is probably wrong."

> Sir Arthur C. Clarke, noted author, past chairman of the British Interplanetary Society, member of the International Academy of Astronautics, the Royal Astronomical Society and many other scientific organizations.

"The evidence is *overwhelmingly* compelling that cold fusion is a real, new nuclear process capable of significant excess power generation."

> Dr. Eugene Mallove, Harvard D.Sc., MIT graduate and author, *Fire from Ice: Searching for the Truth behind the Cold Fusion Furor*, 1991, editor of *Infinite Energy* magazine and president of the nonprofit New Energy Foundation Inc.

"*Fire From Ice*" is a masterpiece of science documentation."

> Dr. Henry Kolm, cofounder of MIT's Francis Bitter National Magnet Library

"No cover-up like this has happened before. It is a profound scandal in American science."

> Charles Beaudette, MIT graduate and author, *Excess Heat & Why Cold Fusion Research Prevailed*, 2002

"Historically, it will be recorded that Beaudette wrote the truth at a time when science was a bit confused and not quite willing to accept it right away."

> Dr. Michael R. Staker, materials scientist and research engineer for a major U.S. government research laboratory, April 2, 2003

"I am totally convinced that there is more than enough evidence for nuclear reactions to be occurring in these experiments. "

Dr. M. Srinivasan, associate director of the physics group (retired), Bhabha Atomic Research Centre, India, Sept. 22, 2003

"If Professor X.Z. Li [of Tsinghua University, China] is correct, then I'll have to throw away about 14 of the 16 chapters in my book *Introduction to Fusion Energy*, because it will no longer be relevant to the kinds of fusion that could result from this 'cold fusion' process."

Dr. J. Reece Roth, head of the industrial plasma engineering group, University of Tennessee, Nov. 8, 2003

"Experimental evidence has now verified that nuclear reactions can be caused to occur in heavily loaded solids [i.e., palladium]. It is premature to predict where this is headed from an applications point of view, but the basic science is clearly revolutionary."

Dr. George H. Miley, director of the Fusion Studies Laboratory, University of Illinois, Urbana, Nov. 22, 2003

"It appears that the people who would benefit most by this work being discredited have taken the initiative to cause us great difficulty ... They might cause us difficulty, but they will not stop the science."

Dr. Stanley Pons, co-discoverer of cold fusion, former chairman of the department of chemistry, University of Utah, quoted by JoAnn Jacobsen-Wells, "U.S. Fusion Panel Cancels Plans to View University Research" (Deseret News), May 28, 1989

"If it had been anything else, we would have said, 'People don't want us to do it. Forget it. Let's just leave it alone.' But this is not in that category. This is interesting science. New science. With a hint of a possibility of a very useful technology. Therefore, if you've got any integrity, you don't give up. You only give up if you find you are wrong. But as long as you believe that you are right, you have to continue. And you have to take the consequences."

Dr. Martin Fleischmann, co-discoverer of cold fusion, formerly the president of the International Society of Electrochemists, a Fellow of the British Royal Society, and recipient of the BRS Medal for Electrochemistry and Thermodynamics, "Too Close to the Sun" (BBC Horizon/CBC) March 21, 1994

"The only thing pathological about cold fusion is the way the scientific establishment has treated it."

Sharon Begley, "Cold Fusion Isn't Dead, It's Just Withering From Scientific Neglect" (Wall Street Journal), Sept. 5, 2003

Basic Terminology

Nuclear Fission: Fission is an energy-generating process in which the nucleus of an element (typically radioactive uranium) is split into two smaller fragments, simultaneously releasing energy. Fission is the type of nuclear energy which powers existing nuclear power plants. Fission also produces radioactive waste and dangerous radiation.[1]

Nuclear Fusion: Fusion is the energy-generating process that fuels the sun and stars. It is the opposite of fission in the sense that the nuclei of two atoms (typically deuterium, an isotope of hydrogen) combine to make a single larger nucleus (typically helium or tritium). This process releases energy.

In accordance with Einstein's equation, $E=mc^2$, the energy arises from a loss of mass. The mass of the new nucleus together with the lighter particle is slightly less than the mass of the two initial nuclei.

At this time, no useful power is produced by any form of fusion. Because deuterium is abundant in ocean water, the prospect of fusion is very attractive as an inexpensive and virtually inexhaustible source of energy. In addition, fusion is generally much safer than fission. It is free of combustion products and greenhouse effects. Conventional fusion produces short-lived radiation which can be contained within a power plant.[2] Cold fusion produces no harmful radiation.

Conventional ("Hot" or "Plasma") Fusion: Conventional fusion is an experimental approach whereby hydrogen atoms are heated to multimillion-degree temperatures so that they may collide with enough energy to fuse. Scientists report steady progress, but after 50 years, these experiments do not produce any "excess heat." This is because the experiments require so much electricity to generate the effect that they consume more energy than they produce.

Cold Fusion: "Cold Fusion" is a broad term which encompasses several types of reactions, the most promising of which is the sustained production of excess heat. The major distinction between "cold" and "hot" fusion is that cold fusion involves the interaction of hydrogen with a metal, such as palladium, which hosts the fusion reaction. Hot fusion, on the other hand, occurs in free space.

The basic cold fusion experiment is performed in a relatively simple electrolysis apparatus at or near room temperature [see Exhibits 1a and 1b]. Scientists immerse two pieces of metal, typically a palladium cathode [see Exhibit 2] (negatively charged) and a platinum anode (positively charged) in a beaker containing a conductive solution of "heavy water." A small electrical current passes through the solution between the two metal conductors. Deuterium is released from the heavy water at the cathode, where either it tries to escape as a gas or it enters the "lattice," the crystalline atomic structure of the palladium. Fusion occurs within the lattice. (Note: Readers desiring a more complete explanation are directed to "The Cold Fusion Effect: A Technical Explanation.")

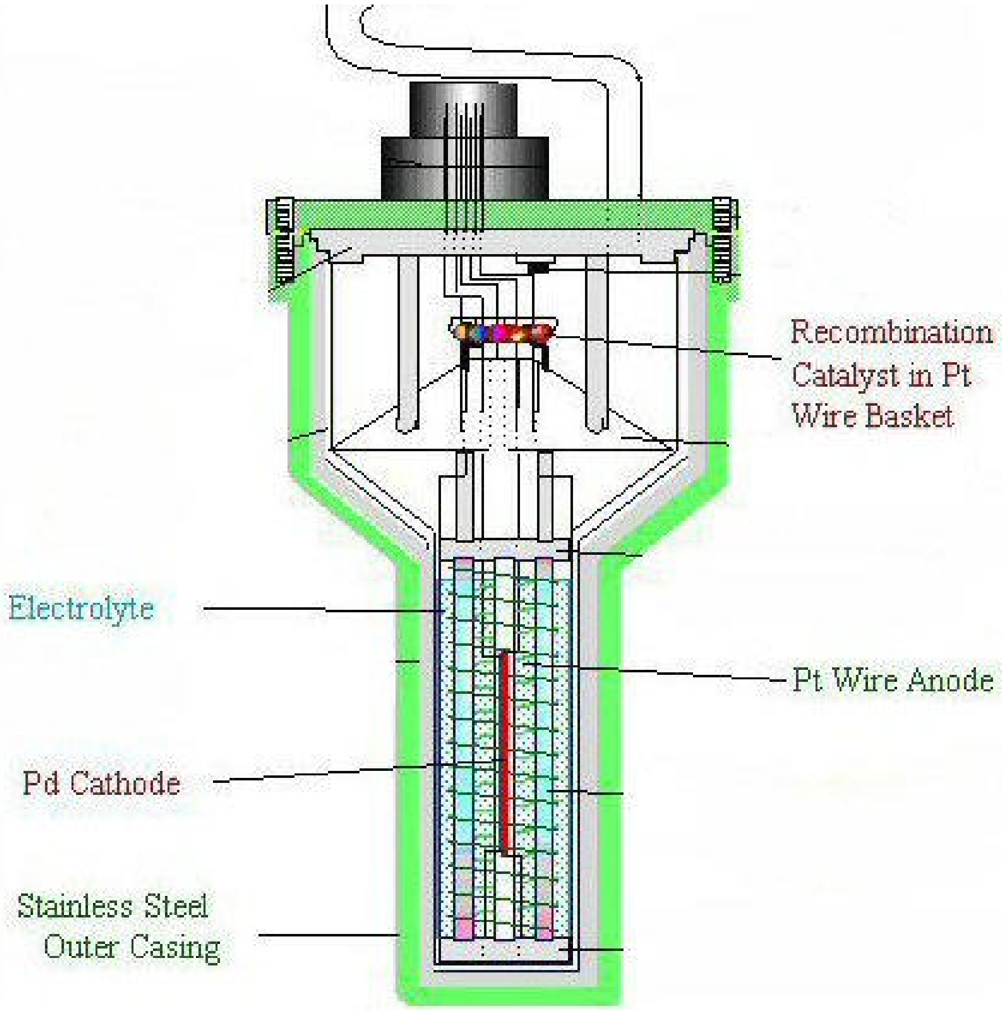


Exhibit 1a. SRI International Electrolytic Cold Fusion Cell Schematic
Palladium (Pd) Cathode is in the center. Platinum (Pt) Wire Anode is coiled around it.
(Drawing courtesy of SRI International)

Exhibit 1b. Electrolytic cold fusion cell,
approximately 14cm tall
(Photo courtesy of Edmund Storms)

Exhibit 2. Palladium Cathode used
in an Electrolytic Cold Fusion Cell
(Photo by Steven Krivit)

The Cold Fusion Effect: A Technical Explanation

by Steven B. Krivit
In Conversation with Dr. Scott Chubb and Other Theoretical Physicists

Rev. 3/1/2004

In a nuclear fusion process, two atomic nuclei combine to make a new larger nucleus, a lighter particle, and energy. In accordance with Einstein's equation, $E=mc^2$, the energy arises from a loss of mass. In fusion, the mass of the new nucleus together with the lighter particle is slightly less than the mass of the two initial nuclei.

Two nuclei strongly repel each other, and they must somehow be forced together before fusion will occur. In conventional thermonuclear, or hot fusion, as in the Sun, extremely high temperature (about 10 million degrees) supplies the necessary force.

Many methods of deuterium-deuterium cold fusion experiments exist, in both liquid and gas forms. The basic cold fusion experiment is performed in a relatively simple electrolysis apparatus at or near room temperature. Scientists immerse two pieces of metal—a palladium cathode (negatively charged) and a platinum anode (positively charged)—in a beaker containing a conductive solution of deuterium-deuteroxide (D_2O), a.k.a. “heavy water.” An electrical current is passed through the solution between the two metal conductors. Deuterium is released from the heavy water at the cathode, where it either tries to escape as a gas or enters the "lattice," the crystalline atomic structure of the palladium, where large pressures are then exerted on the deuterium.

If precise parameters and requirements are met, the reaction generates “excess heat” and ordinary helium. “Excess heat" means that more energy exits the experiment than entered it.

Conventional nuclear fusion of deuterium makes light helium (helium-3), tritium, protons and neutrons. Ordinary helium (helium-4) also is produced in conventional nuclear fusion, but only on rare occasions. When helium-4 is produced, not only is energy released in a way that is consistent with the change in mass (associated with Einstein's $E=mc^2$ equation), but the reaction also is known to involve subtle effects involving the behavior of the deuterium nuclei, far away from the location where the ordinary helium is produced. Briefly and simply stated, these effects are observed as "gamma radiation" and are deadly.

It is not clear how two deuterium nuclei can approach close enough to fuse at room temperature, even in palladium. However, it is now known that the amounts of excess heat in "cold fusion" are consistent with the change in energy that results when heavy hydrogen is converted into helium-4. Most scientists who have been studying the subject believe that this particular effect is related to subtle differences between the fusion processes, associated with the helium-4 reaction. No high-energy gamma radiation is seen in "cold fusion."

Unfortunately, because it was initially assumed that cold fusion is a "colder" form of conventional nuclear fusion, most scientists assumed that light helium or tritium had to be produced. For this reason, they ignored the possibility that ordinary helium might be involved and concluded that the excess-heat cold fusion phenomenon either did not involve nuclear fusion or, alternatively, could be the result of some other, as-yet-unknown nuclear process.

With time, scientists involved with cold fusion have learned that the excess-heat effect is only one of many nuclear phenomena that can take place when deuterium atoms are forced into a solid. For this reason, the term "low energy nuclear reaction" is a more technically accurate descriptor than cold fusion.

Because of the confusion that resulted from the assumption that cold fusion is a "colder" version of nuclear fusion, it is apparent not only that the name is inappropriate but also that the use of this name has adversely affected the field.

For better or for worse, the name has remained, and the term "cold fusion effect," which also has been used, serves as a shortcut for the unexplained reaction observed in these experiments.

The 2004 Cold Fusion Report

"We do not know if cold fusion will be the answer to future energy needs, but we do know the existence of the cold fusion phenomenon through repeated observations by scientists throughout the world. It is time that this phenomenon be investigated so that we can reap whatever benefits accrue from additional scientific understanding."

Dr. Frank E. Gordon, Head, Navigation and Applied Sciences Department
Space and Naval Warfare Systems Center of the United States Navy[1]

COLD FUSION APPEARED AND DISAPPEARED -- OR DID IT?

Since the early 1950s, nuclear scientists have spent billions of dollars to re-create here on Earth the sun's natural energy-generating process, known as fusion. If scientists achieve this goal, it may mean the dawning of a new age in technology – one that would see fossil fuels, and the dangers they reap, replaced by an era of clean, abundant energy, with a promise of increased health, comfort and safety. Toward this end, nuclear physicists have developed arrays of enormous lasers [see Exhibit 3] and three-story-tall "Tokamak" machines [see Exhibit 4] to contain multimillion-degree plasmas to initiate the process. Yet after five decades of research, the goal of a controlled, self-sustaining energy-generating process has not been achieved.

