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CLINICAL

An analogy between effects of ultra-low doses of biologically active substances on biological objects and properties of spin supercurrents in superfluid ^{3}He-B

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The effects of ultra-low doses (ULDs) of biologically active substances (BASs) (with concentrations of 10^{-13} M or lower) on biological objects (BOs), such as cells, organisms, etc., and the properties of spin supercurrents in superfluid ^{3}He-B are discussed. It is shown that the effects of ULDs of BASs on biologic objects can be specified by the same set of physical characteristics and described by the same mathematical relations as those used for the specification and description of the properties of spin supercurrents between spin structures in superfluid ^{3}He-B. This is based on the up-to-date physical concepts: 1) the physical vacuum has the properties of superfluid ^{3}He-B; 2) all quantum entities (hence, the BAS and the BO, which consist of such entities) produce spin structures in the physical vacuum. The photon being a quantum entity, the features of the effects of low-intensity electromagnetic radiation on BOs can be explained using the same approach. *Homeopathy* (2011) **100**, 187–193.

Keywords: Ultra-low doses; Low-intensity electromagnetic radiation; Homeopathy; Model of the superfluid physical vacuum; Spin supercurrents; Homogeneously precessing domain

Introduction

Ultra-low doses (ULDs) are defined here as those with concentrations of 10^{-13} M or lower.[1] Note that introduction of a substance in doses of 10^{-12}–10^{-13} M into an organism will result in about 1–10 molecules of the substance per cell. That is, at concentrations beyond 10^{-13} M there will be, from the point of view of classical physics, no molecules of the substance in a cell. The levels of biological organization at which the action of ULDs of biologically active substances (BASs) has been demonstrated include macromolecules, cells, organs, tissues, plants and animals.

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The features of the effects of ULDs of BASs on biological objects (BOs) are[1–3]:

1. The kinetic paradox: the effect of an ULD of a BAS on a cell or an organism is the strongest when the latter contains the same substance but in concentrations some orders of magnitude greater than the ULD used. It may be objected that a BAS in ULD may have actions where the substance is not present in the cell or organism.[4,5] It will be shown that the effects of ULDs in such cases are due to the same physical process.
2. A change in sensitivity (usually an increase) of the BO with respect to a subsequent exposure to a BAS in ULD.
3. Dependence of the 'sign' of the effect (inhibition or stimulation) on the initial state of the BO being treated.
4. A non-monotonic, polymodal (oscillatory) dose–response dependence. In most cases the activity maxima are observed within definite ranges of doses, separated by so-called 'dead zones'. In some cases, the same effects are produced by doses of BASs differing by several orders of magnitude.

There are also cases where a change in the 'sign' of the effect is observed in the dose dependence.

Hahnemann's law of similars (similia similibus curentur)[6] can be seen as a consequence of the last feature: a small dose of a substance cures a disease and a large dose of the same substance may cause it. It is empirically established that the effects characteristic of the action of ULDs of BASs on BOs also occur with low-intensity electromagnetic (EM) radiation.[1] (Electromagnetic radiation is referred to as low-intensity radiation if its flux density is less than 1 $\mu W/cm^2$.) For many researchers, explanation of the effects of ULDs on a biological organism, when there are no molecules of the substance introduced, seems impossible. To the author's knowledge, no physical process in the physical vacuum has been suggested so far to explain the effects of ULDs.

I show in this paper that there is a physical process in nature, which could underlie the effects of ULDs of BASs on BOs and determine the above features of the effects. Such a process is the spin supercurrent such as that emerging between spin structures in the helium isotope ^{3}He in its superfluid B phase (^{3}He-B). One of the remarkable properties of ^{3}He-B is that spin structures with coherently precessing spins of the constituent atoms, the so-called homogeneously precessing domains (HPDs),[7–9] may exist there. An HPD is characterized by spin, spin precession angle, nutation angle, and precession frequency. If there is a difference in the precession angles and/or nutation angles of two spin structures, a spin supercurrent arises between them tending to equalize the values of the respective angles. The extent to which the equalization is effected depends on the difference in the precession frequencies. The dependence of spin supercurrent on the difference in the precession angles has a non-monotonic (oscillatory) character. The spin supercurrent changes the energy of the spin structures between which it arises.

There are many theories which explain some effects of ULD based on concepts of quantum mechanics, such as quantized fluctuations and quantum coherence (quantum non-locality),[10–13] or 'singularities' in the physical vacuum.[14,15] But there are no theories drawing an analogy between the effects of ULDs on BOs and the features of a real physical process, specifically, the spin supercurrent. I address the properties of spin supercurrents emerging between the spin structures in superfluid ^{3}He-B to explain the features of the effects of ULDs of BASs on BOs on the basis of the following modern physical concepts[16]:

1. The physical vacuum has the properties of superfluid ^{3}He-B.
2. All quantum entities, including BASs and BOs which consist of such entities, produce spin structures in the physical vacuum, for example, through the process of production of pairs of virtual particles. The existence of virtual particles agrees with the Uncertainty Principle; and the size of the area where pairs of virtual particles are formed may be thought of as being of the order of magnitude of the de Broglie wavelength of the quantum object that has created the virtual particles, and consequently can exceed the size of the quantum object by some orders of magnitude. As a result of this, the notion of substance concentration ceases to have its conventional meaning in this case.

On the basis of the above physical concepts it can be explained why in the action of low-intensity electromagnetic radiation on BOs similar effects are observed as in the action of ULDs.[1] Electromagnetic radiation consists of quantum entities, photons, and, consequently, produces in the physical vacuum (as in the case of ULDs of BASs) spin structures that interact with the spin structures of BOs. Thus the same physical processes may underlie the action of both an ULD of BAS and low-intensity electromagnetic radiation on a BO.

The properties of spin supercurrents in superfluid ^{3}He-B

One of the remarkable properties of ^{3}He-B is that areas with coherently precessing spins of ^{3}He atoms, the so-called HPDs,[7–9] may exist there. An HPD is characterized by spin S, precession angle (or precession phase) α, nutation angle β, and precession frequency ω (Figure 1). The precession and nutation angles are order parameters for superfluid ^{3}He-B, and there are processes that tend to equalize the order parameters throughout the whole volume of the superfluid. Such processes in superfluid ^{3}He-B are spin supercurrents. In the case where the precession frequencies are directed along axis z, the spin supercurrent component in the direction of axis z, J_z, is determined[7] by the following:

$$J_z = -b_1 \frac{\partial \alpha}{\partial z} - b_2 \frac{\partial \beta}{\partial z}, \qquad (1)$$

where b_1 and b_2 are proportionality factors dependent on β and the properties of the medium.

