

# **Towards a Consciousness-Inclusive Science for Our World**

by

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## **Introductory Experimental Background**

For the past 35 to 40 years, in parallel with my traditional science research and teaching at Stanford University, I have been seriously investigating the effects of human intention on both the properties of materials (inorganic and organic; non-living and living) and on what we call physical reality.

From this research, I and my colleagues have discovered that it is possible to make a significant change in the properties of a material substance by consciously holding a clear intention to do so. For example, we have repeatedly been able to change the acid/alkaline balance (pH) in a vessel of water either up or down, without adding chemicals to the water, by creating an intention to do so.

This is very exciting – but even more exciting is the fact that we have been able to use a simple electronic device and actually “store” a specific intention within its electric circuit. This is important because, now, this intention-host device can be placed next to a vessel of water at any physical location and one can expect to obtain the same results. In this way, we have had others replicate these water results at multiple locations around the world; such results are consistently reproducible!

So one might ask, “How is it possible for something like this to occur in the physical reality with which we are all so familiar?” The answer is that, from our experimental work of the past ten years, we have discovered that there are actually two levels of physical reality and not just the one with which we are all familiar. It is this new level of physical reality that can be significantly influenced by human intention – not our familiar electric atom/molecule level!

The two basic kinds of unique substances inhabiting these two levels of physical reality appear to interpenetrate each other but, normally, they do not interact with each other. We label this state as the uncoupled state of physical reality. In the uncoupled state, with one’s five physical senses, we can detect out normal physical environment all around us. This new level of substance, because it appears to function in the physical vacuum (the empty space between the fundamental electric particles that make up our normal electric atoms and molecules), is currently invisible to us and to our traditional measurement instruments. It also appears to be of a magnetic information-wave nature.

It is the use of these intention-host devices that affects the experimental space in such a way that meaningful coupling begins to occur between these two very different kinds of substance. Then, the vacuum level of physical reality becomes partially visible to our traditional measurement instruments. We have labeled this condition the coupled state of physical reality. Figure 1 metaphorically illustrates a key difference between a

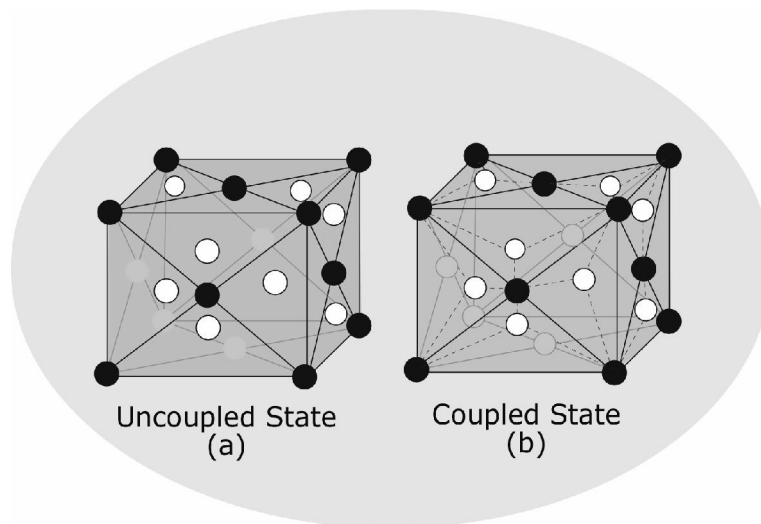


Figure 1. The physical reality metaphor; (a) the uncoupled state and (b) the coupled state.

material in these two states of physical reality. In Figure 1, the black balls represent the electric substance and the smaller white balls represent the magnetic substance. The black lines joining the black balls to each other represents that they are interacting with each other and, in (a), since no lines connect the white balls with the black balls, this represents that they are not interacting with each other – the uncoupled state. In Figure 1 (b), the dashed lines connecting the white balls with the black balls represents that use of an intention-host device has caused them to significantly interact with each other and produce the coupled state of physical reality.

The implication of all of this for our world is enormous! However, before proceeding to discuss some major implications of large-scale use of such intention-host devices in scientific laboratories and industrial sites around the world, let us look at a few of our key experimental results upon which I have based the foregoing remarks.

### Phase 1 Experiments:

The first phase of our intention-host device experiments<sup>(1)</sup> involved designing four separate target experiments. Each was to be influenced by an appropriate, separate intention-host device that would be plugged into a wall outlet of the experimental space, placed within a few feet of the target experiment apparatus and switched on. Our novel procedure for introducing a specific intention into a host device was to do it mentally and emotionally from a deep meditative state<sup>(1)</sup>.

For the first target experiment, the intention was to increase the pH of a vessel of water in equilibrium with air at room temperature by +1.0 pH units with no chemical additions. Our measurement accuracy was  $\pm 0.02$  pH units. Figure 2 shows a sample result for this target experiment. One can readily see that it was robustly successful in producing the intended result (which was 100 times larger than the noise level).

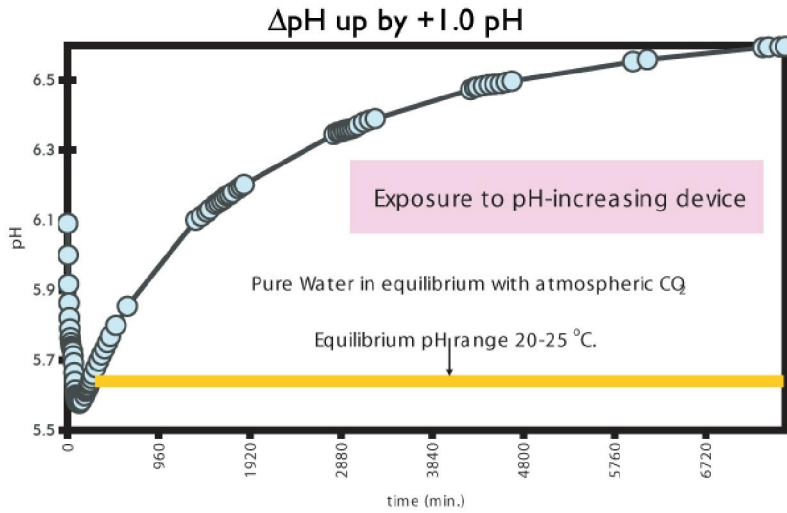


Figure 2. Plot of pH rising one full pH unit due to exposure to a pH-increasing intention-host device.

