

Bioelectromagnetic and Subtle Energy Medicine

The Interface between Mind and Matter

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The concept of a "life energy" can be found in many cultures in the present time, as well as in past eras reaching back to the ancients. Various names called *qi (chi)*, *ki*, the "four humors," *prana*, "archaeus," "cosmic aether," "universal fluid," "animal magnetism," and "odic force," among other names, this purported biofield is beginning to yield its properties and interactions to the scientific method. Subtle energy is the term used in this chapter, which traces the recent history of subtle energy studies from Harold Saxton Burr and Björn Nordenström to Jim Oschman and Jacques Benveniste. This work takes signaling in living systems from the chemical/molecular to the physical/atomic level of communication. Effects on heart rate variability, stress response, inflammation, and the vagus nerve have been demonstrated and raise the question - Can the power of subtle energies be harnessed for health enhancement? It is fully accepted that good health depends on good communication both within the organism and between the organism and its environment. Sophisticated imaging procedures brought to bear on telomere, stem cell, and genetic research are confirming the ability of meditation and some other traditional practices to promote optimal health through stress reduction.

Key words: *chi*; electrical circulatory system; magnetotherapy; subtle energy communication; heart rate variability; cancer as a Disease of Adaptation; the "third eye"; melatonin; inflammation; stress

Chi, Prana, Archaeus, Animal Magnetism, Orgone, and Other Energy Fields

Belief in a restorative life energy that pervades living things dates back to antiquity. Hindu *prana*, Chinese *Qi (chi)*, and Japanese *ki* are a few examples of some sort of poorly understood vital energy that flows throughout the body and is intimately linked with physical, mental, and spiritual health. Elements of this appear in the three *doshas* in Ayurvedic medicine and in Galen's four humors, all of which are associated with different personality

types, emotions, and related disorders. Similar energy-field concepts have resurfaced over the years as the "archaeus" of Paracelsus, Newton's "cosmic aether," Mesmer's "universal fluid" and "animal magnetism," Carl von Reichenbach's "odic force," Brunler's biocosmic energy, the "orgone energy" of Wilhelm Reich, the etheric body, and Rupert Sheldrake's morphogenetic fields. Some of these biofields can be seen using Kirlian and gas discharge visualization photography or detected by devices and even individuals who are unusually sensitive to low levels of electromagnetic energy. The intensity and other characteristics of these biofield auras are believed to reflect health status and can vary with different emotional states like anger and love, as seen in Figure 1. The ability of certain healers to transmit or transfer their

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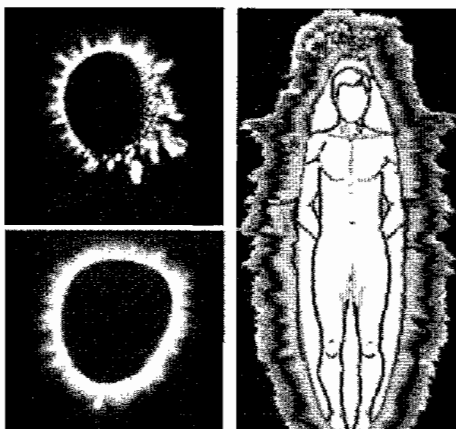


FIGURE 1. Kirlian and GDV (Gas Discharge Visualization) auras. Kirlian photographs of finger tip aura during feelings of anger (*upper left*) and love (*lower left*). Note difference in symmetry of the energy field. GDV representation of aura surrounding a healthy body (*right panel*). (Black and white reproductions are not as vivid.) GDV photos courtesy of Dr. Konstantin Korotkov.

biomagnetic energy to others appears to be supported by special photographic techniques as seen in Figure 2.

Various types of energy medicine practices have also been designed to harness such subtle energies to promote health by manipulating bioenergy fields through acupuncture, acupressure, therapeutic touch, *Qi Gong*, *Johrei*, *Reiki*, crystals, permanent magnets, and all sorts of electrical and electromagnetic devices. Despite solid scientific support for some of these approaches, Western physicians have understandably been skeptical because of the lengthy list of charlatans associated with many of these modalities going back to Mesmer. So many worthless electrotherapeutic and other energy devices making outrageous and unsubstantiated claims were being promoted in the early 20th century that doctors viewed anything having to do with "electromedicine" as being fraudulent. As a result, the baby was often thrown out with the bathwater.

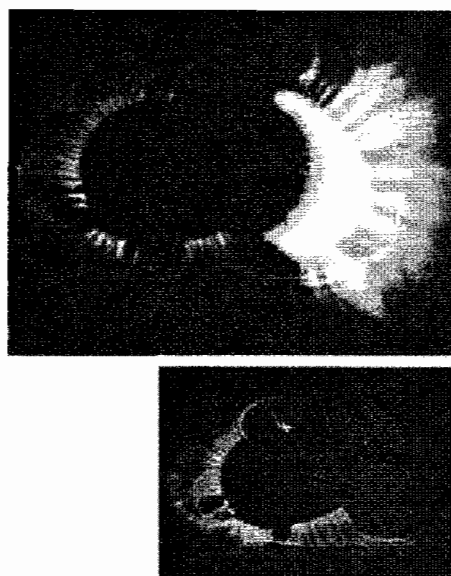


FIGURE 2. Kirlian photograph of a healer. Aura around the finger pad of a faith healer (*upper*) taken while treating a patient. Aura around the finger pad of the same healer at rest (*lower*) before starting therapy. (Difference in pattern of brilliant colors and flares not as impressive in black and white reproductions)