There exists such a phenomenon in ^{3}He-B as phase slippage. It can be explained using the following example. There are two HPDs with respective precession frequencies ω_1 and ω_2 ($\omega_1 \uparrow\uparrow \omega_2$), and there is a difference in the precession angles between the HPDs, which equals $\Delta\alpha$: $\Delta\alpha = \Delta\alpha_0 + (\omega_1 - \omega_2)t$, where t is time. The difference results in a spin supercurrent between the HPDs. At a definite $\Delta\alpha = \Delta\alpha_c$ determined by the properties of the superfluid medium, a precession phase slippage of the value of $2\pi n$ takes place. The critical spin supercurrent J_c corresponds to the value $\Delta\alpha_c$.

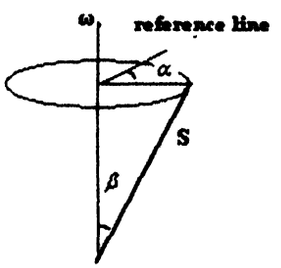

Figure 1 The diagram of precession of spin S with frequency ω; α is the precession angle relative to a reference line, β is the nutation angle.

Figure 2 shows the experimentally obtained dependence[9] of the normalized spin supercurrent J/J_c between two HPDs with respective precession frequencies ω_1 and ω_2 on the hypothetical difference in the precession angles, $\Delta\varphi$, which is determined as $\Delta\varphi = (\omega_1 - \omega_2)t$. Up to the value of $\Delta\varphi$ equal to $\Delta\alpha_c$, the hypothetical difference in the precession angles is equal to the precession angles difference determining the spin supercurrent, $\Delta\alpha$, that is, $\Delta\varphi = \Delta\alpha$. In Figure 2, the line a–b corresponds to the change in the supercurrent in the process of phase slippage, the 2π phase slip taking place and $\Delta\alpha_c = \pi$. As the curve suggests, the spin supercurrent outside the range of phase slippage can be taken to be proportional to $\Delta\alpha$:

$$J = k\Delta\alpha, \tag{2}$$

where k is a proportionality factor. To date, there is no experimental data on the features of the dependence of the spin supercurrent between two HPDs on the difference in the nutation angles. So we shall consider from now on only the component of the spin supercurrent determined by the difference in the precession angles.

In a HPD, energy U is determined by the frequency of precession, ω:

$$U = S\omega. \tag{3}$$

Generally, the determination of time dependency of the magnitude of the spin supercurrent between two HPDs is a difficult problem, because the speed of transmission of information of the existence of a gradient of the order parameter is, in theory, infinite, and the speed of the spin supercurrent is finite. Besides, a possibility of phase slippage should be taken into account. The respective precession and nutation angles of the interacting HPDs will become equal, provided the distance X between them and the difference between their precession frequencies, $\Delta\omega$, satisfy the following conditions:

$$X \to 0, \tag{4a}$$

$$\Delta\omega \to 0. \tag{4b}$$

The mechanism of action of ULDs of BASs on BOs

The effects of ULDs of BASs on BOs can be explained by the properties of spin supercurrents emerging between HPDs (the spin structures) in superfluid ^{3}He-B based on the following principles[16]: the physical vacuum has the properties of superfluid ^{3}He-B; the BAS and BO produce spin structures in the physical vacuum. Theoretical grounding of these principles will be provided in the section 'Legitimacy of the postulates of the model'. Let us discuss the ULD effects features given in Introduction.

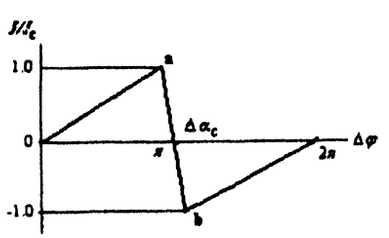

Figure 2 Normalized spin supercurrent J/J_c as a function of hypothetical precession phase difference $\Delta\varphi$. The phase slippage is shown by line a–b. Up to the line a–b, $\Delta\varphi = \Delta\alpha$.

The kinetic paradox

Under the condition (4b), the interaction between the spin structures generated in the physical vacuum by a BAS and a BO is most pronounced if the difference in spin precession frequencies characteristic of the structures is minimal. Evidently, this is the case if the substance of BAS is present in the BO in sufficient concentration. The high concentration of such a substance in the BO is necessary for the spin structure produced by the BO in the physical vacuum to have the characteristics determined by the properties of the substance.

A change in sensitivity of the BO with respect to a subsequent exposure to a BAS

According to the present model, on exposure of a BO to a BAS there occurs a change in the characteristics of the spin structure generated by the BO in the physical vacuum, specifically, the precession frequency, the precession and nutation angles of spins of the particles which constitute the structure. Thus by the time of a subsequent exposure of the BO to the BAS the difference between these characteristics of the spin structures generated by the BAS and BO will not be the same as the corresponding difference before the first exposure. Since the value of spin supercurrent depends on both the gradient of precession angle and the gradient of nutation angle, the value of spin supercurrent between the spin structures in subsequent exposures to ULDs will be different from that in the first exposure.

Dependence of the 'sign' of the effect on the initial state of the BO being treated

The magnitude and direction of the spin supercurrent emerging between a BAS and a BO are determined by the difference between the respective angles of precession and nutation of spins of the particles in the spin structures generated by the BAS and BO in the physical vacuum. Consequently, for the same BAS the characteristics of spin supercurrent depend on the characteristics of the BO by the beginning of the exposure.

A non-monotonic, polymodal dose–response (or dose–effect) dependence

This is accounted for by the same dependence of the value and direction of the spin supercurrent between their spin structures on the difference between the precession angles. The latter dependence is caused by such an effect in superfluid ^{3}He-B as 'phase slippage' (see Figure 2).

Let us discuss now in more detail the mechanism of action of BAS on BO using some mathematical relations.

We assume that the spin structures produced in the physical vacuum by the BO are characterized by a single value of the

precession frequency and single values of the angles of precession and nutation, that is, the structure is a HPD in the physical vacuum. In the model discussed here, it is convenient to express an ULD of BAS in terms of so-called 'quanta'. A 'quantum' is a dose of the substance that produces in the physical vacuum a spin structure that is characterized by a single value of the precession frequency and single values of the angles of precession and nutation, and thus the structure can be thought of as being a HPD in the physical vacuum.

