



# Update on preliminary elements of a theory of ultra high dilutions

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**Introduction:** The different mechanisms: A. of the interaction between the molecular mother substance and the solvent water or ethanol B. of the storage of molecule-specific information in the solvent. C. the physiological basis of the sensitivity of the living organism towards an ultra high dilution (UHD). D. the mechanism of the interaction of the test dilution with the organism are largely unknown. Several ideas have been postulated, and experiments to test them carried out in physics and in biology.

**Method:** The authors revisited a 1994 contribution on ‘preliminary elements of a theory on UHDs’ and updated it with regard to more recent literature and research findings.

**Results:** Although the experimental basis can still be questioned in most cases, remarkable fundamental observations have been made to explain the effects of UHDs. For some topics in question, it appears that information specific properties of the diluted substance to be transferred is stored by means electromagnetic fields. The interaction between the UHD and the organism seems to be electromagnetic in nature. The transmission of information from (bio-)molecules to the UHD is of special interest. Again, electromagnetic actions and vector potential fields appear to be implicated.

**Conclusion:** The mechanisms of information storage and transfer in UHDs are far from fully understood, but progress has been made at experimental and theoretical levels. *Homeopathy* (2015) 104, 337–342.

**Keywords:** Ultra high dilutions; Homeopathy; Information storage; Information transfer; Sensitivity

## Introduction

The major questions addressed in ‘Ultra high dilution (UHD)’<sup>1</sup> are how any information can be transferred to the carrier substance water or ethanol, how information can be stored there permanently and how this information can be transferred to the living system (plant, animal, human). These questions have not been answered in 1994, nor in 2015, but pieces of that puzzle have been turned around and elucidated. Furthermore, as already stated in 1994, we wish, of course, to encourage others to perform further experiments in order to solve that puzzle.

Although the experimental basis can still be questioned in most cases, researchers can start from remarkable fundamental observations in order to explain the effects of UHDs. For some topics in question, it seems to be evident that the information to be transferred is stored in the specific properties of the diluted substance by means of long-range electromagnetic fields. Also, the interaction of the UHD and the organism seems to be based on long-range electromagnetic interactions. The transmission of information from (bio-)molecules to the UHD is an area of special interest.

## Method

The authors revisited the 1994 contribution on ‘preliminary elements of a theory on UHDs’<sup>1</sup> and updated it with regard to more recent literature, especially to the papers presented in this issue, discussing the authors’ own follow up research, and a cornerstone publication by Bellavite *et al.*<sup>2</sup>

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## Results and discussion

### Some unsolved questions

The different mechanisms

- A. Of the interaction between the molecular mother substance and the solvent water or ethanol.
- B. Of the storage of molecule-specific information in the solvent.
- C. The physiological basis of the sensitivity of the living organism towards the UHD.
- D. The mechanism of the interaction of the test dilution with the organism are all largely unknown. Several ideas, however, have been postulated.

#### A. *Transfer of information from the molecule to the UHD*

Homeopathic remedies are traditionally diluted in bipolar liquids such as water and alcohol or are diluted in lactose. An important role of hydrogen bonds (O—H) is what these substances have in common. Especially with regard to water, a theoretically well based approach was formulated by Del Giudice<sup>3</sup>: quantum electrodynamics allows an ensemble of molecules — beyond a density threshold — to move coherently and be kept in phase by an electromagnetic mode with ‘coherence domains’ the size of which is the wavelength of the mode (superradiance). Thus, with regard to the process of information storage in the solvent, the most common idea is that there is a coherent interaction between the electromagnetic or magnetic vector potential fields of molecules of the diluted mother substance and the dipoles of the solvent water, including the permanent polarization of the water, which thus becomes coherent. The analogy to a laser is used, but in water the coherence is in the ground state. An overview of some recent work on transduction of molecular information through water and electromagnetic waves conducted over the past decade can be found in Montagnier *et al.*<sup>4</sup>

The idea of perimolecular charges (charges linked to the solute molecules) was promoted by Benveniste<sup>5</sup> and an experimental approach to the possibility of their transmission was done.<sup>6</sup> An electronic circuitry was used to transmit information from thyroxine to pure water, which was then tested on a model with amphibians versus water submitted to the same electronic process. Significant differences between test and control group were reported in 1994<sup>6</sup> and in a repetition experiment.<sup>7,8</sup> If an electronic device could transfer biological activity, this would support the hypothesis of the electromagnetic nature of the molecular signal. Benveniste’s ideas and findings were since experimentally developed further by Thomas.<sup>9</sup>

