Historic 25th Anniversary Cold Fusion Meeting at MIT

Christy L. Frazier

Sincere appreciation is extended to the speakers for reviewing summaries of their work.
Photos are courtesy of Ruby Carat at Cold Fusion Now.

The 2014 Cold Fusion/Lattice-Assisted Nuclear Reactions Colloquium was held at the Massachusetts Institute of Technology from March 21-23, appropriately on the 25th anniversary of the cold fusion announcement by Pons and Fleischmann. Mitchell Swartz, Gayle Verner and their team at JET Energy once again organized a fantastic conference, filled with excellent presentations. Nearly 100 people were in attendance. The three-day meeting featured 28 speakers and nearly 40 talks.

A remarkable archive of video, audio and slides is located at http://coldfusionnow.org/interviews/2014-cflanr-colloquium-at-mit-full-coverage/. Ruby Carat of Cold Fusion Now (http://coldfusionnow.org) and Jeremy Rys of Alien Scientist (http://www.alienscientist.com) provide this reporting service on their own dime, so we encourage readers to make donations to them using the PayPal donation links on each of their sites.

FRIDAY, MARCH 21

Meeting organizer Mitchell Swartz opened the session with a truncated version of his talk "Our Emergent Need for a Clean, Efficient Energy Production Source." He said, "The reason we need cold fusion is energy. The reason is we don't have enough. Cold fusion is clearly the light at the end of the tunnel." The main reasons why cold fusion is the answer are: when deuterons are burned to make helium-4, an abundance of energy results; the experiments, and resultant devices, are safe; the process is pollution-free; the field has proven a large energy density, far beyond the chemical energy being burned.

Swartz credited the work of those present as "the whole reason that this field has flourished." Peter Hagelstein led the audience in applauding Swartz for his 25 years of efforts in the field, not just experimentally but also in organizing numerous colloquiums at MIT since 1991. Readers can delve into the science presented at five previous meetings by searching "colloquium" on our website at: http://www.infinite-energy.com/iemagazine/readarticles.html

Arik El-Boher, Research Group Leader at the Sidney Kimmel Institute for Nuclear Renaissance (SKINR), provided an update on the work conducted at SKINR in "Progress Toward Understanding the Anomalous Heat Effect." The five-year, $5.5 million SKINR project has almost three years remaining and has made "a lot of progress" thus far in discovering what the mechanism for cold fusion is. Seven groups at the University of Missouri, where SKINR is located, are involved in the multi-disciplinary research of cold fusion. They have multiple experiments running, with varying protocols. El-Boher invited interested groups to approach SKINR about collaboration, and indicated that they have recently worked with ENEA, SRI, TSEM, Coolescence, ReResearch and Aerospace Corp.

El-Boher discussed the Energetics Experiment 64A, performed in May 2004, which exhibited a 2500% energy gain over 17 hours. After de-loading, Experiment 64B exhibited 1500% excess heat over 80 hours. The average energy gain over hundreds of experiments ranged from 5 to 20%. A recent experiment at SKINR (#1012) had excess power gain of 70%, creating what they call negative crystals and a reproducibility rate of 40%.

El-Boher insisted that one problem still exists from the early days—lack of patience. He said, "People are rushing. They are running experiments for one week; if they don't get excess heat, they leave it. Experiment #1012 was run for 41 days. If we were running it for one week, we couldn't see anything." Experiments performed in November took over 400 hours before exhibiting excess energy, and confirmed the importance of inductive resonance. From the new data, what SKINR has further gleaned about the excess heat effect includes: RF emission is an indication of resonance in cathodes; surface contaminants are important as well as surface morphology as measured by Atomic Force Microscopy (AFM) and analyzed by Power Spectral Density Function (PSDF); unstable and increasing voltage and unstable cathode resist-

Meeting organizer Mitchell Swartz

ance are seen during excess heat events; acoustic triggering seems relevant; there is no activation of materials in electrochemical cells. The team's electrochemist is currently focused on what is causing the resonances and the increase in cell voltage.

El-Boher closed by saying, "This is not still a breakthrough, but we believe we are in the right direction to get control of this very complex phenomenon."

Frank Gordon, retired from SPAWAR, discussed the evolution of co-deposition experiments in his talk, "LANR Cathode Preparation for Electrolysis Experiments: A Comparison of Protocol Implications." He gave an overview of SPAWAR co-deposition results, beginning in 1991 when the team (Szpak, Mosier-Boss and Gordon) discovered that the cathode was warmer than the solution, evidence that heat was being produced at the cathode. They proved electrolytic co-deposition of palladium and deuterium from a solution containing lithium chloride. Since then, a wide variety of co-deposition protocols have been successfully employed.

While co-deposition has "always been credited with producing high loading ratios," some questions still remain. What is the role of the magnetic and/or electric field? Do different protocols lead to different reaction paths? What is the role of superabundant vacancies? Papers by Fukai *et al.* state that superabundant vacancies are produced during co-deposition. Gordon discussed the 2012 work of Dennis Letts and Peter Hagelstein; they used a modified SPAWAR co-deposition experiment and found that higher current density resulted in shorter co-deposition times and excess energy was produced which may be attributed to the formation of superabundant vacancies.

Larry Forsley, of JWK International Corp., presented "Neutron and Charged Particle Spectroscopy." He provided an overview of energetic particle diagnostics utilized, including some of the issues with each of the diagnostics. Forsley is currently working on a high-temperature solid state nuclear track detector protocol, influenced by Celani's high temperature work. He also developed a real-time fast neutron, simultaneous time-of-flight and neutron recoil unfolding spectrometer.

In current and previous work with Mosier-Boss *et al.*, and in the literature, Forsley has found that the cosmic ray spallation neutron flux is inconsequential with very significant numbers of co-deposition tracks observed. The background is less than 1 track/mm^2 vs. 10,000 tracks/mm^2 from co-deposition. He reported that multiple nuclear reactions and exit channels are present. With fast neutrons, there was a peak at 2.5 and another at 14.1 MeV, and with fast protons multiple peaks between 3 and 15 MeV; they found fast alphas up to 16 MeV, consistent with earlier reports by Roussetski and Lipson.

Tom Claytor, of Los Alamos National Laboratory, reported on collaborations with Edmund Storms and Malcolm Fowler. In "Tritium Evolution from Wires and Foils" he overviewed work beginning in 1993.

Powder wires used in initial experiments weren't pure palladium. In 20 experiments, they only found large outputs of tritium on seven occasions. They began conducting plasma experiments because they thought palladium impurities were important and had better reproducibility of tritium.