1. To describe the spin structures produced by a 'quantum' of ULD of BAS and by the BO, we shall introduce a number of notions relating to time t: ω_{1t} will be the frequency of precession in the structure produced by the ULD, ω_{2t} the frequency of precession in the structure produced by the BO, and $\Delta\alpha_t$ the difference in the precession angles of these structures.

Let us assume that the interaction between the spin structures produced by the ULD and the BO takes place at time $t = \tau_1$. The spin supercurrent, J_{τ_1}, caused by the difference in the precession angles, $\Delta\alpha_{\tau_1}$, will be determined, according to (2), as:

$$J_{\tau_1} = k\Delta\alpha_{\tau_1}. \tag{5}$$

If the difference $\Delta\omega = \omega_{1\tau_1} - \omega_{2\tau_1}$ meets the condition (4b), the condition (4a) being taken to be satisfied automatically, then, in accordance with the properties of the physical vacuum, there will be equalization of the precession angles. As a result, there will be a decrease in the difference in the precession frequencies in the spin structures produced by the ULD and the BO, that is, we have:

$$\Delta\alpha'_{\tau_1} = 0,$$

$$|\omega_{1\tau_1} - \omega'_{2\tau_1}| < |\omega_{1\tau_1} - \omega_{2\tau_1}|. \tag{6}$$

The variables $\Delta\alpha'_{\tau_1}$, $\omega'_{2\tau_1}$ correspond to respective $\Delta\alpha_{\tau_1}$, $\omega_{2\tau_1}$, but their values are taken after the action of the ULD on the BO. Thus the action of the ULD on the BO at time τ_1, provided conditions (4a) and (4b) are valid, will result in that the characteristics of the spin structure produced by the BO will tend to become the same as those of the spin structure produced by the ULD. (From this viewpoint, one can speak of sensitivity of the BO to the action of ULD.)

Note that condition (4b) is always valid for those BASs which are contained in the BO but in doses some orders of magnitude higher than the ULD used. The high concentration of such a substance in the BO is necessary for the spin structure produced by the BO in the physical vacuum to have the characteristics determined by the properties of the substance, i.e. for the frequency $\omega_{2\tau_1}$ to become as close to the frequency $\omega_{1\tau_1}$ as possible.

These conclusions following from the model agree with the 1st feature of the effect of ULDs of BASs, mentioned in Introduction, the kinetic paradox: the effect of an ULD of BAS on a cell or an organism is the strongest when the latter contains the same substance but in a concentration some orders of magnitude greater than the ULD used.

2. In the preceding subsection it was shown that, after the action of the ULD of BAS on the BO, the frequency of precession in the spin structure produced by the BO will change. Because of this change, condition (4b) may not be valid for a subsequent action of another ULD on the same BO, although before the action of the first ULD it was valid. Thus the action of an ULD upon a BO affects the sensitivity of the latter with respect to a subsequent action of other ULDs. Let us consider the case where the frequency of precession in the spin structure produced by another ULD is equal to the precession frequency (which was designated above as $\omega_{1\tau_1}$) in the spin structure produced by the first ULD acting at $t = \tau_1$. As follows from (6), after the action of the first ULD on the BO the quantity $\Delta\omega$ ($\Delta\omega = \omega_{1\tau_1} - \omega'_{2\tau_1}$ now) used in condition (4b) becomes smaller than before the action of the first ULD. This increases the sensitivity of the BO to a subsequent action of an ULD whose spin structure has the same precession frequency.

These conclusions agree with the 2nd feature of the effect of ULDs of BASs, mentioned in Introduction: a change in sensitivity (generally, an increase) of the BO with respect to a subsequent exposure to a BAS in ULD.

3. According to (3), the energy possessed by the spin structure produced by a quantum object in the physical vacuum is proportional to the precession frequency. If the precession frequency varies, the energy varies too. For example, there occurs the action of an ULD of BAS on a BO at time τ_1. The action results in changing the precession frequency by the quantity $\omega'_{2\tau_1} - \omega_{2\tau_1}$, which follows from (6). Consequently, taking into account (3), the energy of the spin structure produced by the BO will change by ΔU as follows: $\Delta U = S(\omega'_{2\tau_1} - \omega_{2\tau_1})$.

The direction of energy flow at an arbitrary time t is determined by the sign of $\omega_{1t} - \omega_{2t}$. At $\omega_{2t} < \omega_{1t}$, the energy flow occurs towards the BO, and at $\omega_{2t} > \omega_{1t}$ the direction of energy flow is opposite. The direction of energy flow is the same as that of the spin supercurrent. Thus, depending on the sign of $\omega_{1t} - \omega_{2t}$, BASs can be classified into two categories: 'cooling' and 'heating' with respect to the specific BO. The effect of an ULD at the initial moment of time can differ from that at subsequent moments of time. Actually, in accordance with (5), at $t = \tau_1$ the direction of the spin supercurrent J_{τ_1} and, consequently, the energy flow direction is determined by the sign of $\Delta\alpha_{\tau_1}$ and does not depend on the sign of $\omega_{1\tau_1} - \omega_{2\tau_1}$.

If we associate the 'sign' of the effect of ULD of BAS on the BO with the direction of energy flow between the respective spin structures produced by them in the physical vacuum, we obtain the agreement with the 3rd feature of the effect of ULDs of BASs: the dependence of the 'sign' of the effect on the initial state of the BO.

4. Let us examine the action of an ULD of BAS on a BO provided the ULD consists not of a single 'quantum', as in the above cases, but of r 'quanta'. Let J^r be the spin supercurrent between the spin structures produced

by the ith 'quantum' of the ULD and the BO. Then the total spin supercurrent, J_T, caused by all 'quanta' will be determined by the expression $J_T = \sum_{i=1}^{r} J^i$. Assuming that $J^i = J$ for all i, the maximum value of J_T, J_T^{max}, will be expressed as:

$$J_T^{max} = rJ. \quad (7)$$

In ^{3}He-B there will be slippage of the angle (phase) of precession by the value of $2\pi n$ ($n = 1, 2,...$) at a certain $\Delta\alpha_c$ and respective J_c. Taking into account (7), we shall introduce the critical value of the number of 'quanta', r_c, which causes the quantity J_T^{max} to take the value of J_c:

$$r_c = J_c/J. \quad (8)$$

The value $\Delta\alpha_c$ and, correspondingly, J_c are not constants for the superfluid medium; they depend on the characteristics of the spin structures between which the spin supercurrent emerges. For example, in the experiments whose results are shown in Figure 2, $\Delta\alpha_c = \pi$ and the phase slippage is 2π; the phase slippage leads here to a change in the sign of the spin supercurrent and, consequently, in the direction of energy flow. According to experimental data,[8] $\Delta\alpha_c$ can exceed 2π. In this case the phase slippage may lead not to a change in the sign of the spin supercurrent, but to a decrease of the latter. The value r_c, as follows from (8), is not constant either: firstly, it depends on the varying J_c, and secondly, on the value of J, which, in its turn, is determined by the characteristics of the spin structures produced in the physical vacuum by the ULD and the target BO. As a consequence, for the same pair 'ULD–BO' there may be several values of r_c. Thus the phase slippage phenomenon makes the effect–dose curve non-monotonic and polymodal.

