On the fifth anniversary of cold fusion's discovery

Now would be a good time to right the wrong done to cold fusion researchers, whose continuing discoveries challenge "conventional wisdom." Carol White reports on the Fourth Cold Fusion Conference.

When, on March 23, 1983, President Reagan announced the Strategic Defense Initiative (SDI), it could have had an impact far greater than the accomplishment of a strategic shift. Had President Reagan been allowed to implement the program as it had been conceived at that time, in consultation with Lyndon LaRouche and his associates, it should have presaged an industrial revolution. Since then, laser and beam technologies have been developed and incorporated into production, but not on the scale which would have been inevitable had the SDI been pursued as an anti-missile defense system based upon the application of new physical principles. In any event, such an impetus would also have counteracted the take-down of science and R&D capabilities which has characterized the past decade.

It was coincidental that Martin Fleischmann and Stanley Pons chose March 23, 1989 to announce their experimental cold fusion findings; they did not intend to connect cold fusion and the SDI in any way—although, of course, both cold as well as hot fusion can have some military implications. Nonetheless, it was appropriate, not for any connection to an anti-missile defense system or for any weapons application, but because it presented another chance for the United States to push ahead with potentially revolutionary science. Unfortunately, as with the SDI, this chance was largely sabotaged.

Many of the same scientists who had opposed the SDI became very vocal opponents of cold fusion. Dr. Robert L. Park, then executive director of the American Physical Society, expressed the attitude adopted by the scientific establishment within months of March 1989, in a statement he made to the *Washington Post* on May 15, 1991: "The story of cold fusion was shaped less by flawed science than by common human frailties: greed, ambition, vanity. . . . To be sure, there are true believers among the cold fusion acolytes, just as there are sincere scientists who believe in psychokinesis, flying saucers, creationism, and the Chicago Cubs. . . . A Ph.D. in science is not an inoculation against foolishness—or mendacity." Park's argument, and every other attack on Fleischmann and Pons since, boils down to the claim that, since cold fusion violates the laws of physics as they are presently understood, then it cannot be true. By such reasoning, every great advance in our scientific understanding could have been outlawed. The case of Galileo comes to mind.

Wilford Hansen of Utah State University and Micahel E. Melich of the Naval Postgraduate School have collaborated in analyzing the highly publicized experimental data from Britain's premier atomic laboratory Harwell, which data were used to discredit cold fusion in 1989. Their conclusion—like that of Melvin Miles who analyzed similar experiments done at the California Institute of Technology—indicates many shortcomings and downright sloppiness of these early experiments. Readers of books, such as that very bad book, *Bad Science* by Gary Taubes, will have heard time and again, that Harwell claimed in 1989 to have definitively disproved the reality of cold fusion. Like the highly publicized experiments by Nate Lewis at Caltech, these experiments were used to buttress the negative report by the Energy Research Advisory Board (ERAB) to the U.S. Department of Energy, chaired by John Huizenga.

Fortunately, there have always been courageous men and women who have refused to deny truth, even sometimes at the cost of their lives, and this is also true among scientists. While we know of no death threats in the case of cold fusion research, Fleischmann and Pons were threatened, at least through the medium of hostile news coverage. The press mooted that they would be prosecuted for criminal fraud: Their crime was the claim that they been able to release atomic energy using the simple tools of the laboratory chemist. Other scientists working on cold fusion were threatened with loss of funding, or even (in academic settings) that they would not be given tenure.

The exception to this miserable picture has been Japan, where research on cold fusion has been pursued by industry, with government support, to the point where today there is a Ministry of International Trade and Industry (MITI), $30 million, five-year research program to follow up the possibilities presented by the Fleischmann-Pons experiment. Also in the United States there has been a substantial research program underwritten by the Electric Power Research Institute (EPRI), which has allocated several millions of dollars for a program conducted at Stanford Research Institute (SRI), and on some campuses.

A solid record of achievement

Notwithstanding the generally negative environment which has slowed the pace of development, results have still been substantial, as we report below.

