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The Memory of Water

Homeopathy is nonsense and superstition diluted beyond all reason and given as a remedy to the grossly misinformed or scientifically illiterate. And yet there persists that very odd creature, the modern homeopath. While the practice is indistinguishable from ritual and witchcraft (with all due apologies to witches), the modern homeopath would like to cloak himself in the respectability of science. That is the path to acceptance, official recognition, and reimbursement. So homeopaths have added a new head to their hydra of pseudoscience—the memory of water.

A Brief History of Homeopathy

Homeopathy was invented (it is not accurate to say it was discovered, which would imply it has some basis in reality) by Samuel Hahnemann in the late eighteenth century. Hahnemann developed his principles of homeopathy from anecdote and superstition without any chain of scientific research, evidence, or reasoning. It is therefore no surprise that more than two hundred years later, scientific progress has failed to validate any of Hahnemann's ideas (House of Commons 2010).

Scientific knowledge builds on itself, and when someone discovers a fundamental property of nature, it leads to further discoveries and a deepened understanding. Homeopathy led to nothing. Hahnemann's "law of similars" is the notion that "like cures like"—that a small dose of a substance will cure whatever symptoms it would cause in a high dose. This, however, is not based upon anything in biology or chemistry. It is often falsely compared to the body's response to vaccines, but this is not an apt analogy.

Hahnemann's "law of infinitessimals," the notion that a substance becomes more potent when diluted, violates the law of mass action and everything we know about chemistry. Also, many homeopathic remedies are diluted past the point where even a single molecule of the original substance is likely to be left behind. Hahnemann believed that the water retained the magical "essence" of the substance, which makes homeopathy a vitalistic belief system.

Hahnemann's ideas are sufficiently silly that even at the time, early in the history of science, they were ridiculed and dismissed. Homeopathy remains utterly nonsensical, but it is now much more sophisticated nonsense.

A recent fascination with unscientific health modalities has caused a resurgence of interest in homeopathy, leading to many clinical trials of the effectiveness of homeopathic products for specific ailments. After hundreds of clinical studies of homeopathy, systematic reviews reveal that homeopathic remedies are indistinguishable from placebos (another way of saying that they do not work) (Ernst 2010).

This is not even a scientific controversy—the evidence that homeopathy cannot work and does not work is overwhelming. Only ideology, wishful thinking, and scientific illiteracy keep it alive.

Water Memory

Modern defenders have desperately tried to justify homeopathy with scientific-sounding explanations, but they have failed miserably. One such attempt is the notion that water is capable of having memory—that it can physically remember the chemical properties of substances that have been diluted in it.

The notion of water memory was first raised by French homeopath Jacques Benveniste in 1988. He was not studying the water structure itself, just trying to demonstrate that water can retain the memory of antibodies or other substances diluted in it. His research, however, has been completely discredited due to the many flaws in Benveniste's methods, his lab's cherry-picking of data, his improper statistics, and his recounting data points that did not fit their desired results (Scrimgeour 2007).

Materials scientist Rustum Roy, who was enamored with spiritual healing, built upon Benveniste's discredited research, claiming that water molecules are like bricks—they can be used to build structures that contain greater complexity and information than the bricks themselves. Specifically, water molecules can encode in their structure the chemical properties of what was diluted in them.

However, the evidence does not support this claim. What has been demonstrated is that water molecules form transient bonds with other water molecules, creating a larger ultrastructure—but these water structures are extremely short-lived. They are not permanent. In fact, research shows that water molecules very efficiently distribute energy from these bonds, making them extremely ephemeral. One such research paper concludes: "Our results highlight the efficiency of energy redistribution within

the hydrogen-bonded network, and that liquid water essentially loses the memory of persistent correlations in its structure within 50 fs" (Cowan 2005). That's fifty femotoseconds, or fifty quadrillionths (10^{-15}) of a second. Contrary to Roy's claims, water does not hold memory. In fact it is characterized by being extremely efficient at *not* holding memory. Scientists can argue about whether or not water can display ultrastructure lingering for longer than femtoseconds under certain conditions—but they are arguing over incredibly small fractions of a second.

Recently Nobel Laureate Luc Montagnier has given a boost to the "water memory" hopes of homeopaths by publishing a series of experiments in which he claims that DNA highly diluted in water is able to generate radio signals (Montagnier 2009). There are numerous problems with these studies, however. Prime among them is that Montagnier's study design is laughably sloppy (see Myers 2011). Montagnier used a crude signal detection device hooked up to a computer and generated worthless noise-ridden results. His studies proved nothing (and, not surprisingly, have not been replicated), but that has not stopped homeopaths from seizing upon his work to claim vindication.

So we are still left with no plausibility and no evidence that water can form ultrastructures for a biologically meaningful amount of time. It is amazing that Roy, Montagnier, and others so enthusiastically extrapolated from the claim that water can hold structures slightly longer than previously believed (itself probably bogus) to the notion that this can explain the biological effectiveness of homeopathy. Let's take a close look at the nontrivial steps they glossed over.

If this kind of water "memory" is an explanation for homeopathy, then these structures would have to survive not only in a sample of water but through the physical mixing of that water with other water. In fact, they would have to transfer their structure, like a template, to surrounding water molecules. This would need to be reliably repeatable over many dilutions. Then these structures would have to survive transfer to a sugar pill (often homeopathic remedies are prepared by a drop of the water being placed onto a sugar pill).

These water structures would then have to be transferred to the sugar molecules because before long the water will evaporate. This pill will then sit on a shelf for days, months, or years before it is finally consumed by a gullible patient. The sugar pill will be broken down in the homeopathy proponent's stomach, and the sugar molecules will then be digested, absorbed into the blood stream, and distributed through the blood to the tissues of the body.

Presumably, whatever molecules are retaining this alleged ultrastructure are sticking together throughout all of these processes and finding their way to the target organ in which they are able to have their chemical/biological effect.

Absurd does not even begin to cover the leaps of logic that are being committed here. In short, invoking water memory as an explanation for homeopathic effects just adds more layers of magical thinking to the notion of homeopathy; it wouldn't offer a plausible explanation even if the theory of water memory was true, which it isn't.

Some chemical bonds are strong enough to survive this process intact and make it through the body to the target tissue where they can bind to receptors or undergo their chemical reactions. Even most chemicals, however, cannot make it through this biological gauntlet with their chemical activity intact—which is why the bioavailability of many potential drugs is too low for them to be useful as oral agents. The chemicals are simply broken down by the digestive process. In other words, the ephemeral bonds of this alleged water memory—if this fiction of water memory even existed—would have a bioavailability of zero.

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Conclusion

The notion that water has memory is nothing more than a restating of Hahnemann's superstitious notion that substances can transfer their "vital essence" to other substances. Water memory is another fiction of homeopathy; it is not based upon any science and is implausible in the extreme. ■

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