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THE PLAUSIBILITY OF HOMEOPATHY: THE SYSTEMIC MEMORY MECHANISM

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Despite 200 years of practice of high dilution therapy known as homeopathy, and despite a number of recent studies documenting homeopathic treatment effects under double-blind conditions, the medical and scientific community has generally dismissed these findings because of a lack of a plausible mechanism for the observed effects. This article outlines how modern systems science reenvisions memory in water and dynamic systems in general. We present the logic that inexorably leads to the prediction that *recurrent feedback interactions result in the storage of information and the creation of systemic memories in dynamic systems at all levels in nature.* The complex nonlinear interactions that naturally accumulate through the circulation of information and energy in systems are shown to be dynamic memories that reflect the evolving identity of systems as emerging wholes. The theory provides a highly plausible mechanism for understanding numerous seemingly implausible and controversial observations in contemporary science and medicine, including memory in water and homeopathy. (Int Med 1998;1:53–59) © 1998 Elsevier Science Inc.

Key Words: homeopathy; systems theory; systemic memory; logic.

INTRODUCTION—PLAUSIBILITY AND HOMEOPATHY IN THE HISTORY OF SCIENCE

The history of science reminds us that by reenvisioning accepted findings in terms of seemingly implausible observations in nature, new theories can emerge that may account for persistent "obvious" observations and generate novel predictions that can be confirmed or disconfirmed in future research. Common sense derived from persistent obvious observation (everyday experience) suggested that the earth is flat, that the sun revolves around the earth, and that water and other physical-chemical systems do not have memory. In the case of the earth being flat, it is now understood that the earth persistently appears this way because of our limited vision—it is actually spherical as documented by Columbus and extended by modern astrophysics. In the case of the sun revolving around the earth, it is now understood that the sun persistently appears this way because of our limited vision—the earth actually rotates on its axis and around the sun, as documented by Copernicus and extended by modern astrophysics. Similarly, although we typically view water and other physical-chemical systems as being static systems incapable of storing information and energy, the present article proposes that water persistently appears this way also because of our limited vision—water (and in fact, all dynamic systems) can be shown under appropriate conditions to store information and energy to various degrees.

The logic that leads to the prediction of the systemic memory mechanism comes from modern systems science [1–3] (including neuroscience and computer science, and complexity and chaos theory), though this fact is not widely appreciated. The ramifications of the systemic memory hypothesis for science and society are potentially as wide ranging as the ramifications of the spherical earth and solar system hypotheses were for science and society [4]. The systemic memory mechanism provides a highly plausible explanation for homeopathy and other seemingly implausible observations in complementary and alternative medicine such as cellular memory in certain cardiac transplant patients [4,5].

In their recent comprehensive meta-analysis of placebo-controlled trials of homeopathy published in *The Lancet,* Linde et al. noted that between 30% and 70% of patients in developed countries use complementary, alternative, or

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unconventional medicine, and that homeopathy is one of the most widespread and controversial of these therapies [7–9]. There are two main theoretical tenets underlying homeopathy: the principle of "similars" and the use of high dilutions, called "potencies" [10,11]. The principle of similars states that patients with particular signs and symptoms can be cured if given a drug that produces similar signs and symptoms in healthy individuals. The second principle is that remedies retain biological activity if they are repeatedly diluted and agitated or shaken ("succused") between each dilution. These dilutions are said to produce effects even when diluted beyond Avogadro's number in which no original molecules of the starting substance remain. How the solution "remembers" the original substance has received attention from some physicists [12] and reflects the core mechanism question addressed in the present paper.

The controversy played out in the pages of the distinguished journal *Nature* illustrates the profound challenge created by the apparent implausibility of homeopathy. In June, 1988, Davenas et al. [13] reported that human basophil degranulation could be triggered by very dilute antiserum against IgE. The Editor of *Nature* preceded the article with an editorial titled "When to believe the unbelievable" [14].

