



# BRIDGES

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*International Society for the Study of Subtle Energies and Energy Medicine*

## Science, Mysticism, and the New Tomorrow

**Elizabeth Rauscher, Ph.D.**



*Professor Rauscher received her Ph.D. from the University of California, Berkeley, CA. She lectures worldwide, receiving this impression from a listener. "I am still in awe, feeling like I was in the presence of the smartest woman on the planet. A female Albert Einstein . . . she is warm, funny, articulate, and cursed by a brain that goes faster than the speed of light."*

### **Introduction**

My involvement in the field of science and consciousness started when I was about maybe between 9 and 12, and I thought to myself, if I'm going to understand what consciousness is, I better study the very small, which is nuclear particle physics, and the very large, the astro-cosmological physics, and maybe I can find consciousness somewhere in between. I thought this might take me about ten thousand years, but that is a great deal of lifetimes, so I wanted to cut the whole process short. I decided to just go full bore out and study consciousness.

I think that the fundamental ingredient that we are really dealing with in existence, is consciousness, which is the primary force, spirituality or whatever you wish to call it. The spirit, those aspects of subtle energy that give life to everything on this planet, everything in the universe, comes through these dimensions and a little gets precipitated out at the bottom, and that's called physical matter. Now, for a physicist to say that is unusual, but I think that is the way it is. It is like ten percent of the iceberg that is sticking above the water corresponds to physical matter, and the rest is many dimensions of what appears unseen, but is often perceived. It's really the basis of healing, health and energy medicine. One of the most fundamental healers, that we all know, is our selves. Healing is a very personal matter, and we know when we are not well. Sometimes it is good to seek a traditional practitioner. If you have a broken wrist it might be a good idea to get it set instead of seeing a psychic healer. I found that when I became ill from pain and stress, I did not go to a doctor; I went to a psychic. The two times that I really became ill, I went to a psychic healer and it worked out a great deal better, the price was right, and I didn't get killed in the hospital, which is now likely to happen. About a hundred thousand people die a year from medical malpractice in hospitals. If one gets a cut it heals, but I think there is a whole energy flow through all of us, a life force that goes through us and is what mediates our existence. Illness is a personal matter, if one gets out of balance so that one cannot channel the life force properly, this causes illness. Sometimes it takes another person to bring us back into enough balance so that we can re-heal ourselves, but it's a healer-healee relationship.

Currently there is a wave of new knowledge coming upon us. It's like surfing, which I tried, but I was not very good at it. You get out there and you're really trying to catch that wave, and you're paddling as hard as you can, trying to get up on the board. This is an analogy to preparing to catch knowledge, life energy and truth. There was a period in the late sixties and early seventies when there was a wave of new knowledge, and there is another wave coming for the last few years. I can predict that there is a new vision coming to being to this field of energy

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## Bridges

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*The Magazine is published quarterly and includes theoretical or informational papers, short research articles, case studies, reports, book reviews, and interviews with leading figures in the study or uses of subtle energies. Readers are encouraged to submit manuscripts to be considered for publication. Articles should be related to subtle energies and/or energy medicine and may range between 500 and 2500 words.*

*The Magazine includes diverse opinions and explorations. Any therapies presented are not necessarily proven, but are only indications of treatment modalities that may be of interest to readers. Papers included reflect the opinion of the individual and do not necessarily reflect the thoughts of the editors, the staff, or the board of ISSSEEM.*

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## Message from the Editor-in-Chief

*Carol J. Schneider*

Carol J. Schneider, Ph.D.,  
*Editor-in-Chief*

# The Quantum Plenum: *The Hidden Key to Life, Energetics and Sentience*<sup>1</sup>

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## Mark Comings



*Mark Comings is a mystic a theoretical physicist and an engineer who has spent the last twenty-five years working to articulate a mathematically rigorous, clear and precise spirit-based science, that can serve to help the long standing rift between science and spirituality.*

For a long time, I've been aware of some fundamental mysteries around energy. First of all, the basic question: what is energy? This is a big topic itself. But in the context of living systems, the problem or the challenge is to really understand energy as it pertains to organisms or bio-energetics. The question here involves not only the issue of the nature of energy but understanding precisely how living systems engage with energy; how they're powered so to speak. This is a central feature of the mystery of life itself, and it is far from well understood.

Jim Oschman has directed me to some very interesting research that indicates clearly that this matter is far from settled. The fact that there are some serious gaps in our understanding of the bioenergetics of life has more or less been conveniently forgotten by the life sciences. As an example; there is the basic question of how do we as organisms move? Or put more specifically: Where does the energy for muscle contraction come from? Well, there is a standard model, which is more or less the reigning paradigm. It says that the high-energy phosphate bond of adenosine triphosphate (ATP) is the immediate energy source for all biological processes. If you ask pretty much any biologist, this is where the conversation starts and very often ends. Everything involving living systems is seen as being driven by this chemical reaction going on inside the mitochondria of cells. The mitochondria are thought to be the dynamos of the cell, and to power living systems. And muscle contraction is the example that is usually used to show how this works.

A. V. Hill was the noted British physiologist and bio-physicist who received, with Otto Meyerhof, the Nobel prize in Physiology or Medicine for discoveries concerning the production of heat in muscles. In 1950 and then again in 1966 he challenged biochemists to account for the source of energy for muscle contraction.<sup>3,4</sup> In other words it hadn't yet been accounted for, in his opinion. By the first law of thermodynamics, in a closed reaction system, the heat plus the work produced must be equal to the sum of the energy. That's the first law of old paradigm thermodynamics and it has some relevance.

In 1962, Davies and colleagues showed that ATP really does break down during the contraction of muscle.<sup>5,6</sup> Here they were actually moving toward quantifying the hypothesis.

In 1970, Jim Oschman heard a lecture by D. R. Wilkie at Woods Hole. Wilkie described experiments that enabled him to determine how much ATP was consumed during a single muscle contraction. He had to rapidly freeze the tissue in order to get these quantitative measurements. Wilkie and his assistants showed the relation between heat produced and the ATP and phosphorylcreatine splitting during the isometric contraction of frog muscle.<sup>7</sup>

There is quite a bit of unexplained energy in this reaction.<sup>8</sup> His research and that of others exploring muscle energetics are summarized in two review articles.<sup>9,10</sup> Experiments have shown that ATP splitting does not produce enough energy to account for all the heat plus work liberated during this contraction. The difference is referred to as the "unexplained energy." The total energy liberated during muscle contraction cannot be entirely accounted for by ATP or PC splitting, therefore Wilkie concluded, "additional reactions during contractions are not yet known but must occur."

There is something missing in our understanding of bioenergetics. This is just one example. Jim Oschman, who is such a thorough researcher of literature, said he went to the citation index, to see if anyone had cited these two papers. They were not cited, thus the problem has been conveniently forgotten.

So there are many ways that this unexplained energy could be accounted for, the important thing is that it has not yet been accounted for and that there is in general very little awareness that there is even a problem.

The obvious scientific approach to solving this problem would be to try to find the additional chemical reactions that can account for the unexplained energy that is involved in muscle contraction. This is a worthy research pathway but I want to talk today about another direction from which possible explanations for this gap in our understanding of basic bio-energetics could come. I want to raise some issues that bear on this issue that are not generally brought into the discourse. This is because these approaches to the question of bio-energetics require a whole new way of thinking about energy and definitely challenge some basic assumptions. However it is all based in good physics . . . with some creative speculative flights added. So when contemplating this issue of the energetics of life, the energy in the quantum vacuum state that is embedded in the very structure of space itself immediately comes to mind. This is something I've been focusing on and studying for a very long time as a physicist. It is turning out to be central to one of the great conceptual revolutions happening in science right now. This revolution in our thinking about fundamental processes has to do with the discovery of the quantum vacuum state and assimilating the vast implications of this discovery into the frameworks of physics, chemistry, biology and science as a whole. There is now widespread recognition that the quantum vacuum is not really a vacuum at all because its actually filled with enormous amounts of energy and potential. In fact it is so full of energy that calling it a vacuum (which means a total emptiness or vacuity) is a serious misnomer, thus I prefer to refer to the quantum vacuum as the "quantum plenum" as a way of reminding us of what we are actually dealing with. The word plenum means an absolute fullness and that's what we've got with the quantum plenum. The actual situation appears to be that the fundamental nature of so-called empty space is enormously energetic. It is, in fact, a very energy dense medium filled with radiant potential to degrees that far exceed, by many orders of magnitude, the energies constituting matter. I believe that this issue bears not only on bioenergetics, but it really goes to the heart of the nature of life itself.

Such a mystery, as the nature of life, I think truly requires us to be bold and explore the new frontiers of human thought for how we can come up with the means to articulate some radically unifying perspective

that can help solve this question. This area is so riddled with confusion and contradiction that in a very real sense ISSSEEM and this whole conference exists because we understand that there is something missing in our scientific understanding of life. The fact is that there is more to life than simply mechanical dynamics, and this "more" is what we have been calling "subtle energy." Yet we are very aware of how hard it is to rigorously integrate this into our existing scientific paradigm. I am going to illustrate some of the contours of the potential applicability of a number of relatively new ideas coming out of physics to the nature of living systems at the most fundamental level. This really amounts to a deeper appreciation of the nature of space and light. I'm going to discuss these . . . in a nontechnical and hopefully evocative way that can perhaps trigger and open up some new avenues of thought and imagination for comprehending the nature of living systems in this new context that I'm going to begin to illustrate.

