FUSION facts

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WELCOME INVENTORS CONFERENCE

***Fusion Facts* is pleased to welcome inventors of the world to Utah for the convention of the National Congress of Inventor Organizations and the International Federation of Inventors' Association.**

This special issue of *Fusion Facts* is our gift to each inventor at this special conference. The speech of our Editor-in-Chief is included, in full, in this issue beginning on page 2. **Inventors of the world, *Fusion Facts* pays tribute to you for making this a better world. Keep up the good work, this planet needs you more than ever.**

A. ZERO POINT ENERGY
An Introduction by Dr. Hal Puthoff

The possibility of extracting useful energy from vacuum zero-point fluctuations has been noted in the scientific literature, both by the author [1] and others [2,3]. The basic principle underlying this possibility is that modern quantum theory predicts (and experiment verifies) that, even in the absence of matter, each cubic centimeter of space contains an enormous amount of untapped electromagnetic energy known as the electromagnetic zero-point energy. (The meaning of the adjective zero-point is that such field activity exists even at a temperature of absolute zero where no thermal effects remain.) The amount of energy associated with this (usually unobserved) background is conservatively estimated to be on the order of nuclear energy densities or greater [4]. As shown by the author, the source of this energy can be traced to radiation from the fluctuating quantum motion of charged particles distributed throughout the universe [5].

Well-known physical consequences of the ubiquitous background zero-point energy include the perturbation of atomic spectral lines known as the Lamb shift [6] (for which discovery Lamb was awarded the Nobel prize), stabilization of atomic structure against radiative collapse [7], field mechanisms underlying the gravitational interaction [8], and the Casimir effect, a unique attractive quantum force between closely spaced metal plates, named for its discoverer [9]. For a semipopular overview of these and related phenomena see Ref. [10].

Of special interest with regard to extracting energy from the vacuum is the last-mentioned effect, the so-called Casimir effect. An elegant analysis by Milonni et al. at Los Alamos National Laboratory [11] shows that the Casimir force, which results in closely-spaced metal plates being pushed together by so-called "empty space", is due to radiation pressure from the background electromagnetic zero-point energy which has become unbalanced due to the presence of the plates. This attractive force is proportional to $1/D^4$, where D is the spacing between the plates, and becomes quite strong at spacings on the order

of 1000 Angstroms or less. The attractive force is sufficiently strong so that in certain technological applications such as the scanning tunnelling microscope, special precautions must be taken to prevent metal surfaces in close proximity from being drawn together. Therefore, this zero-point energy pressure is quite robust, and not merely of academic interest.

In a rudimentary form of application to energy extraction [2], the plates in a Casimir experiment are electrically charged with the same sign charge (for example, with electrons). This results in a so-called Coulomb repulsion force between the plates which is proportional to an inverse square law ($1/D^2$) or less, depending on the geometry. This repulsive force can, however, always be overcome by the stronger attractive Casimir force at small spacings between the plates. Hence, the overall charge distribution becomes concentrated as the plates come together. As a result, the zero-point energy that drives the Casimir effect is transformed into stored electrical energy as the charge distribution condenses. This energy can then be extracted by a variety of means. In [Ref.2], for example, it is shown how in principle the stored energy could be used to charge a battery. Although demonstrating **in principle** energy extraction from the vacuum, the specific embodiment envisioned in [Ref. 2] is admittedly impractical for significant, continuous energy generation.

An alternative candidate approach to obtaining energy from vacuum fluctuations might lie in the generation of cold, dense, charged plasma in which charge condensation occurs on the basis of a Casimir **pinch effect.** This approach could be dubbed a **"Casimir-fusion"** process. It would begin with an initial energy input to contract the plasma initially so as to overcome the Coulomb barrier to be followed, hopefully, by the Casimir force creating a condensation of the charged particles in the plasma. In principle, if the energy used to generate the appropriate plasma conditions is less than the energy that one could recover from the plasma, then the result would be the efficient tapping of zero-point vacuum energy. Laboratory experiments are underway to investigate this possibility.

If one wishes to speculate on whether the world's energy problems could be resolved on the basis of tapping the zero-point energy, the following comment by R. Podolny of Moscow is especially cogent, "It would be just as foolish to deny the feasibility of useful application as it would be irresponsible to guarantee such application."

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B. COLD FUSION FACTS

by Hal Fox, Editor-in-Chief

This presentation was made to the attendees of the convention of the National Congress of Inventor Organizations (NCIO) and the International Federation of Inventors' Association (IFIA) at the first such convention held in the United States. Presentation given at Sherwood Hills Resort, Wellsville, Utah, September 26, 1991.

As an **expert** in cold fusion, I would like to begin my presentation to this outstanding group of inventors by quoting from some previous experts. As **experienced inventors**, you will appreciate the following quotations more than any other group:

FAMOUS MEN & TECHNOLOGICAL FORECASTING

(Many of the following were published in Beam Defense, an Alternative to Nuclear Destruction, Scientific staff of the Fusion Energy Foundation, published by Aero Publishers, Inc., 1983. Used by permission.

1875 - INTERNAL COMBUSTION ENGINE

"Gasoline in the hands of people...would constitute a fire and explosive hazard of the first rank. ... The development of the new power may displace the use of horses, which would wreck our agriculture..."
Congressional Record of 1875.

1880 - ELECTRIC LIGHT

"...after a few more flashes in the pan, we shall hear very little more of Edison or his electric lamp. Every claim he makes has been tested and proved impracticable."
New York Times, January 16, 1880 quoting "noted electrician".

1895 - X-RAYS

Lord Kelvin, President of the Royal Society stated, "X-rays will prove to be a hoax." In addition Lord Kelvin declared some years later, "Radio has no future."

1902 - THE AIRPLANE

Professor Simon Newcomb (naval advisor on scientific matters) wrote, "Flight by machines heavier than air is unpractical and insignificant, if not utterly impossible."

Editorial: "We hope that Professor Langley will not put his substantial greatness as a scientist in further peril by continuing to waste his time, and the money involved, in further airship experiments." *New York Times*, December 10, 1903.

December 17, 1903. Wright brothers fly at Kittyhawk, N.C.

"...inventors of a North Carolina box kite machine want the government to purchase it." *New York Times*, December 26, 1903

1910 - TRANSATLANTIC FLIGHT.

"The popular mind often pictures gigantic flying machines speeding across the Atlantic carrying innumerable passengers in a way analogous to our modern steamships. . . it seems safe to say that such ideas are wholly visionary." Statement by American astronomer William Pickering.

1920 - SPACE TRAVEL

Editorial: "...Professor Goddard. . . does not know the relation of action to reaction, and of the need to have something better than a vacuum against which to react... Of course he only seems to lack the knowledge ladled out daily in our high schools. But there are such things as intentional mistakes..." *New York Times*, January 13, 1920.

1923 - NUCLEAR ENERGY

"There is no likelihood man can ever tap the power of the atom. The glib supposition of utilizing atomic energy when our coal has run out is a completely unscientific Utopian dream, a childish bug-a-boo. . . . elements . . . have no energy to give up in the process of disintegration." Robert Millikan, Nobel prize winner for 1923 (theoretical physicist).

1933 - STRATEGIC BOMBER

"The best protection is to build upon American tradition and not try to purchase freedom with gadgets." Secretary of War George Dean.

1937 - CYCLOTRON LIMITS

"...either the resonance or the focusing is destroyed by the relativistic change of mass irrespective of the special choice of the magnetic field. . . .Thus it appears that the cyclotron cannot be made to give much higher energies than those obtained thus far." Hans Bethe, *Physical Review,* 1937-38 series of papers. Similar comments made by Nobel prize winner James Chadwick in *Nature* in a 1938 article.

Bethe's limits were exceeded by five times by a design made by L.H. Thomas that was finally built in the 1950's. However, Bethe did get a Nobel prize.

1939 - AMERICAN PRODUCTION

President Roosevelt was urged not to try a crash program for aircraft production because, he was advised, it was so far beyond current production capacity that it would result in chaos. The advisor was U.S. Army Chief of Staff George C. Marshall.

In 1942 the U.S. produced more aircraft than Germany, Japan, and Britain combined (48,000). In 1943 the U.S. produced 86,000 planes. In 1944 the U.S. produced

96,000 planes and the bombs to be delivered (included the A-bomb).

1945 - ATOM BOMB

"...the biggest fool thing we've ever done. The atom bomb will never go off and I speak as an **expert** on explosions." Admiral William Leahy, naval aide to President Roosevelt.

1945 - ICBM

"These people...annoy me...talking about a 3,000 mile high-angle rocket shot from one continent to another, carrying an atomic bomb and so directed as to be a precise weapon which would land exactly on a certain target, such as a city. . . . I feel confident that it will not be done for a very long period of time to come. . . . I think we can leave that out of our thinking." Dr. Vannevar Bush, President of Carnegie Institute, Washington, D.C.

1950 - HOT FUSION ENERGY

"We cannot find in the development of the fusion bomb any such peacetime values as are inherent in the development of nuclear fission. . . . Thus when we discuss the 'hydrogen bomb' we are clearly speaking of a weapon, and a weapon only." Dr. Louis Ridenour, U.S. Air Force chief scientist, *Scientific American*, March 1950.

1956 - SPACE TRAVEL

"Space travel is utter bilge." Sir Richard Woolley, Astronomer Royal for Britain. The Soviets launched the Sputnik in 1957.

1991 - COLD FUSION

"That does not shield them from making errors. I would certainly bet only at long odds that there is any such thing as cold fusion." Dr. Robert K. Adair, nuclear physicist at Yale University, *Science News*, January 19, 1991.

January 1991. Drs. Liebert and Liaw receive "Fusion Scientists of the Year" award for their invention of a molten-salt fusion cell that produced as much as 16 times the input energy.

The foregoing quotes are from **experts**. Today, I have the privilege of addressing you as an **expert.** Therefore, I would suggest you consider the following claim: If an **expert** tells you something **can be done, he is probably correct**. If an **expert** tells you something **can't be done, he is probably wrong**.

Today, **as an expert**, I want to review with you the developments of cold fusion and, in addition, suggest that there are other technologies that also can produce excess energy (more energy produced than consumed) from unusual fuels. We shall call such devices, **Enhanced Energy Devices (EED).**

After Pons and Fleischmann submitted their paper [1] to the Journal of Electroanalytical Chemistry for review, the University of Utah called a press conference. At this press conference Pons and Fleischmann claimed to have discovered a relatively simple means by which excess energy can be provided by a lithium, deuterium (from electrolysis of heavy water), palladium system. The experimental arrangement appears simple but has proved to be very difficult to replicate. After over two years of effort, laboratories in 23 countries have reproduced one or more of the claims Pons and Fleischmann made for their cold fusion cells: excess heat, tritium, and neutrons.

A brief summary of the cold fusion successes follows:

Contrary to the findings in **hot-fusion experiments** (that neutron production is expected about half of the reactions, tritium is expected half of the time, and ^{4}He is observed about one in a million), in **cold fusion experiments**, the "branching ratio" highly favors tritium production over neutron production. Somehow the palladium lattice did not attend the correct hot-fusion classes. Several independent laboratories have found that the production of tritium is about 100 million times more likely than the production of neutrons from a deuterium-deuterium nuclear reaction within a palladium lattice [e.g. Ref. 2].

The problem has been that if one takes into account both the tritium production and the neutron production, less than ten percent of the observed excess heat is accounted for. Recently, Miles and others at the Naval China Lake, California facility have shown that ^{4}He is produced in a working cold fusion cell and is about the right amount to account for half (or more) of the excess energy [3].

How good is the best cold fusion electrochemical device? To date experimenters have reported a few percent to over 200 percent in excess heat. McKubre at SRI International has reported 250% but will do more thorough work before publishing the results. Pons and Fleischmann have reported some remarkably results in "bursts" of excess energy and are expected to provide some good news on their latest work using silver-palladium alloys. Eagleton and Bush (Cal Poly) [4] have reported about 30% excess heat over several weeks in a thin film of palladium plated onto silver. They calculate that they have achieved over 2 kilowatts of excess energy per cubic centimeter of palladium. From the papers we've read, that is a record for continuous (as contrasted with burst) excess heat production.

