Fusion in a cold climate

For most researchers, any mention of cold fusion brings back memories of a shameful period in modern science. Now, 20 years after **Martin Fleischmann** instigated this field, he tells **Jon Cartwright** that he could not have done anything differently, and that if we cannot get fusion of some sort to work on a large scale soon, we're doomed

MARTIN FLEISCHMANN can still remember the morning he entered his lab and saw the terrific hole in the workbench. It was about the size of a dinner plate. Beneath, nestled in a shallow crater in the concrete floor, were the remains of a chemistry experiment that had been fizzing idly for several months without incident. "It had obliterated itself!" he recalls.

It happened overnight, so no one witnessed the meltdown that took place in a basement lab at the University of Utah, Salt Lake City, in 1985. But for Fleischmann and his longtime colleague Stanley Pons, there could be only one cause: room-temperature or "cold" fusion. If they were right, the chemists had made a reaction that nuclear physicists had thought next to impossible, one that potentially held the key to almost limitless clean energy. Yet four years later, and just weeks after they had announced their discovery at a now infamous press conference on 23 March 1989, their work was dismissed from mainstream science. Cold fusion became a pariah field, and Fleischmann and Pons fell under the shadow of disrepute.

At his home near Salisbury, UK, 82-year-old Fleischmann looks too beaten to entertain suggestions that, after two decades, cold fusion might actually be gaining acceptance. He has Parkinson's disease, and although he still speaks in his usual measured phrases and Czech accent, he is slow and often loses his train of thought. "All my activities are devoted to giving up," he laughs, glancing at his coffee cup performing another involuntary rattle on its saucer.

Even so, he regrets not having resolved his past dealings with the mainstream science community, who he thinks behaved in a "very unscientific" manner. "When we wrote this up I said [to Pons] we had to write exactly what we had done and how we analysed the results, which is what we did," he says. "Is it wrong? Where's the mistake? And that has never been answered really."

Fleischmann and Pons's experiment was, on the surface, simple enough. It was a glass electrochemical cell filled with heavy water, which contains a heavier isotope of hydrogen called deuterium. They thought that by passing a strong electric current through the water between two electrodes, deuterium atoms might cram into the negative electrode and fuse, thus releasing energy.

The meltdown was their first indicator that this could work, because their calculations suggested it had involved far more energy than was available from chemical processes alone. In later tests they scaled down the electrodes for safety, and spotted large amounts of "excess heat" generated above the electrical energy supplied, which would signal a nuclear reaction. "Chemical reactions produce a certain amount of heat," says Fleischmann. "If you're outside that range, what is there left? There must be a nuclear effect."

But after Fleischmann and Pons announced their results, most labs – particularly major ones like Harwell in the UK and Caltech in the US – could not reproduce them. Scepticism spread. Perhaps the most damning event was a meeting of the American Physical Society in Baltimore in May 1989, when Caltech physicist Steve Koonin announced to a packed audience they were "suffering from the incompetence and perhaps delusions of doctors Pons and Fleischmann". For Pons, who was head of chemistry at Utah, and Fleischmann, who was retired but a member of the Royal Society of London, it was effectively career over.

Many scientists berated the two chemists for publicly announcing their results before having them published in a peer-reviewed journal. Fleischmann has always insisted they had no choice, because they had to apply for a research grant, which revealed a similar line of research being performed at Brigham Young University, also in Utah. When officials at the University of Utah heard of the competition, Fleischmann says he and Pons were railroaded into applying for a patent and delivering a press conference. "It was a very unfortunate time to try to float the idea," he explains.

Was there no way of avoiding the announcement, and the subsequent backlash? "No, I don't think so," he answers after a moment's reflection.

