Cold fusion still hasn't given up the ghost

As cold fusion approaches the second anniversary of its dramatic entry into the scientific arena, it holds on to life like the final embers of a once-roaring fire.

Scientists who still think cold fusion holds promise for generating power might fit into a Yugo. These diehards apparently include chemist B. Stanley Pons of the University of Utah in Salt Lake City and his British colleague Martin Fleischmann, who have kept some of their data under wraps, allegedly to protect patent applications. The two researchers opened the cold fusion drama on March 23, 1989, when they told the world that some of their electrochemical cells produced so much heat that only unknown nuclear fusion reactions could account for it (SN: 4/1/89, p.196).

Several buses might suffice to hold researchers still investigating cold fusion as a far subtler phenomenon. Driving the lead bus would be Steven Jones of Brigham Young University in Provo, Utah, who strode into the cold fusion drama just days after it began, reporting experiments that appeared to produce extremely low levels of fusion products. Since then, he and others have conducted several types of experiments that yield sporadic signs of fusion products.

Most scientists have written off the Pons-Fleischmann variety of heat-producing cold fusion as a case of wishful thinking overriding scientific judgment, and have dismissed the lower-profile phenomena described by Jones and others as irreproducible or too subtle to justify further time and money.

Money was a major issue last week for the State of Utah, which in August 1989 allocated $4.5 million of its public funds for research at the National Cold Fusion Institute (NCFI) in Salt Lake City. On Jan. 8, the state's Fusion/Energy Advisory Council demanded that Pons and Fleischmann turn over portions of their data for review on Jan. 22 and Feb. 1.

If the chemists fail to comply, the state will withhold the $160,000 still earmarked for their research, says NCFI Director Fritz Will. The state will release the remaining $750,000 earmarked for funding the next six months of NCFI research as long as Will submits detailed program and budget plans to the advisory board by Feb. 1, he says. After that money runs out, NCFI's survival will depend on outside funding, which it has yet to secure.

At the same meeting, the board accepted a reorganization plan submitted by Will, in which Pons and Fleischmann will no longer report to NCFI but instead will report to University of Utah officials, who will also oversee their grant money. According to Will, this change — which Pons and Fleischmann also wanted — became necessary because the two chemists consistently failed to report their data, preventing him from assessing their claims. "No one has been able to make a complete validation," Will says.

"The buzzards were circling [over cold fusion funding]," says Larry Weist, a University of Utah public information officer who attended the Jan. 8 meeting. "You got the feeling that it was all over."

But it's not over yet, Will stresses. Dozens of ongoing experiments in many countries amount to a substantial effort to reproduce cold fusion phenomena, he says, and an external review panel has deemed the quality of NCFI research as mostly satisfactory. NCFI scientists are "highly competent," Yale University nuclear physicist Robert K. Adair, one of the four review panelists, told SCIENCE NEWS. "That does not shield them from making errors," he added. "I would certainly bet only at long odds that there is any such thing as cold fusion."

Pons appears undaunted. On Jan. 1, he resigned from his teaching position to free up time to "explore and develop the technology associated with the research," according to a statement released by the university. In February, university officials will consider hiring him as a research professor.

Salt Lake City doesn't hold a monopoly on cold fusion research. Last November, 160 scientists from several countries gathered at Brigham Young University for a conference titled "Anomalous Nuclear Effects in Deuterium/Solid Systems" — a lengthy alias for cold fusion reactions. Jones says the many reports of small amounts of neutrons, tritium and other possible fusion products fueled participants' resolve to push ahead. "The small nuclear effects are still being pursued hotly," he says.

Jones and Howard Menlove of Los Alamos (N.M.) National Laboratory left for Japan this week to begin what might prove to be a make-or-break search for cold fusion. With University of Tokyo astrophysicist Yoji Totsuka, they will perform experiments with the underground Kamiokande detector, now used for neutrino studies. By simultaneously seeking fusion products with the detectors they have been using in the United States and with the Kamiokande detector, which Jones says is 100 to 1,000 times more sensitive, they hope to determine whether previous hints of cold fusion reactions were merely persistent instrumental errors or indeed the signature of heretofore unknown nuclear reactions.

For these investigators, a few embers of hope remain. *— I. Amato*

Probing a trapped molecule's dynamics

An alien molecule lodged in a crystal lattice responds to the nudges of its neighbors as they shift in position or flip from one molecular configuration to another. By carefully monitoring the light given off by a single, trapped molecule, two researchers have made the first direct observations of these local motions within a crystal.

The single-molecule spectroscopic technique, pioneered by W.E. Moerner and William P. Ambrose of the IBM Almaden Research Center in San Jose, Calif., paves the way for detailed analyses of molecular dynamics in both crystals and glasses. "You can see new things — new physics," Moerner says. The IBM researchers describe their results in the Jan. 17 NATURE.

Moerner and Ambrose studied the light given off by single molecules of the organic compound pentacene embedded in the crystal lattice of another organic compound known as *para*-terphenyl. They used laser light tuned to a specific wavelength to excite certain pentacene molecules, which then fluoresced, giving off light at a particular wavelength. By using a crystal only 1 to 10 microns thick and cooled to 1.5 kelvins, and by keeping the laser beam tightly focused and selecting the appropriate exciting wavelength, the researchers could ensure they were dealing with only one pentacene molecule at a time.

"As we changed the laser [wavelength], we could pick out different, single molecules in the same volume," Moerner says.

He and Ambrose discovered that a pentacene molecule's fluorescence wavelength can shift abruptly by small amounts.

"We saw that [a molecule] would stay at a particular wavelength for a certain time period — seconds to minutes — and then jump to another wavelength nearby," Moerner says. "It would stay there for a while, then maybe jump back to the original or to a new wavelength."

Such jumps apparently result from local changes in the structures or positions of the molecules surrounding the impurity. Because *para*-terphenyl molecules consist of three molecular rings linked by single bonds to form a string, one possible cause for the jumps may be sudden shifts in the central ring's tilt with respect to the two outer rings.

Conventional spectroscopic techniques, which collect and analyze light absorbed or emitted by large collections of molecules, would wash out such subtle effects. Only by focusing on single molecules can researchers begin to study what happens within a solid material on a microscopic level. *— I. Peterson*