

FUSIONfacts

A Monthly Newsletter Providing Factual Reports On Cold Fusion Developments

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

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FUSION FACTS

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A. BEGINNING 6TH YEAR OF PUBLICATION.

"If you last for a year, then I'll believe in you," was the comment made by one of the first industrial subscribers to *Fusion Facts*. Congratulations are in order, we've lasted five and are still growing and contributing to the world-wide interest in the new science of cold fusion.

The sixth year of publication begins with this issue. Although there are no monumental breakthroughs to report, every issue brings our readers further information about developments in cold fusion (and other enhanced energy systems) around the world. Aided by Eugene Mallove's "*COLD FUSION*", Mitchell R. Swartz's *Cold Fusion Times* ("to Coldly Go ..."), these are the publications that are primarily devoted to sharing information about the new and viable science of cold fusion. Together with publications that **do print articles about cold fusion**, such as *Fusion Technology*, *Journal of Electroanalytical Chemistry*, *21st Century Science and Technology*, *Nuovo Cimento* (Italy), *Physics Letters A*, and some foreign language journals, the technology of cold nuclear fusion lives and is growing.

This sixth year of publication begins with a series of conferences that will further promote information about cold fusion. During the week of July 11-17, 1994, the Solar Energy Exposition and Rally (SEER) will have their annual meeting. Hal Fox will be presenting three lectures on the growth and potential of cold fusion. The Russian cold fusion scientists have planned for the Second Russian Conference on Cold Fusion and Nuclear Transmutation, to be held in September of this year (see page 22) at a resort on the Black Sea. In April 1995, the Fifth International Conference on Cold Fusion will be held in Monaco. *Fusion Facts* will be reporting on these (and other) conferences.

PRELIMINARY ANNOUNCEMENT

FIFTH INTERNATIONAL
CONFERENCE ON
COLD FUSION
(ICCF-5)
9-13 APRIL 1995
MONTE-CARLO CONVENTION
CENTRE
MONTE-CARLO, MONACO

The continuing development of cold fusion will be most effectively accomplished as we improve on our resources and ability to report the latest cold fusion discoveries. For example, Drs. Robert Bush and Robert Eagleton will share with us their latest findings about promoters and inhibitors in light-water electrochemical cells. Strange as it may seem, a tiny bit of copper can make a lot of difference in a light-water, nickel-cathode, electrochemical cell. We are more fully understanding why some workers have continued successes while other workers do not. We do know that this problem is not exclusive to cold fusion research. Just talk to a solid-state electronic worker of the 1960s and 1970s and you will appreciate the trail of discovery that has so ably provided the world with highly-effective and low-cost electronics.

This sixth year of publication will print more news of triumphs and disappointments; improvements and new discoveries; and new theories and discarded old ones. These added values will be based on our current knowledge to create a fuller understanding of cold fusion. Compared to our sketchy beginnings in July, 1989, we can base our developments on the following foundation:

1. Nuclear reactions can be produced and controlled in a heavy-water, palladium cathode, lithium-containing electrolyte. Papers from thirty countries support this experimental fact. Also well known is the fact that cathode preparation is highly important and not fully understood.
2. Excess heat in light-water, alkali-metal-containing electrolytes, using nickel (and other) electrodes appear to produce nuclear reactions. A chain of proton-capture events appears to be the basis for a string of possible transmutations.
3. Electric arcing, sparking, and plasma devices provide excess heat, lead to transmutation of elements, and are being further studied, developed, and improved.
4. Proton conductors (solid-state electrolytes) are proving to be of increasing interest as another nuclear-fusion phenomenon.
5. Heated nickel reactors in hydrogen or deuterium gas (combined with as-yet-undisclosed proprietary techniques) appear capable of providing large amounts of

excess heat. The nuclear reactions may be p+d, but further evidence is needed.

6. Building on an increasing amount of experimental evidence, theories are improving. One of the best examples is the most recent work of Robert Bass who has built his theory on contributions from several others. This latest theory explains much of the cold fusion experimental evidence and is based on fundamental physical principles.

Therefore, the sixth year of publication begins with about eight separate and independently discovered methods by which nuclear reactions (at least excess heat reactions) are produced. That is quite a change from 1989. A basic theory has been declared and readers are invited to provide contrary or supporting evidence for further improvement. Books have been written, published, and applauded or attacked. The flow of information is accelerating (*Fusion Facts* has collected over 1500 articles on cold fusion and enhanced energy systems.) Engineering applications are being seriously discussed and, in some cases, design work toward implementation is being accomplished.

Of collateral interest is an unexpected development. In the august halls of Science some are beginning to question the basic concepts that underlie much of our modern physics. Not all of the accepted and replicated experimental observations can be encompassed by standard Einsteinian relativity, nor by the complex structure of the various quantum mechanics or dynamics (including electro-, and chromo-dynamics). The walls of physics are not tumbling, but some of the lower-level foundation bricks are about to be replaced. Perhaps one of the first bricks to go will be the one labeled "empty ether." One of the crumbling bricks (a favorite of the hot fusioners) is labeled "if in gas plasma, so also, in a metal lattice". However, we suggest that brick never was in the foundation, it was only a late invention by political lobbyists (masquerading as scientists) to buttress their own belief structure.

This sixth year will bring reports on new experimental discoveries, revised theories, complaints and attacks, and **maybe, if we are fortunate, in an unequivocal development that forces the acceptance of the new science of cold nuclear fusion.** But, whatever this sixth year of publication brings, *Fusion Facts* must give much of the credit to those correspondents in various parts of

the world who are supplying us with the information that we present to our readers. **Thanks to all of you!** Also, thanks to our many readers for their financial support.

B. NICKEL EXPERIMENT REPRODUCED

Pursuant to Jerry Bishop's article on Cold Fusion in last August's *Popular Science* magazine, H. Malcolm Ogle writes that it "inspired me to run a series of experiments to try to find the physical truth. As a result of this effort I have developed the Double Nickel Demonstration which is described below. This experiment is so simple that anyone can duplicate it and I would urge them to do so. I have repeated this demonstration five times and it has consistently given excess heat. Skeptics everywhere should try this; especially those in the DOE and the Patent Office." Mr. Ogle is a consulting electrical engineer and a Fellow of the AAAS.

THE DOUBLE NICKEL DEMONSTRATION

By H. Malcolm Ogle, June 24, 1994

This experiment is meant to show that certain electrochemical processes can apparently result in the generation of "excess heat." It uses two five cent pieces as electrodes in a simple electrolytic cell. This is a modification of the Mills experiment using nickel and light water. Potassium carbonate is used to make the electrolyte.

A 100ml beaker is used to hold 95ml of distilled water with 32g of potassium carbonate dissolved in it. Two laboratory type thermometers are used; one to measure the electrolyte temperature and one to measure the air temperature. The beaker is placed on a small block of foam plastic to isolate it from the table and room air is free to circulate on all sides of the beaker.

The electrode assembly uses two paper clips to hold the nickels and conduct electricity while minimizing the loss of heat from the cell. The clips are bent to grasp the edge of the coins and are clamped in a barrier terminal strip to hold them in position. The surfaces of the paper clips are coated with epoxy to insulate them from the electrolyte.

A ten ohm, ten watt resistor is used to calibrate the cell. To preserve thermal symmetry, the copper leads of the resistor are extended by soldering on paper clips that

have been straightened out. The surfaces of the clips, the soldered joint and the copper leads are then insulated with epoxy.

To insure consistent temperature readings it is necessary to continuously stir the electrolyte. A small motor connected to a variable voltage power supply can provide the needed gentle stirring action. When the power input to the cell is modified, approximately two and one-half hours are required to reach thermal equilibrium.

A second variable voltage power supply is used to provide current for the cell. Suitable instruments are needed to measure the cell current and the cell voltage.

With 300 milliamperes flowing through the cell, an excess heat of 20 to 40 percent is consistently observed.

MATERIAL AND EQUIPMENT REQUIRED:

- 100 ml beaker
- Foam plastic block (2"x2"x1")
- Potassium Carbonate (calcinated)
- Two thermometers
- Two US nickels
- Four paper clips (#1 GEM)
- Epoxy
- Two 4-position barrier terminal strips (Radio Shack 274-658)
- A ten ohm, ten watt resistor (Radio Shack 271-132)
- A small motor for stirring
- Two variable voltage dc power supplies
- Instruments for measuring current and voltage

EDITOR'S COMMENTS

The author of this experiment found that with 300 milliamperes current flowing through the cell, an excess heat of 20 - 40 percent was observed. Some changes in excess heat were noted depending on the spacing of the electrodes. Closer gave better results.

The readers are challenged to duplicate this experiment to convince themselves of the reality of excess energy production.

In order to increase the credibility of the expected results, some improvements can be recommended to the protocol of the experiment.

In order to determine the thermal energy loss through the wall of the beaker one should provide the conditions typical in isoperibolic (denotes uniform thermal surroundings) calorimetry. Under steady-state conditions, essentially all the heat generated within the electrochemical cell will pass readily to the external environment through the wall of the beaker. One should insulate the beaker thermally not only at the bottom but also at the top. Foam plastic can be used to insulate the top of the beaker provided that holes are used for electrical leads-in and for the evolved gas to escape without recombining.

Having such a set up one can calculate the rate of energy loss through the glass of the beaker:

$$Q = h \cdot S \cdot (T_i - T_o) \quad (1)$$

where h is the specific thermal conductivity of the cell vessel wall (which is equal to 0.9 to 1.2 $\text{w/m}_r \cdot \text{K}$ depending upon the specific glass composition);

S is the area of heat conducting surface (which is equal to $A = 2\pi R \cdot H$, where R is the radius of the beaker and H is the height up to the level of electrolyte);

T_i is the temperature inside the cell;

T_o is the temperature outside the cell.