The fact is that by many estimations there abides in one cubic centimeter of empty space an amount of energy greater than the total amount of energy contained or expressed in all of the matter in the known universe. This is a very, very profound point to seriously contemplate in our attempts to understand, not only the missing energy in bioenergetics, but the nature of life itself. I want to take some time here to evoke and unpack a little bit about what this means. In 1963, John Archibald Wheeler in his book, *Geometrodynamics* came up with a calculation from applying the principles of general relativity to the quantum realm.<sup>11</sup> He was looking at particles, not as just objects of matter, but exploring the possibility that they themselves could be seen as points of extreme curvature in the space time continuum. This means that matter itself may be nothing but space in a highly curved or distorted mode. He was exploring the idea that all matter may simply be the topological or geometric dynamics of emptiness. [His calculation in this very brilliant book has been improved upon and developed by many physicists since then]. He computed the amount of energy present in one cubic centimeter of space. And he was looking at summing the amount of energy of the quantum fluxuations as you go down towards the planck length. The planck length is  $10^{-33}$  centimeters. This is a very, very short distance. It is, in fact a distance at which space and time, as we know them, break down into a turbulent froth of fluctuations sometimes called the quantum or sub-quantum foam. At this scale there exists a very dynamic realm of fluctuations, and when you add up the total amount



of energy that can actually do work from those fluctuations, you end up with a number that's 10 to the 94th power grams per cubic centimeter. That's 1 with 94 zeros behind it. Now notice that's grams, that's a unit of mass, per cubic centimeter but as we know  $E = mc^2$ , energy equals mass. So this huge number is the  $m$  in the equation, so in order to get  $E$ , you have to multiply it by  $c^2$  which is about ten orders of magnitude more.  $C^2$  is just a large number that serves as a conversion constant between mass and energy. And so that brings us to 10 to the 104th power ergs of energy, which is present and pervading and potentiating every cubic centimeter of space. That is so much energy, just to contemplate it is very mind expanding. It is estimated that the number of atoms in the visible universe is somewhere in the order of 10 to the 80th power. So this is 24 orders of magnitude beyond that, but we're talking about grams here. A gram can include many many trillions of atoms. I did some calculations and it really is accurate to say that if you took all the mass in the visible universe and fissioned it into pure energy, into pure light, and then you took all that energy and you compressed it into a cubic centimeter, you still have to add about 24 orders of magnitude (or zero's) to that to get to the magnitude of energy that is enfolded in potential in a single cubic centimeter of space.

Now this is a completely mind blowing figure, I mean, just to contemplate it and to try to feel what this could mean is a very mind expanding practice. I've spent twenty years trying to wrap my mind around what this could possibly mean. And I've really explored it in quite a bit of depth. It points to the fact that we (i.e. our bodies) are arising in the midst of an infinitely coherent field. With the energy density of the quantum plenum so extreme, it must be an immensely coherent field. Perhaps infinitely coherent! I think it's safe to say that, but that may be partially inaccurate because you know infinity is a big concept. But I think as far as we're concerned, dealing with a number like that, it might as well be infinite. It's at least a pretty good approximation compared to the human scale of things. So we can ground our consideration of this space in which our bodies as well as all forms are arising as being a very profoundly coherent field . . . much more coherent than matter which can be thought of as arising as deformations or asymmetries within this immensely coherent and radiant quantum plenum.

To continue elaborating the significance of this extreme energy density, let's consider that the density of water is by definition 1 gram per cubic centimeter. The density of our bodies which are mostly water is slightly more than that but not that much more, perhaps 2 to 3  $g/cm^3$  if you include our bones. The density of lead is just a little more than 11  $g/cm^3$ , which for us is considered heavy. Now what is the heaviest or densest form of matter that we know of? It is the proton itself in the nucleus of the atom and/or a black hole. Protons are very tiny but they contain most of the mass of a given atom. Most of the atom, when measured from the outer electron orbit, is empty space, which in this new perspective is anything but empty. The density of the proton is actually around  $10^{16} g/cm^3$  and interestingly that is also the estimated density of a black hole, causing some physicists to speculate that protons and neutrons (which have only a slightly different density than the protons) making up the nuclei of atoms are in fact mini black holes or singularities. Now the fact that the densest known forms of matter have a density of  $10^{16} g/cm^3$  is most interesting in light of the fact mentioned above that the estimated energy density of the quantum plenum of space is on the order of  $10^{94} g/cm^3$ ! That indicates a curious fact: that the energy density of the space that we are presently pervaded by is 78 orders of magnitude (78 zeros) greater than the density of a black hole or the proton! This stunning fact is generally being ignored when it is practically screaming for attention and calling out to be assimilated into our understanding of the fundamental nature of things. The fact that 99.999999999999 on for dozens of more 9's % of the energetic field of being itself is largely being ignored by a materialistic science that instead is focusing entirely on the tiny dynamic modifications on the surface of this powerful field of radiant wholeness that we call matter, and forgetting about the rest, is, I feel, a major oversight. I simply want to initiate this issue as a topic of serious consideration, exploration and discussion for this organization. I would like to see us all join together in a creative cross disciplinary effort in bringing forth this new context involving a deeper understanding of the fundamental nature of energy as evidenced by the mysterious potency of the quantum plenum and then bring these new ideas to bear on many areas of scientific interest, issues such as bio-energetics, in a way that can help clarify and illumine the domain that we have been referring to as "subtle energies," the "life force" and the biofield. I feel that we can do this in a way that is congruent with what our great spiritual wisdom traditions are telling us about the fundamental nature of Reality which is often referred to as Spirit, a non physical field that is the ultimate source

of all that temporarily arises into form. For me it is a huge fringe benefit when our scientific models are elegantly in phase with spiritual wisdom. That is the sign that we are on the right track of the new synthesis that we are searching for.

So the articulation above by Wheeler of the energy density of the quantum plenum is only one of many different approaches in conceptualizing the nature of space at the sub-quantum level. There is the general recognition of space being filled with what is called zero point energy which is typically conceived of as being purely electromagnetic energy. It is called “zero point energy” because it was discovered that even at or around absolute zero which is, by definition, the temperature where all thermal motion is supposed to cease, there was still this irreducible motion which was clearly non thermal in nature. This energy was thus named the zero point energy and it has become abundantly clear that it is a fundamental feature of the ultra microstructure of space. The zero point energy spectrum is homogeneous (uniform) and isotropic (identical in all directions) as well as ubiquitous (being present everywhere). It also has the interesting property that the intensity of the energy at a given frequency is proportional to the cube of that frequency.

This is significant because it results in the intensity of this energy spectrum increasing exponentially with higher frequencies resulting in an infinite energy density that fills all of space. This is just another way of approaching this same fact, that we are inescapably immersed in a field of infinite energy density in the guise of what appears to be empty space. The standard approach of looking at the zero point energy filling all space as purely electromagnetic in nature, in my opinion brings with it an unnecessarily limiting assumption.

Speaking of electromagnetism in general, we all know that subtle energy cannot be reduced to electromagnetism. There is something about the life force that includes, yet transcends, electromagnetism. The Biofield is not explainable in a satisfactory way solely as an electromagnetic phenomenon. This is part of the reason that ISSSEEM was formed, to address this mysterious domain that is intrinsic to life processes that cannot be reduced to purely electromagnetic phenomena as they are typically understood in the physical sciences. This brings me to another important aspect of the quantum plenum: it's radiant aspect.

It is very important to note that the quantum plenum is also primarily characterized by radiance, which

means light. But there is more to this light-energy of the quantum plenum than what can be fully accounted for by the standard models of the electromagnetic spectrum. There is overwhelming evidence that there is more to it than that. Our existing models of electromagnetism have great power and utility but it just may be that their usefulness is limited when applied to the ultra microstructure of the quantum plenum. There is a tendency for us scientists to become electromagnetic reductionists because we have such a strong grasp of the electromagnetic field: we can measure it, we understand a lot about it's behavior as part of the material universe and have very sophisticated theoretical models of how it operates. Thus it becomes a model that gets broadly applied to many areas where it seems to fit. It turns out however that these models are not as comprehensive or consistent as one may think. Upon careful inspection, our understanding of electromagnetism has numerous holes, omissions and internal contradictions within it. New phenomena have been discovered that call for extensions and expansions of our models of electromagnetism. There are aspects to our basic models of light that do not always correspond to empirical data. It is important to remember that the map is not the territory and that we may need to extend and adapt our cartography when it comes to these mysterious micro realms of the quantum plenum. Even our models of basic electromagnetism or 3-dimensional light need more work. What we call Maxwell's equations are actually truncated and leave out a whole oscillatory component of light, the longitudinal component. So we have been operating from a truncated model of even 3-D light. That is to say nothing about our models of higher dimensional light, which are hardly ever seriously considered, and yet they may end up being the most important of all in the long run. There is clearly more to light than meets the eye!