In July, 1988, a set of letters were published addressing the "explanation of Benveniste" (the director of Davenas's laboratory). The opinions ranged from "this will turn out to be yet another case of artifacts (or worse) but the harm has already been done; worldwide recognition of this important paradigm of homeopathy by a major scientific journal" [15] to "scientific belief belongs on a flat earth. There is no danger, no threat to science, in the restatement of the drug–diluent paradox—we need only apply the scientific method and then seek the verdict of experience" [16].

In the same issue, a team consisting of the Editor (John Maddox), a well-known professional magician (James Randi), and a scientist concerned with errors, inconsistencies, and misconduct in science (Walter W. Stewart), summarized their visit to the Benveniste laboratory in a compelling article titled "'High-dilution' experiments a delusion" [17] followed by Benveniste's equally compelling response to their "inaccuracies and distortions" [18].

The debate continues unabated. In response to Linde et al.'s cautious conclusion in *The Lancet* that "the results of our meta-analysis are not compatible with the hypothesis that the clinical effects of homeopathy are completely due to placebo" [6] the commentaries began with "Homeopathy trials: Going nowhere" [19]. The intense nature of the criticisms (from both sides) indicate more than just a difference of academic opinion—it mirrors the process of scientific controversy that has been replicated repeatedly in the history of science when empirical findings that seemingly challenge current models become too strong to be ignored.

A century ago, Marcel Proust (1871–1922) reminded us that "the real voyage of discovery consists not in seeking new lands but in seeing with new eyes." We offer the present paper from the perspective recently recounted by Karl Pribram [20]: "In this regard I would caution the reader to adhere to a maxim once issued by Warren McCulloch: "Do not bite my finger; look where I am pointing." Our goal is to illustrate how concepts from modern systems science not only incorporate the findings in homeopathy, but extend them.

As will become clear, the systemic memory mechanism is the implicit logic used to explain the well-accepted mechanism of recurrent feedback, the basis for the creation of memory in neural networks, and ultimately, in all dynamic network systems [4,5]. Thus far no obvious flaws in the logic underlying the systemic memory hypothesis have been uncovered by numerous scientists who have examined the hypothesis. Though nature is often more interesting and complex than the prevailing logic predicts, it is significant and helpful to discover that logic derived from well-accepted principles in current science has the potential to envision seemingly implausible observations in science—even if the proposed logic ultimately turns out to be incomplete (if not in error) in the future.

SYSTEMS THEORY AND RECURRENT FEEDBACK INTERACTIONS

The root meaning of the word "system," which derives from the Greek *synhisanai* ("to place together") is the concept of an *integrated whole whose essential properties arise from the relationships between its parts.* According to Miller [3], a system is "a *set* of *interacting units* with *relationships* among them. The word 'set' implies that the units have some *common* properties. These common properties are essential if the units are to *interact* or have relationships. *The state of each unit is constrained by, conditioned by, or dependent on the state of the other units.* The units are *coupled.* Moreover, there is at least one measure of the sum of its units which is *larger than the sum* of that measure of its units" (italics added).

A classic example of holism in a system is how atoms of hydrogen and oxygen, each with their own unique set of holistic properties, can combine to form H_2O, a molecule whose unique (holistic) properties are qualitatively different from the individual properties of hydrogen and oxygen, and only emerge when hydrogen and oxygen interact recurrently (e.g., at room temperature, oxygen and hydrogen are invisible gases whereas water is a visible liquid). The same logic applies to the atoms of hydrogen and oxygen themselves. Electrons, protons, and neutrons each have their own unique set of properties. They can combine to form hydrogen, an atom whose unique (holistic) properties are qualitatively different from the individual properties of the subatomic particles, and only emerge when the particular combination of the subatomic particles interact recurrently as an atom.

When the logic of interaction is carefully analyzed, especially interactions that occur recurrently (i.e., circular feedback), the logic leads to the conclusion that a complex version of the history of the recurrent feedback interactions

are stored within the inherent circulation of information and energy in systems. The emergence of a system, therefore, involves the storage of systemic memory, and as will become clear, systemic memory is memory of the whole. Since the logic of recurrent (circular feedback) interaction is systemic and general, it can (and in fact must) be applied to any system at any level.

