FUSION facts

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***Fusion Facts* Now Reports on Both Cold Fusion and Other Enhanced Energy Devices.**

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COMING IN MAY 1992

***Fusion Facts* Reports on**
Takahashi's Visits to MIT and Texas A&M

A. THE COMMERCIALIZATION OF COLD FUSION

By Hal Fox

BACKGROUND

In the United States, there has been an unfortunate and misguided attack on cold fusion by some who are associated with the expenditures of $500 million per year of tax-payer's funds on hot fusion research. In Japan there have been scientists who have found it difficult to accept cold fusion as a new science, however, the decision was made to fund further studies of cold fusion. **The end result is that there are now no cold fusion skeptics in Japan and considerable progress has been made in developing the science of cold fusion.** By contrast, in the United States, progress has been slowed but not stopped. Pons and Fleischmann are being supported by Japanese funds in their work in France and they expect to demonstrate a cold-fusion fired "boiler" by the end of 1992. Research funded by EPRI (Electric Power Research Institute) in the U.S. has made sufficient progress that EPRI has announced a $12 million budget for the next three years for cold fusion research and development.

I. MEASURES FOR COMMERCIALIZATION

Before cold fusion is ready for commercialization the following measures of performance should be achieved:

1. The amount of excess heat generated must be sufficient for economic performance.
2. The phenomena must be repeatable.
3. The costs of production plus operation must be economically attractive.

4. The production units must be reliable.
5. The systems must be non-polluting, non-hazardous.
6. There must be market acceptability.

The following discussion will consider each of these six measures of commercialization and suggest appropriate measures by which the degree of commercialization can be ascertained. For the purposes of this discussion the following assumptions are made:

1. Cold fusion involves nuclear reactions that are, in general, about 1 million times more energetic than chemical combustion reactions in terms of energy produced per reaction.

2. It is not necessary to completely understand the theory of cold fusion events for cold fusion to be commercial.

3. The data published in scientific papers is, in general, true and honest reporting from dedicated scientists.

4. The nature of the cold fusion process is such that the earlier commercial cold fusion energy systems will be for heat processes such as space heating, water heating, cooking, baking, distilling, and etc.

A. EXCESS HEAT (OR ENERGY PRODUCTION)

Heat for commercial and industrial purposes is produced predominantly by electricity, natural gas, oil, coal, or wood. Electricity is usually generated by water (hydro-electric plants) or by the burning of fossil fuels, especially oil, coal, and natural gas or by nuclear power plants.

To evaluate cold fusion commercialization, it is recognized that the cost of cold fusion power must be less than or equal to the cost of natural gas energy used to produce the same amount of heat. A cold fusion electrochemical cell uses high-priced electrical input to provide a lower-cost heat output. Therefore, a measure of commercialization is defined such that the cold fusion cell produces an amount of excess heat equivalent to the amount of heat produced by the same dollar amount of natural gas. Therefore, we shall use the ratio of costs of electrical power and natural gas as the desired figure of merit for excess heat.

In Utah, a home water heater can use either electrical input or (most often) natural gas. For the equivalent amount of energy produced, the cost of electricity is about three times the cost of natural gas. Therefore, a cold fusion cell will be determined to have commercial potential when the total energy output is three times the total energy input.

A cold fusion system needs to produce at least 200% excess heat.

B. REPEATABILITY

A scientific fact is best defined as, "The close agreement of a series of observations of the same phenomena." Therefore cold fusion can be (and is) a scientific fact even if the observed phenomena only occurs a fraction of the time. However, commercialization requires a higher degree of repeatability. This does not mean that a 100% repeatability is required for commercialization. It does mean that where repeatability is not achieved, then there is an economic consequence that must be taken into account. For example, if the product achieves the required (production specifications) performance 80% of the time then the incurred costs of 10 units must be spread across 8 units.

Repeatability must be viewed from at least two viewpoints: Repeatability of the process (production of excess heat) and repeatability of the magnitude of the process (produces 200% or more excess heat.)

We shall define commercial potential as follows: The cold fusion system shall function to specified levels in at least three out of four production prototype units. (Obviously, it is strongly desired that the production units have much higher replicability.)

C. COSTS OF PRODUCT AND OPERATION

The costs of a cold fusion energy system are a combination of purchase price plus operating costs. The operating costs are a combination of fuel costs and maintenance. For example, consider a natural gas water heater. During a typical five-year life the following costs could be incurred:

Purchase price + installation: $200
Monthly fuel costs: $12 per month
Maintenance costs: $ 0 (Furnished free by natural gas company.)

The total costs are best summarized as follows:

Cost of capital:	
$200 at 1% per month.....	$ 2
Fuel costs per month.....	$ 12

Total costs per month.....	$ 14

It is readily apparent that the majority of the cost of a home-type hot water heater is fuel cost. It is also easily observed that a cold fusion hot water heat, even at zero fuel costs could not be priced at more than $ 1,400 and be competitive with a natural gas-fired water heater. The $1400 comes from using the same cost of capital (1 % per month) times the expected total costs per month of $14.

There is no question that until cold fusion energy systems are proven to be safe, they will not be placed into a home environment. Let us assume that for the first few years, cold fusion heaters will require an inspection/maintenance/refueling visit every six months at a cost of $ 48.

Costs of maintenance per month.....	$ 8
Allowable system cost of capital.....	$ 6

Total costs per month.....	$ 14

Using the cost of capital as being 1% per month, then the allowable cost of the cold fusion energy system can be $600 and be competitive with a natural gas water heater.

In summary, the lower the cost of capital the more difficult it may be to justify the replacement of a natural gas heating unit with a cold fusion energy system. However, it is easy to see that if the cold fusion energy system costs the same or is less than the cost of the system being replaced, the fuel costs immediately become the decision-making cost factor.

D. RELIABILITY

In a recent computer specification sheet, the mother board reliability is listed at "over 200,000 hours MTBF." A mean time between failures (MTBF) of 200,000 hours is absolutely phenomenal. That means that if used 8 hours per day 50 weeks per year (a standard working year of 2,000 hours), **the MTBF is over 100 years.** It is immediately evident that such reliability far exceeds that for any other appliance, tool, or device that we use that has moving parts. It is known that an electrode used in any kind of a electrochemical device (battery, electrochemical cell, etc.) has a limited life time. The flow of electricity through the electrode will cause gradual erosion of the electrode. (This is the reason that metal pipes laid in the ground to carry natural gas are often wrapped with an insulating cover, especially if there are large ground currents such as developed by electrical trolley cars that use the ground as one conductor.)

We will make the specification that the design goal for a cold fusion electrochemical cell shall be five years of life. This is believed to be an achievable design goal because many electrode-using rechargeable batteries have a 5-year guarantee.

E. HAZARDS AND POLLUTION

To be commercial acceptable, the cold fusion energy system must be non-hazardous (both electrically and chemically) and must be non-polluting to the environment.

ELECTRICAL HAZARDS: By following the usual standards for electrical appliances, it does not appear to be any problem to design a cold fusion energy system that will meet United Laboratory (UL) standards.

CHEMICAL HAZARDS: The cell must be designed to be fully contained and not easily opened by the casual user. Some electrochemical cells may have corrosive (especially alkaline) chemicals. However, these chemicals are not as severe as battery acid, therefore, good design is expected to minimize chemical hazards.

NUCLEAR HAZARDS: Some electrochemical cold fusion cells have been shown to emit neutrons (in small quantities) and tritium. Because the neutron emission is seldom above background, neutrons are not deemed to be a hazard. Fortunately, some cells produce no measurable neutrons. Tritium is a potential problem. Tritium is unstable and decays by the release of a beta particle (an electron). Tritium can be combined with oxygen to produce a super-heavy type of water that can be taken into living cells just as water is absorbed. In such cells, especially germ cells, the tritium decay can cause cell damage and even birth defects. Therefore, it is essential that any tritium-producing cells use recombiners so that any tritium produced is kept in the electrolyte. Further, exposure to the electrolyte must be limited to properly trained and skilled maintenance personnel.

EXPLOSION HAZARDS: The temperature of the heat produced in a water-based electrolyte is limited to about 100 C unless the cold fusion cell is pressurized. Pressures can be caused by two processes: heat and gases evolved by electrolysis. The pressure produced by elevated temperatures is readily found by using steam tables. The pressure that can be produced by continued electrolysis is essentially unlimited. In other words, the pressure produced by evolved gases does not cause the electrolysis to be cut off, it is not a self-limiting process. The explosion potential comes not only from possible high pressures (from temperatures or evolved gases) but also from possible explosion of hydrogen and oxygen gases.

Therefore, the design of the commercial cold fusion cell **must provide for safety devices to ensure that the cell cannot explode and hurl shrapnel-like pieces.**

Note: Explosion proofing the active cold fusion cell is probably the primary safety concern for the commercial cold fusion energy system. Here are a few of the high-pressure and/or possible explosion-producing devices that we now use: Pressure cookers, lead-acid batteries, internal combustion engines (even on hand-held appliances), refrigeration compressors, and inflated tires.

F. MARKET ACCEPTABILITY

There must be market acceptability. Even in this enlightened age, there are only a few people who will eat food that has been exposed to radiation (to maintain freshness.) The words "nuclear", "fusion", "radiation", conjure up views of Hiroshima-type devastation and death. This will be the biggest consumer fear to be overcome before cold fusion energy system will find widespread use in homes. Industrial markets will be much easier to penetrate provided that organizations like OSHA agree that there are no nuclear hazards using properly designed cold fusion energy systems. The U.S. Nuclear Regulatory Commission is being asked to rule that some types of cold fusion cells do not come under their jurisdiction because there are no hazardous nuclear byproducts.

The most important factor to encourage the use of cold fusion devices will be the degree of cleanliness (non-polluting) and the resultant cost of energy. Both of these factors, as shown below, appear to be highly favorable to promote market penetration.

COST OF COLD FUSION ENERGY: Current projections (technological forecasting) indicate the cold fusion energy systems will supply heat energy at 20% to 25% of the current heat energy costs. These costs are based on low fuel costs but include the projected increased cost of capital (due to expected higher system acquisition costs). If cold fusion energy systems can deliver heat energy at one-fourth the current costs, this will be a compelling factor in market penetration.

NON-POLLUTING ENERGY: From an ecological or environment viewpoint, the concept that cold fusion energy systems produce no hazardous chemicals, no harmful radiation, no atmospheric pollutants, and do not even produce carbon dioxide is a powerful advantage to cold fusion energy systems. This places the desirability of cold fusion in the same category as hydro-electric power or banks of solar cells (in terms of non-polluting.) However, some environmentalists object to the building of any more dams and solar cells are unlikely to compete economically with cold fusion energy systems.

FUEL COST COMPARISONS

Assume that gasoline costs $0.25 per liter.

MILLS-TYPE CELL: Assume that in the Mills-type electrochemical cell that the fuel is the hydrogen being collapsed below its ground state to give up energy. This heretofore unknown type of energy is considered to be about 20 times more energetic than chemical burning of fuel. Even assuming a high cost for the Mills-type cell electrolyte of $0.25 per liter, the fuel cost would then be about 1/20th the cost of gasoline or about $0.02 per liter.

BUSH-EAGLETON TYPE CELL: Assuming that the fuel in the Bush-Eagleton cold fusion cell is hydrogen and potassium this nuclear reaction is at least 500,000 times more energetic than the chemical burning of fuel. The following reaction:

$$_1H^1 + _{19}K^{39} \text{ ---> } _{20}Ca^{40} + 8.3 \text{ MeV},$$

consumes hydrogen and potassium in the electrolyte and produces calcium plus a strong gamma ray which is turned into heat in the cold fusion cell. At $25 per kilogram (about the same weight as 1 liter of gasoline) for technical grade potassium carbonate, it can be seen that the cost of fuel from this type of reaction is less than $0.0005 per liter for the gasoline equivalent of heat production.

Another way of looking at the fuel costs is that 1 gm of potassium carbonate would provide the equivalent of about 500 liters of gasoline. Therefore, it is conceivable that a cold fusion electrochemical cell can be designed with sufficient "fuel" to last for 6 to 12 months of energetic operation.

II. HEAT CELLS THAT QUALIFY FOR COMMERCIALIZATION

The following electrochemical cells are deemed qualified for early commercialization:

1. The Mills-type potassium-carbonate cells. [Mills cell]

2. The Bush-Eagleton hydrogen-alkali fusion cells. [B-E cell]

3. The EPRI/McKubre Pd/Li/D_2O pressurized cells. [EPRI cell].

4. The Pons-Fleischmann or Takahashi Pd/Li/D_2O cold fusion cells. [P-F cell].

Comments on the above cells will be made under the various headings of measures of performance. These headings are in the same order as provided in the above discussions.

A. EXCESS HEAT (OR ENERGY PRODUCTION)

Mills cell: A cell producing 1,000 watts in excess heat is now running.

B-E cell: Excess heat ranging up to several hundred percent has been achieved in small unpressurized closed

cells at low input levels. Scaling to larger, pressurized cells is expected to result in cells producing 300% to 500% excess heat.

EPRI cell: Pressurized cells have produced up to 250% excess heat (McKubre, Como) and higher levels (According to an EPRI VP at luncheon meeting.)

P-F cell: P-F report excellent results. Takahashi has cell running at average of 250% excess heat.

Conceptually, all four of these types of electrochemical cells are candidates for commercialization by the measure of being able to achieve excess heat of 200% or more.

B. REPEATABILITY

Mills cell: The Mills cell "has never not worked".

B-E cell: Except for the first cell, the B-E cells have always produced excess heat but not always in sufficient amount to be deemed commercial.

EPRI cell: Using the pre-selection of the Pd electrodes, EPRI achieves a high-degree of repeatability.

P-F cell: Only verbal reports available. Takahashi cell structure now being tried in several labs. Replication as yet not defined.

C. COSTS OF PRODUCT AND OPERATION

The Mills and B-E cells both use nickel cathodes and light water electrolytes. The EPRI cell and the P-F cell both use Pd cathodes and heavy water. All cells currently use Pt anodes.

Mills cell: According to Mills' theory, this cell should be 10 to 20 times less costly than other forms of energy production.

B-E cell: According to the author's interpretation of Bush's theory, this cell should be highly qualified for low cost production and operation.

EPRI cell: This cell is deemed to be suitable to early commercialization.

P-F cell: These types of cells deemed to be suitable for early commercialization.

D. RELIABILITY

There has been insufficient work done to determine the degree of reliability of any of the following cells. The comments made are subjective and based on technological forecasting, not on factual data.

Mills cell: Has had the most experimental data in terms of replication and therefore predictable operation. Cell is deemed qualified subject to suitable testing.

B-E cell: Insufficient data. Forecast to be highly reliable for 6- to 12-month periods between servicing.

EPRI cell: Insufficient data. Forecast to be reliable for 6- to 12-months of operation.

P-F cell: Insufficient data. Forecast to be reliable especially where the Pd/Ag alloys are used for cathodes.

E. HAZARDS AND POLLUTION

All of these cells are deemed to be essentially hazard free. Some cells should be protected so that the electrolyte is controlled. All cells designed to operate at temperatures in excess of 100 C will require proper safety handling and proper shut-down fail-safe controls.

Mills cell: No hazards.

B-E cell: No hazards.

EPRI cell: Possible tritium production and very low-level neutrons.

P-F cell: Possible tritium production and very low-level neutrons.

F. MARKET ACCEPTABILITY

None of the cells will be deemed to be immediately acceptable to the market if they are labeled or considered to be based on nuclear-type reactions.

Mills cell: Not nuclear according to Dr. Mills, therefore, should not prevent ready market acceptance.

B-E cell: Based on benign nuclear reactions. Consumers will have to be educated that there are no harmful nuclear reactions.

EPRI cell: With care in handling the electrolyte and with proper testing and proving, these cells should be considered safe. The fact that one scientist was killed in a laboratory accident should not distort the logic of safety through proper design and testing procedures.

P-F cell: Same as for EPRI cell except no harmful accidents reported.

In general, the availability of clean low-cost energy should provide enormous free publicity for cold fusion devices

that will speed their acceptance in the market place. Only a concerted anti-cold fusion campaign by misguided or ill-informed groups could damage the market acceptance. An anti-cold fusion campaign (such as the now-dying campaign that has been supported by some hot fusionists) is not expected to occur. It is a zero-win game to fight reality. The previous tirade against cold fusion has only brought condemnation and damage to the hot fusion cause and would be even more damaging to any commercial energy companies.

It is expected that as soon as the environmentalists find that almost unlimited sources of clean low-cost energy are available, they will become strong advocates of cold fusion energy systems. If such organizations are only dedicated to zero-growth, then they will not accept cold-fusion and will become anachronisms in the path of history.

B. LISTING & ABSTRACTS OF PAPERS IN THE SCIENCE OF COLD FUSION: PROCEEDINGS OF THE II ANNUAL CONFERENCE ON COLD FUSION June 29-July 4, 1991 in Como, Italy; Edited by T. Bressani, E. Del Giudice, & G. Preparata.

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40124 Bologna, BO, Italy ($110 by air mail.)

Note: The following authors, titles, abstracts are listed in the order they appear in the book:

ITALY - 17% EXCESS HEAT

L. Bertalot, L. Bettanali, F. De Marco, V. Violante (ENEA, Dipartimento Fusione, Centro Ricerche Energia Frascati, Rome, Italy), P. DeLogu, T. Dikominos Makris, A. La Barbera (ENEA, Dipartimento Inn-PCM Rome, Italy), "Analysis of Tritium and Heat Excess in Electrochemical Cells with Pd Cathodes," The Science of Cold Fusion, Proceedings of the II Annual Conference on Cold Fusion, Como, Italy June 29-July 4, 1991, pp 3-7, 4 refs, 3 figs, 1 table.

AUTHORS' ABSTRACT

A series of electrochemical cells was set up mainly with the objective of tritium detection. In the framework of a collaboration with the Texas A&M University also some calorimetric measurement were carried out. In the experiments aimed to tritium analysis particular care was given to a clear assembling of the cells and to avoid possible tritium contamination. Nine cells were installed with different materials and geometry. No tritium in excess of the isotopic enrichment was detected. Post mortem surface analysis shows contamination of the Pd surface. In the calorimetric experiments, one cell out of three gave about 17% of excess heat for ten days, corresponding to 55 kJ.

SPAIN - CATHODE SURFACE ANALYSIS

J. Brillas, G. Sardin (Universitat de Barcelona), J. Casado, X. Domenech, & J.A. Sanchez-Cabeza (Universitat Autonoma Barcelona), "Product Analysis from D_2O Electrolysis with Palladium and Titanium Cathodes", The Science of Cold Fusion, Proceedings of the II Annual Conference on Cold Fusion, Como, Italy June 29-July 4, 1991, pp 9-13, 4 refs.