Recently Claytor's team has switched to experimenting with nickel and palladium foils. They have found these experiments to be more reproducible, though tritium production is lower. They use longer pulses, higher pressure and hydrogen/deuterium mixtures. The nickel alloy is more reproducible than palladium and can be run longer before it degrades. Claytor now believes that there is a diffusion drive process happening across some surface. The effect can be obtained in a day or two. He said, "If we can increase the X-ray/electron effect, then we might have a pretty good coffee break demo."

The team has not yet investigated all the parameter space and plan to do experiments at higher pressures. Claytor said, "This driver probably indicates that if we do make these multi-layer materials and we do have a number of interfaces, we'll see a bigger effect."

Yasuhiro Iwamura reported on progress at Mitsubishi Heavy Industries (MHI) with "Deuterium Permeation-Induced Transmutation Experiments Using Nanostructured Pd/CaO/Pd Multilayer Thin Film." In 2010, MHI performed basic research using gas permeation. Using electrochemical permeation in 2011 and 2012 to increase the deuteron density near the surface of the palladium, they increased the amount of transmuted products. In 2013, Iwamura and his team began focusing on consecutive processing. They added a fixed quantity of cesium in a flowing electrolyte process. With consecutive processing, MHI has seen higher reaction rates and an increase in products compared to batch processing.

Iwamura stated that MHI has detected "statistically significant γ-rays which have clear energy spectra." They presently have limited examples and will undertake further experiments.

Recently, the Toyota Central R&D Laboratory team of Tatsumi Hioki *et al.* has successfully reproduced MHI's permeation-induced transmutation of cesium into praseodymium.

Mitchell Swartz's presentation on "Excess Power Gain on Both Sides of an Avalanche Through a ZrO_2-PdNi Nanostructured Cold Fusion/LANR Component" continued his reports of investigations using cold fusion nanomaterials. He highlighted how he has measured heat coming out of these electrically driven nanomaterials, including ZrO_2 materials containing palladium loaded with deuterium, palladium loaded with ordinary hydrogen, and mixtures of palladium and nickel with deuterium.

Swartz has for several years presented the results of his experiments involving driving these with electric and magnetic field across the nanomaterials. In this presentation, he showed some of his latest NANOR®-type CF/LANR components where the nanomaterials are arranged to look like resistors, but demonstrate much higher heat outputs.

Previously, he reported that he found very high electric currents resulting in an electrical avalanche through them, resulting in three regions in input power and time located before, during and after the avalanche. By increasing the electric field intensity across the nanomaterial just before the avalanche results in increasing current, he has been able to show that in this so-called "Region 1" he can evoke "massive amounts" of excess energy gain from these components.

Swartz has shown previously that there is usually no further excess heat in "Region 3," which occurs just following the avalanche. These demonstrations have required separate runs, but at this meeting, Swartz showed that after many years of experimentation and utilizing both optimal operating point control to improve loading, he (particularly with ZrO_2-PdNiD materials) was finally able to clearly demonstrate in a single sample, during a single run, that it is possible to control and show that the nanomaterial excess heat disappears following the avalanche behavior.

Swartz also reported on magnetically treated NANOR®-type components (M-NANORs) which have shown very large excess energy gains and surprisingly have also exhibited never-before-seen dual optimal operating point manifolds. This discovery was remarkable because all other CF/LANR systems have only a single OOP manifold.

MIT Professor of Electrical Engineering Peter Hagelstein focused his first talk, "Electron Emission and X-Ray Emission from a Vibrating Cu Foil," on an experiment conducted at SRI since August 2013, motivated by the Alexander Karabut collimated X-ray emission experiment. (There was support from DARPA for the work up through last August, but Fran Tanzella has continued experiments at a low level on his own time.) Hagelstein said, "Collimated X-ray emission is an unxpected effect, not consistent with textbook physics." He noted that a similar collimated X-ray emission effect was seen in recent experiments of Alla Kornilova and Vladimir Vysotskii.

Features of the collimated 1.5 keV X-rays in the Karabut experiment include: similar emission is observed for a variety of different metals; similar emission is observed with different discharge gasses; they are spectrally broad; the shape changes with different discharge voltage; they are observed to originate on or near the cathode surface.

The goal of the experiment was to test the conjecture that collimated X-rays are due to conversion of vibrational energy to nuclear excitation. A large electron emission effect uncorrelated with surface mercury was observed early on in the campaign. With no Hg on the surface, there were no counts above pile up in the X-ray detector; however, with a small amount of Hg on the surface the detector gave a very large response. Both effects are reproducible. Subsequent work after the meeting showed that some of these large signals in the X-ray detector are artifacts, perhaps due to charge from photoionization of air by lower energy X-rays. A line is observed at 1.5 keV in many of the spectra, and further tests are needed to determine whether this signal is due to X-rays produced by the nuclear transition in Hg-201 at 1565 eV as hoped.

Vladimir Vysotskii, of Kiev Shevchenko University, presented a "Review of Cavitation X-ray Emission Experiments" performed by he and Alla Kornilova. The report presented a comparative analysis of two processes—the generation of soft X-Ray radiation at liquid cavitation and generation of the same radiation in LENR experiments.

Vysotskii discussed some similarities between the Karabut work (which Peter Hagelstein earlier presented) and his own. Soft X-ray radiation (E_γ = 1...3 keV) was detected outside the working chamber when palladium or nickel samples were exposed to deuterium and hydrogen. Such effects were observed regularly during electrolysis, gas discharge, thermocycling, etc. The radiation intensity was uncorrelated with heat generation and isotopic changes in the working chamber.

Radiation was frequently registered in absolutely abnormal systems—*e.g.*, behind the "black" screen (wall) with a thickness that surpasses the absorption mean free path of radiation. Vysotskii reported that these abnormal results are similar to the X-ray radiation generated on the outer surface of a closed chamber (and registered behind this surface) at cavitation of liquid. X-ray processes have been associated with a liquid (machine oil or water) jet moving through a narrow channel. They found that the outer surface of the working chamber is a source of intense X-radiation, generation of which is related to cavitation processes in the liquid jet bulk and subsequent excitation of internal shock waves. Interaction of these shock waves with external surface atoms of the water jet, metal tube or thick screen leads to external X-ray generation. The energy of X-radiation depends on the types of atoms on a radiating surface and increases with the charge of atoms. The total X-ray activity of working chamber reaches $Q \approx 0.1$ Ci.