There are additional aspects of light that are deeply connected to the mystery of awareness or sentience itself. Electromagnetism is the light that we see with our eyes or measure with our 3-D instruments, but what about the light by which we see? What of the light of consciousness, or sentience itself which enables us to be having an experience in the first place. This has been called the “inner light” by many spiritual traditions. I believe that hidden within the mystery of light (as well as space) there lies the potential for an elegant precise and deeply satisfying resolution of the long standing rift between science and spirituality. Consider for a moment that this inner light is not just a poetic metaphor but is in fact a real light that is just

different than the outer 3-D light of electromagnetism. Taking this step out of the third dimension in our conceptualizations of the phenomenon of light is a huge step in the right direction in my opinion. It seems to me a very simple and elegant yet profound conceptual leap to conceive that this inner light is actually higher dimensional light and has a physics to it that can be elucidated. Consider that this higher dimensional light is distinct yet connected to the ordinary and familiar electromagnetic field. What is this connection? This is an important question. If you add new degrees of freedom to our equations of light and you get a higher dimensional description of light which comprises a higher dimensional embedding space within which standard electromagnetism is a dynamic subset, resonating within the parameters of 3 dimensions. To put it simply, consider this rough analogy: perhaps ordinary three dimensional light or electromagnetism is a crystallized and condensed form of this higher dimensional or inner light in a similar way that mass is understood to be a crystallized and condensed form of energy. So this higher dimensional "inner light" and electromagnetism are not really separate but are distinguished by the dimensions in which they operate. If this is true there is a critical part of the energetic step-down process into matter that we have ignored because it involves higher dimensional light and we are a very 3-dimensionally focused species at this time. So much so that taking higher dimensions seriously i.e. as real, is not the norm. Perhaps there is a relationship between this higher dimensional light and electromagnetism that is analogous to the relationship between matter and energy. So perhaps the phenomena of "subtle energy" has to do with the subtle effects that these higher dimensional levels of light have on or around living systems. But this implies that there is a special attraction or connection of some sort between living organisms and this higher dimensional light that is not the case with inorganic matter. We will consider this unique coupling between organisms and these higher light fields in more depth shortly.

An important question to pose here is: how do we explore these higher dimensions? Other than using our intellect to contemplate the structure of higher dimensions as abstract mathematical structures, we can simply look within . . . because "in" is up dimensionally! The more deeply you can direct your attention to inner space the more you find freedom, inner freedom.

This is what many spiritual teachings say. As the physicists say, higher dimensions are higher degrees of freedom. That is an interesting co-relation. I believe that hidden within the mystery of light there lies the potential for an elegant precise and deeply satisfying resolution of the long standing rift between science and spirituality as well as a much deeper understanding of the deep nature of life and living systems. A simple and obvious way to begin thinking about this is to presume that there are forms of light that have greater degrees of freedom than the light of the electromagnetic spectrum. This simple assumption opens up a rich new territory for the mapping and understanding of radiance that includes yet transcends standard electromagnetism, as simply the third dimensional aspect of a multi-dimensional radiant phenomenon that surpasses the perceptible world in it's activity and dynamics.

In order to begin to understand the mysteries of life we must begin to seriously and comprehensively think of life as an interdimensional phenomena with the familiar third dimensional material bio-crystalline matrix being only the material base or foundation of a multi-dimensional process or psycho-energetic dynamic that spans many higher dimensional spectrums of light.

What we know from physics about the quantum plenum is that it is a dynamic medium characterized by enormous amounts of luminosity; that space is literally efflorescing with what are called vacuum photons. That means that light is being emitted by space itself, and emitted in great quantities. These so-called vacuum photons or virtual photons are spontaneously arising and then being re-absorbed back into the quantum plenum extremely rapidly. Space is thus a dynamic radiant medium at a fundamental level, it is in fact fundamentally characterized by the emission of light. If you actually calculate the amount of vacuum photons being emitted in the very space we're presently sitting in, it comes out to be a hundred times the intensity of the light coming off the surface of the sun. That's 100 times the brightness of the sun's corona! So we are sitting, that is we are arising in the midst of this bright radiant matrix that has this infinitely coherent and highly energetically potentated quality. So given this I think it's not such an outrageous idea to consider that this might have something to do with energetics of life at a fundamental level. I also believe that the quantum plenum has something profoundly to do with and can reveal important often overlooked features of the fundamental nature of energy itself. But looked at in the context of this mystery of life, understanding the central role of the quantum plenum really



brings us to a radically new perspective. And I mean radical in the true sense of the word, going to the root of things. Living systems are thus not arising in an empty vacuum; quite the contrary. I think that this energy filling space has to be considered in our attempt to find a coherent and rigorous way to understand the subtle energy realm in a way that is coherently congruent with empirical science, and in a way that can be articulated clearly and precisely, in a way that everyone can agree on. That is our aim here.

We know that living organisms are literally efflorescing with bio-photons which are more and more being understood to be fundamental to their functioning. Looking at life in the context of the quantum plenum we can say that because space is also itself radiating an enormously intense flux of vacuum photons they must be pervading and thus somehow influencing living systems in fundamental ways that are not yet comprehended. Perhaps all this work going on in bio-photonics needs to be contextualized within the pre existing radiant flux of vacuum photons . . . or what I would prefer to call “plenum photons” . . . that characterizes space at a fundamental level. What possible correlations between these two fundamental domains of light could there be and how may it pertain to helping us understand fundamental features of bio-energetics? This is definitely an area that calls for further attention and focused exploration.

Another unifying perspective is to look at all matter, all of manifest material existence as being a crystalline or para-crystalline manifestation. All mass can be seen as a crystallization spontaneously arising out of this radiant field. It is known in physics, though not emphasized enough, that when two photons of the right energy interact at 90 degrees out of phase with each other they mysteriously join and become an electron! Two mass-less photons become an electron that has mass! It really begs the question: what exactly is mass? It is apparently some sort of geometrodynamics or topological modification of this field of radiance. Electrons can also spontaneously dematerialize back into two mass-less photons 90 degrees out of phase with each other. So mass is in a very real sense crystallized and condensed light. The nature of mass can be thought of or modeled in numerous ways but the most promising approaches appear to look at mass as geometric and or topological distortions of the plenum, seeing mass as arising due to dynamic asymmetries in this field. Mass can also be seen as quasi-stable vortices or vortical dynamics arising in this luminous medium which has the characteristics of an incompressible super fluid

aether. The frontiers of quantum biology are calling us to fundamentally re-contextualize our understanding of life to be in alignment with our latest conceptualizations of the nature of matter or mass itself as a dynamic modification or quasi-stable dynamic field asymmetry of the indivisibly coherent and thereby invisible background field of space itself. Space not in the conventional sense of an insignificant nothing or vacuum, but instead space understood as a highly energetic medium that has the characteristics of an incompressible superfluid aether that can support sustained vortical dynamics due to its property of zero viscosity. That is what superfluidity means; it refers to a special kind of fluid with zero viscosity. Similar to the way that superconductivity occurs when a material substance has zero resistance, viscosity is the fluidic analog of resistance in solid matter. So a superfluid is a resistanceless fluid with no viscosity. The quantum plenum of space fits the bill for such a superfluid medium as it has no viscosity. That means that a vortex in it would spin forever and never dissipate. Vortexes dissipate due to the friction and resistance to the flow caused by viscosity. No viscosity, no dissipation in a vortex. One can actually think of the quantum plenum of space as being like an absolutely transparent medium, like a liquid diamond, in which we and all creation are swimming. Our bodies and all matter composing the cosmos are thus arising as quasi-stable vortices and turbulences in this highly coherent transparent medium that we rather naively call “empty space.”

I think that we need to keep our minds open to the real possibility that there is more to the quantum plenum than just the electromagnetic zero point fluctuations and that this “more” may have to do with the fundamental pre-electromagnetic nature of energy at this level. In this connection an exploration of the geometry and topology of the quantum plenum may bring forth critical insights that have powerful utility in articulating an elegant holistic framework for fundamental energetic processes that can give us a rich new framework within which we will gain new insights into the deep nature of life itself.

This creates a genuine new area of scientific exploration that we could call “plenum biophysics.” This field would embed and guide the ongoing study and exploration of life in this new and energized context provided by the quantum plenum. This is a wholly new context in which to think and re-think about the problems presented to us in biology as well as to re-conceptualize the ultimate nature of life and the physical world in general. Speaking generally in common

non-technical language, this context is the context of “infinity and eternity” or a context outside or beyond conventional space-time. This is a context that is free of the ordinary constraints of 3-D space and a context which is supersaturated with enormous vibrant potential. This contexts leads us to conceive of all matter inclusive of living systems to be dynamically arising out of a pre-physical substrate or domain of pure potential energy (which can be thought of as a kind of “pre-energy”) underlying all material forms. The quantum plenum provides a vibrant radiant matrix, a sentient dynamic medium which is the generative source of the mysterious aspects of the subtle energetic forces enveloping and sustaining living systems.

