^{3}He-B, the effects of ultra-low doses
biologically active substance and the target biological object. The properties of the spin supercurrents are similar to
those in superfluid
^{3}He-B.

Keywords: Homeopathy; Veterinary; Ultra-low doses; Model of superfluid physical vacuum; Spin structures in physical vacuum; Spin supercurrents

Introduction

The homeopathic remedies used nowadays represent dilutions of D30 and higher. Note that the probability of the event that a D30 dilution of 1 mole of a substance contains at least one molecule will be ~0.001%. This makes explanation of the efficacy of highly diluted homeopathic remedies extremely difficult in the framework of existing physical conceptions.

That is why along with attempts to explain the effects of highly diluted remedies on organisms from the physical standpoint, there are explanations based on the placebo effect. The latter is associated with a therapeutic effect caused by suggestion or autosuggestion inducing a positive response of the immune system.

However, the efficacy of using highly diluted homeopathic remedies for treating animals, including evidence given in this paper, cannot be accounted for by the placebo effect, which applies to humans only.

It is noteworthy that the positive results of homeopathic treatment of animals, i.e. cows, as described in this paper, are often achieved by using the same homeopathic medicines that are used in treating similar diseases in humans. Thus both for humans and for animals there seem to be the same mechanism of "correcting" the organism's functions (No doubt, the placebo effect may take place as concerns humans, however, there should be a different mechanism determining the efficacy of treating an organism with a highly diluted homeopathic remedy).

Looking at the problem from the physical standpoint, it is natural to use the formalism of quantum physics. Firstly, in quantum physics the size of a particle is determined by its de Broglie wavelength. The de Broglie wavelength of a quantum object can exceed the classical size of the quantum object by some orders of magnitude (e.g. the de Broglie wavelength of the electron in a hydrogen atom in the ground state is five orders of magnitude greater than the electron's "classical" radius). As a result of this, the notion of substance concentration ceases to have its conventional meaning in this case. Secondly, there are effects, relating to quantum nonlocality, which suggest that quantum correlations may exist between any quantum objects, including correlations between the remedy and target organism as consisting of quantum objects.

There are a number of works where the explanation of some effects of homeopathic remedies is based on concepts of patient-practitioner-remedy entanglement, [1-3]. But to the authors' knowledge, no physical process in physical vacuum has been proposed so far for explanation of the effects of highly diluted homeopathic remedies.

Note that the effects of highly diluted homeopathic remedies on organisms are similar to those of low-intensity electromagnetic radiation and low-density streams of quantum particles (electron, proton, neutron, etc.) [4,5]. This suggests that there is the same physical mechanism underlying the effects of ultra-low doses on biological systems.

It is shown in this paper that under assumption that physical vacuum has the properties of superfluid ^{3}He-B [6-8] the effects of ultra-low doses (ULD) of biologically active substances (BAS) on biological objects (BO) can be taken to be due to spin supercurrents between spin structures produced in such physical vacuum (hereinafter referred to as the superfluid physical vacuum - SPV) by the BAS and the target BO [8-10]. The properties of these spin supercurrents are similar to those of spin supercurrents in superfluid ^{3}He-B.

Thus the main feature of the approach discussed here is that it is based on accounting for the properties of physical vacuum.

Treatment of Cows Using Homeopathic Remedies

Liudmila B. Boldyreva, The State University of Management, Moscow, Russia, Tel: +7910-413-1776; E-mail: boldyrev-m@yandex.ru

Elena M. Boldyreva, Weston Learning Center, ON Canada, Tel: +1(647) 924-9664; E-mail: elena-boldyreva@hotmail.com

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out of ventilation systems, wear-out of the barn premises led to a high incidence of various diseases of the cows and calves. In these “extreme” conditions homeopathic remedies were used in the therapy of the milking cows with mastitis [11].