Liaw and Liebert [5] have achieved over 15 times as much energy out as in by using a clever invention in which an eutectic mixture of molten salts is used as the electrolyte.

They are having problems with the corrosive environment in (molten salts at about 400 °C.) However, their results, when repeatable, can form the basis for the commercialization of cold fusion. We count the molten salt approach as a second type of a cold fusion device (after the Pons-Fleischmann heavy water cell [1]).

A third type of cold fusion device consists of two large electrodes sealed in a low-pressure (a glow-discharge device) deuterium gas environment. Using about 600 volts d.c. over 150% excess heat has been generated as reported by Karabut [6] but the process also provides large numbers (a million per second) of neutrons. Those of you whose body is subject to neutron degradation should be careful with this device unless it is shielded.

THE BIGGEST PROBLEM

There is no longer a valid argument about the reality of cold fusion. Cold fusion, in the hands of expert experimenters produces, on occasion, definite evidence of nuclear reactions. Cold fusion is real. What are the problems? Currently, the following problems need testable solutions:

1. We do not understand the mechanism by which deuterium ions can be caused to overcome the Coulomb barrier (the force of repulsion between like electrical charges) and fuse. The theory needs to be improved and proven.

2. Very few experiments (or experimenters) are replicable. As in the early days of integrated circuits, where the yield varied widely, a closely similar experiment often fails to be a successful (excess heat produced) experiment. It took about ten years to isolate and understand all the problems with the yield of semiconductors, however, that experience is expected to reduce the development time for cold fusion.

3. The attack on cold fusion, its theory, its results, and (sometimes) on the scientists themselves by those **experts** who seem to feel threatened by cold fusion, by progress, or by electrochemists.

The **biggest political problem** is number 3. These unwarranted and, sometimes, malicious attacks, (especially from the "hot fusionists" in the U.S. and Europe) have temporarily damaged the public's perception of cold fusion.

The **biggest experimental or scientific problem** is number 2. However, great progress was reported at the second annual cold fusion conference held in Como, Italy (June 30-July 4, 1991). Specifically, it appears that the use of silver-palladium alloys for the cathode in a cold fusion electrochemical cell and/or the plating of the cathode with palladium black (finely divided palladium) greatly improves replication. During this next year, we expect that the cold fusion problems of replications will be solved.

Problem 1 will be resolved as more data is reported and the theorists have more experimental data on which to base their theories.

Problem 3 will not just go away. In the words of Max Planck, **"A new scientific truth does not triumph by convincing its opponents and making them see the light, but rather because its opponents eventually die, and a new generation grows up that is familiar with it."**

EXPERT PREDICTIONS

The following predictions are made:

1. The problems of replication will be solved and there will be progress made toward commercialization of cold fusion during this next year.

2. The emerging theories of cold fusion will coalesce into a few candidate theories and some excellent experiments will be designed to prove/disprove these theories. The final proven theory or theories will be surprising to almost everyone.

3. Excess heat over 300% on a steady-state basis will be achieved.

4. The U.S. Navy will lead the United States government agencies in supporting and developing cold fusion technology. The Department of Energy will be embarrassed.

5. New ways of creating nuclear reactions in solid-state lattices will be found.

6. The price of palladium will rise.

7. **Most important: Many inventors in many countries will participate in the development of new cold fusion-related inventions that will, collectively, help resolve the world's energy and energy-related environmental problems.**

THE ENERGY SOURCE FOR COLD FUSION

Deuterium is found in heavy water. Deuterium is a heavier version of hydrogen. One part in about 7,000 of ordinary water is heavy water and represents an enormous supply of fuel for cold fusion energy systems. The nuclear reaction: **d + d ---> ^{4}He + energy** is the most energetic nuclear reaction known to man. If this reaction proves to be the predominant source of energy in cold fusion, then we have plenty of fuel for millions of years. The

deuterium in one gallon of heavy water (which costs less than $1,000 to separate) will produce more energy than 100,000 gallons of fuel oil. Therefore, the **fuel costs** for cold fusion will be less than 5 cents a gallon! More important, there is strong evidence that a cold fusion energy system, **properly designed**, is environmentally benign - having little or no radioactive nuclear byproducts. There may be some tritium produced which decays by giving off an electron. In a closed cell, the tritium remains in the electrolyte. The tritium-laden electrolyte would be about as dangerous to handle as leaded gasoline -- so don't drink either one.

A NEW ENERGY FUEL?

There appears to be a new energy source hovering on the horizon. Quivering, awaiting for the ingenuity of the world's inventors to harness the available energy. That energy is the energy of the structure of space. Consider the following: Go to the remote vacuum of space, where the temperature is 0°Kelvin. There is no energy of matter and no thermal energy. All that is left is electromagnetic zero (cold) point energy (ZPE). Hydrogen atoms placed there would still have orbiting electrons (as would other matter at zero °K) because the electrons exchange energy with ZPE. This is the reason that the hydrogen atom does not lose energy and collapse into the hydrogen nucleus. The exchange of energy of the hydrogen electron with the energy of space keeps the hydrogen electron in its "ground state."

How energetic is ZPE or the structure of space? According to Dr. Hal Puthoff [7] each cubic centimeter of space has the energy equivalent of 10^{94} grams of matter. In other words if you could turn all of the energy of a cubic centimeter of space into usable energy you could supply the earth's energy needs for a few years!

Is the energy in the structure of space, ZPE, available to tap? On that question, scientists are divided into the following groups: 1. What is ZPE? 2. I don't understand ZPE. 3. ZPE exists but is not accessible. 4. A way will found to tap ZPE. 5. We propose a method to tap ZPE.

Groups 3, 4, and 5 together appear to account for a small fraction of the scientific community. Without speculating what the hot fusionists are going to do with this discovery, let me share with you the information from a recently issued patent [8].

Dr. Hal Puthoff developed a theoretical structure that indicated that a group of electrons could be compressed into a bead and the bead would be stable in spite of the Coulomb forces (the force that repels electrical charges of the same polarity). In my inventor's English, a summary of how this can happen is the following:

H.B.G. Casimir [9] first described the following experimental evidence for ZPE: Take two conducting plates that are highly polished and gradually bring them closer together. If there is an energetic structure of space, then the energy is likely to have a large variety of wavelengths. Wavelengths substantially longer than the distance between the two plates cannot fit between the plates and react to push the plates apart. As the plates move closer together more energy wavelengths are denied between the plates. At some close distance the forces acting on the exterior will drive the plates together. You have availed yourself of the ZPE to collapse the two plates. By the way, this Casimir force appears to be a fourth power force.

Electrons are repelled by the Coulomb force and is proportional to $1/d^2$ (a second power force). The speculation is that if I can energetically force a lot of electrons together until there is no room (in terms of distance between electrons for the Coulomb force, then the Casimir forces will hold the electrons together. Remember that the Casimir force is a fourth power force. Now that the method for making an electron bead is understood, how does an inventor make electron beads? Shoulders tells us how in his patent [8].

To create electron beads, the inventors used the concept that a sharply-pointed electrode tends to amplify the strength of the electrical field. They eventually found that in a vacuum they could use a needle-pointed electrode to create electron beads by pulsing the electrode with a negative pulse of the order of 500 to 2,000 volts. Such an electron bead consists of about 10^8 to 10^{10} electrons. If more electrical energy is used several beads are formed and as they travel through a vacuum, these beads appear to arrange themselves into a circle (necklace) of 8 to 10 beads aligned perpendicular to the line of travel.

Each electron bead is about one micron in diameter. A necklace of beads may be about 20 to 30 microns in diameter. The beads travel at about one tenth of the speed of light. The beads last long enough to traverse several feet in a vacuum tube or in a tube filled with low pressure gas (such as Xenon or mercury vapor). If the beads hit an anode, they may leave a small crater and dissipate their energy. Directed to a suitable target plate, the electron beads can be used to create X-rays.

Of considerable interest is that electron beads will travel through a small channel in an insulator. If the channel wiggles back and forth (like a snake's track) the bead will give off R.F. energy with a wavelength depending on the curves in the channel. In their travel, the electron beads appear to exchange electrons with the insulator (dielectric) and, apparently, regenerate as the beads move forward

toward an anode at ground potential (or at a more positive potential than the generating cathode).

Now for the most interesting part of Shoulders patent [8]. Under appropriate conditions, the electron bead can be launched through a quartz tube with a wire coil (similar to a traveling wave tube) and provide more energy out than is required to create the bead. The patent states, "In any event, energy is provided to the traveling wave output conductor, and the **ultimate source of this energy appears to be the zero-point radiation of the vacuum continuum."**

Inventors of the world, it is suggested that there is no greater need on earth than the development of non-polluting, inexpensive energy. I have been privileged to discuss with you two major recent scientific developments that appear to qualify for the production of inexpensive, non-polluting energy. You and your associates in many countries will be the creative forces that turn this potential into useful energy systems. The opportunity to build a less-polluted world is yours. In the future, as in the past, the world will be a better place because you lived and were creative. Thank you.

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[3] M.H. Miles, G.S. Ostrom, (Naval Weapons Center, China Lake) B.F. Bush, J.J. Lagowski, (Dept of Chem, U of Austin, Texas), "Heat and Helium Production in Cold Fusion Experiments", Proceedings of The Second Annual Conference on Cold Fusion, June 30-July 4, 1991, Como, Italy. See also *J. Electroanal Chem,* **304**, p 271, 1991.

[4] Robert D. Eagleton & Robert T. Bush (Phys Dept, Calif St Polytechnic U, Pomona, Calif), "Calorimetric Experiments Supporting the Transmission Resonance Model for Cold Fusion", *Fusion Technology*, Vol 20, No 2, pp 239-245, 8 figs, 3 refs, September 1991.

[5] Bor Yann Liaw, Peng-long Tao, Patrick Turner, Bruce E. Liebert (U. of Hawaii), "Elevated Temperature Excess Heat Production Using Molten Salt Electrochemical Techniques", *Special Symposium Proceedings - Cold Fusion,* World Hydrogen Energy Conference #8, p 49-60, July 23-24, 1990, Honolulu, Hawaii. [See also *Fusion Facts*, Vol 2 No 4, Oct 1990, pages 1-14 for a reprint and an extensive review of all references.]

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[7] Harold Puthoff, "Everything for nothing', *New Scientist,* pp 52-55, (28 July 1990). See also: "Where does the zero-point energy come from?', *New Scientist,* p 36, (2 December 1989) and "The energetic vacuum: implications for energy research", *Speculations in Science and Technology,* Vol 13, No 4, pp 247-257, (1990), 33 refs.

[8] Kenneth R. Shoulders, "Energy Conversion Using High Charge Density", U.S. Patent Number 5,018,180; Date of Patent: May 21, 1991, 42 claims, 38 drawing sheets.

[9] H.B.G. Casimir, *Proc. K. Ned. Akad. Wet.,* Vol 51, p 793.

C. NEWS FROM THE U.S.

CALIFORNIA - EXCESS HEAT

Robert D. Eagleton and Robert T. Bush, (California State Polytechnic University), "Calorimetric Experiments Supporting the Transmission Resonance Model for Cold Fusion", *Fusion Technology,* Vol 20, no 2, pp 239-245, 12 Fig, 3 Ref.

AUTHORS' ABSTRACTS

The experimental details of calorimetric experiments that provide support for the transmission resonance model (TRM) to explain cold fusion are presented. For the first time, a theoretical model provides a good fit to calorimetric data and permits an understanding of that data. After the first experiment in which excess power was achieved, the model was employed to guide further experiments. Not only does the TRM suggest which experimental parameters to hold fixed and which to vary, it also predicts significant nonlinear structure and guides the search for that structure. The following are described: calorimeter and cell designs, electrode preparation, electrode charging, and excess power measurements.

EDITOR'S COMMENTS

This important paper reports on experimental results which are consistent with a model for cold fusion. The paper is highly recommened. Those developing theories should certainly study these experimental results.

LOS ALAMOS NAT'L LAB - TRITIUM RELEASE

Edmund Storms and Carol Talcott-Storms (Los Alamos National Laboratory), "The Effect of Hydriding on the Physical Structure of Palladium and on the Release of Contained Tritium", *Fusion Technology*, Vol 20, no 2, 19 fig, 24 Ref.