This conclusion agrees with the 4th feature (mentioned in Introduction) of the effects of the ULDs of BASs: a non-monotonic, polymodal dose–effect curve; in some cases a change in the 'sign' of the effect is observed.

Thus the above mentioned properties of spin supercurrents arising in the physical vacuum as a result of interaction of the spin structures produced by an ULD of BAS and by the target BO agree with all the features of the effects of ULDs of BASs on BOs cited in Introduction to this paper.

Legitimacy of the postulates of the model

The effects observed in actions of ULD of BASs on BOs can be explained by the properties of spin supercurrents such as those emerging between HPDs in superfluid ^{3}He-B, if we assume the following postulates: 1) the physical vacuum has the properties of superfluid ^{3}He-B; 2) BASs and BOs produce spin structures in the physical vacuum.

Some grounds for accepting the legitimacy of these postulates from the point of view of the existing physical concepts are:

1) The physical vacuum has the properties of superfluid ^{3}He-B.

   The validity of ascribing the properties of superfluid ^{3}He-B to the physical vacuum is substantiated in a number of works. For example, in Ref. 17 a possibility of laboratory simulation of cosmic string formation in the early Universe using superfluid ^{3}He was shown, in Ref. 18 there were revealed analogies between some properties of superfluid ^{3}He-B and gravitational properties of space. It was shown in Ref. 19 that electromagnetic waves can propagate through the physical vacuum having the properties of superfluid ^{3}He-B. The analogy between the features of the superfluid ^{3}He-B and those of the physical vacuum was mentioned by Yuri Bunkov,[7] who, together with Vladimir Dmitriev and Igor Fomin, was awarded the Fritz London Memorial Prize in 2008 for the discovery and understanding of the "Phase Coherent Spin Precession and Spin Superfluidity of ^{3}He-B".

2) BASs and BOs produce spin structures in the physical vacuum.

   Spin structures in the physical vacuum can be formed, for example, by virtual particles. According to quantum field theory, quantum objects create pairs of virtual particles, or particle–antiparticle pairs, in the physical vacuum. For virtual particles the classical relation between mass, energy and momentum does not hold, however, they have spin which is the same as for the real particles. The existence of virtual particles agrees with the Uncertainty Principle; and the size of the area where pairs of virtual particles are formed may be thought of as being of the order of magnitude of the de Broglie wavelength of the quantum object that has created the virtual particles, and, consequently, can exceed the size of the quantum object by some orders of magnitude (e.g. the de Broglie wavelength of the electron in a hydrogen atom is five orders of magnitude greater than the electron's 'classical' radius, $\sim 10^{-13}$ cm).

The BAS and the target BO consist of quantum entities: electrons, protons, etc. Therefore, the BAS and the BO produce pairs of virtual particles with spins in the physical vacuum, that is, they produce spin structures in the physical vacuum. Since the size of such a structure can be some orders of magnitude greater than the size of the parent object, the notion of substance concentration ceases to have its conventional meaning in this case. According to the postulates of quantum mechanics, spin has no definite direction, and by the magnitude of spin the magnitude of its projection onto a preferential direction is meant. This can be interpreted as a precession of the spin about the preferential direction and allows one to introduce the frequency of the precession. Thus the spin structures produced in the physical vacuum by the BAS and the target BO can be characterized by respective frequencies of precession, precession angles and nutation angles. Consequently, spin supercurrents can exist between such structures, caused by gradients of precession and nutation angles.

The present physical model elucidates why in the action of low-intensity electromagnetic radiation on BOs the same effects are observed as in the case of action of ULDs of BASs on such objects. Electromagnetic radiation

consists of quantum entities, photons, and, consequently, produces in the physical vacuum (as in the case of ULDs of BASs) spin structures that interact with the spin structures of BOs. Thus the same physical processes underlie the action of both an ULD of BAS and low-intensity electromagnetic radiation on a BO.

Discussion

What do we mean by 'analogy'? If we assume that the properties of the physical vacuum are like those of ^{3}He-B and all quantum objects produce spin structures in the physical vacuum, which is consistent with modern physics, then the effects of ULDs of BASs on biologic objects can be specified by the same set of physical characteristics and described by the same mathematical relations as those used for spin supercurrents arising between spin structures in superfluid ^{3}He-B. In such an approach we have:

1. The kinetic paradox (the effect of an ULD of a BAS on a cell or an organism is the strongest when the latter contains the same substance but in doses that are some orders of magnitude greater than the ULD used) is due to the dependence of the characteristics of spin supercurrent on the difference in the frequencies of precession of spins of the interacting spin structures. The maximum efficacy is reached if the difference is zero.
2. A change in sensitivity (generally, an increase) of the BO with respect to a subsequent exposure to a BAS in ULD is due to the changes in the precession angles and/or nutation angles of spins in the process of interaction of the spin structures.
3. The dependence of the 'sign' of the effect (inhibition or stimulation) on the initial state of the BO being treated is due to the dependence of the direction of spin supercurrent on the sign of the difference in the angles of precession and/or nutation of spins of interacting spin structures.
4. A non-monotonic, polymodal dose–response (or dose–effect) dependence is due to the non-monotonic dependence of spin supercurrent on the difference in the angles of precession.

The approach discussed suggests a definition for the term 'BAS'. The BAS is a substance that generates spin structures in the physical vacuum, whose spin precession frequencies are of the same order of magnitude as those of the spin structures generated by the target BO (see Eq. (4b)). In other words, if a substance in ULD has an effect on a BO, then this means that the spin structures produced in the physical vacuum by the substance have the spin precession frequencies of the same order of magnitude as those of the spin structures produced by the BO.

