SHORT PAPER
Modified water

Alex M. Andrew
Earley, Reading

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Abstract *Discusses the phenomenon of biological effects of homeopathic "high potencies" and reviews recent literature on the subject.*

The recent paper by Berliocchi (2000) draws attention to the very puzzling phenomenon of biological effects of homeopathic "high potencies". These are diluted solutions of some active substance, usually aqueous solutions, where the dilution is so great that the probability of any molecule of the original substance being present is vanishingly small. At each stage of dilution the procedure of "succussion", or subjection of the sample to mechanical shock, is applied, as described by Berliocchi. Each stage normally involves either tenfold or one hundredfold dilution.

A revival of interest in the scientific examination of these findings is also indicated by at least two other recent publications, namely the book edited by Schulte and Endler (1998) and the more general treatment of properties of water by Ball (1999).

The only explanation that seems at all feasible is that somehow the structure of the water is modified, so as to carry some imprint of the molecules originally present. The picture is slightly complicated by the remark of Boyd and Pathak (1965) that the diluent is sometimes alcohol rather than water. It may be that alcohol also has a complex and imprintable structure, such as has to be postulated for water, though it is also possible that the effect is mediated by the small amount of water that is probably still present when the solvent is nominally alcohol.

The Boyd Medical Research Trust

Biological and biochemical effects of potencies have been studied in a research facility set up in Glasgow with that express aim. Two main sets of experiments were carried out using potencies, as described by Boyd (1946; 1953; 1954). The set reported in most detail referred to the action of a high potency of mercuric chloride on the action of the enzyme diastase in hydrolysing starch. Ordinarily, mercuric chloride inhibits the action of the enzyme, but the potency has the opposite effect of enhancement.

A long series of careful experiments is reported in the 1954 paper and seems to leave no doubt that the effect exists, even allowing for the fact that diastase, being a natural product, has some variability from sample to sample.

The other series of experiments studied the effect on exposed frog hearts of potencies prepared from Strophanthos sarmentosus, a herbal medicine

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employed clinically in homeopathic potencies. The amount of experimental data was not so great in this series, and it is reported in less detail in the 1954 paper, but the results were also judged to be statistically highly significant.

Some further tests on frog hearts are reported by I.A. Boyd, a son of the W.E. Boyd who set up and directed the Boyd Medical Research Trust Laboratories. These tests (Boyd and Pathak, 1965; Boyd, 1968) did not involve "high potencies" nor succussion, but the papers are worth consulting in the present context since the study was prompted by interest in homeopathy and there are various significant incidental comments.

Magnetism and microwaves

Other evidence for modification of the structure of water comes from experiments in which water was exposed to either a steady magnetic field or to microwave radiation. A paper by Rai *et al.* (1994a) reports tests in which samples of purified water were placed in the field of a permanent magnet for some hours, and thereafter were found to differ from control samples in their biological effects. The control samples were exactly the same except that they had not been exposed to the magnet, and the biological tests were made away from the magnet, showing that the effect was conveyed by the water.

The paper by Rai *et al.* (1994a) is in fact one of four in the same issue of the journal reporting effects of the sort, two of them referring to effects of steady magnetic fields and the others to exposure of the samples to microwave radiation. All four papers are from the same laboratory in the Banaras Hindu University, Varanasi, India. The biological effect reported in this particular paper is the inhibition, by the magnetically modified water, of fungal spore germination. A number of species of microfungi were used, and the strongest effect was observed with *Alternaria alternata*. The germination of spores of this species was completely inhibited by water which was a mixture of a sample that had been adjacent to the north pole of the magnet with another that had been adjacent to the south pole. The unmixed samples also produced inhibition, but not total inhibition.

In a later paper, Rai *et al.* (1994b) report differences in magnetically modified water observed by X-ray crystallography. No explanation is offered for the biological effects.

Other evidence from fungi

Another intriguing study that may possibly have a connection is reported by Filippov *et al.* (2000). It has been found that the exposure of potato tubers to a low-frequency electric field, prior to planting, improves their resistance to "late blight" caused by the microfungus *Phytophthora infestans*. The improvement has been demonstrated both by field trials and by the laboratory inoculation of pieces of tuber with the fungus.

The fact that a microfungus is involved suggests a connection with the Indian studies, though there are many obvious differences between the two situations. The Russian work with potatoes used low-frequency electric fields,

distinct from the magnetic or electromagnetic influences in the other study, and the treatment was applied to intact tubers rather than to purified water. The explanation tentatively put forward by the Russian workers is that stress imposed on the biological system by the electric field stimulates a defence mechanism that is effective against the fungus. An explanation along these lines, not explicitly implicating (nor excluding) modified water, seems highly plausible, but the fact that both the Indian and Russian results involve microfungi is intriguing and suggestive.

Water softening

Another curious interaction of water with magnetic fields is in certain "water softening" devices. A simple version consists of a permanent magnet placed against the pipe through which the water flows, but in the more complex system denoted by Scalewatcher®[1] a modulated magnetic field is applied. Since the pipe is intact, the device clearly does not remove the dissolved mineral substances responsible for "hardness", but nevertheless the water is claimed to be effectively "softened" so that it feels more pleasant when taking a bath or shower, and less scale is deposited.

The effectiveness of such "softeners" has been verified by an impressive number of reputable bodies, and seems to be genuine although nobody knows why. It appears that the magnetic field alters the state of solution of the "hardening" mineral substances so that they are less readily precipitated. There is a strange assortment of unexplained phenomena that suggest that water has a complex structure capable of modification by a variety of influences.

Note

1. Promotional literature from Fast Systems Limited, Dalton House, Newtown Road, Henley-on-Thames, Oxon RG9 1HG, UK.

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