The author does not describe the procedure used to determine the excess heat in the experiment. The voltage of the electrolysis is also not available in the information presented. It prevents us from verifying the results stated by the author. However, the author specified the concentration of the electrolyte. Note that the closer the spacing the lower the resistance, therefore, the voltage has to be adjusted to keep the same current.

All those who are going to duplicate the experiment should take into consideration the following procedure of excess heat evaluation.

The total power consumed by the cell during the electrolysis can be calculated as:

$$E_{in} = IVt \quad (2)$$

(current x voltage x time) where power is in joules if t is in seconds.

In order to exclude any likely influence of hydrogen/oxygen internal recombination (resulting in heat release) make sure the gas released does not contact metal surfaces and allow the gases to escape freely into the atmosphere.

The ratio of the excess heat to the input energy can be calculated as:

$$R = E_{ex}/E_{in} = (Q-IVt)/IVt \quad (3)$$

One is also challenged to try a blank experiment using copper coins (e.g. pennies) as electrodes. It is believed that such a set up should not produce any excess heat. The difference in heat (temperature of the cell) in the control cell (using pennies) and the cell with nickel electrodes is then due only to the effects promoted by the electrode material. You can even connect the cells in series so the same current runs through both cells. However, the voltage used in your calculations should be the voltage across each cell.

C. IMPURITY PROMOTION & INHIBITION

Fusion Facts is presenting this paper, partially abridged, because of its importance to everyone now doing cold fusion research.

R. T. Bush (Phys. Dept., Cal. Poly. Univ., Pomona, and ENECO and Proteus Processes and Technology, Inc.), "Impurity Promotion and Inhibition of the Excess Heat Effects of Cold Fusion," to be published in Cold Fusion Source Book.

AUTHOR'S ABSTRACT

A model is presented to describe impurity promotion and inhibition of both light water and heavy water excess heat effects of cold fusion based upon the well-known effects upon the magnetism of Ni and Pd, respectively, produced by alloying with different metals. For the light water case (Ni), promoters, in increasing order of efficiency, are predicted to be Cu, Zn, Al, Sn, and possibly Pb. Inhibitors, in increasing order of efficiency, are predicted to be Co, Fe, and Mn. Ag, Au, and Cu are indicated as promoters for the heavy water case (Pd).

INTRODUCTION

The light water excess heat effect has recently become highly controversial with a group of researchers [1] at Bose Corporation insisting that the open cell research for which positive results have been reported may have simply been the dupe of unsuspected partial internal recombination acting as a spurious source of excess heat. The closed cell work they claim [1] to be flawed by the difficulty of calibration associated with the internal recombination process. The present author has addressed and countered both of these claims in a Letter to the Editor being submitted for publication to *Fusion Technology* entitled, "Is the Light Water Excess Heat Effect a Figment of Our Recombination? No!" In this rebuttal it is made clear that the failure of the Bose Corp. group and other researchers to achieve a genuine light water excess heat effect is almost certainly associated with either the absence of an impurity promoter or, if the promoter is present, the simultaneous presence of an impurity inhibitor.

The idea that impurities of various sorts might act as promoters or inhibitors of the excess heat effects in the case of light water (Ni cathode) and heavy water (Pd cathode) has been steadily acquiring currency. In the light water case, Bush hypothesized and Bush and Eagleton (Cal Poly) have shown experimentally that Cu is a promoter, and this has received initial corroboration from Srinivasan et al. of BARC. The latter group has found that Fe acts as an inhibitor of the light water excess heat effect. Initial experimental work at Cal Poly points to the strong possibility that Bush is correct in hypothesizing Au, and Pb, to be potential promoters of the light water excess heat effect. Prior to these light water instances Fleischmann and Pons (Como Conference) had indicated that a 10% alloy of Pd and Ag improved excess heat in the heavy water case, and this may indirectly have received support from the thin film research of Bush and Eagleton involving thin films of palladium electroplated onto a Ag substrate.

In what follows a model is presented that treats the promotional and inhibitory aspect of impurities with regard to their ability respectively, to either inhibit or promote the magnetism (paramagnetism or ferromagnetism) of the cathode material (Ni in the light water case and Pd in the heavy water case). Thus, the association of an impurity promoter with its ability to inhibit magnetism of the cathode material is viewed as

follows in terms of the model: It is hypothesized that there is a larger cross section for the case of cold nuclear reaction for which the product nuclear spin is given by the difference between the nuclear spins of the two reactant particles when the spins of the colliding reactants are antiparallel as opposed to parallel. (This part is not new, having been emphasized by Cravens and others.) Examples are afforded by the case of two d's (spin 1 each) combining to produce an He-4 nucleus of spin zero, or a p (spin 1/2) and a d combining to form an He-3 nucleus (spin 1/2). Now, ferromagnetic and/or paramagnetic fields in the cathode tend to maintain the spins of the colliding reactants parallel since the spins have associated magnetic moments, which are in the lowest energy state when they are in a parallel orientation relative to the field. Thus, it is hypothesized that impurities that help to decrease the magnetic susceptibility of the cathode material should help to randomize the spin directions and assure a maximal number of collisions for which the spins are antiparallel which, in turn, should promote the excess heat effect. Inhibitors, on the other hand, would be impurities tending to enhance the magnetic susceptibility of the cathode material. (There may well be, other promotional and inhibitory aspects other than those associated with the magnetism of the cathode material. However, these remain to be discovered and treated theoretically.)

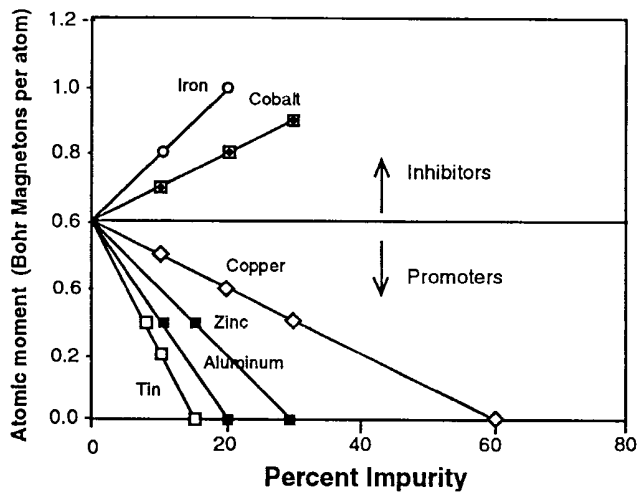
Impurity Promoters and Inhibitors of the Light Water Excess Heat Effect with Ni

Band theory shows that the ferromagnetism of Ni in the solid state is associated with holes, i.e. vacancies, in the electronic d band, with the number of holes in the d band of Ni producing a saturation moment per atom of 0.6 Bohr magnetons per atom. (In this, and what follows, the treatment of the magnetic susceptibility of the transition metals such as Ni, Fe, Pt, and Pd, follows that presented by Mott and Jones in "The Theory of the Properties of Metals and Alloys". Limitations upon length do not permit detail here concerning energy band theoretical considerations so that Mott and Jones is highly recommended for those interested.)

Now suppose that Cu is alloyed with Ni, where Cu has one more electron per atom than Ni: Mott and Jones point out that Cu-Ni alloys possess "a face-centered cubic lattice with no superstructure for all compositions," so that "if a nickel atom is replaced by a copper atom in an alloy we may suppose that the lattice is unaltered except

that an extra electron is added." Since band theoretic considerations show that the d band density of states is much greater than the s band density, this extra electron annihilates one of the holes. Thus, for the case of a 60% alloy all the holes are filled and Ni's ferromagnetism should disappear. So, for an alloy fraction f of Cu with Ni less than 0.60, the number of holes, H_h , in the d shell for the solid would be

$$N_h(f) = 0.6 - f. \quad (1)$$



The figure portrays this situation with the atomic moment in Bohr magnetons per atom shown as 0.6 for a 0% alloy falling to 0.0 for a 60% alloy. [The plot is equivalent to plotting $H_h(f)$ in (1) versus f .] Of course, it is not clear that 60% would be the optimal percentage "impurity" to use because of the fact that Ni is known to be a better absorber of hydrogen than Cu. Experiments at Cal Poly have employed a maximum f of a 0.10 for Cu with Ni and this has proven the effectiveness of Cu as a promoter of the excess heat effect. Work is under way to determine the optimal impurity concentration of Cu. [In this regard it should also be borne in mind that the absorption of hydrogen by the Ni should also decrease the magnetic susceptibility of the cathode material just as it does in the case of Pd. In Pd the paramagnetic susceptibility drops to zero for stoichiometry of about 0.55 protons (or deuterons) per Pd atom in agreement with the fact that the outer d shell of the Pd atom averages 0.55 holes. However, since Ni tends to absorb hydrogen to a lesser extent, presumably the absorbed hydrogen would provide less effect in decreasing the susceptibility of the Ni. Addition of copper nitrate to the

electrolyte produced excess heat, but was not as effective as direct addition of Cu to the nickel mesh. Electroplating of Cu onto the Ni mesh should also be effective since the excess heat effect seems to be a surface, or near surface, effect.

Cu has an excess of electrons per atom of +1 over Ni. For the general case of the number of electrons per atom outside that of an inert gas given by n_e , the formula in (1) is generalized to the following

$$N_h(f, n_e) = 0.6 - (n_e - 10)f, \quad (2)$$

where $n_e = 10$ is the number of electrons for Ni outside the closed Argon shell. Thus, for n_e greater than 10 we have the impurity promoters of excess heat as portrayed in the figure, and in order of increasing effectiveness as Cu ($n_e = 11$), Zn (12), Al (13), and Sn (14). Of these, Sn, with the largest n_e value, should be the most effective per percent of alloy with Ni. Thus, it would be interesting to try a 15% alloy of Sn with 85% Ni corresponding to $f=0.15$ and the theoretical extinction percentage of 15% for the curve for Sn in the figure.