Vysotskii noted, "It was found for the first time that the impact of shock acoustic waves, which are formed in the air as a result of cavitation jets of water, on distant screens leads to the generation of a quasi-coherent directional X-ray emission from the back side of these screens. The spatial parameters of this radiation depend on the shape and cross section of the screen and the spatial characteristics of the shock wave." Vysotskii concluded that there is a high probability that the X-ray phenomena is similar to that which takes place during generation of similar shock waves at formation of numerous micro-cracks at loading and interaction of hydrogen or deuterium with metals matrix during electrolysis, gas discharge or thermocycling.

Olga Dmitriyeva of Coolescence discussed how quantum chemistry methods can help us better understand the chemical environment that can potentially trigger the cold fusion event, in her talk "Using Numerical Simulations to Better Understand the Cold Fusion Environment."

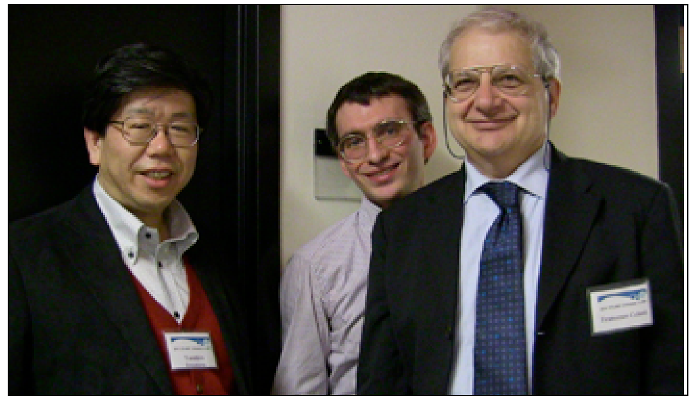
Dmitriyeva provided an overview of density functional theory, a computational quantum mechanical method for investigating electronic structures of many-body systems. She noted that using computer and numerical methods simulates the particle interactions accurately enough so that significant experimental time can be saved and a better understanding of the mechanisms can be realized to help enhance effects through optimization of material parameters. Dmitriyeva said, "DFT-based codes are powerful and versatile tools to study material properties and bulk/surface chemistry" that can predict certain material properties and suggest material characteristics.

Parameters studied include: H/D adsorption and absorption conditions; surface morphology, crystallography and chemistry; change of physical properties of palladium alloy material. High H/D concentration inside the metal lattice is considered to be an important condition for excess heat reproduction. Modeling shows that there are multiple factors that can influence the process of adsorption and consequently promote or obstruct the possible reaction. For example, wet etching on a palladium cathode can be highly anisotropic and expose different crystal planes on the surface, thus, affect hydrogen adsorption; halogens as well may interfere or compete with hydrogen adsorption sites on the palladium surface.

SATURDAY, MARCH 22

Brian Ahern, an independent energy researcher from Vibronic Energy Technologies, in "Nanomagnetism for Energy Production" discussed four "extraordinary circum-

Vladimir Vysotskii, Charles Beaudette, David Nagel



Yasuhiro Iwamura, Riccardo Felisari, Francesco Celani

stances" he found himself in over the years, leading up to LENR-related experiments.

Following a few years of collaboration with Yoshiaki Arata and Akito Takahashi and discovery of the 5 to 10 nanometer "sweet spot" in which the materials behave "cooperatively," in 2011 Ahern conducted high voltage experiments using magnetic nanopowders. During this time, he was visited by New Hampshire inventor Arthur Manelas, also interested in high voltage pulses through magnetic nanoparticle systems. In September 2011, Ahern visited Manelas' home and tested a barium ferrite power supply that was running a 1997 Solectria; the ferrite billet had high voltage pulses traveling through it, creating excess electricity. They drove the car for 25 miles with four passengers, then stored the car for one week. The battery capacity increased from 69.6% after the trip to 89.4%. Ahern stated, "I believe in the measurements as much as anything that I have ever done, but I don't know why it worked."

Ahern noted, "I think LENR is something extraordinary that we have yet to figure out...We can anticipate new and exciting properties from these kind of magnetic interactions that may be the root cause of what we see in LENR."

Francesco Celani of the Italian Institute of Nuclear Physics posed the question, "Are Specific Glass Surfaces Co-factors for Generation of Anomalous Effects by Catalytic Materials, Under H_2 Gas at High Temperatures?" He has recently been studying a new approach to increase the amount of heat produced from his experimental system.

Using the same basic set-up and geometry as he has for the past two years, Celani inserted activated wires inside fiberglass sheaths and closely braided them with a platinum wire also in a glass sheath. While the original motivation was to allow electrical insulation, Celani stated, "There is some probability that we found, by chance, a geometric set-up and simple, low-cost, apparently inert material (*i.e.*, fiberglass) that can increase the amount of anomalous heat produced during experiments at high temperature with hydrogen and proper catalytic materials." He said the thinner the fiberglass, the better performance expected. Celani suggested that the effect of hydrogen adsorbed at the surface of the glass has an intrinsic co-effect on the generation of anomalous heat.

Celani will conduct further work to rule out any as-yet-unknown error and to increase the level of the effects.

Pamela Mosier-Boss, a visiting scientist at MIT, discussed "CR-39 Results Obtained Using Pd/D Co-deposition." The first part of the talk covered the most analyzed—and traveled—CR-39 detectors in the field. The detectors traveled all over the world—back and forth from Pam's lab in San Diego to the SRI lab of Fran Tanzella in San Francisco, then to Washington, DC for Larry Forsley's microscopic examination, then later to Russia for sequential analysis. The scanned data was then analyzed by Dazhuang Zhou of NASA using an LET spectrum method. During SRI's replication with the detector (Experiments 10-5, 10-6), Tanzella kept magnets in place during plating, against the typical SPAWAR protocol. SRI's Ben Earle forgot to take off the 60 micron thick polyethelene film between the CR-39 detector and the cathode, which "turned out to be a good thing." The wrongful placement of the film helped discover the branching ratio of the primary reactions, which is "close to unity."

CR-39 detectors used in the Pd/D co-deposition experiments show the same products as seen in hot fusion. DT reactions are favored over ^{3}HeD reactions. Triple tracks have been observed that are indicative of neutrons greater than 9.6 MeV. Mosier-Boss indicated tracks on the back side are due to neutrons, while front side tracks are due to 3 MeV protons, >10 MeV protons and long-range alphas. At ICCF17, Mahadeva Srinivasan suggested that transmutations are due to fissioning of the palladium nucleus, a theory that Mosier-Boss supports because of the observation of long-range alphas as well as the relative size of the palladium to other peaks in EDX spectra.