Harold Saxton Burr, a professor at Yale Medical School, began studying energy fields in living systems in 1932. He set up a series of ingenious experiments, later repeated by other researchers, which demonstrated that all living organisms are surrounded and encompassed by their own energy fields, which he called Life-fields (L-fields). He showed that changes in the electrical potential of the L-field would lead to changes in the health of the organism. By studying trees on the Yale campus that had been hooked up to his L-field detectors for decades, Burr was able to demonstrate that changes in environmental electromagnetic fields, caused by such things as the phases of the moon, sunspot activity, and thunderstorms, substantially affected the L-field. He found he could detect a specific field of energy in a frog's egg, and that the nervous system would later develop

precisely within that field, suggesting that the L-field was the organizing matrix for the body. In his work with humans, he was able to chart and predict the ovulation cycles of women, locate internal scar tissue, and diagnose potential physical ailments, all through the reading of the individual's L-field.¹

His student and later co-worker, Leonard Ravitz, a neurologist and psychiatrist, extended Burr's clinical studies. He showed that there was a correlation between the lunar cycle and L-field activity and that L-field strength reached a peak when the moon was full. Ravitz later demonstrated that changes in L-field activity could be influenced by a subject's mental and emotional state and reported that, "Both emotional activity and stimuli of any sort involve mobilization of electrical energy, as indicated on the galvanometer; hence, both emotions and stimuli evoke the same energy. Emotions can be equated with energy."² Burr had also conducted some intriguing experiments showing that he could detect "electrometric" signs of cancer in the female genital and urinary tract long before any clinical signs of pathologic changes were evident. Some of his other findings in experimental cancers induced in animals are described by Jim Oschman, who also explains how Burr's important observations were ignored by his colleagues and the medical community.³

Differences in the electrical impedance and capacitance properties of benign and malignant tumors had been described in the 1920s and similarly neglected.⁴ However, it was rediscovered by Björn Nordenström a half century later, who noted a strange corona or aura that occasionally appeared around malignant tumors on routine chest x-rays. His extensive investigations revealed that this was due to a difference in the electrical characteristics of cancer tissue that eventually led to a very successful treatment for pulmonary and other malignancies. Nordenström described one patient with a history of ovarian cancer and another with adenocarcinoma of the breast, both of whom now had pulmonary metastases. The

only reason they had been referred to him was that both were considered inoperable. After one day of his painless "electrochemical" treatment the tumors gradually disappeared, and he showed that both patients were well 8 and 10 years later with no clinical or x-ray evidence of cancer.

Is There an Electrical Circulatory System?

I first became aware of Björn Nordenström's research through the cover story in the April 1986 issue of *Discover Magazine* that began: "Dr. Björn Nordenström claims to have found in the human body a heretofore unknown universe of electrical activity that's the very foundation of the healing process and is as critical to well being as the flow of blood. If he's right, he has made the most profound biomedical discovery of the century."⁵

It went on to state that some distinguished scientists and physicians believed that if his findings were confirmed by others, they would prove to be as important as William Harvey's discovery of the circulatory system. Others compared his 1983 book explaining his theory of an electrical circulatory system⁶ to Harvey's 1628 treatise on how blood circulates through the body. Nordenström's credentials are impeccable. Chairman Emeritus of the Department of Radiology at the prestigious Karolinska Institute, he had also chaired the Nobel Assembly Committee that selects the Nobel Laureate in Physiology or Medicine and has also been mentioned as a possible future recipient. His remarkable results in cancer have been confirmed by others in thousands of patients and he has progressively refined his theory of an electrical circulatory system in the body composed of "biologically closed electric circuits" (BCEC). Reviews of these concepts have been published in *Bioelectromagnetic Medicine*.⁷ These traced the origin and evolution of the BCEC concept, how it led to the electrochemical treatment of cancer and explained why the ATP-driven pump

that kept sodium out of the cell might represent an example of one of these biologically closed circuits.⁸

According to Nordenström, the body's electrical communication system can be compared to a battery in which the circuit is driven by separation of oppositely charged ions. Once the circuit is closed, long-distance current flows through the conducting cables; and, within the battery, ions drift across the permeable barrier. When tissue is damaged by injury or malignant growth, there is a buildup of positively charged ions in the affected area, whereas adjacent healthy tissue is negative. As a tumor grows, its inner cells are cut off from the circulatory system and slowly perish. This cell death leads to chemical changes and the production of positive electrical potential in the tumor compared to adjacent tissue. In Nordenström's 1998 book *Exploring BCEC-Systems (Biologically Closed Electric Circuits)*, he points out that ancient Oriental philosophy and approaches to health are based on the existence of *chi*, a universal energy that can be converted to serve different purposes. How this energy is transformed is described in the concept of Tao, the order that exists in the cosmos that makes nature and its behavior explicable and with which man must learn to live in harmony. Nordenström goes on to explain that these rules lead to an appreciation of the cyclic motions of energy in the universe with respect to expansion and condensation. He believes that *chi* is analogous to the energy flowing through his "electrical" circulatory system and that *yin* and *yang* may be thought of as positive and negative charges.⁶