The second target experiment was with water in equilibrium with air at room temperature but the intention was to decrease the pH by ~1.0 pH units, again with no chemical additions. Figure 3 shows a sample result for water more alkaline than the Figure 2 example.

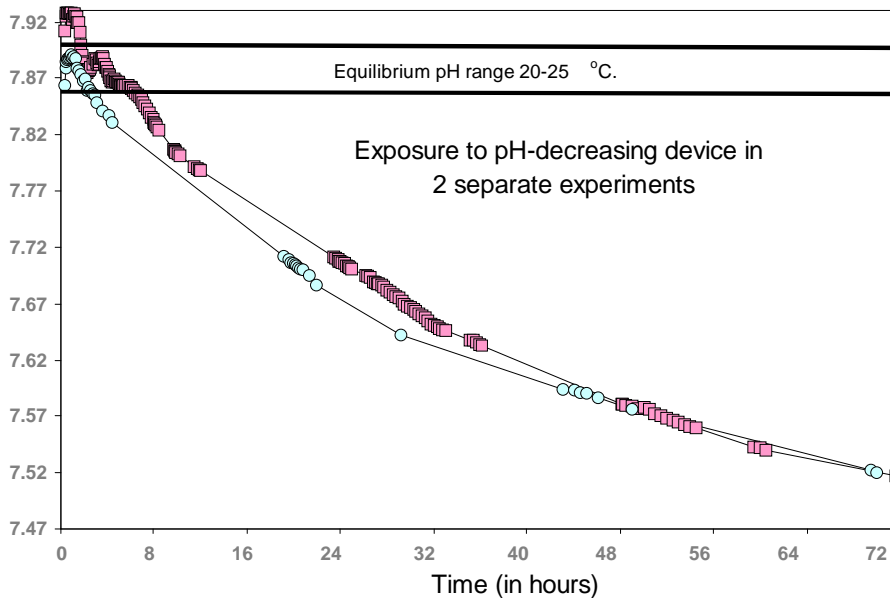


Figure 3. Plot of pH decrease via exposure to a pH-decreasing device.

Once again, this experiment was successful. Similar successful results have been obtained for a variety of water types.

For the third target experiment, the material medium was an *in vitro* biological molecule, alkaline phosphatase (ALP), a liver enzyme. The intention was to increase the chemical activity of ALP by a significant amount via just exposing the ALP for a period of 30 minutes to its intention-host device “conditioned” space that had been brought to the coupled state. Once again, the experimental results<sup>(1)</sup> were remarkably successful compared to the built-in controls. About a 25%-30% increase in ALP chemical activity was achieved at  $p < 0.001$ .

In the fourth target experiment, the material medium was an *in vivo* living system, fruit fly larvae. Here, the intention was to significantly increase the ratio of the cell’s energy storage molecule, ATP, to its chemical precursor, ADP, so as to make the larvae more physically fit and thus have a greatly reduced larval development time,  $\tau$ , to the adult fly stage. Again, with built-in controls, this living system was exposed to its intention-host device-“conditioned” space for the entire period,  $\tau \sim 28$  days. We found that the ratio [ATP/ADP] increased by  $\sim 15\% - 20\%$  with  $p < 0.001$  and  $\tau$  decreased by  $\sim 20\% - 25\%$  at  $p < 0.001$ .<sup>(1,2)</sup>

An overview perspective on the time-dependence of these remarkably successful experimental results is schematically illustrated in Figure 4.

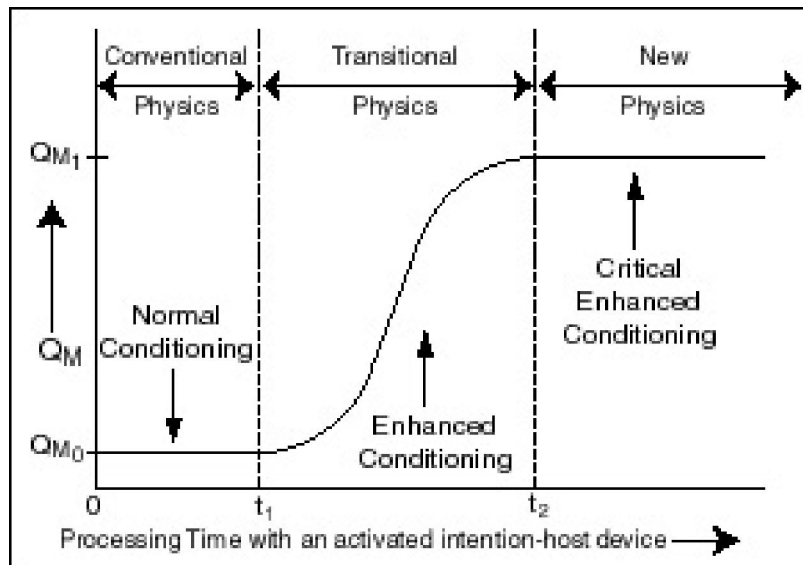


Figure 4.

For any typical physical measurement,  $Q$ , the qualitative magnitude change,  $Q_M$ , is plotted versus the degree of locale conditioning produced by continued intention-host device use.

Here, one sees that nothing much happens to  $Q_M$ , the magnitude of the material property under consideration, during exposure of the experimental space to the particular intention-host device for time,  $t$ , until a threshold time  $t_1 \sim 1$  month has been passed. Then  $Q_M$  begins to change from  $Q_{M0}$ , the uncoupled state value, always in the direction of the

particular intention before it begins to level off and plateau at time  $t_2 \sim 3$  months, when  $Q_{M1} - Q_{M0} = \Delta Q \sim$  the magnitude of the intention imprint.