AUTHORS' ABSTRACT

The possible generation of tritium in the electrolyte and the incorporation of species such as tririum, lithium and platinum to cathodes during the electrolysis of 0.1M LiOD solutions with Pd and Ti cathodes and Pt anodes at low and high current densities have been studied by means of different techniques.

SPAIN - PHASE TRANSITION IN Ti

B. Escarpizo, F. Fernandez, J. Sevilla, F. Cuevas and C. Sanchez (Dept of Applied Physics, U. Autonoma de Madrid), "Solid State and Electrochemical Phenomena Related to Cold Fusion in Titanium," The Science of Cold Fusion, Proceedings of the II Annual Conference on Cold Fusion, Como, Italy June 29-July 4, 1991, pp 15-20, 2 refs, 5 figs.

AUTHORS' CONCLUSIONS

We therefore can conclude from the content of this communication that: Deuteration of Ti cathodes in electrolytic cold fusion experiments seems to take place in only the first grain layer. Grain boundaries seem to be barriers for the propagation of Deuterium in the next grain layer. Differences in behavior are found between the hydrides formed in acid and basic electrolytes. In basic media, used by most of the authors, the deuterated grains release from the cathode and a new and clean surface of Ti appears periodically.

ITALY - MULTI-CELL EXPERIMENTS

D. Gozzi, P.L. Cignini and M. Tomellini (Dipartimento di Chimica, Universita "La Sapienza", Roma, Italy), S. Frullani, F. Garibaldi, F. Ghio, M. Jodice and G.M. Urciuoli (Lab. di Fisica, Istit. Superiore di Sanita and Sezione INFN, Roma, Italy, "Multicell Experiments for Searching Time-related Events in Cold Fusion," The Science of Cold Fusion, Proceedings of the II Annual Conference on Cold Fusion, Como, Italy June 29-July 4, 1991, pp 21-47, 15 refs, 12 figs, 4 tables.

AUTHORS' ABSTRACT

A new ten-electrochemical cell experiment is running in order to confirm previous results and to understand the key role of some experimental parameters in triggering cold fusion events. The experiment is designated to detect: a) heat excess; b) loading factor by in situ measurement of the cathode displacement; c) nuclear products: neutrons, tritium in the electrolytic solution and in the recombined heavy water, gamma-rays; d) effect of the palladium electrode preparation. To measure the heat excess, a calibration curve of the input power vs. the temperature of the solution was obtained for cells equal in the shape, materials and in the same experimental condition in which the experiment is now running. The unique

difference lays in the cathode. The cathode used in the calibration measurements was made of palladium rod gold-plated by electrochemical deposition. The growth of the gold layer was carefully controlled by microprobe analysis to be sure that all of the palladium cathode surface was covered by gold. After that a further deposition of gold was done. In the multicell experiment one of the ten cells is a calibration cell previously utilized. This allows to have both a blank and to control the stability of the calibration curve. Two cells out of the ten are equipped by micro-displacement transducers which allow to measure the palladium swelling, caused by the deuterium loading, with at least 0.1 micrometer resolution. Neutron detector is a He proportional counter, the same used in the previous experiments, but the data acquisition is now implemented by a fast pulse-shape storage and off-line discrimination for very accurate counting. The gamma-ray detection has also been improved by using a more efficient high purity Ge detector and a large NaI(Ti) monocrystal detector. Each of the cathodes is different from the others in shape, dimension, and preparation.

CHINA - RESEARCH SUMMARY

Zhou Hongyu, Wen Chenlin, Rong Yanin, Fan Guoying, Yan Hua, Zhou Weidong, Wang Dachun, Hua Ming, Liu Shuzhen and Han Zhuen (Institute of Low Energy Nuclear Physics, Beijing Normal University). Wu Zhongda, Yu Runhu and Liu Zhanghao (Chemical Department, Beijing Normal University), Ren Guoxiao (Institute of High Energy Physics, Chinese Academy of Sciences), "Some Results on Cold Fusion Research," The Science of Cold Fusion, Proceedings of the II Annual Conference on Cold Fusion, Como, Italy June 29-July 4, 1991, pp 49-54, 6 refs, 4 figs.

AUTHORS' ABSTRACT

Anomalous nuclear effects in Pd+Ti+D_2 system were investigated by means of a double liquid scintillator system. A recoil proton spectrum of 2.45 MeV neutrons was obtained from heavy water electrolysis experiment using Pd as cathode. Burst neutrons and random neutron emissions were observed in discharge experiments and temperature cycle experiments for Pd+Ti+D_2 system.

HAWAII - MOLTEN SALT UPDATE

Bor Yann Liaw, Peng-Long Tao, and Bruce E. Liebert* (Hawaii Natural Energy Institute, and *Department of Mechanical Engineering, University of Hawaii), "Recent Progress on Cold Fusion Research Using Molten Salt Techniques," The Science of Cold Fusion, Proceedings of the II Annual Conference on Cold Fusion, Como, Italy June 29-July 4, 1991, pp 55-64, 17 refs, 11 figs, 2 tables.

AUTHORS' ABSTRACT

We have demonstrated a novel elevated-temperature molten salt technique for generating high-level excess heat. More than 4MJ/mole D_2 of excess heat, at least 600% over the input power, was measured in two incidents using a torched Pd anode and an aluminum alloy cathode merged in a eutectic LiCl-KCl mixture saturated with excessive LiD at about 370C. No thermochemical explanation can account for this excess heat. Measurements on the hydrogen based system showed normal endothermal behaviors. The Pd samples were later examined for their morphological behaviors and for He analysis. A very porous microstructure of the samples was found. Electrolysis and deuteriding processes changed the morphology substantially. Enhancement of alpha-particles in the deuterated sample was detected while the hydrated sample showed an opposite effect. The amount of the alpha-particles in the sample, however, were not commensurate with the measured excess heat. On-line neutron (using BYU facility) and particle measurements (using ETEC/Rockwell facility) were planned and at work. Reproducibility of the experiments is poor to date.

ITALY - GOOD TRITIUM DATA

G. Mengoli, M. Fabrizio (IPELP-CNR, Padova, Italy), C. Manduchi, G. Zannoni, L. Riccardi, (Dip. Fisica "G. Galelei", Padova, Italy), A. Buffa (IGI-CNR, Padova, Italy) "Tritium and neutron emission in conventional and contact glow discharge electrolyses of D_2O at Pd and Ti Cathodes" (work performed in collaboration with ENEA-Frascati), The Science of Cold Fusion, Proceedings of the II Annual Conference on Cold Fusion, Como, Italy June 29-July 4, 1991, pp 65-70, 4 figs.

AUTHORS' ABSTRACT

We recently found that the level of ^3H in D_2O / 0.1 M LiOD solutions electrolyzed at Pd sheet cathodes increased, although sporadically (<20%), till an order of magnitude over background, we indeed used D_2O with very low background. The surface of a Pd sheet cathode (1 x 1x0.5 cm^3) which gave apparent generation of ^3H had developed localized swelling with deep pitting underneath; if this phenomenon was relating with ^3H, the latter was likely formed by means of a near-surface process, which might be easier to reproduce if electrodes of relatively larger dimensions are utilized. The experimental design adopted for the four conventional electrolytic runs hereafter described was mostly in agreement with the above consideration. We are also reporting on contact glow discharge electrolyses (CGDE) aimed at inducing critical conditions at/in the metal deuteride cathode.

JAPAN - LARGE Pd CATHODE RESULTS

H. Numata, I. Ohno (Tokyo Institute of Technology), R, Takagi (Research Lab. for Nuclear Reactors, Tokyo), K. Kawamura (Inst. of R&D, Takai Univ., Kanagawa), S. Haruyama (Tokyo National Col. Of Tech., Tokyo, JAPAN), "Neutron Emission and Surface Observation during a Long-term Evolution of Deuterium on Pd in 0.1 M LiOD," The Science of Cold Fusion, Proceedings of the II Annual Conference on Cold Fusion, Como, Italy June 29-July 4, 1991, pp 71-80, 16 refs, 13 figs. 2 tables.

AUTHORS' ABSTRACT

Long-term electrolysis for well annealed thick Pd rods (9.0 and 21.2 mm phi) in 0.1M LiOD have been performed to examine anomalous phenomena; neutron emission and heat bursts. The count rate of neutron (CRN) bunched for 3 h showed no significant increase at low current densities. High CRN appeared a few days later after the current increased to 102.4 mA/cm_2 and the temperature was raised to 50°C. In two experiments CRN and neutron energy spectrum of 2.45 MeV was reproduced. Metallographic observation showed two faults, blisters, cross slips and holes on Pd surface and a raw of defects in a recrystallized grain. Microstructural changes of Pd electrode during long-term electrolysis is discussed.

JAPAN - NEUTRON BURSTS

Y. Fujii, N. Takahashi, M. Nakada, T. Kusunoki, M. Okamoto, "Anomalous Neutron Burst in Heavy Water

Electrolysis," The Science of Cold Fusion, Proceedings of the II Annual Conference on Cold Fusion, Como, Italy June 29-July 4, 1991, pp 81-85, 1 ref, 4 figs, 1 table.

AUTHORS' ABSTRACT

Anomalous neutron burst has been detected in heavy water electrolysis using a Pd cathode. The burst events occurred five times periodically for ca. 140 hours. The numbers of the burst neutrons increased gradually from 5.3--(the 1st event/10min.) to 135--(the 5th event/10min.) and the last event continued for 50 min. and gave 1779 neutrons to the five ^3He neutron countors of 1% detection efficiency. The reproducibility has been examined three times, but any further event did not occur.

CALIFORNIA - NAVY - Pd ELECTRODEPOSITION

S. Szpak, P.A. Mosier-Boss (NOSC, San Diego, CA) & J.J. Smith (DoE, Washington, D.C.), "Reliable Procedure for the Initiation of the Fleischmann-Pons Effect," The Science of Cold Fusion, Proceedings of the II Annual Conference on Cold Fusion, Como, Italy June 29-July 4, 1991, pp 87-91, 5 refs, 5 figs.

AUTHORS' ABSTRACT

*Statistics on the initiation of the Fleischmann-Pons effect are rather poor. Reports presented at The First Annual Conference on Cold Fusion have indicated that, at best, only about 1 out of 10 attempts were successful in either producing excess enthalpy or yielding products associated with nuclear reaction(s). Recently, [S. Szpak et al., J. Electroanal Chem, **302**, 255 (1991)] we have shown that the Fleischmann-Pons effect can be reproducibly and rapidly initiated by employing Pd electrodes prepared by the electrodeposition from Pd^{2+} salts in the presence of evolving deuterium. The effectiveness of this procedure is examined in terms of tritium production. Effects of deposit morphology, electrolyte composition and temperature on the rate of tritium production are discussed.*

JAPAN - SUCCESS WITH PULSING

A. Takahashi, I. Iida, T. Takeuchi, A. Mega, S. Yoshida and M. Watanabe (Osaka University, Japan) "Neutron spectra and controllability by PdD/electrolysis cell with low-high current pulse operation," The Science of Cold Fusion, Proceedings of the II Annual Conference on Cold Fusion, Como, Italy June 29-July 4, 1991, pp 93-98, 5 refs, 4 figs.

AUTHORS' ABSTRACT

Neutron spectra with two components (2.45 and 3-7 MeV) have been repeatedly observed by pulse electrolysis of D_2O-Pd cell. Tritium production with (T/n) ratio 10_5 w as also confirmed with low-high current operation. These results are consistently explained with the products and byproducts in competing process of d-d and d-d-d fusions in PdD lattice.

COLORADO - PARTICLES FROM D-LOADED Ti

D.H. Beddingfield, F.E. Cecil, C.S. Galovich, H. Liu (Colorado School of Mines, USA) Sally Asher (Solar Energy Research Institute, USA), "Characterization of charged particle bursts from deuterium loaded thin Titanium foils," The Science of Cold Fusion, Proceedings of the II Annual Conference on Cold Fusion, Como, Italy June 29-July 4, 1991, pp 99-103, 2 refs, 3 figs, 2 tables.

AUTHORS' INTRODUCTION AND CONCLUSION

Following our recently reported observation of intense bursts of charged particles from deuterium gas load thin Titanium foils, we conducted a relatively exhaustive analysis of the samples involved in this study in order to better understand the has loading process, to characterize the elemental and structural properties of the samples, and to ascertain, if possible, any differences between those samples which evinced particle bursts and those which did not.

In conclusion, the studies which we have carried out on the hydrogen and deuterium gas loaded Titanium foils indicate that we employed a reliable and reproducible gas loading technique, capable of achieving gas-metal ratios of order unity to depths of at least several microns and probably more. No differences, however, were noted between those sample from which charged particle bursts were observed versus those which did not.

ITALY - D-Ti NEUTRON MEASUREMENTS

T. Bressani, D. Calvo, F. Iazzi, C. Lamberti and B. Minetti (INFI Sez di Torino, Italy) R. Cherubini, A.M.I. Haque and R.A. Ricci (Laboratori Nazionali di Legnaro, Italy), "A Study of the Neutron Emission from Ti Loaded with D in Gas Phase by Means of a Time-of-Flight Spectrometer," The Science of Cold Fusion, Proceedings of the II Annual Conference on Cold Fusion, Como, Italy June 29-July 4, 1991, pp 105-111, 9 refs, 7 figs.

AUTHORS' ABSTRACT

The final results of an experiment carried out in order to detect and measure the energy of the neutrons emitted from Ti metal loaded with D in gas phase are reported. A neutron spectrometer based on the time-of-flight and double scattering technique was used. We observed a 2.5 sigma signal for the emission of 2.45 MeV neutrons, corresponding to 1.3 +/- 0.5 neutrons s^{-1} g^{-1}.

ITALY - FUSION IN SUPERCONDUCTORS

F. Celani, A. Spallone, L. Liberatori (INFN, Lab. Naz. Frascati, Roma Italy), F. Croce, L. Storelli (Univ. di Roma, Italy), S. Fortunati, M. Tului (CSM ILVA-IRI, Italy), N. Sparvieri (ALENIA-IRI, Italy), "Search for neutron emission from deuterided high temperature superconductors in a very low background environment," The Science of Cold Fusion, Proceedings of the II Annual Conference on Cold Fusion, Como, Italy June 29-July 4, 1991, pp 113-121, 16 refs, 4 figs.

AUTHORS' ABSTRACT

Following the experiments performed with deuterided High Temperature SuperConductors (HTSC) at underground Gran Sasso Laboratory, we have learnt the capacity to absorb Deuterium (D) by these materials and the role played by non-equilibrium conditions to get neutron burst emissions in the framework of Cold Fusion. So far, some $Y_1Ba_2Cu_3O_7$ (YBCO) pellets and high pressure D_2 gas were enclosed in stainless steal vessel and a charging-up procedure was performed. The vessel was put in a thermal neutrons field and some thermal cycles (300-> 77-> 300 K) were performed; moreover, for comparison, background and blank runs were performed. A specific acquisition system, able to detect multiple neutron signals in defined time-

windows ("time-correlated events"), was set up. One thermal cycle run showed a large increase of time-correlated events in respect to the blanks; one other urn, although with no relevant mean-value increase of events detected, showed, on the other hand, one interesting multiple neutron signal (triple); other similar runs produced no relevant values. One-other kind of experiment, at constant temperature (300 K), characterized by a heavy D_2 gas refill, showed both some increase of time-correlated events and few 'triple' neutron signals.

CHINA - SEARCH FOR CHARGED PARTICLES

Da-Wei Mo, Yi S. Liu, Li Y. Zhou, Shi Y. Dong, Ke L. Wang, Shi C. Wang, Xing Z. Li (Tsinghua Univ, Beijing, China), "Search for Precursor and Charged Particles in Cold Fusion," The Science of Cold Fusion, Proceedings of the II Annual Conference on Cold Fusion, Como, Italy June 29-July 4, 1991, pp 123-127, 6 refs, 5 figs.

AUTHORS' DISCUSSION

It is clear that the energy of charged particle has a peak above the 5 MeV. It does not fit with any conventional binary D-D-> ^{4}He+23.8 MeV, might give more energy, we had to assume an anomalous branching ration. It is suggestive to use dE /dx detector for identification of the charged particles. If we assume that the low energy signals were caused by electromagnetic radiation, this was a good manifestation of precursor. We planned to use photo-electric diode for confirmation of this observation. Was there any mistake which might cause the fault signals? We were worried about this also. A good verification was that we did not detect any signals as before when the vessel sealing failed in one of the experiments.

ITALY - NEUTRONS AND TRITIUM

A. De Ninno, F. Scaramuzzi (ENEA, Areea Energia e Innovazione), A. Frattolillo, S. Migliori (ENEA, Associazione EURATOM-ENEA sulla Fusione), F. Lanza (JRC Euratom), S. Scaglione (ENEA, Aea Energia e Innovazione), P. Zeppa (ENEA, Frascati, Italy), C. Pontorieri (ENEA student), "The Production of Neutrons and Tritium in Deuterium Gas-Titanium Interaction," The Science of Cold Fusion, Proceedings of the II Annual Conference on Cold Fusion, Como, Italy June 29-July 4, 1991, pp 129-137, 12 refs, 2 figs, 2 tables.

AUTHORS' ABSTRACT

*The emission of neutrons from a titanium-deuterium gas system has been detected in experiments performed in the Spring of 1989 [DeNinno et al. Europhysics Letters, **9**, 221 (1989)]. One of the most striking features was the structure in bursts (duration of about 100 microsec) of the neutron emission. Using a detection system proposed by a Los Alamos Group [Menlove, Proc of First Ann Conf on Cold Fusion, Mar 1990, pg 250], suitable to analyze the structure in bursts of the emission, a preliminary set of measurements has been performed with satisfactory results [F. D'Amato et al., Proc of First Ann Conf on Cold Fusion, Mar 1990, pg 170]. A better tailored detector is now in use in a low neutron background setup (INFN, Lab Nazionale del Gran Sasso). The first results of this experiment will be presented. Furthermore, the search for tritium excess in the samples used for neutron detection has been continued, with the technique described in above reference. Also these results will be reported.*

CHINA - RESULTS FROM ION-IMPLANTATION

Shu Yun Duan, Wei Shu Guan, Shi Qing Cheng, Jun Zhang, Shu Li Hao, Biao Gu, Jia Quan Li, Wen Xue Liang, Guang Yang Zhang, Si Xiu Pei, Jun Cheng Huang, Kang Wei Cheng, Rong Liu, Xi Rong Liu, Ying Li (Southwestern Inst of Physics, Sichuan, China), "Fusion Neutron Emission Induced by Injection of Deuterium into Titanium Target in a Mirror Plasma," The Science of Cold Fusion, Proceedings of the II Annual Conference on Cold Fusion, Como, Italy June 29-July 4, 1991, pp 139-143, 2 refs, 4 figs.