In support of Sn as a possible promoter of the excess heat effect may be the following anecdotal evidence from our Cal Poly research: Following the success with Cu as a promoter impurity at Cal Poly, we then experienced several cases where even the Cu did not suffice to produce observable excess heat. The author suggested this might be associated with the use of solder in the cell connecting the wire to the Ni mesh cathode. It was then discovered that Eagleton had recently switched from soldering to form the connection of the Ni mesh cathode to its wire lead (a solder connection that would have been in contact with the electrolyte during cell operation) to spot welding the connection. When the soldering was restarted as a check of the author's hypothesis it was found that excess heat could once again be produced. Since Sn is a major ingredient (around 40%) of solder, this is encouraging for the Sn impurity promotion hypothesis. Of course, Pb (60% of solder) may also be a promoter, and perhaps as efficacious as Sn, or more effective. [It is not yet clear how to fit Pb into the scheme of (2).] In this respect, it should be noted that the Bose group employed spot welding as opposed to soldering for the nickel mesh cathode-wire lead connection, and this may account for their lack of any positive results in attempting to achieve the light water excess heat effect. In light of this it seems likely that

other groups such as Notoya (Hokkaido University) and Srinivasan et al. (BARC) really have been successful at seeing the excess heat effect in the open-cell light water case, and their reports are given credibility.

Finally, if the metal to be alloyed with Ni has fewer than 10 electrons (Ni case) outside an inert gas shell, the value of $(10 - n_e)$ in (2) will be negative and the magnetic susceptibility enhanced. Examples are Co ($n_e = 9$), Fe (8), and Mn (7). Curves for Co and Fe are shown in the figure, and clearly these are predicted by the model to be impurity inhibitors of the light water excess heat effect in the case of Ni.

Impurity Promoters and Inhibitors of the Heavy Water Excess Heat Effect with Pd

Cu, Ag, and Au predicted to have about the same effectiveness as impurity promoters of the Fleischmann/Pons heavy water excess heat effect.

Relation to the Piantelli Effect and the Letts Effect

A second strategy for achieving the excess heat effect would be to actually apply an external magnetic field to the cathode and employ an oscillating source of emf at microwave frequencies to induce transitions to the higher energy state (non-parallel orientation of the nuclear moments relative to the external field) to achieve a greater degree of spin randomization. This is the basis of the Letts effect. (Incidentally, the fact that the well-known "skin effect" restricting the microwave radiation to a region near the surface would be operative emphasizes the near-surface aspect of this excess heat phenomenon.) The Piantelli effect would then very likely be essentially equivalent to the Letts effect applied to the light water case, although Piantelli et al. utilize hydrogen gas upon a nickel rod in a closed chamber without employing electrolysis.

EDITOR'S COMMENTS

As reported by Dr. Bush, there have been well-publicized cold fusion experiments for both light water and heavy water electrolytes in which no excess heat has been found. In experimental work by Bush and Eagleton at California Polytechnical University at Pomona, these researchers have found strong evidence for promoters and inhibitors. They are now thoroughly investigating this important cold fusion parameter. In addition, their

experimental work is being guided by a new model, conceived by Dr. Bush, and presented in this paper. Simply stated, the model declares that certain elements can increase or decrease the ferromagnetism or paramagnetism of the cathode material. For example, with a Ni cathode in light water experiments, it is hypothesized that there is a larger cross section for nuclear reactions if the difference between the nuclear spins of two reactants are antiparallel (as contrasted with parallel spins.) Dennis Cravens has suggested and shown that this effect is real. Bush's model suggest that ferromagnetic and/or paramagnetic fields in the cathode tend to maintain the spins of the reacting ions (or atoms) because the spins have associated magnetic moments. Bush's model concludes that impurities that help to randomize the spin directions (to help assure the maximum number of collisions for which spins are antiparallel) should promote the excess heat effect. In contrast, impurities tending to enhance the magnetism of the cathode would act to inhibit the excess heat effect. Bush further describes the band structure of materials and alloys in terms of the number of holes in the 3d energy band (d band). Thus copper alloyed with Ni provide an extra electron to fill a "hole" in the Ni lattice. Bush extrapolates this model to predict that the proper alloying of Ni with Cu, Zn, Al, or Sn will reduce the ferromagnetism of the Ni alloy and promote the excess heat effect. See the following figure for a plot of inhibitors versus promoters.

This short paper is an important contribution to the understanding of cold fusion excess heat production. It is now necessary for those who claim that they have found no excess heat to demonstrate the degree of impurities in their experiments that may act as inhibitors. It is no longer sufficient to report a negative result. Those who report negative results must show that they understand the effect of inhibitors and promoters and that they have observed proper procedures to ensure that this important factor has been included in their experimental protocols.

We congratulate Dr. Bush for this additional model of cold fusion reactions. We commend both Dr. Bush and Dr. Robert Eagleton for their continued excellent work to improve cold fusion experiments and to share their findings with the rest of us.

D. NEWS FROM THE U.S.**CALIFORNIA - ISOPERIBOLIC CALORIMETER**

Turgut M. Gür, Martha Schreiber, George Lucier, Joseph A. Ferrante, Jason Chao, and Robert A. Huggins (Stanford Univ., Dept. Mat. Sci. & Engr., Sanford, CA), "An Isoperibolic Calorimeter to Study Electrochemical Insertion of Deuterium into Palladium," *Fusion Technol.*, vol 25, no 4, July 1994, pp 487-501, 25 refs, 11 figs.

AUTHORS' ABSTRACT

The design and the operational characteristics of a new isoperibolic calorimeter that is developed to study the electrochemical insertion of deuterium into palladium are described. The design is simple and involves inexpensive materials to build. It possesses a number of distinct advantages that makes it suitable for thermal measurements in other electrochemical systems. It is insensitive to the nature and the location of the heat source within the electrochemical cell. The calibration constant is found to be stable with $\pm 0.5\%$ uncertainty over a wide range of input power levels up to 22 W. It also has the capability of operating over a wide temperature range. In principle, the calorimeter can be used up to 600°C, provided that the electrochemical cell design and materials are chosen appropriately. The design also provides flexibility to adjust the sensitivity of the calorimeter according to the needs of the system under study.

AUTHORS' SUMMARY

An isoperibolic calorimeter was designed and fully characterized for electrochemical studies of deuterium insertion into palladium electrodes. The calibration constants obtained by several different methods agreed exceptionally well with each other and were found to be stable over a considerable range of power levels, cell temperatures, time, and the manner in which calibration heat was supplied.

This new design possesses many advantages that make it very suitable to conduct careful studies of the thermal behavior of palladium cathodes during electrochemical insertion of deuterium. It can also be used for calorimetric studies in other electrochemical and chemical systems without the need for altering the basic design features. The design also provides flexibility to

allow changes in the spacing between the two aluminum cylinders to respond to specific system requirements such as calorimeter sensitivity.

CALIFORNIA - FASTER THAN LIGHT

Courtesy of Samuel P. Faile

K.A. Fackelmann, "Faster-Than-Light Time Tunnels for Photons," *Science News*, Vol. 146, No. 1, July 2, 1994, page 6, 1 figure.

EDITOR'S SUMMARY

Recently, Raymond Y. Chiao, Paul G. Kwiat, and Aephraim M. Steinberg of the University of California, Berkeley have measured the velocity of pairs of photons. When one photon travels through air and the other photon strikes a special mirror, some of the photons tunnel through the mirror and appear to travel to the detector at about 1.7 times the speed of light. One explanation for this unusual behavior is that the wave packet of the photon is distorted so that the peak amplitude of the wave packet moves from the center of the wave packet to its leading edge, thereby giving the appearance of having arrived early at the detector. Obviously, additional experiments are planned.

CALIFORNIA - HEAVY WATER RESULTS

Melvin H. Miles, Benjamin F. Bush (Naval Air Warfare Ctr., Research Dept., Chem. Div., China Lake, CA), Joseph J. Lagowski (Univ. Texas, Chem. Dept., Austin, TX), "Anomalous Effects Involving Excess Power, Radiation, and Helium Production During D₂O Electrolysis Using Palladium Cathodes," *Fusion Technol.*, vol 25, no 4, July 1994, pp 478-486, 22 refs, 5 figs, 4 tables.

AUTHORS' ABSTRACT

Previous experiments showed that eight electrolysis gas samples collected during episodes of excess power production in two identical cells contained measurable amounts of ⁴He while six control samples gave no evidence of helium. However, the detection limit for helium diffusion into the Pyrex glass sample flasks established a minimum helium detection limit of 3×10^{13} atom / 500ml (3 ppb) for these experiments. New D₂O

and H₂O control experiments involving helium measurements of electrolysis gas samples collected in metal flasks support this conclusion. This places the ⁴He production rate at 10¹¹ to 10¹² atom/s per watt of excess power, which is the correct magnitude for typical fusion reactions that yield helium as a product. Simultaneous evidence for excess power, helium production, and anomalous radiation was present in these experiments. Completely new experiments with more precise helium measurements are reported that again show simultaneous evidence for excess power, helium production, and anomalous radiation.

AUTHORS' CONCLUSIONS

Simultaneous evidence for excess power, helium production and anomalous radiation in several different experiments suggests that nuclear reactions do in fact occur in Pd/D₂O + LiOD electrolysis experiments. Results from other laboratories provide collaborative evidence for ⁴He production in deuterated palladium systems.