Along with the idea that energetic signals play a decisive role in the information transfer from biomolecules to the organism, the possible role of biomolecules as passive (coherent?) resonator systems has to be discussed. This way of looking at the phenomenon could include the recently well-established knowledge of coherent energetic excitations from living organisms, organs and cells (see C below) which would then actively scan the biomolecules and cause resonances (-D-). The information from the bio-

molecules could then be transferred to different levels, reaching from the direct effect of the molecule and the electric charges which carries to an indirect effect that specifically depends on the actual state of the organism (see below -D-).

During the succussion process, the perimolecular water would then be separated from the molecule, but, continues to carry its bio-information, probably by means of specifically organized water dipoles.

Little was known in 1994 about the processes during agitation where exogenous energy is brought into the dilution. Auerbach<sup>10</sup> described the preparation of UHDs within the frame of fluid dynamics, where the mechanical mixing process combines saddle flow, vortex flow, shear flow and diffusion flow. The issue later evolved in an extended research discussion on so called ‘nano particles’ and ‘nano bubbles’<sup>11–13</sup> (see B below).

#### B. *Storage of molecule-specific information in the solvent*

Typical water structures such as clathrates, helical structures, different other types of clusters or typical water phases and network systems over the whole fluid were hypothesized and described e.g. by Anagnostatos.<sup>14</sup> As 20 years later was summed up by Bellavite *et al.*,<sup>2</sup> “the clathrate model is very speculative, but the presence of clusters in water is well established both by computer simulations and analytical evidence. The possibility that clusters may form nanoscale cages in liquid water is universally accepted: infrared spectroscopy and X-ray diffraction have confirmed that clusters of dozens or even hundreds of water molecules exist in nature.” However, “there is still no consensus on how such aggregates can persist in stable form for sufficiently long periods to justify their medical use as suggested by homeopaths”.<sup>2</sup>

In general and simple terms, it must be kept in mind that the information of a carrier substance that is stable enough to provide long-term effects of UHDs must, to our present knowledge, be based on quantum physical processes that might support coherent structures.

The picture of information storage and transport that has been given by Schulte’s comprehensive contribution<sup>15</sup> might be a general picture for a variety of promising theories which had already been developed in 1994. E.g. Berezin<sup>16</sup> has discussed the isotopic diversity of chemical elements as a physical foundation of homeopathy. Homeopathic remedies based on water or water-alcohol mixtures basically consist of molecules built of hydrogen (H), carbon (C) and oxygen (O) atoms. From nuclear physics it is known that, for almost all elements (atoms) there are atoms of the same type, but slightly different mass (caused by a different number of neutrons in the atomic nucleus). Some of those atoms with different mass (isotopes) are stable, most of them are unstable and suffer radioactive decay.

Thus, besides the different chemical and physical properties of atoms in a molecule, we get two more characteristics: the diversity in mass, and the diversity in abundance. With a different mass, the vibrational interaction among the molecules changes. From the natural abundance of the isotopes an average distance may be

estimated, and vibrational modes and mode differences determined. Taking Berezin's theory on isotopic diversity into consideration together with a picture of cybernetic switches, we may imagine the isotopes as characteristic nodes in a pattern of information, and the diversity of vibrational modes as the dynamical carrier (amplifier, multiplier) of information. Thus, a drug molecule may change the pattern of nodes, which causes a different coupling of vibrational modes. The pattern of isotopic nodes may be stabilized (amplified, multiplied) by the coupling of vibrational modes, even when the drug molecule has been extracted from the system. This theory, as in 1994, is still asking for a new type of experiments in homeopathy, the high resolution LASER spectroscopy.