John Dash, Director of the Eugene F. Mallove Laboratory for New Energy Research at Portland State University, provided an overview of his 25 years of work in the field in a talk titled, "Scanning Electron Microscope and Energy Dispersive Spectrometer Studies of Metal Surfaces Before and After Interaction with Hydrogen Isotopes." Dash began working on cold fusion experiments within a week of the Pons and Fleischmann announcement in March 1989. In that time, he has mentored and worked with two Ph.D. students, eight Master's students and about 50 high school students—all of whom were actively involved in experimentation in his lab.

From the beginning, Dash altered the P&F protocol. He used a 25 micron thick chunk of palladium, whereas P&F used a millimeter thickness. Dash said, "The palladium foil buckled. I'd never seen anything like that. I started using a microscope and have been doing it ever since." P&F used a basic electrolyte, whereas Dash used sulphuric acid, which has better conductivity. The energy given off usually exceeded the energy put into the control cell.

In regards to his transmutation findings in particular, Dash said, "It's been a lot of fun for 25 years and we will keep going as long as we can. We've made extraordinary claims but we have to keep going to get irrefutable evidence for the proof that there's no artifact."

Early in his second talk, theorist Peter Hagelstein said, "If a model doesn't work, I'm happy to take it out in the back and shoot it and bury it." He estimates he has accumulated more than 300 "dead" models. But, he has recently made positive progress in matching experimental data with theory, presented in "Inverse Fractionation: Basic Theory and a Model Calculation."

A theory-related issue for cold fusion has been the relative absence of energetic nuclear products commensurate with energy produced. Hagelstein believes that for the first time, a combination of fractionation and a new fundamental Hamiltonian theory can account for the 24 MeV in the cold fusion reaction. He utilized the collimated X-ray experiments of Karabut because they have "good observables" (fractionation effects).

Hagelstein focused on up-converting vibrational energy to produce nuclear excitation. He used the stable nucleus that had the lowest excitation energy from the ground state (Hg-201). By studying vibrational excitation of the 1565 eV level in Hg-201 much can be learned about how nuclear energy is down-converted to vibrational energy in the Fleischmann-Pons experiment in particular.

In the new fundamental Hamiltonian for condensed matter, a relativistic description is used for the nuclei. There is a coupling between vibrations and the internal nuclear degrees of freedom that appears naturally. A reduction of this new fundamental Hamiltonian to a lossy spin-boson model was presented, and solutions were described. The inverse fractionation energy predicted for the Karabut experiment was about 5 keV for a sample containing about 10^{20} atoms (with about half assumed to be moving to connect with the idealized model); this agreed closely with Karabut's experimental findings, where collimated X-rays were seen up to about 4 keV.

Hideki Yoshino, of the Hydrogen Engineering Application & Development Company (HEAD), presented "Replicable Model for Controlled Nuclear Reaction Using Metal Nanoparticles" on behalf of Tadahiko Mizuno, who greeted the attendees via Skype before the talk and answered questions after.

Yoshino said, "In the past naysayers have criticized the ability for others to replicate cold fusion reactions, so we are here today to share our findings with you of how one may replicate a cold fusion reaction." The three main purposes of HEAD's recent efforts have been to formalize a replicable cold fusion methodology with nickel and deuterium gas, analyze the gas composition during the test and find the cold fusion reaction kinetics.

Yoshino reported on the company's *in situ* means of preparing nickel and other materials prior to gas loading experiments. In a month-long run with nickel and D_2 gas, they achieved 75 W of excess power and a total excess energy of 108 MJ. Excess power was obtained with both hydrogen and deuterium gases and the vapors of both light and heavy water.

Fabrication of commercial prototype reactors at the 1 and 10 kW levels has already begun, which puts HEAD on the short list of serious contenders for sales of units that might heat a home.

George Miley, of LENUCO and the University of Illinois at Urbana-Champaign, spoke on "Ultra-dense Clusters in Nanoparticles and Thin Films for Both Hot and Cold Fusion." His team's recent LENR and D-beam experiments use ultra-dense hydrogen/deuterium clusters. These "clusters" contain 100-1000 atoms of hydrogen or deuterium at densities approaching metallic density as demonstrated by both SQUID EM measurements and temperature-pressure desorption measurements.

Miley proposed that the clusters formed in both thin films and nanoparticles provide the nuclear reactive sites for LENR. Miley said that this "potentially offers routes to both LENR power units and to D-beam fast ignition for inertial confinement fusion (ICF)." Miley noted that using clusters for fast ignition provides important advantages over other schemes, including: improved focusing and "bonus" added energy gain due to fusion reactions as the deuterium beam slows down creating the center hot spot of the target; this bonus beam target fusion gain can be used to either relax the required total flux of deuterons or alternately reduce the input laser energy needed. While initial experimental results at LANL's TRIDENT Petawatt laser are encouraging, future experiment will focus on removing surface contamination layer to avoid proton contamination interference with the deuteron acceleration.

Miley presented a proposal for a distributed power unit using cluster-based LENR via pressurized nanoparticles. The 1.5 kW "LENR-Gen Module" would be gas-loaded and could be scaled to higher power units after some thermal power handling modifications. The design and operational parameters for this unit is based on data taken from current pressurized nanoparticle LENR experiments. Miley briefly reviewed these experimental results. It would provide co-generation of heat and electricity. Miley estimated the unit could cost as little as $3,000 or $2/W installed, which is half of the installed cost of typical renewable energy power units (solar, wind etc.). He suggested that continued development and improvement to the LENR device could eventually drop the cost even more. The operational cost of such a unit would include replacing nanoparticles every six months, which he estimates at $500 per reload. The goal would be to do that at six-month or more intervals.

Nikita Alexandrov, President of Permanetix Corporation, presented his view of the way forward in understanding and engineering the LENR effect ("Advanced Analytic and Highly Parallel Cold Fusion Experimentation"). Alexandrov compared this scientific problem to the human genome project, a huge scientific problem that will be solved by lowering the cost of data and developing new tools and experimentation methods. He noted that over $250 billion a year is spent on alternative energy research and the cold fusion field needs to be ready to adapt to utilize these resources.

Alexandrov spoke about how the combinatorial material discovery technique is already being used in other fields to identify materials which are hard to predict. Sputtering of thin films is one technique he has identified which is scalable, familiar to industry and very repeatable. By combining a combinatorial material discovery process with new real-time analytical tools, we can drastically lower the cost of data and accelerate the understanding of this complex effect.

He discussed the benefits of real-time analytic tools, like an *in situ* soft radiation detector his company has developed for this field. By examining soft radiation, single nuclear events can be detected as well as individual molecules of tritium. By examining soft radiation which would never be detected outside of the experiment, more can be understood about this effect. He believes that low-cost helium isotope analysis needs to be developed for the field, and proposed a low-cost residual gas analyzer coupled with a custom sample processing system, which Permanetix is exploring.