On Dec. 4-9, 1993, the Fourth International Conference on Cold Fusion (ICCF) was held on Maui, in Hawaii, attended by both scientists from all around the world and a significant number of industrialists. Oil companies, power companies, venture capitalists were present, as were some larger firms which have made substantial contributions to the research over the years. For example, the continuing research activity of Fleischmann and Pons, who are now working in France, is supported by the Aisin group, the Japanese Toyota affiliate, in collaboration with the Japanese think-tank, Technova, Inc. Italy's Fiat and Montedison are also emerging as joint cold fusion sponsors. An American group ENECO (formerly known as FEAT) has become influential in the patent sphere, and has purchased licensing rights for the Utah University Fleischmann-Pons patents.

Reports at Maui spanned many disciplines, and they showed a solid record of achievement over the past year. The depth and breadth of material covered in this conference was impressive. Not only has the Fleischmann-Pons experiment been successfully repeated in laboratories all over the world, whole new directions of research have spun off from their original discovery. It is not precluded that, by the end of the century, we will have technological applications of cold fusion; certainly, we will have major insights into solid-state physics and electrochemistry, which will spill over into many other fields.

The new science

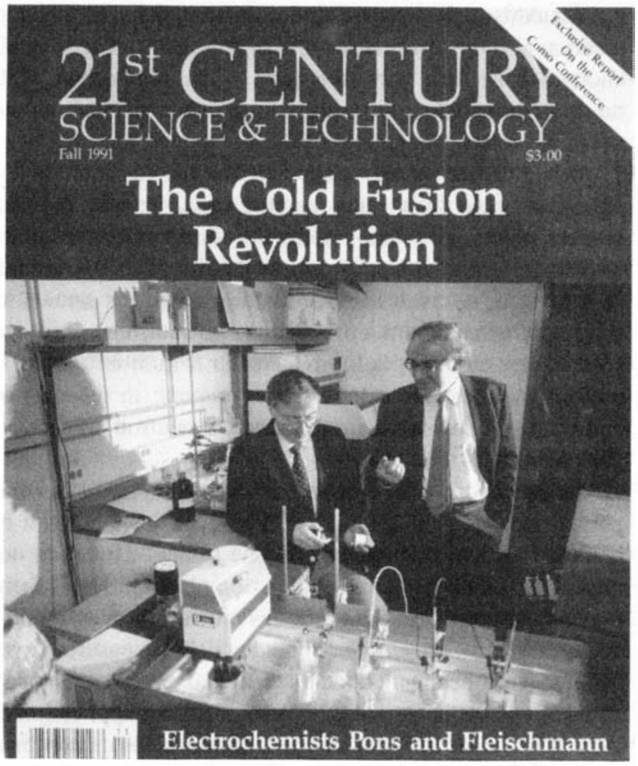
Martin Fleischmann and Stanley Pons began experimenting with cold fusion cells in 1983. At that time they did not expect to see large amounts of excess heat, but they thought that the ability of palladium to absorb large amounts of hydrogen (in this case, of deuterium (D), a heavy isotope of hydrogen which is traditionally used as a fusion fuel) might create a sufficiently high-pressure environment to detonate a fusion reaction at room temperatures, using electrolysis cells small enough to be held with one hand. (The comparison with the huge dimensions of a hot fusion machine, such as the tokamak, is mind-boggling.)

It is still not entirely clear whether the phenomena described as cold fusion are fusion events, or may only be nuclear events. Hot fusion normally occurs when the nuclei of two deuterium atoms overcome the Coulomb barrier and fuse to form an even heavier hydrogen nucleus known as tritium (which contains a proton and two neutrons) or fuse to form a new element, helium-3. When tritium is formed, a proton is also released to the environment; in the case of helium-3, which has two protons and one neutron in its nucleus, a neutron is released.