Plenum Biophysics can provide a much needed new context for the life sciences in which the vast range of new discoveries and ongoing developments in the physics of quantum plenum and in quantum physics in general can be explicitly integrated and applied to our developing models of life and the bioenergetics of cells and organisms. This brings about a marriage between physics and biology at the most fundamental level thus uniting both disciplines in an unprecedented integral synthesis.

All matter and energy as we conventionally think of them is clearly arising within a kind of pre-energetic field or continuum of enormous potential that transcends ordinary space-time as we have generally come to think about it and yet informs and infuses all material form with a vital source of flowing energetic sustenance and support. This manifests as a living flux that supports organic matter to organize into living organisms. Understanding how this flux comes about and operates in the context of living systems is an important area of scientific research that requires us to think out of the box of our standard constructs and categories that have served us up to this point, but may now be limiting our ability to see elegant solutions to these most essential issues.

An important note here is that there are presently around the world a large number of people claiming to be tapping into the zero point energy filling space and drawing useful electrical power from this field. This is a highly controversial domain of research yet quite significant in its implications, namely that it is possible to extract useful energy out of the quantum plenum.

This area of research may provide us with a seminal clue that could help answer or at least provide a new context within which to find the answer to the question of “where does the unexplained energy that drives muscle contraction (and presumably a much broader range of biological processes basic to life) come from?” It is very possible if not highly probable that this missing energy may come directly from the quantum plenum, and that living organisms are in fact uniquely geometrically designed at the molecular level to function as bio-crystalline transducers that tap into, channel and utilize the zero-point energy of the quantum plenum for essential aspects of their energetic functioning. This transductive bio-coupling with the quantum plenum may be a central yet so far largely unrecognized feature of the mysterious nature of life, a hidden source of the capacity that enables living systems to do the many remarkable things that they do that distinguishes them from non-living or inorganic systems.

From the point of view of plenum biophysics we can now shed some new light on the long standing mystery of the nature of the division between living systems and organic matter and so-called non-living systems considered inorganic and often thereby called “inanimate.” The difference between organic and inorganic matter has never satisfactorily been understood. Both systems are composed of atoms that are in the same periodic table of elements. So what is the real difference between living and non-living systems? We know that there is a difference but we do not understand that difference with enough clarity. How can certain groupings of atoms participate in the dynamic activity that characterizes organic matter including the molecular synthesis of large polymer chains, the elaborate formation into cells and DNA helixes that replicate, the activity of metabolism from photosynthesis to the oxidative phosphorylation cycle to respiration, which drives the electron transport cycle by which ATP is created, which provides an energy reaction based on the breaking off of phosphate groups from a phosphate chain in the molecule? This reaction enables the remarkable capacity for the building of complex proteins, motility, muscle contraction (in part), and the capacity for regeneration, repair & reproduction that characterize organic life from the individual cell to entire organisms. Interestingly there are vast numbers of groupings of inorganic atoms that simply cannot and do not participate in such dynamic self-organizing activity at all. There must be some subtly hidden feature within the chemistry of life that enables this remarkable energetic patterning that is characteristic of life. It is reasonable to presume that there may be

something about organic chemistry (which is primarily composed of Carbon, Hydrogen, Oxygen & Nitrogen atoms: C-H-O-N) that induces or makes possible some kind of as yet not clearly understood direct energetic exchange with the quantum plenum that provides the basis and is perhaps the essential feature of this not yet satisfactorily understood distinction between living and non-living systems.

There may be something fundamentally special or different about the atomic and molecular geometry (bond angle geometry, shape etc.) of C-H-O-N matrices that are thereby able to resonantly engage the quantum plenum such that they become capable of inductively coupling into this vast field of potential in space that is already present in the midst of any given atomic and molecular matrix. The C-H-O-N matrix may well be uniquely geometrically configured so as to be able to bio-couple into the quantum plenum and thus transduce some of its enormous energetic potential into the living molecular matrix of organic matter thus energizing and enlivening the living matrix with a current or a kind of inductive flux or subtle convection of flowing energy that surrounds the atomic matrix of life. This life current drawn directly from the quantum plenum somehow mysteriously enables organic matter to self-organize, draw more atoms into their organizing field, overcome entropy and under go syntropic evolution toward higher levels of complexity and orchestrated order. This is precisely what living systems do! There must be something unique about the geometry of the assembly of organic molecules that enables this bio-coupling and transductive relationship with the quantum plenum, whereas the molecular geometries of inorganic matter do not resonantly engage the plenum even though they are also dynamically arising out of it and not in any way separate from it. The bio-crystalline geometries of living organisms should be investigated with this hypothesis in mind. Perhaps there exists a kind of geometry or pre-geometry enfolded in the implicate order within the plenum of space that organic matter resonantly engages and couples to? It is clear that inorganic matter just does not resonate with and/or couple back into the plenum in the same way as organic matter does. Perhaps this kind of organic bio-transduction process accounts for and literally induces the mysterious subtle force field, which is called variously the life force, chi or the biofield that accompanies living systems. The autopoietic self organizing behavior of living systems may be fundamentally enabled or driven by just such an energetic exchange with the geometrodynamical topologies of the quantum plenum of space. Inorganic matter just may not have

the right structural geometries to engage the plenum the way organic matter does.

It very well may be that the difference between living and non-living systems ultimately comes down to the issue of the differing types of crystalline geometry of their molecular assemblages. There may be something geometrically unique about the C-H-O-N based living matrix that comprises organic chemistry that has a capacity to energetically, geometrically and even perhaps topologically engage and transduce energizing streams of aetheric current from the quantum plenum, which can be described as a super-fluid aether, and thereby utilizes this extra energy in fundamental energetic processes involved in living systems. This may be exactly what the life-force is actually comprised of: flux currents of the superfluid aether of space that are induced to flow into the molecular assemblages of organic matter, which by their unique geometries, are rendered "plenum interactive."

It is becoming clear that our most fundamental understandings of life are inseparable from our developing understanding of the fundamental nature of space, time, mass, light and energy.

This coherent field of the quantum plenum has the property of a fundamental pre-quantum coherence that may well be the underlying source of and basis for the important property of quantum coherence, which is turning out to be of fundamental importance in understanding the living matrix of organic matter. This phenomena of quantum coherence is a situation in which a large assemblage of quantum states comprising atoms and molecules come into a stable quantum phase relationship such that together they act as if they were in a single larger quantum state, amplifying quantum phenomena into the macroscopic domain such that quantum phenomena manifest and become operative in domains typically dominated by the rules of classical physics. Examples of this kind of quantum coherence are superconductivity, superfluidity and lasers, all of which manifest phenomena characteristic of the quantum realm in the macroscopic domain.

Another conceptual perspective to explore is that living systems may well couple into the higher dimensional light, which is enfolded within the quantum plenum, and thereby may translate and contribute some of its higher dimensional pre-energetic potential into the energy that drives living systems. This model necessarily involves some fundamentally new or extended concepts of the nature of energy. This is an important

area for future research. Understanding the nature of energy much more deeply will give us a richer context within which to understand the nature of life. Perhaps the source of the “unexplained energy” driving living systems has been missed because is not located in the third dimension. It is perhaps invisible and non-linearly enfolded into the dynamic quantum plenum. I’m saying that the power source for certain aspects of living systems may be a higher dimensional potential which may be somehow translated into utilizable energy in living systems.

The exact nature of the bio-coupling mechanism that effects the translation of the indwelling energy potential of the quantum plenum into useful energetic currents which can supply the necessary force to augment bioenergetics such that the “unexplained energy” mentioned earlier can be satisfactorily explained, has not yet been adequately articulated or even conceptualized. Nevertheless I believe that we have a powerful clue to this mystery in the fact that there lies an indwelling reservoir of immense energy within the very structure of space itself, which radiantly pervades all living organisms as well as all that arises into material form. It is clear that material form—mass and matter—is in fact nothing but a specific class of dynamic modifications of this pervasive medium which we call space. It is worthy to note that this perspective is precisely congruent with the perspective articulated in the Heart Sutra of Buddhism considered to express the pith essence or Heart of the Buddhist teachings: “Form is nothing but emptiness—emptiness is nothing but form” We are here beginning to see the outlines of a very elegant rapprochement between our scientific models and time honored spiritual wisdom.

It is interesting to note that light and space are the two great common metaphors that mystical spirituality (which has surpassed and transcended anthropomorphic conceptions of God) uses to refer to the nature and divinity of being. These are also two areas of focus in science that are undergoing fundamental new thought and re-definition. It is thereby interesting to look at whether these new and emerging scientific perspectives can offer us an opportunity to redefine our scientific framework in ways that are more congruent and continuous with the spirit based frameworks of our spiritual traditions. This new adaptation of science to a context congruent with fundamental spiritual wis-

dom or dharma may also help us gain newfound clarity and deeper insights into the hidden depths and deeper meanings encoded within our spiritual wisdom teachings that have been around for millennia.