According to Webster [21], one of the original definitions of circulation was "*a series in which the same order is preserved, and things return to the same state.*" When the concept of circulation is reinterpreted in terms of dynamically changing, recurrent feedback interactions, things are not predicted to return precisely to the same state. Instead, the order that is predicted to be preserved is the *evolution (accumulation) of the dynamical interactions among the parts.*

HISTORICAL ANTICIPATION OF THE SYSTEMIC MEMORY MECHANISM

The systemic memory mechanism was anticipated in 1890 by the distinguished psychologist William James [22]. He proposed that "When two elementary brain-processes have been active together or in immediate succession, one of them, on re-occurring, tends to propagate its excitement into the other."

When we substitute the word "subsystems" for "brain-processes," the systemic memory mechanism is anticipated. "When two subsystems have been active together or in immediate succession, one of them, on re-occurring, tends to propagate its excitement into the other."

The systemic memory mechanism is implicit in writings of the distinguished neuroscientist Warren McCulloch [23]. Not only did he propose in 1951 the idea of "reverberatory memory," he pointed out "The reverberating activity patterned after something that happened retains the form of the happening but loses track of when it happened. Thus it shows that there was some time at which such and such occurred. The 'such and such' is the idea wrenched out of time." He went on to say, "It is an eternal idea in a transitory memory wherein the form exists only so long as the reverberation endures. When that ceases, the form is no longer anywhere."

McCulloch did not extend his logic to physical and biological systems other than neurons. Had he done so, he would have discovered that "reverberation" (circulating interaction) in systems is the rule, not the exception, and that according to modern quantum dynamics, reverberation persists in liquids such as water and solids such as ice, even at absolute zero temperature and in a vacuum [24].

The concept of recurrent feedback interaction is implicit in the writings of Karl Pribram in his holonomic brain theory of perception and language [25]. His writings are replete with such descriptions as "local circuit interactions," "ensembles" with "iterations," "spatial interactions," "back propagations," and "cooperative interactions." For example, Pribram wrote "A microprocess is conceived in terms of *ensembles* of *mutually interacting* pre- and postsynaptic events distributed across limited extents of the dendritic network. The limits of *reciprocal interaction* vary as a function of input (sensory and central) to the network—limits are not restricted to the dendritic tree of a single neuron. In fact, reciprocal interaction among pre- and postsynaptic events often occurs at a distance from one another."

It is this capacity for reciprocal interactions to occur between highly interconnected, distributed, mutually interacting dendritic processes that allows for the emergence of holographic-like information to be *stored throughout complex dendritic (network) systems*. At the end of their Appendix [25], Yasue, Jibu, and Pribram note that information "comes to be stored in the new neural *channel between the units A and B. The inference process thus has a procedure for enlarging the scope of inference.*" Though not emphasized by Pribram, the logic he has used to explain dynamic memory formation in an interconnected, mutually interacting neural network system can be applied to dynamic memory formation in *any highly interconnected, mutually interacting dynamical network systems of A's and B's* (described below).

The modern concept of recurrent feedback loops in neural networks [2] is actually a special case of systemic feedback cycles—circulating recurrent feedback interactions—in all systems at all levels. However, the fact that the logic used to explain recurrent feedback loops in neural networks can be applied equally to recurrent feedback networks in all dynamic systems at all levels has not been appreciated [4,5]. Moreover, the insight that circulating recurrent feedback interactions provide an explanation for holism in all dynamic systems has not been appreciated as well.

In this paper, we use the term *memory* generically to refer to the storage of information and energy in systems. In everyday experience, episodic (explicit) memory can be recalled consciously. However, substantial research in psychology documents that the storage of information can occur in the absence of awareness [26]. Typically these implicit memories can not be recalled consciously. The use of the term memory in computer science (e.g., hard disc memory) and electrical engineering (e.g., DC battery memory) refers to the storage of information and energy. From a systems perspective, the phenomenon of explicit memory may be viewed as a special case of implicit memory.

DERIVING THE LOGIC OF SYSTEMIC MEMORY: RECURRENT RESONANCE IN TUNING FORKS

We illustrate the logic of how recurrent feedback interactions create systemic (holistic) memory using the example from classical physics of two tuning forks that come into resonance. Once the fundamental and inexorable logic of this simple system is understood, the richness of its application to complex networks of systems such as water and other solvents will be self evident.