Put into equation form, the results of Figure 4 can be represented by

$$Q_M(t) = Q_e + \alpha_{\text{eff}}(t)Q_m \quad (1)$$

where  $Q_e$  is our normal electric atom/molecule value,  $Q_{M0}$ , of the uncoupled state,  $Q_m$  is the vacuum level value and  $\alpha_{\text{eff}}$  is the time-dependent coupling coefficient between these two types of substance due to use of the intention-host device as the space transitions from the uncoupled state to the coupled state of physical reality. The magnitude of  $\alpha_{\text{eff}}$   $Q_m(t > t_2)$  is  $\Delta Q_M = Q_{M1} - Q_{M0}$  in Figure 4.

These experimental results have been published in over a dozen scientific papers and three seminal books<sup>(1,3,4)</sup>. Experiment 1 has been replicated by others in ten U.S. and European laboratories<sup>(3,4)</sup>.

## Phase 2 Experiments:

The second phase of our experimental research began with the performance of a replication study for experiment #1 because of its simplicity. The study was conducted at ten sites in the U.S. and Europe<sup>(3,4)</sup>.

Three of the intention-host sites, in Arizona, Missouri and Kansas, had control sites 2 to 20 miles distant. These control sites had exactly the same type of equipment and water but never an intention-host device. Excellent experimental replication occurred at all three intention-host device sites with the pH(t) rising exponentially with time in the following fashion:

$$pH(t) = pH_{th} + \Delta pH(1 - e^{-\beta t}). \quad (2)$$

Here,  $pH_{th}$  is the theoretically predicted value for an uncoupled state space at room temperature,  $\Delta pH$  is the total magnitude of pH change, and is usually quite close to the intended value, while  $\beta$  determines how rapidly the exponential function,  $e$ , decays. Both  $\Delta pH$  and  $\beta$  are site-specific. Surprisingly, at the nearby control sites, very similar pH(t)-behavior was observed (see Figures 5). This behavior strongly suggested that room temperature, information entanglement was occurring between the intention-host device sites and their control sites 2 to 20 miles away.

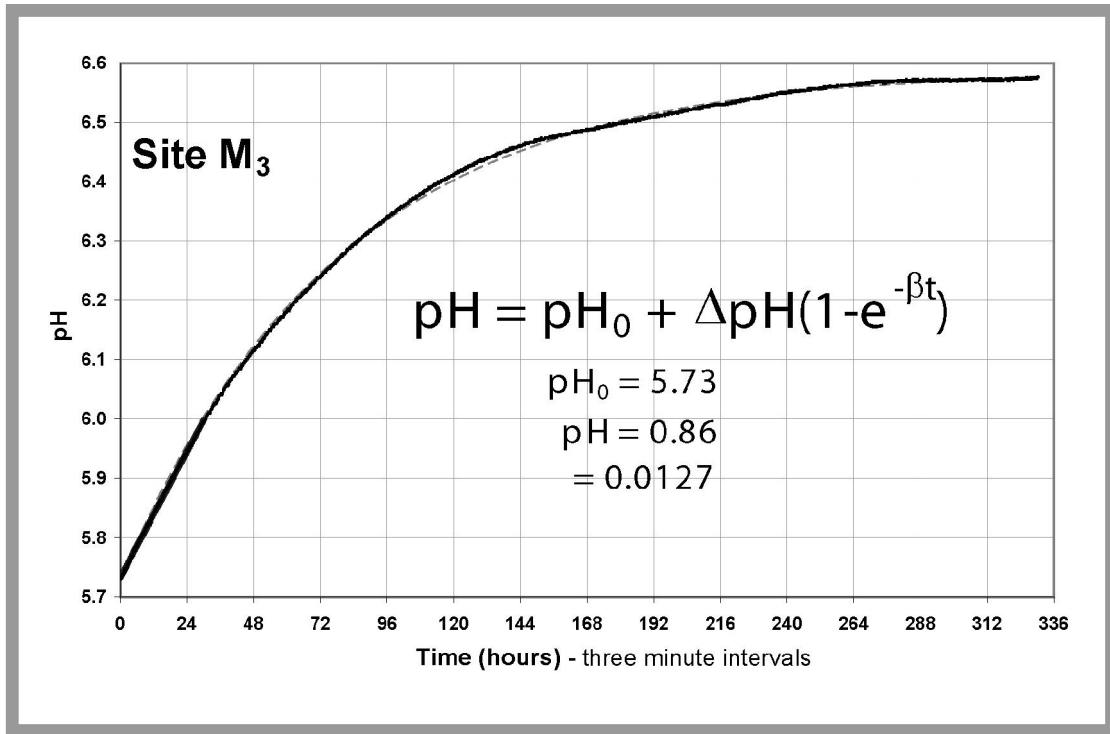


Figure 5a. pH vs. time at control site M<sub>3</sub>.

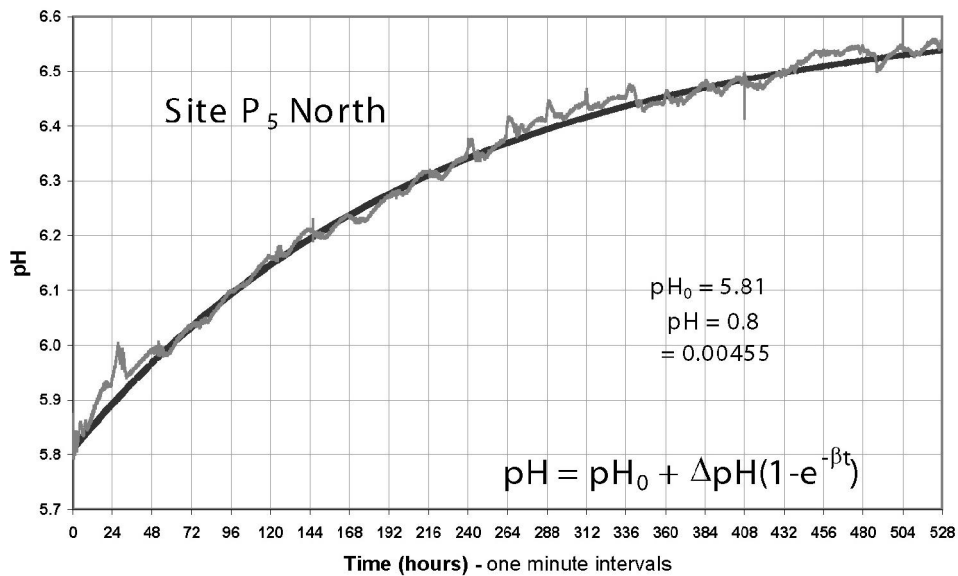


Figure 5b. pH vs. time at control site P<sub>5</sub> North room.