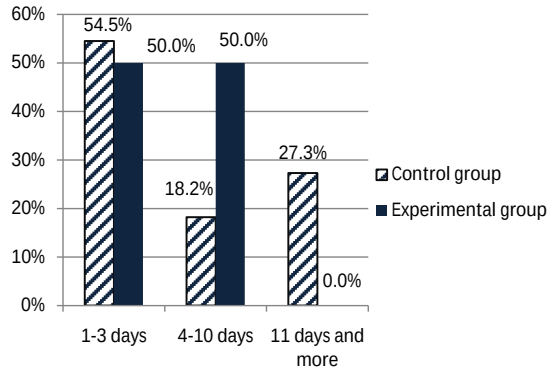
A great advantage of the use of homeopathic remedies over the administration of antibiotics in the case of mastitis is that a er the treatment milk can be used without any restrictions. In the research conducted, conventional and homeopathic methods of treating cows with serous and catarrhal mastitis were studied. Mastitis was caused mainly by improper milking machine functioning and had traumatic etiology. In summer period cows were also fetched to pasture that increased the incidence of traumatic mastitis. ere was a loss in milk production; milk had a watery appearance and akes in it. Udder quarters a ected were reddened, edematous, painful and hot to the touch. California Mastitis Test was conducted additionally to estimate somatic cell count that proved to be elevated.

Two experiments were conducted at an interval of six months, that is, with di erent weather conditions. In the 1st experiment 44 lactating cows with mastitis were equally allocated to the control and the experimental groups; in the second experiment 32 cows with mastitis were divided into two equal groups, the control and the experimental ones. At the beginning of both experiments the cows of both the control and experimental groups had the same symptoms of mastitis described above.

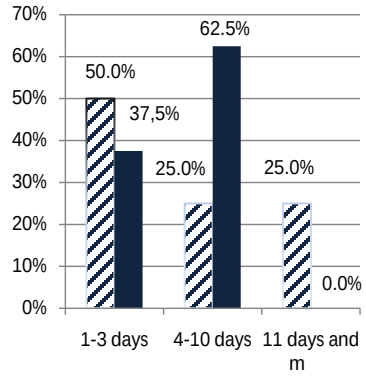
Table 1 shows the schedule of administering antibacterial medications to the cows of the control group in both experiments, and homeopathic remedies to the cows of experimental group in the 1st experiment, and those of experimental group in the 2nd experiment.

e homeopathic remedies used were as follows. *Traumeel ad us. vet.* and *Echinacea compositum ad us. vet.* are complex homeopathic remedies produced by *Biologische Heilmittel Heel GmbH*, Germany (www.heel.de). *Traumeel ad us. vet.* contains een plant, mineral and metallic ingredients in homeopathic dilutions from D3 to D11 [12]. Its “symptom picture” includes pain, in ammation, swelling and fever; this remedy is widely used in veterinary and human medicine in trauma-related conditions. It explains the choice of this remedy for the treatment of cows with mastitis, taking into account such dominant predisposing factor as trauma.

Echinacea compositum ad us.vet. contains eight ingredients of plant and animal origin, minerals and metals in homeopathic dilutions from D3 t4 -1.57lqinto account su-[2n7Ds remedy,(of)0.6 (om picturent)]TJ4 includes nt 7entnd ssoci (condit6 5 (serous6entsion, swellin6 Tw T*etiology.is reg



Percentage of animals cured in the 1st experiment in various time intervals, in days. The day number is counted off from the beginning of the experiment.



zero. e model is based on the properties of super uid ^{3}He-B, whose atoms have non-zero spin as well and form pairs whose total angular momentum (the sum of the orbital and spin angular momenta) is zero in the pure state. One of the properties of super uid ^{3}He–B is that areas with coherently precessing spins of ^{3}He atoms, the so-called homogeneously precessing domains (HPDs) [17-21], may exist there.

A HPD is characterized by spin *S*, precession angle (or precession phase) α, nutation angle β, and precession frequency ω (Figure 3). In a homogeneously precessing domain, energy *U* is related to the frequency ω of precession as

$$U = S\omega. \quad (1)$$

According to the model, a quantum object is a HPD in the SPV [8].

e precession and nutation angles are angles of orientation of the order parameter, and there are processes that tend to make respectively equal both the values of precession angles and the values of nutation angles throughout the liquid volume. Such processes in super uid ^{3}He-B are spin supercurrents. For example, the value of spin supercurrent in the direction of axis **z**, J_z, is determined as follows:

$$= - _1\frac{\partial\alpha}{\partial} - _2\frac{\partial\beta}{\partial}, \quad (2)$$