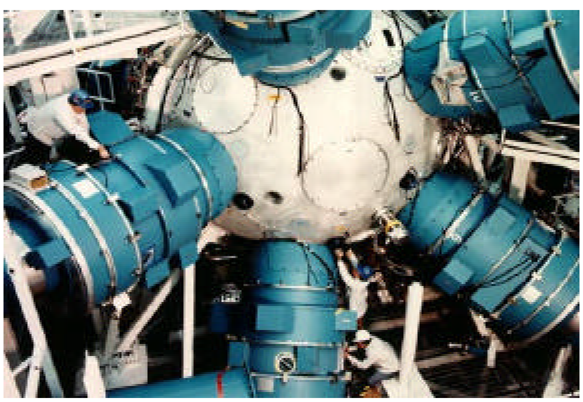


Exhibit 3. NOVA laser, a 10-beam, 50,000 joule laser used for Inertial Confinement Fusion research. Look carefully to see the three technicians.

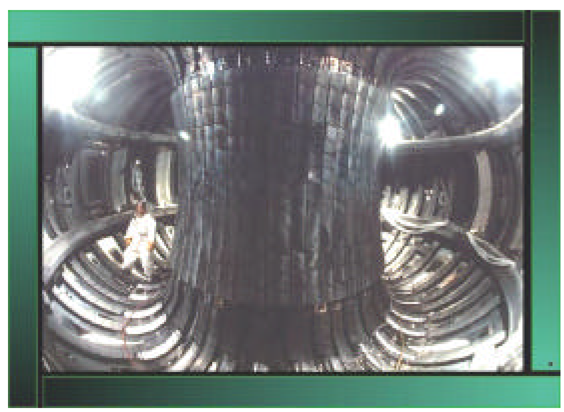


Exhibit 4. Interior of "Tokamak" Experimental Fusion Reactor. Man in white suit shows proportional size of reactor.

How preposterous, then, the claims of *cold* fusion appeared to these scientists, when they were first announced by electrochemists Martin Fleischmann and Stanley Pons 15 years ago, on March 23, 1989. Nuclear fusion, generated at room temperature? In a test tube? Without lethal radiation?!

Carl Sagan once said that extraordinary claims require extraordinary evidence. Unfortunately, the early claims by Fleischmann and Pons were weak at best. Not only did the two University of Utah chemists fail to provide satisfactory evidence for their assertion of a nuclear reaction, but they could not reproduce the experiment on demand. Within half a year, the scientific community pronounced cold fusion a hoax and accused Fleischmann and Pons of practicing "pseudo-science." The two returned to relative obscurity, and their claim seemed to fade into history.

In truth, however, not only has experimentation into the viability of cold fusion persisted in the years since, but a worldwide scientific group now believes that cold fusion is *real*. Today, 15 years after the initial announcement of cold fusion, evidence for this new science is extraordinary. While theoretical understanding remains incomplete, scientists' capacity to replicate the experimental heat-generating effect has matured dramatically. Virtually all points of initial criticism have been answered.

Within the past 10 years, scientists have found proof that "cold fusion" is indeed a nuclear process. Excess heat (energy) has been measured convincingly with precise mass-flow calorimeters (heat measurement instruments). Nuclear products have been found in significant quantities. And, most important, the quantities of energy and nuclear products match, in agreement with Einstein's theory of relativity, $E=mc^2$. In other words, the total amount of energy plus mass going into the experiment equals the total amount of energy plus mass coming out. However, as a result of the experiment, some mass is converted to energy, such that the outcome yields a lower quantity of mass and a higher quantity of energy than before the experiment. Evidence of this nuclear reaction has appeared repeatedly, around the world, through a variety of methods.

A Historical Perspective, part 1 of "The 2004 Cold Fusion Report," examines what led the scientific community to a premature conclusion regarding the validity of cold fusion. It explains the reason why cold fusion-related information has been largely unavailable to the world. It reviews studies which reveal that the early experiments conducted by prominent laboratories, experiments which were presumed to have debunked cold fusion, were seriously flawed. It exposes the unpublished reports of respected mainstream scientists who verified the anomalous energy claims of Fleischmann and Pons in the early 1990s. It also uncovers the fact that numerous credible laboratories, including the U.S. Navy, major oil companies, and dozens of universities, have successfully produced the cold fusion effect.

Discoveries and Mysteries, part 2 of the report, presents findings from around the world which support the validity of cold fusion. It discusses the current status of cold fusion research, reviewing key advancements over the past decade and identifying major questions that remain. Part 2 concludes with a glimpse at possible future applications for cold fusion technology.

PART 1: AN HISTORICAL PERSPECTIVE

IS ANYONE ACCEPTING COLD FUSION?

Sandia National Laboratories is one of the United States' most important government-owned sites for the development of science-based technologies that support national security. In September 2003, James Corey, a senior member of the technical staff at Sandia, delivered to the 2003 Energetic Materials Intelligence Symposium a presentation titled "History of and Current Claims for [Cold Fusion]." The presentation corroborated the reality of cold fusion.

Corey identified various economic concerns related to potential changes in energy production and world trade.[2] He pointed to the fact that several foreign nations exceed the United States in its support for research and development of cold fusion technology. In particular, China, with its extensive ornamental plating manufacturing facilities, could readily take the lead in commercializing a new method of cold fusion known as "thin film low energy nuclear reactions." (Though not mentioned in Corey's presentation, Japan's Mitsubishi Heavy Industries is known to have a multiyear program in cold fusion experimentation,[3] and Toyota and Honda are rumored to be engaged in cold fusion research, as well.[4])

The Corey presentation predicted, "An overdue revolution in science will arrive, [and] the reputations of cold fusion scientists, and those who revile them, may be reversed."[5]

While unanswered questions remain, hundreds of expert scientists around the world, including more than 60 physicists,[6] most with extensive experience in the field of hot fusion, have come to accept the reality of new methods for creating nuclear reactions at room temperature. Dr. George Miley [see Exhibit 5], director of the Fusion Studies Laboratory at the University of Illinois, Urbana, and 1995 recipient of the Edward Teller Medal from the American Nuclear Society, wrote in a November 2003 e-mail, "Experimental evidence has now verified that nuclear reactions can be caused to occur in heavily loaded solids [i.e., palladium]. It is premature to predict where this is headed from an applications point of view, but the basic science is clearly revolutionary."[7]

Exhibit 5. Dr. George Miley
(Photo Courtesy of Alternative Energy Institute)

WHY HAVEN'T WE HEARD ABOUT IT?

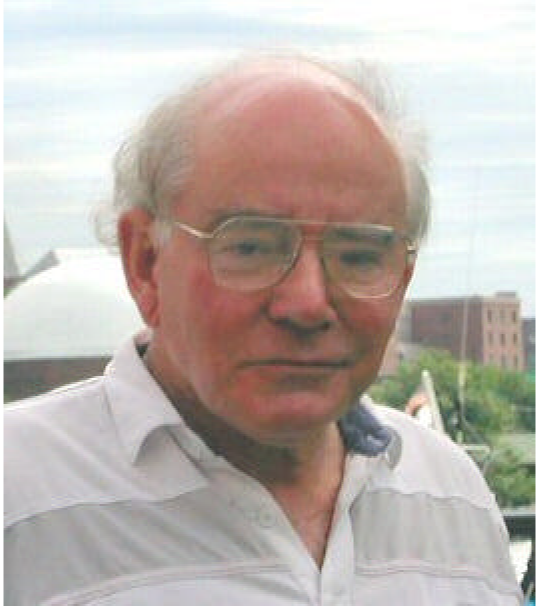
With such strong support in so many scientific corners, it seems hard to believe that the results of cold fusion experiments have remained hidden, but that is exactly the situation. In spite of the fact that more than 3,000 scientific papers have now been written on cold fusion, progress has been underreported because of a rift between cold fusion researchers and the scientific establishment, whose journals refuse to publish articles relating to cold fusion. The general media tend to overlook papers published in less prominent journals because the information may not have been held to as high standards by the journals' editors. Some people assume that the experiments were conducted with less rigor and that the conclusions are unreliable.

Dr. Antonella De Ninno [see Exhibit 6], an Italian nuclear physicist and fusion researcher with the Italian Agency for New Technology, Energy and Environment, stated in a September 2003 letter to her cold fusion colleagues that all of the journals to which she submitted a scientific paper on cold fusion rejected it without a referee's scrutiny. One journal replied, "This paper cannot be published neither here or elsewhere [sic] because it deals with a subject which has already proved to be false."[8]

Exhibit 6. Dr. Antonella De Ninno
(Photo Courtesy of Alternative Energy Institute)

The fact that cold fusion researchers have repeatedly proved initial criticisms wrong has escaped most conventional fusion physicists, including the critics, who figure that they would have read about any significant developments in cold fusion in scientific journals.

Even so, it is clear to anyone who scratches below the surface that cold fusion and its founding fathers received a bad rap. The label of "charlatans" never did quite seem plausible. Dr. Martin Fleischmann [see Exhibit 7] is regarded by many as the world's top electrochemist. Formerly the president of the International Society of Electrochemists, Fleischmann is a Fellow of the British Royal Society, the most prestigious scientific honorary society in England, and a recipient of its Medal for Electrochemistry and Thermodynamics. Dr. Stanley Pons, retired from science, has written or co-written 150 scientific publications, and before the cold fusion debacle, he served as the chairman of the University of Utah's department of chemistry.



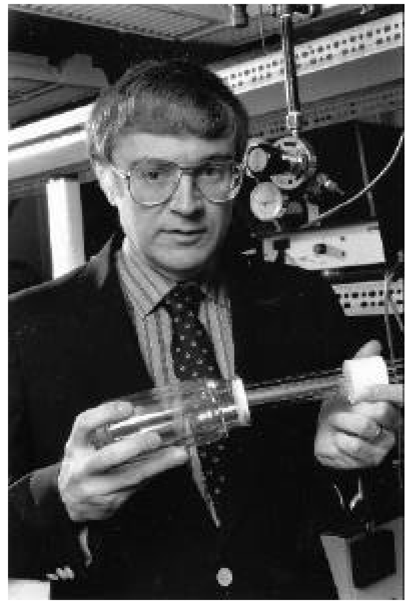


Exhibit 7. Dr. Martin Fleischmann, 2003
(Photo Courtesy of David Nagel)

Exhibit 8. Dr. Stanley Pons, 1989
(Photo Courtesy of Special Collections Dept., J. Willard Marriott Library, University of Utah)

SO WHAT WENT WRONG?

The answer to what brought Fleischmann and Pons ill repute lies in a combination of scientific and human factors that are integral to the acceptance or rejection of any radically new scientific endeavor: the competition for resources and acclaim, the personalities of the various scientists and officials involved, and the problems of communication that develop when conflicting scientific paradigms and interests are at hand.

Problems began with Fleischmann and Pons' own raw enthusiasm for their proposed discovery. Their manner of presentation to the scientific community was brash. Not only did they inconsiderately deviate in several ways from scientific protocol, but in one magazine interview, Pons poked fun at the thermonuclear physics community by referring to their glass beaker as a "little" Tokamak.

To be fair, Fleischmann and Pons had little choice in most matters. The University of Utah's patent- and grant-seeking interests took precedence over correct scientific procedure. The initial announcement of the discovery, which was edited by university administrators, took place through a press release and provided limited details of the experiment. The result was a frenzy of media activity and a circus atmosphere in which the electrochemists' claims were evaluated not in scientific journals but in a court of the worldwide media.

The scientists' unpolished demeanor further worked against their credibility. One plasma fusion physicist who played a key role in the 1989 dismissal of cold fusion by the panel consulted by the Energy Department's Energy Resources Advisory Board, Dr. William Happer of Princeton University, said of Fleischmann and Pons, "just by looking at these guys on television, it was obvious that they were incompetent boobs."[9] One can wonder what Happer would have said of Albert Einstein.

Additional science-based problems contributed to the development of a turf war from which the two researchers and their scientific legacy have not recovered. Nuclear reactions from a chemistry experiment, such as the electrolytic process that Fleischmann and Pons used, were previously unknown. Physics professor Robert Bush of the California Polytechnic Institute, Pomona, recalls that the nuclear physics community almost immediately began expressing strong doubts about the unique presentation of the supposed nuclear reaction, asking, "Where are the neutrons? Where are the gamma rays?" According to conventional fusion theory, neutrons or gamma rays should have killed the chemists if the experiments had generated as much power as they claimed. In the 1996 documentary "Fire from Water," Bush said physicists decided that "the nuclear interpretation was the result of 'bad physics' being conducted by chemists who were theorizing outside of their field of expertise."[10]

Even if this were the case, Fleischmann and Pons were not *experimenting* outside of their field of expertise. Is it possible that this experiment could have been devised only by a top expert in electrochemistry, one who had no preconceived notions about an acceptable presentation for nuclear fusion?

If an alternative approach to fusion were verifiably possible, physicists would have to reconsider the assumptions underlying traditional nuclear theory.