According to Bellavite and Signorini[6]: "*There is some preliminary evidence demonstrating a homeopathic effect not only of solutions but also of closed ampoules containing solutions and placed in contact with the system to be regulated (human or animal).*" The authors refer to Ref. 20; see also Refs. 5, 21. This striking phenomenon, if confirmed, could be explained within the model discussed here. Actually, whatever material the ampoule be made of, it is a molecular substance. Spin supercurrents through which the solution and 'the system to be regulated' interact propagate in a 'finer' physical medium (the physical vacuum) than the molecular one. Therefore, the spin supercurrents may not be shielded by molecular substances. The model presented in this paper allows us to predict a similar effect. The effect refers to action of low-intensity electromagnetic radiation on BOs. Under 'Legitimacy of the postulates of the model' it was mentioned that electromagnetic radiation as consisting of quantum entities, photons, will produce spin structures in the physical vacuum, which, as in the case of ULD of a BAS, will interact with the spin structures of the BO by spin supercurrents. As in the experiments referred to by Bellavite and Signorini, these supercurrents will pass through various shielding screens including electromagnetic screens.

According to (5), the ULD effect depends on the initial value of the difference in the precession angles in the spin structures generated in the physical vacuum by the ULD and the target. For the description of the effect of ULD, the notion of 'quantum' was introduced into the model in the section 'The mechanism of action of ULDs of BASs on BOs'. The 'quantum' is characterized by a single value of the precession frequency and single value of the angle of precession (and nutation as well in the general case). For all the ULD 'quanta' acting on a BO to produce the same effect, it is necessary that the 'quanta' had the same initial values of the angles of precession and nutation. It is experimentally established[22] that in superfluid ^{3}He-B the Barnett effect takes place: the uniform spin orientation induced by rotation. One of the techniques to equalize the angles of precession and nutation in the spin structures generated by ULD may be the process of potentiation including succussion.

Although the model of action of ULDs discussed here is based on the principles of quantum mechanics, it views the interaction between a BAS or low-intensity EM radiation and the target BO not as an interaction of ensembles (collections) of quantum objects but as an interaction of individual quantum objects. That is, not a statistical but a deterministic description of the interaction is used. This approach agrees with Schrödinger's view expressed in his book 'What is life?'[23] "*The living organism seems to be a macroscopic system which in part of its behaviour approaches to that purely mechanical (as contrasted with thermodynamical) conduct to which all systems tend, as the temperature approaches absolute zero and the molecular disorder is removed.*" In fact, the same is true for the model of action of ULDs of BASs upon living organisms: the action is deterministic, taking place in the physical vacuum that has the properties of a molecular liquid with its temperature tending to absolute zero (the properties of superfluid ^{3}He-B).

Conclusion

I have shown that, if we assume that the properties of the physical vacuum are like those of ^{3}He-B and all quantum objects produce spin structures in the physical vacuum, which is consistent with the modern physics, then the

effects of ULDs of BASs on biologic objects can be specified by the same set of physical characteristics and described by the same mathematical relations as those used for the specification and description of the properties of spin supercurrents arising between spin structures in superfluid ^{3}He-B. This approach is used as a basis for a physical model describing the features of ULD effects.

Such a physical model implies that the same physical processes underlie the action of both an ULD of BAS and low-intensity electromagnetic radiation on a BO.

The model is based on the principles of quantum mechanics. On the quantum level, the classical notion of substance concentration ceases to have its conventional meaning and this accounts for the fact that ULDs affect BOs in concentrations of less than 10^{-13} M.

The model of action of ULDs advanced in this work suggests a possibility for an ULD of BAS to act on a BO without contacting (on a molecular level) each other.

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LETTERS TO THE EDITOR

Nanoparticles and membrane anisotropy

Sir,

In our work using *Aconitum napellus*, we predicted that after repeated dilution the aggregates of drug molecules reduce in size and approach the range of nanodimensions.[1] We showed for the first time the effect of this size reduction due to dilution on membrane anisotropy. At high dilutions, when the size of the drug cluster is in the nanorange, membrane anisotropy increases with increasing dilution, indicating that more drug molecules have entered in the membrane moiety.

To summarise, repeated succussion used to dilute the drug also reduces the size of the drug cluster and it becomes more potent as more drug enters in the membrane.

In May 2010, a paper using metal-derived homeopathic medicine was published in Homeopathy where a similar idea is suggested.[2] The authors of this paper hypothesize that succussion results in high temperature resulting in clustering due to melting of the metal surface and the associated high pressures reduce the aggregate size.

Our observations on this work are as follows:

A) If the temperature rises to such high value such that the metal surface melts, (no reference given as to how this temperature has been estimated) in association with vibration of large magnitude then
   - The water cavity should evaporate at such high temperature.
   - The vibration would break up the clusters, rather than forming them.

B) The aggregation of nanoparticles would become equivalent to the initial starting material indicating that the succussion process has no impact, which is contrary to the observed result.

C) The authors have used several methods (TEM and SAED) to determine the size, morphology and confirm the elemental composition of the nanoparticles. But in all these methods, the solvent has been totally evaporated and hence the situation is in no way equivalent to the actual case where the solvent plays an important role.

D) The authors did not detect any major potency-dependent difference in the size distribution of nanoparticles as the dilution was increased from 30c to 200c. What then is the role of dilution?

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Homeopathy for the panic attacks following the L'Aquila earthquake

Sir,

I write to report my personal experience of treating children with panic attacks after the devastating earthquake (6.3 on the Richter scale), which struck L'Aquila, capital of the Abruzzo Region in the center of Italy at 3:32 a.m on the 6th April 2009. The city and many surrounding villages were severely damaged causing the death of 300 and injuring 1500 people. 65,000 people were forced to leave their homes for emergency camps. Many survivors had panic attacks and were emotionally disturbed.

My immediate intervention was in a situation of real emergency and I could not plan a controlled clinical study. Nevertheless, I believe my experiences may be of interest. Homeopathic medicines were administered to children showing symptoms of acute psychological trauma: feelings of fear, pain and bitterness for the loss of their relatives. "Fight, Flight, Freezing" are the result of the trauma and may evolve from acute Panic attacks to chronic PTSD (Post Traumatic Stress Disease) after 4 or 5 weeks. Fear is a natural and understandable reaction and has an important adaptive function (alert) if it is limited to the period immediately after the traumatic event. But if not of short duration, it may cause anxiety, dissociation, or PTSD.