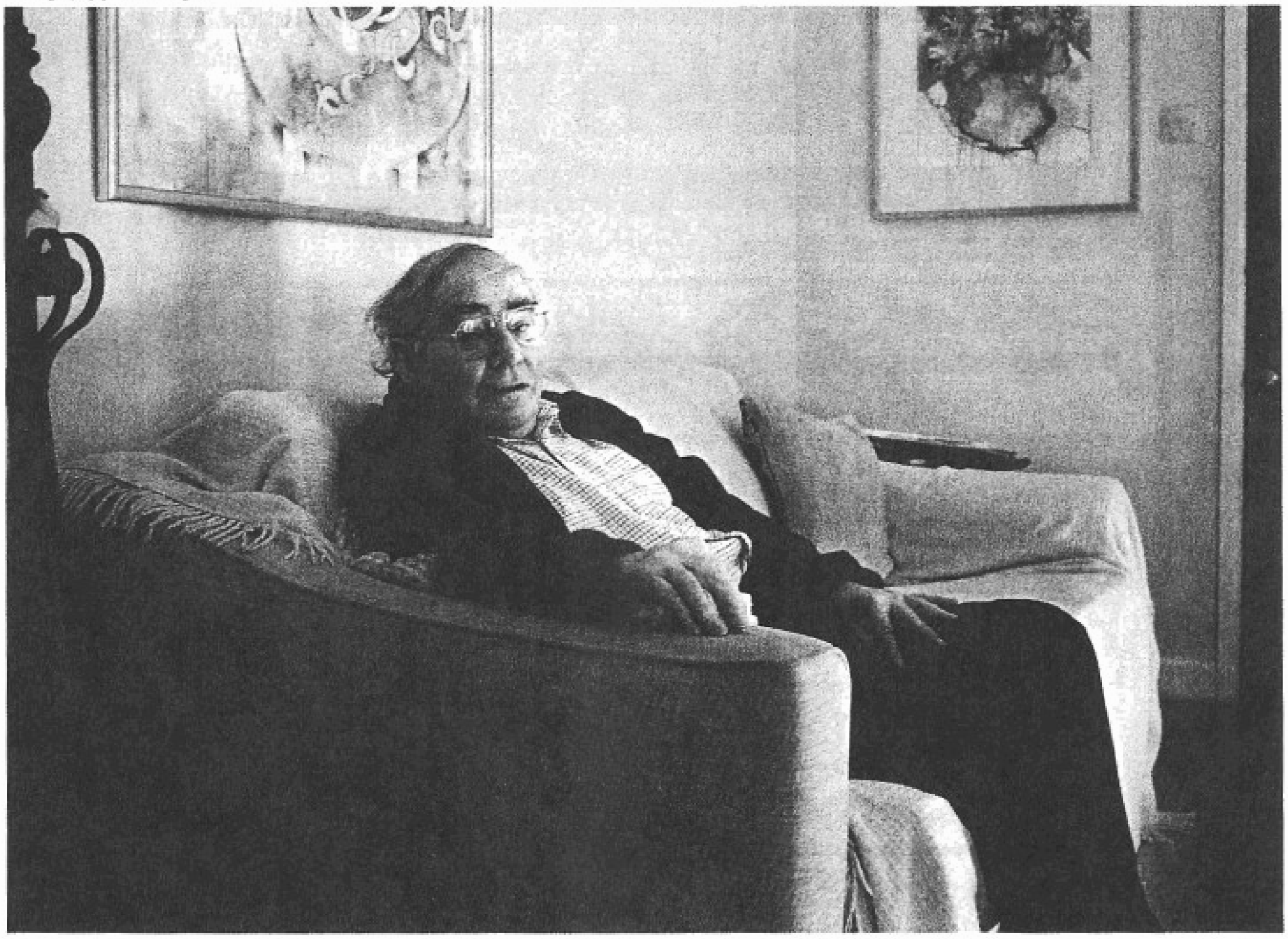
Scientists had other reasons to be sceptical. Few groups had been able to make reliable measurements of nuclear by-products, the telltale signs that fusion has taken place. And nuclear physics implies that fusion should be sustainable only at the high temperatures and pressures found in stars, which are powered by the reaction. Even with a sun's worth of deuterium at room temperature, accepted theory suggests you would be lucky to have two atoms fuse per year.

Fleischmann considers it "naive" to assume hot fusion in free space should proceed via the same mechanism as cold fusion, which – if it does exist – takes place in the metal lattice of

PROFILE

Born in Czechoslovakia, Martin Fleischmann took a PhD in chemistry at Imperial College London and then became professor of electrochemistry at the University of Southampton, UK. He received many awards, becoming president of the International Society of Electrochemistry in 1970. He took early retirement in 1983, but continued to collaborate with Stanley Pons at the University of Utah, where they announced their work on cold fusion in 1989. In 1992 they worked on cold-fusion experiments for a subsidiary of car giant Toyota in France until Fleischmann returned to the UK in 1995.

Photography: Jon Cartwright



an electrode. "The notion that processes in the lattice are different to processes in free space is anathema to the physicists," he says.

During the years following 1989, a number of researchers shrugged off scepticism about cold fusion and persevered with the field. As the numbers of reports of excess heat ran into the hundreds, scientists uncovered possible reasons why the major labs failed to get positive results, such as insufficient "loading" of deuterium in the electrodes. Patchy evidence also accumulated for several different by-products such as tritium, neutrons, helium-4, gamma rays and X-rays, which hint at a fusion reaction.

Sceptics say such measurements have been badly executed, and any positive results are probably artefacts. However, this year, on the 20th anniversary of Pons and Fleischmann's press conference, a group at US military company SPAWAR in San Diego, California, announced persuasive evidence for high-energy neutrons ejected during the fusion of a deuterium and tritium atom in an electrode, using the same detectors developed for hot fusion (*New Scientist*, 28 March, p 10). Then in April, Robert Duncan, an expert in instrumentation and measurement at the University of Missouri in Columbia, appeared on US news programme *60 Minutes*, having

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spent months visiting cold-fusion labs and crunching data for himself. Duncan, who had previously felt cold fusion was "junk science", concluded that the excess heat is "quite real".

Support like this is unlikely to cut ice with hardened sceptics, however, and Fleischmann thinks any big developments in the field will have to be made away from the US and the UK. "The west has dedicated itself to the hot fusion field," he says. "And really, the success of that field has depended on putting forward the view that this is the only way to go."

Fleischmann believes hot fusion projects such as the JET reactor in the UK and the upcoming ITER in France will ultimately prove too complicated to generate useful energy, although he agrees that it is worth investigating all avenues: "I think unless we get fusion to work in some fashion we are doomed, aren't we?"

This may be true. But perhaps the real tragedy is that Fleischmann will probably never know whether his work turns out to be futile, or if he made a vital discovery that was dismissed unfairly. "Whenever anything new happens, people always try to say it is nonsense, because of x, y, z," he says. "That is the natural behaviour of people: to say that what is known is all there is to be known; everything that is outside that region has to be wrong." ■