INDIANA - COULOMB BARRIER

Yeong E. Kim (Purdue Univ., Dept. Phys., West Lafayette, IN) and Alexander L. Zubarev (Hebrew Univ., Racah Inst. Phys., Jerusalem, Israel), "Improved Coulomb Barrier Transmission Coefficient for Nuclear Fusion Cross Sections," *Fusion Technol.*, vol 25, no 4, July 1994, pp 475-477, 5 refs.

AUTHORS' ABSTRACT

Higher energy (≥ 20 keV) data are customarily extrapolated by using the Gamow transmission coefficient to estimate the nonresonance nuclear fusion reaction cross sections $\sigma(E)$ for charged particles at low energies (< 20 keV), which are needed for fusion energy production and astrophysical calculations. A general extrapolation method is presented based on a more realistic Coulomb barrier transmission coefficient that can accommodate simultaneously both nonresonance and resonance contributions.

EDITOR'S COMMENTS

The resonances present in fusion reaction cross sections $\sigma(E)$, which are shown by some related experiments to

be of non-Coulomb barrier transmission (CBT) type, are regularly treated by conventional methods. Very broad resonance behaviors for cross sections observed in many nuclear reactions, such as for reactions ²H(D,p)³He, ²H(D,n)³He, ³He(D,p)⁴He, and ³H(D,n)⁴He, may correspond to resonances and may yield different low-energy extrapolations from those obtained by the use of the conventional transmission coefficient, since the low-energy tail of the CBT resonance is expected to be different from that of the conventional case.

In the previous parameterizations of $\sigma(E)$, the resonance part of $\sigma(E)$ is parameterized with the Breit-Wigner resonance formula to be subtracted from the experimental data. A nonresonance formula is then used to fit the resultant data.

The more general formula of these authors will allow one to parameterize the experimental data exhibiting the CBT resonance behavior by the same formula, thus avoiding separate use of the Breit-Wigner formula for subtracting the resonance contribution from $\sigma(E)$. Furthermore, the interference term between the resonance and the non-resonance contributions is automatically included in the formula to obtain transmission coefficient.

TEXAS - SCIENTIFIC EXPLORATION

Peter Graneau (Center for Electromagnetics Research, Northeastern University, Boston, MA), "Cold Fusion at the SSE Meeting in Austin," report for *Fusion Facts*.

The Society for Scientific Exploration (SSE) held the 13th Annual Meeting at Austin, Texas, from June 9 - 11, 1994. The first day of the meeting was devoted to zero-point-energy and cold fusion subjects. H. Puthoff spoke about the possibility of "mining" vacuum electromagnetic energy for useful purposes. B. Haisch outlined his ideas of how zero-point-energy could be the cause of the force of inertia. The audience of over one hundred participants, mainly from universities and research organizations, showed considerable interest in the quantum mechanical contention of the storage of vast amounts of energy in otherwise empty space. Puthoff outlined his explanation of the stabilization of the Bohr atom by balancing radiation from orbiting electrons with incoming zero-point-energy. He also suggested that the Casimir effect had the best chance of converting the radiation energy into mechanical work.

The first speaker on cold fusion was R.T. Bush who asked the question: "Is cold fusion merely a scientific curiosity or is it the millennial energy project?" He presented facts strongly on the side of the latter and argued there was no doubt about the heavy-water excess heat production. "It was more than likely of nuclear origin", stated Professor Bush. In the center of his presentation stood the Bush-Eagleton experiments of cold fusion with light-water and some associated element transmutations. Bush quite freely maintained that this type of experiment opened the door to a modern epoch of alchemy. His conclusion was that if heavy-water cold fusion is correct, it will be the discovery of the century. Should light water cold fusion be correct, it may become the discovery of the millennium.

In a spirited presentation, spiked with cartoons, G. Mallove addressed 'Cold Fusion: Heat (and Light) after Death'. He explained that this title has two meanings. In the first place it referred to the world-wide resurrection of cold fusion research after Maddox, the editor of *Nature*, had certified it to be dead several years ago. The second meaning was that cold fusion cells had been observed to produce heat after the current through them was turned off. Apart from the palladium-heavy-water systems, there were reports of successful experiments with ceramic proton conductors, strong water turbulence, and ultrasonic excitation.

Mallove remarked that the treatment of the MIT theoretician Hagelstein was a sad reflection on academic freedom, and then told the story of how a well-known MIT physics textbook writer, Herman Feshbach, once reprimanded Mallove with: "I've been a nuclear physicist for fifty years. I know what is possible and what is not!" Leon Lederman, Nobel physicist and author of the 'God Particle', was even less tolerant and suggested Pons and Fleischmann deserved a public spanking. Gene Mallove, the editor of the new magazine 'Cold Fusion', could foresee a time where recent events might become known as the 'Heavy Watergate'.

J. Bockris said, by comparison with the previous speakers, his talk would be dry science and limited mainly to experimental findings at Texas A&M University. What he called 'ultra low nuclear changes in metals' had been observed from the 1940s onward but, as he pointed out, had received very little attention. Amongst the phenomena were the synthesis of tritium from deuterium at room temperature, possible changes in

metals of higher atomic weight including precious metals, and the nuclear conversion of carbon to iron. Now about fifty laboratories, including Texas A&M, had found tritium as unmistakable evidence of nuclear activity in cold fusion electrochemical cells. In addition to this, small quantities of helium-four had been detected in four or five laboratories.

Bockris' own group had led the way in finding and documenting nuclear transmutations in small but verifiable amounts which included the famous chain lead-mercury-gold. Most puzzling were biological transmutations which certainly have to be described as ultra-low nuclear activity.

My own contribution to the conference dealt with capillary fusion. I pointed out that non-thermal fusion was discovered in deuterium pinch tubes at Berkeley in the early 1950s as part of the U.S. Atomic Energy 'Project Sherwood' on controlled fusion. Proof of the non-thermal nature of the reactions came from the axial emission of neutrons, instead of the isotropic emission which should have resulted from thermo-nuclear reactions. The U.S. and other governments have, in fact, been funding this kind of cold fusion research for forty years under the headings of plasma focus and solid deuterium fiber fusion. Capillary fusion, as discovered in Germany, was of the same non-thermal nature, with the magnetic confinement replaced by mechanical confinement. Capillary fusion experiments are being re-started in Canada.

E. NEWS FROM ABROAD

BRITAIN - MINIATURE HOT FUSION

"Nuclear Fusion in a Pinch," in *TechUpdate, Popular Science*, vol 171, no 7, July 1994, p 22.

At Imperial College, in London, a MAGPIE machine has taken off. The Mega-Ampère Generator for Plasma Implosion Experiments has 4 pulse generators which send 2 trillion watts into an optical fiber. The fiber becomes heated over 180 million °F, crushed by magnetic forces, and becomes a thermonuclear plasma for a split second. This technique is called pinch fusion and predates the magnetic-confinement fusion occurring in tokamaks. Now with less available money to build facilities and continue research, this much smaller and

cheaper machine will enable scientists to still carry on plasma fusion research.

GERMANY - BREAKTHROUGH RETRACTED

Courtesy of Samuel P. Faile

Daniel Clery & David Bradley, "Underhanded 'Breakthrough' Revealed," *Science*, Vol 265, Number 5168, July 1, 1994, p 21.

EDITOR'S SUMMARY

This article reports on a retraction of a discovery that had been reported in the German journal *Angewandte Chemie* in February, 1994. Apparently, the leader of the team which had reported on a new discovery in "handedness" of biomolecules (such as proteins and DNA) found that a team member had manipulated the experiments. **The sad part of this report is the following statement: "it could have become organic chemistry's version of cold fusion, says organic chemist T.V. RajanBabu of Dupont's Central Research and Development department in Wilmington, Delaware."** We are puzzled that reporters for the prestigious American Association for the Advancement of Science and its publication *Science* are so ill informed about cold fusion that they are still, after five years and hundreds of successful experiments, so fundamentally **under informed**.

HUNGARY - REPRODUCIBLE AND POSITIVE

Ödön Pintér, László Daruházi and Ödön Farkas (Inst. Chem., Eötvös Loránd Univ. of Sci., Budapest), "Reliably Reproducible Electrochemical Experiment Resembling Nuclear Fusion with "Positive" Energy Balance," to be published in Cold Fusion Source Book, 5 mms pages, 3 refs, 6 figs.

AUTHORS' ABSTRACT

The result of an electrochemical experiment is described, in which a process resembling nuclear fusion could be induced with a high level of reproducibility. It has been measured, that the thermal energy output of the electrochemical cell exceeds significantly the amount of electrical power supplied to the cell. In the γ -spectra recorded, there is a significant increase in the range of

0.6-2 MeV measured in heavy water, used as electrolyte, compared to the corresponding experiment in light water. (The supporting electrolyte was 0.2 mol. cm^{-3} LiOH made from analytical grade LiOH. Two different LiOH solutions were prepared, one using ordinary distilled water and one using heavy water containing 99.5% D_2O and 0.5% H_2O .)

AUTHORS' CONCLUSIONS

A cell and electric power source arrangement have been developed that enabled us to carry out electrochemical experiments resembling nuclear fusion with a high level of reproducibility. In the course of the experiments we have detected significant γ -activity in an electrolyte which contained heavy water, as solvent compared to a solution of the same composition except for using light water. Integrating the input electrical current and computing the thermal energy output, an excess of thermal energy could be observed with respect to the electrical energy input.

JAPAN - COLD FUSION WITH FISSION

Reiko Notoya (Catalysis Res. Ctr., Hokkaido Univ., Sapporo), "Cold Fusion Accompanied with Fission in Alkali Ions' Light Water Solutions Mainly on Nickel Electrode," Cold Fusion Source Book, Proceedings of Minsk International Symposium on Cold Fusion and Advanced Energy Sources, 24-26 May 1994, 5 pages, 11 refs.

