UNIVERSITY OF MINNESOTA

RESEARCH REVIEW

Office of Research and Technology Transfer

February 1995

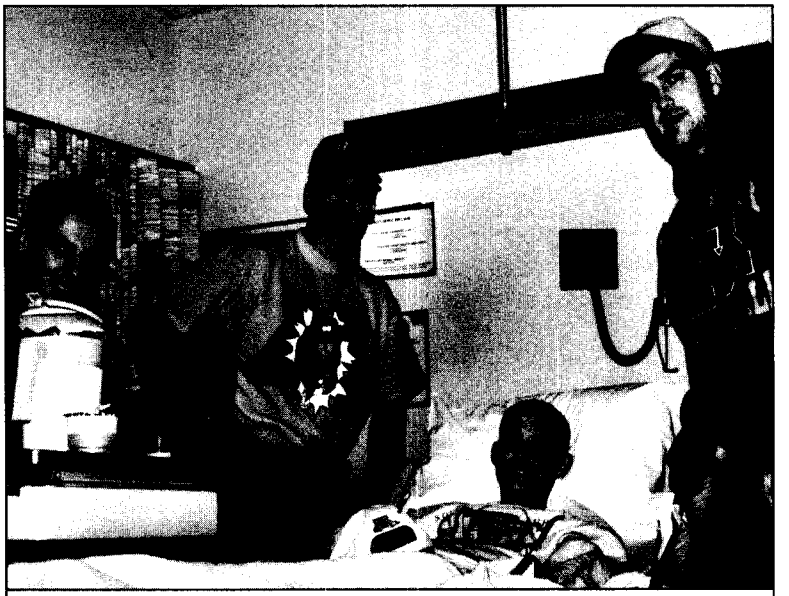
Take Cold Fusion Seriously, Advises University Chemist

Richard Oriani Addressed IT Alumni

Cold fusion, Richard Oriani told an audience of Institute of Technology alumni, "is certainly worthy of study and funding."

There are good reasons for skepticism, he acknowledged, but there are also good reasons for genuine interest. "Here is some new kind of nuclear physics, and it is too late to heap ridicule on it," he said.

Oriani, professor emeritus in the University's Department of Chemical Engineering and Materials Science, spoke at a December 7 seminar sponsored by the IT Alumni Society. He wished to give his audience "an appreciation of where cold fusion research is after these five years," he said. "People have made a lot of headway."



From left, Sam Jacobson, Eric Harris, Aaron Osterman, Jeremy Schlim and Ryan Wolf. The Gopher basketball players delivered gifts donated by trademark licensees to patients at the University of Minnesota Variety Club Children's Hospital. See page 8.

Oriani framed his presentation with comments on the reputation and abuse of cold fusion, but he devoted most of his time to reviewing two sets of data from the scientific literature: first, "credible experiments" by twelve groups of researchers, including Oriani's own group, who have measured energy production from palladium and deuterium at relatively low temperatures; second, reports from ten groups who have measured tritium, helium, neutrons and charged particles released from combinations of deuterium with palladium or titanium. Throughout his review, Oriani emphasized the lengths the experimenters went to avoid contamination of samples and errors in instruments.

Blandin/Sota Tec Fund Awards $1 million for third year of technology development program. See page 17.

When nuclear reactions release energy, Oriani's explanation of the data began, it is because some part of the mass in-

(Continued On Page 4)

Inside

volved is converted to energy. For example, in one of the reactions theoretically associated with cold fusion, an atom of deuterium combines with an atom of tritium to yield helium,

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a free neutron, a decrease in mass of 0.0188 atomic mass units (amu), and energy at the rate of 1.49×10^{-10} joules per amu (equivalent to 8.97×10^{13} joules per mole).

In the five most accurate energy-measurement experiments, the energy output ranged from 106 percent to 170 percent of the energy put into a palladium-deuterium system. For two groups of experimenters, there was a net gain of energy every time they tried the experiment. Oriani's group produced a net gain in two attempts, but thirty subsequent attempts produced no energy. The inconsistent results, said Oriani, seem to depend on the sample of palladium. His third success came after the thirty failures when he obtained a new sample of palladium from a Japanese source. Other groups have measured, in three less-accurate experiments, energy production ranging from 5 to 15 times the energy input.

Cold Fusion:

$D + T \rightarrow {}^4He + n + (1.49 \times 10^{-10}$ j/amu)

D is *Deuterium*, hydrogen with one extra neutron. *T* is *Tritium*, hydrogen with two extra neutrons. *4He* is the common isotope of helium, with two protons, two neutrons. A *joule* (*j*) is equivalent to one Newton-meter. An *atomic mass unit* (*amu*) is roughly the mass of a single neutron or proton.