In hot fusion, what is called the branching ratio—a comparison between the amount of tritium and the amount of helium-3 which is produced—is one to one. This does not turn out to be the case in a cold fusion reaction. Here, there may be produced a million times as much tritium as helium-3. Furthermore, the amount of heat which is measured (over and above the heat generated by chemical reactions that may be taking place, or resistance heating from the application of current to the electrolyte) can be a billion times greater than either of the nuclear products. Thus, there appears to be a nuclear "fire" with no nuclear "ash." How to account for this state of affairs is one of the continuing theoretical anomalies of cold fusion. Although there are many theorists who have ventured solutions, the experiment is not yet sufficiently refined to allow testing them.

One thing which has bedeviled this new science from its earliest days has been the low repeatability of the experiment. One reason has been the failure of many experimenters to succeed in loading sufficient deuterium into the palladium in order to create the necessary density for a nuclear reaction to possibly occur. Here, again, we cannot overlook the fact that, according to traditional accounting by physicists, this probability, even with a very high loading ratio of deuterium to palladium, is so low as to seem inconceivable—$10^{-45.}$

Fleischmann and Pons believed—and experiment has appeared to bear them out despite the conventional wisdom of physicists—that they could create some kind of unique state within the palladium which would foster a fusion reaction at room temperature, in defiance of the probabilities. If they could pack enough deuterium into the palladium metal (they figured something close to as many deuterium atoms as palladium atoms), they hoped then that not only would sufficient compression occur, but also some other conditions analagous to those which allow high-temperature superconductivity. This one-to-one ratio is known as the loading ratio. It has since been conclusively established that it is absolutely necessary to achieve a loading ratio at least above .85 for the reaction observed by Fleischmann and Pons to occur. Early attempts to replicate their experiment failed, most likely, because loading ratios were far too low, and even where a high loading might



21st Century Science & Technology *covered the groundbreaking achievements at the Second International Conference on Cold Fusion held in 1991 at Como, Italy.*

be achieved, deuterium was not confined within the lattice long enough to allow a fusion reaction to occur.

Fleischmann and Pons chose to use electrolysis in order to separate deuterium gas from heavy water—D_2O. (Deuterium is chemically equivalent to hydrogen, but has a heavy nucleus, one which contains both a proton and a neutron, as opposed to hydrogen which has only the positively charged proton in its nucleus.) The advantage of this over introducing gas directly into the palladium is the ability to vary current in order to transform the conditions of the experiment over time.

For example, the surface of the palladium can be modified by introducing an additive to the water, such as lithium, silicon, or aluminum. (Lithium is also necessary to allow current to be conducted through the water.) Palladium is used as a negative electrode and platinum as a positive electrode. Both are submerged in the electrolyte and are connected by wires to a source, such as a battery.

The deuterium and oxygen are ionized, so the deuterium becomes positively charged. This is why a negative current is introduced into the palladium—so that the deuterium will be attracted to it. It migrates to the palladium and ultimately enters it. The greater the amount of current applied to the two electrodes, the greater the negative potential at the cathode, and the greater the attraction for the positively charged hydrogen or deuterium ions.

Some experimenters have skipped the step of electrolysis and simply introduce deuterium as a gas into an evacuated chamber. Since palladium readily absorbs deuterium, the results have also produced cold fusion reactions. Increasing the pressure of the gas and decreasing the temperature of the palladium both serve to enhance the rate at which hydrogen or deuterium will be loaded into the sample.

Reports at the Maui conference

At Maui, Fleischmann and Pons showed a good deal of interesting data indicating that, even after the current was turned off during their electrolysis experiment, it appears that fusion ignition may continue to occur in the palladium electrode—producing a considerable amount of excess heat—for up to 20 hours. Michael McKubre, who heads the cold fusion research group at SRI, told the audience that he had been able to reproduce one of the remarkable effects reported by Fleischmann and Pons in the Third International Conference on Cold Fusion Conference, held in Nagoya, Japan in November 1992.