If one tuning fork (A) is struck, a second tuning fork (B) some distance from A will begin to vibrate (resonate) especially if B is identical in shape, size, and substance to A. How is this phenomenon traditionally explained? The classi-

cal, nonsystemic interpretation is to say that tuning fork A generates sound waves that reach tuning fork B, and if B naturally vibrates at a frequency similar to the frequency generated by A, B will begin to move in synchrony with A. A acts on B, and B reacts to A.

A systemic interpretation requires that we reinterpret the relationship between tuning forks A and B as interactive, dynamically coupled, and cyclically connected. A does not simply *act on* B, A *interacts with* B. A and B are connected through the air. Since A and B are connected (coupled) when the energy from A begins to move B (causing vibration in B), B begins to generate a sound (energy), which returns (feeds back) to A. Therefore, *B begins to cause vibration in A shortly after A begins to cause vibration in B.* This statement implies that the functioning (behavior) of A (e.g., measured by the sound A generates) will be modulated in some complex ways by the functioning (behavior) of B (e.g., measured by the sound B generates).

To document these predicted interactive effects, it becomes necessary to measure the sound coming from both A and B simultaneously. Using two highly directional microphones, one microphone can be focused on A, pointed away from B, and the other microphone can be focused on B, pointed away from A. The sounds must be monitored simultaneously and displayed over time. Data need to be collected striking A in the presence of B and striking A in the absence of B. *The systemic prediction is that we should observe that A's behavior is quantitatively and qualitatively different (e.g., more dimensionally complex) when struck in the presence of B as compared to when A is struck in the absence of B.* Conversely, we should observe that B's behavior is quantitatively and qualitatively different (e.g., more dimensionally complex) when struck in the presence of A as compared to when B is struck in the absence of A.

This seemingly simple feedback interaction is not simple to model mathematically over time. Complex phase interactions (dynamic interference patterns) need to be calculated over time and distance, and as will become clear below, the interaction will naturally evolve over time due to the circulation and sharing of energy and information between A and B.

Tuning forks A and B can be shown to be interdependent and interactive, processing information generated by each of them as they interact. Because all systems are open to varying degrees at various times, it follows that all systems should interact informationally and energetically in complex and sometimes powerful ways as explored by complexity and chaos theory [2].

The interaction between tuning forks A and B (or between any As and Bs—e.g., photons, subatomic particles, atoms, molecules, cells, organs, organisms, groups of organisms, etc.) contains a profound implication. As A and B interact with each other, they literally create a memory of their interaction over time through the circulation of their information and energy. *In fact, this memory is part of the expression of their interactions as a whole, and is a natural requirement for them to interact.* The memory is the relationship. The relationship information is systemic information, and systemic information is an expression of the whole. Moreover, it follows that the information of the whole of a system is stored within each of the parts comprising the system to varying degrees.

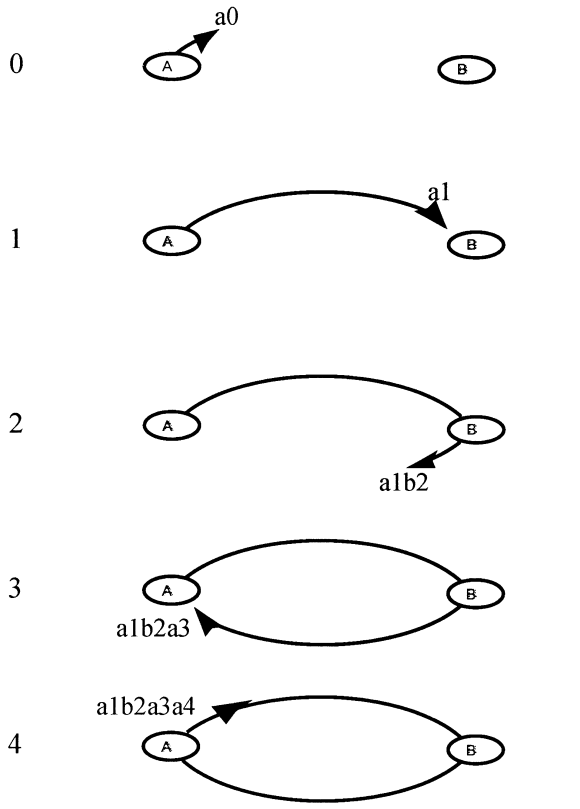

Figure 1. Graphic description of the logic of the systemic memory mechanism (see text for explanation).