To test this hypothesis, we utilized the Baltimore and Bethesda sites as control sites for the Arizona, Missouri and Kansas intention-host device-sites. We found that

within one to two months the pH(t) was increasing exponentially by ~0.8 pH units. Thus, the room temperature information entanglement was both found to exist and now had been extended to ~1500 miles.<sup>(3,4)</sup>

Next, we decided to use the London-site, and ~3 months later the Milan site as control sites for the (AZ, MO and KS) intention-host device sites. Within 3 weeks the  $\Delta$ pH had increased by ~1 pH unit at the London-site and, 3 months later the Milan site went online and within 1 week the  $\Delta$ pH at that site had increased exponentially to ~1 pH unit. Thus, this information entanglement phenomenon had now been proved to extend at least 6000 miles.

Switching gears now, during this replication experiment, we invented a new and novel procedure for actually measuring, for the aqueous  $H^+$ -ion, the excess thermodynamic free energy change,  $\delta G_{H^+}^*$ , of the coupled state relative to the uncoupled state for an experimental space. Values of  $\delta G_{H^+}^*$  were measured for all ten sites involved in the replication experiment. Figure 6 illustrates experimental data for two intention-host device sites, P<sub>1</sub> and P<sub>7</sub> in the Arizona laboratory and two control sites, U.K.

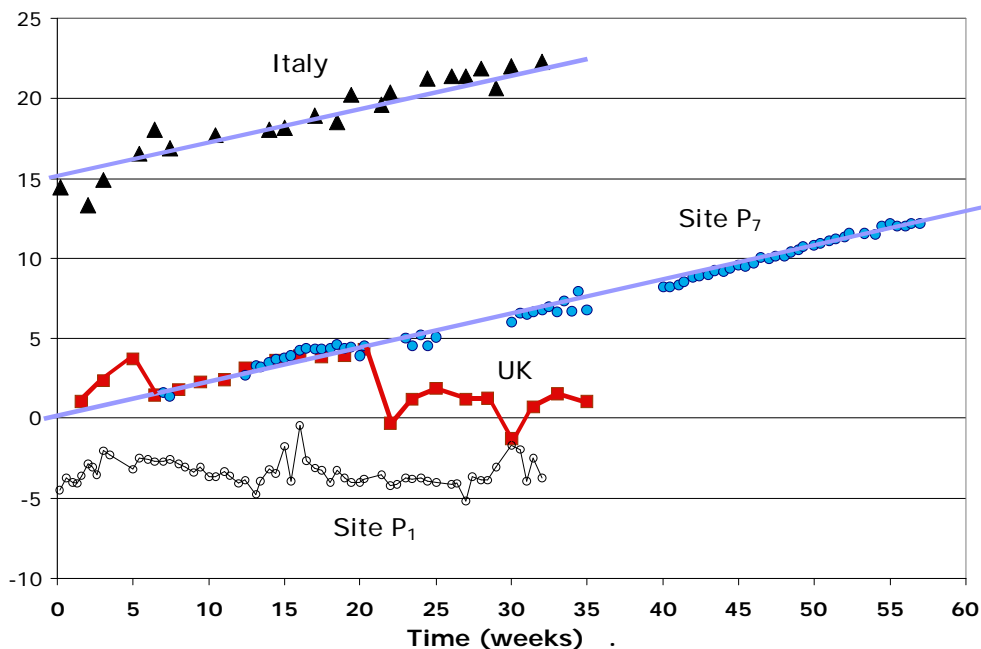


Figure 6.

$\delta G_{H^+}^*$  vs. time at four diverse sites.

and Italy. The fact that all of the control sites exhibited non-zero values for  $\delta G_{H^+}^*$  demonstrates very clearly that the control sites are informationally connected to the intention-host device sites even over such huge distances. In energetic terms, the magnitude of the  $\delta G_{H^+}^*$ -values can be quite large, equivalent thermal energy changes



for an uncoupled-state space of ~150 °C. to ~500 °C. even though there was no significant change in the measured temperature at these sites.

Switching gears one final time, we utilized advanced kinesiological techniques to show that humans and perhaps all vertebrates, at least, have their acupuncture meridian system at the coupled state level of physical reality compared to the rest of the body which is at the uncoupled state. We found that the south-pole of a simple bar magnet strengthened muscle groups being tested while the north pole of the same bar magnet weakened these same muscle groups. Such a D.C., magnetic field, polarity effect is not allowed by our traditional physics of the uncoupled state which consists of only magnetic dipoles but is allowed by coupled state physics involving both electric and magnetic single charges. Thus, all humans already have a built-in infrastructure in their bodies via which they can use their own sustained intentions to build themselves to significantly higher levels of capability and performance than they presently manifest!

Once again we say that the implications of all this new experimental data for our world are enormous!

### **For Humans:**

It means that biofeedback devices can eventually be built to measure and display the strength of an individual's ability to "intend" so that the individual can flex that ability, much like muscle-building in a gym, to enhance their personal capability in any area of endeavor they wish- be it music, art, drama, sports, education, science, technology, business, etc. It seems that, what you intend for yourself, with a strong and sustained desire, you become!

### **For Science:**

It means that having intention-host devices in one's laboratory "conditions" that space to the coupled state of physical reality where traditional measuring instruments can then begin to access the vacuum level of physical reality. This will naturally reveal new phenomena, new understanding, new inventions, etc. We may even come to see new ways to reverse global warming in our world!

### **For technology:**

At present, it means that large scale use of such intention-host devices can beneficially enhance the performance of every technology used in our world today and create many new ones. As a few example possibilities, one can foresee (1) adding another dimension of intelligence to computers, (2) significantly increasing the conversion efficiencies of present primary energy sources such as gasoline or ethanol in transportation vehicles and (3) since the coupled state is significantly more coherent than the uncoupled state, this allows the creation of significantly more coherent electrical current and magnetic current systems, perhaps even reaching the long-sought goal of room temperature superconductivity.