Fleischmann and Pons then reported that they had been able, for a brief, ten-minute period, to produce power at a density equivalent to that of a fission breeder reactor, almost 4 kW/cm^3. They did this, they believe, by inducing a phase transition in the palladium and then rapidly heating it to boiling. McKubre found that he accidentally reproduced this same circumstance, when the cooler in one of his cells became blocked. He believes that he was producing scaled-up excess power at the rate of 168 W/cm^3. (In fact, both he and Fleischmann and Pons generated less actual power, because their palladium electrodes have a volume smaller than a cubic centimeter.)

Russians take a new direction

Cold fusion research was begun in Russia as soon as Fleischmann and Pons had announced their results. One very interesting experiment was by a fusion scientist, Yan Kucherov, who devised a plasma experiment: A very low-energy spark caused deuterium gas to ionize; as it was absorbed into the palladium, not only was high excess heat released, but many nuclear products were also observed—neutrons (indicative of the production of helium-3) and also such products as radioactive rhodium, which appeared to come from transmutations of the palladium itself. The Kucherov experiment is currently being repeated at the Massachusetts Institute of Technology, with encouraging, if not conclusive, results.

Another group, led by Aleksey Baraboshkin, Ural director of the Russian Academy of Sciences, announced that they were getting high heat and particle emissions from a tungsten-bronze single crystal. Since last year, several more researchers have begun working with perovskite materials, ceramics which are similar to the materials used to achieve high-temperature superconductors. As with a Fleischmann-Pons cell, there are two electrodes, one positive and one negative, but, here, a solid material takes the place of the liquid electrolyte. Following up on last year's work with tungsten-bronze single crystals, the Baraboshkin group has expanded its work to other perovskites. They have been able to replicate a pattern of neutron emissions which they first observed last year using tungsten-bronze. Now, they are using a ceramic made of cerium, stronium, and barium. The 20-millimeter-diameter disk is connected on each face with either platinum or palladium electrodes. When the disk is saturated with deuterium, a rapid two-second neutron burst is observed.

Jean-Paul Biberian (a physicist pursuing cold fusion research independently) and Tadahiko Mizuno (Hokkaido University) have followed this path as well. (*21st Century Science & Technology*'s Summer 1994 issue will feature an interview with Mizuno.) While he has seen some extremely high heat excursions which have even melted his apparatus, these have obviously been uncontrolled occurrences. At the conference, he reported that he could achieve 50 watts excess heat in a cell which used a solid electrolyte, which was raised to temperatures between 400° and 500°C. A sample that has been saturated with deuterium will remain at this heat, while one that has absorbed only hydrogen cools. This standard is a point of comparison which Mizuno uses to estimate that he is achieving high excess power.

He uses samples made from a mixture of strontium, carbon, oxygen, yttrium, and niobium powders ($SrCO_3$, CeO_2, Y_2O_3 and NbO_5), which is ground to a powder and put through two heating cycles, covered with a porous platinum film and then introduced to a hydrogen or deuterium gas environment.

Tritium at Los Alamos

Results announced from Los Alamos National Laboratory did not appear to be dramatic, but this was partly due to the perceived hostility between the hot and the cold fusion communities. In reality, Los Alamos researchers are showing an increasing ability to produce sufficient tritium on a repeatable basis to produce tritium fuel for hot fusion reactors, in the not-too-distant future. This would certainly put egg on the face of the many hot fusion scientists—particularly the group at the Massachusetts Institute of Technology—who have been vituperative opponents of cold fusion.

Physicist Thomas Claytor and chemist Dale Tuggle have concentrated upon tritium production over a period of years. While their results have never matched those of M. Srinivasan or John Bockris in rate of tritium production, they do have a very impressive record. At Maui, they reported upon a plasma experiment that they had just begun, which is extremely promising. In this instance, they use a palladium plate as an anode and a palladium wire as cathode, with deuterium gas as their fusion fuel; they are able to generate at a rate of .1 nanocurie per hour of tritium over a 600- to 700-hour period, with repeatability. (The experiment only comes to an end when the plate begins to sputter.) Tritium is found in the anode and at the back of it. They are also checking for gamma ray emissions to see whether they may be finding radioactive rhodium.