AUTHORS' ABSTRACT

*A target, titanium sheet laden with deuterium, is immersed in the deuterium plasma confined in MM-2U magnetic mirror and the target is biased to a high negative voltage about 10 kv. The deuterium nuclei-deuterons are infused into the crystal structure of titanium target. **After about three and a half hours' implantation**, random neutron emissions are observed and neutron bursts are measured by using two identical BF neutron detectors No. 1 and No. 2 located at different positions and a neutron dosimeter. The neutron count rates are 10^2 higher than the background rates of 0.8 counts/sec. It is corresponding to neutron flux of (2-5) x 10^5 neutron/sec. No gamma-ray counts above background are detected in our experiments. It is suggested that random neutron bursts may be from cold nuclear fusion reactions related to the propagation of microcracks of the metal lattice.*

CHINA - NEUTRON BURSTS USING CR-39

Shangxian Jin, Fuxiang Zhang, Decheng Yao, & Bailu Wu (Dept. of Physics, Academia Sinica, Beijing, China), "Anomalous Nuclear Effects in Deuterium Palladium Systems, "The Science of Cold Fusion, Proceedings of the II Annual Conference on Cold Fusion, Como, Italy June 29-July 4, 1991, pp 145-149, 6 refs, 4 figs.

AUTHORS' ABSTRACT

Intense bursts of charged particles far larger than background have been reproducibly detected for the first time by using CR-39 solid state nuclear track detector during either a high voltage discharge between deuterated palladium electrodes or a non-equilibrium out-diffusion of deuterons in palladium. Not any anomalous effects were found in the control experiments of Pd-H system under the same experimental conditions. This indicates that some anomalous nuclear effects were definitely produced in the Pd-D system under certain conditions.

ITALY - TRITIUM FROM TANTALUM

F. Lanza, G. Bertolini, V. Vocino, E. Parnisari, C. Ronsecco (Commission of the European Communities, Joint Res. Center, Ispra, Italy), "Tritium Production Resulting from Deuteration of Different Metals and Alloys," The Science of Cold Fusion, Proceedings of the II Annual Conference on Cold Fusion, Como, Italy June 29-July 4, 1991, pp 151-155, 9 refs, 2 tables.

AUTHORS' ABSTRACT

Previous experiments have shown that tritium is produced in deuterated titanium. To define better the phenomenon a series of tests have been performed using various metals and alloys and different deuterating conditions. Sheets and shaving of titanium, zirconium, hafnium, tantalum, Zircaloy 2 and Ti-Zr 50% alloy have been tested. A statistical analysis of

the tritium production shows that significant differences are obtained varying the type of metal used. Using pure metals the tritium production increases with the increase of the atomic number of the metal. Moreover higher productions of tritium have been obtained using materials of technical purity as tantalum, Zircaloy 2 and Ti-Zr alloy.

JAPAN - D_2 GAS DISCHARGE & NEUTRONS

T. Tazima, K. Isii, & H. Ikegami (Nat'l Inst for Fusion Science, Nagoya, Japan), "Time-Correlated Neutron Detection from Deuterium Loaded Palladium," The Science of Cold Fusion, Proceedings of the II Annual Conference on Cold Fusion, Como, Italy June 29-July 4, 1991, pp 157-162, 5 refs, 4 figs.

AUTHORS' ABSTRACT

Significant neutron bursts and good time-correlation between two independent neutron detection systems were observed in two kinds of experiments on cold fusion. One employed two palladium rods of 2 mm diameter and 5 cm length, deuterated under 1 atm for 30 days, and plasma discharge was applied as a trigger. The other was palladium shavings of 10 g deuterated under 11 atm for 40 days. The averaged background level was 5-6 counts/dwell time (100 s). In both cases, significant neutron emission of successive bursts of 13-60 counts/100 s were observed for several hours and repeated several times during 2-11 days in come cases.

CHINA - 2 PAPERS ON USING CR-39

Ke L. Wang, Xing Z. Li, Shi Y. Dong, Shi C. Wang, Da W. Mo, Cheng M. Luo, Qin R. Lin, Xiao D. Wu, Wei Z. Li, Yong F. Zhu, Ping L. Zhou, & Lee Chang (Tsinghua U, Beijing except Shi C. Wang - Inst. of High Energy Physics, Beijing, China), "Search for the Better Material for Cold Fusion Experiment Using CR-39 Detector," The Science of Cold Fusion, Proceedings of the II Annual Conference on Cold Fusion, Como, Italy June 29-July 4, 1991, pp 163-168, 4 refs, 4 figs, 1 table.

AUTHORS' ABSTRACT

CR-39 (plastic track detector) has been proven to be a good detector in the research on cold fusion phenomena. It has high sensitivity and high efficiency in detection of energetic charged products of anomalous nuclear reactions. It does not need a high voltage power supply; hence, it is easy to use in the high pressure vessel of gas-loading experiments (Frascati type), and to eliminate the electronic noises. It has low background because the spurious signals due to cosmic ray can be discriminated by re-etching procedures. It can be run in batch and it is relatively cheap as well. Therefore, CR-39 technique is selected for wide-searching the better material for cold fusion. Different materials such as palladium from USA, Russia, and from different sources in China; pure titanium (in porous state), titanium alloys (e.g. V6-A16-Sn2); zirconium; nickel; lanthanum; and hydrogen-storage materials (such as $LaNi_5$) are tested using CR-39. Preliminary results show that: (1) Russian palladium imported in 1950's gives the highest yield of charged particles (> 100 per sq cm per day). The Ti alloy (Ti-662) is not as good as Russian palladium (about 100 per sq cm per day), but it still has high repetition rate. Other materials give no evident signal distinct from background, which is less than 10 per sq cm per day. The yield becomes less and less after the first usage in the gas-loading experiment. (2) It is important to eliminate the contamination of the surface of the materials due to the radioactive impurities (e.g. uranium 238, radon's daughter, et al.). However, it is possible to distinguish the real signal from the spurious by the shape of track in the microscopy [of CR-39.] (3) Using vapor deposit technique to plate the Russian palladium on another surface did not give positive results. (4) Auger electron scanning probe reveals the complicated surface composition at various points on the palladium foil, although it is pure palladium inside the materials. This may explain the difficulty in reproducing the cold fusion phenomena. [May have some errors - copy quality of abstract was poor.]

SECOND CHINESE PAPER

Shi C. Wang & Tie S. Kang (Inst. of High Energy Physics), Ke L. Wang, Shi Y. Dong, Yu Y. Feng, Da W. Mo, Xing Z. Li (Tsinghua Univ., Beijing, China), "Identification of the Energetic Charged Particles in Gas-Loading Experiment of "Cold Fusion" Using CR-39 Plastic Track Detector," The Science of Cold Fusion, Proceedings of the II Annual Conference on Cold Fusion, Como, Italy June 29-July 4, 1991, pp 169-173, 7 refs, 2 figs, 1 table.

AUTHORS' ABSTRACT

CR-39 plastic track detectors have been used for searching for charged particles from deuterized palladium and titanium foils. Alpha particles, slowed to various energies from a Cf source were used for the calibration. Since high-pressure deuterium gas (up to 58 atm.) and low temperature (down to 77 K) may affect response of CR-39, the calibration was done in the condition which mimics experimental condition as closely as possible. Our results show that pre- and post-irradiation high-pressure deuterium gas and low temperature do not make significant difference of response of CR-39. A calibration curve was obtained, using a 'restricted energy loss model' of track formation, the etching behaviors of 3.22 MeV proton, 1.01 MeV triton, and 0.82 MeV helium-3 were predicted.

GERMANY - NEUTRONS FROM TITANIUM

D. Seeliger, M. Bittner, A. Meister, R. Schwierz and T. Streil, "Evidence of Neutron Emission from a Titanium Deuterium System," The Science of Cold Fusion, Proceedings of the II Annual Conference on Cold Fusion, Como, Italy June 29-July 4, 1991, pp 175-179, 5 refs, 3 figs.

AUTHORS' DISCUSSION AND CONCLUSIONS

In both experimental runs we have observed definite signs for a weak neutron production with a PRE spectrum, which corresponds to the assumption, that dd-neutrons have been detected. Following the paper of Jones et al., the reaction rates should be expressed in terms of the fusion rate lambda $_{DD}$ per dd-pair per second. If we assume a full loading of the Tritanium, corresponding to TiD_x with $x = 2$, the number of dd-pairs in the Titanium probe is equal to the number of Titanium atoms in it, which is equal to 7.28×10^{23}. The fusion rate obtained is $6.6 \times 10^{-25} s^{-1}$, for the average and maximum effect, respectively. However, we have seen, that there is no correlation between the reaction rate N_{DD} and the pressure p. This means that there is also no simple proportionality between N_{DD} and the number of deuterons absorbed in the sample! In opposite, the present experiment gives some indication, that the dd-reaction rate is governed by dp, that means by the particle flow into the metal per second. May be even more pronounced is the dependence on p x dp, that means to the product of already absorbed deuterons and the additional flow of particles through the surface. This would be qualitatively in accordance with a simple plasm model of dd-fusion processes in condensed matter, published recently. However, direct quantitative application of this model in the present case is difficult, due to the complicated surface-to-volume geometry of the titanium turnings.

GERMANY - NEUTRONS FROM LARGE Pd

M. Bittner, A. Meister, D. Seeliger, R. Schwierz & P. Wüstner, "Observation of D-D Fusion Neutrons during Degassing of Deuterium Loaded Palladium," The Science of Cold Fusion, Proceedings of the II Annual Conference on Cold Fusion, Como, Italy June 29-July 4, 1991, pp 181-185, 6 refs, 2 figs.

AUTHORS' CONCLUSION

The present experiment with a 0.5 kg palladium sample shows a definite excess neutron counting rate for an period of about 1 h. This period is just the time interval during which the deuterium is expulsed from the massive palladium sample. The energy of detected neutrons is near to 2.5 MeV, as expected for d-d fusion neutrons. Therefore the conclusion is obvious, that these neutrons are caused by the d-d fusion reaction. The neutron excess counting rate, which is time dependent, corresponds in its maximum to a d-d reaction rate of (3+/-) x 10^{-25} per second and deuteron pair.

ITALY - OVERSCREENING THEORY

Marcello Baldo (INFN, Catania, Italy), "Enhancement of Fusion Rate Induced by the Collective Electron Excitations," The Science of Cold Fusion, Proceedings of the II Annual Conference on Cold Fusion, Como, Italy June 29-July 4, 1991, pp 187-192, 10 refs, 3 figs.

AUTHOR'S ABSTRACT

The anomalously large fusion rate of deuterium absorbed in transition metals, which has been claimed by some authors has produced a large amount of theoretical work. Legget and Baym have demonstrated that a rigorous upper bound to the fusion rate of deuterium, in equilibrium with the crystal, can be obtained in the framework of conventional solid state theory and using the phenomenological helium and deuterium chemical potentials. This bound is too small to be compatible with the claimed fusion rate. We explore the possibility that the interaction energy between helium atoms and the metal crystal possesses a second deeper minimum, which is separated by a potential barrier from the one accessible by the usual absorption experiments, but which can be more easily reached through the path followed by the deuteron-deuteron fusion process inside the crystal. The interaction of a bare positive charge with the electrons of the crystal is modeled in terms of its coupling with a set of harmonic oscillators, which describe the collective excitation of the electron gas. The energies of the latter can be obtained experimentally. Making use of the f-sum rule, evidences are presented which indicate the possibility of an 'overscreening' of the charge, a phenomenon that could render a configuration with delocalized electrons around the charge energetically favorable with respect to a helium-like configuration inside the crystal. Speculations about the possible connection with cold fusion are presented.

ITALY - IMPACT FUSION MODEL

G.F. Cerofolini, R. Dierckx, A. Foglio Para and G. Ottaviani, "Binuclear Atoms as Fusion Precursors in a Hot Cloud," The Science of Cold Fusion, Proceedings of the II Annual Conference on Cold Fusion, Como, Italy June 29-July 4, 1991, pp 193-197, 19 refs.

AUTHOR'S ABSTRACT

Deuteron-deuteron fusions were claimed by a Brookhaven group to result from the impact on deuterated surfaces of clusters of 25 - 1350 D_2O molecules with energy up to 300 keV. The collective motion in the impact region is tentatively assumed to be responsible for these fusion events. The number of involved atoms is of the order of 10^4, with a mean energy of some electronvolts. The model is able to reproduce qualitatively the Brookhaven data according to an Arrhenius plot, with an activation energy approx. equal to $2E_0$, where E_0 is the hydrogen ionization energy. At this energy an activated precursor is postulated to be synthesized; it can tentatively by identified as the binuclear atom $(D^+ -- D^+)2e^-$.

VIRGINIA - LATTICE NUCLEAR CHEMISTRY

Scott R. Chubb & Talbot A. Chubb (Research Systems, Arlington, VA), "An Explanation of Cold Fusion and Cold Fusion By-Products, Based on Lattice Induced Nuclear Chemistry," The Science of Cold Fusion, Proceedings of the II Annual Conference on Cold Fusion, Como, Italy June 29-July 4, 1991, pp 199-204, 9 refs.

AUTHORS' ABSTRACT

At room temperature, solid state effects may alter the framework from which nuclear processes proceed in a manner that is completely difference from the one responsible for nuclear interaction between free space deuterons. Quantum mechanical effects enter during the overcharging of a fully-loaded PdD lattice as a result of periodic order, the requirement that energy be minimized, and the fact that deuterons which share a common potential are indistinguishable and must be described by a single, many-particle wave function. When a macroscopically small number of deuterons are added to stoichiometric PdD, a compound can be created of the form $PdD_{1+DELTA}$, in which solid state physics effects provide a channel for reducing lattice strain by distributing the excess charge (delta) with equal weight to all periodically equivalent locations within the crystallite. Then, the fundamental free space idea that a huge Coulomb barrier must be overcome in order for D+D nuclear interaction to occur is replaced by a new picture in which small portions of each of the excess deuterons, on the average, are distributed throughout the solid, thereby avoiding the stress that results when two deuterons are forced into a common unit cell. Because only a small fraction of each excess deuteron is present at any site and each excess deuteron is indistinguishable from the others, it becomes possible for microscopically large numbers of pairs of excess deuterons to interact. This new form of nuclear interaction is not inhibited by proton-proton repulsion because when the excess charge (delta) is sufficiently small, the lattice provides the dominant electrostatic interaction. Lattice interaction further greatly reduces proton repulsion by inducing a broadening of proton charge. The lattice interaction is responsible for new selection rules in which the energy release is distributed among all unit cells. Release of high alpha energy particles at isolated sites is also allowed. We have previously named this new form of nuclear reaction, Lattice Induced Nuclear Chemistry (LINC). In LINC, the new selection rules allow deuterons to fuse to form ^4He throughout the crystal while maintaining periodic order. Energy release occurs by coupling to phonons or coherent motion (in which the lattice moves as a whole), accompanied by the expulsion of "untrapped," low-energy ^4He into the surface and outgassing regions. In this paper, the underlying assumptions responsible for LINC and the resulting selection rules will be summarized and explained. Comparisons will be made between predictions provided by LINC with recent experiments.

MASS - MIT & HAGELSTEIN'S THEORY

Peter L. Hagelstein (MIT), "Coherent and Semi-coherent Neutron Transfer Reactions," The Science of Cold Fusion, Proceedings of the II Annual Conference on Cold Fusion, Como, Italy June 29-July 4, 1991, pp 205-209, 1 ref, 1 fig.

AUTHOR'S ABSTRACT

The novel process of coherent neutron transfer in the presence of a lattice is proposed to be the basis of a number of anomalous phenomena which have recently been reported in investigations of the Pons-Fleischmann effect.

ANN ARBOR, MI - THEORY

F.J. Mayer and J.R. Reitz, "Summary of Progress in Hydron Physics," The Science of Cold Fusion, Proceedings of the II Annual Conference on Cold Fusion, Como, Italy June 29-July 4, 1991, pp 211-216, 13 refs, 3 figs.

AUTHORS' ABSTRACT

Electromagnetic scattering resonances in the e^-p^+, e^-d^+, e^-t^+ systems produce short-lived, charge-neutral, particles called hydrons. These particles provide the screening of repulsive Coulomb forces so that nuclear reactions between a hydron nucleus and a reaction partner are possible. Hydron formation, reactions, and applications to anomalous nuclear observations in the laboratory and geophysics are summarized.

COLORADO - THEORY

J.A. McNeil, "Relativistic Hyperfine Interaction and the Spence-Vary Resonance," The Science of Cold Fusion, Proceedings of the II Annual Conference on Cold Fusion, Como, Italy June 29-July 4, 1991, pp 217-219, 8 refs, 2 figs.

AUTHOR'S INTRODUCTION

...In an attempt to address this question in a qualitative yet gauge-invariant way, we have studied the two fermion system using the Breit equation. The wavefunctions explicitly obey current conservation so the Coulomb gauge terms can have no effect on the results. For the purposes of obtaining qualitative features of the affect of the hyperfine interaction at short distances we approximate the relative coordinate Breit equation by the equivalent Schrodinger-form equation for hydrogen ($m_2 >> m_2$, for applications to positronium we use the reduced mass). We examine the hyperfine interaction in the axion channel and solve the equation in the energy range of interest (0-> 2MeV). We find the hyperfine interaction introduces an effective attractive interaction at very short distances (approx. 10 fm for positronium), but find no evidence for a resonance in the energy range of interest.

ILLINOIS - EXOTIC PLASMA MODEL

M. Shaheen, M. Ragheb, G.H. Miley, & H. Hora, J.C. Kelly (U of New So. Wales, Kensington, Australia), (Fusion Studies Lab, U. of Illinois except Hora & Kelly), "Anomalous Deuteron to Hydrogen Ratio in Oklo Samples and the Possibility of Deuteron Disintegration," The Science of Cold Fusion, Proceedings of the II Annual Conference on Cold Fusion, Como, Italy June 29-July 4, 1991, pp 221-234, 9 refs, 3 figs, 2 tables.