As a final illustration, consider the effect of a D.C. magnetic field polarity on a vessel of water for both the uncoupled and the coupled state of physical reality. For the uncoupled state, only magnetic dipoles are present so, theoretically, there should be no difference in pH of the water between (a) when the north pole of the magnet points

axially upwards from the bottom of the water vessel and (b) when the south-pole of the magnet points axially upwards. Experimentally this is always found to be true for uncoupled experimental spaces. However, when the experimental space has been intention-host device-“conditioned” to the coupled state we obtain experimental data like that shown in Figure 7. In this case, the south-pole pointing upwards makes the pH

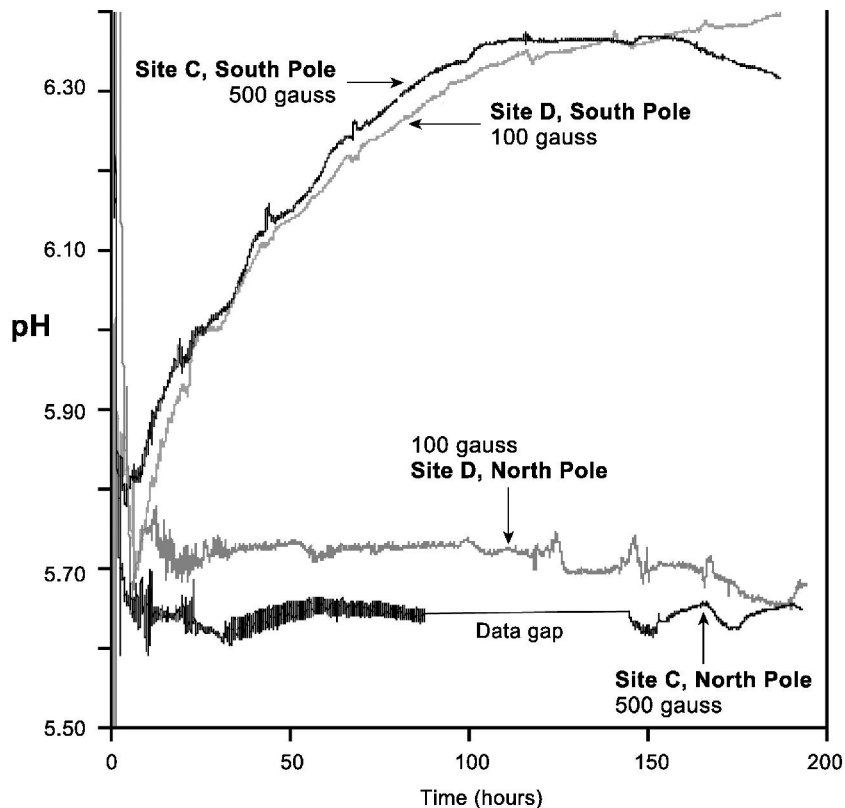


Figure 7.

pH changes with time for pure water for both N-pole up and S-pole up axially aligned DC magnetic fields at 100 and 500 gauss.

increase so the water becomes appreciably more alkaline while, for the north-pole pointing upwards, the water becomes appreciably more acidic. Here, one sees the  $\Delta\text{pH} \sim 0.6$  pH units after  $\sim 3$  days of exposure to the two oriented magnetic fields. Beneficial applications of this phenomenon will abound.

### For Education and Business:

Once again, the increase in general coherence in going from the uncoupled state to the coupled state in an experimental space is expected to significantly enhance human attention span, memory capacity and creativity for both students and employees. Because of this, significantly enhanced capabilities of human thought, cooperation, inventiveness and action are expected to result.

## **Introductory Theoretical Background**

As we reflect upon our world and upon the humankind that populate its surface, one soon perceives that there are several categories of phenomena and information wherein we need to gain reliable understanding in order to understand our life's journey. These might be classified as (1) things of the physical, (2) things of the psyche, (3) things of emotion, (4) things of the mind and (5) things of the spirit. In addition, we need a meaningful perspective or reference frame (RF) from which to view these different categories of phenomena and information. Ultimately, our understanding of all these phenomena must be internally self-consistent. Since we are an evolving species, growing in understanding via a bootstrap process, a useful metaphor for what we need is a “ladder of understanding” that guides us from the simple to the more complex – in the sense of various levels of integration of different categories of infrastructure. Thus Figure 8 represents our metaphorical “ladder of understanding” that we must carefully build by our efforts and then climb upon, rung by rung, as we evolve to higher states of being.



Figure 8. A metaphorical description of the “ladder of understanding”.

From an overly simplistic viewpoint, one could say that for the past ~400 years, establishment science has dealt with multiple aspects of the metaphorical reaction equation with each term being convertible to the other via Einstein's  $E=mc^2$  relationship,

$$\text{Mass} \Leftrightarrow \text{Energy} \quad (3a)$$

where  $E$  = energy,  $m$  = mass and  $c$  = the velocity of electromagnetic (EM) light through physical vacuum. Unstated in Equation 3a is the fact that for this past ~400 years, human consciousness and intent have been rejected as possible and significant experimental variables in physical reality. However, today, from the experimental findings of the previous section, we know that this assumption is no longer true. We now know that our world has entered the era of “Psychoenergetic Science” (things of the psyche) and that we need to expand equation 3a to become

$$\text{Mass} \Leftrightarrow \text{Energy} \Leftrightarrow \text{Information} \Leftrightarrow \text{Consciousness.} \quad (3b)$$

Equation 3a and the bottom rung of Figure 8 relate to spacetime as our RF and the four fundamental forces of gravity, electromagnetism, the long-range nuclear force and the short-range nuclear force discovered by traditional science. Equation 3b and the second rung of Figure 8 relate to an expanded RF plus expanded versions of both quantum mechanics (QM) and relativity theory (RT).