In Dr. David Goodstein's 1994 article titled "Whatever Happened to Cold Fusion," printed in the journal *Accountability in Research*, the Caltech vice provost wrote, "Scientists are aware that they must be prepared, from time to time, to be surprised by a phenomenon they previously thought to be impossible." Goodstein acknowledged that, in 1989, "the anti-cold fusion crowd was ... guilty" of failing to keep their scientific process "firmly rooted in experiment or observation, unladen with theoretical preconceptions."[11]

In a November 2002 interview on University of Utah radio station KUER/PBS, Dr. Michael McKubre [see Exhibit 9], director of the Energy Research Center at SRI International in Menlo Park, Calif., commented, "1989 was a particularly difficult time for the hot fusion community. They were under investigation. Questions were being asked why all the money had been spent and why so little progress had been made. Funding was being cut. The last thing that community wanted was the suggestion that there's a much simpler and cheaper way to achieve the same result."[12]

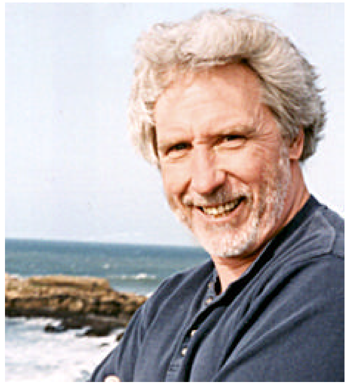


Exhibit 9. Dr. Michael McKubre
(Photo Courtesy of Michael McKubre)

For better or for worse, when Fleischmann and Pons identified the anomalous energy reaction as "n-fusion," or "an hitherto unknown nuclear process," they opened the door for scrutiny, and eventual dismissal, by nuclear physicists who evaluated their claims on the basis of conventional nuclear theory. Three laboratories -- Caltech, the Massachusetts Institute of Technology and the United Kingdom's Harwell Atomic Energy Research Laboratory -- attempted to replicate Fleischmann and Pons' experiments.

Opinions vary as to whether these scientists attempted in earnest to replicate the claims. Some suspect their actions may have been influenced by a priori judgments that the claims of "room-temperature fusion" were mere foolishness. In MIT's case, it appears that the research team wanted to bury the claims. Weeks before the final data analysis, the MIT Plasma Fusion Center held a party billed as a "Wake for Cold Fusion ... sponsored by the Center for Contrived Fantasies [see Exhibit 10]."[13]

Exhibit 10. MIT Plasma Fusion Center Party Announcement

As well, during a series of press conferences, the Caltech team was particularly vocal in delivering its bad news. Chemist Nathan Lewis said, "What we see in our lab is no evidence for any unusual nuclear or chemical reactions."[14] Caltech provost Steven Koonin said, "One could also theorize how pigs could fly if they had wings, but pigs don't have wings,"[15] and "We are suffering from the incompetence and perhaps delusions of Drs. Pons and Fleischmann."[16] These personal assaults on Fleischmann and Pons set a course to oust them from academia. The comments also provided a stern warning to all scientists that they should take caution to avoid such folly.

DID THE DOE CONSULT A BIASED REVIEW PANEL?

Eight months after the initial announcement, a panel of individuals from industry and academia who served on the U.S. Department of Energy's Energy Resources Advisory Board dealt cold fusion a critical blow when the panel decided that Fleischmann and Pons' claims did not warrant special federal funding. The cold fusion panel was selected and directed by John Huizenga, professor emeritus of chemistry and physics at the University of Rochester, New York. In Huizenga's 1993 book *Cold Fusion: The Scientific Fiasco of the Century*, he wrote, "My initial feeling was that the whole cold fusion episode would be short-lived and that it would be wise to delay appointing such a panel."[17]

At the same time that the panel members publicly rejected cold fusion, the actions of some demonstrate that the group never actually discredited cold fusion, just excluded it from federal funding. In fact, Nobel Laureate Norman Ramsey, a Harvard University physics professor who served as panel co-chair, threatened to resign unless the report included a preamble, part of which stated, "With the many contradictory existing claims it is not possible at this time to state categorically that all the claims for cold fusion have been convincingly either proved or disproved, [but] even a single short but valid cold fusion period would be revolutionary."[18]

As well, Tom Passell of the Electric Power Research Institute disclosed in a January 2004 telephone conversation that, subsequent to closure of the cold fusion review, a panel member and an MIT researcher each requested similar funds from the institute.[19]

In a similarly hypocritical fashion, a prominent nuclear physicist who reviewed a paper of a top cold fusion scientist to be published in March 2003 was publicly less-than-generous in his comments on the work under review. He then privately sought funding from the government sponsor of the researcher's work to pursue his own work in the area defined in the paper he was reviewing. Six months later, speaking with a cold fusion scientist, the critic reasoned that he did not wish to be the one leading the charge by supporting cold fusion prematurely, because this would soil his reputation in the physics community.[20]

WERE FLEISCHMANN AND PONS' CLAIMS TRULY DISPROVED?

Around August of 1989, Dr. Michael Melich, a senior research professor at the U.S. Naval Postgraduate School and the former branch head of the U.S. Naval Research Laboratory, became suspicious of the level of integrity with which the scientific community had evaluated the claims of cold fusion.[21] Melich began an investigation of the laboratories whose refutations provided the strongest "proof" against the validity of the "Fleischmann Pons Effect," or FPE.

In 1992, Melich gathered a team of five researchers to review the quality of these experiments and perform independent analyses of their original data. He traveled to Harwell Laboratory, where he found that, in light of the "extreme public scrutiny" during the 1989 media firestorm, the Harwell scientists "had little opportunity to ... mature their instruments or procedures."[22] The inspection further revealed that, in one of the cold fusion cells, there were "more than ten time intervals where an unexplained power source or energy storage mechanism may [have been] operating." In fact, Melich noted possible excess energy in magnitudes similar to that reported by Fleischmann and Pons. He wrote that, for the purpose of rejecting the FPE, "scientists have no business using the Harwell data."[23]

Melich also brought his research team to Caltech, where they conducted a similar inspection. For unknown reasons, their access to the raw data was obstructed.[24] From the data he was able to obtain, however, Melich observed that the Caltech team, under the direction of chemist Nathan Lewis and physicist Charlie Barnes,[25] "did not spend the time to understand the subtleties of the Fleischmann Pons experiment." While aspects of the Caltech work were excellent, Melich sharply criticized their calorimetry, their experimental design and their analysis of the results.[26]

Moreover, within five years of the Caltech cold fusion experiments, five teams of scientists performing retrospective analyses of their work found serious errors, including improper alterations to the calibration constant. Two of the teams, including China Lake, actually concluded that Caltech's results may have replicated rather than disproved the claims of Fleischmann and Pons.[27-32]

All of the teams concluded that, as Noninsky & Noninsky wrote, "the [Caltech] evidence is insufficient to provide a decisive answer ... to the question of whether [the FPE] is real or not."[34]

DID THE MIT EXPERIMENTS PASS THE NAVY'S INSPECTION?

A 1991 team of government scientists with the Naval Air Warfare Center Weapons Division at China Lake, Calif., re-examined the results from Harwell, Caltech and MIT. The team found that all three "contain serious errors that will ultimately undermine the acceptance of these studies as credible electrochemical calorimetry" (i.e., the science of heat measurement). They also concluded that "excess power effects could easily have gone undetected in [these three] early studies."[35]

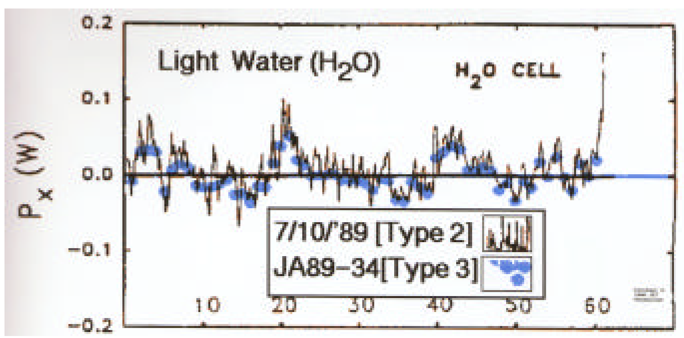
Historically, MIT's cold fusion work has been considered the most significant of the early studies thought to have discredited cold fusion. Its influence stems from the fact that the U.S. Patent and Trademark Office cites it as the reason for categorically rejecting all cold fusion-related applications. This policy has largely prevented research and development of cold fusion in the United States.

Three groups of researchers found flaws in the MIT experiments similar to those of Harwell and Caltech. Two of the groups identified possible evidence of the controversial FPE in the MIT results.

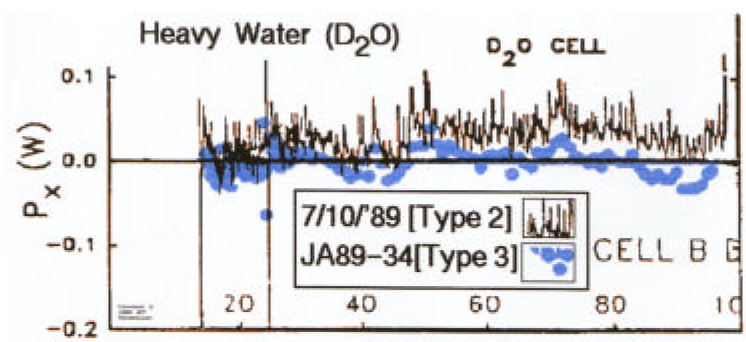
One of these teams was led by Eugene Mallove, a Harvard Ph.D. with a master's degree in aeronautical and astronautical engineering from MIT. As the chief science writer with the MIT news office at the time of the Fleischmann Pons announcement, Mallove was reviewing documents submitted to him by the MIT Plasma Fusion Center and chemistry department team members, when he noticed two misplaced draft documents. "I could see immediately that there was a serious discrepancy between the unpublished, pre-processed raw data [in these documents] and the final published data," he wrote.[36]

Mallove gave the graphs to Mitchell Swartz, a physician and MIT graduate, to conduct a quantitative analysis of the data. Swartz concluded that a "bias was introduced into the [graphs which] obscure[d] the generation of heat.'[37] Mallove later surmised in his Infinite Energy magazine that the published report was "arbitrarily shifted downward to make the apparent excess heat vanish [see Exhibit 11].'[38]

Exhibit 11



Graph showing MIT heat measurements for the control cell.
The black line represents the original, unpublished data; the blue dots represent the published, interpreted data. This graph shows basic agreement between the two.
(Image Courtesy of Mitchell Swartz, Jet Technologies)



Graph showing MIT heat measurements for the experimental cell.
The black line represents the original, unpublished data; the blue dots represent the published, interpreted data. This graph shows a downward adjustment in the interpretation of the data. (Image Courtesy of Mitchell Swartz, Jet Technologies)

Two years after publishing its initial paper, MIT published a "Technical Appendix" which explained that the researchers had interpreted the appearance of heat within their study as an artifact of instrumentation error, and they had made corrections accordingly, to "clarify" the data. Dr. Edmund Storms [see Exhibit 12], a radiochemist formerly with the Los Alamos National Laboratory and a top cold fusion instructor and experimentalist, explained in a November 2003 telephone conversation that, understandably, MIT assumed that its calorimetric instruments and methods matched those of Fleischmann and Pons. Only years later did the scientific community learn that the Utah electrochemists had developed a very sophisticated analytical method. As well, they had engineered a calorimeter capable of detecting excess heat in tiny quantities with an error tolerance of plus or minus 1 milliwatt. In contrast, the calorimeter used by MIT was limited to a tolerance of 40.

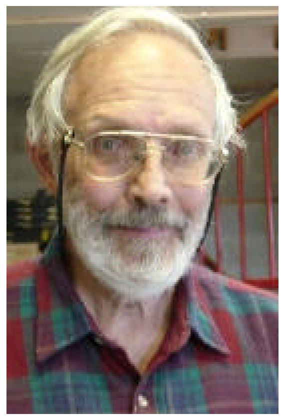


Exhibit 12. Dr. Edmund Storms
(Photo by Steven Krivit)

Had the MIT researchers followed accepted data reporting practices by providing the original results along with their interpretation, accusations of data manipulation would have been avoided. Instead, they replotted the data, creating the impression that the raw data showed zero excess heat. "Since the entire purpose of the experiment was to determine whether or not there was an excess-heat effect," Storms said in his telephone conversation, "the consequences of shifting the data are immense."[39]

As with the Caltech and Harwell experiments, the MIT replication study should have indicated that evidence for the excess heat effect was "inconclusive." Instead, MIT cemented in writing a negative impression which focused on the absence of nuclear products. The quality of its neutron detection work has in fact been described as outstanding. The problem, however, derives from the fact that neutrons and tritium, the dominant nuclear products predicted by traditional fusion theory, are not the only possible nuclear products. In fact, helium-4, which is extremely rare in hot fusion, turns out to be the most common nuclear product in cold fusion. (Details are presented in Part 2 of this report.)

WERE FLEISCHMANN AND PONS' FINDINGS EVER CONFIRMED?