ABSTRACT

During electrolysis of light water solution of potassium ion using the specially designed porous nickel cathode, more than 200% excess heat and the increase of the concentration of calcium ions in the electrolyte measured by use of a flame photo spectrometer were observed. Considerably large heat evolution was also observed in light water solution of cesium ion on porous nickel and platinum cathodes by electrolysis. The one-proton capture initiated successively two-, three- and so on, accompanying the natural disintegration of these products. The several kinds of nuclear species proved to be produced in the order of ppm during electrolysis of cesium solution by nickel and platinum cathodes on the basis of the results of the analysis by ICP-MS. By the observation of γ -ray emission, it was found that

electrolysis of light water solution of cesium ion caused some fission.

RUSSIA - NUCLEAR REACTIONS IN SOLIDS

V.A. Chechin and V.A. Tsarev (Lebedev Phys. Inst., Moscow), "On the Nonstationary Quantum-Mechanical Origin of Nuclear Reactions in Solids," *Fusion Technol.*, vol 25, no 4, pp 469-474, 15 refs.

AUTHORS' ABSTRACT

A model for deuteron reactions in solids is suggested in which an increase in the penetrability of the Coulomb barrier is attributed to a quantum-mechanical perturbation of the wave function caused by nonstationary deuterons in a crystalline lattice.

One of the simplest, most natural models is the "acceleration" mechanism (initially suggested for "nuclear mechanofusion") in which fusion is assumed to be a result of ion acceleration by electric fields in solid-state cracks. When applied to cold fusion, the fracto-acceleration model (FAM) is able to explain many of the features of neutron emission. The relationship between cold fusion and the "hydrogen fracture" FAM allows us to make the following predictions:

1. The stochasticity of cold fusion is a consequence of the stochasticity of the fracture process.
2. Cold fusion is related to the surface volume. The activity is manifested in a hydride layer that is subjected to fracture at a given time interval. As the activity progresses deeper into the sample, more layers become involved.
3. The quasi-periodicity of bursts is a consequence of growth dynamics due to the diffusion of a hydride layer to a certain critical thickness l and then to its fracture. The characteristic interval between bursts is $t \sim l^2 / D_0 \sim 10^2$ to 10^4 s, where D_0 is the diffusion coefficient.
4. A necessary condition for the destruction of the hydride and creation of unstable hydride phases is a nonequilibrium state in the metallic-deuterium system.
5. There may be external effects on the behavior of cold fusion.

6. During cold fusion, changes in physical-chemical properties and structure may occur in some areas.

7. The emission of nuclear fusion products is correlated with acoustic and electromagnetic emissions that accompany crack propagation.

8. Fusion rates over various channels inherent to "hot" fusion can be predicted.

Each of these predictions has been proved to some extent by experiment; thus, the model seems to capture the true correlation between cold fusion and fracture. At the same time, however, the FAM does have a number of serious problems:

1. To quantitatively explain cold fusion experiments, one must assume the presence of strong electric fields in the microcracks (up to 10^7 to 10^8 V/cm).
2. The relationships among the time scales that characterize various competitive processes are not sufficiently clear.
3. One must assume that the dielectric properties of transition metals are enhanced during periods of nuclear activity; this would block the charge relaxation.

EDITOR'S COMMENTS

The fracto-acceleration model (FAM) being one of the simplest, most natural models is the "acceleration" mechanism in which fusion is assumed to be a result of ion acceleration by electric field in solid-state cracks. When applied to cold fusion, the FAM is able to explain many of the features of neutron emission and predict some other phenomena related to cold fusion processes. At the same time, however, the FAM does have a number of serious problems, in particular: to quantitatively explain cold fusion experiments, one must assume the presence of strong electric fields in the microcracks (up to 10^7 to 10^8 V/cm) which is hard to imagine; one must assume that the dielectric properties of transition metals are enhanced during periods of nuclear activity (this occurrence would block the charge relaxation); and some other. In addition, the FAM does not explain other cold fusion phenomena such as in light-water, gas plasma, or proton conductors.

RUSSIA - GLOW DISCHARGE

A.B. Karabut, S.A. Kolomeychenko, I.B. Savvatimova (Sci. Ind. Assoc. "Luch", Moscow, Russia), "Registration of Nuclear Radiation in Glow Discharge Experiments," to be printed in Cold Fusion Source Book.

AUTHORS' ABSTRACT

The experimental results of the nuclear product registration are presented in this paper. In our previous experiments with glow discharges in deuterium excessive release of neutron, gamma and charged particle emission have been observed. Recently we modified the experimental facilities. New measuring techniques were added. New data on emission of radiation (neutrons, gamma and X-rays, heavy charged particles, fast electrons) and on electric processes near the cathode provide clearer understanding of the specific nuclear processes involved into the reported observations. A possible mechanism for the initiation of these reactions is suggested.

AUTHORS' CONCLUSION

A possible mechanism of conversion electron release may operate in the following way. In a high density ion flux in a glow discharge, the energy can be transferred from low energy ions (10-1000 eV) into nuclei in the cathode material step-by-step in nonelastic collisions. It is necessary that nuclear levels (from low levels of neutron resonance type with energies of tens of eV) would have a lifetime longer than the period between two successive ion impacts. The resulting metastable excited levels of Pd release their energy (65-3500 keV) by conversion electrons and partially by a small amount of gamma rays.

This suggestion is confirmed by experiments with Ar and Xe where high voltage generation and X-ray film exposure are also observed. By our estimation 0.1-10 per cent of the discharge power is transferred according to this mechanism. It means that under a flux of 10^{17} ion/sec 10^{10} - 10^{12} excited to MeVs energy nuclei of Pd arise per second.

Under certain concentration of the excited nuclei in the cathode material and density of implanted deuterium up to 10^{22} cm⁻³ some nuclear reactions can occur [Karabut

et al., "Possible Nuclear Reactions Mechanisms at Glow Discharge in Deuterium," below].

RUSSIA - POSSIBLE MECHANISM

A.B. Karabut, Y.R. Kucherov, I.B. Savvatimova (Scientific Industrial Assc. "Lutch," Moscow), "Possible Nuclear Reactions Mechanisms at Glow Discharge in Deuterium," Frontiers of Cold Fusion, Proc. 3rd Int. Conf. on C.F., 1992, Nagoya, Japan, pp 165-168, 2 refs.

AUTHORS' ABSTRACT

Experimental results of impurity concentration measurements in palladium cathode by different methods before and after glow discharge in deuterium experiments are presented. Some very strange elements which we could not find in discharge environment can be seen. An attempt to understand this situation on the basis of fission and fusion in Pd-D system is presented.

AUTHORS' CONCLUSION

In the assumption that mechanisms allowing to overcome nuclear barriers exist, fusion and fission reactions for which conservation laws are fulfilled are taken into account. The analyses of the impurities, appeared in pure palladium after glow discharge experiments, give suspicious correlation with predicated elements. The given results are still difficult to call final, but if they will be confirmed on the basis of larger statistics, they will ask for a new approach to the problem. The unique role of the deuterium will be questioned because the same thing can be constructed for other gases and metals. It will also initiate the search for long-living resonances of nuclear shell of Pd, excited by inelastic scattering of discharge ions (of the type of the laser effect).

RUSSIA - CATHODE PROCESS

I.B. Savvatimova, A.B. Karabut, Ya. R. Kucherov (Sci. Ind. Assoc. "Luch," Russia), "Process on the Cathode of the Glow Discharge in the Deuterium," to be printed in the Cold Fusion Source Book.

AUTHORS' ABSTRACT

Results of the impurity concentration changes in a palladium cathode after deuterium and hydrogen glow discharge experiments are presented. The concentration of some impurities increases up to 10^4 times after deuterium irradiated and to 10 times after hydrogen irradiated. Autoradiography of cathode samples shows that activity of the sample is observed after irradiation by deuterium, hydrogen, argon ions. Isotopes with different radiation energy (more and less 20 keV) exist in the cathode after experiment. The obtained results cannot be explained by the existence of a conventional fusion reaction, but may be explained by a more complex fusion-fission reaction.

RUSSIA - TEC PULSE MODE

Translated by Igor Goryachev

V.A. Zharebtsov, M.A. Lebedev, A.A. Sobolev (Inst. Phys. & Power Engr., Obninsk, Russia), E.E. Antonov, Yu.P. Korchevoy, and I.Ya. Podolukh (Inst. Energy Sav. Problems, Ukrainian Acad. Sci., Kiev), "Experimental and Theoretical Study of the TEC Pulse Mode with $Cs+N^2$ Filling," Proceedings of Intersoc. Energy Conv. Engr. Conf. (IECEC) 1989, pp 1137-1142, 15 refs, 2 figs, 1 table.

AUTHORS' ABSTRACT

Based on the analysis of the processes observed in the cesium-nitrogen plasma a theoretical model of the pulse mode of the thermionic converter (TEC) with $Cs+N^2$ filling was developed. The converter characteristics were calculated and the optimum conditions for energy conversion were found. At lower emitter temperatures the efficiency of the mode in question was shown to be close to that of the pulse mode with direct ion production and to exceed the efficiency of the ignited mode. The duration of the mode cycle discussed is by an order of magnitude greater than the duration of the mode cycle with direct ion production. The advantages of the mode discussed, as compared to the ignited mode, are evident at higher temperatures than in the case of the modes with a direct ion generation.

The effects of the ion production non-equilibrium were investigated. It was shown that since the molecule's vibrational temperature is much greater than the

transitional one, the cesium ion production rate significantly exceeds the equilibrium one calculated according to the Boltzmann distribution of the vibration-excited molecules.

The decay stage of the thermionic diode simulating a thermionic converter with the $Cs+N^2$ plasma was studied experimentally. The period of plasma decay was shown to increase sharply with an increase in the nitrogen pressure as soon as it exceeds a certain value. This evidence supports the idea of cesium ionization being effected by nitrogen.