And this brings me to another key feature of space which I would like to offer and propose as a critically important feature of a new scientific understanding of space that helps us re-introduce sentience into our worldview at a fundamental level. That is the recognition or understanding or active assumption that space is characterized by intrinsic sentience or a primordial awareness that is independent of matter and organisms. Taking this simple leap by embracing this as a working assumption, in one sweep, resolves a vast philosophical and epistemological rift at the core of modern science. We have been toiling under a matter-based paradigm in which matter is assumed to be fundamental and fundamentally insentient or inanimate. Yet somehow large assemblages of matter in the form of living organisms like ourselves are endowed with conscious awareness. How can this be possible? Well science has generally presumed that consciousness is an epi-phenomenon of matter, that is, it is seen as a secondary derivative of matter, which is seen as primary. With our new understanding of the nature of matter as being derived from space we have to wonder what role space plays in the mystery of consciousness or sentience. Could it be that space itself is conscious? Perhaps space or the quantum plenum is endowed with a kind of intrinsic sentience or awareness that is not derived from anything else but is simply the underlying primordial condition of existence. What if Mind in its pure unconditional nature is co-extensive with space and manifests its dynamics via the effulgent display of manifest existence arising from the dynamic patternings of space. This simple yet profound assumption, the assertion that space itself is fundamentally sentient, is not a new idea at all. It is explicitly stated as a fundamental principle throughout the world’s spiritual and mystical literature. Yet taking it seriously as part of a new integral scientific perspective effects a sweeping unification of our scientific models with time honored spiritual wisdom and resolves a whole raft of philosophical problems. For example, it fundamentally impacts and alters the context of the so-called “hard problem” of how is it that we can be conscious at all. This problem is so “hard” because it is asked from a framework that presumes a material world that is inanimate and insentient and then tries to imagine how it is that such a world could give rise to beings that are able to have a subjective dimension of inner experience. How could we be conscious in such an inanimate world? But if sentience



is understood to be intrinsic and primordial, pervading space, time and matter, then the question is turned around and it becomes hard to imagine how we could ever think that being conscious and having a subjective dimension to our existence is unusual or hard to understand at all, in terms of a new sentient scientific framework.

Perhaps the higher dimensions of “inner light” are also intrinsically sentient or aware and have even greater degrees of freedom to radiantly extend this effulgent awareness through the infinite expanse of being? Such perspectives are common in spiritual maps of Reality. However they tend to be ignored or marginalized as not worth taking seriously, as if they are not telling us something important about the nature of the field of being in which our universe is manifesting.

I hope that we can start to put the power of science in the service of the spiritual and emotional awakening and liberation of our species. This would powerfully support the process of awakening from the blindness and darkness of our collective ignorance, part of which manifests as our obsessive and myopic focus exclusively on matter in a way that it is seen as a solid and opaque end in and of itself. Science has really become obsessed with matter as if that is all there is to existence while ignoring the even more substantial yet invisible underpinnings of matter that comprise what we perceive to be empty invisible space or simple nothingness. One of the greatest discoveries in modern science is that this nothingness is something, a very substantial something in fact, the ignore-ance of which leaves us stranded in a very impoverished materialistic worldview. Such a worldview that sees space as a dead insentient vacuum is basically a worldview of scarcity, whereas with the discovery that space is a radiant plenum we can begin to establish, in a rigorous and scientifically sound way, a perspective that reveals that our universe is at bottom an infinitely abundant field of radiant potential. Taking this seriously has a huge impact upon not only our worldview but also, and perhaps even more importantly, upon our self-image. If we see that space is a dead empty void, and that we are utterly pervaded by this void such that our bodies are 99.99999 . . . with dozens of more 9's % empty void, what does that say about our ultimate nature or sense of who we are? Are we just our bodies or is there something more to who and what we ultimately are? Are we just a fragile atomic and molecular lattice suspended in the void, or is there something more to us than that? When we come to understand that space is a highly potentiated energetic medium shining with

vast luminous force and shimmering with intrinsic sentience, this certainly engenders a completely different sense of what underlies our physical organism. This understanding can lead us to quite a different self image, to put it mildly. This infinite potential and radiance is continuous with what we are.

Such a perspective gives solid scientific footing to a fundamentally abundance-based world view which is a much needed antidote to the scourge of nihilistic materialism and the fear and scarcity-based world view that our culture suffers from and which is a major contributory factor to our species collectively behaving in ways that are a menace to our living planet. When you really understand that solid matter is not solid by any means, and your understanding of this can penetrate beyond just the intellect and enter the domain of direct experience or felt immediacy, matter, then, really can dissolve before our scientifically informed and experientially attuned eyes (and other senses) into an insubstantial web of interconnected fields that are actually arising from a much deeper, non-material, yet highly substantial source.

Such a rigorous and clearly articulated scientific perspective that sees through matter to its deeper originary substrate in space is an important feature of a post-materialist science of abundance. This new spirit-based science would be based in an indivisible and invisible unitive order, the ultimate nature of which goes beyond that which we know how to analyze. Requirements for making progress in this new science are more like yogic abilities than just intellectual acumen. Both are required and integrated together into a new disposition of scientific exploration. Such a disposition requires a sincere, tenderhearted determination and courage to investigate the immediacy of pure, uncompounded direct-lived-through and felt experience. Because the field is sentient, it can actually be felt and embodied as our ownmost being. This is a very important aspect of this participatory science that distinguishes it from standard scientific approaches, which are often profoundly disconnected or dissociated from feeling, from the felt sense of our bio-energetic qualities of our embodiment, and instead take place purely in the abstract intellect.

There is abundant evidence from advanced practices of human energy cultivation that if we can become more aligned with this immensely coherent background field we begin to manifest some of these remarkable macroscopic quantum states in our own bodies and literally demonstrate miracles. Because in this new context



many so called “miracles” and paranormal phenomena are very comprehensible, and would even be expected, in the context of a field of this much potential. The question then becomes, why are such demonstrations of coherence and radiance in the human energy system not more commonplace?

I feel confident in saying that this field is what people who have profound and transformative spiritual experiences have direct experiences of in a variety of ways. In certain states of integration and balanced unfolding of our nervous system we can enter into varieties of coherent states where we are able to directly feel the seamless coherence, radiant contiguity and boundary-less qualities of the quantum plenum. Such experiences liberate one from the dense confines and material limits of the organism—and allow one to feel ones continuity with this radiant edgeless field. Presumably it is this field of the quantum plenum by which our human experiences of infinity, peace and unity with all existence are mediated. Such domains of experience are examples of actually touching, with our feeling body, this all-pervading coherent medium of the quantum plenum.

It is important here to point out that the ultimate new synthesis that we are aiming for requires not only new ways of thinking but new ways of feeling, it requires us to rehabilitate our capacity for feeling throughout our organism as a whole. We must learn how to drop out of the conceptual verbal mind and engage directly with our sense fields, our whole bodily felt sense. This enables us to feel the field that we are describing in our models. It is fundamentally important that we actively participate in the process of sensing and exploring this field through feeling and not only through thinking about it, which is a step or two removed from and abstracted away from the field itself, but through opening up directly to the quantum plenum which is enormously available to feel whole-bodily if we allow and train ourselves to develop and cultivate our organic sensitivity to this underlying field.

In my opinion it is desirable to have a science that is phenomenologically congruent, that is, a science that is in phase with what it actually feels like to be alive. The actual feeling of being which is experienced via the whole body as a vibrant sentient unity, is something that is so important to pay attention to as a way of col-

lecting “data” about the nature of this field that we must take into careful consideration as we evolve our scientific models. The fact that we can feel the field that we are discussing here is extremely important.

Another desirable feature of such a science of sentience would be what I call “phenomenological utility”, meaning that our science would provide us with the direct means to deepen the qualitative richness of our felt sense of being alive in this moment. It would provide us not only with precise conceptual maps of the luminous energetic territory in which we are arising but also would provide us with a practical tool-kit of awareness practices for dilating and refining our feeling function, thereby enabling us to enter directly and deeply into experiencing this vibrant and blissful territory as a sensitized whole-body, as a feeling body-mind.

First we need to arrive at a new set of understandings that are at once scientifically lucid, conceptually clear and rigorously tied to empirical data as well as being phenomenologically congruent with our direct experience of being alive. Then we can go forward in working on more important and immediate things, like how are we as a species going to learn to live together harmoniously on our planet. How are we going to heal the damage we are wreaking on the biosphere? There is an awful lot of human energy bound up in conflict of all sorts in our world. In science this conflict manifests as disagreements and debates over conceptual models. I feel very strongly that the crisis that we, as a species, are imbedded in and generating for ourselves really calls for us to be able to learn how to overcome our tendency to polarize around preferred maps and conceptual models and learn to see the insignificance of our conceptual differences compared to some deeper and overarching themes. We need to come together and unify around some very fundamental universals, which provide a primary common ground that we can all agree upon despite our use of differing mental maps of reality, be they scientific or spiritual. Then on that basis we can get on to the work of redesigning our whole planetary civilization in a way that is sustainable, just, peaceful and such that it can work for everyone into the far future. We don't have to all think alike, thank God, but it would be very good to have a much better articulated common ground upon which we all can stand and co-operate toward common goals from this ground of a basic compassionate consensus. A new spiritual-scientific synthesis could provide just such a grounding for this kind of solidarity, and could serve to invigorate new kinds of planetary, cross-cultural and interfaith dialogs that could go a long way

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medicine. I do not know how it is going to get manifest, I do not know how it is going to effect the better part of the public, but one third of people already go to alternative medical healers and practitioners in the United States. Conventional medicine is getting far too expensive. Forty to fifty million people have no health insurance because they cannot afford it, and Medicare may cover less. The driving forces, some actually seem negative, but they're going to push toward a positive end result.