In addition to reviewing the "debunking" experiments, Melich inspected several studies which supported the Fleischmann and Pons claims. In 1990, Wilford Hansen, a professor of physics and chemistry at Utah State University who had been philosophically neutral on the subject, was commissioned by the Utah Fusion Energy Council to head a committee to analyze the original Fleischmann and Pons data. Hansen used computerized data analysis to avoid potential errors resulting from human analysis of calorimetry data. The quantity of excess energy confirmed by Hansen's analysis was "over a thousand times the energy required to vaporize the electrode." Hansen remarked, "It is easy to see that we are not dealing with known chemistry or metallurgy. At issue is a profound energy source."[40]

In concluding his investigation, Melich cautioned, "an observation that simply fails to answer 'yes' (call it 'negative') does not answer 'no.' It simply gives no answer at all. Yet simple negative results have been taken as convincing evidence that the FPE does not exist. And current patent and funding policies are driven by a few negative results." Later, Melich and Hansen together admonished their colleagues: "The challenge to science is to solve the case, with hard work and rational dialogue. We should not allow such a smoke screen to be thrown up that the answers can't be recognized even when they are found. We also must be careful that our motives are purely scientific."[41]

Melich also evaluated the unpublished work of scientists at the Amoco Oil Corp. He noted that, in contrast to the Harwell and Caltech experiments, the 1989 Amoco experiments, which had been performed outside of the glare of publicity, were conducted with patience, care and precision. The Amoco team was able to complete three iterations of experimentation, sequentially improving and maturing their experimental instruments and designs. The result was "large steady levels of heat, as well as bursts of heat, at magnitudes 100 to 1,000 times greater than instrumental error" and tritium levels which increased by a factor of 3 after electrolysis.[42]

The Amoco scientists concluded, "These data support the claims of [Fleischmann and Pons] that anomalous heat and tritium are produced during electrolytic experiments using a hydrogen-absorbing [palladium] cathode."[43]

Shell was another major oil company which, in 1989, quietly explored the claims of cold fusion. Describing its measurements with a 99 percent level of confidence, Shell scientists concluded, "Excess energy production was confirmed in the simple [Fleischmann and Pons] system ... up to several watts."[44] Both the Shell and Amoco scientists discontinued their experimentation, presumably because they could not account for the excess heat effect with evidence of nuclear products. However, one retired scientist who worked on the Amoco team said in an e-mail in February 2004 that, in light of more advanced understandings regarding the different nuclear products observed in "cold" vs. "hot" fusion, he and another former Amoco scientist have become interested in resuming experimentation.[45]

WHAT DID THE CRITICS KNOW, AND WHEN DID THEY KNOW IT?

Unknown to the scientific community in the early 1990s, five high-profile scientists visited the nation's top cold fusion laboratory and conveyed supportive findings to the Pentagon and to the Electric Power Research Institute. Two of the scientists were members of a secretive organization known as the JASONS, a group of 50 scientists, primarily physicists, whom the Pentagon and Energy Department have consulted since 1959 on spending decisions for defense-related technologies. In October of 1993, JASONS chairman Richard Garwin and member Nathan Lewis performed an extensive, two-day evaluation of work performed by Dr. Michael McKubre, director of SRI International's Energy Research Center.

In a follow-up report to the Pentagon, Garwin affirmed, "We held [a cold fusion cell] in our hands and are now quite familiar with its construction." Garwin noted a significant signal-to-noise ratio: "The uncertainty in excess power measurement is about 50 milliwatts, but the excess power appears to be on the order of 500 milliwatts or even 1 watt peak." Garwin and Lewis effectively countered past rejection of the excess-heat claims when they concluded that they had "found no specific experimental artifact [i.e., error] responsible for the finding of excess heat."[46]

In 1991, the institute, SRI's funding source, hired three outside consultants eminently qualified in the appropriate technology. This group included Charlie Barnes, a highly regarded nuclear physicist from Caltech, and two senior electrochemists, Howard Birnbaum of the University of Illinois and Alan Bard of the University of Texas. Bard verified that "the work at SRI to detect and understand excess-heat effects during electrolysis with [palladium] cathodes, has been carried out carefully." Like Garwin and Lewis, Bard bucked mainstream opinion with his conclusion that SRI's experimentation "has shown some excess-heat effects that cannot readily be attributed to artifacts or errors."[47]

The reports of Birnbaum and Barnes expressed similar viewpoints.[48] SRI and its institute administrators privately hoped to break through the communication barrier between mainstream and cold fusion camps. "We were, I guess, disappointed that 'the three wise men,' as we called them, chose just to write a report [in accordance with] their responsibility as consultants [and nothing more]," McKubre said in a January 2004 telephone conversation.[49]

Paradoxically, Garwin, Bard and Birnbaum were all members of the 1989 Energy Department's "cold fusion panel" which four years earlier had rendered the historic decision rejecting cold fusion. Some call their silence hypocritical. McKubre does not blame them, though he commented in his telephone conversation that Garwin in particular could have been very helpful to the field had he chosen to publicize the results of his inspection.

HOW HAVE CRITICS RESPONDED TO THE EVIDENCE?

McKubre further commented on the deeper issues at hand: "The barrier here, what we've been facing all of this time, and what is probably underrecognized is, 'Why can't we convince these people that there's a real effect?' And the problem is that knowledge brings responsibility. If they know there's a real effect, then they're obliged to do something about it. And none of them are willing to change what they are already doing and take on a new task or a new viewpoint.

None of them are willing to face up to that responsibility. It's much, much easier to deny the knowledge.'[50]

Writer Upton Sinclair aptly observed, "It is difficult to get a man to understand something when his salary depends upon his not understanding it."

Many hot fusion physicists contend that, in order to achieve credibility, cold fusion experiments must be verified by people whom they consider reputable mainstream scientists. In fact, many cold fusion researchers have been involved with hot fusion research much longer than they have studied cold fusion. Very few have a history of involvement in eccentric scientific pursuits, and most proceeded gingerly before identifying themselves with the cold fusion community. McKubre of SRI International, for one, reports that it took him a year to become convinced that the field of cold fusion constituted a legitimate scientific endeavor. And Dr. Steven Jones of Brigham Young University, a highly respected physicist known for work in low-temperature fusion which pre-dates the Fleischmann and Pons discovery, re-entered the cold fusion community this year after a decade of denouncing the excess-heat claims [see Exhibit 13].

Exhibit 13. Dr. Steven Jones (left), Dr. Melvin Miles (center) and Dr. Xing Zhong Li (right) have agreed to lay down their (toy) guns and "work together in pursuit of cold fusion facts," Jones says.
(Photo Courtesy of Steven Jones)

Nevertheless, it has been challenging for cold fusion researchers to obtain the participation of scientists within the nuclear physics community to scrutinize their work. "The problem," Storms said in a telephone conversation in November 2003, "is to find a person who is respected by conventional science, who will take the time to learn what is known, and then discuss this with objectivity. Most mainstream scientists are woefully ignorant of the field because they do not take the time to study a subject they either believe--or have been told--is nonsense.'[51]

For example, several cold fusion scientists, including McKubre and Storms, recount rejected attempts to hand-deliver scientific papers to Dr. Robert Park, the director of public information for the American Physical Society. And MIT physics professor Herman Feshbach once astonishingly remarked, "I've had 50 years of experience in nuclear physics, and I know what is possible and what is not. I'm not going to read it. It's all junk."[52]

The investigation behind "The 2004 Cold Fusion Report" included interviews with nearly every prominent critic. None had any knowledge of the current status of cold fusion, although a few ventured a critique based on outdated information.

Walter Gratzer, professor of chemistry at the University of London and author of a 2000 book in which cold fusion is criticized, *The Undergrowth of Science: Delusion, Self-Deception, and Human Frailty*,[53] said in a November 2003 e-mail, "I gave cold fusion as an example of what has been called 'pathological science.' I have to say that it is not my field ... What I wrote in the book was based on my reading at the time, which convinced me that the cold fusion uproar was based on atrociously bad science by people stampeded into hasty experiments and premature publication ... but I do not think it is for outsiders like myself to pronounce judgments ... I think you should consult genuine experts on nuclear reactions."[54] He offered as "big names" Nathan Lewis, Steven Koonin, Alan Bard, Richard Garwin, William Happer, Jacob Bigeleisen at State University of New York, Stony Brook, Frank Close (Exeter College, Oxford), and David Williams, formerly at Harwell.[55]

In a November 2003 telephone conversation, Robert Park said, "This sort of dwindling band of true believers, each year they get together and talk about the wonderful progress that's been made, and none of the rest of us can ever see that." When asked about the allegations that he has refused to read cold fusion papers, he commented, "I read them till I was sick of them. There's a lot of paranoia in that group." Asked what papers he could point to that discussed current claims in cold fusion, Park said, "Golly, I haven't gone through that in so long. I don't know offhand what to recommend." When asked specifically if he was aware of any papers written within the last five or 10 years," he replied, "Nothing, really." Park recommended speaking with "the experts:" Steven Koonin and Nathan Lewis.[56]

Koonin, in a January 2004 e-mail, wrote, "I don't know of any recent events that would cause me to look hard at this business again."[57] In January 2004, Lewis e-mailed a reply about progress in cold fusion, "I've been out of that area for a decade or so. Consequently, I have no basis for commenting on anything that has happened in that period of time science-wise."[58]

Happer, a theoretical physicist with the Princeton Plasma Physics Laboratory, wrote in a January 2004 e-mail exchange, "I do follow these activities with interest [and] there continue to be papers published and claims made. None that I have seen look credible." When asked to mention a few of the papers he has seen, he deflected the question: "Well, if you want the complete archive from a 'true believer,' you might want to contact Bob Bass [Rhodes Scholar and theoretical physicist formerly with the Princeton Plasma Physics Laboratory]." Asked again to identify a paper, Happer said, "I am still looking around."[59]

Dr. Frank Close, author of the 1991 book *Too Hot to Handle: The Race for Cold Fusion*,[60] and Dr. David Williams, who led Harwell's team on its Fleischmann-Pons replication study, each said of the past decade in cold fusion research that they had heard nothing of substance. Close elaborated, "No one in mainstream science is putting serious research time into this ... When someone produces hard evidence, then I'll get interested. But I've been saying that for 15 years now.'[61-62] When asked for his definition of "hard evidence" he offered "evidence that is reproducible and under varied conditions... performed rigorously.'[63]

HAS ANYTHING CHANGED IN THE PAST 10 YEARS?

Over the past decade, cold fusion researchers have developed a love-hate relationship with their ostracism from mainstream science. While some enjoy the anonymity, all would gladly welcome adequate funding and broader scrutiny of their experiments. In view of their exclusion from the formal peer review process of mainstream science, cold fusion researchers have developed an ethic of constructive criticism toward one another's work. While this does not take the place of a more formal peer review, after 15 years of focused study of the anomalies in metal deuterides and hydrides, the analysis of cold fusion has become so specialized that few outside of the community would qualify as knowledgeable peers.

Dr. David Nagel [see Exhibit 14], a research professor at the George Washington University and fusion physicist who worked for 36 years at the U.S. Naval Research Laboratory, explained to a public audience at the August 2003 10th International Conference on Cold Fusion, "This so-called simple cold fusion cell is a sophisticated experiment that requires real expertise ... This field is intrinsically interdisciplinary. It requires knowledge of physics, chemistry, electrochemistry, nuclear physics; electrical, mechanical and thermal engineering, instrumentation science and technology, solid-state physics, chemistry materials science, statistics and data analysis.'[64] Senior cold fusion scientists from North America, Europe and Asia are beginning to address this by launching a new online journal, the Journal of Condensed Matter Nuclear Science (http://www.cmnsjournal.com), to facilitate true peer review.

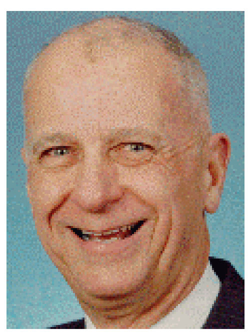


Exhibit 14. Dr. David Nagel
(Photo Courtesy of David Nagel)

In a potential sign of changing times, in 2003 several cold fusion experimenters gave well-received presentations at meetings of the American Physical Society and the American Nuclear Society. Some nuclear physicists who strongly criticized cold fusion in the past have begun to express support for the field. Dr. Lowell Wood, for one, a prominent physicist with the Lawrence Livermore National Laboratory and former protégé of Edward Teller, recently wrote in an e-mail in November 2003, "The claims of the cold fusion community are undeniably exceptional, and the experimental results supporting such claims must withstand exceptional scrutiny in order to be taken seriously. Thus far, ... no single example of them does so -- though some already come close, and I wouldn't be surprised if one or more of them eventually does."[65]

Nagel believes that time has come: "There are many individual studies where the data is essentially bulletproof. The collection of them is very, very compelling."

Because of numerous challenges, "many of the early experiments were deficient," Nagel said. Many discontinued the work because of inconsistencies. "Investigators who stayed with the problem in the early 1990s realized the complexity involved and systematically addressed the needs of the experiments," Nagel said. "Hence, the quality of the experiments and the results increased with time. For the past 10 years, the precision and accuracy of cold fusion experimentation has been very good, with experimental errors many times smaller than the observed excess powers in many cases."[66]

PART 2: DISCOVERIES AND MYSTERIES

WHO CARES ABOUT COLD FUSION?

Recently, certain departments within the U.S. government have begun to re-assess their opinion of cold fusion. On Nov. 6, 2003, three scientists met with representatives of the U.S. Department of Energy and requested a second national study to review the status of the field and make funding recommendations. As Bennett Daviss first reported in the March 20, 2004, issue of New Scientist, the Energy Department has agreed to re-open the case for cold fusion.

In addition, in January 2004, the Department of Defense held a workshop for 70 participants at which Nagel informed them, "it is highly likely that your perceptions of the cold fusion field are (a) out of date, and (b) wrong."[67]

Cold fusion's rejection by the scientific establishment at the outset encumbered progress toward the understanding of this scientific discovery. At the same time, in light of the relatively modest resources available to them, scientists have made remarkable headway. In fact, cold fusion research has reached several milestones on the road to fulfilling the dreams inspired by its founders.

Today, many researchers indicate that cold fusion is highly reproducible. Scientists around the world have replicated the effect repeatedly.[68] They have demonstrated it using many different experimental methods.[69] The supposedly lacking nuclear products, which originally prompted critics to dismiss cold fusion's founders as "delusional," have been measured convincingly.[70]

The current question on scientists' mind is not, "Is cold fusion real?" but rather, "Can the energy cold fusion generates scale up to fulfill any of the world's need for electricity and heat?"