We illustrate this inexorable conclusion by considering memory from the point of view of tuning fork A (see Fig. 1). At time 0, before A is struck, A is spontaneously vibrating as predicted by quantum dynamics (e.g., its atoms and subatomic particles are vibrating and moving in complex, interacting, resonating ways). When A is struck at time 1, it vibrates with a frequency "a1." The frequency "a1" moves (at the speed of sound) to tuning fork B at time 2. B begins to vibrate at time 2, which is some complex (linear and nonlinear) product of "a1" (we will, for the sake of simplicity, assume for the moment that "a1" has not changed much as it travels to B) and B's state at time 2. We will call this complex interactive product "a1b2".

As B vibrates, the sound now returns to A at time 3. The sound that returns to A at time 3 is a complex interactive product of "a1b2" plus whatever interference occurs with the continued sound coming from A at time 3 (a3). This gives us "a1b2a3" that returns to A at time 3.

Now, let us hypothesize that A is influenced by this return sound at time 3 to some degree, and starts to interact with A's vibration at time 3. Not only will A's vibration have changed spontaneously by time 4 (e.g., it might be decreasing—the simplest case), *but it will have further*

changed by the "a1b2a3" feedback interaction returning to it. The resulting sound will be a4 modulated by "a1b2a3", or "a1b2a3a4."

In other words, in one complete "cycle" of A–B interaction, the sound coming from A at time 4 contains the *complex history (both linear and nonlinear) of the A–B interaction (their relationship) over the cycle.* We see an "image" of a1, modulated by b2, interacting back with a3, reaching A, so that A at time 4 includes the *complex history of the first A–B interaction in its next interaction.* Meanwhile, from the perspective of B, a somewhat parallel set of interactions is also occurring.

Each cycle includes the previous information, hence the history (memory) continues to grow. *As long as the units are connected (e.g., the two forks are interacting through the air), the memory trace circulating between them will be retained, albeit modified as time goes on.* All things being equal, the memory trace will "grow" with time through the continued circulation of the recurrent feedback interactions (even if the intensity of the recurrent feedback interactions decrease, which is the case for the simple two tuning fork example).

The logic and simple mathematics of the two-tuning-fork example are grossly oversimplified. We have chosen only four time points, and have described the interaction only from the perspective of tuning fork A. However, the essence of the logic should be self evident. Any time two (A + B) or more (A + B + *n*) things interact, information concerning their history accumulates. Recurrent feedback interactions are systemic—theoretically they occur between electrons, protons, and neutrons, between molecules in a liquid such as water, between the two strands of DNA in cells, or between the brain and the heart, to name just a few. From a systems perspective, *at whatever levels the systems are interacting, the interactive history of the energy and information should be contained in a complex way to some degree.* Hence, this mechanism suggests that memory will occur in all dynamic systems to varying degrees. It is a general model of stored systemic (relationship) information. *It is the inherent capacity of a system to circulate interactive information and energy that enables a system to have a holistic history and therefore be whole* [4,5].

IMPLICATIONS AND RAMIFICATIONS OF THE LOGIC OF SYSTEMIC MEMORY

It logically follows that the more rapidly recurrent feedback interactions occur in a given system, the more rapidly a stabile holistic will emerge. For example, atoms vibrate billions of times a second. Therefore, although it would be predicted that it should take a finite amount of time for a molecular holistic history to form when hydrogen and oxygen first come together as H_2O, the time it actually takes may be a few nanoseconds.

According to systems theory, systems are always interconnected to various degrees in various ways. Hence, energy (and the information riding with the energy) is continually being exchanged and circulated to various degrees in various ways. As a result, the memories should continue naturally.