Nordenström's theories reinforce an emerging paradigm of communication at a physical/atomic level that emphasizes the connectedness not only among the body's components but also between the organism and all of nature. This holistic approach helps us to understand why certain Indo-Tibetan practices provide benefits that cannot be explained by the current chemical/molecular or key/keyhole model of cellular communication. It has also led to an appreciation that living tissues are much more

sensitive to electromagnetic fields and subtle energies than previously appreciated. This is particularly true with respect to the significant nonthermal physiological effects of radiation that are not accompanied by any detectable heat transfer. It is also clear that stronger stimuli do not always evoke greater responses in living systems and that less is often more in certain circumstances. Jim Ochsman suggests, "This is possible because of two important phenomena, cellular amplification and stochastic resonance"³ and refers to the research of Ross Adey and A. R. Liboff to explain this. Among other numerous discoveries, Adey first described a "window of activity" above and below which electromagnetic fields had decreasing biological effects. We now recognize that such windows of opportunity can refer to frequency and amplitude characteristics that induce resonant responses.⁹ Liboff also has introduced the related concept of ion cyclotron resonance.^{10,11} What we may glean from all of this is that in addition to being a protective shield, the cell wall is emerging as a powerful amplifier for electromagnetic and possibly other subtle energy therapies. The resultant cascade of signals can stimulate or suppress numerous intracellular activities, as illustrated in Figure 3.

Chemical/Molecular Versus Physical/Atomic Communication

Ochsman's figure (Fig. 3) depicts this process as being initiated by physical contact between a neurotransmitter, antigen, or some other chemical messenger with a specific receptor on the cell wall. However, this key/keyhole model of chemical/molecular communication is not consistent with numerous observations that are best explained by communication at a physical/atomic level. Molecular signal and molecular signaling are terms that are frequently used but rarely defined, which prompted Jacques Benveniste to ask, "Would you please tell me what is the physical nature of the molecular

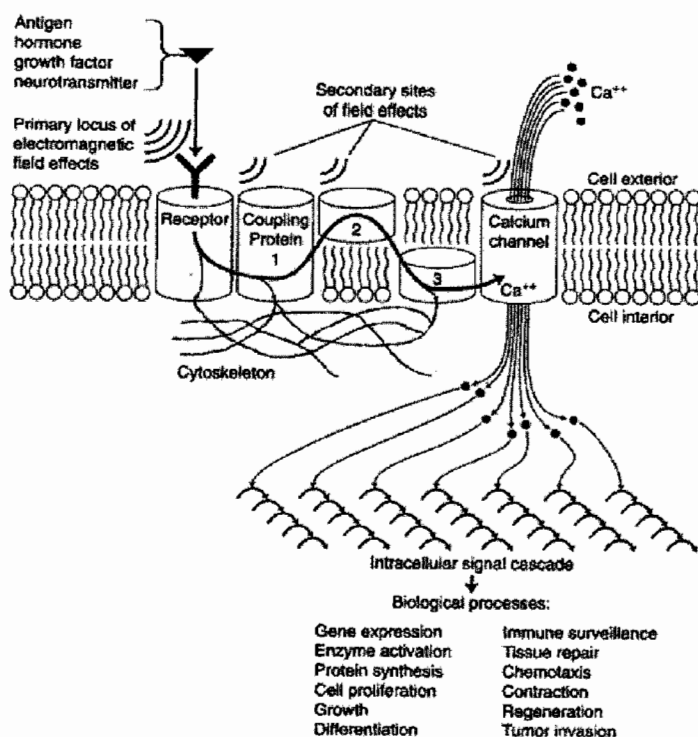


FIGURE 3. Schematic of the cellular cascade and amplification process that provides a basis for the effects of pulsing electromagnetic field therapies as well as various complementary therapies such as Reiki and Therapeutic Touch. A single antigen, hormone, pheromone, growth factor, neurotransmitter molecule, or a photon of electromagnetic energy can produce a cascade of intracellular signals that initiate, accelerate, or inhibit biological processes. This is possible because of enormous amplification – a single molecular event at the cell surface can trigger a huge influx of calcium ions, each of which can activate an enzyme. The enzymes, in turn, act as catalysts, greatly accelerating biochemical processes. Some of the reactions are sensitive to electromagnetic fields, some are not, and others have not yet been tested. (After Ochsman.³)

signal?”¹² The reason for his question is that the current QSAR (quantitative structure-activity relationship) theory of molecular signaling claims that two structurally matched molecules exchange specific information by mere contact that sends a signal to the interior of the cell. Such interactions, requiring random collisions on a trial-and-error basis, would have little statistical chance of occurring within seconds for molecules that depend on the circulation to reach their target. Such chemical/molecular

communication could never explain the myriad automatic and immediate reactions that occur throughout the body in the “fight or flight” response to acute stress. As shown below in Figure 4, Benveniste proposes that the ligand molecule emits an electromagnetic signal with a frequency identical to the receptor’s molecules that causes them to co-resonate and activate the same intracellular responses. This model does allow the simultaneous transmission of different messages to different sites, much as a radio that

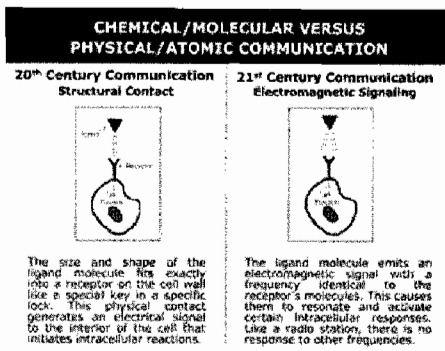


FIGURE 4. The key/keyhole concept (*left panel*) requires random collisions on a hit or miss basis that sends a signal to the interior of the cell. These would have little statistical chance of occurring with great frequency and therefore could not explain the rapidity of responses to stress or immediate humoral antigen-antibody reactions. Nor does this explain how signals are sent back to indicate what changes have been made that need to be responded to. In another model (*right panel*), the ligand molecule emits an electromagnetic signal with a frequency identical to the receptor's molecule that causes them to co-resonate and activate intracellular responses. This can occur at very low frequencies a long distance away, much as one tunes in to a radio station by changing the AM, FM, or short wave frequency. (After Benveniste.¹²)

can tune in to various AM, FM, or short-wave stations because the receiver and transmitter are vibrating at identical frequencies.