Oriani's second set of reports dealt with observed effects that could only result from nuclear reactions. For example:

Fritz Will, et. al., electrolyzed heavy water with cathodes made of palladium from two different suppliers. (Heavy water is D_2O, i.e. water containing deuterium rather than common hydrogen. Will was director of the Utah Cold Fusion Institute). One type of palladium yielded no tritium. The other type yielded tritium at 50 times background levels, in four trials out of four. From that second type of palladium, 140 samples not subjected to electrolysis were found to contain no tritium.

Melvin Miles and Benjamin Bush, using palladium and heavy water, produced helium in concentrations ranging from 5.4 parts per million to 9.7 ppm. The background concentration of helium in air is 5.2 ppm. George and Stringham, using sound to cavitate heavy water on palladium foil, produced helium at 10 times background levels in ten trials out of ten. Y. R. Kucherov, et. al., by means of "glow discharge" with a palladium electrode in low-pressure deuterium gas, produced helium at 4 to 100 times background levels and counted 10^7 neutrons per second.

Skepticism and ridicule of cold fusion began in 1989, Oriani remembered, when Stanley Pons and Martin Fleischmann announced their discovery through publicity rather than peer review. "They described their work so poorly it seems they wanted to keep it obscure," said Oriani. His own interest in cold fusion was sparked shortly after that, by the work of Steven Jones at Brigham Young University.

Since the Pons and Fleischmann debacle, cold fusion experiments have not been adequately published, Oriani argued, because the journals *Science* and *Nature* have been "caustic and abusive" toward the work. When Oriani tried to publish his own experiments, he said, the two journals' replies were to the effect of "We already know cold fusion doesn't work, and you don't understand your results. We're not going to publish them." Oriani's reply: "Many things are published without full understanding, and that's the way it should be."

Oriani then published in the December 1990 issue of *Fusion Technology* (Oriani, John C. Nelson, Sung-Kyu Lee, and J.H. Broadhurst, "Calorimetric Measurements of Excess Power Output During the Cathodic Charging of Deuterium into Palladium," volume 18, pp. 652-658). *Fusion Technology* and the *Journal of Electroanalytical Chemistry and Interfacial Electrochemistry*, where Pons and Fleischmann first published, are the only two journals still publishing such work, said Oriani.

"I want you to understand my attitude," said Oriani. "A new idea should expect to fight its way to recognition. But in this particular case the fight has been particularly hindered by

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ridicule. Cold fusioneers have been accused of incompetence, self-delusion, and pathological science. Bockris at Texas A&M was accused of fraud by Gary Taubes in *Science* [vol. 248 (1990), pp. 1299-1304], of doping his experiment with tritium. That certainly was not the case."

Among sound reasons for skepticism regarding cold fusion, Oriani acknowledged several:

One, "the results are not yet [consistently] reproducible, and we don't why," he said.

Two, no one has satisfactorily explained what is taking place. "There are as many theories as theorists," said Oriani.

Three, classical physics says the nuclear reaction supposedly taking place can only take place under tremendous heat and pressure, like inside the Sun.

Four, "Cold fusion has attracted a lot of crackpots and mystics," said Oriani. "You have no idea the letters I receive from people who know cold fusion works because *the spirit* has told them."

It may not be odd, then, that cold fusion research has been difficult to publish or fund. Small federal funding has come from only one agency, the Office of Naval Research, said Oriani. A half-dozen other U.S. groups are working "on a shoestring." The University of Minnesota originally funded Oriani's experiments. They are now "self-funded," he says. In addition, the U.S. Patent Office rejects all applications that mention cold fusion.

Nonetheless, said Oriani, there are pockets of rich funding for cold fusion: SRI International (formerly the Stanford Research Institute) has $2 million a year from the Electric Power Research Institute (EPRI), Japanese interests have equipped a lab in Southern France for Pons and Fleischmann, and significant work is being done in several labs in Japan. "The Japanese are really going after this," said Oriani. "The U.S. is getting behind the 8-ball." A U.S. corporation is, however, buying every cold-fusion-related patent application it can get its hands on, he added.

And the reason EPRI and the Japanese are investing in cold fusion? "*If* cold fusion is real," said Oriani, "it's an inexhaustible source of energy."

By Phil Norcross

A model of the cold fusion cell that Pons and Fleischmann showed the press in March 1989.
Courtesy University of Utah

Et Cetera

Jeff Edleson, professor in the School of Social Work, has been named to the National Academy of Science's new Panel on Research on Violence Against Women.

The Republican cochair of the Congressional Biomedical Research Caucus recently urged House and Senate budget chairs to appreciate the value of biomedical research. The cochair, Representative George Gekas of Pennsylvania, argued that each federal $1 invested in biomedical research returns $1.50, a figure recently presented to the National Academy of Sciences by White House Economic Advisor Laura Tyson.

Advice for writing winning grant proposals, titled "Grantsmanship: What Makes Proposals Work," appeared in *Science* 265 (23 September 1994): 1921-22.

Two faculty of the Humphrey Institute were recently named fellows of the National Academy of Public Administration: John Brandl, professor of public affairs; and Paul Light, professor of public administration and director of the Surviving Innovation Project.