

The memory of water



The life and work of Jacques Benveniste taught us valuable lessons about how to deal with fringe science, says Philip Ball.

Philip Ball

Jacques Benveniste, who gave the world the 'memory of water', died in Paris on 3 October. He will certainly be remembered for the phrase his work inspired, which has become the title of a play and a rock song, as well as a figure of everyday speech.

But his controversial career also highlighted the tricky issue of how to deal with research on the fringes of science, a question with which Nature itself became intimately entangled.

In France, Benveniste was a celebrity, and it is not hard to see why. He was a charismatic showman who knew how to wield a rhetorical foil. His talk of witch-hunts, scientific priesthoods, heresies and 'Galileo-style prosecutions' played well with those inclined to regard science as an arrogant, modern-day Inquisition.

He conjured up images of a conservative orthodoxy, whose acolytes were scandalized by a groundbreaking discovery that demolished their dogmatic certainties. He was, he suggested, a Newton challenging a petty-minded, mechanistic cartesianism.

Back in 1988, however, Benveniste was very much part of the establishment. He was the senior director of the French medical research organization INSERM's Unit 200, in Clamart, which studied the immunology of allergy and inflammation.

"A talk he delivered last June was a blinding blizzard of histograms."

That was when he sent his notorious paper to Nature¹. In it, he reported that white blood cells called basophils, which control the body's reaction to allergens, can be activated to produce an immune response by solutions of antibodies that have been diluted so far that they contain none of these biomolecules at all.

Incredible result

It was as though the water molecules somehow retained a memory of the antibodies that they had previously been in contact with, so that a biological effect remained when the antibodies were no longer present. This, it seemed, validated the claims made for highly diluted homeopathic medicines.

After a lengthy review process, in which the referees insisted on seeing evidence that the effect could be duplicated in three other independent laboratories, Nature published the paper. The editor, John Maddox, prefaced it with an editorial comment entitled 'When to believe the unbelievable', which admitted: "There is no objective explanation of these observations."

Naturally, the paper caused a sensation. "Homeopathy finds scientific support," claimed Newsweek. But no one, including Benveniste, gave much attention to the critical question of how such a 'memory' effect could be produced.

The paper itself offered only the suggestion, at face value almost meaningless, that "Water could act as a 'template' for the [antibody] molecule, for example by an infinite hydrogen-bonded network, or electric and magnetic fields."

The idea that water molecules, connected by hydrogen bonds that last for only about a picosecond (10^{-12} seconds) before breaking and reforming, could somehow cluster into long-lived mimics of the antibody seemed absurd.

Other teams were subsequently unable to repeat the effect, and the independent results that the reviewers had asked for were never published. Further experiments carried out by Benveniste's team, in double-blind conditions overseen by Maddox, magician and pseudo-science debunker James Randi and fraud investigator Walter Stewart, failed to verify the original results.

The Nature paper was never retracted, but Maddox subsequently commented, "My own conviction is that it remains to be shown there is a phenomenon to be explained" (see "Waves caused by extreme dilution": <http://www.nature.com/cgi-bin/doifinder.pl?URL=/doifinder/10.1038/335760a0>).

Digital biology

Benveniste was unmoved by the wave of scepticism, even derision, that greeted his claims. At DigiBio, the Paris-based company he set up in the wake of the controversy, he devised another explanation for his strange results. Biomolecules, he said, communicate with their receptor molecules by sending out low-frequency electromagnetic signals, which the receptors pick up like radios tuned to a specific wavelength.



Benveniste's paper seemed to validate the claims made for homeopathic medicines.

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Benveniste claimed that he was able to record these signals digitally, and that by playing them back to cells in the absence of the molecules themselves he could reproduce their biochemical effect, including triggering a defence response in neutrophils, which kill invading cells².

The questions this raises are, of course, endless. Why, if this is the way biomolecules work, do they bother with shape complementarity at all? (When I asked Benveniste this, he said something about audio earpieces being shaped to fit the ear.)

How could a molecule act as an antenna for electromagnetic wavelengths of several kilometres? And how does the memory of water fit into all of this? Benveniste proposes that transmission of the signal somehow involves the 'quantum-coherent domains' proposed in a paper³ that now seems to be invoked whenever water's 'weirdness' is at issue - for example, to explain cold fusion.

Blinded by science

The details were not, Benveniste said, his responsibility. He was an immunologist, not a physicist.

But his failure to simplify his experimental system so that he could clarify the precise nature of the effects he claimed to see, or the mechanisms behind them, fell short of rigorous science. Benveniste could surely have tested his radio-transmission theory at the level of simple, cell-free molecular systems.

I have found no evidence that he ever devised such experiments: he stayed at the level of cells, tissues or whole organisms, where direct cause-and-effect is hard to track and statistical tests are needed to cope with the significant responses from control samples. The talk that I saw he and his co-workers deliver last June was a blinding blizzard of histograms.

There can be no doubt that Benveniste was genuinely convinced he had chanced upon something revolutionary. It is a shame that he became isolated (he may have played a part in that), which meant that genuine enquiry into his curious findings was hampered by posturing on all sides.

But the fact that it is the 'memory of water', not 'digital biology', that he will be remembered for illustrates a point that I think Jacques failed to appreciate: his work tapped into a potent and persistent cultural myth about the miraculous properties of water. And under the influence of myth, it can be hard to keep a level head.

References

1. Davenas E, *et al.* Nature, 338. 816 - 818 (1988). | [Article](#) |
2. Thomas Y., *et al.* Medical Hypotheses, 54. 33 - 39 (2000). | [Article](#) | [PubMed](#) | [ISI](#) | [ChemPort](#) |
3. Del Giudice E., Preparata G. & Vitiello G. Phys. Rev. Lett., 61. 1085 - 1088 (1988). | [Article](#) | [PubMed](#) | [ChemPort](#) |