Big chill for cold fusion as energy source

Scientists are no closer to harnessing fusion for generating power than they were before the term "cold fusion" became commonplace just over two months ago, researchers concluded in Santa Fe, N.M., at a conference sponsored by the U.S. Department of Energy's Los Alamos National Laboratory.

The intensive cold-fusion research effort, which some estimate has involved more than 1,000 scientists and more than $1 million a day, has yielded some support for physicist Steven E. Jones of Brigham Young University in Provo, Utah, and his colleagues. On March 31 they claimed to have found a room-temperature route to minuscule levels of nuclear fusion.

"I personally am quite optimistic that this phenomenon is real," remarks physicist Robert J. Schrieffer of the University of California, Santa Barbara, co-chairman of the May 23-25 workshop. Adds co-chairman Norman Hackerman of the Welch Foundation in Houston: "I believe that nuclear reactions are taking place, and that possibility continues to exist until proven otherwise."

The same body of research has evaporated nearly all hope of eventually using cold fusion to generate power, the prospect raised by B. Stanley Pons of the University of Utah at Salt Lake City and British co-worker Martin Fleischmann in a March 23 press conference. The two declined an invitation to the Santa Fe conference in order to continue their work, according to James J. Brophy, the University's vice president for research.

In their experiments, Pons and Fleischmann pass an electrical current between palladium and platinum electrodes immersed in a flask containing lithium ions dissolved in deuterium oxide — a heavy version of water made of oxygen and the hydrogen isotope deuterium. The electrical energy splits the heavy-water molecules into their atomic constituents. Deuterium nuclei then pack into the palladium electrode in great numbers. The scientists have reported that more heat energy emerges from their flasks than they put into them in the form of electricity, and that they detected particles and gamma rays supposedly resulting from heat-producing fusion reactions among the crowded deuterium nuclei. They have said they are unsure of specifically which fusion reactions could account for these observations. Since their initial press conference, they have retracted most of their claims of detecting fusion products, and no other researchers trying to duplicate their work have credibly reported observing both heat and fusion products simultaneously.

At the workshop, research teams from Stanford University and Texas A&M University in College Station reported measuring anomalous amounts of heat in their ongoing and incomplete experiments, but they could not connect the heat directly to fusion. The anomalous heat phenomenon most likely occurs independent of the cold-fusion phenomenon, several researchers at the meeting suggested to SCIENCE NEWS.

Texas A&M chemist A. John Appleby told the workshop he and co-workers had placed electrochemical cells similar to those of Pons and Fleischmann inside a sensitive calorimeter that allowed them to measure tiny amounts of heat generated in the cells. When the researchers used regular light water with dissolved lithium ions, nothing unusual happened: The amount of heat energy they measured matched the sum of energy put into the cells in electricity and the chemical energy from cell reactions. But when they used heavy water, they observed rates of heating beyond those attributable to electrical and chemical energies. They also found that replacing the lithium ions with sodium ions quenched the effect, which could be recovered by reintroducing lithium ions. This suggests the lithium plays an important role in generating the heat, Appleby surmises.

Other Texas A&M researchers have examined the liquid in some of Appleby's cells and may have detected mysteriously high amounts of tritium — a triple-heavy atomic isotope of hydrogen and a possible fusion product, says nuclear chemist Kevin L. Wolf. The scientists do not know if fusion reactions actually produced the tritium. A search by Appleby's team for helium — another key by-product of deuterium fusions — came up negative.

In another "heat-seeking" experiment, Stanford materials scientist Robert A. Huggins reports observing about 20 percent more heat generated in cells containing heavy water compared with cells containing light water. But many scientists at the workshop expressed strong doubts about the reliability of Huggins' experiments.

Several groups at Los Alamos and one from Bologna, Italy, have collaborated recently with Jones. They report detecting excess neutrons at very low levels similar to those Jones originally announced in March and reported in the April 27 NATURE.

Some critics, including Moshe Gai of Yale University, stress that errors lurk everywhere in experiments involving measurements of tiny differences in neutrons. Gai likens attempts to measure small, above-background neutron emissions in cold-fusion experiments to determining the weight of a tanker's anchor by weighing the ship with and without an anchor and then subtracting one value from the other. He reports only negative results from his own cold-fusion experiments using a supersensitive neutron counter. Another sensitive experiment by French scientists also got null results.

Still, Jones remains confident that fusion is occurring in his experiments and has accepted a challenge to run experiments using Gai's neutron counter. In fact, he says, "things keep turning up roses."

One petal of support for his case comes from electrochemical experiments in Italy somewhat similar to those of Pons and Fleischmann, who have said their cells contain only one additive, lithium. The Bologna researchers use a complex brew of metals and ions, which Jones calls "Mother Earth soup" because it is based on the chemical ingredients in underground regions where he and Brigham Young geologist E. Paul Palmer believe cold fusion may be occurring (SN: 4/8/89, p.212).

Antonio Bertin of the National Institute of Nuclear Physics in Bologna describes ongoing experiments carried out with co-workers in a lab under a mountain where potentially confusing radiation signals from cosmic rays would be roughly 1 million times less than in laboratories at or near sea level. Bertin says his group has detected about 1,200 neutrons per hour, or roughly the maximum rate reported by Jones. In addition, he reports, the detected neutrons carry the amount of energy that would be expected if they were emitted during certain fusion reactions. "The only reasonable explanation we see for this fact is the fusion of two deuterons [deuterium nuclei]," Bertin told the workshop.

Jones gathered another petal of support from nonelectrochemical experiments done in collaboration with researchers at Los Alamos. After forcing deuterium gas into pressurized cylinders containing titanium and/or palladium pieces, then cycling the cylinders between room and liquid-nitrogen temperatures (about 25°C and -210°C respectively), they detected excess neutrons — sometimes in bursts of several hundred in less than 100 microseconds, sometimes in more random emissions at about the rate Jones detected. Several other groups have reported neutron bursts in experiments of similar design. The neutron levels were too low to allow his group to determine their energy, notes Howard O. Menlove of Los Alamos. "Nor have we identified the mechanism for this neutron source," he cautions.

The message from the workshop is that the Pons-Fleischmann results may come from an unexpected chemical reaction that occurs in parallel with, but independent of, any low fusion levels, Schrieffer says. Much of the confusion over the past nine weeks, observers say, may stem from researchers' attempts to fit a circular peg (anomalous high heat from unknown chemical reactions in electrochemical cells) into a square hole (tiny levels of cold fusion). — *I. Amato*