Benveniste goes on to explain that every atom of every molecule and every intermolecular bond emits specific frequencies that can be detected at astronomical distances by radiotelescopes. Many of these signals are in a spectrum of frequencies between 20 Hz and 20,000 Hz, the same range as human hearing. It is well known that certain musical frequencies can have significant biological and emotional effects. High-pitched rapid sounds seem to engender lightness of spirit, deep and rapid sounds awaken the fighting spirit, deep and slow sounds are more apt to invoke sadness and mourning, etc. Some of the Indo-Tibetan meditative chants that have evolved over cen-

turies may take advantage of these physiological responses.

It is important to appreciate that subtle energies generated in the body can also have powerful effects that may help explain the benefits of Eastern practices. Research in this area has been hampered by the difficulty in defining exactly what these strange forces are, how they can be measured, and how they relate to other forms of energy. The person who has arguably contributed the most to our knowledge of the nature of subtle energies is Bill Tiller, Professor Emeritus of the Department of Materials Science and Engineering at Stanford. He believes that although subtle energies are frequently assumed to be similar to or associated with electromagnetic fields, this is erroneous. In addition, subtle energies involved in biologic processes are not necessarily weak but rather elusive, because they cannot be measured directly, but only by their effects. To help clarify these and some other issues, Tiller explains the role of subtle energies in bioelectromagnetic phenomena and the difference between electromagnetism and bioelectromagnetism.^{13,14}

He has been studying intentionality, a subtle energy that he has demonstrated can be used to increase or decrease the pH of an aqueous solution by one full unit and to increase the *in vitro* thermodynamic activity of alkaline phosphatase, a liver enzyme.¹³ There are also substantial effects on living systems since intentionality can increase the ratio of ATP to ADP in developing fruit fly larvae, which significantly reduces the development time required to reach the adult fly stage.¹³ Even more impressive has been Tiller's ability to develop what he calls IEDs (intention imprinted electrical devices). These allow intentionality to be stored and used at a later date in a different location to produce the same effects, much like information can be copied onto a computer diskette or flash drive to use elsewhere.¹⁴ Jacques Benveniste described how he could also transfer his "memory in water" to a computer chip that allowed his results to be replicated in laboratories on other continents.¹²

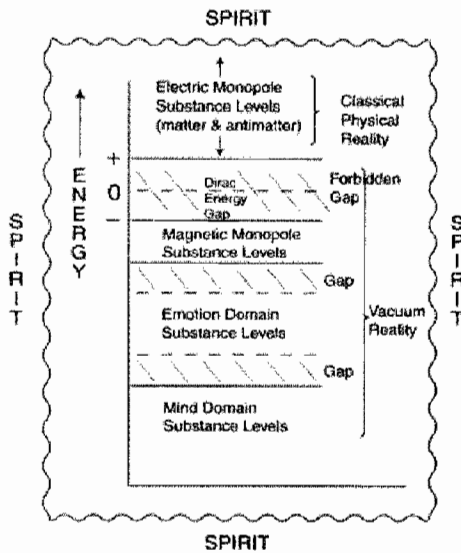


FIGURE 5. Tiller's energy level diagram embracing both classical physical substance and "unseen" vacuum substances. Acupuncture, homeopathy, and other subtle energies are thought to reside in this vacuum level. (After Tiller.¹⁴)

So where does intentionality come from? Tiller studied *Chi Gong* practitioners, faith healers, and others who had demonstrated the ability to transfer their energies to other individuals without physical contact as evidenced by effects on the recipient's EEG, accompanied by simultaneous voltage drops in the healer. Intentionality may be thought of as the subtle energy summoned up in association with the intention to heal in such individuals. Tiller had also shown for the first time that it was possible to separate the poles of a permanent magnet and that a magnetic monopole had distinctive energy effects.¹⁴ These and other subtle energies such as those involved in acupuncture, homeopathy, ESP, and remote viewing reside in what Tiller refers to as the vacuum level of nature as shown in Figure 5. This diagram represents a summary of a vast amount of data that is discussed at length in both of Tiller's chapters. The main points are (1) that people manifest a heretofore undetected energy that has the prop-

Emotions are Reflected in Heart Rhythm Patterns

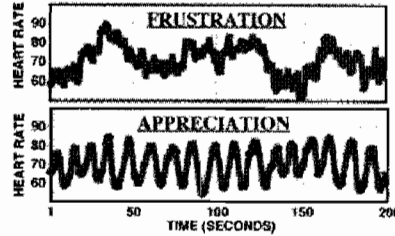


FIGURE 6. Disordered and chaotic heart rhythm pattern during feelings of frustration in contrast to smooth and synchronous pattern associated with positive emotions. (After McCraty.¹⁵)