AUTHORS' ABSTRACT

A hypothesis is presented to explain the anomalous D/H ratio observed in samples from the site of the naturally occurring fission reaction at Oklo. The experimentally observed D/H ratio of 127 ppm exceeds the naturally occurring value of 150 ppm. Further, using a multicomponent system consisting of hydrogen, deuterium, tritium and helium nuclei to model the Oklo reaction phenomenon and assuming a thermal fission process term, we calculate a D/H ratio of 445 ppm in the presence of the thermal neutron fluence attributed to Oklo. However, solving the same rate equations with a deuterium sink term to represent the hypothesis of deuteron disintegration, we find a deuteron disintegration constant of $7.47 \times 10^{-14} s^{-1}$ yields the observed D/H ration. Indeed, deuteron disintegration would provide a neutron source (in addition to the fission neutrons) that could have driven the Oklo system as a subcritical (vs. a critical) reactor overt the extended period attributed to it.

ITALY - CROSS SECTION FACTORS

A. Scalia (Dipart. di Fisica, Univ di Catania, Corso, Italy) & P. Figuera (Lab Nazionale del Sud, Doria, Italy), "The Cross Section Factor for the Reactions $^2H(d,p)^3H$ and $^2H(d,n)^3He$ at Very Low Temperature," The Science of Cold Fusion, Proceedings of the II Annual Conference on Cold Fusion, Como, Italy June 29-July 4, 1991, pp 235-242, 9 refs, 2 figs, 2 tables.

AUTHORS' ABSTRACT

*The fusion cross section is obtained in terms of the Rutherford scattering by assuming that the fusion process is the "shadow" of elastic scattering. [A. Scalia, "The sub-barrier fusion as the shadow of the elastic scattering" to be publ. in Il Nuovo Cimento. See also Nuovo Cimento, **103,** 85,213,255,927,1177 (1990).] The parameters which appear in the analytical expression of fusion cross section are determined by fitting the experimental values of fusion cross section. The cross section factor, <sigma nu> is obtained by using this fusion cross section and by assuming that the distribution of relative velocity between two different sets of particles will be described by Maxwell-Boltzmann distribution. The values of <sigma nu> at different temperatures are determined by performing numerical integrations. At energies at which the experimental data are available the values of cross section factor obtained coincide with those reported in the literature, at very low energies experimental data are not available and our approach is able to give the values of cross section factor. At T = 300 K, we obtain:*

$$N_A \langle \sigma \nu \rangle = 3.5286 \times 10^{-27} \text{ (cu cm per mole per sec.)}$$

ILLINOIS - IMPROVED CALORIMETER

Thomas F. Droege & Lee John Droege (Batavia, IL), "An Improved Zero Gradient Calorimeter for the Investigation of Cold Fusion Phenomena," The Science of Cold Fusion, Proceedings of the II Annual Conference on Cold Fusion, Como, Italy June 29-July 4, 1991, pp 243-248, 2 refs, 5 figs.

AUTHORS' ABSTRACT

A second generation null balance calorimeter has been constructed for measuring anomalous heat in electrolytic cells. This calorimeter is similar in concept to an isothermal calorimeter except that it is operated with zero temperature differential. The calorimeter accuracy is 4 milliwatts when operated at a total power of 12 watts. Calibration is performed in situ by operating the cells under test reversed or at zero current.

ITALY - DOUBLE-SCATTERING N DETECTOR

M. Agnello, F. Iazzi, & B. Minetti (INFN Sezione di Torino, Italy), E. Botta, T. Bressani, O. Brunasso, D. Calvo, D. Dattola, P. Gianotti, C. Lamberti & A.

Zecchina, "Improvement of the TOFUS Apparatus," The Science of Cold Fusion, Proceedings of the II Annual Conference on Cold Fusion, Como, Italy June 29-July 4, 1991, pp 249-254, 5 refs, 6 figs.

AUTHORS' ABSTRACT

The TOFUS experiment was started in order to detect 2.45 MeV neutrons emitted from a Ti/D system in the gas phase. Improvements in the electronics of the neutron detector, based on the double scattering technique, and in the performances of a new cell are described.

ITALY - SOLID ANGLE NEUTRON DETECTOR

G. Ricco, M. Anghinolfi, P. Corvisiero, P. Prati, M. Taiuti, C. Boragno, R. Eggenhoffner, U. Valbusa (Dept. of Physics, Sezione di Genova, Italy), "A Large Solid Angle Multiparameter Neutron Detector," The Science of Cold Fusion, Proceedings of the II Annual Conference on Cold Fusion, Como, Italy June 29-July 4, 1991, pp 255-260, 5 refs, 3 figs.

AUTHORS' ABSTRACT

We present the results of recent measurements, performed in Genoa with a novel neutron detector, on some titanium-deuterium systems. In spite of the good detector sensitivity, better of the one claimed by Jones and co-workers, no neutron emission was found.

SWEDEN - NEUTRON DETECTOR

K.A. Sjoland, P. Kristiansson & K.G.J. Westergard, "Liquid Scintillator Detection and Multiparameter Data Acquisition for Neutron Detection in Cold Fusion Experiments," The Science of Cold Fusion, Proceedings of the II Annual Conference on Cold Fusion, Como, Italy June 29-July 4, 1991, pp 261--265, 6 refs, 5 figs.

AUTHOR'S ABSTRACT

We have designed a low level neutron detector for cold fusion experiments with titanium and deuterium gas. The basic principle of the system is to monitor as many relevant parameters as possible and store them event-by-event and analyze the data afterwards. The result of the experiment was that no significant excess of neutrons was observed. We also discuss the cosmic radiation that may influence low level measurement of neutrons.

ITALY - CRACK FUSION

L.H. Bagnulo, "Crack-fusion: a Plausible Explanation of Cold Fusion," The Science of Cold Fusion, Proceedings of the II Annual Conference on Cold Fusion, Como, Italy June 29-July 4, 1991, pp 267-270, 3 refs, 7 figs.

AUTHOR'S CONCLUSIONS

A hypothesis is postulated that crack growth results in charge separation on the newly formed crack surfaces, which act like a miniature "linear accelerator"; i.e. D^+ ions are accelerated in the electric field across the crack tip to kinetic energies of 10^4 eV or more, sufficient to raise the D+D fusion probability. We assume that also in the case of deuterated Ti or Pd there is an occurrence of D+D fusion in accordance with the dynamics as described in this article. Here too, it is a case of a fusion process resulting from the liberation of deuterium atoms within the tip of an external crack.

COLORADO - MEASURING VERY LOW ENERGY

F.E. Cecil (Colo School of Mines), & G.M. Hale (Los Alamos Nat'l Lab), "Measurement of D-D and D-^{6}Li Nuclear Reactions at Very Low Energies, "The Science of Cold Fusion, Proceedings of the II Annual Conference on Cold Fusion, Como, Italy June 29-July 4, 1991, pp 271-275, 11 refs, 4 figs.

AUTHORS' ABSTRACT

The nuclear reactions of very low energy deuterons (down to center-of-mass energies of 2 keV) with deuterons and ^{6}Li have been measured. The measured D-D reactions are in good with agreement recent R-matrix calculations. The reaction ratios D(d,p) T/D(d,n)^{3}He and ^{6}Li(d,p)^{7}Li/^{6}Li(d,alpha)^{4}He in particular were examined for possible evidence of an Oppenheimer-Phillips type enhancement. No significant enhancement was found in either ratio or in the absolute yields of the reactions. The radiative capture reactions D(d,lambda)^{4}He and ^{6}Li(d,lambda)^{8}Be were likewise measured. The branching ratios of these radiative capture reactions to the nucleonic branches of the reactions appear roughly independent of energy. The role of these reactions in the production of heat in cold-fusion experiments is evaluated.

HUNGARY - MOSSBAUER SPECTROSCOPY

E. Kuzmann, M. Gal, G.K. Solymos, & CS. Szeles (Eotvos Univ., Budapest, Hungary), "Mossbauer Spectroscopic Characterization of Samples for Cold Fusion Experiment," The Science of Cold Fusion, Proceedings of the II Annual Conference on Cold Fusion, Como, Italy June 29-July 4, 1991, pp 277-281, 7 refs, 12 figs, 1 table.

AUTHORS' ABSTRACT

In our previous works Mossbauer spectroscopy (as well as neutron and gamma-spectroscopy) was used to study the possibility of cold nuclear fusion in Fe-Zr amorphous alloys deuterized electrolytically both in air and in nitrogen atmosphere. Electrical monopole and quadrupole as well as magnetic dipole interactions measured by Mossbauer spectroscopy can provide information about the surrounding of Mossbauer atoms in deuterized samples. Consequently, the localization of deuterium can be sensitively studied. Mossbauer spectroscopy can be especially advantageously applied to the study of the effect of electrolytical hydrogenation of Fe-Zr amorphous alloys because the considerable changes appearing in the spectra (due to the change in the deuterium concentration or due to small heat effects) allow us to detect any structural changes caused by deuterization. Because Celani et al. have shown neutron burst activity in deuterized high T_C superconductor, we have prepared $EuBa_2(Cu_{1-X}{}^{57}Fe_X)_3O_{7-DELTA}$ high T_C superconductors for cold fusion experiments to be performed in an international collaboration. Both the Cu(1) and Cu(2) as well as the rare earth sites can be sensitively monitored by the Mossbauer measurements. The preliminary results of ^{151}Eu and ^{57}Fe Mossbauer investigation of these samples will be discussed.

CANADA - D IMPLANTATION

M.S. Mathur, H.L. Johnston, A. Mirzai, J.S.C. McCkee, G.R. Smith, J.J.G. Durocher, K. Furutani, J.K. Mayer,

Y.H. Yeo, H. Hnatiuk, S. King, A. Hempel, K.S. Sharma & G. Williams, "Recent Modifications to the Manitoba Deuterium Implantation Accelerator and a Study of the Properties of the Online Neutron Monitor Detector," The Science of Cold Fusion, Proceedings of the II Annual Conference on Cold Fusion, Como, Italy June 29-July 4, 1991, pp 283-288, 6 refs, 4 figs.

AUTHORS' ABSTRACT

Deuterium molecules have been implanted into Palladium, Titanium and Indium targets in recent experiments at Manitoba by means of the 60 keV, 100 micro A D_2+ 'Narodny' ion accelerator. Neutrons from D-D interactions involving beam particles with previously stopped D atoms were detected by a large plastic scintillator viewed by two Photomultiplier tubes. We describe recent modifications to the accelerator made to improve the quality of the implanting beam, and some of the properties of the neutron detector used.

MARYLAND - NAVY THEORY ON Pd DENSITY

Hans S. Uhm & W.M. Lee (Naval Surface Warfare Center, Silver Spring, MD), "High Deuterium Concentration in Palladium for Application to Cold Fusion," The Science of Cold Fusion, Proceedings of the II Annual Conference on Cold Fusion, Como, Italy June 29-July 4, 1991, pp 289-293, 9 refs, 2 figs.

AUTHORS' ABSTRACT

Based on a theoretical calculation, a new scheme to increase deuterium density in palladium over its initial value is presented. High deuterium concentration in palladium is needed for application to the solid-state fusion. The first deuterium enrichment scheme makes use of the plasm ion implantation, which consists of a cylindrical palladium rod (target) preloaded with deuterium atoms, coated with diffusion-barrier material and immersed in a deuterium plasm. The second deuterium enrichment scheme makes use of the temperature gradient effects on the deuterium solubility in palladium. A heat source at temperature T_2 and a heat sink at temperature T_2 (where $T_2 > T_2$) are in contact with two different parts of a palladium sample, which has been presoaked with deuterium atoms and has been coated with diffusion-barrier material or securely locked in a metal case.

JAPAN - COLD FUSION RESEARCH

H. Ikegami, "Cold Fusion Researches in Japan," The Science of Cold Fusion, Proceedings of the II Annual Conference on Cold Fusion, Como, Italy June 29-July 4, 1991, pp 297-307, 16 figs, 1 table.

AUTHORS' ABSTRACT

Positive results as well as some negative results from cold fusion research in Japan are reviewed with some comments. Out of 11 research groups taken up in the present review, three groups are mainly working on excess heat calorimetry, and the rest of the eight groups are involved in the detection of nuclear fusion products.

CHINA - REVIEW OF COLD FUSION RESEARCH

Xing Zhong Li (Tsinghua University, Beijing, China) "Chinese Effort in Understanding the Cold Fusion Phenomena," The Science of Cold Fusion, Proceedings of the II Annual Conference on Cold Fusion, Como, Italy June 29-July 4, 1991, pp 309-317, 16 refs, 1 fig.

AUTHOR'S ABSTRACT

Review on cold fusion research in China in the past two years is presented with the emphasis on the experiments after the first national symposium on cold fusion (May 10, 1990. Beijing). There were three phases: hot, quiet, and deep-going phases. Hot phase is characterized by failures in experiments in repetition and is restrained in thinking by the conventional ideas. Quiet phase started with different approaches and newly-designed experiments. Deep-going phase encourages the scientist to be respectful to the facts and creative in mind. Three anomalies in deuterium / solid system may exist.

RUSSIA - REVIEW OF SOVIET WORK

V.A. Tsarev, "Cold Fusion Studies in the USSR," The Science of Cold Fusion, Proceedings of the II Annual Conference on Cold Fusion, Como, Italy June 29-July 4, 1991, pp 319-336, 71 refs, 4 figs, 5 tables.

AUTHOR'S INTRODUCTION

This special report is dedicated to the soviet scientists whose work seems not to be well known to the western scientific community. It is possible that some of the early soviet work has been "precursors" to the "cold fusion" era. The first Soviet National Conference on CF took place only recently in March of this year (March 22-26, 1991, Dubna-Moscow). This paper illustrates by a map, the centers of work that was presented at the Dubna conference. This work was carried out by about 45 Institutes. However, others stopped or "froze" their activities after the first unsuccessful attempts and under the pressure of wide-spread skepticism. The CF reputation in our country has suffered greatly from rush and inexact experiments of the initial period, widely boosted with a mass media. The total number of soviet publications on CF certainly exceeds one hundred (more than 80 papers were submitted at the Dubna Conference). About half of them are devoted to CF experiments, about a quarter are connected with methodical and structural studies, and the rest with theoretical models. This paper categorizes and summarizes the soviet CF work and provides suitable references.

TEXAS - FUGACITY & EXCESS HEAT

J.O'M. Bockris, D. Hodko, & Z. Minevski (Texas A&M Univ.), "The Mechanism of Deuterium Evolution on Palladium: Relation to Heat Bursts Provoked by Fluxing Deuterium across the Interface," The Science of Cold Fusion, Proceedings of the II Annual Conference on Cold Fusion, Como, Italy June 29-July 4, 1991, pp 337-362, 8 refs, 7 figs.

AUTHOR'S ABSTRACT

In recent times much attention has been given to interpretations of the so-called fusion reactions which were related to the concept of high fugacity within the metal depending on the overpotential applied. In the present paper some preliminary electrochemical investigations of mechanisms of D_2 evolution on Pd are outlined together with a report on some recent research upon the effect of electrical pulsing upon the initiation of excess heat generation. Cathodic overpotentials and overpotential decay transients for PdD_2 electrode were measured in KOD and LiOD solutions. The mechanism of the deuterium electrode reaction is investigated and two Tafel slopes are obtained. In order to characterize the Pd surface and to find out the influence of different species, present on/in Pd, on the mechanism of D.E.R. surface techniques XPS and EDS were employed. Surface spectra and depth profiling up to 200 A are analyzed for samples exposed to

different pretreatment such as annealing/abrading or exposed/not exposed to electrolyzing conditions. The atomic concentration of ad/absorbed species (Zn, Pt, Au, Cu, Fe, etc.) changes with the pretreatment and electrolysis. In respect to above impurities, the presence of Si is much less pronounced. Neutron activation analysis was employed to determine the presence of different species in solutions before and after the electrolysis. Following species are found at detectable levels: Pt, Au, and Na. Light water concentration measured by NMR technique is found to be less than 1%. Enthalpy generation during long term electrolysis of Pd in O.1 M LiOD is measured by a calorimetric method. Four-probe resistivity measurements were used to optimize a current-charging regime and to monitor changes in D/Pd ratio. Increase in current occasionally caused enhancement of D/Pd ratio (up to 0.8). After charging, the electrodes were pulsed in a potentiostatic mode. A typical pulsing regime consisted of cathodic (up to 1 A per sq cm) and anodic pulses of equal duration. The cell pulsed with 5 ms regime for more than 30 days showed no measurable excess heats. Applying 5s pulsing regime excess heats of up to 23% were observed, Fig. 2. The application of 5s pulsing regimes caused electrode to slowly discharge. An interesting observation was that excess heat bursts appeared to be correlated with the process of charging of electrode and enhanced with repetitive pulsing. The total energy production in excess enthalpy bursts shown in Fig. 1 is approx. 39 MJ per mole, the amount exceeding known chemical origin.

UTAH - F&P NOW WORKING IN FRANCE

Martin Fleischmann (Dept. of Chemistry, University of Southampton, UK) and Stanley Pons (Dept. of Chemistry, University of Utah, USA), "The Calorimetry of Electrode Reactions and Measurements of Excess Enthalpy Generation in the Electrolysis of D_2O Using Pd-Based Cathodes," The Science of Cold Fusion, Proceedings of the II Annual Conference on Cold Fusion, Como, Italy June 29-July 4, 1991, pp 349-362, 8 refs, 11 figs.

AUTHORS' ABSTRACT

The major measurement technique which we have used in our investigations of the anomalous behavior of palladium cathodes polarized in heavy water has been the calorimetry of these systems. Three types of signatures were detected in our experiments up to October 1989:

1. Low to medium levels in the rates of excess enthalpy generation (0.1 - 100 watts per cu. cm., 5-40 % excess of the rate of enthalpy input to the cells);
2. Increases of the rates of excess enthalpy generation with decreases of the rates of enthalpy input; and
3. Bursts in the rates of excess enthalpy generation lasting for periods of a few hours to 16 days (typically 10 watts per cu. cm., 1000% excess of the rate of enthalpy input to the cells).
It is the magnitudes of the excess enthalpies (typically 50 MJ per cu. cm. in the base line values and up to 16 MJ per cu. cm. in the bursts) which demand explanations of the phenomena in terms of anomalous nuclear processes in these solid state systems. We have continued to use calorimetry as a major method of investigation in the period since October 1989. In this paper we describe the various types of signature which are readily observed using such measurements. We report on the observation of a pattern of behavior intermediate to that of the base line generation of excess enthalpy and the enthalpy bursts which can be observed with some types of cathode materials.