RUSSIA - DENEUTRON THEORY

Translated by Igor Goryachev

Y. Istomin, K. Kaliev, V. Istomin (Institute of High Temperature Electrochemistry, Ekaterinburg, Russia), "Deneutron Theory of Cold Nuclear Fusion", Proceedings of the International Symposium on Cold Fusion and Advanced Energy Sources, Minsk, Belarus, 24-26 May 1994, pp 317-330, 15 refs.

The basics of Deneutron Theory of Cold Nuclear Fusion have been developed. The Theory is based upon assumption that in the environment of dense low temperature plasma a force of electrons by deuterons can happen. It results in production of an "exotic" nucleus with mass equal to 2.01398105, a zero charge and with a spin equal to 1. The capture of electrons is possible because, contrary to protons and tritons, deuterons obtain the minimal electron orbit which is metastable (that makes a K-capture possible). Moreover, the reaction of electron absorption by a deuteron with a neutrino release has a positive energy balance (i.e. exoenergetical) and is not restricted by spin orbital interactions and because of that it results in generating a stable nucleus (deneutron). Deneutron can easily penetrate in practically any nucleus, especially in neutron deficient nuclei, and gets coupled with other nuclear associations by means of nuclear forces, provided that in order to excite such nuclear reactions no additional energy is required to be spent.

The Deneutron Theory explains all the strangenesses of cold fusion. In particular, only by means of this theory one can explain the preferential running of CF nuclear reactions by "tritium" channel. It also eliminates at once all the contradictions of astrophysics.

The Deneutron Theory of Cold Nuclear Fusion understands this phenomenon as being nothing but the result of nuclear interaction between deneutrons and nuclei of chemical elements (it also determines those elements which do not participate in reactions of cold nuclear fusion).

Using the Deneutron Theory the authors gave explanations to various CF experiments (including those of Pons and Fleischmann's). The Theory also predicts the magnitudes of energy release in cold nuclear fusion reactions. The authors have carried out special experiments proving existence of deneutrons.

UKRAINE - RELAXATION CHARACTERISTICS

Translated by Igor Goryachev

Eugene E. Antonov, Yuri P. Korchevov, Igor Ya. Podolukh (Plasma Phys. Dept., Inst. Energy Sav. Problems, Kiev, Ukraine), "Relaxation Characteristics of Cs-N₂ TEC with Pulsed Ionization," Proc. 28TH IECEC, 1993, Atlanta, GA, 4 pages, 5 refs, 3 figs.

AUTHORS' ABSTRACT

The investigation has been devoted to experimental realization of the previous theoretical proposal to utilize molecular nitrogen as buffer gas in thermionic energy converter (TEC) with pulsed ionization of Cs atoms. Similar problems were investigated also by J. McVey (1990) who observed the relaxation of discharge current in decaying Cs-N₂ plasma but obtained no positive effect being connected with the addition of nitrogen. Further investigation of the above problems has been carried out. The results of the investigation have confirmed the theoretical assumptions and previous experimental data concerning the possibility of essential increase of the working stage of Cs-N₂ thermionic energy converter pulsed ionization.

UKRAINE - LOW PRESSURE DISCHARGE

Translated by Igor Goryachev

E. Antonov, V. Dresvjannikov (Plasma Phys. Dept., Inst. Energy Sav. Prob., Ukrainian Acad. Sci., Kiev), "Generation of Clusterization Centers in H₂O Low-Pressure Discharge," Proc. XX Int. Conf. Pressurized Ionized Gases, Pisa, Italy, 1991, pp 61-62, 5 refs.

AUTHORS' ABSTRACT

The investigation of H₂O vapor plasma properties has an importance not only for theory development but also for practical needs, in particular for optimization of some electrical power engineering equipment. For this purpose it needs the detailed analysis of clusterization in low-pressure discharge water vapor plasma...

In the report the particularities of clusterization process for water vapor plasma were investigated and the mechanism of instability evolution for generation of (OH)⁻ ions as condensation centers had been considered. The possibility of substantial increase of the number of centers of heterogeneous condensation in water vapor have been shown.

UKRAINE - VIBRATIONAL RELAXATION

Translated by Igor Goryachev

E.E. Antonov, V.I. Popovich (Dept. Plasma Phys., Inst. Energy Sav. Prob., Ukrainian Acad. Sci., Kiev) "Vibrational Relaxation of Electronically-Excited Molecules O₂ (b¹Σ_g⁺, v=1) in Oxygen Discharge Afterglow," Proc. XX Int. Conf. Pressurized Ionized Gases, Pisa, Italy, 1991, pp 285-286, 4 refs, 2 figs.

AUTHORS' ABSTRACT

The investigation of spectral intensity distribution of atmospheric O₂ (electronic transition b¹Σ_g⁺ - x³Σ_g⁻) for low-pressure discharge and its afterglow indicated that rotational T_r and vibrational T_v temperatures of O₂ molecules in b¹Σ_g⁺ state are almost equal despite the fact that excited molecules in these conditions were generated by recombination of oxygen atoms and had redundant vibrational energy E_v > 3.5eV. The assumption was made that vibrational relaxation for electronically-excited molecules is more effective than the one for the ground electron state. This phenomenon is not completely clear due to the lack of necessary experimental data, so the report is devoted to more detailed measuring of spectral intensity relaxation for atmospheric (O-O) bands for O₂ molecules in oxygen low-pressure discharge afterglow. The characteristic times of vibrational relaxation for electronically-excited O₂ molecules were measured depending on oxygen pressure in afterglow of pulse-pressure discharge. The more rapid vibrational relaxation of excited O₂ (b¹Σ_g⁺) molecules comparative to VT-

relaxation of O_2 in the ground state ($x^3\Sigma_g^-$) was confirmed experimentally.

UKRAINE - Cs-N TEC / PULSED IONIZATION

Translated by Igor Goryachev

E.E.Antonov, Y.P.Korchevoy, I.Y.Podolukh (Inst. of Energy Sav. Prob., Ukrainian Acad. Sci., Kiev), "Emission Features of Cathodes and Relaxation Characteristics of Cs-N₂ TEC with Pulsed Ionization," *Optics and Spectroscopy*, vol 67, no 2, 1989, pp 298-302, 17 refs, 4 figs.

AUTHORS' ABSTRACT

Relaxation of Cs-N₂ plasma has been investigated under conditions close to the working regimes of thermionic converters (TEC) with pulsed ionization of Cs atoms. A number of factors have been disclosed to increase the duration of working phase of such TEC's addition of molecular nitrogen into the gap. The space distribution of the parameters of relaxing plasma in the gap of TEC as well as the emission features of cathodes will determine the dynamics of plasma decay.

F. SHORT ARTICLES

ENHANCED ENERGY SYSTEMS -- IMPACT ON DEVELOPING NATIONS

By Hal Fox, Editor

Gordon Romney, who has recently returned from living in Guatemala with his family, related the following story. Gordon was driving with his nine-year old daughter near the mouth of a Utah Canyon where many years ago a power plant had been built to convert some of the canyon water into electricity. "That's a dumb place to put a power plant," the daughter stated, "anyone could bomb it." This nine-year-old girl had lived in a developing country where terrorists and the occasional bombing of the power distribution system was a part of her life. Dr. Romney stressed the need for distributed power systems in such a country. The thought was new to me.

Cold fusion (or space energy) systems will have a strong impact on developing countries. Our best estimates are that power will be able to be generated and distributed

locally for about one-fourth the cost of fossil-fuel power. Developing countries will be an excellent customer for power systems for the following reasons:

1. Power can be provided where it is used. There will be no requirement for an expensive power distribution system. This feature also lends itself to the protection of the power delivery system against terrorist activities.
2. Inexpensive power, generated locally, will mean considerable savings of scarce monetary resources that would otherwise go to pay for imported fuel.
3. Cheap power will save tropical (and other) forests that are being harvested for fuel for cooking and heating.
4. Cheap power means that water can be boiled, sewage can be sanitized, and/or pumped to improve sanitation.
5. Cheap power can provide light for an extended day for work, study, or play. Mature citizens can earn more wages or study to improve their work status. Both functions can add to the economic well being of a family and, therefore, of a nation.
6. Cheap, local power can be used to provide simple cottage industry power. For example, cloth weaving can be greatly accelerated by using power looms instead of the traditional hand-weaving equipment still in use in many countries.
7. Local power provides for expanded markets for various appliances, especially for televisions, video cassette players, computers, and communication equipment. All of these devices tend to increase the standard of living for a country. Even a television purchased for entertainment adds to the gross national product and can improve the economic well-being of the users by providing information services, news, weather, and instructions from local and federal government agencies.

The citizens in the western world, and especially the U.S., have enjoyed the use of abundant energy. With the increasing population of the world and the decreasing fossil-fuel resources, our children and grandchildren will not be able to enjoy the same degree of energy use **if we must rely on the burning of fossil fuels**. In addition, our planet would not be able to support the

environmental damage and still provide clean air and clean water to five billion people.

If we are to provide abundant energy to our children and our grandchildren and also extend this increased standard of living to all of the people of the developing countries, we must develop alternative energy sources. **We must also realize that neither the existing nuclear fission power plants nor the proposed future hot fusion power plants are an acceptable alternative.** Both of these types of power plants are unacceptable due to the constant output of harmful radioactive byproducts. In addition, the cost of such plants is unacceptable.

Two major sources of energy are now theoretically available: cold nuclear fusion and space energy. It is true that neither of these sources of energy is currently developed into commercial products. **However, the demonstrated potential for the production of energy is far greater than hot fusion power production, which is currently being funded at about \$500 million per year.** It is a strange twist of the development of science that has caused so-called scientists to leave their scientific integrity behind and become political lobbyists against the use of new energy systems just to preserve the status quo of science (especially to preserve the flow of funds into hot fusion research.)