Looking at Equation 3b and ignoring the fact that the human community does not have an appropriate, agreed-upon definition of the word “consciousness”, when we ask what consciousness does rather than what it is, one immediately realizes that it manipulates information in the form of numbers, alphabetical letters, jigsaw-puzzle pieces and, most generally, symbols. Further, for the past ~60 years, establishment science has recognized the existence of a quantitative relationship between information in units of bits and the thermodynamic quantity, entropy, in units of calories per unit temperature<sup>(3,4)</sup>. For the past 150 years, entropy has been a very important contribution to the Gibbs’s thermodynamic free energy function,  $G$ , given by

$$G = PV + E - TS \quad (4)$$

where  $P$ =pressure,  $V$ =volume,  $E$ =energy,  $T$ =temperature and  $S$ =entropy. It is changes in  $G$ ,  $\Delta G$ , that drives all the processes in nature that humankind has so far discovered. Thus, all the terms in  $\Delta G$  ( $P\Delta V$ ,  $V\Delta P$ ,  $\Delta E$ ,  $T\Delta S$  and  $S\Delta T$ ) are all equally important for producing significant changes in our world. The terms  $P\Delta V$  and  $V\Delta P$  were very important in our steam engine era and in today’s era of refrigeration and heat pumps (compressors). The term  $\Delta E$  gained great popularity via the efforts of Einstein (Equation 3a) and particle physicists when they accelerate electrons, protons, neutrons, etc., to high kinetic energies and smash them into various material targets. The term  $S\Delta T$  is important in future geothermal energy conversion to electricity while the  $T\Delta S$  term is very important to the change in information content from a natural process inherent in Equation 3b. One can see from all this the intimate bridge that exists and connects energy and information in Equation 3b.

Our present form of QM is fine with Equation 3a where the four fundamental forces are spatially varying and one can use spacetime as a suitable RF. However, in Equation 3b and in any psychoenergetic process, information and consciousness are thermodynamic variables that appear to be independent of distance. Thus, both QM and our present RF must be expanded to allow our science to adequately deal with the experimental data described in the previous section.

On this path of necessary change, the experimental data of the previous section reveals the following key insights: (1) two unique levels of physical reality, the electric atom/molecule level and the magnetic information wave level of the physical vacuum appear to exist, (2) two distinct states of interaction, the uncoupled state and the coupled state, for these two unique kinds of substance appear to exist and are both experimentally accessible when an appropriate form of consciousness is brought into play and (3) when

$\alpha_{\text{eff}} \sim 0$  in Equation 1, only the uncoupled state is accessible but when an intention-host device is added to them,  $\alpha_{\text{eff}}(t)$  grows in magnitude with time and the coupled state of physical reality becomes instrumentally accessible. All of these factors are keys to the proper design of our new RF. However, there is one more factor that needs to be brought into play.

The two key cornerstones of QM were (1) Max Planck's experimental and theoretical observations that EM radiation emission and absorption by physical matter was in discrete-sized bits (quanta) rather than continuously variable sized bits and (2) de Broglie's particle/pilotwave concept illustrated in Figure 9 where the pilotwave envelope encloses the particle and guides it. Harrison<sup>(6)</sup> has shown that all the rest of the QM formalism can be generated provided one assumes the simultaneous existence of physical matter as both a particle and wave. One problem for us is that human cognition does not perceive a continuous looking wave like that shown in Figure 9. The waves that human's cognitively discriminate are all modulations of particle densities or modulations of particle fluxes. It is the bunching of particles to create density variations in space and time that make the waves that we sensorily detect as light, sound, etc.

Shortly, I will propose a particular duplex RF to handle this obvious dilemma; however, before I do, it is important to consider Figure 9 and reveal two important consequences that come from applying simple QM and simple RT mathematics to this

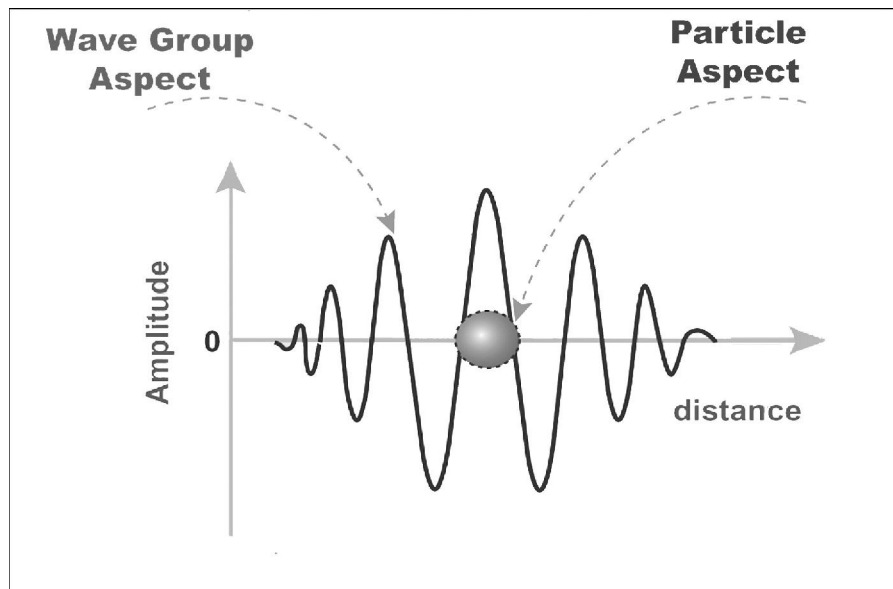


Figure 9.