U. S. NAVY - FINDS ^{4}He IN EFFLUENT GASES

M.H. Miles, B.F. Bush, G.S. Ostrom (Chem Div, Naval Weapons Center, China Lake, CA), & J.J. Lagowski (Dept. of Chem, U. of Texas, Austin), "Heat and Helium Production in Cold Fusion Experiments," The Science of Cold Fusion, Proceedings of the II Annual Conference on Cold Fusion, Como, Italy June 29-July 4, 1991, pp 363-372, 20 refs, 3 figs, 2 tables.

AUTHORS' ABSTRACT

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 lack of neutrons, gamma-rays, and other forms of radiation in these experiments has prompted theoretical proposals of fusion processes in the Pd-D lattice that yield only heat and helium as products. Calorimetric evidence of excess heat production during the electrolysis of heavy water using a palladium cathode will be presented. Effluent gas samples collected during episodes of excess heat production and sent to the University of Texas for analysis by mass spectrometry showed the presence of helium-4. Furthermore, the amount of helium detected was within experimental error of the theoretical estimate of helium production. Various control samples gave no evidence for helium. Attempts to measure the neutron activation of metal foils in cold fusion will also be discussed.

Comments from Fusion Facts Editor: ***The U.S. Navy can take great pride in the cold fusion work done by Miles et al., by Szpak (NOSC) and by Chubb (NRL) in making large experimental and theoretical strides in cold fusion.*** *By contrast, the DoE hasn't found out that cold fusion is real.*

UTAH NCFI - TRITIUM EVERY TIME

F.G. Will, K. Cedzynska, M-C Yang, J.R. Peterson, H.E. Bergeson, S.C. Barrowes, W.J. West and D.C. Linton (National Cold Fusion Inst., University of Utah, USA), "Studies of electrolytic and gas phase loading of palladium with deuterium," The Science of Cold Fusion, Proceedings of the II Annual Conference on Cold Fusion, Como, Italy June 29-July 4, 1991, pp 373-383, 11 refs, 8 figs, 2 tables.

AUTHORS' ABSTRACT

Highlights are presented of recent results obtained on the deuterium and hydrogen loading of palladium both in electrolytes and in the gas phase. Experimental approaches are described to achieving deuterium to palladium loading ratios in excess of 1.0. The electrochemical cell design allows continuous determination of the loading ratio and observation of temperature excursions of the palladium electrode with a sensitivity of .05C and a response time of a few seconds. Light water controls are run simultaneously with heavy water cells. Neutron generation is monitored with helium^3 detectors, employing electronics that enables neutron bursts to be observed within a time window of eight microseconds. Gas, electrolyte, and electrodes are analyzed for tritium. Gas phase experiments of the Wada-type have been performed on palladium, using electrical discharges to activate the palladium. Neutron bursts up to 280 neutrons in 120 microseconds and tritium enhancements in the palladium of up to 25 x background have been observed in the palladium.

NEW MEXICO - LANL & NEUTRONS

H.O. Menlove, M.A. Paciotti, T.N. Claytor & D.G. Tuggle (Los Alamos Nat'l Lab), "Low-Background Measurement of Neutron Emission from Ti Metal in Pressurized Deuterium Gas," The Science of Cold Fusion, Proceedings of the II Annual Conference on Cold Fusion, Como, Italy June 29-July 4, 1991, pp 385-394, 7 refs, 5 figs, 4 tables.

AUTHORS' ABSTRACT

A wide variety of neutron detector systems have been used at various research facilities to search for anomalous neutron emission from deuterated metals. Some of these detector systems are summarized here together with possible sources of spurious signals from electronic noise. During the past two years, we have performed experiments to measure neutron emission from pressurized D_2 gas mixed with various forms of titanium metal chips and sponge. Details concerning the neutron detectors, experimental procedures, and results have been reported previously. Our recent experiments have focused on increasing the low-level neutron emission and finding a way to trigger the emission. To improve our detection sensitivity, we have increased the shielding in our counting laboratory, changed to low-background ^3He tubes, and set up additional detector systems in deep underground counting stations. This report is an update on this experimental work.

NEW MEXICO - T & NEUTRONS IN Pd-Si

T.N. Claytor, D.G. Tuggle & H.O. Menlove, "Tritium Generation and Neutron Measurements in Pd-Si under High Deuterium Gas Pressure," The Science of Cold Fusion, Proceedings of the II Annual Conference on Cold Fusion, Como, Italy June 29-July 4, 1991, pp 395-408, 16 refs, 8 figs, 1 table.

AUTHORS' CONCLUSIONS

A reproducible method of tritium generation has been demonstrated. The tritium output scales with the current applied to various configurations of the cells. The tritium yield is found to depend strongly on the type of palladium metal used (powder or foil) and it may be expected that other parameters that have not been investigated thoroughly will have similar effects Various tests for tritium contamination confirm that there is little chance of initial tritium contamination in the powder, foil or other materials used in this study. The tritium and neutron results are self consistent, and consistent with other reports. However, more sensitive neutron measurements are required to give a definitive neutron emission result.

SWITZERLAND - ABSORPTION OF H

Louis Schlapbach (Solid State Physics Group, Univ. of Fribourg), "Hydrogen and its Isotopes in and on Metals," The Science of Cold Fusion, Proceedings of the II Annual Conference on Cold Fusion, Como, Italy June 29-July 4, 1991, pp 409-418, 14 refs, 5 figs.

AUTHOR'S ABSTRACT

A summary description is given of phenomena related to the surface adsorption and bulk absorption of hydrogen and of its isotopes by a metallic host. Thermodynamic and surface properties, electronic and crystal structure and diffusion are illustrated for the examples of the hydride formation of Pd and of $LaNi_5$ as typical examples of hydride forming elemental metals and intermetallic compounds.

CALIFORNIA - EPRI RESULTS

M.C.H. McKubre, R. Rocha-Filho, S.I. Smedley, F.L. Tanzella, S. Crouch-Baker, T.O. Passell & J. Santucci, "Isothermal Flow Calorimetric Investigations of the D/Pd System," The Science of Cold Fusion, Proceedings of the II Annual Conference on Cold Fusion, Como, Italy June 29-July 4, 1991, pp 419-443, 6 refs, 14 figs.

AUTHORS' INTRODUCTION

An experimental program was undertaken to explore the central idea proposed by Fleischmann et al. that heat, and possibly nuclear products, could be created in palladium lattices under electrolytic conditions. Three types of experiments were performed to determine the factors that control the extent of D loading in the Pd lattice, and to search for unusual calorimetric and nuclear effects. It is the purpose of this communication to discuss observations of heat output observed calorimetrically in excess of known sources of input heat. The central postulate guiding the experimental program was that anomalous effects previously unobserved or presently unexplained in the deuterium-palladium system occur at a very high atomic ration D/Pd. Emphasis was placed on studying phenomena that provide a fundamental understanding of the mechanism by which D gains access to the Pd lattice, and how very high loadings (near, at, or perhaps, beyond unity) can be achieved and maintained. Measurements of the interfacial impedance and of the Pd cathode voltage with respect to a thermodynamic reference electrode were made in order to characterize the electrochemical kinetic and thermodynamic processes that control the absorption of D into Pd. Measurements of the Pd solid phase resistivity were used to monitor on-line, the degree of loading atomic ratios, specifically D/Pd, H/Pd and H/D. Calibration of the resistance ratio-atomic ratio functionality has been made by reference primarily to the works of Baranowski [2-4] and Smith [5,6], but also by volumetric observation of the displacement of gas during loading in a closed system at constant pressure and temperature. The overall conclusions of this study are that, by careful control of the electrode pretreatment, the electrolyte composition and the current density, it is possible to load Pd to an atomic ratio approx. $D/P^{\sim} 1$, and to sustain this loading for periods of weeks.

ITALY - GAS LOADING SURVEY

F. Scaramuzzi, "Survey of Gas Loading Experiments," The Science of Cold Fusion, Proceedings of the II Annual Conference on Cold Fusion, Como, Italy June 29-July 4, 1991, pp 445-452, 5 refs, 2 tables.

AUTHOR'S INTRODUCTION

In March 1989 the results of two experiments claiming for nuclear reactions taking place, at room temperature, in metal lattices (Pd and Ti) charged with deuterium, were presented. In both cases the technique chosen for charging the metals with deuterium consisted in using an electrolytic cell, containing heavy water, in which the cathodes were made out of Pd or Ti. Soon later, in April, the Group led by the writer addressed a very straight forward question: if nuclear reactions take place in a metal lattice because of the interaction between the deuterium nuclei and the lattice, is electrolysis the only route to be followed, in order to produce them? Wouldn't it be possible to perform experiments, having the same purpose, by letting the lattice to interact with deuterium in the gaseous phase? The question seemed quite appealing, mostly for one reason: the physical system consisting in an electrolytic cell is a very complicated one, and has to take into account a great number of parameters, while the system consisting in a metal and a gas looks much simpler. The latter would permit much cleaner experimental conditions, and thus it would be possible to analyze more clearly the experiments; it would also favor a higher reproducibility, and would enable testing the proposed theories. Experiments were performed at the Frascati Laboratory of ENEA following this alternative route, using titanium: furthermore, it was decided that, in order to favor nuclear reactions, temperature cycles should be performed on the system (from 77K to room temperature). Positive results were obtained, consisting in the detection of neutron bursts, and were soon published.

ITALY - PHYSICS OF FUSION

Giuliano Preparata (Dep di Fisica, Univ di Milano), "Cold Fusion: What do the Laws of Nature Allow and Forbid?",

The Science of Cold Fusion, Proceedings of the II Annual Conference on Cold Fusion, Como, Italy June 29-July 4, 1991, pp 453-461, 29 refs, 1 fig, 2 tables.

AUTHOR'S INTRODUCTION

I shall try to examine first the strange facts of hydrogen incorporation into Palladium, and then I shall discuss the phenomena of cold fusion in relation to those facts. In the light of the known experimental data I will then discuss the general features of what we might call "possible" and "impossible" theories of cold fusion, somehow drawing a demarcation line between which theoretical ideas can and cannot explain those observations, given the well established and accepted general laws of condensed matter (Quantum Electro Dynamics, QED) and nuclear physics (Quantum Chromo Dynamics, QCD). My discussion will follow quite closely a paper recently completed in collaboration with M. Fleischmann and S. Pons [Possible and impossible theories of Cold Fusion, preprint MITH 91/23 (1991)].

GERMANY - REVIEW OF COLD FUSION

H. Gerischer (Fritz-Haber-Institut der Max-Planck-Gesellschaft, Berlin), "Is Cold Fusion a Reality? The Impressions of a Critical Observer," The Science of Cold Fusion, Proceedings of the II Annual Conference on Cold Fusion, Como, Italy June 29-July 4, 1991, pp 465-474, 14 refs.

AUTHOR'S INTRODUCTION

Having received, at short notice, the invitation to attend the second international conference on cold fusion as a skeptical observer, I began to study some of the papers which have appeared since the fall of 1989 after which I had stopped following the publications in this area. Being skeptical from the beginning, the many negative reports from renowned laboratories seemed to confirm that the disputed claims of cold fusion occurring in a solid were, unfortunately, based on the erroneous interpretation of ill-defined experiments. I now realize that in the meantime many new positive results have been published which cannot be pushed aside quite so easily. Two reviews, currently in the course of publications, were very helpful and yielded much information on the present situation. These are the reviews of M. Srinivasan and E. Storms. Together with my reading and the lectures given on the first days of the conference, I eventually felt able to present my impressions in a lecture on the last day of the conference, as the organizers had requested. I am aware that all the arguments pro and contra the reality of cold fusion have been pointed out by others before. The first part of my contribution to the report of this conference is therefore mainly a reminder of the problems. In the second part I raise some questions seen with the eyes of a physical chemist being specially experienced in electrochemistry.

ENGLAND - FLEISCHMANN REPORTS

M. Fleischmann, "The Present Status of Research in Cold Fusion," The Science of Cold Fusion, Proceedings of the II Annual Conference on Cold Fusion, Como, Italy June 29-July 4, 1991, pp 475-527, 1 fig.

EDITORIAL NOTE: Martin Fleischmann was asked by the Royal Society of Chemistry to give an account of the II Annual Conference on Cold Fusion for the Newsletter of the Electrochemistry Group of the Society. This is a reprint of that article. This article was revewed and quoted extensively in the December 1991 issue of Fusion Facts.

C. NEWS FROM THE U.S.

CALIFORNIA - D IN SKYRME MODEL
Courtesy of Dr. Samuel P. Faile

W.Y. Crutchfield, N.J. Snyderman, and V.R. Brown (Lawrence Livermore Nat'l Lab), "Deuteron in the Skyrme Model," *Phys Rev Letters*, Vol 68, No 11, Mar 16, 1992, pp 1660-1662, 2 figs, 22 refs.

AUTHORS' ABSTRACT

Classical bound-state solutions for the baryon number = 2 section of the Skyrme model have been found by numerical simulations in 3+1 dimensions. The Bohr-Summerfeld level of quantization is implemented. Properties of the deuteron obtained by quantization about the periodic classical solution improve on previous work based on quantization about the minimum energy static toroidal configuration.

MISSISSIPPI - C.F. REVIEW
From Chem Abstracts Feb 10, 1992

M. R. Ault (Aerojet Div., Gen-Corp, Iuka, MS 38852-8998 USA), "Cold fusion: the story behind the headlines," *Radiat. Prot. Manage.* 1991, 8(3), 49-57 (Eng).

ABSTRACT

The article looks at the cold fusion issue which got a lot of attention in 1989. It provides interesting background information, a brief explanation of the experimental methods and problems encountered, and the basis for some of the controversy. The current state of the research effort is also outlined.
45 refs.

NEW YORK - CHEMISORPTION OF H ON Ni
Courtesy of Dr. Samuel P. Faile

Jia Sheng & John Z.H. Zhang (Dept of Chem, N.Y. Univ.), "Dissociative chemisorption of H_2 on Ni surface: Time-dependent quantum dynamics calculation and comparison with experiment," *J. Chem Phys,* vol 96, no 5, Mar 1, 1992, pp 3866-3874, 10 figs, 26 refs.

AUTHORS' ABSTRACT

A time-dependent quantum wave packet method has been applied to studying the process of activated dissociative chemisorption of H_2 on Ni (100) surface. The Ni surface is treated as static and the effect of weak surface correlation is neglected in our dynamics calculations. The

three-dimensional calculation is fully quantum mechanical without any reduced dimension approximation. An empirical London-Eyring-Polany-Sato (LEPS) potential surface has been used and modified in our dynamics calculation to produce a reasonable barrier height compatible with experiment. Sticking probabilities have been computed as a function of initial normal incident kinetic energy and are compared to experimental results as well as another 3D quantum dynamics calculation. Good agreement has been found between our theoretical calculation and molecular beam experiment in the energy dependence of the dissociation probability. It is also found that vibrational excitation of H_2 enhances dissociation probability, in agreement with the prediction of an earlier theoretical calculation. Snapshots of the wave function are plotted that provide intimate details of the dissociation dynamics in time and space.

NEW YORK - C.F. SOCIOLOGY
From Chem Abstracts Feb 10, 1992

B. V. Lewenstein, W. Baur (Dept Commun., Cornell Univ., Ithaca, NY 14 853 USA), "A cold fusion chronology," *J. Radioanal. Nucl. Chem.* 1991, 152(1), 273-97 (Eng).

ABSTRACT

To assess the historical and sociological significance of the cold fusion saga, researchers need accurate information about the dates of various events associated the saga. Based on materials in the Cornell Cold Fusion Archive, this article provides both a chronology and citations to documentary evidence for cold fusion events for 1926 to the end of 1990. 163 refs.

NEW YORK - PULSED CURRENT
From Chem Abstracts, March 9, 1992

Janet Osteryoung, (SUNY, NY), "Square-wave and staircase voltammetry at small electrodes," *NATO ASI Ser., Ser. E*, 197(Microelectrodes), 1991, pp 139-175, 19 refs.

AUTHOR'S ABSTRACT

Square-wave and staircase voltammetry at small electrodes constitute dynamic experiment in which a train of pulses is applied at a stationary electrode. The response thus depends in a complex way on the size and shape of the electrode as well on the parameters of the excitation. The most striking feature of the response is that in square-wave voltammetry the peak shape and position are largely independent of the size and shape of the electrode for reversible systems. Attributes of square-wave and staircase voltammetry are illustrated for embedded circular and for cylindrical electrodes, and for arrays. Applications in which nonplanar diffusion is an important aspect include anodic stripping voltammetry and mechanistic studies.

NEW YORK - 3D IMAGING
From Chem Abstracts, March 9, 1992

J,J.Barton, L.J. Terminello (T.J. Watson Research Center, IBM, New York), "3D images of surface structure from photoelectron holography," *Springer Ser. Surf. Science*, 24(Struct. Surf. 3), 1991, pp 49-54, 7 refs.

AUTHOR'S ABSTRACT

Photoelectron holography combined the image reconstruction theory of inline holography with the electron scattering theory of photoelectron diffraction to open an avenue to fully 3-dimensional imaging of surface adsorption sites. Image degradation from electron multiple scattering and holography twin images can be reduced by an analysis exact Fourier filtering process. Experimental holograms and the progress to date on solving the practical problems which remain in the multidimensional data analysis leading toward 3-dimensional images are discussed.

NEW YORK - SOLID-ELECTROLYTE C.F.
From Chem Abstracts, February 24, 1992

Evan Granite, Jacob Johne (University of Rochester, New York), "A novel method for studying electrochemically induced cold fusion using a deuteron-conducting solid electrolyte," *Journal Electroanal. Chem, Interfacial Electrochem.*, 317(1-2), 1991, pp 285-290.

AUTHOR'S ABSTRACT

The solid state apparatus (e.g. an electrochemical cell with beta"-alumina placed between 2 porous Pd electrode, D_2, Pd/beta"-alumina/Pd, P_2) allowed the application of an electrochemical potential in a gas-loading experiment bursts of neutrons have been observed during the solid state electrolysis of deuterium, although firmer evidence is needed addressing the questions of reproducibility, simultaneous background measurements and neutron energy spectrum. Temperature measurements showed no excess enthalpy and a limit of detection of 10^{-10} fusions/D-D pair per sec has been estimated. Catalytic recombination of deuterium and oxygen (previously generated in a D_2O pre-electrolysis cell) over a polarized palladium catalyst did not reveal excess neutrons or enrichment in tritium concentration. Further experiments are needed to establish the energy spectrum of the emitted neutrons, the reproducibility from test to test and the comparison with an independent background counter.

PENNSYLVANIA - VOICE FROM THE PAST
Courtesy of Dr. Samuel P. Faile

Carl Hering (Fellow, A.I.E.E, Consulting EE, Philadelphia), "Electromagnetic Forces: A Search for More Rational Fundamentals; a Proposed Revision of the Laws," originally published *Trans Am. Inst. Elect. Engineers,* vol 42, no 311, (1923), pp 311-325, 17 figs. Reprinted in *Deutsche Physik*, Vol 1, no 3, July-Sept 1992, pp41-50 with Editor's Comments.