AUTHORS' ABSTRACT

The behavior of tritium released from a contaminated palladium cathode is determined and compared with the pattern found in cells claimed to produce tritium by a cold fusion reaction. Void space is produced in palladium when it is subjected to hydrogen absorption and desorption cycles. This void space can produce channels through which hydrogen can be lost from the cathode, thereby reducing the hydrogen concentration. This effect is influenced, in part, by impurities, the shape of the electrode, the charging rate, the concentration of hydrogen achieved, and the length of time the maximum concentration is present.

NAVAL OCEAN SYSTEMS CENTER - CHARGING Pd RODS

S. Szpak and C.J. Gabriel (Naval Ocean Systems Center), J.J. Smith (Dept. of Energy), R.J. Novak (Office of Naval Research), "Electrochemical Charging of Pd Rods", *J. Electroanal. Chem.*, 309(1991), pp 273-292, 13 Fig, 26 Ref.

AUTHORS' ABSTRACT

A model describing the electrochemical charging of Pd rods is presented. The essential feature of this model is the coupling of the interfacial processes with the transport of interstitials in the electrode interior. It is shown that boundary conditions arise from the solution of equations governing the elementary adsorption-desorption and adsorption-absorption steps and the symmetry of the electrode. Effects of the choice of rate constants of the elementary steps and the charging current on the surface coverage, the electrode potential and the time required to complete electrode charging are examined.

NAVAL WEAPONS CENTER - He 4

B.B. Bush, J.J. Lagowski, Dept. of Chemistry, Univ. of Texas), M.H. Miles and G.S. Ostrom (Chemistry Division, Research Dept., Naval Weapons Center, CA), "Helium Production During the Electrolysis of D_2O in Cold Fusion Experiments", *J. Electroanal. Chem.*, Vol 34, pp 271-278, (1991).

AUTHORS' INTRODUCTION

Our interest in the "cold fusion" process was piqued by the apparent lack of systematic investigation into the composition of the gaseous products produced during the electrolysis of D_2O. A critical issue in determining whether or not the cold fusion process exists is the quality of the evidence concerning the composition of the gaseous products. The low intensity of neutrons has prompted proposals of other fusion processes such as d + d --> ^{4}He + gamma and p + d --> ^{3}He. Accordingly, we report the results of experiments designed to detect helium in the effluent gases from electrolysis reactions at palladium cathodes while rigorously excluding possible helium contamination from other sources. The calorimetric electrolysis experiments reported here were performed at China Lake, and the analysis designed to establish the composition of the effluent gases were performed in Austin.

NEW YORK - PROTECTING INVENTIONS

Gary Slutsker and David C.Churbuck, "Whose invention is it anyway?" *Forbes*, August 19, 1991, pp 114-118.

THE LEADIN: If Thomas Edison were around today, there's a good chance his inventions would get rejected by the U.S. patent system. Are we mistakenly stifling innovation?

PURDUE UNIV - CLUSTER IMPACT FUSION

Courtesy of Dr. Samuel Faile

Y.E. Kim (Purdue Univ.), M. Rabinowitz (EPRI), Y.K. Bae (SRI), G.S. Chulick and R.A. Rice (Purdue Univ.), "Cluster-impact Nuclear Fusion: Shock-wave Statistical Analysis", *Modern Physics Letters B,* Vol 5, nos 14 & 15 (1991), pp 941-959, 6 Fig, 25 Ref.

AUTHORS' ABSTRACTS

Cluster-impact nuclear fusion is analyzed via a shock-wave model. We show that shock waves can be generated by clusters. Energy loss mechanisms are considered, and the conditions, when they are not negligible, are determined. Our theoretical model indicates that shock-wave enhanced fusion temperatures are possible with molecular size clusters impacting upon hydrogen isotope targets, somewhat as envisioned by Winterberg and Harrison for macro-projectiles. Our theory explains and reproduces the yields from known target and cluster compositions, as a function of cluster size and energy. Predictions are made, and new tests proposed. We show that contaminants are an unlikely artifact in the experimental data.

TEXAS A&M - DEUTERIUM LOADING

Courtesy of Dr. Samuel Faile

Del R. Lawson, Michael J. Tierney, I.F. Cheng, Leon S. Van Dyke, M.W. Espenscheid and Charles R. Martin (Dept. of Chemistry, Texas A&M Univ.), "Use of a Coulometric Assay Technique to Study the Variables Affecting Deuterium Loading Levels within Palladium Electrodes", *Electrochimica Acta,* Vol 36, no 9, pp 1515-1522, 6 Fig, 37 Ref.

AUTHORS' ABSTRACT

We report in this paper measurements of hydrogen and deuterium loading stoichiometries in Pd electrodes. We accomplished these analyses using an electrochemical method developed for *in situ* determination of palladium deuteride stoichiometries. The electrochemical method quantifies the amount of deuterium incorporated into the metal lattice by collecting the charge released during the potential controlled discharge of deuterium loaded Pd electrodes. In addition, *ex situ* gravimetric analyses were used to confirm electrochemically measured D/Pd atom ratios. Gravimetric analyses were also used in cases where the diameter of the Pd electrode precluded the relatively slow diffusion-limited electrochemical discharge method. A variety of electrolytic factors were studied to determine what conditions, if any, promote the greatest absorption of deuterium into the Pd lattice. We observed loading values of 0.73+-0.02 deuterium atoms per Pd lattice atom under all the electrolytic conditions studied in LiOD and D_2SO_4 solutions. As found in previous studies, H/Pd values were approximately 10% higher than D/Pd values. These measurements of D/Pd stoichiometries indicate that interfacial parameters, current density, pD, charging time and surface purity have a negligible effect on the maximum deuterium concentration within Pd electrodes.

UTAH - CURRENT ISSUES

Courtesy of Dr. Steven E. Jones, BYU

Steven E. Jones, "Current Issues in Cold Fusion Research: Heat, Helium, Tritium, and Energetic Particles", (paper available from author 176 Eyring Science Center, BYU, Provo, UT 84602), 11 pages, 3 tables, 17 ref.

AUTHOR'S INTRODUCTION

In this paper, I consider four issues which currently confront the community studying cold fusion phenomena: 1. The possibility of nuclear-energy transfer to a metal lattice, perhaps an analogy to the Mossbauer effect; 2. Claim of commensurate heat and helium production by Miles et al.; 3. Evidence for tritium production without associated, commensurate secondary neutrons or gamma rays; and 4. The tenuous connection between excess heat and nuclear measurements.

EDITOR'S COMMENTS

Professor Jones addresses item 1 by citing Wong's Introductory Nuclear Physics and its discussion of virtual energy transfer. Jones then concludes with "The numbers simply do not work out by several orders of magnitude. I can find no quantum-mechanical arguments which would alter this conclusion."

On heat and helium, Jones lists several things that could have led to incorrect measurements and concludes, "I know of no other claims correlating heat and helium-4 quantitatively." On tritium production Jones suggests that many tritium readings had to be corrected and challenges the scientific community to provide data for tritium together with X-rays, gammas, and/or **14 MeV neutrons**. Jones fails to mention that researchers have reported tritium/neutron ratios of around one million to one.

In his discussion of excess heat, Jones points out that "It is terribly misleading to claim that a handful of nuclear products implies that the "excess heat" is due to fusion. One must be quantitative." All honest researchers would agree that more measurements are needed to demonstrate the relationship between excess heat and nuclear reactions. Dr. Harold Puthoff suggests that some of the excess heat may stem from processes (as yet undefined) that tap the zero-point energy. Perhaps in a manner that is similar to the electron bead. In that regard, *Fusion Facts* would like to suggest to Professor Jones that he considers the possible use of electron beads (micron-size collections of about 100 million electrons) as a substitute for muons in the possible production of "electron-bead catalyzed cold fusion". We should also like to congratulate Drs. Jones and Menlove on their successes in Japan in measuring neutrons at Kamioka.

WASHINGTON, D.C. - COMO REVIEW

Carol White (Science and Technology Editor), "Cold Fusion is a Revolution in Science", *Executive Intelligence Review*, Vol 18, no 31, pp 36-47.

AUTHOR'S ABSTRACT

This author attended the Second Annual Cold Fusion Conference held in the beautiful alpine setting of Como, Italy from June 20 through July 4, on behalf of *21st Century Science and Technology* magazine. Contrary to the deliberate disinformation campaign--led by the *New York Times, Nature* magazine, and the European Center for Nuclear Research (CERN)--which seeks to describe cold fusion as a dead issue, the conference established stunning

confirmation that cold fusion is indeed a nuclear phenomenon. My collaborators on coverage of the conference were Jonathan Tennenbaum, Director of the Fusion Energy Forum in Germany, and Evanthia Frangou and Giuseppe Filipponi of the independent Italian-language science journal *Ventunesimo Secolo.* It was the consensus of this team that the discovery of cold fusion is the most important scientific event of the latter half of this century. It is a unique experiment which calls into question all of existing quantum theory. For five days, 200 scientists met to consider a wide range of results confirming the reality of that process known as cold fusion. Cold fusion pioneers Martin Fleischmann and Stanley Pons were there to report on their newest, highly successful experiments. For the first time, using a palladium-silver alloy, they were able to guarantee the reliability of their experiment.

EDITOR'S SELECTED QUOTES

The following are direct selections from the article, used by permission:

"Any list of highlights of the meeting for me, would have to include the following: 'Boil-off results' achieved by Pons and Fleischmann, in which tremendously large amounts of heat were generated in a few hours time in a palladium cathode to boil off the electrolyte in the calorimeter. There were 11 successive events achieved of this type, so that reproducibility is essentially 100%. Moreover, this effect, which necessitates excess heat production on the megajoule levels, leaves no room for doubters." Carol White quoting Dr. Robert T. Bush of Cal Poly.

The most recent news reported from Japan, on June 19, was that neutrons were detected in the underground Kamiokande research neutrino-detection facility, verifying neutron emissions previously reported by Steven Jones. Jones' results were deprecated by the **experts** from *Nature,* who claimed that the neutrons could have come from cosmic radiation. Kamiokande's results were the second independent confirmation-- the first having come from Los Alamos.

Important results from the past year were also reported by A. Takahashi, from Osaka University. These were electrolysis experiments, and he used pulsed power in order to trigger excess neutron emissions. His team also reported finding tritium and helium, in increasing amounts as the duration of the experiment increased, so that they were getting 1.5 times more helium by the third month than at the beginning. They also got anomalous heat burst. They detected both helium-3 and helium-4, with a greater ratio of the former to the latter. This, again, is the kind of result which is more in line with traditional thermonuclear fusion than some of the other results.

For myself, the meticulous detail necessary to achieve positive results in this intricate experiment [to achieve excess heat] was also extremely impressive. This came out not only in the presentation by Pons, but was a theme repeated time and again by the speakers--particularly the electrochemists. These experiments are not simple, even though they actually can be done on top of a table. It is not surprising that they still cannot be repeated at will, and only 20-40% of most cold fusion experiments to date have proven successful.

Most recently, Fleischmann and Pons have used a palladium-silver alloy in order to increase the stability of the electrode, and they report virtually total repeatability: positive results in 10 out of 11 tests, with one ambiguous result. Rumors circulating at the conference that the "ambiguity" occurred because the experiment actually blew up, appeared to be corroborated by Fleischmann's comment about the difficulty in developing calorimeters capable of withstanding higher heats, with the design constraints of his experiment. He pointed out that there was no question that they got excess heat and a boil-off, but that they could not estimate how long the experiment could have continued had the electrolyte not boiled-off.

Pons turned the microphone over to Dr. Wilford Hansen, a physicist from Utah State University, who had been commissioned by the Fusion Energy Council of the State of Utah to conduct an independent study of unreleased data of Pons and Fleischmann. Reflecting on the witchhunt against cold fusion, which is continuing in the United States, he began with the comment: "Last January I was asked to do an independent study, an analysis, of some unreleased data of Pons and Fleischmann. My colleagues warned me not to do this--it was a no-win situation. Whatever that might be, I now have a report, and I have brought copies of that for Pons and Fleischmann to read. It is also being reviewed by some other people. I would like to tell you about it before the world grabs it and burns it, and me with it. But soon it will be out."