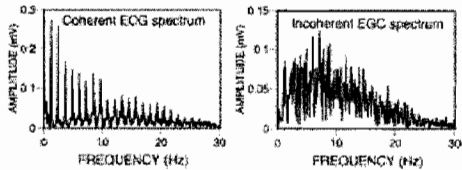


FIGURE 7. Amplitude spectra of 10-second epochs of ECG data. Example of a spectrum associated with a type of physiological coherence generated during feelings of appreciation and love (left panel). Depiction of an incoherent spectrum reflecting disordered heart rhythms and negative emotions such as those associated with feelings of anger or frustration (right panel). (After McCraty.¹⁵)

erty of increasing both electron microavalanche size and number in a nearby gas discharge system, (2) that a person can direct the flow of this energy in a chosen direction using his or her mind to influence both inanimate and animate material, and (3) that the mind-electron interaction can be effective over an appreciable distance and transferred to a computer chip to reproduce the same effect.

Subtle energy communication between people is discussed at length by Rollin McCraty, who demonstrates how the heart can be a powerful source of energy and how it is affected by stress.¹⁵ Just as Kirlian photographs show distinct differences in energy patterns between love and anger, these emotions also have a profound effect on heart rhythm patterns as shown in Figures 6 and 7. The ancient Greeks

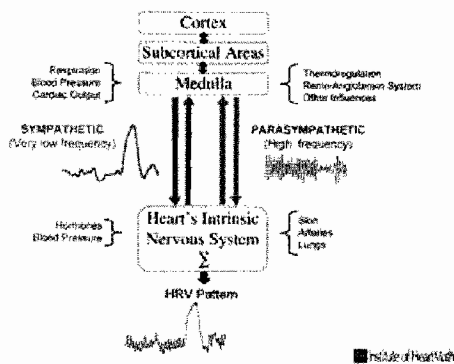


FIGURE 8. Institute of HeartMath diagram showing communication links between the heart and the brain that can influence heart rate variability patterns. (After McCraty.¹⁵)

taught that the heart rather than the brain was the seat of emotions, and we still describe people as being “heartbroken,” “cold-hearted,” having a “heart of gold,” etc. The brain and the heart communicate with each other via nervous system and humoral pathways, as well as by biophysical (pulse wave) and energetic (electromagnetic) connections as shown in Figure 8. Standard methods of recording electrical fields using skin surface electrodes may not accurately reflect bioelectric activities in the heart or brain because the electrical resistance of different tissues can vary by a factor of as much as 30. In contrast, the magnetic permeability of all tissues is about the same, so that biomagnetic measurements provide a much better picture of brain and heart activities.³ The heart produces an electric field 60 times stronger than the brain’s, but its electromagnetic field is 5,000 times stronger, and these forces can affect others, as illustrated by the EEG changes seen in Figure 9. Other studies show that physical contact is not essential in individuals who are less than three feet apart since the same signal can be transferred by radiation, although it is not as strong. Individuals who are in close proximity without physical contact often show a tendency to develop similar heart rhythm patterns.¹⁵

The Electricity of Touch

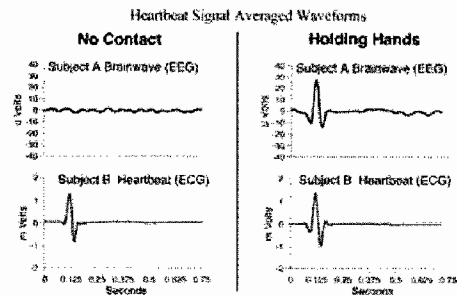


FIGURE 9. Signal averaged waveforms showing the detection of electromagnetic energy generated by Subject A’s heart in the receiving Subject B’s EEG. The baseline recording (*left panel*) is from a 10-min period during which time the subjects were seated 4 feet apart without physical contact and the recording from the 5-min period during which the subjects held hands (*right panel*). The EEG data shown here were recorded from the C3 location of the EEG. (After McCraty.¹⁵)

Heart Rate Variability, Stress, Inflammation, the Vagus and Resonance

HRV (heart rate variability) refers to the beat-to-beat alterations in heart rate that normally occur during respiration. Heart rate increases during inspiration and decreases during exhalation, a rhythmic phenomenon known as respiratory sinus arrhythmia. This is usually evident only on ECG tracings as shown in Figure 10, and the greater the standard deviation in successive R-R intervals, the higher the HRV. A low HRV is associated with poorer health and increased risk of sudden death, whereas a high HRV reflects a greater ability to maintain homeostasis and health by adapting to any demands for change. The growing importance of HRV measurement and analysis is evident from the more than 26 different types of arithmetic manipulations of R-R intervals currently available. Power spectral density analysis also provides information on the frequency distribution of HRV components that reflect different influences depending on whether they

Heart Rate Variability

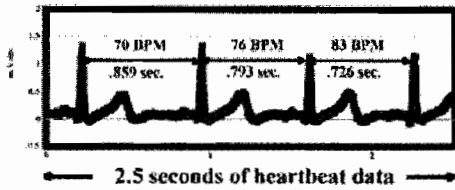


FIGURE 10. Heart rate variability showing the millisecond changes in beat-to-beat intervals that vary with respiration. Low heart rate variability is associated with increased stress and reflects a diminished ability to respond to demands for change. (After McCraty.¹⁵)

are high (0.15–0.40 Hz), low (0.04–0.15 Hz), and very low (0.003–0.04 Hz). In general, the high-frequency component measures vagal and parasympathetic activity, low frequency reflects sympathetic effects on the heart, while very low frequency is influenced by a variety of other factors such as chemoreceptors, thermoreceptors, and the renin-angiotensin system. Diminished HRV is emerging as a very sensitive barometer of current stress levels as well as cumulative allostatic load.