## Our Environment and Us

We had one of the most unusual solar cycles this last time of high solar activity, which lasted a long time. The sun is talking to us, giving us electromagnetic energy that does affect our brain waves. The energy flows through us, and all these natural frequencies effect us. So some of it is subtle and some of it mediates through the electromagnetic spectrum. We had, in the past, mechanical medicine in setting bones, chemical medicine in taking allopathic remedies or medicine that has not been a gentle medicine. Some of this medicine is extremely useful. Now there's a new wave coming for some of these methodologies that is going to be synergistic to current modern medicine.

Sometimes one needs to take antibiotics, but the synergy is going to come together for the viable parts of current medicine and new concepts in medical practice. There is going to be a new thrust to move in the directions that we in ISSSEEM are researching and applying and we are on the forefront. We appear to have been thirty years before our time, but the new wave is catching up to us, and we are going to be able to catch this wave and it is going to carry us to some places that we probably cannot even imagine.

We live on a very beautiful planet. I always thought and felt since I was a child (I grew up on Indian land) that everything was alive. Think about it, everything in your life supports you. Your car supports you, unless it runs out of gas (but that's your problem), your house keeps you sheltered, and the world in which we live supports us when we are living in harmony with all existence. Plants, animals, rocks and the sky support you. If you feel that feeling that everything has its identity and reality, everything has its

“being-ness,” there is an interconnectedness that feels wonderful. That is part of energy medicine, the inner connectedness of people that can make healing possible; healing and learning more and a new tomorrow. We are making strides and understanding the nature of reality through some aspects of physics, the physics of non-locality and remote connectedness. Remote connectedness, the universality and unity of consciousness and higher states of consciousness which also include psychic phenomena and psychic healing. A new field is emerging to encompass one's personal being, one's state of health, one's personal responsibility. A new cycle of self-awareness and consciousness, which arises, will eventually affect society as a whole. I will discuss the tools of science and the powers of mind and I will make some predictions about the future. We are on a new threshold of new knowledge. My predictions are based on the fact that I not only traveled in my mind but I traveled physically through the far reaches of this planet and had a great time doing it.

## Health is All

The unity of mind, body and spirit is essential to the natural order of the universe, and the restoring force creating and maintaining life health. Health is everything, in the sense that health is all aspects of the whole person; health and happiness are natural states of consciousness. Yet the current view in many cultures including the western European culture, which also dominates America, is that optimum health is unusual and not the norm and happiness is rare. Current healthcare practices are basing treatment on pathology. As one medical practitioner said, he could not obtain a grant for research on health, but could very easily get funding for researching pathology.

There appear to be “two forces,” one toward health and ease and one toward illness, dis-ease, unease or not ease. The fundamental nature of health and healing operates at many dimensions, of physical, mental, emotional, and spiritual levels. Healing is an individual as well as a collective process; an individual can maintain health in a more optimum degree in a healthy society, and a healthy individual can contribute significantly to the society as a whole. In the broadest interpretation of healing, it is a global dimension that connects all individuals in the global sphere. The parts and wholes are connected, the universe is a single inter-connected organism, a great unity; all is inter-connected locally and non-locally. Anything that affects a part affects the whole. This is the grand scheme of things. Pythagoras of the Pythagorean

theorem said that he was a seeker to attempt to discover the laws governing the universe, the unity that binds mankind, the earth together. Nothing is without meaning. We affect our state of health through our thoughts, our sense of the whole and the concept of our place in the universe. The consideration that it all is alive and interconnected gives us a larger sense of self, and our ability to overcome adversity and illness. The mind, body, and spirit must work in harmony for optimum health because it's not just physical health we seek, but our whole health and that of society and the universe as a whole.

Everything is in flux and change, everything in our environment, ourselves, our relationships, are in flux, ever-changing. We must recognize this fact because, if we are ill, we can move toward health, which is a restorative force. The state of our health is a measure of our attunement with our environment and our own being. An optimum state of health is achieved by maximizing harmony between ourselves and the universe. This concept is expressing from my heart my feeling about the nature of things. Some of you may have seen the movie *The Butterfly Effect*, in which the main concept, which has been talked about for a number of years, is that whatever happens in one local space and time affects the whole universe. I thought as a child, that thoughts are real. Whatever I think really does affect the whole universe, and it is our responsibility to think about what that actually means, that is to realize how important what we do and think really is.

There are principles in physics that indicate this holds true. In quantum mechanics, we can say that it matters *when* we look at a certain event and what matters in relativity is *where* one looks, and this determines what we perceive. These principles involve the frame of reference of the observer, and the quantum theory, which demonstrate remote connectedness via Bell's Theorem. Physics principles are speaking to us about this interconnected reality, so our observation perspective affects what we see. It is by our observing and participating that we actually change the universe. One of the principles we need to consider is that every thought and every action affects what we are observing. We have the universe here in our eye, and we're looking at the universe, but our looking, our observation, our thoughts, all are real and all affecting reality.

## The New Physics

When I started talking about non-linear processes in 1960's to the physics community, who like to make linear approximations only, I was almost thrown out of the physics department. They did not accept non-linear phenomena like they are today. So, the question is, what is reality? It does depend on your point of view. What is life, what is the basis of life? Far from equilibrium, non-linear energy flux, subtle energy information and resonance all have to do with all living organisms' functioning. These principles are displayed in current chaos theory, the theory of nonlinear phenomenon and fractal geometries in physics.

We can ask what are the methodologies which people are using to examine the most extreme opposites, the mystical and the scientific? Science is knowledge ascertained by observation and experiment, critically tested, systematized and brought under general rules and laws. Mysticism is the belief that the most reliable source of knowledge is intuition rather than reason or the scientific method. Immediate and true knowledge is obtained through a direct experience that it does not depend on systematic mental activity or sense impressions. But, in fact, true science combines these principles because one must have the intuitive information first which tells one what to look for by the scientific test and experimental method. It is that spark that tells us what experiment to conduct or what theory to construct. I have literally dreamed up equations, which were published in physics journals, so direct intuition occurs, but I did not tell the journal editors this fact. In fact, the basis of one of my books on general relativity came when I was on a field trip studying lichens out in a cow pasture taking close up photographs. That night I dreamed this one equation,  $F = c^4/G$  to use in Einstein's field equation and then, you know, the old calculators had that red error bar that came up when you divided by zero. I was attempting to plug the numbers in to my new equation in my dream, and the big red error bar came up in my dream and woke me up. I wrote down the equation and I said, "I'll figure out what numbers I substituted incorrectly into the new equation," which I did. It was very interesting. Being purely mystical without the basis and the grounding in the physical plane is inadequate and part of the whole. One must examine things in detail by the scientific method. A happy blend of science and mysticism are necessary. There are some experiments that one does not replicate too often. We have to examine not always having to replicate everything, because it's not possible in our life, i.e. one's birth.<sup>1,2</sup>

## Our Laboratories and Research on the New Medicine

My husband and I set up three laboratories. I will present some of our research and the manner in which our work demonstrates an inner-connectedness between certain frequencies of electromagnetics in the solar system, and certain effects on biological systems. Some of you knew my husband, William Van Bise, who recently went to another dimension. He passed away in February 2005. Through our relationship I discovered some things. Number one, its great to find someone that loves you and that you love, but it is sure difficult when they are not in physical matter anymore. But I did feel a strong sense that he was at peace. The research I will discuss is joint research by William and me. We were colleagues, husband and wife, co-inventors, and watched the same Rambo movies together. He really was into action movies and he got me listening to things I would not have listened to otherwise. Co-partners, we formed several corporations together, we spent a lot of time together for the last twenty years, so I did notice a large change in my life early this year with his change of venue.