Hansen then proceeded to verify the statistical methods used by the team to determine the production of "excess" heat--as much as 100 times more than any which could be attributed to a known chemical reaction. He chose eight cells; two were controls, which used hydrogen and showed no excess heat. The rest were intended to be heat cells and used deuterium as an electrolyte. Of these, five of the six, in his words, "showed definite excess heat." He determined that the whole set of experiment was impressive: In one cell, 6,000 electron volts of power were generated per palladium atom--1,000 times beyond any effect known to chemistry. As a point of comparison, with only five electron volts, a palladium electrode will be heated to its boiling point and vaporize.

The generation of excess heat which Fleischman and Pons report appears to scale approximately quadratically with the current density, leading them to prefer thin, 1 millimeter diameter cathodes. When the diameter is increased to 8 mm, no excess power is generated. Furthermore, the current must exceed 100 milliamperes per square centimeter if the experiment is to succeed. An increase in average excess heat generated correlated to an increase in the current.

Dr. Fritz Will (NCFI) was particularly happy with the finding by the Naval Weapons Center of Helium-4, even though these are yet to be confirmed. He believes that these will break the stalemate in which it was otherwise impossible to refute critics who maintain that there may be a mechanism of mechanical or chemical energy storage at work that is consistently being overlooked by experimenters, particularly those who report energy excess in the amount of 10-20%. These critics speculate that a small error, for example a 10% error in calculation of the power might be accumulated over a period of a million seconds to create the appearance of a small but significant energy excess. So far only Fleischmann and Pons, the team at the University of Hawaii--in two experiments which they have been unable to repeat--and Robert Bush have reported a sufficiently high heat excess to obviate such an error factor. Many cold fusion researchers had predicted that this might be the explanation for the otherwise anomalous results. The amount of helium-4 produced is much more consistent with the excess heat. In fact, in Dr. Will's opinion, the discovery of helium-4, as reported by the NRL team (and by the spring 1991 issue of *21st Century Science & Technology),* is the single most important development reported at the conference.

The finding of tritium by Dr.Will [as reported in his paper] is no isolated occurrence: Tritium findings have been reported by the Bhabha Atomic Research Center (BARC) in Bombay, and by Storms and Talcott at Los Alamos, and particularly by Bockris at Texas A&M. However, in no case has the experiment been so precisely controlled as to put an end to the doubt that the tritium was somehow present at the inception or introduced extraneously while the experiment was in progress. Clearly then, a nuclear event is occurring in these cells. Dr. Will's work should have put to rest some of the skepticism about the reality of cold fusion which has been generated in honest members of the scientific community.

McKubre began by emphasizing, as had many before him, that the loading ratio, which is the number of deuterium to palladium atoms in the palladium lattice, must be close to one. In fact, during the discussion period, he admitted that SRI researchers **only get positive results when the loading ratio is above 0.9**. To understand how to achieve a high loading ratio, however, it is first necessary to determine what occurs at the interface between the palladium and the electrolyte medium. He was not apologetic about the fact that, despite making measurements, at SRI they do not find significant amounts of tritium or other nuclear products.

Another key feature to their design [McKubre's work] is that where they ran control cells they multiplexed them to a single multimeter. ... "When we are running light [water] experiments, experiments in series produce excess heat in one and not in the other. It is very hard to attribute that to an error in the multimeter. An error in the multimeter should show up in all the cells that we are running."
McKubre also emphasized that they needed to run a typical cell around 2,000 hours in order to have a successful experiment... his team's experiments are getting something like 250% excess energy, in terms of the electrical input, which is somewhat more than 45 megajoules per mole. Furthermore, they have never seen an energy deficit during an experiment. He raised the question: If the excess heat is the result of a mechanical malfunction of the heat calibration, why would there not be an equal number of deficits as energy excesses? His team has never observed excess energy in light-water experiments, although it is his estimation that they have yet to do a sufficient number of these to establish the point definitively.

His [McKubre's] conclusion: "We are unable to account for the excess temperature by any artifact that we have considered, and we are unable to account for it by any chemical or mechanical processes that we are aware of." In the discussion period, he also emphasized that he had achieved high repeatability. He asserted that this depended upon accurate control of the initial conditions--state of the electrodes, loading ratio,and control of the current.

Melvin Miles's group [Naval Weapons Center, China Lake] had expected to find helium-3; instead they were surprised to find helium-4. The finding, however, was in accord with several theories: It is otherwise difficult to account for both the small amounts of neutrons and tritium compared to heat generated in cold fusion experiments, and also for the fact that there is as much as a discrepancy of 10 million between the amount of tritium discovered, and to the amount of neutrons. This runs counter to the branching ratio observed in thermonuclear fusion, where it is equally probable for either helium-3 or tritium to be produced.

Miles announced during his presentation that he had just received a facsimile transmission from his collaborator Ben Bush; Ben reported that when he performed the experiment with a palladium cathode that had been blackened with palladium black, he achieved excess heat within about two hours. This would be seen as confirmation that cold fusion is a surface effect by Robert Bush, John Bockris, and Miles--although they were already

convinced that this would be the case. Robert Bush reported that he platinizes his electrodes. Others at the conference, such as Will and McKubre disagreed, and they contended that the best results come from a palladium rod which is shiny rather than coated.

As opposed to the physics community, Bockris [Texas A&M] points to the discrepancy between tritium and neutron detection as **proof** that the result--cold fusion--cannot be evaluated in terms of **thermo**nuclear fusion, and that it therefore represents a new type of nuclear reaction. He also points out that cold fusion has an advantage over thermonuclear fusion: It does not produce the same amount of charged particles, which would make containment of the radiation necessary. Since it is established that the excess heat is produced in these experiments, far in excess of any known chemical reaction, then this must be a nuclear event, whatever the problems with detecting tritium or neutrons.

V.A. Tsarev from the Soviet Union reported that the witchhunt against cold fusion by *Nature* magazine put a "freeze" on what had looked like a promising cold fusion program, which originally had 45 institutes [in the USSR] engaged in the work.

Both the Republic of China on Taiwan and the People's Republic on the mainland have ambitious cold fusion programs. They have favored gas-loading experiments, and interestingly, observe a bluish glow at the tip of the palladium cathode, which may be a signal for helium. This occurred at the Southwestern Institute of Nuclear Physics and Chemistry in China. According to Zing Zhong Li, who is from Tsinghua University in Beijing, they are seeing particles with energies greater than 5 MeV and, in some cases, charge numbers greater than 2. If it is borne out that there are emissions of particles with charges greater than 2, this would weigh the balance heavily in favor of those theorists like Mayer and Hagelstein, and Professor Yang of Hunan Normal University, who believe that what is occurring is a neutron transfer, not the fusion of two nuclei.

Dr. Heinz Gerischer of the Max Planck Institute, who recently retired as director of the Fritz Haber Institute, is perhaps the most eminent electrochemist living today. He was invited to speak as an unprejudiced observer. In fact, as he admitted in his address, he was invited as someone who had accepted the mainstream line that cold fusion was a dead letter. However, after reviewing the available material before the conference and then attending the sessions at Como, he changed his view. He would repeatedly resort to the image of confirmed religious **believers** to describe some of the conference participants; yet, turning his irony on himself, when it came to cold fusion, he described himself, humorously, as an agnostic. However, he echoed the **believers** when he expressed the conviction that the anomalies in the ratio of charged particles to the production of excess heat, is in fact, evidence of the occurrence of a new nuclear process. Echoing the thoughts of many at the conference, he said, "If these quantities are correct, if a revolution in the nuclear theory has to combine solid state theory with nuclear force, we have a fantastic new discovery."

D. NEWS FROM ABROAD

ENGLAND - FLEISCHMANN INTERVIEW

Courtesy of Marge Hecht, 21st Century Science and Technology.

Nigel Hawkes, "Blowing Hot on Cold", *The Times* (London), Aug 10, 1991.

AUTHOR'S LEADIN

Martin Fleischmann thought he had observed cold fusion, the key to endless cheap energy. But science derided his claims.

EDITOR'S REVIEW

Nigel Hawkes writes, "Today Fleischmann is a rueful survivor of that disaster. He is neither penitent about the claims he made, nor particularly bitter about the attacks on his reputation. While established science may have rejected his findings, he still believes them to be interesting and true. He is continuing to work, secretly, and believes that those who led the witch-hunt against them will one day be called to account." It is amazing how little an investigative reporter knows about the positive developments in cold fusion (such as the report below summarizing the Japanese efforts.)

This article is one of the first to tell the correct story about the University of Utah press conference held on March 23, 1989 in that the conference was not called by Pons and Fleischmann but by the University of Utah. Hawkes continues with a forthright description of the cold fusion technology as discovered by Pons and Fleischmann. Hawkes also quotes Dr. Edmund Storms of the Los Alamos National Laboratory (New Mexico) as saying, "If Pons and Fleischmann exaggerated, then the worst exaggeration they made is that this was a simple experiment."

Fleischmann is reported as having said that some other scientists had expected the cold fusion phenomena would disappear with experiments of greater sophistication and better equipment. However, such has not been the case, Fleischmann notes. Those of us who attended the Como conference in July can attest to that observation. The

better equipment and experiments have led to having the reality of cold fusion more firmly established.

Hawkes states, "The curious thing is that, despite the refutations that many highly respected laboratories have produced, research into cold fusion has not stopped. What has stopped is media interest in it." As an example, there was a great lack of media interest in the Como conference in that not one British nor U.S. journalist was present, Hawkes reports. [*Fusion Facts* and *21st Century Science and Technology* were there. Ed.]

Fleischman is quoted with the following wisdom, "My dictum is that a good piece of [experimental] work is 80 percent wrong and a bad piece is 90 percent wrong. If work was perfect when it was first produced, science would progress much faster." Hawkes notes that the unusual part about cold fusion was that the corrections were being debated in the international media rather than in the technical journals.

Hawkes reports a favorable summary of cold fusion as learned from Dr. Edmund Storms in which he lists numerous papers reporting strong positive results with cold fusion. The article ends with the following observation, "Cold fusion may well be a delusion, but it provokes enough questions to encourage independent people around the world to continue working on it quietly, in a low-key, low-profile way. They deserve respect, for it takes courage to work in a field that has been virtually anathematized by the majority of scientists. Fleischmann, at least, has no doubts that the work must go on, 'We are right. If you are right, you are right. What else can you do?'"

This relatively favorable article in The Times coupled with a highly favorable article published recently in a prestigious Japanese publication *Bungeishunju*, (see summary page 13) are expected to renew the public and media interest in cold fusion.

GERMANY - FUSION PROS & CONS

R.W. Kuhne (Germany), "Cold Fusion: Pros and Cons", *Physics Letters A*, Vol 155, No 8,9, pp 467-472, 99 Ref.

The observational data of several experiments which might have confirmed electrochemical fusion are discussed.

ITALY - TRITIUM

Guiliano Mengoli, Monica Fabrizio (Istituto di Polarografia ed Elettrochimica Preparativa del CNR), Claudio Manduchi, Giorgio Zannoni, Lucia Riccardi, Fiorella Veronesi (Dipartimento di Fisica "G. Galilei", Universita de Padova), Antonio Buffa (Istituto Gas Ionizzati del CNR). "Tritium Observation in the Electrolysis of D_2O at Palladium Sheet Cathodes",

AUTHORS' SUMMARY

Electrolysis experiments are presented in which we observed tritium production at palladium sheet cathodes. The ^3H content was determined by an high sensitivity spectrometer designed and assembled by the authors.

JAPAN - COLD FUSION IS A REALITY

Fujio Nakano, "The Reality of Cold Fusion can no Long be Denied", *Bungeishunju* (in Japanese), March 1991.

Translation by courtesy of Jed Rothwell, Atlanta, Georgia.

Translator's comments: The following article appeared in the September 1991 edition of the monthly magazine *Bungeishunju*, with the subheading, "What To Make Of These Realities: Excess Heat Production, 100% Reproducibility." The author published another, longer article about cold fusion in the March 1991 edition of this magazine, titled: "Nuclear Energy From Water." He is now writing a book about Cold Fusion.

The *Bungeishunju* (Literary Chronicle) is the largest, most prestigious monthly journal in Japan. One of the editors, Mr. Aoyama, says their circulation is over 700,000. The magazine is a general interest magazine somewhat like the New Yorker or Harper's. Like the New Yorker, it also regularly features articles about current events, politics, economics, and scientific issues.