Many signs and symptoms of stress are due to stimulation of sympathetic nervous system activities such as those that result in “fight or flight” responses. The antithesis of this is the “relaxation response” that is associated with increased parasympathetic tone. This is a simplified form of meditation characterized by slow rhythmic breathing in which a word or phrase is repeated with each exhalation. Practicing this for 20 minutes several times a week has been shown to reduce stress and lower blood pressure by promoting parasympathetic predominance, which is associated with increased HRV. Optimal breathing patterns vary, especially with respect to the duration of exhalation, and this is best determined by finding the respiratory rhythm that produces the highest HRV pattern. The recent availability of relatively inexpensive hand-held devices that provide immediate HRV feedback signif-

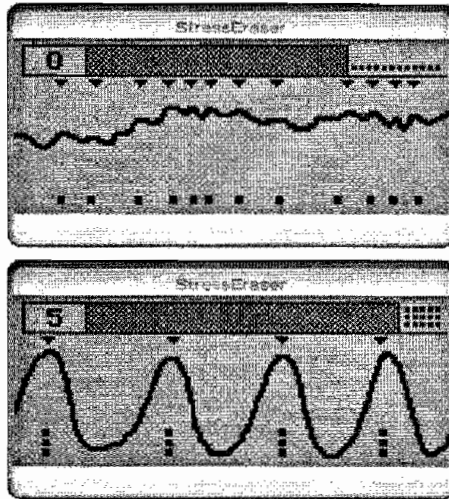


FIGURE 11. StressEraser Heart Rate Variability Feedback Display. Small jagged waves (upper panel) are indicative of diminished heart rate variability and decreased parasympathetic tone. Long smooth waves are (lower panel) seen during slow rhythmic respiration reflecting increased heart rate variability due to parasympathetic predominance. Users are encouraged to find a breathing pattern that produces regularly spaced triangles and corresponding waves containing two or three squares (see www.stresseraser.com). Quantum Intech’s EmWave uses changing colored lights to provide feedback (see www.emwave.com) and RESPeRATE, which is approved for the treatment of hypertension, utilizes a numerical display (see www.resperate.com).

icantly facilitates learning how to achieve and sustain the stress reduction and other benefits associated with increased HRV as shown in Figure 11. Feedback is provided by displaying increases or decreases in HRV by visual or sound cues that are easy to interpret. Most subjects can quickly determine by trial and error what breathing in and what breathing out tempo and number of breaths/minute is best for them using such devices, some of which can store data that allows the user to track their progress.

Other reports have shown that transcendental meditation and yoga, both of which are popular stress reduction techniques, also improve

HRV by stimulating vagal and parasympathetic responses.^{16,17} Additional health rewards from vagal stimulation include a reduction in inflammation, which has increasingly been incriminated in the pathogenesis of metabolic syndrome and cardiovascular disease. Chapters in *Bioelectromagnetic Medicine* are devoted to the use of vagal stimulation in seizure disorders,¹⁸ depression,¹⁹ and morbid obesity.²⁰ There is also a fascinating chapter by Jacob Zabara describing what led to his discovery of vagal nerve stimulation and the evolution of its current FDA-approved indications.²¹

The mechanisms of action responsible for the benefits associated with meditation and other traditional Eastern practices are not clear. Some that involve nonthermal biologic responses are difficult to explain since the absence of detectable heat exchange would appear to violate the laws of thermodynamics and Newtonian physics. However, these and other seemingly inexplicable subtle energy effects, such as those described by Tiller, are quite consistent with quantum physics. As astronaut Edgar Mitchell explains, there is no difference between energy and matter at subatomic levels.²² And we are only starting to appreciate how resonance can dramatically increase the effects of energy communication in biological systems. Most of us first become aware of the power of resonance as kids on a swing, who quickly learn that they can go faster and higher by pulling on the rope and kicking at just the right time. Similarly, if you were pushing someone else, a little shove just when the swing reached the top got great results but not if you did it a second or so before. And applying the same push lower down on the upswing would have the reverse effect. Resonance explains why singers can shatter a glass several feet away if the note they create is the same resonance frequency as the glass. The collapse of the Takoma suspension bridge at Puget Sound in 1940 was caused by wind-induced vibrations that were not particularly strong but just happened to coincide with the bridge's resonance frequency. Atoms and molecules vibrate, but at different frequencies,

which helps to explain why seemingly feeble forces can have such powerful effects if they happen to resonate with something having the same frequency. This has important medical implications, since each type of body tissue resonates differently. Magnetic resonance imaging (MRI) is a particularly powerful diagnostic aid because, unlike x-rays, nuclear magnetic resonance signals identifying blood vessels, cartilage, muscle, and other tissue are readily transmitted through bone. Not as much progress has been made with respect to treatment based on resonance technologies, but there is growing interest in this and other aspects of what has been referred to as "vibrational medicine."