AUTHOR'S ABSTRACT

Reasons are given why it is desirable to revise some of our older laws regarding electromagnetic forces and motions which are the basis of all electromotive devices, in order to conform better to more modern developments. Researches with high-current densities is such mobile conductors as liquids and arcs, have brought out some heretofore unnoticed forces, the existence of some of which had been denied. some of our older laws are claimed to mislead, to be inaccurate, incomplete, to involve unnecessary complications such as the forced definitions of a sliding contact, are based on the wrong fundamentals, specify results contrary to the facts, and are not universal, thereby checking possible progress if accepted as universal. A new and simple general law is proposed, based on one of the fundamental universal laws of physics. It is shown how this might also be made the basis of a much desired universal law of induction. It leads to the existence of a force longitudinal to the conductor, which our older laws deny. Numerous experiments are described illustrating and bearing out the arguments. suggestions are made showing how the laws and the present usual methods of mathematical treatment of such forces might be revised in order to make them more satisfactory, easier for the student to understand, and for the engineer to use. If the alleged improper restrictions imposed by former laws are removed, developments in new fields may become possible. In conclusion a tentative plan for revision is suggested.

DEUTSCHE PHYSIK'S EDITOR'S COMMENTS

The preceding paper shows clearly that something is rotten in the realm of physics. The experiment presented by Hering in his figure 9 [An experiment with one conductor joining another conductor at right angles with the vertical conductor free to move left and right along the horizontal conductor. The experiment shows conclusively that there must be a current-induced force parallel with the current.] give an indisputable demonstration that there are magnetic forces acting in parallel to the current elements. According to the Lorentz equation and to Grassmann's formula which is a direct inference from the Lorentz equation, the magnetic force must be always perpendicular to the current element. Can one then consider physics as a respectable science if 70 years it has worked with a formula which is contradicting an experimental fact that can be checked by every child?

One will perhaps object that with the wrong Lorentz equation the Americans have landed on the Moon. Yes, the Americans have landed, but nevertheless, **the formula is WRONG**.

And look which were the motivations of the editors who refused the publication of Hering's paper: a) Publication was at first refused on the ground that if the experimental evidence was correct, which was easily demonstrated, it was so serious a matter to change one of the older laws, that it ought to be kept a secret. b) In another case the refusal was because it was "so subversive of long established principles", and in physics the age of a law is considered more important than its correctness.

Middle ages! Realm of darkness and obscurantism! That's our physics.

COMMENTS BY *FUSION FACTS* EDITOR

If we are still having problems with the basics of electricity, can we not be a bit less dogmatic in viewing the data of cold fusion. Perhaps we are missing some major point in our traditional view of the Coulomb barrier. I share the enthusiasm of an old-time supervising engineer when he complained about a newly graduated engineer saying, "They know too damn many things that aren't so!"

NORTH CAROLINA - Li + D CROSS SECTION
From Chem Abstracts, February 24, 1992

J.Z. Williams, G. Feldman, H.R. Weller, D.R. Tilley (Duke University),"The ^{6}Li(d)^{8}Be reaction at E_3=9.0 MeV and the D-state of beryllium-8," *Physics Letter B*, 273(3), 1991, pp 211-215.

AUTHOR'S ABSTRACT

Measurements of the ^{6}Li(d,gamma)^{8}Be cross section, sigma(theta), the vector analyzing power. A_V(theta) and the tensor analyzing powers, A_{VV}(theta) and T_{20}(theta) were obtained at $<E_{dLab}>$ = 9.0 MeV. A transition matrix element analysis was performed. A direct-capture and a multichannel resonating group model (MCRGM) calculation indicated a ^{6}Li + *d*D-state probability of (0.3-1.5)% in the ground state of ^{8}Be.

SOUTH CAROLINA - Pd HYDRIDE
From Chem Abstracts, March 9, 1992

R.T. Walters, M.W. Lee (Savannah River Lab), " Two plateaux for palladium hydride and the effect of helium from tritium decay on the desorption plateau pressure for palladium tritide," *Mater. Charact.*, 27(3), 1991, pp 1577-66.

AUTHOR'S ABSTRACT

Two plateaux are observed in the desorption isotherm for palladium hydride; a lower plateau pressure for a hydrogen/metal atom ratio (H/M) less than about 0.3 and slightly higher plateau pressure for H/M greater than about 0.3. This higher pressure corresponds to the reported pressure for palladium hydride. These observations were made for a large surface area palladium powder exposed to both protium and tritium. Helium buildup from tritium decay decreases the lower plateau pressure but does not affect the observations for H/M greater than about 0.3. A multiple-energy hydrogen site occupancy model is proposed to explain qualitatively both the dual plateau and the helium effect in palladium hydride.

WASHINGTON, D.C. - COLD FUSION BOILER
Courtesy of Marge Hecht

Carol White & Laurence Hecht (with 21st Century Science and Technology), "Cold Fusion Boiler to be Built this Year," *The New Federalist*, April 6, 1992, pg 9.

The authors report on a packed press conference at the National Press Club in Washington, D.C. to hear Dr. Giuliano Preparata (University of Milano, Italy) talk about cold fusion progress. Dr. Preparata announced the release of the book The Science of Cold Fusion, which contains the papers given at the Como, Italy conference held in Como, Italy in July 1992. Preparata emphasized that the greatest importance with the giving birth to a new science.

Preparata announced that Dr. Stanley Pons expects to have a demonstration boiler operating at about 158 F by the end of the year. The boiler will be powered by a cold fusion reactor. Preparata stated that Drs. Fleischmann and Pons have been financed by the Japanese high-tech consortium Technova. They have been working with a group of 10 assistants in a laboratory in Nice, France.

Dr. Eugene Mallove (author of Fire From Ice) chaired the session. Mallove reviewed the unfair treatment suffered by cold fusion scientists at the hands of poorly informed scientists who failed to understand the importance of the new science of cold fusion. Mallove stated, "Within this decade, I would expect to see cold fusion cells heating homes and perhaps even powering home-generating stations in certain situations."

Preparata gave a strong observation, "We are witnessing the birth of a new physics here, but the scientific establishment behaves like a priestly caste that will not allow in any new ideas. Really, we are in a situation with respect to microphysics analogous to the situation after Copernicus had shown that the Ptolemaic epicycles could be replaced."

[We applaud both Preparata and Mallove for their continued fight for the acceptance of cold fusion as a reality. Ed.]

WASHINGTON - CLUSTER IMPACT
From Chem Abstracts, February 24, 1992

R. Vandenbosch, T.A. Trainor, D.I. Will, J. Neubauer, I. Brown (University of Washington, Seattle), "Cluster-impact-fusion yields: no collective effect observed for small water clusters," *Physics Review Letter*, 67(25), 1991, pp 3567-70.

AUTHOR'S ABSTRACT

D + D nuclear fusion rates were measured for 225-keV water cluster anions OD^-, O_2D_{3-}, and O_3D_{5-}. Contrary to a recent report for similar cations, these rates fall rapidly with cluster size and are consistent with free-deuteron rates.

D. NEWS FROM ABROAD

CHINA - ELECTRODE POTENTIAL
From Chem Abstracts, February 24, 1992

Linshao Zhang, (Jilin University, China), "An expression of absolute electrode potential of hydrogen electrode reaction," *Gaodeng Xuexiao Huaxue Xuebao*, 12(6), 1991, pp 806-808.

AUTHOR'S ABSTRACT

An expression given of the absolute electrode potential of hydrogen electrode reaction which is obtained from the electron transition condition expression of the hydrogen electrode reaction of the thermal activation theory extended in the compact electric double layer.

CHINA - COULOMB SCREENING
From Chem Abstracts, February 24, 1992

Shunjin Wang, (Department Mod. Physics, Lanzhou University, China), "Effect of Coulomb screening on

deuterium-deuterium fusion cross section," *Gaoneng Wuli Yu Hewuli*, 15(8), 1991, pp 761-764.

AUTHOR'S ABSTRACT

The popular Gamow formula for the *d-d* fusion cross-section is generalized to take into account the Coulomb screening effect. The generalized formula was used to discuss the fusion process occurring in the metal medium.

DENMARK - GAMMA EMISSIONS
From Chem Abstracts, March 9, 1992

D. Britz, (Kem. Inst., Aarhus University, Aarhus, Denmark), "Parameter correlations in cold fusion measurements," *Journal Radioanal. Nuclear Chemistry,* 155(6), 1991, pp 377-382.

AUTHOR'S ABSTRACT

Cross correlations as a function of time-shift between gamma-emissions and electrolysis cell temperature, in a cold fusion experiment by Birgul, et. al. (1990), were calculated, and show a distinct maximum of 0.34.

DENMARK AND BRAZIL - FUSION ENHANCEMENT
Courtesy of Dr. Samuel P. Faile

C.H. Dasso (Univ or Copenhagen) & R. Donangelo (Univ Federal do Rio de Janeiro), "Fusion enhancement via the soft dipole mode in neutron-rich nuclei," *Physics Letters B,* vol 276, 1992, pp 1-2, 2 figs, 9 figs.

AUTHOR'S ABSTRACT

Neutron-rich nuclei exhibit a soft dipole mode which we show may lead to an important dynamical enhancement of the fusion cross section at subbarrier energies. This effect could ease the formation of heavy systems through fusion reactions induced by radioactive beams.

ENGLAND - TRANSMUTATION IN PdD
From Chem Abstracts, February 24, 1992

I.M. Chapnik, (Birkbeck Coll., University of London), "Possibility of electrochemically induced transmutation in palladium deuteride (PdD)," *Physics Letter A*, 161(2), 1991, pp 111-113.

AUTHOR'S ABSTRACT

New data are discussed in connection with a previously published article by Kuehne (1991) on the possibility of induced beta radioactivity in PdD.

FINLAND - IMPACT FUSION
From Chem Abstracts, February 24, 1992

S. Valkealahti, M. Manninen, E. Hammaren (Department of Physics, University, Jyvaskyla, Finland), "Simulation of cluster impact fusion," *At., Mol. Clusters*, 22(2), 1992, pp 547-551.

AUTHOR'S ABSTRACT

We report molecular dynamics simulations of impact of TiD clusters on TiD targets. In each cluster collision the total fusion probability seems to be due to a single D-D collision. The kinetic energies of incident D atoms gradually level off around the initial cluster energy, but do not reach the high energy tail of a corresponding Maxwell-Boltzmann distribution. Neither any other support for a thermonuclear fusion mechanism was observed. The enhanced fusion rate is rather due to channeled many-atom collision cascade type mechanism.

FRANCE - IMPACT FUSION
From Chem Abstracts, February 24, 1992

Alexandre E. Pozwolski, (Paris, France), "Cumulative effects in impact fusion," *Indian J. Pure Appl. Physics*, 30(1), 1992, pp 33-34.

AUTHOR'S ABSTRACT

Conversion of the kinetic energy of a projectile into heat is a powerful means to get high temperatures expected for fusion. But if the projectile is deuterated, Pd fusion may occur just when loading the metal with D. Moreover just at the moment of the impact the rupture of the crystals may result in fractofusion. Finally, fusion may also result by tunneling the Coulomb barrier at intermediate temperatures.

FRANCE - SHAPE OF DEUTERON
From Chem Abstracts, February 24, 1992

Alain Boudard, Michel Garcon, Stephane Platchkov (France), " What shape has the deuteron?," *Recherche*, 22(235), 1991, pp 1094-1097, 6 refs.

AUTHOR'S ABSTRACT

Investigations of the electromagnetic structure of the deuteron using electron beam scattering.

GERMANY - EXCITATION IN ALKALI-METAL
Courtesy of Dr. Samuel P. Faile

H. Ishida & A. Liebsch (Inst für Festkorperforschung, Julich), "Electronic excitations in thin alkali-metal layers adsorbed on metal surfaces", *Phys Rev B*, Vol 45, No 11, 15 Mar 1992, pp 6171-6187, 11 figs, 63 refs.

AUTHORS' ABSTRACT

The dynamical linera-response properties of realistic Na and K layers adsorbed on a semi-infinite jellium substrate corresponding to the electron density of Al are studied with the aim of elucidating the nature of the adlayer electronic excitations and their variation with coverage. The ground-state properties are described by a first-principles method and the dynamical response in the long-wavelength limit is treated within the time-dependent density-functional approach. At coverages near the work-function minimum, the adsorbate-induced excitations are dominated by intra-atomic excitations between adatom resonant states. Nevertheless, these atomiclike transitions do not lead to any spectral features in the electron-energy-loss function because of the strong hybridization between adatom and substrate states. Instead, as a result of surface screening processes and matrix element effects, a broad loss peak appears near the threshold for emission. This mechanism explains the frequently observed correlation between the coverage dependence of the work function and that of the energy loss induced by the alkali-metal adlayer. As the coverage is increased to one monolayer, the threshold mechanism is replaced by collective excitations consisting of heavily broadened volume plasmons and multiple surface plasmons of the alkali-metal adsorbate. At double-layer coverage, these two modes become very sharp and can clearly be resolved. These collective excitation show only small influence due to the lattice structure of the alkali-metal adlayer.

AUTHORS' SUMMARY

We have studied the dynamical linear-response properties of alkali-metal adlayers on metal surfaces in the long-wavelength limit based on a first-principles method. Realistic three-dimensional Na and K layers in a wide range of coverage values were used as adlayers, and the metal substrate was modeled by semi-infinite jellium with r_S=2 corresponding to the electron density of Al. We calculated the density response to a uniform electric field oriented normal to the surface and also the current response to a uniform field parallel to the surface within the time-dependent density-functional theory in order to elucidate how the nature of the adsorbate excitation changes with coverage.

At low theta [symbol for number of adlayers], the screening process is dominated by the intra-atomic excitations between adsorbate resonances, and the induced density is strongly localized near the adatoms. However, it was found that these atomiclike transitions are rather broad because of the strong adsorbate-substrate orbital interaction. Thus, in contrast to the traditional picture, these transitions do not lead to any observable features in the electron-energy-loss function. Instead, as a consequence of the surface screening process and matrix-element effects, the loss function at theta near the work-function minimum exhibits a threshold enhancement which correlates with the theta dependence of the work function. Toward monolayer coverage, a strong peak appears in the loss function due to collective excitations localized in the quasi-two-dimensional adlayer because of the formaton of wide free-electron-like resonant bands. At monolayer and double-layer coverages, the adlayer-induced collective modes (multiple surface plasmon and adsorbate volume plasmon) are virtually unaffected by the lattice structure of Na and K layers and they are well described within the two-step jellium model.

The plasmon excitations in adsorbed alkali-metal layer have been observed not only on Al as investigated here but also on transition metals and even on semiconductor. In the latter case, the free-electron-like resonant bands of alkali-metal adlayers are strongly modified by the interaction with localized substrate states. Nevertheless, the observed features of the adsorbate response properties in such systems are quite similar to those on Al. It would be interesting to study how the results obtained in the present study using a jellium substrate (delocalized limit) may be generalized to systems involving more localized states.

GERMANY - D-D FUSION IN A MINIREACTOR
From Chem Abstracts, Jan 13, 1992

H. Gentsch (Univ of Essen), "Deuterium-deuterium fusion reactions in a palladium-silver (deuterium) target in a minireactor," er Bunses - Gex Phys Chem, **1991**, vol 95, no 10, pp 1283-86.

ABSTRACT

Deuterium ions with an energy of < 30 keV collide with D-saturated PdAg as a target. If the ion energy is > 25 keV, then a measurable neutron flux is noticeable. Results for ion currents of 2 microamps and 27 keV are reported. The PdAg, in the form of a tube closed on one side, serves as the cathode of an electrolytic cell. The

open side is connected to a vacuum apparatus. From this side, a coaxially arranged high-voltage insulated-collision ion gun is projected into the tube. It produces ions from the gas diffusing into it, which are accelerated in the electric field in the vacuum gap between the ion gun and the metal tube and penetrate the metal with a high energy compared to the diffusion current. The fusion rate is a factor of 100 greater than in a pure gas target.

GERMANY - D BINDING ENERGY
From Chem Abstracts, March 9, 1992

K.H. Gronemeir, O. Kranz, (Tech. Univ. Braunschweig, Germany), "Calculation by approximation of the binding energy of the deuterium nucleus," *Prax. Naturwiss., Phys.*, 40(8), 1991, pp 14-15.

AUTHOR'S ABSTRACT

The process used previously on a simple atom, atom-ion, and molecule can be used in calculating the nuclear binding energy of the N(p + n) in the D nucleus. A nuclear binding energy of 2.2 MeV is released if the formation of the D nucleus from a *p* and *n* takes place by a strong interaction or must be absorbed if the *p* and *n* of the D nucleus are to be separated. The minimal principle of total energy with quantization of the rotational momentum lends itself useful in the approximation calculations without a great expenditure in calculation time.

GREECE - BAND STRUCTURE
Courtesy of Dr. Samuel P. Faile

M. Sigalas (Res Centre of Crete), D. A. Papaconstantopoulos (NRL, Wash, D.C.) & N.C. Bacalis (Nat'l Hellenic Res Found., Athens), "Total energy and band structure of the 3d, 4d, and 5d metals", *Physical Rev B, Condensed Matter*, Vol 45 No. 11, 15 Mar 1992, pp 5777-5783, 2 figs, 8 tables.

AUTHORS' ABSTRACT

We performed total-energy calculations by the scalar-relativistic augmented-plan-wave method in the local-density and muffin-tin approximations for all 3d, 4d, and 5d transition metals in the fcc and bcc structures. These calculations predict the correct equilibrium structure and give good agreement with experiment and other calculations for lattice constants and bulk moduli.

AUTHORS' SUMMARY

We present a systematic study of the crystal structure stability between fcc and bcc for all the 3d, 4d, and 5d metals including the alkaline-earth elements. Our results predict the correct crystal structure for all elements except for Fe in agreement with previous works. Equilibrium lattice parameters and bulk moduli have the usual, in the LDA, small discrepancies from experiment with the 5d series giving the best agreement. We also presented a compendium of characteristic bandwidths and Fermi level values of density of states across the Periodic Table.

HUNGARY - FINAL WORLD FLASH ON C.F.
Courtesy of Dr. Peter Glück

T. Braun (Inst of Inorganic & Anal Chem, L. Eöstvös Univ), "World Flash on Cold Fusion No. 13 (Final one in the Series), A Selective, Annotated Bibliography", *J. Radioanal. Nucl. Chem., Letters*, (to be published), 30 papers reviewed.