Homeopathy may help recovery of body and mind homeostasis and, without toxicity and addiction, it can

precede or support drug treatment and/or Psychotherapy. I started working on organizing aid within hours of the quake. S. Bernardini, scientific coordinator of the Pitigliano Hospital project and president of Italian Homeopathic Association of Integrated Medicine (SIOMI), entrusted me with the distribution of homeopathic remedies for fear-related symptoms. The initiative was supported also by Tuscany Region, and Italian Civil Emergency authorization. Homeopathic medicines were made available by Laboratoires Boiron.

A team of SIOMI homeopaths chose three drugs: *Arnica*, *Gelsemium* and *Ignatia*. I administered at *Arnica* 30 cH for physical and mental traumas, *Ignatia* for bitterness, restrained pain, *Gelsemium* for suppressed fear; it was very helpful for children, improving their nightmares and reducing their morbid attachment to their mothers. In my view the therapeutic aim of homeopathic treatment is not to erase an event from memory, but to change our emotion so that the resulting reaction does not create suffering but let us grow inwardly in good and bad fortune.

The coincidence of the effect noted in our experience in the field and the evidence accumulating in rigorous laboratory studies on *Gelsemium sempervirens* is particularly provocative and stimulating for future controlled studies.[1,2] It suggested to me that I should communicate this experience to the scientific community to emphasize the need for further research.

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Homeopathy in severe sepsis

Sir,

For several reasons, I was puzzled by the re-publication of the study by Frass *et al.*.[1] I believe it raises several questions.

1. If real, the findings reported are of ground-breaking importance and could save many lives. Did Frass *et al.* not feel a responsibility to conduct a more definitive, appropriately powered study during the 6 years since the first publication of their trial? Is such a study in progress? If yes, why re-publish this preliminary report?
2. Can the authors confirm that the two study endpoints were the only ones evaluated according to the protocol approved by their ethical committee?
3. If there were other endpoints (which their phrase "*the evaluated endpoint was death...*" seems to imply), do the authors agree that the *p*-values should have been corrected and are therefore misleading?
4. Do the authors agree that the endpoint at 180 days is likely to be entirely unrelated to sepsis?
5. Could they provide the sites of sepsis by treatment group, as this is an important determinant of prognosis?
6. Could the authors provide causes of deaths?
7. Could they also provide the details of the concomitant therapies administered to both patient groups?
8. Could the authors explain the figure of 67.7% as it seems to imply that 21 of 31 patients survived at day 30? If that is correct, what happened to the other three patients in the control group?
9. One of the most puzzling features of this study is the fact that 70 patients "*were assessed eligibility, all were included in the study*". How do the authors explain that not the usual percentage of patients declined to participate?
10. As this small study was conducted in Vienna, what were the roles and contributions of the co-authors many of which did not work in Vienna? What were their conflicts of interest? Who financed this study?

I suggest that, in future, clinical trials of this nature are published in accordance with CONSORT guidelines. The re-publication of this trial makes it essential that all of these questions receive a full answer, if not, the reputation of the journal and its editorial board would suffer.

Sincerely,

Reference

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Reply to Professor Ernst

I thank Prof Ernst for his valuable comments. This paper was originally published in 2005, it was reprinted as part of the Centenary issue of Homeopathy. This is clearly stated: 'This article is a reprint of a previously published article. For citation purposes, please use the original publication details Homp 2005; 94: 75–80. DOI of original item: doi:10.1016/j.homp.2005.01.002. Received 3 August 2004; revised 11 January 2005; accepted 26 January 2005'. I was not involved in selecting the paper for reprint. I agree that in PubMed it appears as if it was a new paper, we have requested that this be clarified.

Taking Prof Ernst's points as numbered in his letter:

1. If real, the findings reported are of ground-breaking importance and could save many lives. Did Frass et al. not feel a responsibility to conduct a more definitive, appropriately powered study during the 6 years since the first publication of their trial? Is such a study in progress? If yes, why re-publish this preliminary report?

With regard to responsibility to conduct a more definitive, appropriately powered study, I would have been willing to do so. However, I changed my position at the Vienna Medical University to the "*Outpatient Unit Homeopathy in Malignant Diseases*" 7 years ago and I am no longer working at the ICU. I want to take this opportunity to discuss the many problems a homeopath is facing when performing research: (1) High quality studies can only be performed at universities or university – affiliated institutions. To my knowledge, there are very few homeopaths working at such institutions fulltime. (2) In my experience, it is extremely difficult to obtain financial resources for studies of classical homeopathy. The reasons are diverse: the size of the homeopathic pharmaceutical industry is much smaller than conventional pharmaceutical industry. The homeopathic pharmaceutical industry is interested in the evaluation of so-called "*complex*" remedies, which contain a number of substances, which is not in the interest of classical homeopaths. Studies performed according to classical homeopathy using the extremely cheap and non-patentable remedies are not in the focus of the industry. I have applied for other homeopathic studies (e.g. for instance in Crohn's Disease), which received Ethical approval; however, I was unable to obtain financial support despite applying to several different institutions. (3) There are few facilities designated for research in homeopathic at academic institutions. (4) A good climate facilitates performance of studies: however research in homeopathy often faces inappropriate, unscientific, negative and even hostile reactions which inhibit acceptance of research at academic institutions.

2. Can the authors confirm that the two study endpoints were the only ones evaluated according to the protocol approved by their ethical committee?

The two study endpoints were the only ones to be evaluated according to the protocol.

3. If there were other endpoints (which their phrase "the evaluated endpoint was death..." seems to imply), do the authors agree that the p-values should have been corrected and are therefore misleading?

There were no other endpoints. I agree that it should read "*the evaluated endpoint was survival ...*" But since death and survival are directly, inversely related, this makes no practical difference.

4. Do the authors agree that the endpoint at 180 days is likely to be entirely unrelated to sepsis?

Yes, the endpoint is entirely unrelated to sepsis; however, it is often used in intensive care studies as endpoint and is a meaningful endpoint. It may also be pointed out that homeopathy does not cure a disease, but the patient. Therefore, it is not the disease sepsis alone but the constitution of the patient which is improved and/or healed by homeopathy.

5. Could they provide the sites of sepsis by treatment group, as this is an important determinant of prognosis?

The primary sites of sepsis were (homeopathy *vs.* placebo group):

Pulmonary infection 27 *vs.* 28.

Abdominal infection 4 *vs.* 5.

Urinary tract infection 2 *vs.* 1.