Cold fusion research continues in at least 13 countries [see Appendix A]. Among them, 73 researchers are known to work in university laboratories, 53 in government and military laboratories and 48 in private industry.[71] In the United States, although many cold fusion researchers work in military or university settings, the lack of government funding has meant that some scientists have resorted to setting up their own laboratories. Many have devoted their retirement years to solving the riddles of cold fusion.

While cold fusion researchers have not experienced a single "Eureka!" moment, as is commonly depicted in popular science fiction movies, dozens of important albeit incremental advances have occurred. Many significant pieces of the puzzle have materialized.

ARE THE RESULTS REPRODUCIBLE?

Initially, experimentation achieved excess heat less than 10 percent of the time. Two years after the initial announcement, scientists made important strides in their ability to reproduce the Fleischmann and Pons Effect. As researchers improved their understanding of the subtle properties of palladium, they learned that different batches from the same manufacturer varied in their capacity to host the excess-heat effect. While some samples resisted cracking, many were vulnerable to developing microscopic cracks in the palladium as the deuterium loaded into it. This defeated the palladium's capacity to retain deuterium in the lattice at high enough values to obtain excess power.

As did other researchers, Fleischmann and Pons began using silver-palladium alloys, instead. The alloys resisted cracking; however, according to Storms, "the silver prevents significant amounts of deuterium from going in. So you solve one problem, but you create another." Storms now bypasses this problem by laying down either thin films or micro particles of palladium, which "prevents stress from concentrating in one area and allows the entire sample of palladium to expand."[72]

Systematic experimentation additionally resulted in several insights regarding what is needed for a successful experiment. First, the excess power requires that the "loading" (i.e., the ratio of deuterium atoms to palladium atoms) be above a certain threshold. The electrical current density also must surpass a threshold, one which varies widely from one experiment to another. Third, researchers must take care to prevent normal water from being present with the laboratory-grade heavy water.[73]

The fourth discovery was that, to exercise control over the start of the excess-heat effect, in Nagel's words, "you have to shock the system in some fashion."[74] Originally, days or weeks went by before scientists would notice excess heat. Then one day, "just for fun,"[75] U.S. cold fusion experimentalist Dennis Letts [see Exhibit 15] said in a December 2003 e-mail, he aimed a low-power 30 milliwatt laser pointer at an experiment, and he watched as the experiment started "cooking" [see Exhibit 16]. Excess heat developed in historic time -- less than five minutes. This effect reportedly has been replicated by laboratories in California, New Mexico and New Hampshire.[76] Researchers have used many other means of jump-starting the system, as well.

Exhibit 15. Dennis Letts
Alternative Energy Researcher
(Photo courtesy of David Nagel)

Exhibit 16. A 30 mw laser-triggered cold fusion cell
(Photo Courtesy of Dennis Letts)

With current understanding, Nagel said, there is "an equation available that allows us to predict the excess power if we know the thresholds for the current density, and for the loading, and the time variation of the loading," Nagel says. "That's substantial progress."[77]

As a result of many such discoveries in recent years, the rate of reproducibility of cold fusion experiments has increased significantly. Dr. Antonella De Ninno, an Italian physicist, said in an e-mail in October 2003, "We have improved our techniques year after year, and we now know why an experiment does or does not work. The percentage of our successful experiments in recent years is about 75 percent, up from about 40 percent five years ago."[78]

The authors of "The 2004 Cold Fusion Report" conducted a confidential survey of cold fusion researchers who attended the August 2003 10th International Conference on Cold Fusion [see Appendix B]. Their primary objective was to ascertain the average rate of reproducibility for experiments showing excess energy or nuclear products. Of 43 researchers whose e-mail addresses were publicly available, 24 chose to participate in the survey. Ten respondents answered the questions on reproducibility.

The success rate of cold fusion experiments within the prior 12 months was 83 percent. This was up from 45 percent five years ago. Impressively, within batches of palladium previously shown to be effective, several researchers claimed a 100 percent rate of success.[79] And Dr. Emilio Del Guidice, physicist and senior scientist with the National Institute for Nuclear Physics in Milan, Italy, wrote in a September 2003 e-mail, "In our experiments we successfully observed cold fusion every time that we were able to attain the proper loading ratio."[80]

CAN EXCESS HEAT BE REPLICATED?

The basic claim, that low-energy nuclear reactions produce more heat than they consume, has been demonstrated repeatedly in numerous experiments, laboratories and countries around the world. In 1998, Storms wrote, "Over 50 studies reporting repeated examples of excess energy production have been done, most of which have been published at least in conference proceedings."[81]

Adding to the validity of this new science are the handful of different methods by which cold fusion has been demonstrated.[82] Of course, having a variety of approaches also has made the process of replication more challenging, because cold fusion scientists cannot possibly develop the skills or have the time to pursue knowledge of all the methods. The replication of experiments is therefore an area which remains underdeveloped.

"[Replication] is a very complicated issue," Nagel commented. "Variables such as current density, loading density, equipment, materials geometry and materials sources can vary immensely ... but there's been a lot of progress made on that front."[83]

HAVE NUCLEAR PRODUCTS BEEN IDENTIFIED?

Cold fusion research initially drew strong skepticism from the scientific community for its failure to demonstrate evidence of neutrons and tritium, the dominant nuclear products of hot fusion. Over time, researchers learned that, because of the differences in the environment between cold and hot fusion (as well as the possibly different nuclear process involved), different by-products can be expected. In cold fusion, Nagel said, "Neutrons are rare. Tritium is much more common, but not enough to account for the heat that is seen in the calorimetry experiments, if hot fusion reactions had occurred."[84]

Over the past five years, cold fusion researchers have achieved a landmark finding: the measurement of helium-4 consistently correlates with the measurement of excess heat.

At least five scientific papers have reported quantitative relationships between heat and helium-4. Two of these studies were conducted in the United States, two in Italy, and one in Japan.[85-91]

Early on, signs had been present that helium-4 might supply the missing nuclear evidence required to establish the reality of nuclear reactions at low temperature. But Helium-4 is particularly difficult to measure accurately at the low power levels of cold fusion experiments. So testing this hypothesis took time.

In hot deuterium fusion, helium-4 is rarely observed; the probability is on the order of one in 10 million relative to other fusion products. As well, in hot fusion, helium-4 is always accompanied by a high-energy gamma ray.

Cold fusion scientists now know that by contrast, in low-temperature fusion, the dominant nuclear product is helium-4, along with the energy of about 24 MeV (million electron volts). In his September 2003 e-mail, Del Guidice wrote, "The appearance of helium, which was absent before the experiment, means without any conceivable doubt that a nuclear reaction has taken place."[92]

Contrasting cold fusion with conventional fusion, Nagel said, "The most remarkable difference is that the helium-4 doesn't come out with the dangerous gamma rays as occur in hot fusion."[93]

In cold fusion, Nagel explained, the excess energy "gets coupled into the palladium lattice." Consequently, the reaction is influenced by the solid structure of the palladium. "This," Nagel said, "is in contrast to what happens in the unbounded environment of free space in a plasma, where the excess energy is carried off by gamma rays" or by other fast-moving particles.[94]

CAN THE RECORD BE SET STRAIGHT?

In Richard Garwin's Dec. 23, 1993, report to the Pentagon, he stated, "Of course, all of us would be fascinated and would feel great admiration if it were possible reliably to produce excess heat ... The same would be true of a new way of producing nuclear particles under such circumstances." Sufficient data now exists to support the assertion that both of these possibilities have come to pass.

The findings also successfully counter past criticism that cold fusion failed to meet the requirement that nuclear products correlate with heat. Ten years ago, professor John Huizenga, who chaired the panel of cold fusion consultants hired by the Department of Energy, asserted, "Room-temperature nuclear fusion without commensurate amounts of fusion products is a delusion and qualifies as pathological science."[95]

In September 2003, science columnist Sharon Begley of the Wall Street Journal wrote, "The only thing pathological about cold fusion is the way the scientific establishment has treated it."[96] Begley is one of a few science journalists who have expressed any awareness of the fact that premature judgments by Huizenga and other science authorities with vested interests in conventional fusion research derailed the scientific process and detracted from the public interest.

Nagel has decided to set the record straight. In his public address at the August 2003 10th International Conference on Cold Fusion, he concluded, "There are many, many cold fusion experiments in which [the nuclear evidence] is nowhere near marginal ... with strong, robust signal-to-noise ratios and many standard deviations for the data above the background noise. If the experiments which were performed by capable and careful workers with adequate funding and good calibrated equipment do hold up -- and I'll bet my retirement they do, then ... it's not chemistry! ... You can burn the whole experiment and you can't get that [amount of energy] out. You cannot make helium or tritium by chemistry ... We are talking about a nuclear effect at low energies, ordinary temperatures."[97]

WILL ONE OF THESE THEORIES WIN THE PRIZE?

"While major experimental progress has been made," Nagel told the audience at the conference, "understanding still eludes us. In terms of asking theory to do what it normally does -- explain the past and predict the future -- we're not quite there yet."[98]

Theory remains an area of critical importance to establish the legitimacy of cold fusion with mainstream scientists. Many critics have dismissed cold fusion research because it has not produced a proven explanation which adheres to accepted scientific principles and mathematically predicts the observations. In Charles Beaudette's book *Excess Heat & Why*

Cold Fusion Research Prevailed, the MIT graduate countered that critics "failed to realize that science, at the beginning, does not expect or require understanding."

"That would become the *continuing* purpose of scientific study," Beaudette added. "In 1903, Pierre Curie did not understand the self-heating of radium ... and in 1911, Dr. H. K. Onnes did not understand what enabled superconductivity. Nevertheless, both won Nobel prizes."[99]

At least seven scientists, all physicists, have entered the race to explain cold fusion. The eventual winner must be able to explain how, at room temperature, atomic nuclei can overcome what is known as the "Coulomb barrier," a powerful, repulsive electromagnetic force which prevents nuclei from joining together easily. In addition, the theory will have to explain how the energy and momentum from the fusion reaction are conserved by being transferred to the palladium lattice as a whole, rather than to a gamma ray or other fast-moving particle, as is normally the case with hot fusion.[100]

Dr. Peter Hagelstein [see Exhibit 17], a professor of electrical engineering and computer science at MIT who is credited with designing the x-ray laser for Ronald Reagan's "Star Wars" program, reportedly has developed one of the more complete theories. Hagelstein said in a January 2004 e-mail, "I examined more than 100 models and variants before arriving at the model currently under investigation ... The new models can be understood perhaps simply. Instead of formulating nuclear reactions in a vacuum, as is done in nuclear physics textbooks, the proposal is that one needs to begin with a formulation that includes the lattice at the outset."[101]

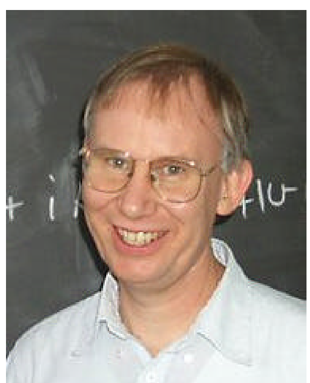


Exhibit 17. Dr. Peter Hagelstein
(Photo Courtesy of Peter Hagelstein)

Still, what about the problem that the experimental observations contradict known physics?

Ten years ago, Dr. Edward Teller, known as one of the great physicists of our time and as "the father of the hydrogen bomb," requested that Dr. McKubre provide him an update on the status of cold fusion. Teller did not change his view at the end of McKubre's presentation, but he reportedly informed McKubre that, if a cold fusion effect did exist, he "could encompass an explanation of it with a very small change in the laws of physics."[102]

University of Tennessee professor J. Reece Roth said in a telephone conversation in November 2003 that developments in fusion theory within the past five years are in fact beginning to expand the scope of known physics in a way which can explain both hot and cold fusion. Roth is an esteemed, 46-year expert in fusion energy, a 10-time patent awardee, and the author of a college textbook titled *Introduction to Fusion Energy*.

Roth emphasized the published work of Dr. Xing Zhong Li [see Exhibit 18], a physics professor at Tsinghua University, known as the "MIT of China." Li returned to the origins of fusion calculations developed in the 1930s and '40s. He found that the original cross sections were based on experimental data taken at various labs, since they were initially of interest for H-bombs. Roth said of Li's findings, "The measured cross sections were phenomenologically fit to a formula that was basically pulled out of thin air, rather than a formula derived from first principles, which would allow one to calculate what the cross sections should be as a function of, for example, energy."[103]

Li's findings amounted to an improper initial assumption. Correcting this assumption, Roth said, "greatly simplified the mathematics and the nature of the cross-section calculations of the original fusion reactions." Li explained to Roth that some of his calculations were derived from quantum mechanics, where two deuterons within the lattice are treated as colliding waves.

Exhibit 18. Dr. Xing Zhong Li
(Photo courtesy of Alternative Energy Institute)

"If Li is correct," Roth said, "the theoretical reasons why cold fusion can't work which applied prior to Li's theory, just simply no longer apply." Roth tells his students that, if this is the case, he "will have to throw away about 14 of the 16 chapters in [his] textbook."[103]

Little consensus exists among cold fusion theorists. Several theoreticians, such as Hagelstein, and Naval Research Laboratory physicist Talbot Chubb [see Exhibit 19] and Scott Chubb of Research Systems, Inc. [see Exhibit 20], have offered models which claim to explain nearly completely the cold fusion observations, as well as predict results. The approaches are extremely diverse in nature. According to Storms, most of them rely partly on techniques drawn from quantum mechanics.