Twenty-five year old Alexandrov issued a sort of call to action to other young scientists: "For a generation whose famous technical advances include facebook and phone apps involving birds, this is an amazing opportunity to use that aggressive innovation, flexibility and forward vision to build a real technology and change the world forever."

Asking good questions is key to development of research programs. David Nagel, Research Professor at George Washington University and CEO of NUCAT Energy, posed eight key "Scientific and Practical Questions About Lattice-Enabled Nuclear Reactions" that "are not getting the attention they deserve."

Is there one or more physical mechanism in LENR experiments? Nagel asked, "What compels us to think that of the dozen or so LENR theories that it will be a 'winner-take-all' situation?" He suggested, "It is possible that various products are due to different mechanisms." On the question of whether excess heat from electrochemical and gas loading is due to the same mechanism, Nagel suggested an experiment using a cylindrical material coated with nanomaterial in both types of experiments to see if excess heat is achieved in both experiments.

Do LENR occur as individual uncoupled events or are chain reactions possible? Some think craters are due to LENR and very many nearly simultaneous events produce these craters.

A controversial question for the field is whether excess heat is due entirely or partially to nuclear reactions. Some have developed compact object theories, which could lead to reactions like muon-catalyzed fusion. Nagel has not seen empirical data that compact objects exist.

What are the roles of electrical, magnetic, electromagnetic, ultrasound and other applied fields in LENR experiments? Nagel suggested that confined-field experiments are needed. He said, "Ten years from now we can have our homes heated by devices in which there is simultaneous application of dynamic fields that have to be tuned to each other in order to work properly."

Additional questions included: Do LENR occur on or near surfaces or in the bulk of materials or other locations? What is the role of sudden thermal changes within electrochemical cells? How can you defeat sintering over months to avoid degradation in an LENR reactor?

A three-part paper based on this presentation will be published in *Infinite Energy* Issues 118-120.

Charles Beaudette, author of *Excess Heat: Why Cold Fusion Research Prevailed*, discussed "Post-Missouri Priorities for Cold Fusion," with a focus on the relationship between cold fusion scientists and the rest of the scientific community, and media incompetence.

Beaudette said, "This field will eventually require a substantial degree of public financing, so public attitudes toward it need nurturing." He is concerned about the aptitude of most science journalists currently employed by major media outlets, and how this will impact accurate interpretation of the field for the masses. Often, reporters will only reference work if they have made the effort to contact those researchers. Beaudette noted, "This inability of science journalists to make use of published research papers is an endemic flaw in current science reporting."

In 2003, Beaudette presented on cold fusion at a New Hampshire MIT Club monthly meeting. The late Dr. Mort Goulder, a philanthropic patron of the MIT Physics Department, visited said department to see if he could interest them in the evidence for excess heat energy. The MIT Physics Department rejected Goulder's proposal to fund graduate students to work on the excess heat effect. Beaudette was already familiar with many of their reasons, as they had been used by many skeptics: cold fusion is theoretically impossible; the government has spent millions chasing this "wild goose" to no avail; those who report positive results have little credibility in the scientific community.

Beaudette discussed the positive progress made in recent times, especially with the onset of SKINR at the University of Missouri. He said, "Critics who suggest there might be error in this data are, proverbially, led to the campus laboratory where they can make a major contribution to the field by identifying that error." He sees this as a winning strategy, but cautions that it requires a formalized laboratory.

Beaudette is hopeful the Department of Energy will undertake another review of the field (the second and last one was in 2003) and hopes this time they will focus on the following question: Has a single, valid anomalous heat period occurred?

Vladimir Vysotskii's second talk was on "Observations of Biophysical Effects from Cold Fusion and LENR." He presented qualifying examinations of stable and radioactive isotope transmutation processes in growing microbiological cultures. It was shown that transmutation of stable isotopes during the process of growth of microbiological cultures (at optimal conditions in microbiological associations) is 20 times more effective than the same transmutation process in the form of ''one-line'' (pure) microbiological cultures. Vysotskii and Kornilova studied the process of direct, controlled decontamination of highly active intermediate life-time and long-lived reactor isotopes (reactor waste) through the process of growing microbiological associations. In a control experiment (a flask with active water but without microbiological associations), the ''usual'' laws of nuclear decay apply, and the life-time of the Cs-137 isotope was about 30 years. Vysotskii said, "The most rapidly increasing decay rate, which occurred with a lifetime $\tau^* \approx 310$ days (involving an increase in rate, and decrease in lifetime by a factor of 35 times) was observed in the presence of Ca salt in a closed flask with active water containing a Cs-137 solution and optimal microbiological association."

Vysotskii discussed a theoretical model of low-energy nuclear transmutation in biological objects. He suggested that the most probable mechanism for suppression of the Coulomb barrier and optimization of LENR in biological systems is associated with the self-formation of coherent correlated states in different growing biological systems.

Patent attorney David French, who practiced in front of the USPTO for 30 years on behalf of Canadian inventors, discussed "The Role of the Patent Attorney in Patenting Cold Fusion Inventions." He spoke generally about what all inventors should expect from their patent attorney, though noting that in a complex field like cold fusion the inventor has to "educate the patent attorney."

French spoke about the basics of patenting that are sometimes overlooked. Patent applications must propose an invention that is useful (*i.e.*, works), describe the invention well enough that other people can build it, and have a feature of the idea that is new (the whole invention need not be new, but some component or function of it needs to be novel). The patent attorney is especially useful in helping the inventor determine the key feature that is likely to be accepted as new and unobvious. French cautioned that a patent is not a direct path to market sucess or a "high-profit win," especially if the claims are weak.

Many in the audience spoke to their own personal experience with the USPTO's repeated rejection of cold fusion-related patents (including ones that are careful not to mention any of the key terms used in the field). French indicated that there are some areas—perpetual motion, antigravity, universal cure for cancer, and apparently cold fusion—that patent examiners will reject outright, with the directive, "Prove that this works." He noted that some examiners may wrongfully rely on Sagan's well-known phrase "extraordinary claims require extraordinary evidence." If the examiners can't believe the claims, they are unlikely to believe the evidence presented. French acknowledges that of the thousands of USPTO patent examiners, there are still some that will reject an application for a cold fusion invention even when sufficient "proof" of utility is filed. Since so many researchers in the field have faced patent rejections, French offered his suggested procedure for responding to such objections and outlined the recourses for an inventor in such a situation.