Good health and life itself are entirely dependent on good communication between components of the body at the organ, cellular, molecular, atomic, and quantum levels, preserving homeostasis, for example, by maintaining the concentrations of sodium, potassium, calcium, and glucose as well as other ions and molecules within fairly narrow limits. The same applies to blood pressure, heart rate, temperature, and essential physiologic functions. If any of these vital components of good health are above or below their acceptable ranges, immediate corrective changes must be made to restore normal values. Constant feedback is necessary to signal any such change in status so that appropriate alterations can be made. This could not be accomplished without some incredible system of communication that can constantly detect and respond to any threat to homeostasis within milliseconds. This again emphasizes that good health is entirely dependent on good communication – good communication within the internal environment as well as with the external milieu.

But how does communication take place in the body? The role of the central nervous system with its autonomic sympathetic and parasympathetic components that are antagonistic but complementary is fairly well delineated. The endocrine system has its own balancing mechanisms in which the

secretion of hormones is regulated by feedback from target glands or metabolic consequence. Much less is known about how equilibrium is maintained in neurotransmitter networks or in the immune system, which has both hard-wired and humoral central nervous system connections.

All of these neurotransmitter, endocrine, immune, and nervous system responses and interrelationships have been exquisitely honed over millions of years of evolution to preserve life and health by acting in concert with one another, much like individual instruments in an orchestra. Does this orchestra have a conductor? It is difficult to conceive how this staggering amount of complex and constant communication back and forth can take place with such speed without the intervention of some other agency. But what could it be? The ancient concept of *chi* with its complementary *yin* and *yang* energies that pervade the body and all of nature allegedly served such a purpose. However, we are unable to define or quantify this mysterious force, and the closest we can get is to compare it with electrical or electromagnetic signals. The speed, versatility, and integration of all these activities suggests the existence of the biologic equivalent of electrical systems composed of electrodes, switches, amplifiers, resistors, and capacitors that can store and regulate energy flow similar to the model proposed by Björn Nordenström.

Life on earth evolved under constant geomagnetic influences, and the earth itself is a huge magnetic sphere. Thus, it should not be surprising that all living cells, tissues, and organs are sensitive "electromagnetic systems" with specific electrical or magnetic resonance characteristics. This can be readily demonstrated in lower forms of life as well as in birds, fish, and mammals that utilize such subtle signals for navigational purposes. Most humans retain an innate ability to sense the direction of magnetic north. Our sense of direction in the absence of visual cues can be obliterated by placing a bar magnet against the forehead for only five or ten minutes, and

this blockage can last for up to two hours.²³ Tibetan Buddhists have used bar magnets for centuries to block influences that might affect the minds of novice monks during their training to achieve deep meditative states. Electromagnetic energies can also influence behavior and emotions, and a strong correlation has been found between magnetically vigorous solar storms and mental hospital admissions.²⁴ The gravitational or other force of the full moon has long been associated with mental disorders (lunacy) and according to folklore, werewolves required the power of the full moon to change into their bestial form. Some dowzers are allegedly able to detect underground deposits of water because they are sensitive to changes in geomagnetic energies. Such forces were also believed by the ancient Chinese to influence future health as well as good fortune. *Feng shui*, the art of placement and arrangement to achieve harmony with nature, dates back thousands of years and is still used to determine the architectural design of buildings and the internal arrangement and orientation of its contents based on geomagnetic energy interactions.²⁵

A vivid example of how electromagnetic signals from the environment can be intimately related to internal signaling and communications networks is represented by melatonin production by the pineal gland. Daily cyclic light is registered by the pineal gland, at least partially, if not entirely through the optic nerve, stimulating the gland to produce melatonin during darkness and suppressing it in light. This is part of the control network that maintains the body's circadian rhythms. Melatonin secretion is also significantly suppressed by low-frequency electromagnetic fields.²⁶ In addition to melatonin, which can have powerful effects on mood and behavior, the pineal gland also produces other psychoactive neuropeptides like serotonin and dopamine. Therefore, it is quite possible that disturbed pineal function from exposure to invisible electromagnetic fields can produce a variety of behavioral and emotional abnormalities that are attributed to some other cause, if

not physiologic perturbations associated with disease.

Can the Power of *Chi* Be Harnessed for Health Enhancement?

Over 2,500 years ago, Lao Tsu, the "Father" of Taoism, described *chi* as follows:

Look, it cannot be seen – it is beyond form

Listen, it cannot be heard – it is beyond sound

Grasp, it cannot be held – it is intangible.

Ancient Chinese medical texts taught that good health depended on the orderly flow of *chi* through prescribed pathways called meridians. Blockages in flow could be relieved by stimulating special sites on the skin where meridians came close to the body's surface by needling (acupuncture) or by applying heat (moxibustion) or a static magnetic field (lodestones). We have not learned much since ancient times about either the composition or structure of *chi* or its varied effects and functions. However, it would now appear that *chi* can also emanate from the body in the form of an electromagnetic radiance that can be seen with Kirlian and gas discharge visualization photography.²⁷ The magnitude and intensity of this aura can vary with health status and emotions and appears to be greatest in healers or *chi gong* practitioners who can focus and transmit their *chi* energy to others. Robert Becker studied various healers and *chi gong* masters and authentic reports of their ability to transmit or their *chi* energy to another person or object without having any physical contact.²⁸ Some healers could induce a marked increase in the voltage of EEG's of recipients who were not aware they were being targeted. This often corresponded with a simultaneous similar drop in the healer's voltage. Nuclear magnetic resonance studies confirmed the ability of *Chi gong* masters to change the molecular structure of a liquid in a closed container several feet away. Repeated efforts produced further changes.