Exhibit 19. Dr. Talbot Chubb
(Photo courtesy of David Nagel)

Exhibit 20. Dr. Scott Chubb
(Photo courtesy of David Nagel)

CAN SCIENTISTS GET NUCLEAR ENERGY FROM NORMAL WATER?

Some scientists are working on a theory to explain an even more unusual set of observations. In the early 1990s, scientists found evidence of nuclear reactions occurring in normal water. These experiments are often referred to as "light water" low energy nuclear reactions, though some scientists believe that the term "light water" is technically imprecise, because true "light" water is devoid of deuterium, whereas normal water has trace amounts of deuterium.[104]

Although opinion on this subject varies widely, scientists who conduct light water experiments are essentially claiming modern-day alchemy. In contrast to heavy water experiments, which primarily yield heat and helium-4, light water experiments have been observed to yield heat plus nuclear transmutations of heavy elements -- in other words, the conversion of one heavy element into another [see Appendix C]. Worldwide, light water experiments resulting in transmutations have been conducted in 14 separate laboratories.[105]

Miley, who received the 1995 Edward Teller Medal from the American Nuclear Society and served as the editor of the journal Fusion Technology for 20 years, presented a paper at the 10th International Conference on Cold Fusion in which he noted that, to date, light water experiments have generated a low level of excess power because of the small amount of metal in the films. However, he said, "the specific power density [i.e., the capacity of a particular quantity of palladium to generate energy relative to its own mass] is 10 to 100 times that of the typical solid-electrode [heavy water] experiments. Thus, a scale-up in power could be obtained using multiple electrodes."[106]

In his recent paper, Miley stated, "The ultimate objective is to achieve 100-watt to 20-kilowatt units for distributed power network applications [i.e., small power units for homes and businesses]."[106] This design is of particular interest to scientists because of its potential to be manufactured by existing microelectronic production facilities.[107] Still, researchers will need to obtain control over a number of variables before resolving the critical commercial issues of longevity and controllability pertaining to such power sources.

WHAT MIGHT THE FUTURE HOLD?

The future of cold fusion is unknown. Nagel said, "it could turn out to be a science that's very interesting -- like, say, the knowledge of a supernova -- but not really useful. It could wind up as technology that works but doesn't make money. Or it could become commercial technology, as many of us think indeed it might."[108]

In a September 1996 report which culminated many years of experimentation, Dr. Melvin Miles and others at the Naval Air Warfare Center Weapons Division at China Lake, Calif., wrote, "In our opinion, these factors provide compelling evidence that the anomalous effects measured in deuterated systems [i.e., cold fusion effects] are real. This research area has the potential to provide the human race with a nearly unlimited new source of energy. We hope that other scientists will continue to investigate this difficult research area until the challenging problems impeding progress are solved. It is possible that [cold fusion] will prove to be one of the most important scientific discoveries of this century."[109]

Cold fusion scientists see several specific applications on the horizon. "Desalination ranks as one of the very attractive possibilities for using the energy that would be available from this kind of a power source," Nagel said. The heavy water experiment lends itself to this possibility because, as the experiment generates excess heat, water evaporates, and its condensation results in "sweet" (pure) water. "Ten percent of the world's countries get their water from sources in other countries, he commented. "Another large fraction of countries have problems such as we do in the United States with the Colorado River. It's a very important issue."[110]

Roth predicted that, if Li and other theorists are right, "cold fusion may very well be capable of producing fusion energy under conditions that will make it very inexpensive and environmentally very desirable. It's entirely possible that if cold fusion goes the way [it has been] described, everybody will be able to have their own fusion reactor in their basement, and the distributed power from electric utilities will be a thing of the past."[111]

WILL THE U.S. DEPARTMENT OF ENERGY FUND COLD FUSION RESEARCH?

Emphasizing the many hidden variables left to be uncovered, Nagel, addressing a maturing audience of cold fusion scientists, said that "the pressing question for many of us in the community who are not in the earliest stages of our careers is, 'Can we get it right soon?'"[112]

Resolving the remaining issues requires additional funding, which to date has been quite limited. In a March 23, 2004, presentation to the Naval Research Laboratory titled "Cold Fusion: Problems, Progress and Prospects," Nagel plans to discuss the need for improved instrumentation and materials, expanded efforts to explain and predict the observations, and pursuit of new methods of experimentation, as well as replications of already successful experiments.

Fifteen years ago, the panel consulted by the Department of Energy closed the book on cold fusion just eight months after the initial Fleischmann and Pons announcement. Not only did panel members miss many available facts at the time, but they overlooked the potential for future gains in scientific knowledge.

In a telephone conversation on March 17, 2004, Department of Energy spokeswoman Jacqueline Johnson confirmed that the department has begun laying the groundwork for a second review of cold fusion. The review is expected to determine whether federal funds should be applied to research in this field. According to sources, a review panel should be selected before June 2004. Cold fusion researchers hope for a fair trial this time around.

The approval of funding for cold fusion research would likely resurrect the battle between hot and cold fusion camps, particularly because the funds would have to be diverted from existing research projects. This time, however, the cold fusion community is prepared to stand its ground. A shift in funding is also likely to embarrass some who have vilified cold fusion, especially if the orphaned science ever becomes the favored child.

If cold fusion is to realize its full potential, not only must adequate funding arrive, but discrimination by the U.S. Patent Office must cease. Companies wishing to invest in cold fusion research need to have the opportunity to protect their investment. And, academia must choose to accept the awakening interest of the nation's youth, who have been downloading cold fusion papers from http://www.lenr-canr.org by the tens of thousands.

Acknowledgments

No cold fusion researchers have taken the heat so much as Martin Fleischmann, Stanley Pons and John O'M. Bockris. We salute you and thank you not only for showing us the secrets of nature unrevealed to ordinary scientists but also for demonstrating conviction in your beliefs.

Next, we thank the numerous men and women of science who, from March 23, 1989, onward, pursued scientific truths, propelled by their inner wisdom and humbled by the possibilities of the unknown.

This project stands on the shoulders of several great people. We recognize and thank Gene Mallove, who, in his 1991 book *Fire from Ice: Searching for the Truth behind the Cold Fusion Furor*, courageously expressed the truth that cold fusion is real, long before any science journalist even dared to ask questions that challenged the prevailing view. Gene maintained the torch that initially drew us toward his research facility and lit our own passion to investigate the brewing mystery of cold fusion. And George Miley, the former editor of Fusion Technology, modeled integrity in science journalism. Gene and George, we thank you for your courageous achievements in keeping this field alive.

Our project also would not have been possible without the work of Charles Beaudette, who dedicated six years to chronicling the travails and science of cold fusion in his book *Excess Heat & Why Cold Fusion Prevailed*. For the brilliant road map you provided, we thank you, Charles.

Words cannot express our gratitude to and appreciation for Ed Storms, who provided sage advice and steadfast guidance, which at times during the six-month production of this report included daily phone support. Ed taught us about cold fusion research, from the broad to the specific. He also clarified our misperceptions and gently steered us back whenever he sensed that we were off the mark. Ed, for us and many others, your teachings have been a lighthouse in a stormy sea.

We are truly grateful for Dave Nagel, a pioneer who has worked tirelessly to develop a path for cold fusion to gain acceptance as a legitimate science. Dave played a direct role in this project by providing us information, advice and direction. Scott Chubb also played a key role by providing extensive information ... which, unfortunately, because of its highly technical nature, we were able to include only a fraction of in this report. Dave and Scott, we thank you for your belief in us, your enthusiasm for our project and your generosity with your time.

We also thank Jed Rothwell, who, for the last few years, has thanklessly provided an immense public service by digitizing and publishing hundreds of cold fusion papers on the www.lenr-canr.org library.

Around the midpoint of our research, we consulted with two skeptical plasma physicists who requested anonymity. They perhaps offered the most important sounding board for this project, confirming for us that the information we had obtained from the cold fusion community made sense and offered value to the larger scientific community. It was a pleasure talking with you gentlemen on conference calls and discussing the strengths and weaknesses of our investigative findings. We hope that this work will re-ignite hope for your own dreams of viable fusion power.

Lest we forget our dutiful and devoted editors, Diane Winocur and Cindy Goldstein, who, despite their full lives and schedules, graciously (and we hope), found every flaw and provided expert guidance on many aspects of the presentation of our work.

We are most grateful to Elizabeth Safran, who, also in the midst of her very hectic schedule, provided public relations assistance essential to the success of this project.

We also wish to acknowledge the assistance of reference librarian Randy Souther, who, without hesitation, assisted us in obtaining many important materials.

To our family and friends, who initially bit their tongues when we talked about our "cold fusion" project, and whose polite tolerance evolved into genuine interest, enthusiasm, encouragement and assistance, we are extremely grateful. We hope to spend time with you soon. Just as soon as we take off a week to spend time with each other.

Endnotes

Basic Terminology

1. General Atomics Fusion Education, "What is Fusion?" *http://fusioned.gat.com/what_is_fusion.html*
2. Nuclear Industry Association, "Radioactivity; Fission and Fusion; and Nuclear Energy," *http://www.niauk.org/article_10.shtml*

The 2004 Cold Fusion Report

1. Gordon, Frank E. from the forward to "A Decade of Research at Navy Laboratories Vol. 1," by Stan Szpak et al., *San Diego, CA., SPAWAR Systems Center*, (2002)
2. Corey, James, "Energetic Materials: History of and Current Claims for Low Energy Nuclear Reactions," *2003 Energetic Materials Intelligence Symposium*, (Sept.10-12, 2003)
3. Nagel, David, private communications, (Feb. 11, 2004)
4. Takahashi, Akito, private communications, (Sept. 18, 2003)
5. Corey, James, "Energetic Materials: History of and Current Claims for Low Energy Nuclear Reactions," *2003 Energetic Materials Intelligence Symposium*, (Sept. 10-12, 2003)
6. Krivit, Steven, data collected from ICCF-10 abstracts, http://www.newenergytimes.com/ICCF10/iccf10.htm
7. Miley, George, private communications, (Nov. 22, 2003)
8. De Ninno, Antonella, private communications, (Oct. 10, 2003)
9. Happer, William (as quoted by Taubes, Gary), *Bad Science: The Short Life and Weird Times of Cold Fusion*, (New York, Random House, June 15, 1993), p. 305
10. Bush, Robert, (in video by Mallove, Eugene), "Cold Fusion: Fire from Water," (1996)
11. Goodstein, David, "Whatever Happened to Cold Fusion?" *Accountability in Research, 2000. 8* (2002), p. 59
12. McKubre, Michael, "RADIO WEST," (by Douglas Fubbrezio), *KUER/PBS, a service of the University of Utah KUER*, (Nov. 27, 2002)
13. Mallove, Eugene, "MIT Special Report," *Infinite Energy, 1999 4(24)*, (1999), p. 64, also at www.infinite-energy.com
14. Lewis, Nathan, (in video by Mallove, Eugene), "Cold Fusion: Fire from Water," (1996)
15. Koonin, Steven, (as quoted by Charles Beaudette), *Excess Heat & Why Cold Fusion Research Prevailed, 2nd ed.*, South Bristol, Maine, Oak Grove Press, (2002), p. 79
16. *Ibid.*, p. 74
17. Huizenga, John R., *Cold Fusion, The Scientific Fiasco of the Century*, New York, Oxford University Press, (1993), p. 297
18. Ramsey, Norman, in the preamble to "Report of the Energy Research Advisory Board to the United States Department of Energy," *http://www.ncas.org/erab* (November 1989)
19. Passell, Thomas, private communications, (Jan. 6, 2004)
20. Storms, Edmund, private communications, (Nov. 4, 2003)
21. Melich, Michael, private communications, (Oct. 12, 2003)
22. Melich, M.E. and Hansen, W.N., "Back to the Future, The Fleischmann-Pons Effect in 1994," *Fourth International Conference on Cold Fusion, Lahaina, Maui: Electric Power Research Institute 3412 Hillview Ave., Palo Alto, CA 94304*, (1993)