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

ere exists such a phenomenon in ^{3}He–B as phase slippage. At a certain di erence in precession angles, $\Delta\alpha_c$, for two HPDs there takes place a precession phase slippage, or phase drop, by $2\pi n$ (n = 1, 2…).

e critical spin supercurrent J_c corresponds to $\Delta\alpha_c$ [21]. Figure 4a and 4b show examples of the character of dependence of normalized spin supercurrent J/J_c between two HPDs with respective precession frequencies ω_1 and ω_2 ($\boldsymbol{\omega_1} \uparrow\uparrow \boldsymbol{\omega_2}$) on the hypothetical di erence in the precession angles, $\Delta\varphi$, which is de ned as $\Delta\varphi = (\omega_1-\omega_2)t$, t being time. Up to the value of $\Delta\varphi$ equal to $\Delta\alpha_c$, the hypothetical di erence is equal to the precession angles di erence determining the spin supercurrent, $\Delta\alpha$, that is, $\Delta\varphi = \Delta\alpha$. On the curves, the line 1–1 corresponds to the change in the supercurrent in the process of phase slippage, the 2π phase slip taking place. In Figure 4a, we have $\Delta\alpha = \pi$ [17]. In Figure 4b, $\Delta\alpha \approx 3\pi$ [20].

Generally, the determination of time dependency of the magnitude of the spin supercurrent between two regions with precessing spins (for example, homogeneously precessing domains – HPDs, see Figure 3) is a di cult problem, because the speed of transmission of information of the existence of a gradient of the order parameter is, in theory, in nite, and the speed of the spin supercurrent is nite [21]. Besides, a possibility of phase slippage should be taken into account. e respective precession and nutation angles of interacting HPDs will become equal, provided the distance *X* between them and the di erence between their precession frequencies, $\Delta\omega$, satisfy the following conditions:

$$\Delta\omega \to 0 \quad (3)$$

$$X \to 0. \quad (4)$$

The Mechanism of Action of Biologically Active Substances in Ultra-Low Doses on Biological Objects

According to the SPV model, a quantum object is a homogeneously precessing domain in physical vacuum, i.e. it is a spin structure in physical vacuum. e biologically active substance and the target biological object consist of quantum entities: electrons, protons, etc. erefore, the biologically active substance and the biological object produce spin structures in physical vacuum.

We shall assume that the spin structure produced in the SPV by a BO is 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 homogeneously precessing domain in the SPV.

In the model discussed here, it is convenient to express ULDs of BAS in terms of so-called quanta. A “quantum” is such a dose of substance which produces in the SPV a spin structure that is characterized by single values of the precession frequency, the angle of precession and angle of nutation, and thus the structure can be thought of as being, like that of the BO, a HPD in the SPV.

To describe the spin structures produced in the SPV by a "quantum" of ULD of BAS and by that of a BO, we shall introduce a number of notions relating to time *t:* ω_{1t} will be the frequency of precession in the spin structure produced by the ULD of BAS, ω_{2t} the frequency of precession in the spin structure produced by the BO, and $\Delta\alpha_t$ the di erence in the precession angles of the structures. Let us assume that the interaction of the ULD of BAS and the biological object starts at time $t = \tau_1$. e di erence in the precession angles, $\Delta\alpha_{\tau_1}$, at time τ_1 is determined as

$$\Delta\alpha_{\tau_1} = \left(\omega_{1\tau_1} - \omega_{2\tau_1}\right)\tau_1 + \Delta\alpha_0, \quad (5)$$

where $\Delta\alpha_0$ is the di erence in the angles of precession of spin structures at time $t = 0$. In the special case of $\Delta\alpha_{0=} 0$ the equation (5) takes the

with the BO changes by the quantity $\omega_{2\tau_2} - \omega_{2\tau_1}$. Consequently, taking into account (1), the energy of the spin structure produced by the BO in the SPV (and, as may be supposed, the energy of the object itself) will change by ΔU as follows:

$$\Delta = (\omega_{2\tau_2} - \omega_{2\tau_1}), \quad (8)$$

where S is the total spin of the spin structure produced by BO in the SPV.

us depending on the sign of $\omega_{2\tau_2} - \omega_{2\tau_1}$ biologically active

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