It is also highly interesting to contemplate the possible future development of new energy sources. The nature of cold nuclear fusion and tapping space energy permits valuable research and development to be performed by any government or private entity that has access to the literature and can provide \$100,000 in research funds. Valuable contributions can be made, and are being made by research groups in China, India, Russia, Belarus, Ukraine, and, to some extent in a few Latin American countries. **When it is realized by government and business leaders, that cold nuclear fusion and/or tapping space energy are viable new alternative energy sources, there will be greatly expanded research and development activities in both government and private laboratories in almost every country in the world.**

Currently, Japan is leading the world in the amount of resources being spent on the development of cold nuclear fusion. In terms of commitment of manpower and laboratory facilities, the member nations of the Commonwealth of Independent States (CIS) and Italy are

among the world leaders in cold fusion research. China and India have viable groups doing important work but with limited support from key government sources.

The current lack of official support from both government and industry will rapidly change as some of the newer discoveries in both cold fusion and other enhanced energy systems are announced and demonstrated. There is scarcely a country in this world that does not have scientists and laboratories suitable for developing enhanced energy devices and systems. **The most important task now is for the rapid and widespread publication of information about these developing sciences. Rapid and accurate information dissemination is the goal of this and an increasing number of publications.**

COLD FUSION AND THE ELECTRIC VEHICLE

By Hal Fox

The state of California is leading the world in promoting the use of electric vehicles (EV). On May 13, 1994, the California Air Resources Board upheld its plan to introduce low- and zero-emission vehicles in California. Despite vigorous opposition from U.S. automakers, EVs will be offered for sale in California starting in 1998.

One of the objections to EVs has been the observation that the mobile pollution is only moved from the highway to the power plant. In a study by the Natural Resources Defense Council (No More Tailpipes), the EVs emission (from the local power plant) was compared with the cleanest gasoline powered competitors assuming that the competition meets the 2010 emission requirements. The EVs were found to be 97-99 percent cleaner for reactive organic gases and carbon monoxide. For nitrogen-oxide emissions the EVs are 41-73 percent cleaner. For carbon dioxide emissions the EVs were 49-66 percent lower.

In a study by the Union of Concerned Scientists (Driving Out Pollution: The Benefits of Electric Vehicles) it was computed that every EV that replaces a gasoline-powered vehicle saves \$16,940 in pollution control costs from other sources. A new book by James J. MacKenzie (The Keys to the Car: Electric and Hydrogen Vehicles for the 21st Century) suggests that the true cost of the polluting internal combustion engine automobile should be paid by

taxing the gasoline consumed. This action would raise the price of gasoline by an estimated \$0.50 per gallon. The end result would be to make the EVs more cost competitive. [Source of the above information: May/June, 1994 issue of *CALSTART Connection*, page 7.]

The above is the traditional view of the result of using EVs. We have some added information. When cold fusion systems are adapted to producing electricity for charging the batteries in EVs, then the pollution (through the power plant) drops to essentially **zero**. This is the story that will be presented to the attendees of the Solar Energy Exposition and Rally (SEER) at their annual meeting in Ukiah, California during the week of July 11-17, 1994.

In a discussion with a marketing manager for Allied Signal, the question was raised as to how their Turboalternator fit into the coming cold fusion technology. The turboalternator is a device that burns oil, gasoline, propane, or natural gas in a turbine and produces electricity. This unit was originally developed for providing electrical power for military tanks. Because the turboalternators operate at one highly-efficient speed, they can be both efficient and meet the year 2000 emission standards. My suggestion was that they consider redesigning the unit so that the turbine operates on vapors produced by cold fusion power systems. Such a combination meets the overall zero emissions standards and does not require a heavy investment in EV charging stations.

Our readers, who are working on system development programs for cold fusion, should carefully consider designing cold fusion thermal reactors to match with efficient turbine alternators to make electricity for EV use. This application appears to make a lot of sense. With an on-board cold fusion electrical source to charge the batteries continuously, the mileage range of the electric vehicle could be extended.

G. LETTERS FROM OUR READERS

LETTER FROM DR. HAROLD ASPDEN

PROTON-DEUTERON ABUNDANCE CONTROVERSY

Hal Fox, in his editorial introduction (*Fusion Facts*, May 1994 p. 1), explained how Mr William Frucht (the Director of the Library of Science), with 'cold fusion' as the subject under discussion, was "willing to provide differing views of scientific controversy."

What is so illogical about this is that 'cold fusion' is not really a controversial issue - meaning a question of opinion - but is one that can only be resolved at the laboratory bench by the facts of experiment. Much of the ongoing funded work since the early publication of the findings of F & P has become the subject of proprietary interest and is being kept confidential. The scope for scientific controversy centers primarily on theory but, so far as popular appeal and general readership interests are concerned, it is both misleading and premature to argue that what can only be a question of experimental fact proved in a laboratory is really scientifically controversial.

That said, I would suggest that those minded to become involved in a relevant scientific controversy should now turn their attention to the very recent experimental evidence (published after 'peer review') that is emerging on the question of "primordial deuterium abundance."

It is stated in the June 1994 issue of *Physics World* (published by the Institute of Physics in U.K.) that if "these first observations of deuterium outside our galaxy are confirmed, some previously cherished conclusions will have to be discarded."

These are indeed strong words, bearing in mind that what is in issue is the credibility of those accredited as expert on the theory of proton fusion who have built what must now be seen as erroneous even though it is "cosmology which successfully accounts for the primordial abundance of the light elements inferred from measurements over nine orders of magnitude."

The new experimental discoveries show quite clearly that those we assume to be qualified to 'peer review' the work of F & P have made a grave error in their primary

pursuit - the understanding of the fusion processes that they see as creating our material universe.

Who, other than someone practical working at a laboratory bench who has glimpsed the facts of an experiment conflicting with the Establishment opinion, would dream of challenging `cherished beliefs' that fit a spectrum of analysis over "nine orders of magnitude." The impartial student of `cold fusion' history may well soon begin to see F & P in that light and come to realize what is at stake in the contest we are witnessing.

If protons needed the Big Bang `hot fusion' scenario to develop into deuterons and heavier elements, their relative abundance now seen in gas clouds in space should, according to those expert theorists, be no greater than 2.3×10^{-5} as deuteron-to-proton ratio. Yet, the experimental findings we now see reported and illustrated at pp. 29-30 in the June 1994 issue of *Physics World* indicate a much greater relative deuteron abundance of the order of 3×10^{-4} per proton. One reads:

"The results from two groups - one using the powerful new 10 m Keck Telescope on Hawaii (A. Songalia et al., Nature (1994) 368 599), the other using the 4 m Mayall Telescope on Kitt Peak, Arizona (R.F. Carswell et al., Mon. Not. R. Astron. Soc. (1994) in press) - suggest a substantially higher primordial deuterium abundance than previously assumed."

The range of measurement error reported is so small that these findings are bound to bring confusion into the prevailing cosmological beliefs about the origins of the universe. Theorists, we are told, may have to invent new types of neutrino to take up the slack between what is and what their theories say should be!

As a footnote I remind readers of my Letter `The Triton Factor in Cold Fusion', *Fusion Facts*, May 1994, pp. 16-17. This referred to my Energy Science Report: Cold Fusion: Part I, which shows how the natural equilibrium value of the relative abundance ratio of deuterons and protons can be calculated in terms of a `cold fusion' process - the answer being 1.49×10^{-4} . The Introduction to that Report concluded by saying that "cold fusion research could well give us the added stimulus leading to the needed insight into the forces at work in creating the hydrogen nucleus and so understanding creation on a universal scale."

The new experimental findings referenced above will give the Big Bang theorists a headache and, to relieve their pain, I prescribe acceptance of `cold fusion' as the needed therapy. Alternatively, if one needs to dwell on scientific controversy the fusion processes of the Big Bang are proper subject matter for such contemplation - not the results of `cold fusion' experimentation.

Harold Aspden,
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LETTER FROM JORGE C. CURÉ

"Dear Colleagues,

"It seem that the multiple collisions of the fragmented comet Shoemaker-Levy 9 (SL9) with planet Jupiter on July 16-22, 1994, should be a matter of serious concern. In all the many scientific articles published in the past few months in relation to these collisions, none of them address the possibility of piezonuclear reactions in the liquid-solid hydrogen core of Jupiter. ...

"Drs. Van Siclen and Jones have estimated that a pressure of 100 million atms. is needed to initiate piezonuclear fusion of deuterons. Late calculations show that the pressure in the metallic-hydrogen core of Jupiter is 60 million atms. Will the shock wave deliver a pressure increment of 40 million atms.? Let us not forget that to detonate a hydrogen bomb only one atomic bomb similar to the Alamogordo type is needed, while in Jupiter, one cometary fragment could deliver energy equivalent to 50 million atomic bombs. To know the answer to the previous question is a vital matter...."

[Editor's Comment - We wonder if this is the scenario responsible for the asteroid belt?]

From *Astronomy* magazine comes this chart of comet fragment impact times.

Fragment	Date	(UT)*
A (21)	July 16	19h26m
B (20)	17	2h38m
C (19)	17	6h29m
D (18)	17	11h31m

E (17)	17	14h38m
F (16)	18	0h29m
G (15)	18	7h12m
H (14)	18	18h43m
J (13)	19	2h10m
K (12)	19	10h05m
L (11)	19	21h22m
M (10)	20	5h31m
N (9)	20	9h50m
P (8)	20	14h38m
Q (7)	20	19h12m
R (6)	21	6h17m
S (5)	21	14h38m
T (4)	21	18h00m
U (3)	21	21g07m
V (2)	22	2h19m
W (1)	22	7h41m

* Subtract 4 hours for EDT, 5 hours for CDT, 6 hours for MDT, 7 hours for PDT

[We wonder how many astronomers will be watching Jupiter this month.]