When tuning forks A and B resonate, they become a two-tuning-fork system. Each tuning fork functions as a subsystem in the two-tuning-fork system (or we can say each tuning fork is a system in the two-tuning-fork suprasystem—the principle is the same). The two tuning forks become a whole.

Tuning forks A and B each contain a network of billions of molecules. Molecules are subsystems within each tuning fork system (or we can say each molecule is a system within single-tuning-fork suprasystem—the principle is the same). Hence, it follows that resonance not only can occur *between* tuning forks A and B, resonance can occur *within* tuning forks A and B. In fact, tuning forks A and B cannot vibrate as individual tuning forks unless their molecules can vibrate (resonate) interactively within each tuning fork as a whole. In other words, the logic of what happens *between* tuning forks A and B applies to what happens *within* tuning forks A and B as well.

Recurrent resonance, therefore, not only occurs *between* physical systems (e.g., between tuning forks A and B), but also occurs *within* physical systems (e.g., within tuning fork A and within tuning fork B). For this reason, the logic that leads to the hypothesis that recurrent interaction creates memory *between* tuning forks A and B, also requires that we entertain the hypothesis that recurrent feedback interaction simultaneously creates memory *within* tuning fork A and within tuning fork B as well, and this intra-tuning fork memory is sustained, even after tuning forks A and B have been separated. The same logic requires that we entertain the hypothesis that once hydrogen and oxygen have interacted recurrently as H_2O, if hydrogen and oxygen are subsequently separated, some version of their history as H_2O will be retained within the hydrogen and oxygen, expressed potentially in terms of their individual, dimensional complexities.

Modern quantum physics indicates that even at the temperature of absolute zero, matter vibrates, and hence, resonates. Quantum mechanical fluctuation energy of the atoms in matter has been measured by measuring the vibrations in a crystal as the temperature of the crystal is lowered. The experimental data agree with the predictions of the equations of quantum mechanics suggesting that quantum mechanical zero-temperature vibrational fluctuations of atoms in matter is a general property of matter. For example, residual quantum mechanical vibrational energy is used to explain why liquid helium does not freeze even when it is cooled to within microdegrees of absolute zero temperature. For the sake of completeness, it should be noted that modern quantum physics also suggests that a vacuum can sustain an infinity of electromagnetic vibrations (the quantum mechanical electromagnetic fluctuations of the vacuum). Hence, interactive recurrent resonance not only occurs within matter, but it would be predicted to occur within a vacuum as well [24].

By definition, systems can potentially store only what

they are capable of responding to (and hence processing), and they will process this information in their own ways. It follows that the nature of information stored between subatomic particles in atoms, for example, will be of a different order than the nature of information stored between neurons (which are composed of billions of atoms). Also, the more reliable and flexible the components of the system (and hence, the more complex the system), the more reliable and flexible should be the storage (and complexity) of the information.

Of course, *outlining the logic that dynamic memory is intrinsically created and stored in systems does not imply that this information, once stored, can be easily accessed and retrieved (at least in human consciousness).* Everyday experience and substantial empirical research reminds us that our ability to recognize information is typically far greater than our ability to recall information [26]. It logically follows that failure to observe recall does not necessarily imply that memory has not occurred. *Forgetting, therefore, does not necessarily imply that memory has been erased—the process may involve an alteration in retrieval.* The deep question of retrieving memory, once stored in systems, remains a central challenge for future science. The solution may require a deep understanding of recurrent resonance as a systemic recurrent pattern recognition process [4,5].