SUNDAY, MARCH 23

The last day of the colloquium began with the third and final talk by Peter Hagelstein, "Anomalies in Fracture Experiments."

Hagelstein discussed the "astonishing" fracture experiments of Alberto Carpinteri *et al.* that report observations of acoustic emissions, electromagnetic emissions, neutrons, alphas and elemental anomalies. Very large amplitude and high frequency vibrations were produced by catastrophic failure of large granite test samples with increased load. The elemental anomalies in particular drew Hagelstein's attention. They show a reduction of iron and an increase in aluminum on the surface of the fracture plane, a fracture-induced fission reaction. The Italian group is correlating these results with geology, suggesting that aluminum mines are located in fracture zones and that there is reduction in iron and a corresponding increase in aluminum on geological time scales.

Hagelstein referenced LENR experiments that produced elemental anomalies and are qualitatively similar to the Carpinteri work. The models proposed to account for these effects are closely connected with fission models, so Hagelstein did further study. He found that splitting iron into near equal mass daughters occurs for electron or gamma energies in excess of 1 GeV; that is more probable to have highly unequal mass products; and that fission was highly nonselective. He said there is no way that an incoherent fission mechanism could be consistent with the elemental anomalies in the fracture or LENR experiments. Hagelstein proposes that a coherent fission mechanism accounts for high levels of elemental anomalies, driven by inverse fractionation. He pointed out that inverse fractionation has the potential to produce incoherent disintegration, and that this was most likely the mechanism responsible for low-level fast protons, fast neutrons and fast alphas in the Lipson and SPAWAR experiments.

Hagelstein would like to investigate whether different end products are produced with less energetic fractures.

In his second talk, "Enhanced Tc Superconductivity and Anomalous Nuclear Emissions in YBCO and Palladium," Larry Forsley noted that PdH and YBCO are recognized high-temperature superconductors, but that high hydrogen loading in PdH causes an "anomalously high superconducting transition temperature" as noted by Lipson and Miley, and approaching room temperature as reported and patented by Tripodi and Vinko. Perhaps similarly, Celani has electrolytically loaded hydrogen into YBCO, increasing its superconducting transition by 10 degrees Kelvin. Although Forsley has observed charged particles and neutrons produced by PdD, Jin reported the same with YBCOD also using solid state nuclear track detectors.

Forsley and Mosier-Boss report at least seven distinct nuclear exit channels in PdD using their patented co-deposition protocol, and Jin showed five with YBCOD. Forsley is currently investigating the relationships among the PdH and YBCOH superconducting systems and the nuclear reactions that occur in the deuterated form.

Vladimir Vysotskii's third and final talk covered the "Application of Coherent Correlated States of Interacting Particles for Cold Fusion Optimization," in which he considered the "most universal mechanism of essential acceleration of low-energy nuclear reactions on the basis of correlated states of interacting particles." The mechanism provides a large increase of barrier penetrability under critical conditions (low energy, high barrier), where the effectiveness of ''ordinary'' tunneling effects is negligibly small, and can be applied to different experiments. The physical reason for the increase of the probability of the tunneling effect is related to the fact that the formation of a coherent correlated state leads to the cophasing and coherent summation of all fluctuations of the momentum for various eigenstates forming the superpositional correlated state. This leads to a very great dispersion and fluctuation of kinetic energy of the particle in the potential well and an increase in the potential barrier penetrability.

Vysotskii discussed preconditions and methods of formation of correlated coherent states of interacting nuclei in non-stationary dynamical systems. The formation of a correlated particle state was considered for different types of monotonic decrease in the frequency of a harmonic oscillator with the particle located in its parabolic field. Vysotskii reported, "For the first time, we have considered the peculiarities and investigated the efficiency of the creation of a correlated state under a periodic action on a harmonic oscillator. This method is shown to lead to rapid formation of a strongly correlated particle state that provides an almost complete clearing of the potential barrier even for a narrow range of oscillator frequency variations." He showed that in real nuclear-physical systems the very sharp growth (up to a factor of "10^{50}...10^{100} and more") of Coulomb barrier penetrability at very low energy of interacting particles is possible. Several successful low-energy correlated-induced fusion experiments were discussed.

Mark Fisher, son of John Fisher, provided an entertaining introduction to his father's education, experience and experimental methods. John Fisher opened his talk, "LENR Experiment and Theory: From Fleischmann & Pons to Defkalion & Rossi and Beyond," by presenting four experiments that provided evidence to influence his development of a cold fusion model. Fisher was skeptical about the original Fleischmann-Pons experiment, but Richard Oriani's replication finally convinced him about excess heat. Melvin Miles got helium in proportion to heat. Oriani's nickel cathode experiments resulted in energetic particles, which ultimately led Fisher to believe that the polyneutron theory is the only explanation for the results obtained in cold fusion experiments.

The polyneutron theory suggests that neutron clusters of sufficient size are bound and stable against strong decay, and that they can react with ordinary nuclei by transferring neutrons to them, accepting neutrons from them and binding with them to form composite nuclei. Such nuclear reactions could occur at low temperatures because electrically neutral particles have no coulomb barrier to overcome. Fisher stated that the polyneutron theory offers explanations for most cold fusion experimental findings, including Rossi and Defkalion. He discussed the polyneutron growth fuels and fission fuels involved in various cold fusion experiments. He supposed that Defkalion and Rossi use deuterium dissolved in hydrogen gas; future fuels could be deuterium in natural hydrogen, deuterium in natural H_2O or cerium. The polyneutron fission fuel used in previous experiments included palladium, calcium and possibly sulfur and oxygen; Defkalion uses nickel, as presumably does Rossi with some "secret ingredient." In the future, he suggests use of argon or other gasses. Fisher touched on reaction control methods, noting that Defkalion uses cooling water flow and Rossi external power reduction. Fisher's "essential ingredients" for practical power generation include: a polyneutron growth fuel such as deuterium; a polyneutron fission fuel such as calcium or nickel; a reaction starter such as a heat pulse ignition; mixing, to bring polyneutrons and fuels together (solid state diffusion, mechanical stirring, hot gas diffusion); a control system. He indicated that there are limitations with both Rossi and Defkalion's control system.

Fisher concluded, "A significant level of power generation has been achieved and a basis for theoretical understanding has at least begun to be achieved. These insights must be refined and taught to the science and innovation communities."

On this third and final day of the colloquium, Mitchell Swartz gave up half of his presentation time so that other speakers could use their full time allotments. He summarized "Successful Applications of the Deuteron Flux Equation in Cold Fusion."