We are on the threshold of a new medicine, and what I'm going to talk about is some specifics of it, and contrast it with a conventional view of medicine. We determined certain frequencies that affect brain waves of humans, and canines which is one of the main frequencies that is emitted by proton interactions with the upper ionosphere. We detected this frequency and other major earth and ionospheric frequencies from an electromagnetic and magnetic detector that we patterned together. The relevant frequency is around 9.4 hertz, which can pace a dog's heart. (We did canine studies when we did our FDA studies.) It also affects human brain waves, so maybe there's some relationship between dogs and people. Solar flare activity interacts with the earth, and it is electromagnetic. We have this whole electromagnetic environment that encompasses everything that we experience and do. Bill had conducted some research in the late seventies, and what he found was that 9.4 hertz emitted during solar flare activity affected people's brain waves. This is just one example of many environmentally emitted frequencies that affect all of us. This frequency entrains and drives one's brainwaves at about an alpha frequency, which is a relaxed state of mind. Collective behavior changes over time, for examble one may notice when one is driving one can notice changes in driving behavior during high and low solar flare cycles. The area of research that Bill and I conducted much of our work in is what is termed

the extremely low frequency end of the electromagnetic spectrum. We studied in detail biological frequencies of brain waves, cardiac rhythms, and fundamental aspects of biologic systems, including some of the muscle contraction and bone resonant frequencies.<sup>1</sup>

### Subtle Field Effects

Bill and I both started out as skeptics about the concept that such low intensity and low frequency fields would affect humans and animals so profoundly, but years of research demonstrated how sensitive we are to natural environmental fields and highly specific wave forms, intensities and frequencies, natural and of man-made generated fields. Magnetic and electromagnetic fields emitted from the earth are fundamentally related to life, which evolved on the planet. These fields are varying and some came from the sun and interact with the earth and the ionosphere of the earth. There are many frequencies and waveforms that have little effect on us.<sup>4</sup>

Bill conducted a pilot study of ten human subjects. Temporary changes in brain waves and behavior were seen on exposure to power densities lower than  $10^{-12}$  W/cm<sup>2</sup>, which is substantially below typical urban levels. He found highly significant responses in brain wave signature to very specific radio frequency fields. These frequencies included .1 to 960 MHz continuous wave and 8.5 to 9.6 GHz pulse modulated waves. Effects were observed at very specific frequencies. Since the relaxation frequency of protein-bound water is considered to fall between 100 and 1,000 MHz, absorptions and quantum effects may be the mechanistic basis for the electroencephalogram changes observed in most of the subjects produced below  $10^{-12}$  W/cm<sup>2</sup> cw radio-frequency energy of between 130 and 960 MHz. Constructive and destructive interference patterns from standing waves within the skull possibly interact with the bioelectric generators in the brain, since electroencephalogram wave amplitudes and frequencies increased or decreased respectively at different highly specific radio wavelengths.<sup>5</sup>

I will outline some of Bill's and my research in monitoring natural and man-made magnetic and electromagnetic fields and the detailed examination of specific field effects on human physiological parameters. In other words, we both have the scientific "obsession" of trying to find out what is really happening on this planet and in our lives. Some things we found were quite astonishing to me, in as much as it appeared highly unlikely that electromagnetic energies with power levels as low as a picowatt appeared to have sig-



nificant effects on the brain waves of humans. It was also surprising to us that the frequencies and power levels, which affected a particular person, seemed to also affect other people in a similar manner. The research, which Bill and I pursued, led to two distinct and specific regions of the electromagnetic spectrum. These two regions are the ELF and RF-microwave ranges of the spectrum.

The effects that we found in these frequency regions on humans appeared so unlikely that this fact prompted us to read all the available literature we could find on the subject of the biological effects of electromagnetic fields. Some of the frequencies that affect the tiniest atom also probably affect the largest aggregates of galaxies. We believe that there are natural laws that should be investigated by man and if these laws are not diligently sought after and studied, then man is doing a dis-service to himself and his creator. We both searched for the facts underlying the ideas of these truths. We developed the prototype of a very sensitive magnetic and electromagnetic field detector having a sensitivity of  $10^{-10}$  Gauss, the T-1050 detector that we patented.<sup>6</sup>

## Medical Devices

We have also developed and patented a completely external non-invasive cardiac pacemaker, which has undergone preliminary FDA testing<sup>7</sup> and a non-invasive pulsed pain reduction device and method of treatment which we will discuss here.<sup>7-9</sup>

There has been a great deal of interest in a number of laboratories and institutions on the beneficial effects of pulsed magnetic fields on humans. There is the excellent work of Robert Becker and W. Ross Aden on continuous and pulsed magnetic field. We have found certain highly specific frequencies, intensities and pulse repetition rates that affect and appear to enhance biological functioning. We have developed and applied an electromagnetic and magnetic field emitter system to patients with chronic back pain. Applications of a multi-frequency field signals from a series of emitter coils has been made to patients who reported experiencing low back pain from two to twelve years and had tried a number of modalities for pain relief with little success, prior to entering our FDA approved, two month study we conducted at the Sierra Pain Institute

in Reno, Nevada. This treatment method is completely non-invasive. Stable baselines for reported pain levels were obtained from each of the subjects for up to five weeks prior to initiation of treatment. Treatment consisted of trigger point determination and the application of the emitted signals from small coils to the site of injury and secondary points. It was found that there was a reduction in subjectively reported pain using a visual-analog scale or VAS. The pain reduction was statistically significant at the level of  $p < 0.02$  for each of the patients. The overall significance for the four subjects studied, for independent probabilities, gave a significance of  $p$  less than one in 10 million.

Recently, it has been discovered that in living systems, there are far-from equilibrium processes, which are very sensitive to certain power, frequency and wave form "windows" of very weak low intensity electric and magnetic fields. The intensity of the magnetic field signals are interpreted by the body as being a part of its own electromagnetic biochemical and biocybernetic signal processing. In living tissue, the informational channel appears to be a frequency of phase-shift modulated flux-coupled system. This is one example in the use of complex, pulsed magnetic fields to enhance biological functioning and gaining a better understanding of bio-informational processing in humans.

Our new device system and methods utilize highly specific externally generated pulsed magnetic fields that normalize neuronal processes, reduce and eliminate chronic or current injury and post operative care and other sources of pain. In other clinical trials we successfully treated reduced pain in selected cases of sciatica and other sources of pain including current injury and surgical recovery. Single and double blind studies were conducted and compared against control runs (with the device in a non-active mode). This is possible because the patients, technicians and medical personnel cannot directly sense this non-invasive method of our pain reduction treatment.

Lower back pain and stiffness can occur from changes in vertebral osteoarthritis (which occurs to a greater extent among women) or fibromyalgia (which is more dominant in the male population). Pain is the number one medical complaint and heart disease is the number one cause of death. Over forty percent of the U.S. population suffers from chronic back pain and over seventy million people suffer from some sort of chronic pain in general. At some point in their lives, over ninety percent of the population will suffer temporary or debilitating back pain. Other clinical studies were



conducted with success on forty-six patients in chronic pain and a selected number of surgical recovery and current injury patients. Short and long-term pain reduction was achieved in over 89% of treated patients. Further treatments increase the efficiency of the pain reduction system. New clinical studies are in progress.

These new medical devices are based on new principles that involve nonlinear neuronal and biological system informational models. These concepts involve the fundamental idea that the treatment of cardiac abnormalities, pain and other diseases must be understood to be partially or wholly disruptions in the normal informational processing channels of the human body and that abnormalities in these channels can be corrected by externally applied dynamic pulsed magnetic and electromagnetic fields which carry the appropriate nonlinear information which matches those of healthy organs and tissues. The body reads these external informational pulses as though they are its own and normalizes to them, thus restoring appropriate and normal functioning. We apply these principles to correcting cardiac abnormalities and pain reduction.<sup>7,8</sup> Pain is understood to be an abnormality and therefore normalizing the system reduces and eliminates pain for long periods of time instead of masking pain with drugs or other procedures.<sup>10</sup>

### **Our Purpose**

Our purpose in this work was to increase the quality of life and to open the door to a new and gentler medicine.

From our environmental field measurements and our extensive measurements of human physiological parameters such as EEG, EKG (electrocardiogram) and GSRG (galvanic skin resonance) we have found not only specific frequencies that effect us and enhance our health but also that we respond to specific natural frequencies in our environment. We are very sensitive to these frequencies and we respond to them. Yes, we are extremely connected to all nature, as we are nature. There are many aspects to energy medicine.

### **Assisting the Blind to See**

The nature, structure and function of the brain and the human mind has been a source of fascination and investigation for many centuries. In the twentieth century, several major steps have occurred which have led to significant information as to the manner in which the mind functions. These discoveries have involved improved knowledge of the structure of the brain,

development of the measurement techniques of EEG and MEG, apparent specifics of known functions and anatomical structure of the cortex, subcortex, hypothalamic and reticular regions, individual neuronal mappings which may be modified by function and usage, and chemical-electromagnetic modification of brain activity and function from external sources. Our research conducted by us at Tecnic Research Laboratories of California and Arizona incorporates the use of spatially transmitted low intensity pulsatile complex magnetic field wave forms to modify brain waves and thought patterns in human adults.

We noted that as the complex interactive magnetic wave forms were varied, changes in brain waves occurred. Rapid transitions in the EEG record were observed to be correlated with the specific interaction of multiple frequency fields. Both the emitted fields and brain wave readouts were simultaneously fed to permanent recording apparatus. Care was taken to prevent direct inductance or cross talk from the emitted fields into the EEG system. These experiments have been conducted with several hundred male and female human volunteers, ranging in age from 18 to over 80. Work was conducted with Ph.D. research colleagues. We found that there was about an 85% to 90% replication in response between the specific form of emitted waves and EEG and EKG response.

Two males, ages 29 and 42, each reported five correct images corresponding to specific and unique field emissions in proper sequence with no errors and the third subject, age 45, reported eight images correctly. These were the total number of images used in each run, which were remotely injected into their brain from a half meter from their left hemisphere. Records of the wave form displayed on oscilloscope and/or chart recorder, after the subjects response, corresponded to the subject's description in double blind judging of subject response to wave image form.