Should they be able to scale up their maximum results by merely an order of magnitude, from 5 to 50 nanocuries per hour, they would be in the ballpark for being able to produce tritium for reactors. Unfortunately, the impressive 5 nanocurie per hour figure occurred only in one burst over an hour and a half, in a cell using a different experimental design (a pressed powder sample). They achieve their highest rate of tritium production by first powdering the palladium and then pressing it into samples between layers of silicon similarly ground to a powder and pressed. An electric field is applied directly to the sample.

Current is ramped up slowly, starting at low hundreds of milliamp current but reaching as high as 3 to 6 amps. Voltages vary between 1,500 and 2,000. With the high pulsed voltages, they have achieved rapid heating of the sample and rapid loading and deloading of the palladium under nonequilibrium conditions. These experiments yield only a fair repeatability. In 60% of the cases, there is a probability of getting over 5 nanocuries of tritium in a 100-hour run (in other words, they are producing tritium at an average rate of .05 per hour or less). There is a 20% probability that the rate of tritium generation will produce between 30 and 40 nanocuries in a 100-hour run.

The opposite of 'Eureka'

Steven Jones (Brigham Young University) has made claims that he was a co-discoverer of cold fusion. This is somewhat ironic, because he is also highly skeptical of its existence. His claim is based upon the detection of neutron emissions from cells of his own design (he denies excess heat). At Maui, he cast doubt on his own neutron observations, as well as on those of his Los Alamos collaborator, Howard Menlove. They believe that the observation of five or more neutron bursts which they reported in the past have now definitely proven to be spurious and were caused by electronic artifacts, possibly associated with the presence of moisture in the detecting apparatus. While this has apparently led Jones to say that he "sees no compelling evidence for any nuclear effects in so-called cold fusion," Menlove does not concur. In fact, the collaboration conducted by Jones and Menlove with scientists at Japan's astrophysical facility Kamiokande, do not seem to justify Jones's present repudiation of his own past experiments.

The Kamiokande facility is a world leader in astrophysics research—in particular neutrino detection. While the numbers of neutrons observed from running either electrolytic or gas-loaded Jones cells were barely above background in most instances, important anomalies were witnessed, which could not be explained by uranium contamination—one scenario which had been suggested—nor by cosmic-ray background neutron emissons. (It should be noted that Jones's cells are significantly different from those used by Fleischmann and Pons or by McKubre.)

The published results from Kamiokande on the electrolysis experiment report only 10^{-4} single neutron events per hour. However, four-neutron bursts were observed at a frequency of 0.02 per hour, which could not be explained. In the gas-loading experiment, anomalous events were also observed that were significant, despite the extremely low rate of neutron emissions. Were they to have come from uranium decay, indicating radiation from the environment, which was one hypothesis considered, there should have been two-neutron bursts observed.

The role of Mitsubishi

At Nagoya, one of the most important events reported was that Dr. Eichi Yamaguchi detected helium-4 in his gas-loading experiment. He has spent this past year in France, where he is rebuilding his experimental setup in the same laboratory as Fleischmann and Pons. However, the Yamaguchi experiment is being pursued successfully at Mitsubishi Heavy Industries, by a team led by Dr. Yasuhiro Iwamura. The importance of having a corporation with the industrial and financial weight of Mitsubishi undertake to explore cold fusion cannot be minimized, as well as the fact that they have positive confirmation of a cold fusion reaction in an experiment designed on the model of Yamaguchi's work.

Dr. Iwamura works at the Advanced Technology Research Center of Mitsubishi, where a project to replicate the Yamaguchi experiment has been ongoing since April 1993. In all, they have done 100 experiments, 50 of which were preliminary, to test neutron and tritium detection capabilities separately. The last 50 experiments combined the three detection systems: helium-3 neutron detectors, a Nal scintillation counter to test for gamma-rays, and a high-resolution quadruple mass spectrometer for gas analysis. So far, the Mitsubishi team has detected significant neutron bursts, and what they believe to be strong evidence of tritium emissions; they have yet to see gamma-rays or other evidence of helium-4 production.