The de Broglie particle/pilotwave concept of the 1920's, for which he won a Nobel Prize, proposed that every particle had a pilotwave envelope enclosing it and moving at the particle's velocity. This was eventually to be called "the wave particle duality of QM".

spacetime de Broglie concept<sup>(6)</sup>. When this is done, Eisberg<sup>(6)</sup> shows that

$$v_p v_w = c^2 \tag{5a}$$

and

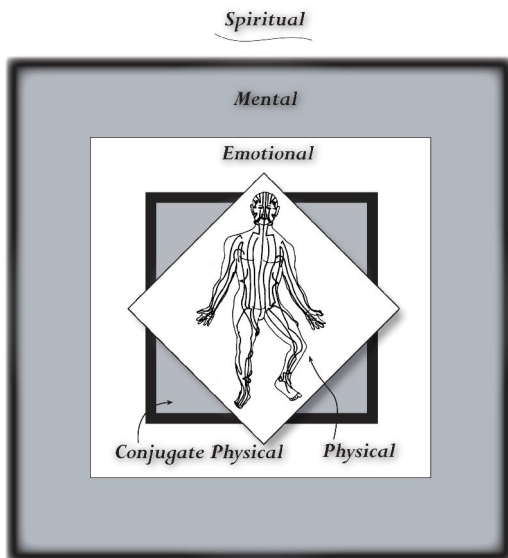
$$\Delta x \Delta p_x = h/2\pi. \tag{5b}$$

Here,  $v_p$  = the mass particle velocity,  $v_w$  = the velocity of the wave components that enter and leave the wave group as the group moves along at  $v_p$ ,  $\Delta x$  is the uncertainty of particle position while  $\Delta p_x$  is the uncertainty of particle momentum in the wave group and  $h$  = Planck's constant.

Since, from RT, we know that  $v_p < c$ , always,  $v_w > c$ , always, so these wave components enter the group from the left and exit the group from the right as the group moves along at velocity  $v_p$ . This calculation troubled physicists in the 1930's when it was first made because of the relativistic constraints, so they labeled them information waves. In those days they thought that such waves could not transport energy and thus could be neglected. However, today we see, via the discussion surrounding Equations 3b and 4, that they cannot be neglected so we are faced with the dilemma of a faster than EM light information wave interacting with and directing a slower than EM light particle with mass. This certainly violates RT; however, Equation 5b, which is a simple expression of the Heisenberg Uncertainty Principle, gives the overall calculation results great credence.

I have chosen to resolve all of the foregoing theoretical dilemmas via the proposing of three postulates:

- (1) The new RF for viewing physical reality is a duplex RF consisting of two, four-dimensional, reciprocal subspaces, one of which is spacetime,
- (2) This physical RF is imbedded in an overall reality RF consisting of the domains of emotion (9-11D), mind (12-14D) and spirit (15D and up) and
- (3) There exists, in the domain of emotion, an moiety called deltron that can be consciousness-activated to serve as a coupler substance between the  $v_p < c$  electric atoms/molecules and the  $v_w > c$  magnetic information waves.



Figures 10 provide both a structural representation (a) and an energy band representation (b) of these two nested RFs. Since the duplex physical RF are reciprocals,

Figure 10a. A structural representation of our RF with the duplex space in the center. If one counts the entire duplex space as a 4-space, then the entire multidimensional representation is a 7-space. If instead, we count the duplex space as a unique member of the general 8-space, then our RF is eleven-dimensional.

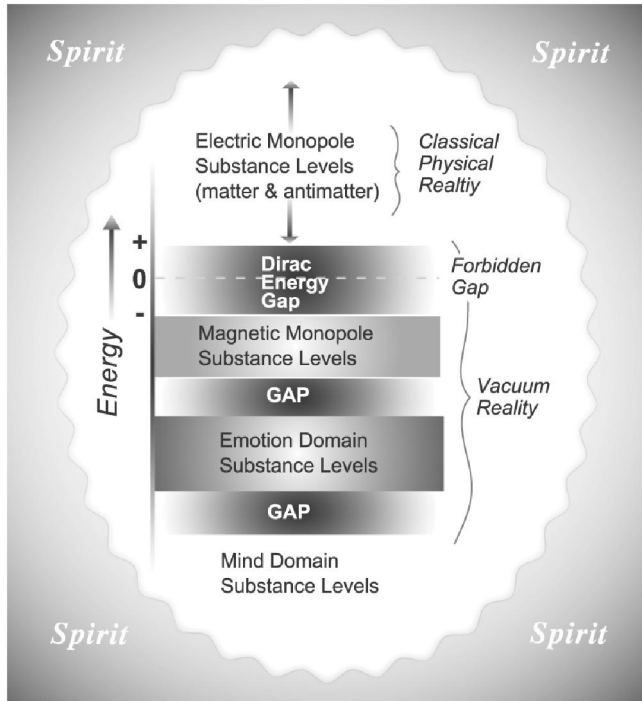


Figure 10b. An energy level diagram embracing both classical physical substances and “unseen” vacuum substances.

the conjugate physical is a frequency domain; and, if all the higher domains are also frequency domains, then sympathetic resonance between the higher domain substances and the magnetic information wave substance of the conjugate

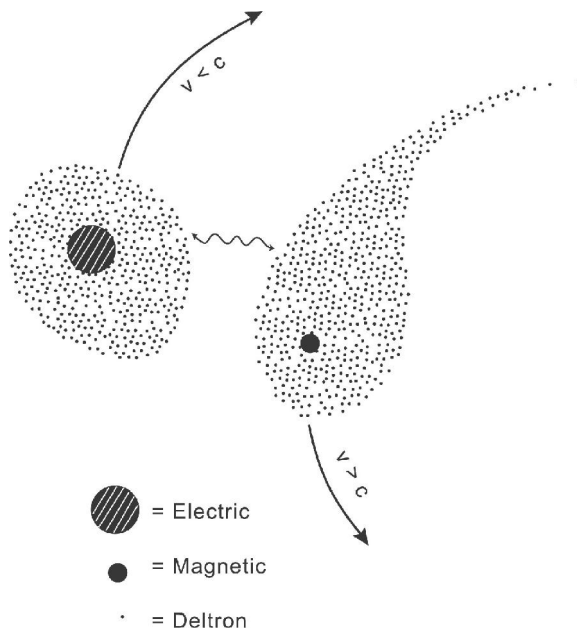


Figure 11. A higher dimensional level of substance, labeled deltrons, falling outside the constraints of relativity theory and able to move at velocities greater than and less than  $c$ , acts as a coupling agent between the electric monopole types of substance and the magnetic monopole types of substance to produce both electromagnetic (EM) and magnetoelectric (ME) types of mediator fields exhibiting a special type of “mirror” principle relationship between them.

physical domain can occur so the deltron coupler ( $\alpha_{eff}$  in Equation 1) can transfer the information to the electric atom/molecule level of physical reality. Figures 11 and 12 illustrate how the deltrons could produce interaction between the electric stuff and the magnetic stuff plus between the particle and pilotwave in the two coordinate systems of the duplex RF, respectively.