23. Hansen, W.N. and Melich, M.E., "Pd/D Calorimetry - The Key to the F/P Effect and a Challenge to Science," *Fourth International Conference on Cold Fusion, Lahaina, Maui: Electric Power Research Institute 3412 Hillview Ave., Palo Alto, CA 94304,* (1993), and *Transactions of Fusion Technology, Vol. 26, Number 4T, Part 2*, (December 1994), p. 355
24. Melich, Michael, private communications, (Oct. 13, 2003), also "Reasonable doubt," (as quoted by Bennett Daviss), *New Scientist, Vol. 177, issue 2388,* (March 29, 2003*)*, p. 36
25. Huizenga, John R., *Cold Fusion, The Scientific Fiasco of the Century*, New York, Oxford University Press, (1993), p. 297
26. Melich, M.E. and Hansen, W.N., "Back to the Future, The Fleischmann-Pons Effect in 1994," *Fourth International Conference on Cold Fusion. Lahaina, Maui: Electric Power Research Institute 3412 Hillview Ave., Palo Alto, CA 94304*, (1993)
27. Miles, Melvin H. and Bush, Benjamin F., "Calorimetric Principles and Problems in Pd-D2O Electrolysis", *The Third International Conference on Cold Fusion, Nagoya, Japan, Universal Academy Press, Inc., Tokyo,* (1991), p. 113
28. Noninski, V.C. and Noninski, C.I., "Notes on Two Papers Claiming No Evidence for the Existence of Excess Energy During the Electrolysis of 0.1 M LiOD/D2O with Palladium Cathodes," *Fusion Technology, Vol. 23,* (July 1993), p. 474-76
29. Miles, M., et al., "Correlation of Excess Power and Helium Production During D2O and H2O Electrolysis Using Palladium Cathodes," *J. Electroanal. Chem., 346:* (1993), p. 99, also published*, Fusion Technol.,* Vol. 25, (1994), p. 478
30. Swartz, Mitchell, "Some Lessons From Optical Examination of the PFC Phase-II Calorimetric Curves," *Vol. 2, Proceedings: Fourth International Conference on Cold Fusion, sponsored by EPRI and the Office of Naval Research,* (1993)
31. Melich, Michael E. and Hansen, W.N., "Back to the Future, The Fleischmann-Pons Effect in 1994," *Fourth International Conference on Cold Fusion, Lahaina, Maui: Electric Power Research Institute 3412 Hillview Ave., Palo Alto, CA 94304*, (1993)
32. Miles, M., et al., "Calorimetric Principles and Problems in Measurements of Excess Power During Pd-D2O Electrolysis," *J. Phys. Chem., Vol. 98,* (1994), p. 1948
34. Noninski, V.C. and Noninski, C.I., "Notes on Two Papers Claiming No Evidence for the Existence of Excess Energy During the Electrolysis of 0.1 M LiOD/D2O with Palladium Cathodes," *Fusion Technology, Vol. 23,* (July 1993), p. 474-76
35. Miles, M., et al., "Calorimetric Principles and Problems in Measurements of Excess Power during Pd-D2O Electrolysis," *J. Phys. Chem., Vol. 98*, (1994), p. 1948
36. Mallove, Eugene, "MIT Special Report," *Infinite Energy, 4(24),* (1999), p. 64
37. Swartz, Mitchell, "Some Lessons from Optical Examination of the PFC Phase-II Calorimetric Curves" *Vol. 2, Proceedings: "Fourth International Conference on Cold Fusion," sponsored by EPRI and the Office of Naval Research,* (1993)
38. Mallove, Eugene, "MIT Special Report," *(Infinite Energy, 4(24),* (1999)
39. Storms, Edmund, private communications, (Jan. 1, 2004)
40. Hansen, W.N., "Report to the Utah State Fusion/Energy Council on the Analysis of Selected Pons Fleischmann Calorimetric Data," *Second Annual Conference on Cold Fusion, Como, Italy,* Societa Italiana di Fisica, Bologna, Italy, (1991)
41. Hansen, W.N., and Melich, M.E., "Pd/D Calorimetry - The Key to the F/P Effect and a Challenge to Science in Fourth International Conference on Cold Fusion," *Lahaina, Maui: Electric Power Research Institute 3412 Hillview Ave., Palo Alto, CA 94304, Transactions of Fusion Technology, Vol. 26, No. 4T, Part 2,* (December 1994), p. 355

42. Melich, M.E. and Hansen, W.N., "Back to the Future, The Fleischmann-Pons Effect in 1994," *Fourth International Conference on Cold Fusion, Lahaina, Maui: Electric Power Research Institute 3412 Hillview Ave., Palo Alto, CA 94304,* (1994)
43. Lautzenhiser, T., Phelps, D.W., Eisner, M., "Cold Fusion: Report on a Recent Amoco Experiment," *Amoco Production Co., Report T-90-E-02, 90081ART0082, March 19, 1990, Private Report, Note: Paper is listed in Abstracts of Fifth International Conference on Cold Fusion 9-13 April, 1995 - Monte Carlo, Monaco but full paper was never published in proceedings*, (1995)
44. DuFour, J., Foos, J., Millot, J.P., "Excess Energy in the System Palladium/Hydrogen Isotopes, Measurements of the Excess Energy per Atom Hydrogen," *Fifth International Conference on Cold Fusion 9-13 April, 1995 - Monte Carlo, Monaco,* (1995)
45. Eisner. M, private communications, (Feb. 14, 2004)
46. Garwin, Richard L., Lewis, Nathan, "*Private Report to Dr. Lee M. Hammarstrom SAF/SS, 4C-1052 Pentagon, D.C. regarding SRI Visit Oct. 19, 1993,"* (Dec. 23, 1993)
47. Bard, Alan J., Report to EPRI, "*Private Report: Comments on SRI RP-3170 Review Meeting 25-26 March 1991,"* (May 13, 1992)
48. McKubre, Michael, and Passell, Tom, private communications
49. McKubre, Michael, private communications, (Jan. 15, 2004)
50. *Ibid.*
51. Storms, Edmund, private communications, (Nov. 25, 2003)
52. Feshbach, Herman, (as quoted by Mallove, Eugene), "MIT Special Report,"*Infinite Energy, 1999. 4(24),* (1999)
53. Gratzer, Walter, *The Undergrowth of Science: Delusion, Self-Deception, and Human Frailty,* Oxford University Press, New York, N.Y. (2000)
54. Gratzer, Walter, private communications, (Nov. 10, 2003)
55. Gratzer, Walter, private communications, (Nov. 11, 2003)
56. Park, Robert, private communications, (Nov. 12, 2003)
57. Koonin, Steven, private communications, (Jan. 25, 2004)
58. Lewis, Nathan, private communications, (Jan. 26, 2004)
59. Happer, William, private communications, (Jan. 26, 2004)
60. Close, Frank, *Too Hot to Handle: The Race for Cold Fusion,* Princeton University Press, Princeton, New Jersey, (1991)
61. Close, Frank, private communications, (Dec. 16, 2003)
62. Williams, David, private communications, (Jan. 24, 2004)
63. Close, Frank, private communications, (Dec. 17, 2003)
64. Nagel, David, "ICCF-10 Public Talk," http://www.newenergytimes.com, (Aug. 25, 2003)
65. Wood, Lowell, private communications, (Nov. 2, 2003)
66. Nagel, David, private communications, (Jan. 14, 2004)
67. Nagel, David, private communications, (Jan. 31, 2004)
68. Krivit, Steven, "Cold Fusion Reproducibility," see Appendix, (2003)
69. Storms, Edmund, "Cold Fusion: An Objective Assessment," *http://edstorms.com/review8.htm*, (2001)
70. See refs. 85-91
71. Krivit, Steven, "Worldwide Cold Fusion Research Demographics," see Appendix, (2003)
72. Storms, Edmund, private communications, (Feb. 17, 2004)
73. Storms, Edmund, "Cold Fusion: An Objective Assessment," *http://edstorms.com/review8.html,* (2001)
74. Nagel, David, "ICCF-10 Public Talk," http://www.newenergytimes.com, (Aug. 25, 2003)

75. Letts, Dennis, private communications, (Dec. 13, 2003)
76. Mallove, Eugene, "Breaking Through, an Editorial," *Infinite Energy Magazine, No. 51,* (Sept. 2003), and Letts, Dennis, private communications, (Jan. 15, 2004)
77. Nagel, David, "ICCF-10 Public Talk," http://www.newenergytimes.com, (Aug. 25, 2003)
78. De Ninno, Antonella, private communications, (Oct. 9, 2003)
79. Krivit, Steven, "Cold Fusion Reproducibility," see Appendix, 2004
80. Del Guidice, Emilio, private communications, (Sept. 22, 2003)
81. Storms, Edmund, "Cold Fusion Revisited," http://www.edstorms.com/review5.html
82. Storms, Edmund, "Cold Fusion: An Objective Assessment," http://edstorms.com/review8.html, (2001), also "A Student's Guide to Cold Fusion," *http://www.lenr-canr.org/StudentsGuide.htm*
83. Nagel, David, "ICCF-10 Public Talk," http://www.newenergytimes.com, (Aug. 25, 2003) and private communications, (Dec. 13, 2003)
84. Nagel, David, "ICCF-10 Public Talk," http://www.newenergytimes.com, (Aug. 25, 2003)
85. Storms, Edmund, private communications, (Nov. 4, 2003), and Storms, Edmund, "Cold Fusion: An Objective Assessment," *http://edstorms.com/review8.html*, (2001)
86. Miles, M., "Correlation of Excess Enthalpy and Helium-4 Production: A Review," *Tenth International Conference on Cold Fusion, Cambridge, Mass.*, (2003)
87. Bush, Benjamin F., et al., "Helium Production during the Electrolysis of D2O in Cold Fusion Experiments," *J. Electroanal. Chem., 304,* (1991), p. 271
88. Bush, Benjamin, F., Lagowski, J. J., "Methods of Generating Excess Heat With the Pons and Fleischmann Effect: Rigorous and Cost-Effective Calorimetry, Nuclear Products Analysis of the Cathode and Helium Analysis," *The Seventh International Conference on Cold Fusion, Vancouver, Canada: ENECO, Inc., Salt Lake City, Utah,* (1998), p. 38
89. McKubre, M., et al., "The Emergence of a Coherent Explanation for Anomalies Observed in D/Pd and H/Pd System: Evidence for 4He and 3He Production," *8th International Conference on Cold Fusion. Lerici (La Spezia), Italy: Italian Physical Society, Bologna, Italy,* (2000)
90. De Ninno, Antonella, et al., "Experimental Evidence of 4He Production in a Cold Fusion Experiment," *ENEA - Unita Tecnico Scientfica Fusione Centro Ricerche Frascati, Roma,* (2002)
91. Gozzi, D., et al., "X-ray, Heat Excess and 4He in the D:Pd System," *Journal of Electroanalytical Chemistry 452,* (1998)
92. Del Guidice, Emilio, private communications, (Sept. 22, 2003)
93. Nagel, David, "ICCF-10 Public Talk", (Aug. 25, 2003)
94. *Ibid.*
95. Huizenga, John R., "Cold Fusion, The Scientific Fiasco of the Century," *New York, Oxford University Press,* (1993) p. 214
96. Begley, Sharon, "Cold Fusion Isn't Dead, It's Just Withering From Scientific Neglect," *The Wall Street Journal*, (Sept. 5, 2003)
97. Nagel, David, "ICCF-10 Public Talk", (Aug. 25, 2003)
98. Nagel, David, "ICCF-10 Public Talk", (Aug. 25, 2003), and private communications, (Dec. 13, 2003)
99. Beaudette, Charles, *Excess Heat & Why Cold Fusion Research Prevailed, 2nd ed.*, South Bristol, Maine, Oak Grove Press, (2002), p.87
100. Storms, Edmund, private communications, (Feb. 16, 2003)
101. Hagelstein, Peter, private communications, (Jan. 9, 2004)
102. McKubre, Michael, private communications, (Jan. 15, 2004)

103. Roth, J. Reece, private communications, (Nov. 8, 2003)
104. Chubb, Scott, private communications, (Feb. 25, 2004)
105. Miley, G.H., Shrestha, P., "Review of Transmutation Reactions in Solids," *Tenth International Conference on Cold Fusion, Cambridge, Mass,* (2003)
106. Miley, George M., "Progress in Thin Film LENR Research," *The Ninth International Conference on Cold Fusion. Beijing, China: Tsinghua University,* (2002)
107. Corey, James, "Energetic Materials: History of and Current Claims for Low Energy Nuclear Reactions," *2003 Energetic Materials Intelligence Symposium,* (Sept. 10-12, 2003), and Miley, George, private communications, (Feb. 18, 2004)
108. Nagel, David, "ICCF-10 Public Talk", (Aug. 25, 2003)
109. Miles, Melvin H., et al., "Anomalous Effects in Deuterated Systems, Final Report," *NAWCWPNS Technical Publication 8302, Research and Technology Division, Naval Air Warfare Center Weapons Division China Lake,* (Sept. 1996)
110. Nagel, David, ICCF-10 Public Talk," (Aug. 25, 2003)
111. Roth, J. Reece, private communications, (Nov. 8, 2003)
112. Nagel, David, ICCF-10 Public Talk," (Aug. 25, 2003)

Appendix A

Worldwide Cold Fusion Researcher Demographics

Number of Scientists Known to Be Studying
Cold Fusion, By Country and Setting
August 2003

COUNTRY	University Researchers	Military Researchers	Other Govt. Researchers	Private Researchers
Australia	1			1
China	14			
Denmark			1	
England				1
France				3
Israel				12
Italy	4		19	8
Japan	27			3
Korea	1			
Romania	1			
Russia	3		19	
Ukraine	1		3	
USA	21	11	3	21
Totals	**73**	**11**	**42**	**49**

LABORATORIES	U.S.	Non-U.S.
Universities	13	21
Military	3	
Other Government	3	16

Note: These numbers are conservative, since they include only scientists who attended the August 2003 10th International Conference on Cold Fusion.
Interest from the following U.S. government/military laboratories is also known:
LANL, NRL, SPAWAR, LLNL, SNL, BNL, ARL, NSWC, NPS, DRAPER
Interest from the following nations is also known:
Nigeria, Spain, India, Norway