AUTHOR'S COMMENTS

This is the thirteenth (and final) part of a flash on a topic which produced a great deal of excitement when made public on March 23, 1989. Terminating the bibliography with part no. 13 can be considered symbolic and reflecting the actual (ambiguous) situation in this topic. For a chronological snapshot on cold fusion interested readers are recommended to consult the following review: B.V. Lewenstein, W. Baur, "A Cold Fusion Chronology", *J. radioanal. Nucl. Chem., Articles,* **152,** (1991) 273.

... The following table gives an overview on the results of cold fusion research as reflected in the papers published in parts 1-13 of the biblography.

STATISTICAL INVENTORY OF PARTS 1-13

Heat	Neutrons	Gammas	Tritium
Positive:			
16	31	12	8
Negative:			
20	55	33	19

EDITOR'S COMMENTS

Science is not decided by vote. The report shows that there were 127 negative reports as compared with 67 positive reports. In previous "flashes" Dr. Braun has stated that he has only reported on papers that he has read. In the excellent summary article by Dr. Edmund Storms (Los Alamos National Laboratory) that was received by *Fusion Facts* May 10, 1991, Storms cites 21 papers that reported excess heat; 36 for neutrons; 13 for tritium. Many additional positive papers have been reviewed by *Fusion Facts* during the 10 months since receiving Dr. Storms article. **The major points are: 1. Successes in cold fusion experiments requires that one be**

"skilled in the art"; 2. Failure to achieve is not proof; and 3. One well conducted experimental success outweighs any number of failures. Therefore we are indebted to Dr. T. Braun for his catalog of the many successes in cold fusion. We might also point out that Pons & Fleischmann; McKubre & associates (SRI, International); Bush & Eagleton (Cal Poly); Mills (Mills Technology); and several others are each now having continued positive results with cells now numbering into the dozens or hundreds. Commercialization has begun regardless of the negative vs. positive counts.

IRELAND - H DIFFUSION
Courtesy of Dr. Samuel P. Faile

F.A. Lewis & X.Q. Tong (Queen's Univ, Belfast), "Gorsky effect origins of uphill hydrogen diffusion in $Pd_{81}Pt_{19}$, $Pd_{77}Ag_{23}$ and palladium membranes," *Jrnl of Alloys & Compounds*, vol 179, Feb 21, 1992, pp L13-L19, 4 figs, 20 refs.

EDITOR'S COMMENTS

In this letter, the authors observe, "Over recent years explanations in terms of Gorsky effects initiated by diffusion elastic effect developments of gradients of lattice expansive strain have been advanced to account for temporary 'uphill' (against overall gradients of concentration) fluxes of hydrogen into or out of membranes of palladium and palladium alloys." They note that such effects can provide a source of complication in deriving hydrogen diffusion coefficients. In some of their work they used thin-wall PdAg alloy tubes. This letter may provide additional insight into the diffusion of hydrogen and deuterium into some type of cathode materials used in cold fusion experiments.

JAPAN - RECALIBRATION
Courtesy of Jed Rothwell

A faxed note from Dr. Akito Takahashi indicates that the room in which Dr. Takahashi is doing his experiments is designed for low-neutron background count and not for constant temperature. The result is that there is about a 1.8 C temperature change possible in the "20 C line" on the recorder. Using a worse-case analysis, this change could account for as much as 30 watts overestimation of excess heat from the experimental cold fusion cell. Therefore, Prof. Takahashi has modified his experimental data to report an average of about 30 watts. Specifically, using these worst-case assumptions, the Takahashi cell produced a net output energy of 160 Joules from Dec 14, 1991 to Feb 14, 1992. The average input power was 50 watts and the average output power was 82 watts (an average excess power of 32 watts). The average excess heat observed per week is about 25 megajoules. This amount is more than 1,000 times the possible chemical heat that could be produced. In addition, there was an observed correlation between heat and neutron yield. The obvious logical conclusion: **<u>An unknown nuclear fusion reaction is being observed.</u>**

JAPAN - D INTERACTION
From Chem Abstracts Feb 10, 1992

K. Tsuchiya, Yoshiko Ohashi, K. Ohashi, M. Fukuchi (Dep Electron Eng., Tokyo Natl. Coll. Technol., Hachioji, Japan 193), "Interaction between two neighboring deuterium atoms in palladium," *J. Less-Common Met*, 1990, 174(1-2), 1371-80.

ABSTRACT

The nearest neighbor distance between 2 D atoms in a face-centered cubic Pd lattice was established by taking into account the effect of an electronic screening cloud. The lattice was assumed to contain a D at the nearest neighbor octahedral site to a vacancy, and the potential energy field experienced by another D was constructed by a pair potential technique. In this resulting field, the Schrodinger equation for another D atom was solved, and the distances between 2 neighboring D atoms was established. Our result for the distance was approximately 0.66 Angstrom, which is smaller than the molecular value of 0.74 Angstrom.

JAPAN - DEUTERIDE FORMATION
From Chem Abstracts Feb 10, 1992

Takao Yamamoto, R. Taniguichi, T. Oka, K. Kawabata, (Res. Inst. Adv. Sci Technol., Univ. Osaka Prefect., Sakai, Japan 593), "In situ observation of deuteride formation in palladium foil cathode by an x-ray diffraction method," *J. Less-Common Met.* 1991, 174(1-2), 1381-7 (Eng).

ABSTRACT

In situ x-ray diffraction observation of a Pd foil cathode (10 micro meter in thickness) was carried out during electrolysis of alkaline heavy water and light water with high overpotentials. The foil cathode served as a wall of an electrolytic cell. One of the purposes was to evaluate the D concentration in the Pd cathode used by Taniguchi et al. (1989 who claimed the possible occurrence of electrochemically-induced cold fusion in a similar cell. No literature data were found by which we could evaluate the high chemical potential of D in a Pd cathode during the electrolysis of alkaline heavy water with such high overpotentials. The lattice constants of the deuteride and hydride phases (beta-PdD_X and beta-PdH_X) were

investigated as a function of applied potential by iterative in situ x-ray diffraction measurement during the electrolysis. The highest lattice constants observed were 4.07 Angstrom for both deuteride and hydride.

JAPAN - TRITIUM FROM Pd
From Chem Abstracts, March 9, 1992

Eiji Kikuchi, Kiyoshi Nomura, Norio Nogawa, Hideo Saito, Kiminori Itoh, Hiroshi Niikura, Masayuki Murabayashi (University of Tokyo, Japan), "Effect of charging current density on release characteristics of tritium from palladium," *Denki Kagaku oyobi Kogyo Butsuri Kagaku*, 59(10), 1991, pp 880-884.

AUTHOR'S ABSTRACT

Electrochem. charging of Tritium into an annealed Pd foil (12.5 micrometer) cathode was carried out at 0.1-100 mA/cm^2 in 0.1M NaOH containing 0.37 MBq/LT and the release rate of T from Pd were measured as a function of time by a liquid scintillation counter. The release rate decreased as the current density on charging increased, suggesting that there are some states with the different energy barrier to be occupied by absorbed H into Pd. Microstructure of Pd was observed by a transmission electron microscope before and after annealing. The release rate also decreased by annealing.

POLAND - H & D IN THIN Pd
From Chem Abstracts, February 24, 1992

Andrezej Czerwinski, Roberto Marassi, Silvia Zamponi (Warsaw University, Poland), "The absorption of hydrogen and deuterium in thin palladium electrodes. Part I. Acidic solutions, *Journal Electroanal. Chemistry Interfacial Electrochem.*, 316(1-2) 1991, pp 211-221.

AUTHOR'S ABSTRACT

A comparative study of hydrogen and deuterium sorption in acidic solutions (0.5M H_2SO_4 and D_2SO_4), using electrodes obtained by electrochemical deposition of a thin layer of palladium on gold was performed. Additional results were obtained with electrodes in which the thin palladium film was deposited on an inert substrate of RVC (reticulated vitreous carbon). The amount of absorbed hydrogen or deuterium has been found to depend on the electrode potential. The maximum H(D)/Pd ratios, at potentials slightly positive of the gas evolution, were 0.73 for hydrogen and 0.70 for deuterium respectively. The isotopic effect for alpha-phase formation appears to be greater than that for the alpha-beta transition.

RUSSIA - ELECTROMAGNETIC VORTEX
Courtesy of Dr. Samuel Faile

Yu. R. Alanakyan (Translated by D. Parsons), "Self-localized electromagnetic vortex in a dense gas," *Soviet Physics JETP, Jrnl of Experimental & Theoretical Physics"* vol 101, no 1, p 53-59, Jan 1992, 18 refs. Published by American Inst. of Physics.

AUTHOR'S ABSTRACT

An electromagnetic vortex self-localized in a region surrounded by a plasma with a high electron temperature is analyzed. It is assumed that the plasma in the interior of the vortex is compressed by the vortex, so its pressure is well above that in the external region. The vortex energy and the plasma pressure in the interior are directly proportional to each other in this case. The entrainment of plasma electrons by the vortex is taken into account. It leads to the generation of a magnetic field. A static magnetic field tends to reduce the energy loss due to the escape of hot particles from the plasma into the surrounding gas. The parameters of the vortex and the plasma are estimated for the case in which the vortex forms in a gas whose compositions and pressure are nearly atmospheric. The mechanism for the appearance of a vortex during the propagation of an electromagnetic wave through a nonlinear medium is discussed. A hypothesis is offered regarding the mechanism for the formation of a vortex during a lightning discharge.

RUSSIA - DECISIVE EXPERIMENT
From Chem Abstracts, February 24, 1992

S.S. Gershtein, L.I. Ponomarev (USSR), "Decisive experiment in cold fusion," *Ref. Zh., Khim.*, 1991, in Russian. Title only translated.

RUSSIA - NEUTRON EMISSION
From Chem Abstracts, March 23, 1992

A.G. Lipson, B.F. Lyakhov, B.V. Deryagin, V.N. Kudryavtsev, Yu Toporov, V.A., Klyuev, M.A. Kolobov, D.M. Sakov (Institute Fiz. Khim, Moscow), "Reproducible neutron emission during the combined effects of cavitation and electrolysis on the surface of a titanium cathode in heavy-water-based electrolytes," *Pis'ma Zh. Tekh. Fiz.*,17(21), 1991, pp 33 - 37.

AUTHOR'S ABSTRACT

The feasibility was studied of intensifying the emission on neutron during the action on a Ti cathode of cavitation

and electrolysis of heavy water. For this purpose, a magnetostriction vibrator (operating at 15kHz) serves as the cathode in an electrolytic cell with separated (by glass filters) cathode and anode compartments. The anode was a Pt plate. The electrolyte consisted of a 1M solution of NaOD in D_2O and O.2M solution of D_2SO_4 and D_2O. The current density values ranged from 1 to 100 mA/cm^2. The reproducibility (80-90%) of neutron emission by the combined action of electrolysis and cavitation-treatment on the surface of a Ti vibrator (cathode) in alkaline and acidic solutions was obtained. The effect is observed with a high degree of confidence on the basis of large statistical values of the exposure time. A method was determined for intensifying the neutron emission during electrolytic saturation of Ti with D and for carrying out the process on a mechanical activated Ti surface.

RUSSIA - NEUTRONS FROM Ti-Fe
From Chem Abstracts, March 23, 1992

V.V. Lobanov, A.S. Zetkin, G.E. Kagan, V.B. Demin, I.I. Mil'man, A.I. Syurdo (USSR), "Study of neutron emission from deuterium-saturated titanium-iron alloys at room temperature," *Pis'ma Zh. Tekh, Fiz.,* 17(23), 1991, pp 22-25.

AUTHOR'S ABSTRACT

Considering the occurrence of the following reaction: D + D -> n (2.45 MeV) + ^{3}He (0.82 MeV), experimental data are presented from a study of the emission of neutrons from a Ti-Fe alloy (46.14 at.% Fe) preliminarily saturated with D from the gas phase during its confinement in a dynamic vacuum at room temperature. The results attest to the pulsed nature of the neutron yield from the alloy deuterated in the gas phase under the above conditions.

SPAIN - D_2O ELECTROLYSIS
From Chem Abstracts, March 9, 1992

E. Brillas, J. Esteve, G. Sardin, J. Casado, X. Domenech, J.A. Sanchez-Cabeza (University of Barcelona, Spain), "Product analysis from heavy water electrolysis with palladium and titanium cathodes," *Electrochim. Acta*, 37(2), 1992, pp 215-219.

AUTHOR'S ABSTRACT

The enrichment of tritium in the electrolyte and incorporation of Tritium, Li, and Pt in cathodes during the electrolysis of 0.1 M LiOD solutions with Pd and Ti cathodes in open cells were studied. All electrolytes show an increase in their tritium activity which is explained by considering values for the T-D separation factor of all cathodes lower than 1. Accumulation of small amounts of Tritium in the Pd bulk, proceeding from the absorption of the species pre-existing in the electrolyte, has been detected by electrolytic transfer of accumulated tritium to a 0.1 M LiOH solution, as well as by extraction of gases absorbed in the cathode, which were identified by mass spectrometry. Small quantities of Li and Pt are also incorporated in Pd and Ti cathodes, which increase by raising the current density SIMS analysis of both cathodes show a preferential accumulation of Li and H in their surface layers and confirms the absence of T in Ti.

SWEDEN - RADIATION OBSERVED
From Chem Abstracts, February 24, 1992

Derek Lewis (Consult. Group, Studsvik Energitek., Sweden), "Some regularities and coincidences in thermal, electrochemical, and radiation phenomena observed in experiments at Studsvik on the Fleischmann-Pons effect," *Journal Electroanal. Chem. Interfacial Electrochem.,*316(1-2), 1991, pp 341-345.

AUTHOR'S ABSTRACT

Experimental work on the Fleischmann-Pons effect (electrochemically induced nuclear fusion) confirmed the generation of excess enthalpy induced by electrolysis and demonstrated coincidence between thermal and radiation events during electrolysis, thus supporting the contention that the primary source of excess enthalpy is a nuclear reaction in the electrolysis of D_2O at a Pd cathode. No steady increase of neutron count rate above background was found to accompany this steady generation of excess enthalpy, but intense flares of neutrons were observed sporadically during the electrolysis. Three definite coincidences between radiation and thermal events in these experiments have been found thus far. In the 1st of them, an independently observed, large burst of cosmic-ray activity at ground level is seen to have quenched for a short time the steady generation of excess enthalpy in 1 experiment. In the 2nd, a similar result was produced by a lab source of neutrons, briefly placed close to the electrolytic cell. In the 3rd, a sharp peak of excess enthalpy, which appears to have occurred spontaneously, clearly coincides with a peak in the neutron count rate, much above background and broad relative to the flares usually observed.

VIETNAM - NUCLEAR FUSION AT NORMAL TEMP
From Chem Abstracts Feb 10, 1992

Tran Dai Nghiep, Tran Duc Thiep, Truong Thi An, Phi Thanh Huong, Tran Van Vuong (Trung Tam Vat Ly Hat Nhan, Vietnam), "Investigation of nuclear fusion at the

normal temperature," *Tap Chi Vat Ly* 1990, 15(1), 29-32 (Vietnamese).

ABSTRACT

The remaking and testing experiments of fusion at normal temperature are investigated in the Center of Nuclear Physics. The explorations are made at liquid and gas phases. The results and remarks are discussed.

E. SHORT ARTICLES FROM READERS

COLD FUSION PATENT APPLICATIONS III

Courtesy Dr. Peter Glück

(See *Fusion Facts*, Dec '91 & Feb '92 for list of first 62.)
[Entries: List No.; Patent Application No.; Title; Applicant; Date of publication; Priority date; Comments.]

63. JP 91 82,991; "Energy Converters Based on Electrochemical Nuclear Fusion"; Matsushita Elect Industrial Co.; 8 Apr 1991; 25 Aug 89; The apparatus contains an electrolytic cell comprising a cathode from an alkali-metal-doped e^{pi}-type compound, a noble-metal anode, heavy H_2O, and an electrolyte containing support material, where the cathode and anode are immersed in the electrolyte.

64. JP 91 105,284; "Apparatus for Cold Nuclear Fusion"; Fujitsu; 2 May 1991; 20 Sept 1989; An application for cold nuclear fusion includes: (a) a chamber with a means to guide a D-containing gas into it, and an exhaust means; (b) a plasma-generating means; and (c) a reactive substrate on which is a H-absorbing metal (e.g., Pd). Nuclear fusion is caused by contacting a plane of the gas with the reactive substrate.

65. JP 91 107,791; "Apparatus for Cold Nuclear Fusion"; Matsushita; 8 May 1991; 21 Sep 1989; The apparatus includes a cathode to adsorb (in crystal lattices or on the surface) a H isotope(s), an anode from a metal, its oxide, or its hydroxide, and an electrolyte containing at least a H isotope. The electrodes are film-shaped. Nuclear fusion is caused gased on the electrolysis of the electrolyte.

66. JP 91 150,494; "Apparatus for Cold Nuclear Fusion"; Toyoaki Omori; 26 Jun 1991; 7 Nov 1989; The apparatus, which includes a reaction tank containing D_2O, a pair of discharge electrodes in the tank, and a power source to apply pulsed voltage on the electrodes, and which causes nuclear fusion based on D io generation by pulsed voltage, and a pressure wave produced by underwater plasma discharge, is equipped with a partition structure around the plasma-discharge area, which controls the pressure of the wave.

67. JP 91 183,987; "Cold Nuclear Fusion Process"; Nippon Telegraph & Telephone Co.; 9 Aug 1991; 14 Dec 1989; In the process, pressure gradient is applied across a Pd or Ti plate which is covered, on 1 side, with a think film (e.g., Au) having a small D-atom diffusion coefficient, so that D pressure on films [sic] becomes greater than the other, accumulating D atoms at the interface of the plate and the film.

68. JP 91 183,988; "Cold Nuclear Fusion Process"; Nippon Telegram & Telephone Co.; 9 Aug 1991; 14 Dec 1989; The process includes: (1) placing in a container a D-absorbed Pd or Ti plate, which is covered on 1 side, with a 1st film (e.g. Si oxide) having a small D-atom diffusion coefficient, and on the other side, with a 2nd film (e.g. Au), having a large D-atom diffusion coefficient and (2) decreasing the pressure inside the container to increase D concentration at the interface of the plate and the 1st film.

69. JP 91 194,493; "Cold Nuclear Fusion Apparatus"; Fuji Electric Co.; 26 Aug 1991; 22 Dec 1989; The apparatus comprises an anode, a cathode, and an electrolyte bath containing heavy H_2O, where the cathode is formed of V, Sr, Y, Nb, Hf, or Ta, and adsorbs D produced by the electrolysis of heavy H_2O.