Bungeishunju is respected by people across all the political spectrum. In terms of circulation and influence, it is roughly equivalent to the New Yorker, Time, Newsweek, and the New York Times Magazine all rolled into one. .....Jed Rothwell.

[The following is a summary of the translation with sections quoted in quotes. Ed.]

THE REALITY OF COLD FUSION CAN NO LONGER BE DENIED

"I am afraid that the group that opposes Cold Fusion thinks that word has the same connotation as **alchemy**. That point of view seems to have soaked into their very bones. If you tell them that Cold Fusion reactions exist, and the cells generate heat, the only way the opposition knows how to respond is to say, *it is too good to be true*. This group denies any possibility that cold fusion is real, and refuse to even look at results." The author correctly notes that this attitude is not limited to Japan.

"But all that is no longer open to discussion. Cold Fusion experiments and replication have left that level of doubt a long time ago, and entered a more concrete stage of development. Anyone who still says, *such nonsense, it can't be!* is simply not looking at the results."

WE GOT TRITIUM!

"As I wrote in my last article, Dr. Mizuno began his experiments in late March 1989, soon after the announcement of cold fusion was made in the U.S., at the University of Utah. After two and a half months, in June 1989, Mizuno became the first researcher in Japan to replicate the cold fusion experiment. At this time, the conclusive evidence that fusion was occurring was the detection of neutrons. Now, in 1991, Mizuno has detected tritium." Nakano relates that on February 22, 1991 Mizuno finished an experiment and took the cell for tritium measurements to the chemistry lab.

"A **cell** is a stainless steel flask that is the core of the cold fusion device. Now, from the term *nuclear fusion* you might imagine that a cell is a great big complicated device. Actually the cell is nothing more than a steel test tube, somewhat larger than a tea cup. The cell is kind of like a tin drinking cup, about eight centimeters in diameter, and twenty centimeters tall. The cell holds about 800 cc. ... the cell is a centimeter thick all around, so it is pretty heavy. The inside of the vessel is coated with teflon. You fill the vessel halfway with 400 cc of heavy water mixed with salts and other chemicals. ... The top of the device is also made of thick stainless steel. The cell has two electrodes built into it (one made of platinum and one of palladium) as well as a temperature sensor... You lower the electrodes and the sensor into the liquid, and then firmly bolt the top on, and then wrap the device all around with heating wires. This is the design of Mizuno's experimental device -- his cell."

Mizuno and his colleague Dr. Kazuhisa Yasuzumi from the chemistry department found tritium in the cell much above any normally explainable amount.

Nakano explains: "No matter how conservatively you measured it, Yasuzumi's data clearly showed an enormous increase in tritium. The results clearly showed that the experiment had evolved tritium to a level at least ten thousand times higher that it had been before the experiment."

THE U.S. - JAPAN JOINT EXPERIMENT UNDERGROUND AT KAMIOKA

After a tutorial explanation of how cold fusion could work and information about the famous Kamioka underground laboratory Nakano goes on to report: "A report appeared in the media that U.S. - Japan joint cold fusion research project was starting up in the underground Tokyo University Cosmic Ray Laboratory in Kamioka. Here is part of report that appeared on March 23, 1991, in the evening *Yomiuri* Newspaper (Tokyo edition):

Today, it has been exactly two years since cold fusion appeared on the scene, but it has still not been determined whether the theory is valid or not. In the later part of next month, a joint group of U.S. and Japanese researchers plan to test the theory in the Kamioka underground observatory located in Kamioka City, Gifu prefecture. They will use the gigantic water tank there.

The tank is located 1000 meters underground where it is not affected by cosmic radiation. This allows the scientists to perform the world's most accurate search for neutron radiation. If neutron radiation is found, it will prove that nuclear fusion is occurring. Because of this, the experiment is attracting worldwide attention. . ."

Nakano continues: "This joint U.S.-Japan experiment began on April 17, 1991; on the U.S. side were Dr. Steven Jones of Brigham Young University, and Dr. Menlove of Los Alamos National Labs; on the Japanese side the experiment was to be performed by a group lead by Dr. Youji Totsuka of the Cosmic Ray Laboratory" [Tokyo University].

Nakano explains about the famous Kamioka Underground Laboratory and about the importance of shielding an experiment from background radiation. Nakano then continues: "But, the Kamioka Underground Observatory is 1000 meters underground and the thick solid rock keeps almost all static [background neutron radiation] out. Even if a neutron should be lucky enough to get through the solid rock, it would probably be stopped by the enormous 1500-ton volume of water. A neutron would run into one of the hydrogen protons in the water. The effect would be like trying to flick a marble through a pile of other marbles the same size; no matter how hard you flick it, it would soon stop dead. A neutron manages to penetrate through the 1500 tons of water to strike the detectors in the center of the tank only once every 14,400 seconds on average; in other words, once in four hours. So, the device allows extremely accurate experiments and measurements."

Nakano reports: "Jones and Menlove performed their experiment with this fantastically accurate measuring device. But, they did not make much progress. On May 29, [1991] the Yomiuri Newspaper began a report:

Cold Fusion Proof Not Found. Several Months Needed To Analyze Data. Joint U.S. - Japan Underground Experiment At Gifu Prefecture, Kamioka.

Researchers from the U.S. and Japan performed experiments to verify that cold fusion exists. The experiments began on the 17th of last month in the underground pool observatory in Kamioka, Gifu. The joint experiments continued until the 22nd, but ended without clear proof that cold fusion reactions had occurred.

Nakano continues: "The article says 'data will take several months to analyze,' yet it declares that the experiment was a failure. It makes me wonder what they have in mind, since this was printed in the morning paper five days after the experiment ended - but I guess I will let that go. In any event, the first joint experiment at Kamioka misfired."

HEAT FOUND

Nakano reports new excitement: "Just before I wrote this article a very strange phenomenon occurred with Dr. Mizuno's device at Hokkaido U. MIzuno set up an experiment on March 20th [1991]. He ran electricity through the platinum to the palladium electrode for six hundred-fifty hours, up to April 22. Then he turned off the electricity and terminated the experiment for the time being. It was the same routine he had always followed. Then, three days later, on the morning of the 25th, he went to the basement laboratory. He reached out to touch the cell. He was astonished to find that it was extraordinarily hot. Far too hot to handle."

Nakano explains that usually the experiment ends when the current is turned off but that a heater keeps the cell and contents at 90 C. Now, however, the cell appears to be much hotter.

Nakano continues the story: "It was clear that the heat was originating from inside the cell, but there was no electricity flowing through the electrodes, so he did not know what could cause the heat, nor could he control the heat. If he left it as it was, there was nothing to stop it from becoming dangerously hot. He turned off the external cell heaters."

"The temperature in the basement is maintained at 20 degrees C year round. Up until now, whenever he turned off the heater, the cell would slowly cool down, until in about twenty minutes it would cool down enough to be handled with bare hands. But not this time. He waited an hour, then two hours, but it stayed far too hot to touch. Mizuno ran around the engineering labs, gathering towels. He wrapped the cell in a bundle of towels and carried it up to the third floor lab. He wrote a warning for everyone there, 'HIGH TEMPERATURE DO NOT TOUCH', put the cell in the corner of the lab, and waited for it to cool."

Nakano tells his readers that two days later during a long weekend the cell had cooled and Dr. Mizuno set about to find where all that heat came from. He examined the cell and then returned to the earlier experimental records.

Nakano reports: "Now, as he carefully examined the detailed record, he found very strange temperature changes were appearing. The experiment had run for 650 hours, when he turned off the electricity and terminated the reaction on April 22. Then, the temperature and pressure within the cell fell rapidly. At 655 hours, the temperature and pressure lines stabilized, and continued horizontally. Around hour 670, the temperature began to climb. It fluctuated only slightly, as it continued to increase. By hour 705 it reached a peak 15 degrees C above the 90 degrees C background temperature set by the heater. Moreover, the temperature declined only slightly over time, continuing until April 25, even after Mizuno removed everything from around the cell including the electric heater."

Nakano relates that during 55 hours the cell produced an average of 4 watts per hour or a total of 55,000 Joules. Reminding his readers that this excess heat is produced with the input electricity turn off Nakano states: "The fact is, the phenomenon occurred **after** the electricity going into the electrode was cut off, which makes it even more astonishing and inexplicable. At the time this happened, Mizuno was in a hurry to finish up a paper he was scheduled to deliver to the Nuclear Physics Society meeting. He only made a brief note at the end of the paper describing this latest discovery. He had encountered enough skepticism when he reported the observing of neutrons; hearing comments like 'that could not happen' and 'you must have made an experimental error' from many skeptics. If he was also going to claim he had observed **excess heat**, in a miraculous unnatural form after turning off the electricity, it was clear that he would be exposed to a flood of criticism."

"POSSIBLE PROOF" MAY HAVE BEEN THERE ALL ALONG

Nakano's article continues: "On July 19, as Mizuno was adding a final note to his report, a sensational headline appeared on the science page of the *Asahi Newspaper*: Neutrons Indicate Possible Experimental Verification of Cold Fusion. The data from the experiment performed from April 17th through the end of May by Jones and Menlove in the Kamioka Underground observatory had been analyzed. It now appeared that neutrons had been detected. Five days after the experiment the Yomiuri Newspaper had reported Cold Fusion Proof Not Found. Now the *Asahi* was reporting **Possible Verification**."

"The article reported that they checked for neutron emission every two thousandth of a second. In six cases more than two neutrons were observed; four was the greatest number counted. Because this experiment took place in an environment where one neutron enters every four hours (that is, every 14,400 minutes; because this is the most **static free** environment on earth), this is a wonderful result."

Nakano goes on to state that other parts of the *Asahi* newspaper article bothered him and cites the following quotation:

Dr. Jones said that is his view, the neutrons measured in this experiment, "were caused by cold fusion." However, Dr. Totsuka said that "we cannot assert this at the present stage."

Nakano ponders why the data from the Kamioka Observatory, the greatest in the world, would cause Dr. Totsuka to question the results. Nakano cites reluctance among Japanese scientists to accept evidence for cold fusion. "The President of Tokyo University was one of the early opponents of cold fusion. At the end of March 1989, the month P&F made their announcement, he stated, 'if cold fusion is as easy to make as they say, I will quit physics, shave my head, and become a Buddhist priest.' I do not suppose that anyone connected with the experiment has allowed those words to color their reporting, but I wonder how to explain their inclination to disclaim and disavow their own experimental results."

"The Kamioka experiment now being conducted by Jones, Menlove, and Tokyo University Cosmic Ray Institute professor is due to be repeated in July, and the final results reported this fall. I guess it will be fun to see the results, but I also feel kind of anxious. The reason is, I watched Jones prepare his experimental device on an NHK (National Television) broadcast, and to be honest, I was surprised at how slipshod the device looked, and how carelessly he was handling it. I have seen devices at Hokkaido U., Texas A&M, and I saw Jones set-up at BYU; to me, the device at Kamioka does not look like it is up to his own standards. Why didn't he bring one of his devices from Utah? I cannot go along with what is happening."

"What also bothers me is the way Jones handled the device. When I watched the Mizuno work at Hokkaido, and when I watched the experiment at Texas A&M, I saw that they handle the equipment carefully. They take pains never to touch the electrodes with bare hands, since sweat or oil from the skin can cause oxidation. Well, as far as I could see on television, when Jones was preparing the device he had his hands all over it. I wondered if it would work; and if the experiment failed because of his rough handling, I wondered if it wouldn't delight the anti-cold fusion gang. This may be none of my business, but it bothers me."

100 PERCENT REPRODUCIBILITY

After a lengthy discussion about Pons and Fleischmann and their relationship with the National Cold Fusion Institute, Nakano discusses the work reported at Como: "Early this summer, the Second Cold Fusion Conference was held in Como, Italy. Two hundred scientists came from around the world: America, Japan, the Soviet Union, China, and so on. There were 20 Japanese participants including Dr. Hideo Ikegami from the National Institute for Fusion Science in Nagoya. I waited for Dr. Ikegami to return, then sped to Nagoya to hear about the meeting. What he told me, and the material from the meeting that he showed me, left me utterly astonished."