Getting successful cold fusion in aqueous solutions, Swartz said, comes as a result of applying the deuteron flux equation, which is key to understanding how to make active cold fusion systems by control of the loading. He stated, "The deuteron flux equation predicts cold fusion is not fusion by electrolysis, it is one minus electrolysis." This implies that many who have sought active cold fusion systems have inadvertently been looking in the wrong place. This is now obvious because the quasi one-dimensional model of flow results in an equation which more clearly allows one to understand deuteron flux through the solution and into, or through, the metallic lattice. With this model and its equation, loading is more controllable. Further developments of the model, by applying the equations to palladium ions as well as hydrogen, early on, led Swartz to derive an alternate means of co-deposition. His theoretical and experimental work indicated that the co-deposition method has faster "turn on" and rapid activation of materials but lower levels of excess heat, so he does not use this method often.

Swartz briefly discussed further results of this successful model and theory of loading, and this is optimal operating points. He said, "When we look at excess power of palladium with deuterium and heavy water or nickel with ordinary water, we see a rise in excess power and then falloff." His method of optimal operating point operation of CF/LANR systems focuses on driving these systems at the optimal operating point to obtain peak performance. Early on, he found (and several graphs demonstrated) that these optimal operating point curves (which he calls OOP manifolds) help explain the vast set of cold fusion experimental data which is not otherwise explicable. When the OOP manifold curves are examined for heat and helium production, they dispel the myth of irreproducibility. Swartz noted, as a corollary, that the reason that some investigators do not get successful, high level cold fusion reactions is that they do not recognize the existence of such optimal operating points and OOP manifolds which exist for all CF/LANR systems.

Finally, Swartz touched on yet another development of this model and equation, and that is the development and use of cold fusion metamaterials where shape impacts performance and material properties. He provided a description of his Phusor®-type cold fusion cathode and the methods that he uses to drive it. The Phusor® is a wound cathode, specifically shaped and spaced, opposite an anode. Swartz discovered that the metamaterial shape is key, because it creates a unique electric field distribution, and when this shape is used with a very high impedance solution, as much as 800,000 ohms, that the results were very impressive compared to all other methods. He said the "finest work comes with ultra pure water, removing paramagnetic ions and with a specific metamaterial set-up."

In "Assuring Sufficient Number of Deuterons Reside in the Excited Band State for Successful Cold Fusion Nuclear Reactor Design," Robert Smith of Oakton International Corporation presented a new mechanism to assure the number of deuterons that can be excited into the band state are sufficient to provide highly probably fusion reactions resulting in successful commercial cold fusion reactor designs.

Smith summarized the ion band state research of the late uncle/nephew team of Talbot and Scott Chubb, who introduced the notion that the Schrödinger equation used to discuss the behavior of deuterons and electrons can be influenced by the number of periodic unit cells, Ncell, that a host metal such as palladium contains. Based on the Arata experiments, the Chubbs suggested that the Coulomb repulsion term of the equation should be modified to have Ncell placed in the denominator of the repulsion term. If the Ncell is greater than 10^5, "the repulsion term tends to zero and the probability of overcoming the Coulomb barrier is a certainty." For commercial reactors the power of ten will have to be at least one decade higher than the equivalent number for a fission reactor of equal power level, say 10^{15} core reactions for the CF/LANR reactor versus 10^{14} core reactions for a fission reactor. Each fusion reaction can produce 23.8 MeV of heat from deuterium versus each fission reaction produces 230 MeV of heat from uranium.

Smith proposed a new mechanism that provides new ways of exciting localized and delocalized deuterons across the band gap and into the ion band state. He said, "If the new mechanism greatly increases the number of deuterons in the band state, then the necessary and sufficient number of fusions would be possible with corresponding heat produced by the increased number of fusions." The mechanism might branch the cold fusion effects further out into a Region 4 or 5. He noted that reactions in wider regions are needed for competitive systems. Reactors will require a new, specific deuteron transport mechanism tailored to the system of parameters making up the reactor components. The reactor design must include control parameters to assure that the supply of deuterons (deuterium ions) to the wave-like ion band state is great enough to sustain constant power levels which can be caused to be reduced by quenching mechanisms such as melting of the lattice, reduced temperature and the reduced combined deuterium fuel/deuterium coolant gas pressure. A small percentage of the deuterium coolant gas is used for "fuel" but is replaced by helium, the product of the fusion reactions. The gas dynamics and heat transfer of the deuterium gas passing through the lattice crystals may be improved by the use of fractal layered periodic ordered computer designed and grown nano-crystals. Gas cooled/fueled reactors operating in the band state energy levels will greatly improve the performance of current electrolytic reactors operating in the lower particle state energy levels which also have electrolytes that can freeze under severe environmental conditions.

Nathan Cohen of Fractal Antenna Systems spoke about "Innovation on the Tortuous Path: Cold Fusion Implications Over the Next Decade," focused on how to push new ideas forward and what one is up against within a paradigm shift. He related his experience as an inventor and entrepreneur, and discussed the ways in which lessons he learned can be useful to LENR scientists.

Cohen noted that, "Cold fusion is without doubt the most important paradigm shift, the most painful..." Detractors close any rational path to acceptance, no matter how much data is presented. He said, "Irrational responses are common with new ideas." He noted, however, that cold fusion may soon be in a "vacuum of opposition" that can be capitalized upon.

Cohen highlighted the "Z comes before A" approach to science—where successful applications drive science funding. He said there are "twenty-five years of, frankly, good science on cold fusion, but the bottom line is everyone is saying, 'When am I going to get the box, when is it going to come out?'" This end-user demand is part of the "tortuous path" innovators take to deliver an innovation. However, adoption of innovation is primarily controlled by competitors, media, investors, government agencies/patent office.

Pitfalls on the path to innovation are numerous; specific to cold fusion, they include: fear factor (fear of change, or capitalizing on people's fears about safety); "Cinderella syndrome" (investors want quick returns); patent napping (slow process time for patent applications, or companies that patent and sit on technologies they don't want others to innovate but have no intention of using); ignored (more common for cold fusion than most technologies).

Cohen said, "There is a high probability that no matter how good your innovation, it will take many years to push it through the tortuous path."

Thomas Grimshaw, Research Fellow at the University of Texas at Austin, spoke about "Cold Fusion Public Policy: Rational—and Urgent—Need for Change." He was co-director of the Lyndon B. Johnson School of Public Affairs Policy Research Project #167, "Shaping the Energy Technology Transition," which includes discussion of cold fusion (online at http://www.utexas.edu/lbj/archive/pubs/pdf/20091016_Submitted_LBJ_School.pdf).