A controversial implication of the hypothesis of systemic memory is the prediction that information, once received, is retained in some form forever, so long as the system remains intact and recurrent feedback interactions (cycling) continue. Not only will the information continue, but it potentially will evolve over time. In fact, in a profound sense, it may be virtually impossible to entirely erase information in an intact system. Only in the hypothetical case of complete entropy would it be predicted that systemic memory could be eliminated completely (however, it should be noted that entropy is a concept derived from classical, nonsystemic physics—systemic physics would predict that recurrent feedback interactions would likely continue, even in the entropic state [4,5]). Theoretically, *if the experiment is sensitive enough, evidence for savings or other subtle measures of change in functioning or behavior of a system should be demonstrable in all systems as a function of the evolution of the hypothesized memory process.*

For example, in the case of homeopathy, agitation (succussion) theoretically increases recurrent feedback interactions in the solution. Although heat may seemingly "destroy" a diluent's "potency," theoretically the systemic memory trace should still be present in the solution. The systemic memory mechanism would predict that the diluent could be "re-potenized" more quickly through a replicated dilution process. Moreover, the systemic mechanism allows for the possibility that a diluent could "re-evidence" its implicit potency over time if allowed to "recover" from the heat manipulation. Such fundamental predictions can be confirmed or disconfirmed in future research.

CHALLENGE FOR SCIENCE AND INTEGRATIVE MEDICINE

In conclusion, the systemic memory mechanism suggests that the wholeness of a system may derive from its capacity not only to interact, but to interact recurrently, and to circulate (and therefore mix and accumulate) this information and energy within the system. Though neurons are especially gifted in storing sensory and psychological information (because neurons are so highly interconnected, creating profoundly complex recurrent feedback interactive networks), it may be time to evolve our intellectual heritage (which understandably encouraged us to adopt a kind of neural "chauvinism") and reenvision the brain as being a marvelous special case of a ubiquitous systemic (holistic) memory process in nature.

It is possible that in the process of researching the phenomenon of recurrent feedback interactions in nature, science will gain a deeper understanding of the essence of holism and evolution, and in the process, will enable us to understand certain heretofore unexplained observations that strain our current models of how memory works. The controversy over memory in water [27] and its challenging implications for cellular memory in transplant patients [28] or homeopathic treatments [6], for example, can be reenvisioned to be a special case of this potentially ubiquitous systemic memory mechanism [4,5]. Systemic computer programs can be written to model this complex dynamic process in physical, chemical, and biological systems, and precise experimental tests of the hypothesis can be constructed in a variety of basic and applied sciences.

Because the mechanism of systematic memory has implications for the storage of information and energy in normal and pathological biophysical systems, implications for classical observations in conventional medicine should also be considered. For example, the systemic memory mechanism may provide an explanation for memory in the immune system and cells in general. At the very least, it seems prudent to reconsider the seeming implausibility of homeopathy in terms of the systemic memory mechanism and to be open to the possibility that the wealth of double-blind basic science [13,27] and clinical studies [6] published to date may reflect a subtle yet significant phenomenon in nature. Homeopathy may prove to be a prototypic case of a fundamental phenomenon worthy of the serious attention of scientists and clinicians concerned with the challenge of integrating medicine [29].

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COMMENTARY

Homeopathy as noted in the article by Schwartz and Russek [1] represents a healing system based upon two tenets. The first tenet espouses the concept of "similars" and holds that patients with a variety of symptoms can successfully be treated by those agents causing similar symptoms in healthy individuals. The second principle is termed *infinitesimals* and maintains that agents repeatedly shaken through multiple dilutions retain their potencies even when diluted beyond Avogadro's number. Allopathic medicine has been critical of homeopathy based both upon its "violation of natural laws" [2] as well as the lack of well-designed clinical trials.

The authors of this article present a model of systemic memories that may involve the storage of information in a traditionally non–biologically active medium such as water. The presentation of their theory and argument is intriguing and draws parallels from both organic and nonorganic systems to redefine our concept of "memory." Systemic memory may be the mechanism explaining the purported benefit of homeopathic remedies diluted beyond Avogadro's number. Understanding the mechanism of an action may in fact assist researchers to better design studies revealing the efficacy of any treatment. The ability to produce a biological effect based solely on the presence of systemic memory represents a future challenge for objective research. Furthermore, mechanistic theory and evidence regarding the concept of "similars" would be welcome.

Although the authors state recent studies have documented treatment effects from homeopathic therapy, review of the meta-analysis cited reveals "little evidence of effectiveness of any single homeopathic approach on any single clinical condition" [3]. The systemic memory mechanism provides direction for future research on homeopathy.

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