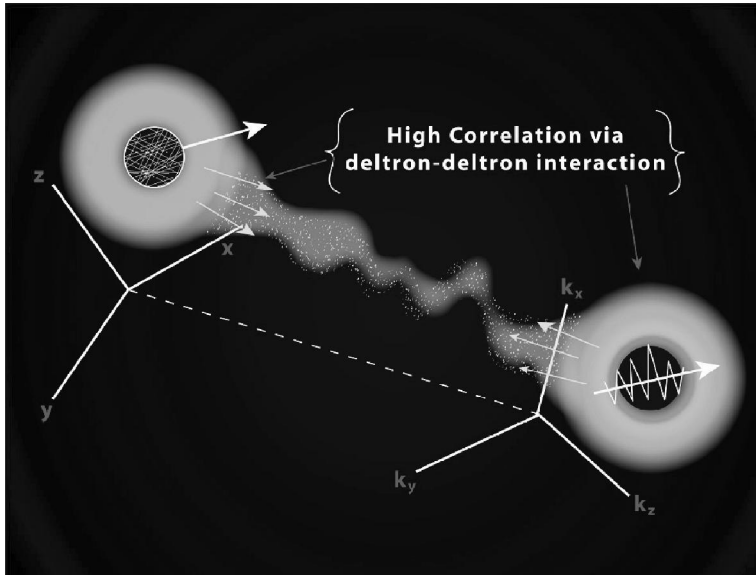


Figure 12. Illustration of how deltron-deltron coupling ( $\alpha_{eff}$ ) allows the two unique levels of physical reality to interact with each other.

Figure 13 illustrates qualitatively how a particular intention from the domain of spirit can create a correlated information imprint on the domain of mind. This, in turn,

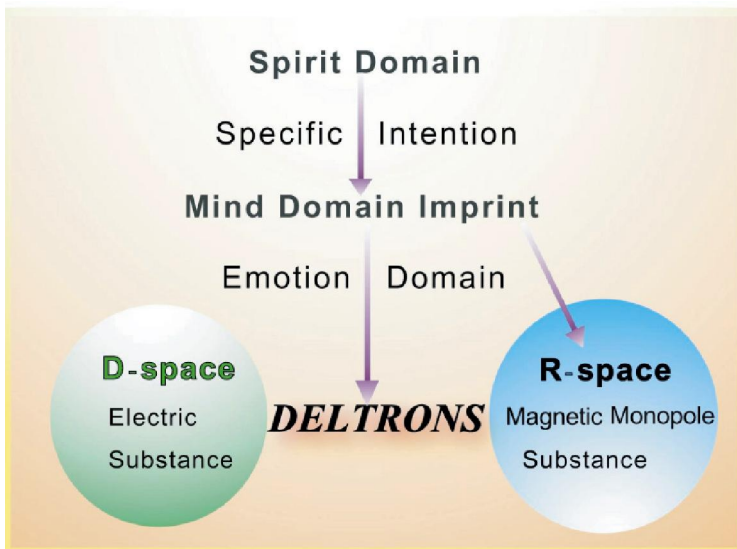


Figure 13. Human consciousness, and specifically human intention, can activate this deltron population, and thereby modulate this electric/magnetic monopole substance coupling, so as to alter the specifics of the EM state of the space where in an object rests, and thus the experimentally measurable properties of that object.



both (1) radiates a correlated information map to the magnetic information wave domain and (2) activates more deltrons so that this new information map becomes  $\alpha_{eff}$ -coupled to the measuring instruments of our atom/molecule world<sup>(7,4)</sup>. This, we believe, is how one can account for the four target experiment results and the long-range information entanglement results of the previous section.

In closing this section, it is important to note that, for a duplex RF with reciprocal subspaces, a quality in one subspace is quantitatively connected to its equilibrium conjugate quality in the other subspace via deltron-empowered, Fourier transform relationships<sup>(1,2)</sup>. This, ultimately, allows us to theoretically calculate many details of the reciprocal subspace provided we quantitatively know (1) an electric atom/molecule quality as a function of distance and time and (2) the ambient activated deltron population.

In a one-dimensional, mathematical D-space representation for a particular D-space quality,  $f(x)$ , and assumed uniform deltron concentration,  $C_\delta$ , with D-space substance and R-space substance partition coefficients  $p_1$  and  $p_2$ , respectively, we have

$$(p_2 C_\delta)^{1/2} F(k) = \frac{1}{(2\pi)^{1/2}} \int_{-\infty}^{\infty} p_1 C_\delta f(x) e^{ikx} dx \tag{6a}$$

$$p_1 C_\delta f(x) = \frac{1}{(2\pi)^{1/2}} \int_{-\infty}^{\infty} (p_2 C_\delta)^{1/2} F(k) e^{-ikx} dk \tag{6b}$$

and

$$I_S(k) = p_2 C_\delta F(k) F^*(k) = \frac{1}{2\pi} p_1^2 C_\delta^2 g'(k) g'^*(k) \tag{7a}$$

where 
$$g'(k) = \frac{1}{(2\pi)^{1/2}} \int_{-\infty}^{\infty} f(x) e^{ikx} dx \tag{7b}$$

and

$$Q_M = \int_{-\infty}^{\infty} I_S(k) dk = \frac{1}{2\pi} \alpha_{eff} \int_{-\infty}^{\infty} g'(k) g'^*(k) dk \tag{8a}$$

is the total quantity of the conjugate R-space quality and

$$\alpha_{eff} = \frac{p_1^2 C_\delta^2}{2\pi} . \tag{8b}$$

One notes, in this formalism, that  $\alpha_{\text{eff}}$  increases quadratically with  $C_\delta$  with the unknown quantity  $p_1^2$ . This quantitative approach is consistent with our earlier, zeroth-order  $\alpha_{\text{eff}}$  approximation. A first-order approximation would utilize  $C_\delta = C_\delta(x, k)$  with standard orthogonal function expansions.

## References

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