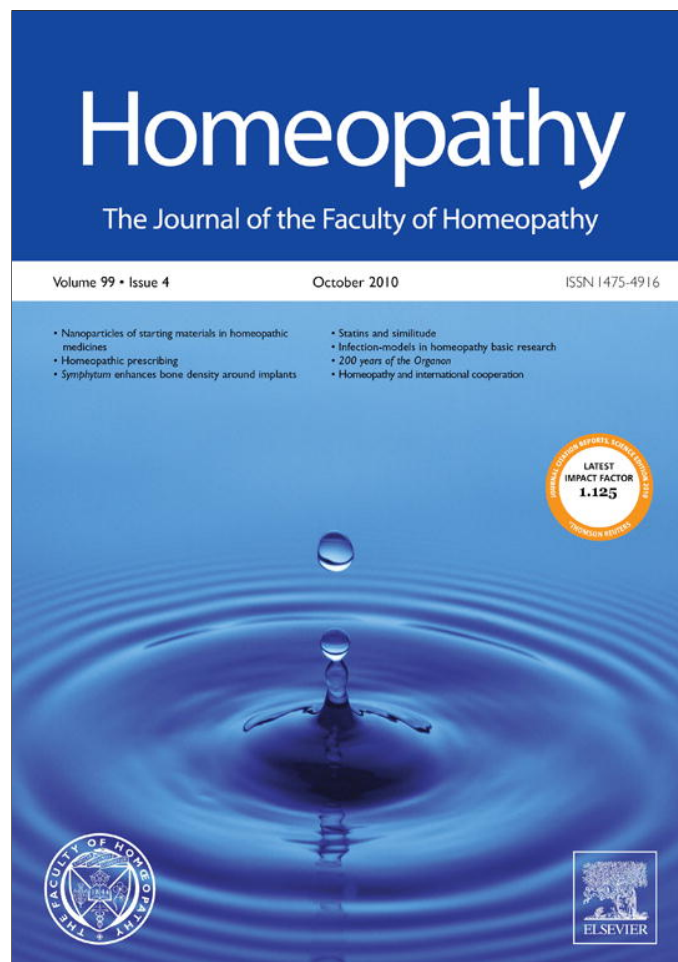


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GUEST EDITORIAL

Do serial dilutions really dilute?

The article by Chikramane *et al.* 'Extreme Homeopathic Dilutions Retain Starting Materials: A Nanoparticulate Perspective', in this issue reports the fascinating observation that high potency homeopathic remedies made from specific metals, prepared at two different commercial plants in India, contain measurable amounts of the starting material, even at 200c.¹ We are all familiar with the simple calculations showing that a series of 1:99 dilutions done sequentially will produce a significant dilution of the starting material in very short order. Specifically, if the starting material is at one molar concentration (6.023×10^{23} atoms [or molecules] per litre), then at about the 12th centesimal dilution (12C) there should be no or very nearly no atoms (or molecules) left of the starting material. At 200c the likelihood of there being even one atom of the starting material approaches zero—if the process of dilution follows the normal assumptions. However, it seems those with those assumptions, we go astray.

Chikramane *et al.* found that, contrary to our arithmetic, there are nanogram quantities of the starting material still present in these 'high potency' remedies. We encourage the reader to inspect this article critically to appreciate the full gamut of the findings and implications.

They offer a possible explanation for this finding. The size and shape of the metal nanoparticles they observe are consistent with the very high forces and temperatures that would occur with putative nanobubbles produced during succussion. From this they hypothesize the formation of nanoparticle–nanobubble complexes that would rapidly rise to the surface of the mixture forming a monolayer, especially at high dilutions. In this way a non-equal distribution of starting material would result during any settling between dilutions. When the top 1% of the solution is used as starting material for the next dilution, as they observed at one plant, and this process is repeated for each 'dilution' step, no dilution in fact occurs.

How these explanations might apply to remedies made from organic starting materials will provoke still further intriguing questions. We have previously shown that there are ponderable contaminants with biological implications present in homeopathic remedies, even at 30c.² Although we briefly considered testing for the presence of compounds from the mother tinctures, at these potencies, this was quickly lowered in our research priority because of the apparent futility and because we did not have the technologies available to measure organic molecules (our choice in mother tinctures). Chikramane *et al.* have now directly tested for the presence of starting material and disproved the tenet that nothing but the 'spirit' is left in high potency homeopathic medicines.

One might expect a different outcome if the starting material were an organic compound as much of the chemistry described here would have very different implications. In addition, there are several other difficulties in determining the relevance of these findings to homeopathy. If nanocomplexes rise to the top of a vial, many manufacturers discard this portion of the solution. For example, the Korsakoff method of remedy manufacture empties the vial and uses the remaining solution from the walls and bottom (not top) of the tube for the next dilution. Finally, even if the persistence of small amounts of any substance were proven, how they could elicit significant clinical responses from the chemicals themselves would have to be explained. We might expect clinical relevance if the concentrations fall within the range of hormesis, which these concentrations appear to be.³

Simultaneously, the study's findings of wide disparity between batches and between manufacturers in the quantity of material identified at high potencies raise new concerns. Is it variations in manufacturing techniques and protocols with the resultant differences in quantity of active moiety in the final remedy that lead to some of the difficulties encountered in clinical homeopathic research?

We do not know the details of these manufacturers' processes or even which pharmacopoeia they employ. As companies operating in India, do they use the Indian pharmacopoeia or that of their original parent company (e.g. Dr Willmar Schwabe India (WSI) Private Limited, the German homeopathic pharmacopoeia; SBL, India, originally Boiron, the French homeopathic pharmacopoeia)? The WHO Safety Report, using the example of *Aconitum*, notes that the amount of mother tincture in the 1DH dilution ranges from 10% in the French pharmacopoeia to 20% in the German pharmacopoeia to 100% in the US and Indian pharmacopoeias with a resulting alkaloid content ranging from 0.002% to 0.075%: a 38 fold difference.⁴

At the very least, the findings in this study beg for renewed efforts at harmonization between the pharmacopoeias and greater specificity and standardization in their descriptions of pharmaceutical methodology.

The identification of nanogram amounts of the starting minerals in 200c remedies is both astounding and welcome. To quote Thomas Pynchon, "If they can get you asking the wrong questions, they don't have to worry about answers".⁵ The skeptics have gotten the homeopathic world so busy trying to defend various theories of water memory that we have overlooked the possibility that some of the material somehow actually persists in highly diluted homeopathic medicines. If these findings are independently replicated, we can perhaps turn to the more relevant questions of how a remedy may interact with the individual organism based on the

Principle of Similars and, beyond a certain threshold, how much the potency matters.

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