6. Could the authors provide causes of deaths?

Infections and cardiac failure accounted for almost all of the causes of deaths.

7. Could they also provide the details of the concomitant therapies administered to both patient groups?

In critical care medicine, concomitant therapies comprise of at least 15, often more than 25 different pharmaceutical agents plus mechanical therapies. Therefore, the details would have exceeded the size of the article. All patients received antibiotics, and randomization produced very similar groups. In addition, as pointed out above, the sites of sepsis were very similar. So it is reasonable to assume there were no important differences in concomitant therapies.

8. Could the authors explain the figure of 67.7% as it seems to imply that 21 of 31 patients survived at day 30? If that is correct, what happened to the other three patients in the control group?

Recalculation of the reported number of 23 divided by 34 multiplied by 100 (%) shows the same result except there is a small error at the first decimal place: it should read 67.6% instead of 67.7%. There were no other three patients in the control group.

9. One of the most puzzling features of this study is the fact that 70 patients "were assessed eligibility, all were included in the study". How do the authors explain that not the usual percentage of patients declined to participate?

The Austrian population has a very positive attitude towards complementary medicine especially homeopathy. Since classical homeopathy does not cause harm if applied professionally, and these patients had little to lose, they, or their authorized representatives, had no objection to the use of homeopathy.

10. As this small study was conducted in Vienna, what were the roles and contributions of the coauthors many of which did not work in Vienna? What were their conflicts of interest? Who financed this study?

The following list describes the roles of the authors. At the time of the study, Dr Banyai was working in Vienna. The co-authors located in Graz cooperated by email and telephone. There were no conflicts of interest, there was no financing of the study, and the authors participated without a fee.

M Frass: principal investigator, decision about remedies, developing protocol, preparation of the manuscript.

M Linkesch: developing protocol, preparation of the manuscript.

S Banyai: collecting data.

G Resch: participating in choosing remedies.

C Dielacher: administration of remedies.

T Löbl: administration of remedies.

C Endler: developing protocol, preparation of the manuscript.

M Haidvogl: developing protocol, preparation of the manuscript.

I Muchitsch: pharmaceutical advice.

E Schuster: statistical analysis.

Again, we thank Prof Ernst for his interest in our study. Since we have other studies in mind, I ask whether he and his Department at Peninsula Medical School would be willing to support our studies theoretically and financially.

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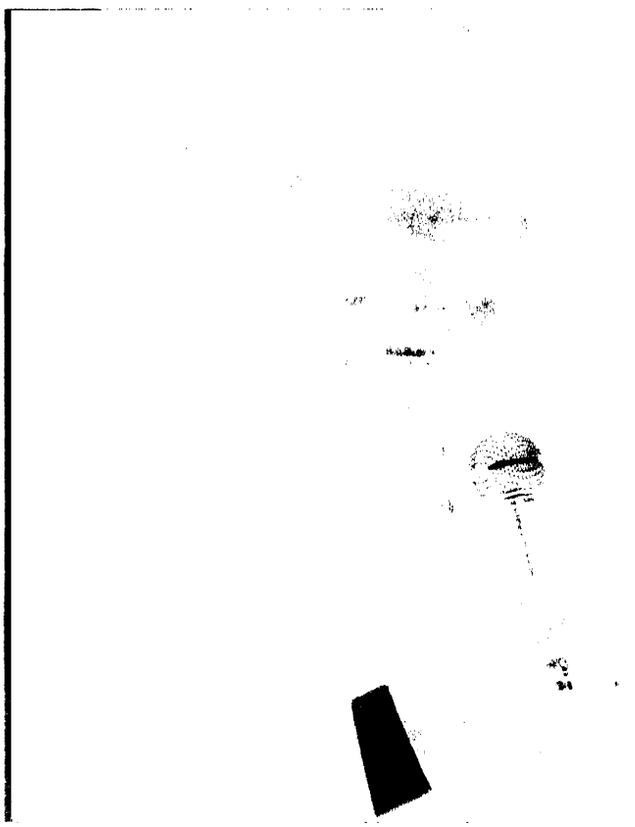
OBITUARY

Dhan Prakash Rastogi: 8 May 1939–15 December 2010



The homeopathic community felt profound grief at the sudden death of Professor Dr Dhan Prakash Rastogi; homeopathic physician, teacher and researcher on 15 December 2010.

Dr Rastogi was born on 8th May 1939 in Bijnor district of Uttar Pradesh, India. He was a graduate from the Calcutta Homoeopathic Medical College, Kolkata with a Gold Medal and did his Post Graduate Diploma (DF Hom.) at the Royal London Homoeopathic Hospital, U.K. in 1962. He also did a Post Graduate Course at Glasgow Homoeopathic Hospital and M.D. (Hom.) from Sri Sainath P.G. Institute of Homoeopathy, Allahabad. Dr Rastogi started working as a homoeopathic doctor in Rajasthan State Govt. in 1963.

As Assistant Advisor (Homoeopathy) to Government of India he contributed significantly in the formulation of Homoeopathic Central Council Act 1973, introduction of Homeopathy in Drug and Cosmetic Act, publication of Homoeopathic Pharmacopoeia of India, establishment of Homoeopathic Pharmacopoeia Laboratory and National Institute of Homoeopathy at Kolkata. He was Principal of Nehru Homoeopathic Medical College and Hospital, New Delhi from 1975 to 1984, and organising secretary of International Congress of LIGA held at New Delhi in 1977. He served as Homoeopathic Physician to the President of India (1988–1992).

He was Director of Central Council for Research in Homoeopathy (CCRH), New Delhi from 1984 to 1999, establishing 52 Institutes/Units all over the country to conduct research activities. He actively monitored research studies on topics including HIV/AIDS, filaria, malaria, bronchial asthma, sickle cell anaemia, diabetes mellitus, sinusitis, malignant diseases, drug addiction conducted at various centres. He was also the Secretary of Homoeopathic Pharmacopoeia Committee. He was a member of Editorial advisory Board of Indian journal of Research in Homoeopathy (IJRH) and of this journal.

He was passionate about teaching and was visiting Professor at several Indian universities. He continued teaching at the Nehru Homoeopathic College and the Dr B.R. Sur Homoeopathic Medical College and Research Centre and Bakson Homoeopathic Medical college until his death. Even after his retirement, he actively participated in different activities including reviewing research studies as external referee. He was an author of more than 60 research papers published in national and international journals and of five books, including '*Golden Tips by Masters*', '*Use of Indigenous Drugs as Common Remedies*', '*An Overview of Repertories for postgraduate students*'.