Questions raised by the presence of helium-4

Is helium-4 the nuclear ash which can account for the production of excess heat? It is elusive to find, permeable through glass, and plentiful in the atmosphere; but, if as now seems to increasingly be the case, it is produced in the cold fusion reaction, then we are well on the way to supplying sufficient nuclear reactions to explain the excess heat. Yamaguchi, Akito Takahashi, and Jirhota Kasagi in Japan, Benjamin Bush and Melvin Miles at the Naval Weapons Center in China Lakes, California, and Daniele Gozzi and his collaborators at the Sapienza University of Rome, have all seen evidence of helium-4 production in cold fusion experiments. Another researcher, Roger Stringham, has also reported observing alpha particles, using a very different type of experiment: He uses an acoustic wave to produce deuterium loading in his palladium sample.

At the Maui conference, Miles Bush (now at SRI) reported on a new series of successful experiments: Whereas, in 1992 they had a run of experiments in which they produced neither produce excess heat nor helium-4, in five recent experiments, they have seen what they deem to be amounts of helium-4, significantly above background. In five other control experiments, no such helium was observed. Their results are in line with earlier ones that showed a good linear correlation between the amount of excess heat observed and the expected helium-4 production, assuming a D-D reaction which produced a helium-4 atom and an energy release of 23.8 MeV. Unfortunately, the amount of helium in question is so low that it is not much above the ambient, and one cannot readily dismiss questions about the accuracy of Bush's measurement.

Gozzi and his co-workers have been researching cold fusion for three years. One of the important elements of their experimental setup is that it includes blank cells. The extreme rigor of their experimental program was certainly demonstrated to the Maui participants, to whom they reported upon a series of inconclusive experiments which, at first, appeared to show evidence of helium-4 production, but also gave evidence of atmospheric contamination. His conference report was reflected on the kind of error which must be guarded against when measuring small-order effects.

Cluster fusion

There have been especially interesting developments in the area of cluster fusion. The Takahashi group has continued with beam implantation experiments, and feels confident in asserting that the energy spectrum which they are seeing, with charged particles in the range of 8-9 MeV, is evidence of helium-4, which the Takahashi three-body fusion model predicts would have an energy of 7.9 MeV. Unfortunately, their present detection system does not allow them to simultaneously measure the presence of the 15.9 MeV deuteron that should also be produced by that reaction. Takahashi has also presented an elaboration of his multi-body cold fusion model, which is beyond the scope of this present report.

Kasagi uses a low-energy, 150 KeV deuteron beam to bombard a titanium target which he has previously loaded heavily with deuterons. The loading ratio of the target must be above 1.3 before he detects the emission of energetic protons. It can be as high as 1.9. As he reported in 1992 at Nagoya, Japan on this aspect of the work, at lower loading ratios only lower-energy protons were detected, such as would be expected from a normal D-D reaction (D+D=T+p). When the loading ratio exceeds 1.2, highly energetic protons were emitted, which he believes indicates that complex cluster reactions are taking place.

Kasagi and Takahashi's results are quite similar, but Kasagi believes that he is seeing a variety of hot fusion events, with some cold fusion intermixed. Most interesting is his contention that he sees multi-body hot fusion reactions taking place simultaneously. Clearly, both his and Takahashi's multi-body fusion models demand new mechanisms for energy enhancement. According to the generally accepted model of fusion reactions, the probability of a three-body fusion occurring is extremely low. For Kasagi's model to work, one would need a probability enhancement factor of 10^{12}. Not a small problem, indeed!

Acoustical and radio waves

It may well be that, in future experiments, energy will be directly coupled with the deuterium which has been loaded into a palladium sample. One such means would be to use a radio-frequency device; another might be the method of using acoustical waves, perfected by Roger Stringham.