The imprint theory developed by Del Guidice<sup>3</sup> is based on a coherence assumption similar to that of Berezin. Instead of isotopes keeping coherence long-time stable, Del Guidice concentrates on coherent states induced by electromagnetic polarization fields. It has been proven that polarization fields are extremely non-local, and may stabilize certain structural states. Since 1994, Preparata and Del Guidice have developed their research<sup>17,18</sup> showing that quantum electro dynamic (QED) interactions "may cause a particular phase transition, denoted 'superradiance', whereby particles oscillate in phase with an electromagnetic field. It was found that the dipole moments of these liquid molecules are aligned so that the domains have a polarization vector, the direction of which changes from one domain to the other, resulting in a net zero polarization."<sup>2</sup> Some of these findings have been confirmed by independent researchers.<sup>19</sup> Although Del Guidice's model seemed different from Berezin's isotope model, in a dynamical (thermal) theory both models are based on electron-phonon coupling, i.e., the coupling of electron interaction and vibrational motion of the atom core. Thermal electrodynamics couples the amplitude of vibrational modes (phonons) and the polarizability of the atomic shell through a non-local integral over vibrational modes and frequency dependent polarizabilities.<sup>15</sup>

Another promising theory on information storage and transfer in high-diluted solutions has been developed by Popp.<sup>20</sup> In Popp's model the homeopathic drug induces a resonance transfer of disregulatory energy from the patient's body (biological cell) to the absorbing homeopathic dilution which then is excreted. Emission and absorption are described by means of coherent states of the 'drug' field and the 'disregulatory' field in the patient's body, respectively. The natural weak coupling of both fields keeps the states coherent. Popp also proposes that the long-time stability of homeopathic remedies might be due to coherent phonon states induced by the succussion (agitation) during their preparation process. With regard to Popp's model, the specific structure and dynamics of these fields would need to be formulated in order to develop it further. The model has influenced others, but was not further developed by the author.

With regard to the more recent nanoparticle and nanostructure hypothesis, NMR measurements showed that

gases dissolved in water affect the hydrogen-bond network and change the structure of nanobubbles or clathrate nanocavities,<sup>21</sup> and also silica released from the glass containers in the homeopathic preparation process may support information transfer into higher potencies.<sup>22</sup> However, the use of silica containers is not a condition sine qua non for the preparation on high dilutions (i.e. plasticware also seems to be suitable).<sup>2</sup> It was reported by Elia,<sup>23</sup> that aqueous nanostructures may also exist in the solid phase.<sup>2</sup>

In any case, with regard to models of energetic coupling between drug molecules and solvents, one should not be trapped by models that exclude further and more subtle interaction mechanisms.<sup>14</sup> According to Smith 1994, it might be necessary to extent our speculations from electromagnetic to magnetic vector potential interactions.<sup>23</sup> This was since then backed by further experimental and theoretical work.<sup>25</sup>

Experimental evidence for the idea of a resonance capacity of UHDs was provided in studies on the exposure of a living system to the interaction phenomena between a coil fed by a laboratory oscillator and UHDs, e.g. serially diluted agitated thyroxine.<sup>26</sup> Here, a distinct pattern of frequencies that obviously caused resonances in the thyroxine dilutions, which again led to biological reactions, has been described. Each succeeding step of dilution and agitation added two further and higher frequencies of resonance. In the range of the frequencies investigated (0.01 Hz–10 MHz), the thyroxine dilutions gave regularly arranged resonances throughout this whole range. When, in return, in order to test the biological effect of such typical frequencies, with the help of a coil fed by a laboratory oscillator, their influence on amphibians was compared to the influence of control frequencies, significant reactions of the animals were found.<sup>27</sup> The pilot experiment from 1994 was not submitted to further repetition since then.

It was further shown that the exposure of UHDs to external electromagnetic fields is able to inhibit their further biological effect.<sup>3</sup>

In studies on different living systems including plants, animals and humans,<sup>28–32</sup> it was shown that homeopathic dilutions can also exert their effects on living systems, when they are separated by a hardglass wall. In our respective study on amphibian published in 1994, the UHDs of thyroxine and of water for control, respectively, were sealed in glass vials (ampoules) in order to avoid that it was mixed with the water containing the organisms.<sup>30,31</sup> It was found that plexiglass is not suitable for the information transfer between the UHD and the organism. This might be because plexiglass has different electromagnetic properties. To verify this hypothesis, the experiment was carried out with different kinds of hardglass and with quartzglass, respectively. The biological effects were much more marked when the UHDs of thyroxine and of water were sealed in quartzglass vials rather than hardglass vials. The electromagnetic (VIS) window that marked the difference in the transmission spectra between quartzglass and hardglass was situated between 210 and 310 nm ( $1.43 \times 10^{15}$  and  $0.96 \times 10^{15}$  Hz). The 1994

study, carried out by 4 multicentre researchers,<sup>30</sup> was repeated later, with confirmatory results by two researchers<sup>8,33</sup> and with negative results by one researcher.<sup>34</sup>