Some example wave forms we projected, and how they were perceived, were a figure-eight (two sine waves cut out of phase making a figure-eight or infinity-like sign), perceived as a figure-eight, a "parabola just went by" corresponding in time to a parabola image, "a spike right there" corresponded to a spike wave. One subject said "I see a series of rectangles" which corresponded to a displayed field of two triangle waves positively and negatively going, which compressed a series of rectangular shapes with top and bottom vertices 90° from the horizontal and the other vertices on the horizontal, like a string of boxes with corners touching.

Control runs, in which fields were either not generated or generated at the incorrect intensities, frequency and wave forms were used and elicited no response from the subjects. On and off periods were not known to the subject who was housed in a separate laboratory room from the generating and recording equipment. The subject was asked at the beginning of the session to report what came to his mind.

It may be possible to mate the system developed by Bill and me to other machine vision systems with the appropriate software. Such a program would involve some of the following areas of consideration and procedures. In order to develop a machine-vision system that can be utilized by the sight-impaired, we need to consider the camera hardware, software, environmental information encoding and display, and emission of field in a form that can be integrated by the human brain's visual interpretation mechanism. Such results comprise a major breakthrough in understanding the information processing technique of the human mind.<sup>4</sup> These results have vast implications for health and knowledge. The Reagan White House spent a week discussing applications of our research.<sup>12</sup>

## Conclusion

There are all kinds of modalities that we can interface through this interface of electromagnetic fields to assist people, and increase the quality of life. Health is the basis of our being in the state of awareness and consciousness, it is personal but it determines the state of being in the cosmos. It is through our personal state of body, mind, and spirit, that we observe ourselves and our environment. The balance of body, mind, and spirit are necessary for the full appreciation of life. We can learn lessons in illness and vast lessons in health. Viable health allows us to have the zest for life. Bill pointed out that it is impossible for anyone to begin to learn what he thinks he already knows. I was a delegate at the United Nations on long term energy sources that are not fossil fuel based. I also spent some time living with the Hopi people. I really felt at home in Hotevilla in Arizona. I grew up on Indian land and have traveled all over and studied Eastern religions. This is a quote from Ed Mitchell, Appolo 13 astronaut, whom I met a number of years ago. "There are no unnatural, or supernatural phenomena, only very large gaps in our knowledge of what is natural." We should strive to fill these gaps

of ignorance, and I think that is what we are attempting to do through ISSSEEM. In science, we leave out the mind, but we cannot, because motivation, purpose, desire and intention are affecting us and we in turn affect our scientific instruments, and thus affect the outcome of one's experiments. We can no longer exclude mind in our research and our thinking about what is going on in the world. Physicists have gone through years of looking at individual particles, the separateness of all existence, but in fact there is a universal connection of all things.

This is a poem I wrote. "In each flower's face there is a touch of the infinite. Appreciate, find a measure of joy there. It is the cosmic joy that we seek. To transcend ourselves to the infinite and absolute bliss, and one flower or more is a pathway there." This is a saying I really care much about by Albert Einstein, who was one of my idols as a teenager. I thought Paul Newman was cute but I really thought Einstein was fantastic! So that is one of the reasons I went into physics and not acting. Einstein said, "The most beautiful and the most profound emotion we can experience is the sensation of the mystical. It is the sower of all true science. He to whom this emotion is a stranger, who no longer can stand rapt in awe, is as good as dead." This is my view of the mystical idea, and the mystical idea of what God is.

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## REFERENCES

1. E. A. Rauscher, The Unity of Consciousness Experience and Current Physical Theory, *Subtle Energy and Energy Medicine* **15,2** (2005), pp. 87-116.
2. E. A. Rauscher, Quantum Mechanics and the Role for Consciousness in the Physical World, *Subtle Energies and Energy Medicine* **16,1** (2006), pp. 1-42.
3. E. A. Rauscher & W. L. Van Bise, Response of Physiological Parameters to Low Frequency and Low Intensity Pulsed Magnetic Fields, *Frontier Perspectives* **8** (Temple University, Philadelphia, PA, 2003), pp. 26-32 and references therein.
4. E. A. Rauscher & W. L. Van Bise, Magnetic Field Interactions with Macro Biological Systems with Application of Effects on Physiology and Consciousness in Humans, *Energy Medicine Around the World* (T. M. Srinivasan, Ed. Gabriel Press, Phoenix, AZ 1988), pp. 205-218.
5. W. L. Van Bise, Low Power Radio-Frequency and Microwave Effects on Human Electroencephalogram and Behavior, *Physiological Chemistry and Physics* **10** (1978), pp. 387-398 and P. L. Stocklin & B. F. Stocklin, Supporting the Results of Van Bis, *Physiological Chemistry and Physics* **13** (1981), pp. 175-177.
6. E. A. Rauscher & W. L. Van Bise, Non Superconducting Apparatus for Detecting Magnetic and Electromagnetic Fields (U. S. Patent No. 4,724,390, 1988).
7. E. A. Rauscher & W. L. Van Bise, External Magnetic Field Impulsed Pacemaker, Non-invasive Method and Apparatus for Modulating Brain Through an External Magnetic Field to Pace the Heart and Reduce Pain (U.S. Patent No. 4,723,536,

February 9, 1988).

8. E. A. Rauscher & W. L. Van Bise, Non-invasive Method and Apparatus for Modulating Brain Signals Through an External Magnetic or Electric Field to Reduce Pain (Patent No. 4,889,526, December 26, 1989).
9. E. A. Rauscher & W. L. Van Bise, Magnetic Control of Lower Back Pain (FDA-IDE No. G880034, February 3, 1998, Food and Drug Administration, Silver Spring, Maryland).
10. E. A. Rauscher & W. L. Van Bise, Magnetic Control of Low Back Pain, *Bulletin of the American Physical Society* **34** (1989), p. 109.
11. E. A. Rauscher, A Mathematical Theory of the Pulsed Magnetic Field Pain Treatment System (PMFM), Tecnic Research Laboratory Report PSRL-12764 (1985), pp. 1-53.
12. K. McAuliffe, The Mind Fields, *OMNI Magazine* (February, 1985), pp. 41-44, 96, 98, 100, 101.

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## Comings

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toward engendering peace and unity in our troubled world. I believe that a deeper comprehension of the centrality of the quantum plenum as a fundamentally important and yet often ignored feature of our universe provides a strong basis and fertile ground from which we can enhance our scientific maps of the phenomenon of life, as well as find deep commonalities between these new emerging maps and sacred & spiritual perspectives as to the ultimate nature of Reality.

The underlying feeling of being itself is an expression of this radiant, transcendental, all pervading plenum of pure being. This field is directly equate-able to unconditional love . . . it has no edges and we are all ultimately That! We are all emanations of this singular unlimited unified field . . . this is indisputable.

We ARE the plenum! We are utterly continuous with this field; there is really no separation at all anywhere except in our divided and dividing minds. It is an artificial dichotomy to say that there's matter and the quantum plenum; there really is only this singular shining radiant field that takes the form of matter as an integrated complex of asymmetries or vortices arising in this field that otherwise remains ever present as pure coherence, as un-manifest force at infinity, invisibly shimmering with infinite potential which radiantly pervades us and all that arises into form, as it is the very source condition and ever-present context of all existence. It is this unified field of pure potential that holds great promise as a new context in which to reconceive our deepest comprehensions of the phenomena of life.

1. From the 2004 ISSSEEM conference.
2. From *The I Ching* and also the frontice piece for *The Turning Point: Science, Society, and the Rising Culture* by Fritjof Capra.
3. A. V. Hill, A Challenge to Biochemists, *Biochim Biophys Acta* **4** (1950), pp. 4-11.
4. A. V. Hill, A Further Challenge to Biochemists. *Biochem Z* **345** (1966), pp. 1-8.
5. D. F. Cain & R. E. Davies, Breakdown of Adenosine Triphosphate During a Single Contraction of Working Muscle, *Biochem. Biophys. Res. Commun.* **8**,361 (1962).
6. A. A. Infante & R. E. Davies, Adenosine Triphosphate Breakdown During a Single Isotonic Twitch of Frog Sartorius Muscle, *Biochem Biophys Res. Commun* **9**,410 (1962).
7. K. M. Kretzschmar & D. R. Wilkie, A New Approach to Freezing Tissues Rapidly, *Journal of Physiology* **202** (1969), pp. 66P-67P.
8. F. D. Carison, D. Hardy & D. R. Wilkie, The relation between heat produced and phosphorylcreatine split during isometric

- contraction of frog's muscle, *Journal of Physiology* **189** (1967), pp. 209-235.
9. N. A. Curtin & R. C. Woledge Energy Changes and Muscular Contraction, *Physiological Reviews* **58**,3 (1978). pp. 690-761.
  10. E. Homsher & C. J. Kean, Skeletal Muscle Energetics and Metabolism, *Annual Review of Physiology* **40** (1978), pp. 93-131.
  11. J. A. Wheeler, *Geometrodynamics* (Academic Press, New York, NY, 1963).