Nakano digresses to point out that to verify cold fusion four problems must be resolved: 1. Detection of neutrons and tritium; 2. Measure excess heat; 3. Reproducibility; and 4. Clarify the connection between excess heat and nuclear reactions. Nakano correctly notes that the first problem was resolved long ago "beyond any argument". He also assures his readers that the evidence for excess heat was also "cleared up a long time ago, as report after report of excess heat measurements came in from researchers all around the world."

Nakano continues: "What amazed me was the progress that has been made in the third problem of replicability. Detailed data was presented at the Como meeting by workers who are able to replicate the phenomenon 100% of the time, at will. They can control the level fusion [reactions], heating water to the boiling point, or boiling it away, at will. furthermore, more than one group has achieved this level of control: P&F can, and so can an American group from the University of Utah." Nakano may have misinterpreted Fritz Will's report that they could produce tritium **every time** or at least in four out of the last four experiments that they performed in the closing days of the NCFI. *Fusion Facts* knows of no one at the University of Utah that is able to reproduce excess heat every time.

Nakano writes about Ikegami's report on the work at SRI, International and credits the excellent results of this group as follows: "Their excellent results [McKubre's group] reflect the difference in commitment between the SRI group, which is putting its full, undivided effort into the research, and the Japanese groups, which are performing 'weekend experiments' in their spare time."

Nakano continues: "Dr. Ikegami reports that McKubre says, 'For the first two long years after I undertook this research, I got no excess heat at all. I don't know how many times I thought about giving up. But, now at last I am getting 250% output heat. With this goal finally at hand, I feel keenly just how long and hard I have struggled.' Ikegami added: 'Of course cold fusion is a strange phenomenon. You have to keep changing the way you do the work, and the materials you use; you have to suffer terribly, until you finally get it right. If you could get cold fusion from a simple, ordinary experiment, somebody would have explicated it ages ago.'"

WHAT IS LEFT TO DO: FORMING A THEORY TO EXPLAIN COLD FUSION

Nakano continues: "As I wrote in my last article [March 1991], cold fusion appears to occur when deuterium nuclei are jammed into the crystalline structure of palladium. The research at Stanford's SRI, International indicates the key point to this phenomenon. The reaction begins when the amount of hydrogen reaches at least 90 percent of the atomic ratio of palladium. SRI has developed a method of ensuring that the ratio reaches the level of 90 percent or better, however the details of this method have not been released because of patent considerations. [It is rumored to be based on pre-selection of those cathodes that show proper evidence of deuterium gas uptake. Ed.] The point is, however, at the Como meeting SRI made it clear that they have conquered the third great problem of cold fusion - reproducibility."

Nakano comments on the reports in the Italian press of the Como conference, but only one brief report in the Japanese press based on an interview with a Japanese scientist who had not attended the meeting.

Nakano continues: "There is only one major unresolved issue left in cold fusion research: **the mechanism**. Scientists still have to explain the theoretical basis of this peculiar phenomenon. That means that cold fusion is in exactly the same stage of development as superconductivity; it does not have a theoretical basis yet. When superconductivity was still studied only under extremely cold conditions, it was thought to be understood in terms of what was known as the BCS theory. Then, as scientists found superconducting materials that worked under hotter and hotter conditions, the domain of that theory was exceeded, and it fell by the wayside. At this point, there is no commonly accepted superconductivity theory. One will have to be devised before experiments can be carried much further; without a theory, scientists have no idea what elements to include in their formulas, or what sort of tests to perform."

"Stop and consider this: have Japanese scientists ever really participated in the earliest stages of research? Do they know what it means to start from zero and grope through the darkness step by step to build a new theory? From the Meiji Restoration (1868), actually, even before that, from the Edo period, we have imported our science ready made from Europe and America, each piece with a complete, accepted theoretical basis already finished. As a result, we lightly dismiss all the difficulties inherent to building a theory from scratch, and all we look for in science is the decisive conclusion. When we are confronted with an incomplete unknown phenomenon, we have gotten into the habit of withdrawing and waiting for someone else to figure it out and issue a final conclusive theory. We seem to have developed a kind of contempt to the groping, early stages of scientific discovery; our attitude toward alchemy is a reflection of that contempt. To those who smugly claim that, 'Cold fusion is nothing but alchemy', I would ask, 'do you understand the historic significance of alchemy, do you realize what it produced?' The age when the professor can maintain his authority in a field simply by importing knowledge of it from the West and re-selling it to his students, is drawing to a close. In postwar Japan we think of *new science* as something you import from the West and immediately apply to practical, profitable enterprise. This way of thinking has come to a turning point."

Mr. Fujio Nakano concludes this challenge to Japan with the following: "Phenomena like cold fusion and high temperature superconductivity, that totally overthrow previously held principles, are rare in the history of science. Japan ought to put more value on this unique chance to participate in a brand new field of research starting from the ground floor. If we pursue this kind of research tenaciously, Japan will secure many invaluable treasures, both material and spiritual."

EDITOR'S COMMENTS

This lengthy hard-hitting and challenging article by Mr. Nakano is predicted to be only a beginning of a crusade. The article provides information that Japan, also, has problems among the fusion scientists in the acceptance of new science. *Fusion Facts* is pleased to have the opportunity to bring to our readers some insight into the impact that cold fusion has and is creating around the world. **It is hoped that there will emerge in America, a equivalent of Fujio Nakano who will bring the reality and the challenge of cold fusion to the attention of the American public.**

Jed Rothwell tells us that he had written to Dr. Ikegami to settle the question as to how much Japan is spending on cold fusion research. After complimenting Jed on his Japanese, Dr. Ikegami reported that about $5 million has been spent to conduct cold fusion research. None of this amount had to be spent on lab rent nor on wages as those items come from other budget sources. *Fusion Facts* wishes to express admiration and appreciation to Jed Rothwell whose interest in cold fusion has caused him to visit Japan, find new sources of information, translate these findings, and share with our readers. Thank you Jed! Jed can be reached at (404)451-9890 or by fax at (404)458-2404. [See Letter from Ikegami, FF Oct. 92.]

JAPAN - A REVIEW OF JAPANESE WORK
Courtesy of Dr. H. Ikegami
National Institute of Fusion Science

The following information was taken from briefing transparencies used by Dr. Ikegami in his presentation on **Cold Fusion in Japan** given at the Cold Fusion Conference held in Como, Italy, June 30 - July 4, 1991.

The following information about research institutions in Japan, their key research personnel, and projects is presented alphabetically by the name of the major institution listed. Comments are the editors based on the information from the available briefing charts.

HOKKAIDO UNIVERSITY
T. Mizuno, T. Akimoto, K. Azumi
1. Detection of neutron energy spectrum.
2. Tritium detection t/n > 10^4.
3. Excess heat 0.1MJ/cm^3 Pd.

COMMENTS: Tritium increase of about 50% was measured. Cell pressure was cycled three times over about 200 days from 1 to 12 atmospheres. The chart showing temperature and pressure indicates that the temperature of the cell dropped from about 150 C to about 75 C over the 200 day period with major drops occurring with pressure reduction. Apparently sufficient neutrons were measured to compute that the tritium to neutron ratio was about 10,000.

HOKKAIDO UNIVERSITY
T. Mizuno
1. Diffusion and density profile of hydrogen/deuterium during cathodic charging in zirconium.

IMRA JAPAN
K. Kunimatsu and his group members
1. Electrolysis with the use of gas permeation anode.
2. Observed 5-20% excess heat with sulfuric acid electrolyte D_2SO_4.

COMMENTS: According to the data the D/Pd ratio rose to about 60% in the first day of charging and then gradually rose to about 92% by the 15th day. This is an excellent illustration of how slowly an electrode may approach the condition in which fusion events could be expected.

NATIONAL INSTITUTE FOR FUSION SCIENCE
H. Ikegami, T.Tazima, K. Ishii
1. Large neutron bursts, which do not carry background neutrons.
2. Coincident detection by independent detectors within a dwell time.

COMMENTS: The charts indicate that large bursts of neutrons were found using deuterium gas-loading of palladium shavings. Data indicates that background was subtracted out so that only neutrons from the experiment are obtained.

NTT BASIC RESEARCH LAB
E. Yamaguchi, T. Nishioka
1. Oxide/Pd:D/Au samples.
2. Large neutron bursts associated with high heat.
3. Current triggered hydrogen bursts and excess heat.
4. Detection of protons (3MeV).

COMMENTS: Excess heat and bursts of neutrons occur during pulsed current injection into a palladium sample sandwiched between gold and oxide layers.

OSAKA UNIVERSITY
A. Takahashi, T. Iida, F. Maekawa, H. Sugimoto, S. Yoshida
1. Detected clear neutron energy spectrum.
2. Propose 3-body fusion reaction.
3. Tritium detection t/n > 10^5.

COMMENTS: Unequivocal neutron count with carefully measured energy spectrum was achieved. Tritium measurements show that tritium was produced about 100,000 times more often than neutrons.

OSAKA UNIVERSITY AND OKAYAMA UNIVERSITY
G. Adati, H. Sakaguchi (Osaka University) and K. Nagao (Okayama University)
1. Generation of excess Helium-3 was detected in deuterium absorbed/desorbed by LaNi ingot.

COMMENTS: Helium 3 is apparently produced when lanthanum-nickel alloy is exposed to deuterium gas in a Jones-Menlove type of gas-loading experiment.

TOKYO INSTITUTE OF TECHNOLOGY AND MUSASHI INSTITUTE OF TECHNOLOGY
M. Okamota, T. Sato, P. Kim, Y. Fujii (Tokyo Inst. of Technology) and O. Aizawa (Musashi Inst. of Technology)
1. Neutron bursts exceeding 3 times background were simultaneously detected by three counter channels.

COMMENTS: Measurements were made using a 50 x 50 x 0.2 mm Pd foil as the cathode in an electrochemical cell with heavy water and LiOD.

TOKYO INST OF TECHNOLOGY, TOKAI UNIV., & TOKYO NATIONAL COLLEGE OF TECHNOLOGY
H. Nunata, R. Takagi, I. Ohno (Tokyo Inst. Technology), K. Kawamura (Tokai University), and S. Haruyama (Tokyo Nat. College of Technology)
1. Detection of neutron energy spectrum.

COMMENTS: Neutrons above background were measured using a Pd rod.

TOKYO UNIVERSITY OF AGRICULTURE AND TECHNOLOGY
N. Oyama, T. Oosaka, O. Hatozaki, S. Yamamoto, S. Kasahara, Y. Kurasawa, T. Terashima
1. Open cell system with constant current electrolysis generated the excess heat up to 40%.
2. Neither neutrons nor tritium observed.

COMMENTS: In this three-day experiments negative results were obtained. Data in briefing charts do not indicate the D/Pd ratio achieved.

UNIVERSITY OF TOKYO
S. Ichimaru
1. Model of Cold Fusion in pressurized liquid metals.
2. Computer simulation.

UNIV OF TOKYO (INST FOR NUCLEAR STUDY); UNIV OF TOKYO (INST COSMIC RAY RESEARCH); TOKYO UNIV AGRICULTURE & TECHNOLOGY; & TOHOKU UNIV.
T. Shibata, M. Imamura, S. Shibata, Y. Uwamino, T. Ohkubo, S. Satoh (Inst. Nuclear Study, U. Tokyo), K. Yamakoshi (Inst. Cosmic Ray Research, U. Tokyo), N. Oyama, T. Ohsaka, N. Yamamoto, O. Hatozaki (Tokyo Univ. Agriculture and Technology), N. Niimura (Tohoku University)
1. High sensitivity, low background, neutron detection system.
2. No enhancement of neutrons, nor tritium generation.

COMMENTS: This rather extensive series of experiments with electrochemical cells did not achieve measured D/Pd ratios over 0.9. Experimental results were negative.

YOKOHAMA NATIONAL UNIVERSITY
K. Ohta and his group members.
1. Calorimetry with powerstat electrolysis detected no steady state, excess heat.
2. Small bursts of excess heat were detected during the electrolysis of heavy water, which were within an error limit.

COMMENTS: These experiments had small bursts of excess heat not considered to be sufficient to exceed error limits. The achieved D/Pd ratio was not reported in the available briefing charts.