H. MEETINGS & MISCELLANEOUS

ENERGY BOOKS FROM RUSSIA

We picked up a number of books and pamphlets at the May, 1994 conference in St. Petersburg, Russia: "The International Conference on Space, Time and Gravitation." Our friends in Russia have sent us the following list of books and short translations of the subjects covered in those books. We will add more information as the rest of the list of books is translated.

A.G. Mitrofanov, Ontological Vacuum-Substance Picture of the Universe, Petrozavodsk, Karelia, 1991, 86 pages.

An attempt has been made in the book to "rehabilitate" materialistic dialectics; to show how, behind the facade of self-evident, century old truths, ambiguity has arisen. There have arisen philosophies in which are hidden combinations of falsehood and truths. The conclusions drawn on the basis of the retrospective dialectical analysis of the collective concepts of modern physics have often presented the solutions of the fundamental mysteries of science in a new way. For example, the book treats such mysteries as gravity, inertia,

corpuscular-wave dualism, etc. and compares old structured beliefs with new concepts.

V.Ya. Bril, "Kinetic Theory of Gravitation and Business Offers that Follow from this Theory," St. Petersburg, 1993, 20 pages.

This is a publicity article under the motto: Our knowledge + your money = common benefit. The essence of the offers: 1) Publication of the monograph "Kinetic Theory Gravitation and its Supplement. 2) Organization of the search for Atlantis with the help of information unknown before, but obtained within the limits of the kinetic theory of gravitation. 3) Establishing a center for data related to the earth's tectonic, seismic (earthquake dangers) regions. 4) Establishing a scientific forecast center for global cataclysms based on the new knowledge of kinetic theory gravitation (KTG) with the help of the method worked out within the limits of KTG. The book also gives approximate estimations of expenditures and expected profits from the realization of these plans.

F.M. Kanarev, "Do You Still Believe? or Did You Decide to Check?", Krasnodar, 1992, 64 pages.

This monograph is a criticism of A. Einstein's theory of relativity.

F.M. Kanarev, The Analysis of the Basic Problems of Modern Physics, Krasnodar, 1993, 255 pages.

The author shows that ambiguity in the understanding of the space and time unity leads to the loss of cause and effect relationships and to an increase in theoretical errors which most vividly manifest themselves in the theory of relativity. It turns out that the space and time unity is an axiom which proves itself in the synchronism of the movement of any objects in the long run. Within the limits of this axiom, all the formerly postulated basic correlations of quantum mechanics are derived from the laws of classical physics. Moreover, electromagnetic structures of photons and electrons are revealed. There occurs spectroscopy, analytical theory, and serious preconditions for the construction of models of atoms and ions which can be created on the basis of their spectra-analysis. There appears a large number of consequences and well-known physical facts which can now be interpreted in a new way.

F.M. Kanarev, "On the Way to the Physics of the 21st Century," Krasnodar, 1994, 25 pages, in English.

It is shown that The Analytical Theory of Spectroscopy provides a new direction for the future of physics. See the previous two books by the same author.

A.I. Veynik, S.F. Komlik, Complex Definition of the Materials Chrono-Physical Properties, Minsk, 1992, 95 pages.

Heretofore unknown choral and metric phenomena and new thermo-electrical effects are considered in this book. These new concepts allow one to successfully break the following well-known physics laws: the third law of Newton's mechanics, Volt's law of the conservation of motion quantity, Klauzius's second thermodynamic law, etc. Experimental methods and definitions of some basic properties of the enumerated phenomena and effects are described.

Academy of Sciences of Russia Institute of Mechanical Engineering Problems, "Aggregative Methods in Multibody Systems Mechanics," edited by V.A. Konoplev, St. Petersburg, 1992, 48 pages, in English.

This preprint contains the main results of the investigations carried out in the Controlled Systems Mechanics Laboratory of the Institute of Mechanical Engineering Problems, Russian Academy of Sciences. A new mathematical formalism of multibody systems is described. This formalism offers the numerically-efficient algorithms which were applied for practical problems.

F.D. Prussov, Ether Phenomenon, Nikolaev, 1992, 133 pages.

The following characteristics of the ether are calculated: density, pressure, viscosity, temperature with due account of disturbances in the ether, discrete values of etheric momentum with its position in the central field (electron in atom, planet) are determined on the basis of which created the theory of Mendeleev's Periodic Table and the solar system. There has also been developed the ether theory of superfluidity, superconductivity, and interactions. The longitudinal effect of the magnetic field on electric charge is predicted and discovered, that is a basic for the electric energy generator of an absolutely

new type - ecologically clean transformer of kinetic energy of ether's particles.

V.A. Kashkintsev, Physics of Engines of Unidentified Flying Objects. The Phenomenon of Gas Weight Dependence on the Imparted Thermal Energy, Zhigulevsk Institute of Radioequipment, 1993, 46 pages.

The possibility to operate or accelerate effective quantities of gas masses by changing their physical state is, for the first time, theoretically explained. The possibility of getting positive results in the Galileo-Newton-Etovish experiments is for the first time theoretically explained. The existence of stellar gas masses hidden within the high temperatures is a fact that for the first time is proved by the author.

The possibility is described of using the discovered phenomenon of gas weight dependence on temperature to make gravitation engines similar to the engines that may be used in hypothetical unidentified flying objects. The possibility to develop a gravitational engine is presented.

PRELIMINARY ANNOUNCEMENT

FIFTH INTERNATIONAL CONFERENCE ON COLD FUSION (ICCF-5) 9-13 APRIL 1995 MONTE-CARLO CONVENTION CENTRE MONTE-CARLO, MONACO

Further progress has been made in many laboratories during the last few months in experiment design, reliability and reproducibility of results both for the generation of excess energy and the observation of nuclear products in "cold fusion" systems.

The development of various experimental devices has progressed to a point where they may be considered to be demonstration of the effect.

Theoretical treatments continue to be developed and several of these are at the point where quantitative predictions can be made.

It is therefore opportune to convene a further scientific conference to consider the significance of these new results, demonstrations, and developments in theory.

PRELIMINARY REGISTRATION

If you are interested in attending this conference, contact one of the organizations below for a Preliminary Registration Form and return it before August 15, 1994. We expect a large attendance and we encourage you to reply as soon as possible. Please note that in view of the widespread interest, we may be required to limit registration numbers.

LOCAL ORGANIZING COMMITTEE OFFICE

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OR

FUSION INFORMATION CENTER

P.O. BOX 58639
Salt Lake City, Utah 84158
Tel: (801) 583-6232
Fax: (801) 583-2963

RUSSIAN CONFERENCE

Second Russian Conference on Cold Fusion and Nuclear Transmutation (RCCFNT-2) will take place in Moscow State University retreat center on the shore of the Black Sea near Sochi, during September 18-24, 1994. The program of the conference includes the subjects: 1. Experimental researches of Cold Fusion and Nuclear Transmutation with the different scientific methods and instruments, 2. Cold Fusion theoretical models, and 3. Cold Fusion applied technologies and devices. The conference will be in Russian with English translation available. Registration fee of \$550 covers Conference proceedings, accommodation, meals, and transportation from Moscow to Sochi and back.

For information write: Russian Conference on Cold Fusion and Nuclear Transmutation, Ap. 184.8 Verknija Maslovka St., "Erzion" Center, 125083 Moscow, Russia. Contact by Fax at (095) 292-65-11 box 6935 Erzion.

"COLD FUSION" REVIEW

In its third issue, *Cold Fusion* magazine, July 1994, vol 1, no 2, has the following features and articles:

A Plethora of 'Miracles,' a theorist's perspective of experimental claims, by Peter Hagelstein
The High Frontier: The implications of cold fusion for space technology, by Eugene Mallove
Chemically-Assisted Nuclear Reactions, by Edmund Storms
What to Do About Uncle Sam?, by Eugene Mallove
Cold Fusion and the Press, by Charles Beaudette
Nova Resources Plans for Cold Fusion Contingencies, by Wm. A. Boas, Jr.
On the Cutting Edge, an interview with Fred Jaeger, CEO of ENECO, by Eugene Mallove
"Too Close to the Sun," a review of the BBC special on Cold Fusion, by Chris Tinsley
Capillary Fusion, by Peter Graneau
We Now Have New Physics: Acoustic observations and related quantum phenomena within metallic lattice structures that support stereotronic nuclear reactions, by David Deak
Newton vs. Einstein, a book by Peter and Neal Graneau, is reviewed
Forbidden Science, suppressed research that could change our lives, a book by Richard Milton, is reviewed.

Also included are short articles on: The Cornell University cold fusion archive; Japan's new hydrogen energy program; the "Good Morning America" interview; a Senate hearing on hot fusion; and Princeton's Tokamak hot fusion results.

COLD FUSION IMPACT BOOK

Four years worth of enthusiasm and scientific research are gathered into this informative book on our enhanced energy future. Hal Fox is an authority on the subject and is now sharing with the reader his far reaching vision of all the changes that low-cost, clean, abundant energy will bring to the world. Written in a simple, non-technical style, Cold Fusion Impact is a clear and concise book that everyone who plans on living in the future needs to read. The future starts tomorrow, and we all need to be ready for the changes that will come as a consequence of the commercialization of enhanced energy systems. Available in English, Russian, and soon in Spanish.

The book is sold with an updated diskette filled with over 4 years worth of scientific bibliography covering research papers, articles and books primarily on cold fusion, with some other energy research also.

The bibliography sells separately for \$25. You can buy both for only \$25, through this publication. Direct inquiries to *Fusion Facts* Subscription office, as listed below.

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