Appendix B

Cold Fusion Reproducibility Survey

November 2003

Researcher's Country	Field of Degree Obtained	Years of Cold Fusion Research	Years of Hot Fusion Research	Estimated Number of Experiments Performed	Repro-ducibility Rate 5 Years Ago	Repro-ducibility Rate Past 12 Months	Do You Conclude That Nuclear Activity Is Occurring?
Italy	Chemical Engineering	na	yes	na	na	50	na
Russia	Condensed Matter Physics	18	na	1,000	na	60	Yes
Italy	Physics	14	16	300	40	75	Yes
United States	Mass Communications	13	no	6,000	25	75	Yes
United States	Physical Chemistry	14	no	200	10	80	Yes
United States	Metallurgy	14	no	3,000	50	90	Na
Japan	Nuclear Engineering	14	20	20	70	100	Yes
Romania	Atomic Physics	10	no	40	70	100	Yes
United States	Radiochemistry	14	no	700	50	100	Yes
Russia	Nuclear Rocket Engineering	13	2	3,500	na	100	Yes
TOTAL ESTIMATED EXPERIMENTS				**14,720**			
AVERAGE REPORTED REPRODUCIBILITY					**45%**	**83%**	

na = Not Available

Appendix C

Cold Fusion Branches

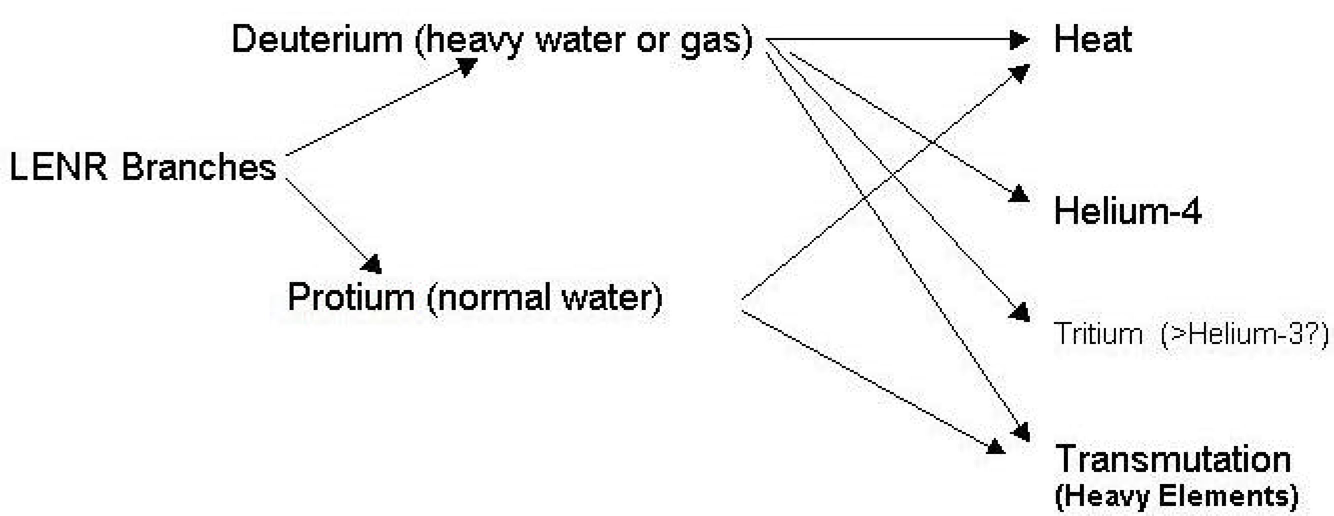
By Steven B. Krivit, New Energy Times, and James Corey, Sandia National Laboratory
Revised Feb. 23, 2004

As of August 2003, the primary results of the heavy water or deuterium gas experiments are understood to be excess heat, helium-4 and, occasionally, small amounts of tritium. Normal water experiments show excess heat and various nuclear transmutations, with mass numbers spanning across the periodic table. Deuterium gas experiments have been shown to yield primarily transmutations of heavy elements along with some tritium and helium. A variety of methods have been shown to demonstrate cold fusion effects.

Note 1: Several of the leading cold fusion scientists have expressed strong differences of opinion as to the magnitude of excess heat and veracity of transmutations in normal water. The polarization of the opinions vary, more or less, based on the individual's area of expertise.

Note 2: It would be fair to regard this diagram as a work in progress. This is a best attempt to offer a graphical perspective on this new and rapidly evolving science. Not all variations of cold fusion experiments are depicted. (See Ed Storms "Cold Fusion: An Objective Assessment" http://edstorms.com/review8.html for more information.)

Note 3: Tritium and helium-3 are seen on rare occasions. The presence of helium-3 may result from tritium decay.



Bibliography

Bard, Alan J., Report to EPRI, "*Private Report: Comments on SRI RP-3170 Review Meeting 25-26 March 1991,"* (May 13, 1992)

Beaudette, Charles, *Excess Heat & Why Cold Fusion Research Prevailed, 2nd ed.,* South Bristol, Maine, Oak Grove Press, (2002), p.87

Begley, Sharon, "Cold Fusion Isn't Dead, It's Just Withering From Scientific Neglect," *The Wall Street Journal*, (Sept. 5, 2003)

Bush, Benjamin F., et al., "Helium Production during the Electrolysis of D2O in Cold Fusion Experiments," *J. Electroanal. Chem., 304,* (1991), p. 271

Bush, Benjamin, F., Lagowski, J. J., "Methods of Generating Excess Heat With the Pons and Fleischmann Effect: Rigorous and Cost-Effective Calorimetry, Nuclear Products Analysis of the Cathode and Helium Analysis," *The Seventh International Conference on Cold Fusion, Vancouver, Canada: ENECO, Inc., Salt Lake City, Utah,* (1998), p. 38

Bush, Robert, (in video by Mallove, Eugene), "Cold Fusion: Fire from Water," (1996)

Corey, James, "Energetic Materials: History of and Current Claims for Low Energy Nuclear Reactions," *2003 Energetic Materials Intelligence Symposium,* (Sept. 10-12, 2003)

De Ninno, Antonella, et al., "Experimental Evidence of 4He Production in a Cold Fusion Experiment," *ENEA - Unita Tecnico Scientfica Fusione Centro Ricerche Frascati,* (2002)

DuFour, J., Foos, J., Millot, J.P., "Excess Energy in the System Palladium/Hydrogen Isotopes, Measurements of the Excess Energy per Atom Hydrogen," *Fifth International Conference on Cold Fusion 9-13 April, 1995 - Monte Carlo, Monaco,* (1995)

Feshbach, Herman, (as quoted by Mallove, Eugene), "MIT Special Report,"*Infinite Energy, 1999. 4(24),* (1999)

Garwin, Richard L., Lewis, Nathan, "*Private Report to Dr. Lee M. Hammarstrom SAF/SS, 4C-1052 Pentagon, D.C. regarding SRI Visit Oct. 19, 1993,"* (Dec. 23, 1993)

Goodstein, David, "Whatever Happened to Cold Fusion?" *Accountability in Research, 2000. 8* (2002), p. 59

Gordon, Frank E. from the forward to "A Decade of Research at Navy Laboratories Vol. 1," by Stan Szpak et al., *San Diego, CA., SPAWAR Systems Center*, (2002)

Gozzi, D., et al., "X-ray, Heat Excess and 4He in the D:Pd System," *Journal of Electroanalytical Chemistry 452,* (1998)

Hansen, W.N. and Melich, M.E., "Pd/D Calorimetry - The Key to the F/P Effect and a Challenge to Science," *Fourth International Conference on Cold Fusion, Lahaina, Maui: Electric Power Research Institute 3412 Hillview Ave., Palo Alto, CA 94304,* (1993), and *Transactions of Fusion Technology, Vol. 26, Number 4T, Part 2,* (December 1994), p. 355

Hansen, W.N., "Report to the Utah State Fusion/Energy Council on the Analysis of Selected Pons Fleischmann Calorimetric Data," *Second Annual Conference on Cold Fusion, Como, Italy,* Societa Italiana di Fisica, Bologna, Italy, (1991)

Happer, William (as quoted by Taubes, Gary), *Bad Science: The Short Life and Weird Times of Cold Fusion*, (New York, Random House, June 15, 1993), p. 305

Huizenga, John R., *Cold Fusion, The Scientific Fiasco of the Century*, New York, Oxford University Press, (1993), p. 297

Koonin, Steven, (as quoted by Charles Beaudette), *Excess Heat & Why Cold Fusion Research Prevailed, 2nd ed.*, South Bristol, Maine, Oak Grove Press, (2002), p. 79

Lautzenhiser, T., Phelps, D.W., Eisner, M., "Cold Fusion: Report on a Recent Amoco Experiment," *Amoco Production Co., Report T-90-E-02, 90081ART0082, March 19, 1990,*

Private Report, Note: Paper is listed in Abstracts of Fifth International Conference on Cold Fusion 9-13 April, 1995 - Monte Carlo, Monaco but full paper was never published in proceedings, (1995)
Lewis, Nathan, (in video by Mallove, Eugene), "Cold Fusion: Fire from Water," (1996)
Mallove, Eugene, "Breaking Through, an Editorial," *Infinite Energy, No. 51,* (Sept. 2003)
Mallove, Eugene, "MIT Special Report," *Infinite Energy, 1999 4(24),* (1999), p. 64, also at www.infinite-energy.com
McKubre, M., et al., "The Emergence of a Coherent Explanation for Anomalies Observed in D/Pd and H/Pd System: Evidence for 4He and 3He Production," *8th International Conference on Cold Fusion. Lerici (La Spezia), Italy: Italian Physical Society, Bologna, Italy,* (2000)
McKubre, Michael, "RADIO WEST," (by Douglas Fubbrezio), *KUER/PBS, a service of the University of Utah KUER,* (Nov. 27, 2002)
Melich, M.E., and Hansen, W.N., "Back to the Future, The Fleischmann-Pons Effect in 1994," *Fourth International Conference on Cold Fusion, Lahaina, Maui: Electric Power Research Institute 3412 Hillview Ave., Palo Alto, CA 94304,* (1993)
Melich, Michael, "Reasonable Doubt," (as quoted by Bennett Daviss), *New Scientist, Vol. 177 issue 2388,* (March 29, 2003), p. 36
Miles, Melvin H. and Bush, Benjamin F., "Calorimetric Principles and Problems in Pd-D2O Electrolysis", *The Third International Conference on Cold Fusion, Nagoya, Japan, Universal Academy Press Inc., Tokyo,* (1991), p. 113
Miles, M., et al., "Correlation of Excess Power and Helium Production during D2O and H2O Electrolysis Using Palladium Cathodes," *J. Electroanal. Chem., 346:* (1993), p. 99, also published, *Fusion Technol.,* Vol. 25, (1994), p. 478
Miles, M., "Correlation of Excess Enthalpy and Helium-4 Production: A Review," *Tenth International Conference on Cold Fusion, Cambridge, Mass.,* (2003)
Miles, Melvin H., et al., "Anomalous Effects in Deuterated Systems, Final Report," *NAWCWPNS Technical Publication 8302, Research and Technology Division, Naval Air Warfare Center Weapons Division China Lake,* (Sept. 1996)
Miles, M., et al., "Calorimetric Principles and Problems in Measurements of Excess Power During Pd-D2O Electrolysis," *J. Phys. Chem., Vol. 98,* (1994), p. 1948
Miley, G.H., Shrestha, P., "Review of Transmutation Reactions in Solids," *Tenth International Conference on Cold Fusion, Cambridge, Mass.,* (2003)
Miley, George M., "Progress in Thin Film LENR Research," *The Ninth International Conference on Cold Fusion. Beijing, China: Tsinghua University,* (2002)
Nagel, David, "ICCF-10 Public Talk," http://www.newenergytimes.com, (Aug. 25, 2003)
Noninski, V.C. and Noninski, C.I., "Notes on Two Papers Claiming No Evidence for the Existence of Excess Energy During the Electrolysis of 0.1 M LiOD/D2O with Palladium Cathodes," *Fusion Technology, Vol. 23,* (July 1993), p. 474-76
Swartz, Mitchell, "Some Lessons From Optical Examination of the PFC Phase-II Calorimetric Curves," *Vol. 2, Proceedings: Fourth International Conference on Cold Fusion, sponsored by EPRI and the Office of Naval Research,* (1993)
Storms, Edmund, "Cold Fusion: An Objective Assessment," *http://edstorms.com/review8.htm,* (2001)
Storms, Edmund, "Cold Fusion Revisited," http://www.edstorms.com/review5.html
Storms, Edmund, "A Student's Guide to Cold Fusion," *http://www.lenr-canr.org/StudentsGuide.htm*

About the Authors

Steven B. Krivit

Steven B. Krivit formed New Energy Times four years ago in anticipation of entering the field of alternative energy technologies, although he had no idea in what way he might contribute. He has been a computer networking expert for 15 years and has earned many technical certifications. In 1990 he was a founding member and served on the international board of directors of the Network Professional Association, a professional organization for computer network engineers. His background includes a 1988 bachelor of science degree in business administration and computer science from National University, as well as earlier study of industrial design at the University of Bridgeport, Conn., and the Art Center College of Design, Pasadana, Calif.

Nadine Winocur, Psy.D.

When not involved in new-energy projects, Nadine maintains a private psychotherapy practice in which she provides emotional healing to adults who have been traumatized or who are seeking personal growth. Nadine earned a doctor of psychology degree in 1995 from Pepperdine University. In 1985, she received a bachelor of arts degree in psychology from the University of Pennsylvania. Her doctoral dissertation examined the relationship between cult involvement and psychological distress in former cult members. From 1988 through 1991, she provided consultation to families with a cult-affiliated member, as well as community education regarding mind-control groups.

Nadine Winocur, Psy.D. and Steven B. Krivit
Authors of "The 2004 Cold Fusion Report"
(Photo by Steven Krivit)

About New Energy Times

New Energy Times is a company which brings to the general public original reporting on research in the field of leading-edge energy and power technologies. Its mission is to provide a forum which offers news and information about potential changes in energy technology. New Energy Times, whose current project is researching cold fusion, collects its data directly from researchers and from original scientific papers.

The New Energy Times team is led by Steven B. Krivit, researcher and reporter, and by Nadine Winocur, Psy.D., writer and editor. Both live and work in Los Angeles, Calif. Other researchers occasionally collaborate with the team on technical documents.

The New Energy Times staff is unaffiliated with any organization, entity or party which invests in new-energy technologies. The staff maintains strict independence from those about which it reports.