EDITOR'S OVERALL COMMENTS

Most of the experimental work in Japan has verified Pons-Fleischmann's results. Dr. Ikegami reviewed the work of twelve different groups in Japan who have been working on cold fusion. Japan has had mixed results in that some groups, as in other countries, did not achieve measurable excess heat, neutrons, nor tritium. Thanks Dr. Ikegami for you balanced report on Japan's achievements.

JAPAN - PRESSURIZED LIQUID METALS

Courtesy of Dr. Samuel Faile

Setsuo Ichimaru (Department of Physics, University of Tokyo), "Cold Nuclear Fusion in Pressurized Liquid Metals", *Journal of he Physical Society of Japan,* Vol 60, no 5, pp 1437-1440.

AUTHOR'S ABSTRACT

Liquid metals pressurized to a few megabars and consisting of light nuclear species such as D-H and Li-H can sustain considerable reaction rates due to electron screening and by the strong internuclear screening potentials when the temperature is raised above the onset of fluidity in hydrogen. The nuclear fusion rates may reach a power production level on the order of kW/cm^3 at a temperature and a mass density of 600 K (550 K) and 3.9 g/cm^3 (6.8 g/cm^3) for D-H (Li-H). The detection of such a nuclear reaction at a density near 2-4 g/cm^3 will make a first laboratory demonstration for the reaction processes in supernova.

TURKEY - ALPHA PARTICLES

Courtesy of Prof. Attila Yildiz

Ozgen Birgülz (Dept. of Physics), Serdar Celebi, Ahmett Ozdural (Dept of Chemical Engineering), Kadir Pekmez, Attila Yildiz and Yuda Yurum (Dept. of Chemistry, all of Hacettepe University, Beytepe Campus, Ankara, Turkey), "Electrochemically Induced Fusion of Deuterium Using Surface Modified Palladium Electrodes",

AUTHOR'S ABSTRACT

Bursts of alpha-ray [sic particles?] emission accompanying sudden temperature rises were observed during the constant current electrolysis of heavy water containing LiOD electrolyte using the surface modified palladium cathodes following the charge-up of the cathode material with the electrolytically produced deuterium atoms. The Macroscopic and microscopic deformations of the cathode material were noticed at the end of electrolysis that could only be caused by extreme positive thermal changes. The results were compared with blank experiments using H_2O in which no such changes occurred.

U.S.S.R. - Pd GIANT CLUSTER

Courtesy of Dr. Samuel Faile

D.I. Kochubey, V.P. Babenko (Institute of Catalysis, Siberian Branch of the U.S.S.R. Academy of Sciences), M.N. Vargaftik and I.I. Moiseev (N.S. Kurnakov Institute of General and Inorganic Chemistry, the U.S.S.R. Academy of Sciences), "Enrichment of Deuterium with

Tritium in the Presence of a Palladium-561 Giant Cluster", *Journal of Molecular Catalysis,* 66 (1991), pp 99-104, 3 Fig., 8 Ref.

AUTHORS' ABSTRACT

In experiments where a palladium giant cluster of $Pd_{561}Phen_{60}(OAc)_{180}$ idealized formula was contracted with gaseous deuterium at room temperature and atmospheric pressure, the content of tritium in deuterium was increased. Among various origins of the effect observed, deuteron-deuteron cold fusion is considered.

U.S.S.R. - FUSION IN H COMPOSITIONS

Igor L. Beltyukov, NIkolay B. Bondarenko, Arsen A. Janelidze, Mikhail Yu. Gapanov, Konstantin G. Gribanov, Stanislav V. Kondratov, Aleksey G. Maltsev, Peter I. Novikov, Sergey A. Tsvetkov, and Vyacheslav I. Zakharov (Scientific Cooperation SORUS, USSR), "Laser-Induced Cold Nuclear Fusion in Ti-H_2-D_2-T_2 Compositions", *Fusion Technology,* Vol 20, No. 2, pp 234-238, 18 Ref.

AUTHORS' ABSTRACT

A laser-induced cold fusion reaction has been obtained in Ti-H_2-D_2-T_2 systems. Correlations are found among gamma-ray pulses, neutron emission pulses, and phase transitions in the Ti-D_2 system. No thermal effect is observed. Gamma-ray fluxes of about 5×10^3 gamma/s and neutron emission of approx. 2×10^2n/s in pulses of less than 0.5 s have been obtained. The possibility of laser generation of gamma rays in the cold fusion reaction is discussed, as are aspects of laser-induced phase transitions in metal-gas systems.

E. SHORT ARTICLES FROM AUTHORS

Anomalous Charging Times for Electrolytic Cold Fusion and the Transmission Resonance Model (TRM)

By Dr. Robert T. Bush, Physics Dept., California State Polytechnic Univ., Pomona, California.

Why are "charging" times ("loading" times) for electrolytic cold fusion often on the order of days and weeks, when diffusion times for deuterons suggest that they should be hours, or minutes, at most. For Example, for the most successful thin film cell that my colleague (Dr. Robert Eagleton) and I have run so far at Cal Poly, Pomona, which employed a cathode consisting of a layer of palladium five microns thick electroplated on a silver substrate, the charging time should have been seconds at most. In fact, the cell did not exhibit excess power until about three weeks after the beginning of charging. The explanation of this apparent incongruity appears to be one of the striking successes of the Transmission Resonance Model (TRM), which I set forth in an article appearing in the March 1991 issue of *Fusion Technology* [1].

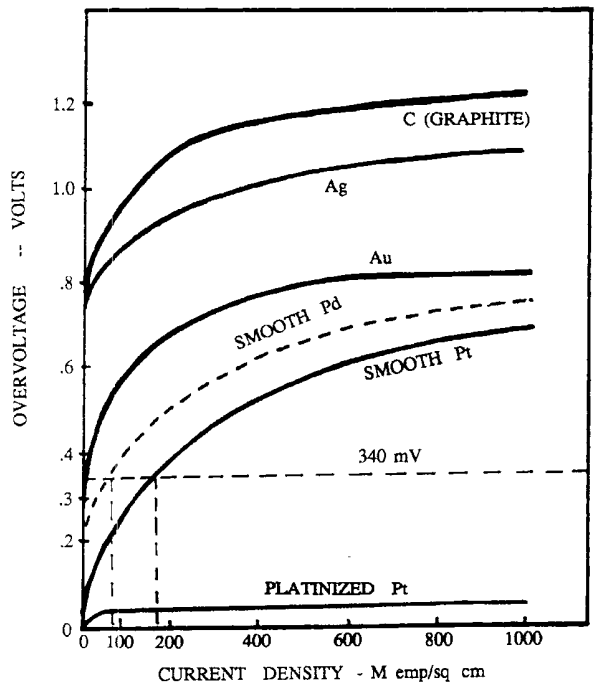
The TRM explains delayed charging times in terms of the relation of current density to hydrogen overvoltage (activation overpotential). It is best understood with relation to the figure below (modified from figure 9 in [1] by addition of dashed lines). I am grateful to D. Hutchinson of the Oak Ridge National Laboratory for the original figure 9 of my paper [1]. However, a mistake in my portrayal of it testifies to my background as a physicist rather than as an electrochemist: In that figure's caption I mistakenly referred to the hydrogen overvoltage as a "concentration overpotential: as contrasted to an "activation overpotential". I am grateful to E. Pye of the Cal Poly Chemistry Department for calling this to my attention.)

The curves in the figure below show the relation of hydrogen overvoltage to current density for different metal surfaces, such as "smooth Pt (platinum)", "platinized Pt", and "smooth Pd (palladium). This latter curve I have extrapolated (dashed line) between those for smooth Pt and Au. The TRM predicts specific energies (actually narrow energy "windows", because of the thermal vibrations of the lattice, which are centered on specific energies) associated with the resonant transmission of deuterons through the PdD_X lattice.

Empirically we have found that the highest useable state is at about 340 meV corresponding to the n=16 order of transmission resonance. Higher states with n=17, 18, 19, etc. have progressively shorter de Broglie wavelengths for which the transmission resonance condition "washes out" by virtue of thermal vibrations. So, if the overvoltage shifts the Maxwell-Boltzmann distribution of diffusons at the surface by an amount greater than 340 meV as hypothesized by the TRM, there are few candidates for the transmission resonance process and, thus, no chance of observing excess power. Thus, in the figure we are limited in terms of useful overvoltages (for observing excess power) to that region below the horizontal dashed line. However, empirically we also know that excess powers can only be observed for current densities of about 75 mA/cm^2 and greater, which limits us also to the region of the figure to the right of the leftmost vertical dashed line. Note then that the region for observing excess power defined by these two lines essentially excludes the curve for smooth palladium. The startling result is that, under ordinary conditions in electrolytic cold fusion, the TRM predicts that no excess power will be observed for cathodes which have shiny (smooth) palladium surfaces!

How do we get around this obstacle, since most of us start our experiments with shiny palladium cathode

surfaces? Note from the figure and the arguments above that, if we had smooth platinum at the surface of the cathode, the relatively small portion of the smooth platinum curve lying between the two vertical dashed lines would be useable for the purpose of observing excess power. Better yet, if we could somehow employ the curve for platinized platinum (platinum black), then most of the curve would be useable. In our experiments at Cal Poly, as in most experiments of other scientists, we employ a platinum anode. So platinum in the form of platinum "black" is deposited on the cathode ("platinized" palladium) resulting in a successful experiment in about eighty percent of our attempts. Thus, the anomalous "charging", or "loading", times may be explained on the



Hydrogen Overvoltage on Various Metals (2 N H_2SO_4 at 25 Degrees C)

basis of the TRM as corresponding to the time period required to condition the cathode surface so that the useful region of the overvoltage-vs-current density curve is brought into play.

Is there any independent corroboration of this predicted result that would tend to support the TRM? At the Como conference, Dr. S. Szpak (Naval Ocean Systems Center, San Diego, CA) and M. Miles and B. Bush -no relation- (Naval Weapons Center, China Lake, CA) both independently announced the ability to induce the onset of an electrolytic cold fusion reaction within a few hours, at most, of the beginning of the loading process by adding palladium chloride ($PdCl_2$) to the electrolytic solution. Szpak claimed an almost immediate tritium reaction, while Miles and Bush claimed several hours, at most, between $PdCl_2$ addition and the advent of excess heat observation.

Adding $PdCl_2$ to the electrolyte results in the deposition of a thin layer of palladium black on the surface of the palladium cathode. Note that although I did not include the curve for palladium black in the figure, it would lie a little above the curve for platinum black (labeled platinized Pt). These experimental successes anticipated an experiment of the author and his colleague, Dr. Eagleton, that had been suggested to us by Dr. Ed Storms, a Senior Scientist at the Los Alamos National Laboratory in May of 1991.

These demonstrations of the link between time delay in observing a nuclear reaction and surface conditioning provide a dramatic verification of my prediction employing the TRM given on page 328 of my paper [1]. The use of palladium chloride could be revolutionary in cold fusion. Researchers might now be permitted to do experiments with a charging time commensurate with the actual, and relatively short time to get an adequate number of deuterons into the cathode. This result could do wonders for reproducibility. Reproducibility might, in turn, do wonders for the acceptance of cold fusion by the general scientific community.

EDITOR'S COMMENTS

There may be conditions in which it is not desirable to add $PdCl_2$ to the electrolyte of the cold fusion cell. The alternative is to pre-process (electroplate) the palladium cathode using a plating bath with $PdCl^2$ in the plating solution. We share Dr. Bush's enthusiasm for the potential future application of this treatment of the palladium cathode. In addition, we are interested in the results that our reader's may achieve by using the palladium-silver alloy that was reported at the Como conference and reported in July's issue of *Fusion Facts. Fusion Facts* would welcome any report or article about the results of using the palladium-silver alloy.

REFERENCE

[1] Dr. R.T. Bush (Cal State Polytech, Pomona), "Cold Fusion: The Transmission Resonance Model Fits Data on Excess Heat, Predicts Optimal Trigger Points, and Suggests Nuclear Reaction Scenarios.", *Fusion Technology*, Vol 19, No 2, pp 313-356 84 ref, 25 fig.

