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Table-top fusion

The beast that will not die

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New claims that cold fusion is no myth

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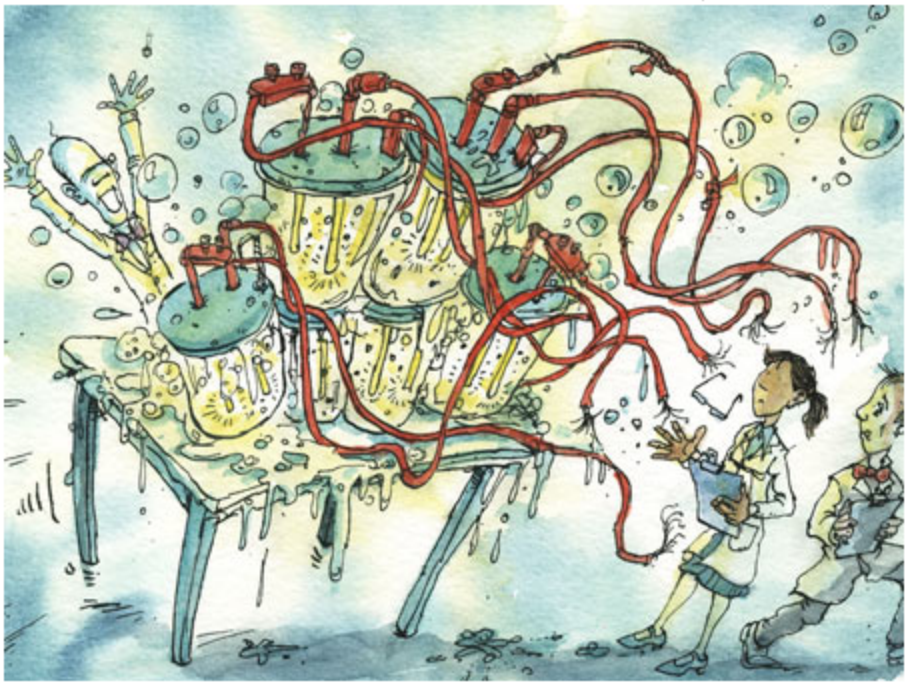

IN GREEK legend, the hydra was a many-headed monster. If a head was severed, it grew back. Indeed, in some versions of the story, two new heads sprouted. Some scientists wonder whether cold fusion is a similar beast. On March 23rd, 20 years to the day since Martin Fleischmann and Stanley Pons announced that they had accomplished nuclear fusion at room temperature in apparatus built on a laboratory bench (they hadn't), experimental results purporting to demonstrate such cold fusion were presented to a meeting of the American Chemical Society in Salt Lake City, Utah.

Cold fusion is so called to distinguish it from the sort that goes on in stars and hydrogen bombs. That needs a temperature of several million degrees. If cold fusion worked, it could provide an inexhaustible supply of clean energy. But it has been cold-shouldered by most scientists. Funding has dried up. What research there is, is conducted outside mainstream laboratories. In fact, its advocates have renamed their endeavours "low-energy nuclear reactions" because cold fusion has received such a drubbing. That is because most scientists think it impossible.

Fusion involves colliding small atomic nuclei together to form larger ones, and thus releasing energy. Because nuclei are positively charged, they are mightily difficult to push together. That is why high temperatures (and also high pressures) are thought by most physicists to be essential to the process. Exactly how two hydrogen nuclei could fuse at room temperature has not been elaborated. But proponents of cold fusion think it is possible.

Rearing another head

To try to persuade their fellow researchers of the reality of cold fusion, Pamela Boss and her colleagues decided to search for evidence of the presence of high-energy neutrons, which should be produced when two nuclei fuse. Dr Boss works for the Space and Naval Warfare Systems Centre in San Diego, California, an organisation that develops communication systems for the American navy. The experiment that she thinks results in cold fusion uses an electrochemical technique in which two electrodes are plunged into an electrolyte made from a recipe that includes heavy water.

Heavy water gets its name because it contains deuterium, a form of hydrogen that has a neutron in its nucleus as well as the usual proton and thus weighs twice as much as the ordinary sort. Deuterium is easier to fuse than simple hydrogen, and so is favoured in these sorts of experiments. Dr Boss and her colleagues reported that one of the electrodes in their experiment got hot, an effect they attribute to fusion.

Most researchers in the field, though, do not accept that heat is sufficient evidence of fusion (if only because it was the basis of the Pons/Fleischmann claim). So to strengthen her case, Dr Boss placed a special plastic called CR-39 next to the hot electrode. If fusion was taking place, then neutrons flying through the plastic would cause protons within the material to recoil, leaving telltale tracks.

Studying CR-39 under a microscope and counting the number of tracks is a standard way to assess how many neutrons bowled past. Dr Boss and her colleagues reckon they have seen enough tracks to provide evidence for the emergence of high-energy neutrons from their experiment. They published the results earlier this year in *Naturwissenschaften*. Dr Boss told the meeting, "taking all the data together, we have compelling evidence that nuclear reactions are stimulated by electrochemical processes."

Certainly there would appear to be something strange going on. But even if Dr Boss's results really are evidence of high-energy neutrons, many physicists will continue to deny that cold fusion could be real. That is because there is no theoretical explanation for electrochemical cold fusion within the existing laws of physics.

A more plausible approach could come from bubble fusion. This technique, which was first reported in 2002 by Rusi Taleyarkhan of Purdue University, is not strictly cold fusion since it uses imploding bubbles to generate the high temperatures and pressures which conventional physics requires as a condition for fusion. But you can do bubble-fusion experiments on a table top using apparatus that costs thousands of dollars rather than billions, so they are conducted in the same spirit as Dr Boss's work.

Unfortunately bubble fusion is also mired in controversy. Dr Taleyarkhan described to the meeting a theoretical paper that would appear to confirm that fusion is indeed possible within such imploding bubbles. Some of his colleagues, though, disagreed with his original findings. After a very public spat, Dr Taleyarkhan sued two of them, claiming that they had made defamatory remarks about him. Earlier this month, he reached a settlement with one of them, the details of which are confidential. However the university launched a series of its own investigations that eventually found Dr Taleyarkhan guilty of scientific misconduct. Purdue stripped Dr Taleyarkhan of his professorship last year, although he remains on the staff.

The hydra was eventually slain by Heracles (or Hercules, as he was known to the Romans). He did it by cauterising the monster's severed necks to prevent regrowth before removing its final head with his bare hands because no weapon could do it. While many physicists would like to perform a similar trick on cold fusion, two decades on, the creature is proving surprisingly resilient.