The potential public benefit from cold fusion as a revolutionary new source of energy has been known since the March 23, 1989 announcement. Today cold fusion policy centers on two main questions: how do we get it, and how do we deal with it when it gets here.

Cold fusion policy, like energy policy in general, should have a rational basis, with decisions based on levels of evidence. The rapidly increasing level of evidence of cold fusion reality, and the associated rising probability that its potential will be realized, mean that there is urgent need for policy change. Change in policy is needed both for public support for research and development and for proactive planning to deal with secondary impacts of broad deployment as an energy source.

The level of evidence was probably high enough (>50%) at the time of announcement in 1989 to warrant R&D support on a par with other emerging energy technologies. The accumulated evidence in the 25 years since increases the level to at least 70%, which warrants much higher priority of support than other emerging technologies. Recent developments, such as new prospective commercial devices, may in aggregate indicate a 90% level of evidence—and need for a crash program for development.

Secondary impacts of broad deployment will be both direct—on the energy industry and infrastructure—and indirect—on communities, tax revenues, workforce training and many other areas. Technology assessment promises to be an applicable and effective method of addressing both direct and indirect impacts.

Significant barriers remain for timely policy changes for cold fusion deployment, including ideological rather than rational approaches to energy policy and "sociology of science" issues that emerged when cold fusion was dismissed by mainstream science shortly after the 1989 announcement. These issues are intractable and persist to this day.

Curt Brown of PointSource Energy reported on "Measuring Anomalous Heat at Elevated Temperatures." In 2009 he began working with Dennis Cravens on developing a toroidal heat-generating module based on LENR. When heated to 300°C it begins emitting heat. Operationally, if the internal module temperature exceeds ambient temperature, then heat is being generated. But for quantitative measurements, Brown described a differential calorimeter. By making two nearly identical devices—one dummy and one with LENR, both with electrical resistance heaters—and controlling power to each heater to elevate and maintain each device by a chosen dT above ambient, then the difference between heater powers gives the LENR power. The temperature can be controlled within a few hundredths of a degree C, and power measurements have a standard deviation of less than 5 mW. The calorimeter is currently being used as part of a rapid cycle time engine development process at PointSource.

Clint Seward of Electron Power Systems presented on "Ball Lightning and Tokamaks." Ball lightning is a self-stable plasma toroid that requires no external magnetic field for stability. Seward built a lab capable of forming electric arcs similar to lightning. From this work he discovered how to make a new class of plasma toroids, or spheromaks, that are self-stable, need no external magnetic fields for containment and have high ion density—10,000 times more dense than Tokamaks and of sufficient density for clean fusion. Seward stated, "To form the self-stable plasma toroid requires a high current, like a lightning bolt, to form an arc, which then develops a toroidal ring around the arc, with separate thin surfaces for ions and electrons." A similar plasma configuration is proposed for electric space propulsion.

Steve Katinsky is working with David Nagel to create an industry association for cold fusion advocacy, which they hope to roll out within one year. Katinsky presented the current "ecosystem" of LENR, made up of research organizations, publishing outlets, commercial endeavors and military/government installments. Now that the field is advancing to the commercial enterprise stage, Katinsky and Nagel recognized the need for an international member association focused on advancing the science and business of LENR.

Among early goals of the association will be to help financially stabilize many of the existing "arms" of the field. The intellectual society ISCMNS, its journal *JCMNS*, the library site lenr-canr.org and various other cold fusion advocacy groups are sorely underfunded. The ICCF conference series also needs support, so that individual chairmen are not taking on undue financial risk.

Greater association goals include: creating a forum for development of industry standards and safety criteria; student advocacy, including establishment of "Cold Fusion Clubs" at various universities (with reference experiments suggested, such as co-deposition); government relations and possible lobbying.

Barry Unger, Associate Professor of Innovation and Technology Management in the Administrative Sciences Department at Boston University and an expert in high technology and venture capital business, presented "'God Helps Those Who Help Themselves': Some Likely Implications from the Known History of Commercializing Radical Innovations—for the Development of LANR Based Businesses." He discussed the business issues the emerging LANR field would face.

Unger stated, "Radical innovations and big new ideas, despite their tremendous advantages, will typically be opposed and discredited by the existing order in business, government, academia and for seemingly unfair and irrational reasons." The theoretical underpinnings behind these new technologies are often initially not well understood and they are not efficient or commercially viable at first; they often conflict with the established scientific paradigms of the time and are introduced by pioneers from outside the dominant traditional academic field. As technologies rapidly improve, their success can threaten the interests of the existing order, in areas ranging from research funding and prestige to who controls the commercial marketplace.

Unger suggested that cold fusion research appears to be slowly but surely winning its quest for academic legitimacy and acceptance. However, the field still has opponents to be fought—"old paradigms die hard and competing claims on research budgets die even harder." He said, "There is a tremendous amount of public education still to be done to explain not only the current state of cold fusion R&D but what it can be in the future as this field continues to make huge scientific and engineering strides." Amid this, he encouraged cold fusion innovators to be ready for a continuing mixture of both "hand-to-hand combat" with its detractors and "charm initiatives" to explain its economic and societal benefits to potential investors, charitable donors, the general media and government leaders.

Unger emphasized that most of all, the pioneers in this field will now face an equally daunting challenge: the many business commercialization issues associated with new and still rapidly improving technologies. He noted the importance of making good early decisions and business strategies, including: focusing on early viable applications; pursuing not the biggest markets but the one(s) that best fit the state of the technology and which can be deployed quickly in order to gain critical early credibility; choosing the best pricing, sales and distribution approaches; making the right patent and intellectual property moves; what partners to collaborate with; how to structure outside investments. He said, "How well these challenges are met in the early stages of companies...can determine how much the pioneers will be able to retain of the significant economic value that is created."

Other talks presented at the colloquium include: Flying Cars and Cold Fusion (Carl Dietrich); Relativistic Quantum Mechanics and Cold Fusion (John Wallace).

Peter Hagelstein closed the 2014 colloquium by noting, "This has overall been one of the strongest and most interesting scientific conferences in the field." Hagelstein expressed his appreciation and thanks for his "comrades in arms for 25 years"—whom he noted have accomplished tremendous "progress under the most adverse conditions imaginable." He marveled at the work still being done in the field, including much of it presented at this conference, with limited resources and no acclaim. Hagelstein ended with a touching memorial of photos of some of the colleagues lost in recent years.

On our website, readers will find summaries of five previous cold fusion colloquiums at MIT organized by Dr. Mitchell Swartz and his team. A report authored by Tom Dolan of this year's event will supplement our online coverage.

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