ESTABLISHMENT OF ADEQUATE DISCLOSURE REQUIREMENTS FOR PATENT APPLICATIONS IN THE COLD FUSION ART

By Stephen A. Roen, Patent Attorney

Inventors filing patent applications in the cold fusion art may face unusual problems in the Patent Office. This is because of the **replication** problem in duplicating their experimental results. The U.S. Patent Office requires that the disclosure contained in the patent application be complete, that is it must contain such description and details to enable any person skilled in the art or science to which the invention pertains to make and use the invention as of its filing date. This is referred to as the **enablement** requirement. Furthermore, the Patent Office requires that the disclosure must adequately describe the claimed invention so as to enable the artisan to practice it without **undue experimentation**. The courts have made clear that the issue was whether the experimentation was undue or unreasonable under the circumstances and having regard to the subject matter. They have also said that the specification is defective if the experimentation requires more than the skill of the art (i.e. invention) or requires an inordinate amount of experimentation to practice the invention.

It is also said that an inventor need not, however, explain every detail since he is speaking to those skilled in the art. What is conventional knowledge will be read into the disclosure. Thus the amount of detail varies greatly depending on the art to which the invention pertains.

The Patent Office has provided eight guidelines for determing the **undueness** of the experimentation required to practice a patented invention:

* The quantity of experimentation necessary in the application;
* The amount of direction or guidance presented in the application;
* The presence or absence of working examples;
* The nature of the invention;
* The state of the prior art;
* The relative skill of those in the art (the level of skill in the art of cold fusion is quite high);
* The predictability or unpredictably of the art (the less predictability the more detail required in the disclosure); and
* The breadth of the claims.

When the Patent Office seeks to reject patent claims as non-enabled, it has the burden of stating specific reasons for doubting that the claimed invention can be practiced without resort to undue experimentaton. If a prima facie case of non-enablement is established by the Patent Office then the burden shifts to the inventor to show that one skilled in the art can practice the invention, from the teaching provided in the specification (and the conventional knowledge known to one skilled in the arts as of the time the application was filed), without undue experimentation.

One way to establish that an invention is adequately disclosed is to provide several experts in the cold fusion art with a copy of the patent application **before** it is filed and request that they **replicate** the disclosed invention based on the disclosure contained therein. Having several experts attempt to replicate the disclosed invention **before** the application is filed would permit changes (i.e. additional critical parameters) thereto **if** the experts are unable to replicate the disclosed invention. By going through this process before the application is filed there would be opportunities to determine if, in fact, the invention was adequately disclosed. If experts were unable to replicate the invention, changes to the application could be made which would result in an adequately disclosed invention. To maintain the information contained in the patent application, the inventor can ask his associates (skilled in the art) to sign a standard **confidentiality** agreement.

Therefore, proof that independent experts could replicate the particular invention in the cold fusion art, preferably **before the date** that the application was filed could be quite useful in establishing that the invention met the **enablement** requirement for a patent application. If there are some doubts that a technology is not valid, then when the applicaton arrives in the Patent Office it would be subject to extraordinary scrutiny. Accordingly, any terms relating to an unaccepted technology should be avoided until there is generl scientific proof that fusion actually occurs and that this proof is accepted by the scientific community.

EDITOR'S COMMENTS

This contribution by Steven Roen is timely. Some of our scientist/inventor friends have reported that the Patent Office is challenging their inventions by citing MIT and the New York Times as saying cold fusion is not a scientific reality. This places a burden upon the inventor who must now **prove to the patent examiner** that cold fusion is real. It was all the more surprising to *Fusion Facts* to find that a patent had been issued to Kenneth Shoulders wherein it is stated that the energy obtained is believed to come from the energy of the vacuum continuum. See July issue of *Fusion Facts*, page 30.

F. LETTERS TO THE EDITOR

VERIFICATION AND VALIDATION SERVICE From Dr. Harold E. Puthoff, Director of Research, Institute for Advanced Studies, Austin, Texas.

The Institute for Advanced Studies at Austin, in cooperation with Zeus Technologies, Inc., both of Austin Texas have established a **Center for Energy Research** for the evaluation of devices/technologies involving claims of energy conversion/generation from such non-conventional sources as vacuum zero-point energy [and cold fusion].

In general, the programs of the center are envisioned to fill a niche presently unoccupied; namely, to provide to the investment community an opportunity for high-quality, independent **Verification and Validation (V&V)** examination of devices under consideration for investment, and, to the inventor, an opportunity for an open-minded, yet rigorous evaluation of a device or process by physicists and engineers sophisticated in forefront technological development. Provided sufficient funding can be obtained from the investment community, the latter service might be provided to the inventor at little or no cost. When appropriate, the Center also stands ready to provide additional expertise with regard to further engineering development of an invention into a practical commercial product. Finally, through its contacts with the National Institute of Standards and Technology (NIST), formerly the National Bureau of Standards, the Center can expedite further independent V&V at that level, if desired.

Following are two examples of ongoing energy research, for which investment funding has been obtained for exploratory efforts using precise calorimetry for energy measurement: (1) a device based on high-charge-density micro-arc discharges (inventor K.R. Shoulders, "Energy Conversion Using High Charge Density," U.S. Patent #5,018,180, issued 21 May 1991); and (2) an electrical generator of unusual design (inventor J.F. Pinkerton, "High-Efficiency Electrical Machine," U.S. Patent #4,945,273, issued 31 July 1990). Additional funding is being sought to accelerate examination of these devices as well as to investigate others (e.g., replication of the device of inventor W.H. Hyde, "Electrostatic Energy Field Power Generating System," U.S. Patent #4,897,592, issued 30 January 1990).

Corporate Structure: The Chief Operating Officer of the Center is George W. "Bill" Church, Jr., retired Chairman of the Board, Church's Fried Chicken, a long-time supporter of high-tech exploration. Projects he has supported include the development by Jupiter Technologies of condensed-charge technology (CCT), a new approach to high-power microelectronics, and the investigation by the Institute for Advanced Studies at Austin of zero-point energy physics as it applies to the stability of matter; gravitation and the cosmology; and energy research.

The Director of Research is Dr. Harold E. Puthoff of the Institute for Advanced Studies at Austin. A physicist and engineer specializing in fundamental electrodynamics and quantum processes, he pursues research on issues ranging from theoretical studies of quantum vacuum states, to laboratory plasma studies. ...

The Engineering staff of the Center have extensive experience in bringing experimental technologies to commercial realization. Specialities include electronics, microprocessors, advanced materials, and mechanical engineering expertise. Also available are competent craftsman experience in a variety of fabrication techniques (lathe, mill, TIG welding, etc.), who have extensive experience in calorimeter design and some who are specialists in the use of measurement instrumentation.

For further details please contact either Mr. Church or Dr. Puthoff at (512) 328-57851. Address: Suite A-232, 1301 Capital of Texas Highway, S., Austin, TX 78746.

G. CONFERENCES, PAPERS & MISC.

FREE COPIES OF FALL ISSUE OF 21ST CENTURY SCIENCE AND TECHNOLOGY

"The Cold Fusion Revolution" is the cover story of the Fall 1991 issue of *21st Century Science & Technology* magazine, which features Pons & Fleischmann on the cover and a 35-page report on the Como conference. *21st Century* is printing 100,000 copies -- double the usual number -- in order to distribute copies on college campuses and to the science community. The magazine is willing to ship issues to any scientist or researcher in cold fusion who will get them out on campus, etc. If you are interested in receiving bulk copies, call or write *21st Century,* P.O. Box 16285, Washington D.C. 20041, phone (703) 777-7473 or FAX (703) 771-9492 Attn. M. Hecht.

FINAL REPORT FROM NCFI

The four-volume final report from the NCFI is available from:

National Technical Information Service
U. S. Department of Commerce
5285 Port Royal Road
Springfield, VA 22161
Telephone: (703) 487-4650

The title: Investigation of Cold Fusion Phenomena in Deuterated Metals.
Vol I. Overview, Executive Summary, Chemistry, Physics, Gas Reactions, Metallurgy.
Vol II. Engineering.
Vol III. Theoretical and Collaborative Studies.
Vol IV. [Title not yet available] Pons & Fleischmann report.

THE 26TH INTERSOCIETY ENERGY CONVERSION ENGINEERING CONFERENCE

Courtesy of Dr. Samuel P. Faile

This conference was recently held in Boston, MA on August 4-9, 1991. A special four-session portion of the conference was titled, **Innovative and Advanced Systems**. The special sessions were chaired by Dr. Patrick G. Bailey Tel. (408) 756-4268. Papers were submitted ahead of the conference and will be published in the *Conference Proceedings* which will be available from the American Nuclear Society. The entire Proceedings cost $180.

American Nuclear Society
555 No. Kensington AVe.
La Grange Park, IL 60625
Tel 708-352-6611
Fax 708-352-6464

BOOK ON ZERO-POINT ENERGY

Moray B. King, is a scientist employed by Eyring Research Institute. In his spare time, King is an avid student of zero-point energy. His book: Tapping The Zero-Point Energy, contains 170 pages with some illustrations and is published by Paraclete Publishing, P. O. Box 859, Provo, UT 84603 (1989) [$10 from Paraclete.] This book contains many references to the literature and is recommended to our readers who want to learn more about the energetic structure of space.

NEW FROM *FUSION FACTS - Fusion Briefings*

New from the Fusion Information Center is *Fusion Briefings,* a 3.5 page newsletter, that is a monthly digest of cold fusion developments. Written with the lay person in mind, it is an overview of what is happening in the areas of research, business, patents, and the companies involved with cold fusion. Designed for the manager who needs to be aware of cold fusion development, but does not require all of the technical details, *Fusion Briefings* lets him track the developments that will have the most impact on his business.

Fusion Briefings is airmailed to you for only $49.00 for twelve issues. Single issues are $5.00 per issue. Mention to us that you saw this notice and we will send you a free complimentary copy.

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NEW BOOK AVAILABLE - Impact Studies

Published in time for the Como Conference, "Fusion Impact" is now available for $15.00. Updated with new statistical information and graphs to illustrate and support the information, "Fusion Impact" is a timely resource book detailing the impact that enhanced energy systems will have on eight industries and the government. Order by mail or phone from:

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FUSION CONCEPTS - A computer-based tutorial.

If you know someone who is interested in learning about cold fusion, "Fusion Concepts" may be the best way to teach over eighty concepts associated with cold fusion. If cathode and anode are meaningless and confusing as you read about cold fusion developments, then "Fusion Concepts" can help clarify what the difference is and how they are used. "Fusion Concepts" is interactive courseware that takes an individual through the physics and chemistry

background that makes up cold fusion, but controls the learning by allowing the student to progress only after the student demonstrates that he understands each concept. "**Fusion Concepts**" is a two-diskette IBM-compatible software package for $95.00, and comes on either 3.5" or 5.25" diskettes. The second diskette include **INFOFIND**, a search and retrieval program that allows the user to enter any non-trivial word(s) and be positioned in the text material at any selected line where that word(s) occurs.

Order **FUSION CONCEPTS** from:

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ELECTRON BEAD PATENT ON DISKETTE

We found the Kenneth R. Shoulders' patent, "Energy Conversion Using High Charge Density" so important and so full of information on electron bead formation, manipulation, and conversion that we **put it on diskette.**

The 80 columns of patent description was so informative that we have indexed all of the words using our **INFOFIND** search and retrieval program. The **INFOFIND** program plus all of the patent written words are combined onto IBM-compatible diskettes (specify either 5 1/4 of 3.5 inch diskette.)

As a special to our subscribers, we will send you this important patent information plus the 38 pages of drawings for only $25. The price is $45 to non-subscribers.

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Fusion Facts Does Accept Short Articles

The goal of *Fusion Facts* is to present the latest information on enhanced energy devices in **the shortest possible time**. Therefore, we use only our local staff, correspondents, and scientist friends in making acceptance decisions on submitted articles.

We are especially interested in any new discoveries that improve the replication of cold fusion electrochemical cells or of other devices that provide excess energy. We are also interested in simply-stated summaries of your theories or models, especially as they pertain to improvements of devices that produce excess energy.

Brief **Letters to the Editor** are also welcome. Topics of interest include latest business developments related to cold fusion, patent information, and your constructive criticism of any cold fusion concepts. We especially welcome news of any **enhanced energy devices** that have been reduced to practice.

Remember to keep your written material simple but precise. A large fraction of our subscribers do not have English as their primary language.

Send your contributions to Hal Fox at

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