70. JP 91 194,494; "Cold Nuclear Fusion Apparatus"; Fuji Electric Co.; 26 Aug 1991; 22 Dec 1989; The apparatus comprises an anode, a cathode, and electrolytic bath, and a means to expose cathode metal, where the electrolytic bath contains heavy H_2O, the cathode is formed of a D-absorbing metal, and the means keeps active the surface of the cathode metal.

71. NETH APPL NL 89 02,962; "Process and Apparatus, and the Use of the Apparatus in Electrolysis-Nuclear Fusion;" Peter Jan Van Noorden; 1 Jul 1991; 1 Dec 1989; The process comprises the application of a magnetic field. The apparatus, comprising an electrolytic cell equipped with 2 electrodes, additional comprises means for generating a magnetic field in the electrolytic cell. The use of the apparatus comprises filling the cell with an electrolyte comprising LiD dissolved in heavy water. The use of the magnetic field increases the rate at which the alleged cold fusion occurs in the D-loaded Pd electrodes. The electrodes (Pt anodes and Pd and Ti cathodes) are connected to one electric source, and the means for generating the magnetic field, i.e., a cooled hollow coil, is connected to another electric source, i.e., a battery.

72. S. AFRICA 115 242,246; "Energy Source System," Shell Research, Ltd.; 29 May 1991; 11 Jul 1989; Energy is produced by: loading a body with equal or greater than

1H isotope where, at least, a part of the body comprises a metal capable of forming a metal hydride-type lattice system; arranging the body as, an electrode of a electrode of a capacitor means in an electric circuit along with another electrode connected with an externally controllable voltage supply means; operating the voltage supply means; and recovering energy produced in the body by operating the voltage supply means. The system produces energy by a process commonly known as cold fusion.

[We wish to thank Dr. Glück for sending us these latest patent applications.]

NOTES FOR GARAGE RESEARCHERS

From Dr. Dennis Cravens
2222 Wheeler St., Vernon, TX 76384

There are a few people working on the cold fusion experiments from garages and basements and operating on a small budget (like me.) Here are a few ways to save money and still do creative things.

I am told by Mark Hugo that a dehumidifier will work for a chilling element for water baths. The chilling coil (from the dehumidifier) can be bent without undue difficulty. As an alternative, the equipment from a cast-off cold water cooler can also be used.

I have used old temperature thermostats designed for photographic baths. Some of these thermostats are good to about 0.2 C. Most are wired to turn on at a temperature drop.

It is my studied judgement that pulsing the current has a beneficial effect on most cells. I think that it keeps the hydrogen (deuterium) in a dynamic and non-equilibrium condition. Current pulsing may also help keep the metal host reduced and clean. An easy way to pulse your cell current is to use a photo-resistor to bleed off current to ground. I initiate the pulse by feeding the output of a frequency generator to a small wheat bulb or LED. This approach gives me a wide range of pulses without costly programmable current power supplies. For longer pulses, I use a small night light and 24-hour timer (the kind used to control water sprinklers.)

For those experimenters getting started, try loading the cathodes at 30 to 70 mAmps per sq cm of cathode surface. A rule of thumb is to load until about 150 amp hours per cc of Pd is reached (assuming small and reasonable sizes of Pd). After loading you can then increase the current density to above 15 milli-amperes per sq cm. This current is about the minimum I've observed that has produced the "excess heat effect." I would advise you to keep the current below 1 amp per sq cm until you have experience that suggests making changes to these limits. In general, I would recommend from 200 to 500 milliamps per sq cm.

Be very careful if you use recombiners. These devices have a habit of "turning on" and "turning off" unexpectedly. When they turn off, the cell can have a sudden increase in pressure unless you have provided for the excess gasses to be bled off. I would recommend about 10 sq cms of recombiner surface area for each 0.1 sq cms of palladium surface.

It is a good idea to feed the bleed of any un-recombined hydrogen to a small bubbler to shield the cell from contamination. I use extra or old electrolyte in the bubbler tube. You should be aware of the fact that the bubble can release hydrogen. You will want to vent the hydrogen accordingly so that you do not cause any hydrogen explosion. It is good safety practice to not bolt or screw the cell together. It is better to use a bolt to compress a spring or to use an elastic band, etc. to keep the lid on the electrolytic cell. The idea is to allow the cell an emergency pressure relief device. [One experienced researcher has already been killed by failure of a pressure-relief valve.]

If any reader has some additional useful or cost-cutting ideas please write to me. I'll summarize what I get from you and make all of the ideas available to the readers of *Fusion Facts*.

F. LETTERS TO THE EDITOR

GLÜCK FROM ROMANIA

Dr. Peter Glück, Institute of Isotopic and Molecular Technology, Romania, sends the following note:

"Since my last note, I have received many good papers including the excellent book by Eugene Mallove, **Fire from Ice,** kindly sent by the author. I am enthusiastic. My friends tell me that the new Srinivasan paper is excellent (*Indian J Technology,* Dec, 1991) but I haven't obtained a copy, as yet."

"**A very important remark:** Professor Louis Smullin's brilliant analogy regarding fire and cold fusion ("When a guy named Prometheus came up with a thing called fire, he had no theoretical basis either.") has actually, according to the Greek mythology - a continuation. Not too merry, but realistic and timely: Prometheus was punished by the gods who had considered fire as their personal property and privilege. Prometheus was tied to a rock and a vulture, a cruel servant of the gods, began to eat systematically his liver (Guess who is coming to supper?) Eventually, Prometheus was liberated by the great hero - Hercules - who killed the vulture. In the case of cold

fusion, Hercules is on the way and will arrive soon! Therefore, a happy ending is predictable in our case, too."

"A bit of pragmatic advice: Invite the vultures to Nagoya!"

LETTER FROM JAPAN
From Professor Takaaki Matsumoto, Hokkaido Univ.

Cold Fusion: Reproducing the Nobles [noble bodies or systems] in the Universe.

At the 1992 Spring Meeting of the Japan Atomic Energy Society which was held at Tokai University on March 28 - 31, I made a presentation. I showed photographs clearly indicating that tiny black-holes were produced and evaporated [annihilated]. The production was proven by the feature that surrounding materials were rolled in toward the center.

These results are so surprising that no one can believe it. So far, many researchers of cold fusion have been trying to prove whether the conventional fusion reaction, or any fusion reactions, really exist during cold fusion. However, cold fusion involves much more exciting physics than anyone can expect: the production of the tiny neutron-stars; the micro-explosions due to the gravity-decays of the neutron-stars; the production/evaporation of the tiny black-holes; and so on. That is [a possible analogy], cold fusion is a small scale simulation of the events which have occurred far [away] in the universe. These events take place on the microscopic level and should not be confused with the macroscopic events. The events occur sequentially but are based on one simple principle which was proposed by the Nattoh Model: the self-compression effect of [a] hydrogen cluster. [This is] The key reason why cold fusion has made big jobs is here [impact on science].

We have now achieved a technique to simulate those great physics [events] in the laboratory. When the nucleus is broken by the gravity decay, the mass energy is transformed partly to the gravitational waves to leave gravity-decay products of extremely tiny particles. It is expected that like Rutherford discovered the nucleus in the center of the atom, we might have entered into the [sub-nuclear] world of 10^{-33} cm. The details are described in the references. I will review the {Nattoh Model and the experimental findings} in the October 1992 Nagoya conference.

Professor Takaaki Matsumoto has reported on his experimental and modeling work as follows. Note: all references except the first appeared in *Fusion Technology* in the volumes, pages, and years shown.

"Progress of the Nattoh Model and new particle emitted during cold fusion", Proc. Int. Conf. Provo (1990).
"'NATTOH' model for cold fusion", Vol 16, p 532 (1989).
"Cold fusion observed with ordinary water," Vol 17, p 490 (1990).
"Observation of new particles emitted on cold fusion," Vol 18, p 356 (1990).
"Prediction of new particle emission on cold fusion," vol 18, p 647 (1990).
"Microscopic observation of Palladium used for cold fusion," vol 19 p 567 (1990)
"Observation of quad-neutrons and gravity decay during cold fusion," vol 19, p 2125 (1991).
"Interference phenomena observed during cold fusion," submitted (1991).
T.M. & K. Kurokawa, "Observation of Heavy Elements Produced during explosive cold fusion," vol 20, p 323, (1991).
"Observation of gravity-decays of multiplied neutron-nuclei produced during cold fusion," submitted 1991.
"Observation of mesh-like traces on nuclear emulsions during cold fusion," submitted 1992.
"Searching for tiny black-holes during cold fusion," to be published, June 1992.
"Observation of stars produced during cold fusion," submitted 1992.

[Dr. Matsumoto has been performing a series of exciting experiments since 1989. While others have been looking at the macro results of cold fusion (heat, neutrons, tritium, etc.), Matasumoto has been carefully examining many of the detailed results of fusion as determined by his extensive use of special nuclear emulsions. While all scientists do not agree with him on his interpretations of his experimental findings, he is to be commended on his diligence in seeking to understand the seemingly enormous complexities of cold fusion. We look forward to hearing from Dr. Matsumoto in Nagoya. Thank you for sharing this letter with us. Ed.]

DR. BOB BASS ON PATENTS

Dr. Bob Bass, a patent expert, has sent us the following paragraph from I. Kaytons's 6-volume treatise on Patent practice: Under the topic **Introduction to Patents and Patent Practice, I. The Functions of Patents and Patentable Inventions in an Industrialized Society,** is the following paragraph:

"In this sense, patent law is a special form of the law that protects property and is peculiarly effective in any society where private property is recognized. In today's world, technological advance is probably the single most significant factor pervading economic, political and social life. For example, commercially viable, **controlled hydrogen fusion** would moot the international cartel in oil

of the Oil Producing and Exporting Countries (OPEC), and remove the intense, internecine and endless warfare among the factions and countries of the middle east from the center of the political and economic stage which it often occupies. It can be appreciated, therefore, that the law that deals with the rational handling of property in technology is of **fundamental importance to all.** [Emphasis by Bass. Ed.]

LETTER FROM COLD FUSION RESEARCH ADVOCATES

From Jed Rothwell, April 2, 1992

Dear Hal,

Gene [Mallove] was in Washington yesterday talking with Congressional staff people. We have been given the final word: there will be no [Congressional] hearings. That [report] is what we have been expecting for some time. ...

[Arthur C.] Clarke wrote an excellent letter to [Congressman George] Brown [Chairman, SS&T Committee], who is a personal friend of his. I faxed it [Clarke's letter] to Brown, but I have not heard a peep out of him. Congress is a hopeless case, a lost cause.

/s/ Jed Rothwell

From Jed Rothwell, March 31, 1992

To: All Cold Fusion Petition Signatories

Last December, and this January, members of the Space Science and Technology Committee contacted us and said that "hearings about cold fusion might be held late winter or early spring."

Mr. Frank Murray, of the House Energy Subcommittee, said on March 30, 1992 that there will "probably not be hearings" about cold fusion, because "there has been no flurry of interest about cold fusion in the media." . . . Congress has been increasingly unwilling to discuss cold fusion with us, and completely unwilling to challenge the DoE, so we were expecting this decision.

Of course, I predict that there **will** be hearings about cold fusion. . . There will be headings when the U.S. public finds out that our government was warned time after time by a group of distinguished scientists, and by the top authorities in Japan that they were developing cold fusion. When the public finds out that the Congress ignored these warnings, the DoE stonewalled, and M.I.T. published fraudulent data, then lied about it for three years, there will be hearings! . . . If we could just have a rational, open-minded, public, scientific discussion of the issues, then we could avoid this fiasco.

I am afraid that our Petition drive is stalled for the time being. Mr. Murray wants to see a discussion of cold fusion in the U.S. press. Although cold fusion has appeared in every major Japanese newspaper, newsmagazine and many scientific journals, there has only been one major article here in the U.S. this year, in *Business Week*. . . . Mr. Murray confronts us with a Catch-22; Congress cannot hold hearings until the media gives Congress permission, but the media will not print anything about cold fusion until Congress holds hearings. . . .

Finally, I suggest you ask Congress what was the purpose of all this empty talk about competing with Japan. Remind Congress what the public will say when they hear this story. The leading Japanese researchers signed a petition and offered to come to Washington to spell out the scientific facts they believe prove the existence of cold fusion beyond any reasonable doubt. This openness on the part of Japan is totally unprecedented; no nation has ever done such a favor for its biggest competitor. Over and over again, the Congress, the President, and the DoE were given copies of letters and faxes from the Japanese researches, and translations of news articles and scientific papers describing the research. We have a paper trail to prove that our government was warned, but it did nothing.

Sincerely, /s/ Jed Rothwell

From Jed Rothwell, March 18, 1992
Excerpt of letter to Mr. Frank Murray, Energy Subcommittee, U.S. Congress.

. . . Last night I had a long talk with the science journalist Fujio Nakano. In March 1992, Nakano published another article about cold fusion in Japan's largest magazine *Bungeishunju*, in which he stated publicly that the Japanese research think tank "Technova" is supporting Pons and Fleischmann in France. I asked him about that, and he said that the president of Technova, Yoshihiro Kyotani, decided to go completely public and reveal the research. . . .

Nakano said that since the January 27th meeting [where Akito Takahashi present his results on cold fusion], "things have been hopping." The power companies and big corporations are rushing to jump on the cold fusion bandwagon, fearing that Technova will get a lead on them. Dr. Mizuno, of Hokaido University . . . said, "10 big companies are starting a fund for cold fusion researchers in Japan." Before January, over 100 researchers were working on cold fusion in the National University laboratories, but they did not attract much attention. Now, they are in the limelight and in demand; corporations and science writers are rushing to ask their advice and publish their technical papers.

I asked Nakano, "how about the skeptics in Japan, is there still resistance at Tokyo University and elsewhere?" He said, "there are no more skeptics. Everyone now believes it is real. The only question is, has Takahashi developed a simple, reliable way to create a sustained, high output reaction. We will find out in a couple of weeks, as the replications roll in."

. . . [Both the editor and a staff writer of the Nikkei Superconductor technical newsletter] responded at once: "the skeptical resistance has collapsed. There are no skeptics. . . ."

[Jed Rothwell, after commenting on the lack of news media articles on cold fusion in American comments:] You would think that since Japan has taken away our entire consumer electronics market, our RAM chip market, and at least a third of our automobile market, that somebody would be interested in hearing what they are doing in the energy business. Alas, few journalists will touch news about cold fusion. . . .

[In his final paragraph, Jed notes the following report:] Other people have told me that the MITI [Japanese agency that directs a large amount of Japanese research and development activity] cold fusion industrial development program will start in April, 1992, which is the beginning of the Japanese fiscal year.

Sincerely, /s/ Jed Rothwell

LETTER FROM BEIJING, CHINA
From Professor Zing Zhong Li

"Thank you for your letter of Feb 5, 1992 and the copy of *Fusion Facts*. . . . After receiving the information from Jed Rothwell, we set up a group to reproduce the light water experiment by Dr. Mills. Once we can reproduce it, I would like to consider the suggestion in your letter for the parametric study for optimization. . . . Right now I have four volunteers for that group working at amateur time. If we work intensively, I have to consider the necessary equipment for their safety. Enclosed please find a copy of preprint [now published in the Proceedings of the Como Conference.

Best personal regards,
/s/ Li, Xing Zhong

LETTER FROM CANADA
From Dr. W.T. Shmayda, Ontario Hydro

Dear Mr. Fox,

I have heard indirectly from Dr. Srinivasan that you are under the impression that we have measured excess heats using a Randy Mills type cell. We have carried out a series of measurements using the cell and his input to determine if excess heat can be produced. The cells have been placed into a calorimeter with a 50mW detection sensitivity and tested under a variety of conditions. We did not stir the electrolyte but did measure the electrolyte temperature in three locations. We used two salts: sodium and potassium carbonate. We did not detect any excess heat, although given the temperature differences we measured, I can see how these results could be misconstrued. The conclusion of our study is: for the cell configurations we studied we did **NOT** observe any excess heat. A report will be issued shortly. I intend to send a duplicate message to Dr. Bush

Regards,
/s/ Dr. W.T. Shmayda
Ontario Hydro, Research Division,
Corrosion and Tritium Technology Section,
800 Kipling Avenue, Toronto, Ontario
CANADA, M8Z 5S4

EXCESS ENERGY FROM PLASMAS?
A letter from Dr. Samuel P. Faile

In our recent discussion about possible excess energy from plasma's, the following article and my summary may be of interest:

Earle R. Williams (MIT), "The Electrification of Thunderstorms," *Scientific American,* Vol 259, No 5, Nov 1988, pp 88-99, 5 refs.

Although much information has been obtained in recent years, there are still many mysteries about lightning. An energy balance shows that during very active storms the electrical energy may be as great as the gravitation energy (from falling rain). However attempts to correlate changes in electrical energy and the fall velocity of precipitation have failed. Also it is not known why at about -15 C there is a reversal in the charging process between ice crystals and larger chunks of ice. Another surprising finding is that electrical discharges tend to be influenced by the charge distribution rather than the field. One wonders if the storm is tapping an unknown energy source. The planet Jupiter with many violent electrical storms radiates 2 1/2 times as much energy as it gets from the sun.

[If readers are aware of experiments with hydrogen plasmas that measure the chemical energy in versus heat energy out, please let us know. Ed.]

G. CONFERENCES, PAPERS & MISC.

2ND ANNUAL CONFERENCE PROCEEDINGS

Tullia Bressani, Emilio Del Giudice, Giuliano Preparata, Editors, VOLUME 33 - THE SCIENCE OF COLD FUSION, Conference Proceedings published by Societa Italiana di Fisica, 46 figs, 528 pages, ISBN 88-7794-045-X.

Three years after the first announcement by Martin Fleischmann and Stanley Pons, it is possible to make a balanced appraisal of the discovery of cold fusion. This book contains the *Proceedings of the Como Conference.* Through the language of science, hints are presented of the subtle and fascinating mechanism by which an enormous amount of energy is stored inside matter and the difficulties met in trying to unlock this treasure.

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THIRD ANNUAL COLD FUSION CONFERENCE

We have included in this mailing of *Fusion Facts* a separate sheet telling about the Nagoya conference and providing our readers with a form to use for papers and/or attendance.

METAL HYDROGEN SYSTEMS SYMPOSIUM

The next International Symposium on Metal Hydrogen Systems is to be held in Uppsala, Sweden from 8th to 13th June 1992. Details will probable be published in the *Journal of Less-Common Metals.*

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.

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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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