Other questions that researchers need to address in this context are, for instance how stable and unique the stored information is, how an information transfer or propagation is being kept pure throughout a physiological system, and how the physiologically useful part of the information can be stable throughout a changing physiological environment until it reaches its distinct trigger point in the system. Furthermore, if information is transferred from an original chemical substance, can it be synthesized and coded by other means? What is the essence of that information in the original substance in the first place? This then touches upon another fundamental question: can the subtle homeopathic mechanism of triggering physiological effects be mimicked, accidentally triggered or annihilated, e.g. by physical intervention such as optical, electromagnetic or alternative physiochemical interactions. These questions were discussed by Schulte<sup>35</sup> in 1998, and are yet awaiting satisfactory answers.

### C. The physiological basis of sensitivity towards UHDs

It appears that the extremely high sensitivity of biological systems provides the key to the understanding of the effects of succussed high dilutions. Living systems can be influenced only slightly by external coherent stimuli more when the system is under good homeostatic control, but more when the system is under biological stress.<sup>20,25</sup> This stress can be present under pathological conditions (in the case of disease) as well as under exceptional developmental conditions. It has been experimentally proven that life phenomena are linked to the emission of coherent electromagnetic waves – e.g. from the DNA lattice system – throughout the whole spectral range.<sup>19</sup> This emission sensitively depends on all biological processes, as cell cycle phase, growth or, obviously, metamorphosis. Living systems also have highly developed electromagnetic bio-communication systems involving transmitter oscillators, sensors and negative feedback control systems. The coherence of the signals provides a variety of extraordinary properties in living systems, e.g. the highest possible transparency for weak-intensity information transfer at the highest possible signal/noise-ratio. It seems that, in nature, such waves serve for regulatory processes, or more generally, for communication within living systems. Specific information can be transferred by electromagnetic frequencies being in phase, which makes them different from the variety of any other incoherent influences, and similar to a technical laser.<sup>3,20,25</sup> Very weak external influences are sufficient to change the intensity or the pattern of the harmonics of electromagnetic emission significantly.<sup>24,26</sup>

### D. Interaction of the organism and the UHD

A concept has pointed out that the basic effect of succussed highly diluted substances is always a delocalization of the energy in a resonance-like interaction between emitter (organism) and absorber (dilution).<sup>2</sup> In the case

of stress, the organism would work as a boson. Its typical – stress-linked – oscillations give rise to perturbations of homeostasis. The agitated high dilution would act as a resonance absorber of stress-linked oscillations as soon as the adequate substance in the appropriate dilution is used. One may suppose that any drug behaves as a passive resonator causing the very gained amplifier of a bio-feedback control system to oscillate. Both negative as well as positive resonance phenomena are to be expected. An analogy would be the effect of a public address amplifier in an undamped empty auditorium. In our amphibian model,<sup>30,31</sup> the organism has completely ceased to oscillate with the frequency (frequencies) linked to the developmental stress after an initial superposition of frequencies out of phase, due to the constant presence of the passive resonator. In a further stage of phase shift, even a positive resonance occurred, which led to an enhancement of the reaction (development) that was initially slowed down. Respective examples on human studies on UHDs were given.<sup>36,37</sup>

This is consistent with our preliminary experiments on electronically transferred information from molecules.<sup>6</sup> Here, we have observed both effects in the sense of those of the original molecular substance as well as effects opposite to those of the original molecular substance. This fact might be a hint concerning the importance of the actual state of the living system. In our respective amphibian experiment, an initial acceleration of development, expressed in terms of both of four-leggedness as well as of tail reduction was found. When the treatment with the electronically transferred information from thyroxine  $10^{-3}$  was continued, a different situation was observed: the information from the test liquid caused an inhibition of reaching the observed parameters. Taking this into consideration, one might conclude that the original molecule in some way is the source of information that is able to interfere with the organism in different ways.