He was honoured with numerous awards including the Hahnemann Award in 1995, Dhanwantri Award in 1997, Hahnemann Memorial Award in 2002, Dr Sahani Memorial Award and Pareek Foundation Award in 2003 and the Life Time Achievement Award in 2008. The Homoeopathic Medical Association of India dedicated the National congress held in New Delhi on 18–19th December 2010 to his memory. His contribution to the association was remembered with great reverence. He was a great ambassador for Indian Homeopathy who will be sadly missed.

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OBITUARY

David Kent Warkentin 20 August 1951—9 September 2010

David Warkentin, creator of Macrepertory, passed away peacefully at his home in the forested hills of Nicasio, California attended by his partner Vajra Matusow and many close friends who cared for him tenderly through his last days. He had no inkling of illness until early July 2010 and survived barely 2 months from the time of his diagnosis. It was stunning to see such a rich and complex life extinguished so rapidly. How we will miss him!

He was born in Atherton, California. We can only imagine the dawning happiness when as a young homeopath David realized that his very birth name contained the heart of homeopathy in it. J. T. Kent was one of David's great heroes as reflected in the name he christened his ground-breaking software company: Kent Homeopathic Associates or KHA.

After studying computer science and electrical engineering at the University of California at Berkeley, David followed his diversified interests with great passion before finding homeopathy. He became an expert river guide, he led wildlife kayaking tours in remote areas of Alaska and Mexico. He was a fantastic outdoorsman, finding renewal in nature. David made hundreds of whitewater rafting trips including nearly a dozen trips down the dangerous Colorado River. In fact his only expressed regret concerning his illness was that he was unable to make a planned trip down through the Grand Canyon this summer. Even after brain surgery, he still held some glimmer of hope that he would be able to make the trip.

I met David in Athens, Greece when I attended the first international seminar given by George Vithoulkas in 1978. At that time, still in medical school, I had never laid eyes upon an actual homeopath. David took me under his wing and we immediately became friends and travel mates. I remember his dry and cutting wit balanced by the gentlest of spirits. At that time, David was already a practising homeopath of high reputation, working in an office with Bill Gray, Nancy Herrick and Peggy Chipkin as a lay prescriber. David attended the month long Esalen seminar given by George Vithoulkas in 1980. While there together, his only flaw as a roommate was that he had an unerring ability to ferret out the stash of chocolate that Geroge Guess tried to hide from him in our joint room. And of course at 6′4″ (1.94 m) he also had a killer spike in our Esalen group volleyball games – I remember Karl Robinson was the victim of a particularly wicked one.

In the early 1980's David decided that gaining a credential would increase his effectiveness as a force for the spread of homeopathy. He earned his degree as a Physician Assistant from the University of California at Davis following his friends Christine Ciavarella and Nancy Herrick in the program. He revered many of his many teachers especially George Vithoulkas, Francisco Eisayaga, Bill Gray, Rajan Sankaran and his dearest friend, Massimo Mangialavori.

In 1985, David was one of the cofounders of the Hahnemann Medical Clinic in Berkeley and one of the first instructors at the Hahnemann College of Homeopathy where he taught until the college closed in 2004. David continued to teach at almost every educational forum in America and in Europe and Asia. David's practice of homeopathy was side-tracked in the mid-1990's due to the increasing responsibilities with KHA, but in 2006 he began to practise again. He told me that his clinical results had reached their highest level in this year and he remained as excited by the miracle of homeopathy as he was when I first met him.

David began his seminal work with homeopathic software in 1986 with his program MacRepertory. Originally designed for use solely on the Apple computer, David introduced the many purist, nature-oriented, vegetarian, California homeopaths to the world of technology. I remember the first computer David convinced me to buy was the second generation of Apple computers. He told me to buy an external hard drive with an astounding 20 MB capacity because "You'll never need more storage than that!"

KHA has remained on the cutting edge of homeopathic software ever since. Many people in competing firms have acknowledged that David was the engine that drove the development of homeopathic software. His innovative spirit,

drive for excellence and desire to help make homeopathy accessible and rapid kept him in dialogue with the finest teachers in our profession, always willing to learn and to adapt the program to the needs and ideas of the profession. For many of us, David's encouragement and willingness to support our work with his technology made our work possible. My own investigation of Carbon remedies would have been impossible without David's help and I know many others feel the same way.

Luckily for KHA, the core staff continues to market, service and support the KHA programs without a hitch. Programmers Mike Hourigan and William Smith, Beth Niles in office management and interfacing with authors, and the rest of the staff have done a fantastic job keeping the company running as if nothing has happened. We assure the profession that the same high standards and openness to the needs of prescribers will be maintained.

But of course we will no longer have David travelling to practically every seminar and conference in the world. Though incredibly shy, David loved exchanging ideas and information with people. His reclusive urges were overcome by his profound wish to facilitate the spread of knowledge and ideas. For example, David served for many years on the board of directors of the National Center for Homeopathy with Todd Rowe, Joyce Frye, Jay Borneman and Julian Winston. Our shy David was paradoxically one of the best storytellers. I ever met and used humor to help connect people from various factions of homeopathy. Perhaps this role as facilitator more than anything else led to David being awarded the Henry N Williams Professional Service.

David died from a very aggressive malignant melanoma having a dozen cerebral tumors at the time he first became symptomatic. His primary tumor was hidden in his pelvis, unnoticed. I mention this because David would want to help others even in his death. There is a well-documented link between electromagnetic frequencies produced by cell phone and other technologies and melanoma. David's computer sat in his lap (immediately above the location of his primary tumor) perhaps 12 h/day (except when river rafting and maybe even then!) hooked up to a cell phone receiver. Let us use this as a caution to be wary of assurances that these technologies are harmless.

David was a loving friend. He gave his heart to many and was loved in return. There has been a tremendous outpouring of love and sympathy from every corner of the globe by which David was profoundly touched and he asked us to tell everyone how much he appreciated these messages. David was deeply concerned with spiritual matters, read widely and participated in many meditation retreats and worked with spiritual teachers from many traditions. He had a great thirst for deeper meaning and realization. One of David's most cherished moments was a private interview with His Holiness the Dalai Lama whom he met with his dear friend Melissa Fairbanks. David will be remembered for his gentle spirit, his devotion to our profession and his innovative genius. The loss to our profession is as incalculable as it is painful to those of us who loved him.

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