Becker, who was the first to prove that acupuncture points had significant electrical characteristics, also showed that meridian pathways had characteristics of transmission lines, with acupuncture points acting as amplifiers to forward the signal.²⁸ It has been reported that stimulation of an acupuncture point in the foot results in EEG changes that are so instantaneous that they are difficult to measure, but clearly exceed the speed of sound.²⁹ Becker also showed that our bodies are magnetic systems with a positive polarity along the central axis and a negative polarity in peripheral structures. He has demonstrated that this polarity is reversed in hypnosis and anesthesia, as well as following an injury, which creates a positive potential at the site of trauma. Becker believes that the body's connective tissue acts as a semiconductor for minute DC currents, which in itself produces a small magnetic field and that this current is synonymous with *chi* energy.

Nordenström also believes that the electromagnetic energy in his biologically closed electrical circuits is analogous to or the same as *chi*. These energies can transform inanimate matter into biological substances and play a crucial role in health, performance, and aging in all living things. The life span of many cell types is genetically predetermined by limiting the number of times it can divide and reproduce. This programmed cell death, called apoptosis, is specific for each cell, which is why life span varies greatly in different plant and animal species and even different tissues. Nordenström has described how biomagnetic forces can influence either regression (apoptosis) or proliferation (regrowth and survival) by explaining how a tree preserves its life during the cold of winter by altering metabolic activities to sacrifice its leaves in the fall. In the spring, apoptotic regression is replaced by proliferative regeneration, when energy preserved in the tree is activated by heat to again produce the same kind of leaf. He illustrates how even a leaf that is "dead" still has energy in the form of a corona around it that can be seen with Kirlian photography. This

repetitive cycle of death and rebirth that is guided by the same energy constantly takes place in other systems. In the Chinese view of nature, they provide balance in the *Sheng* and *Ke* cycles of ongoing regeneration and destruction for the five elements.^{29,30}

How can the same *chi* flowing in the body be transformed into an energy that regulates apoptosis and regeneration in nature? Where does *chi* come from and why do some people have much more than others? Do they attract more from the environment or generate greater amounts? How can *chi* be projected outside the body to affect a person or inanimate object by concentration or some other mental process? Why do stressful emotions cause a diminution in *chi*, whereas positive feelings have the opposite effect? At present, we can only assess what appear to be some of the effects of *chi*. In that regard, it is wise to keep in mind the sign in Albert Einstein's Princeton office that read, "Not everything that can be counted counts, and not everything that counts can be counted."

As indicated previously, the body contains its best pharmacy if we can learn how to tap into the vast innate potential for self-healing that resides in all of us. Indo-Tibetan approaches will facilitate not only achieving this goal but also our ability to promote peace and harmony with others, something that is desperately needed at present. As the Dalai Lama emphasized, "We can never obtain peace in the world if we neglect the inner world and don't make peace with ourselves. World peace must develop out of inner peace." Mahatma Gandhi similarly warned, "You must be the change that you wish to see in the world." As indicated in Figure 12, we are all connected with each other and with nature by some mysterious force that the ancients referred to as *chi*. Bioelectromagnetic energies may provide clues about how these communication links are forged. Learning how to stimulate, simulate, or emulate subtle energies may also teach us to how to attain the benefits of the *vis medicatrix naturae* (healing ways of nature).



FIGURE 12. "No man is an island, entire of itself" – John Donne (1623). As indicated above, we are all connected, not only with each other, but with everything else in nature.

Envoi

I have tried to show how advances in sophisticated imaging procedures, telomere, stem cell, and genetic research are steadily confirming the ability of meditation and other traditional Indo-Tibetan practices to promote longevity and optimal health. Such benefits appear to be linked or due to stress reduction effects that are best explained by an emerging paradigm of communication at a physical/atomic level rather than the current chemical/molecular model. This helps to explain why electromagnetic fields affect living tissues in so many unanticipated ways and why humans also generate electromagnetic and/or other energies that can have profound effects internally as well as on others. Imaging and HRV studies confirm the effects of emotions on energy fields, and it is clear that emotions can also influence the heart rate patterns of other persons as well as animals. Energy fields emanating from the hands of healers have been shown to be within the same frequency range as human brain waves. Tiller has also demonstrated how intentionality affects internal physiology as well as external biologic and inanimate systems and that it can be stored to produce the same effects at other times and locations. Other research shows that

electromagnetic fields as well as conscious intent can also influence numerous genetic programs and activities.

All of the above and other studies cited confirm that good health depends on good communication not only internally but also with the external environment. Thus, it is important to emphasize the importance of unappreciated subtle energy communication links that can best explain how homeostasis is maintained by constant and instantaneous responses to internal and external demands for change. Whether this energy is synonymous with some mysterious force called *chi* that correlates with electromagnetic fields is not clear. However, it does seem likely that *chi* can be cultivated and utilized by Eastern practices that promote a deep concentration that leads to enlightenment and a sense of deep inner peace that abolishes feelings of distress.

I would conclude with the following:

A human being is a part of the whole, called by us the Universe, a part limited in time and space. He experiences himself, his thoughts and feelings as something separated from the rest, a kind of optical delusion of his consciousness. This delusion is a kind of prison for us, restricting us to our personal desires and to affection for a few persons nearest to us. Our task must be to free ourselves from this prison by widening our circles of compassion to embrace all living creatures and the whole of nature in its beauty. Nobody is able to achieve this completely, but the striving for such achievement is in itself a part of the liberation and of a foundation for inner security.

Albert Einstein³¹

Conflicts of Interest

The author declares no conflicts of interest.

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