Recent articles by Bellavite *et al.*<sup>38,39</sup> focused on the information transfer process, i.e., the triggering of a reaction at protein level. The idea brought into the discussion is transient proton transfer in water molecules as trigger mechanism for biological effects. Here, chains of water molecules are thought to contribute to proton transfer within hydrophobic proteins and in that process turning an inactive site into a chain of an active mechanism. A comparison to the well-studied bacteriorhodopsin proton pump was made, emphasizing the fact that such proton migration or hopping, maybe even through long chains of water molecules, may reach trigger points far distant from the original proton-membrane contact point as well as may be much faster than a normal water or proton diffusion process. Thus, the proton trigger mechanism constitutes the link where defined information is transferred by physical means to create a biological effect. For this mechanism to function, the proton trigger and proton migration require energy within a well define range which needs to be supplied at a membrane site that ultimately serves as the trigger point. Water molecules in this process are required to allow for proton hopping.

The energy that is required in this case is the (water) proton dissociation energy which in the case of bacteriorhodopsin may be supplied by electromagnetic irradiation in the form of light of sufficient energy and, in the case of water molecules and protein membranes where no energy from light is present, by other physio-chemical reactions. A further development of Bellavite's synthesis of ideas may elucidate the question of the distinct role of water molecules of homeopathically structured water as transfer or trigger agent.

#### E. Homeopathy between physics and psychology

As described above, speculations on the interaction between the electromagnetic/magnetic vector potential field of an organism and a homeopathic remedy that works as a passive resonator are possible. Furthermore, it indicates itself that the interaction of organisms *per se* — as e.g. in the case of the relationship between a therapist and his living test object — should be investigated with regard to the therapeutical effects of homeopathic remedies. The idea might be productive for further research on therapeutic interaction where the high dilution might serve as a kind of specific amplifier (token) in the conscious/subconscious interaction of a therapist and his living test object. This point of view would localize homeopathy in the field between physics, pharmacology, physiology and psychology, with possible unexpected implications in the relationship between an experimenter and a living test object in experiments on UHDs.<sup>29</sup> A link between a quantum explication of information in an UHD and a quantum hypothesis of consciousness was subject to a speculation given in Berezin's contribution 1994.<sup>16</sup>

The issue since then evolved in an extended discussion on the so called 'entanglement theory'.<sup>40–43</sup> This theory or rather hypothesis may at present tend to overstretch its basis in physics,<sup>44</sup> but it may also open a new horizon for further research. In short, this piece of the puzzle was contrasted<sup>2</sup> to the above mentioned models as follows: "In recent years new explanatory hypotheses of the effect of high homeopathic dilutions have been developed, based on a theory of 'non-local' phenomenon, or 'entanglement'. A 'local' theory postulates a physical structure of the homeopathic remedy, like those shown here in the 'cluster' or 'coherence domains' models; this 'structure' (chemical or vibrational or both) would be the deposit of molecular information that would be transmitted to another structure by 'local contact' in a manner not substantially different from the views of conventional physicochemical interactions, for example with the receptors of the cell or with the genome, etc. The theory on 'non-locality' relies instead on a particular type of interaction, described by quantum mechanics for the submicroscopic particles, called 'entanglement' (correlation). The latter is one of the most profound achievements of quantum physics, revealed for the first time by the phenomenon of Einstein–Podolsky–Rosen (EPR) at the level of photons. It results in a measurement performed on one of the entities instantaneously providing information on its entangled partners, even if they are out of speed-of-light contact. Quantum entities behave as one

*indivisible whole, such that their non-local interaction transcends both space and time. It is a special communication between correlated objects in which the measurement of one, instantaneously affects the other, even when they are in the condition of complete mutual isolation at enormous distance. The quantum entanglement exceeds the distance space-time and instantly connects distant objects in space and time, so scientists had predicted that this 'weirdness' of quantum mechanics would lead to computing systems and communication of unprecedented power.*

*In homeopathy, the entanglement would occur at two levels: one between the remedy and the original substance (principle of potentiation), one between the pathophysiological changes of the patient and the pharmacological properties of the remedy (principle of similarity)."*<sup>2</sup> One could also consider a three-way entanglement between the client, the therapist and the remedy.

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