The eminent electrochemist from Texas A&M, John Bockris, has evaluated a number of experiments using radio-frequency waves, and he believes their results are highly significant. One such experiment was by Dennis Let, an independent researcher funded by ENECO. The important feature of Let's experiment is that he triggers an excess heat reaction with a radio-frequency wave. He also finds a similar heat rise using 533.588 MHz and 81.924 MHz, but not at other frequencies. The heating only occurs in a deuterium, and not a hydrogen system, and begins within 10 minutes after the wave is turned on. The rate of increase of the temperature is proportional to the power of the radio-frequency and the rate of excess power generation is extremely large—2 watts excess power over a .1 milliwatt input. The experiment was carried out in an open cell configuration; the cell was not thermostatted, which means that further refinement in the calorimetery is needed.

Bockris is also very interested in a post-conference report from Prof. Francesco Piantelli, a researcher in Siena, Italy. Using a nickel wire with a diameter of 0.5 cm and a length of 3 cm, in a closed cell filled with hydrogen gas which has some deuterium contamination, Piantelli appears to generate extremely high heat—50 watts over more than 20 days—merely by heating the less than one atmosphere gas, first to 180°C and then to as high as 400°C. A patent on this device is still pending, and all of the details of the experiment have not yet been revealed; nonetheless, there appears to be some radio-frequency stimulation, and also an applied magnetic field. Input energy varies from an initial 250 watts down to 20 watts. Many questions remain open on this one.

Transmutation effects

While Fleischmann and Pons agree with theorist Giuliano Preparata that cold fusion is caused by a new kind of fusing between two deuterium nuclei, and Akito Takahashi and Jirhota Kasagi believe that it is a multi-body fusion effect, other possibilities exist: Perhaps cold fusion is not fusion at all, but rather, neutrons are being transferred from deuterium directly to heavier elements such as lithium or palladium. This is a simplification of an interesting new theory by one of the developers of the X-ray laser, Peter Hagelstein. Now a professor at MIT, he has also been working with plasma physicist Lewis Smullen, in an effort to reproduce the Kucherov experiment. So far, he has found the results of his experiments promising, but not definitive. His research has been sponsored by ENECO, as has Kucherov's and like that of the Baraboshkin group.

Hagelstein reported that although he still regarded experimental results to be preliminary, he has elaborated his theory of virtual neutron transfer to account for the possibility of transmutation effects. If he is correct, then a new kind of atomic process, neither fission nor fusion, is occurring in what is commonly known as cold fusion. It is certainly possible that new kinds of fusion and virtual neutron transfers might occur simultaneously, along with other nuclear events, such as beta decay.

Light water (H_2O) experiments also remain an important, if poorly understood, area of the work. In these experiments, hydrogen rather than deuterium is introduced into nickel cathodes, and excess heat is apparently produced, and perhaps also nuclear products. It is very difficult to understand what the mechanism of these experiments are, but that is no reason to overlook them, especially since nickel is cheaper than palladium, and ordinary water far more available than heavy water. Leaders in this field are Reiko Nottoya at Hokkaido University in Japan, and Robert Bush at California Polytechnical University.

Looking into the future

Our report here has been adapted from more substantial coverage for the Spring 1994 issue of *21st Century Science & Technology*. Although a relatively brief overview, it should suffice to present a convincing picture that research into cold fusion is far from dead.

We can confidently predict that next year will see even more substantial results as the program sponsored by Japan's Ministry of Trade and Industry (MITI) takes off. We have similar hopes for SRI, which has used much of the last year to restart its ambitious research effort, after having had to close down following the tragic explosion in January 1992. Fleischmann and Pons, in collaboration with Italian researchers, are exploring a whole series of new experiments in which an electric field is induced directly into the palladium sample, either in tandem with electrolysis or a gas-loading experiment or independently.

Five years after the historic Fleischmann-Pons announcement is none too soon for the scientific establishment and the U.S. Department of Energy to right the wrong which they have done to these scientists, an act which is vital to the progress of science. Public acknowledgement of the error of the effort to assign the epithet "pathological science" to cold fusion, is much needed. Such acknowledgement would not only bring a welcome infusion of new talent and new material resources to this promising field, but also would encourage other inventive scientists to challenge conventional wisdom.

Without this, science can only wither.