

Article

Biophysical Mechanisms of Genetic Regulation: Is There a Link to Mind-Body Healing?

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ABSTRACT

Over the past several decades, pioneering biophysics work has shown that living tissues interact with electric and magnetic fields in unexpected and dramatic ways. From initial anecdotal accounts of enhanced healing under electromagnetic stimulation, research in this field has progressed to a sophisticated arsenal of investigative tools and theoretical models which include polarized light microscopy to study the liquid crystal properties of living cells and laser-excitation of DNA to induce hybridization through non-molecular information transfer. In almost all cases, the results point to a set of remarkable properties of living tissues, and in particular of genetic material: the emerging picture is that of biosystems as sources and domains of coherent electromagnetic fields, which account for practically instantaneous inter-cellular communication and a highly efficient mechanism of energy utilization, and which seem to reflect very closely the developmental and patho-physiological state of the organism. In addition, a wide spectrum of genetic mechanisms now appears to be under the influence of surrounding electromagnetic fields.

At the same time, an impressive number of studies in the areas of parapsychology and mind-body medicine converge to show that conscious intent can affect practically every single type of genetic program, as well as many physiological parameters [1]. These studies also show that such effects can be produced from great distances, and that occasionally they are accompanied by unusual energy signatures. Is there a correlation between the effects of electromagnetic fields and those of mental intent on genetic regulation and living tissues? This paper will discuss the major experimental evidence and proposed mechanisms of these interactions, as well as the principal obstacles lying in the way of a viable, comprehensive theory. At the same time, we will attempt to formulate several preliminary hypotheses based on this evidence and to sketch some possible directions for future research in this field.

Key Words: genetic control architecture, EMFs, coherence, liquid crystals, interference grids, photon polarization, psycho-physiological remodeling, nonlocal communication, topological geometrodynamics.

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INTRODUCTION

The history of mind-body medicine in the modern era has been one of continuous struggle against both the derisive attitudes of a scientific mainstream firmly embedded into a reductionist, materialistic mind frame and the conceptual difficulties of studying something as elusive as the contents of consciousness. While gradual correlations with general factors such as stress have lead to the acceptance of psychoneuroimmunology as a legitimate field of study, there is very little material in the medical literature about other, more specific effects that mental intent might have on the body.

This unfortunate state of affairs, we hope, is about to change. Over the past decade, thousands of studies have been conducted all over the world, looking at the interactions between conscious intent and living systems - from biomolecules and single celled organisms to human beings - and describing statistically significant effects in very concrete, histological and physiological terms. These studies, reported in the scientific parapsychology literature as well as in some physics and biomedical publications, are part of a rapidly growing body of "human potential science" projects - frontier programs funded by governments such as Japan and China to look at exceptional human abilities and harness their implications. Similar studies have also been carried out in the US, Russia, Germany and other Western countries, unfortunately under less supportive conditions which are generally reflected by their more conservative protocols. A large proportion of this material is now available in abstract format through English-language publications such as D. Benor's "Spiritual Healing: Scientific Evidence of a Healing Revolution" (Vision Publications, 2001 Edition) and the Qigong Institute's Database CD-ROM, updated yearly.

In another paper [1], we have reviewed the main classes of studies described in this literature, with a focus on genetic functions - showing how practically every major genetic program (from DNA replication and cell division rates to gene-specific transcription, translation and mutagenesis, to cell differentiation and apoptosis) can be modulated by intent under experimental conditions. In this follow-up article, we would like to take the discussion one step further and begin to look at a possible mechanism that might account for these startling experimental findings.

The present model of genetic control, based on chemical messengers, transcription factors, molecular feedback loops, enzyme conformation, promoter regions and other forms of cis-/trans modulatory regulation is restricted to describing these all-important programs at a primarily intra-cellular level which fails to fully account for the astounding degree of synchronization between the billions of cells comprising the human body. It has been shown that on average four to eight different transcription factors service each gene's regulatory module and that many hundreds to thousands of genes must be coherently expressed in order to create any given tissue or multicellular structure [2 - p. 9]. Thus higher-level aspects of growth and development, as well as pathological and healing processes, such as the differential spatio-temporal expression of DNA in specialized cells and the emergence/loss of complex architecture during embryogenesis or malignant growth, are still a matter of heated debate and speculation [3,77]. How does the DNA material in each cell respond to its variable environmental circumstances in a way which

reflects the cell's lineage, internal clock and also the activities of thousands of cells in its immediate vicinity? Are chemical messengers sufficient to account for the speed and accuracy of this large-scale orchestration, or are there higher levels of genetic control architecture yet to be discovered? We believe that sufficient evidence has already accumulated to support the existence of such nonlocal, non-molecular controls. We also believe, along with a growing number of biophysical research scientists, that the key to the most effective preventive and therapeutic health interventions lies in the understanding of genetic regulation at the top levels of the control hierarchy - that is, in the way cells communicate with each other, their environment and, possibly, with the poorly-understood physical correlates of mental intent.

We have therefore divided this article into several parts: in the first section we will try to challenge the strict biomolecular approach to medicine by presenting a number of studies which clearly demonstrate that electromagnetic fields play a major role in genetic expression; the second part will briefly review the main characteristics of mind-matter interactions with respect to living systems; finally the discussion will attempt to draw parallels between the biophysical and consciousness-mediated mechanisms and point to theoretical models that might account for the effects of intent on targeted biological structures in a nonlocal framework.

I. THE EFFECTS OF WEAK EM FIELDS ON GENETIC PROGRAMS

A. CELL DIFFERENTIATION IN ADULT, EMBRYONIC AND MALIGNANT STATES

The work of Rose and Becker (1940s-1970s)

Observing that three major characteristics of malignant cells (cell simplicity, mitotic speed and metabolic priority) were also typical of embryonic growth and regeneration, in 1948 Meryl Rose conducted a landmark experiment designed to test whether the physiological environment of regeneration could take over the controls of tumor cells. After transplanting pieces of frog kidney tumor to the limbs of salamanders and watching them grow, he amputated the leg just below or, in some cases, right through the tumor mass. As opposed to controls, where the tumor metastasized and ended up killing the host, these specimens demonstrated a remarkable phenomenon: the tumor cells dedifferentiated more fully as the blastema formed, then redifferentiated along with the blastema - thus proving that "the regeneration's guidance system could control cancer, too" [4 - p. 217]. Furthermore, replicating experiments conducted in 1962-1963 by F. Seilern-Aspang and K. Kratochwil at the Austrian Cancer Institute showed that, in cases where the primary tumor was in the tail, amputation of the tail below that level (i.e. leaving the primary tumor intact) resulted in total disappearance of both the primary mass and all its distant metastases as the tail regenerated [4 - p. 220] - thus complete healing of two aetiologically-distinct injuries. Although this result was obtained only when the amputation was close to the site of the primary tumor, it demonstrated beyond doubt that the key to such "spontaneous remission" was a shift in the tumor's immediate environment - most probably the electrical currents in the neuroepidermal junction, which Becker would later prove were the initiators of regeneration.

In 1961, Becker and his team found that applying a very weak current (in the order of a billionth of an ampere) to a culture of nucleated frog red blood cells induced complete dedifferentiation in the cells, which reactivated their nuclei, lost all hemoglobin and became primitive (unspecialized) in the space of four hours [4 - p. 143].

These changes, which were later found in the RBCs of fish and other reptiles, suggested a reactivation of the DNA - for once the staining characteristics of the nucleus shifted, the process continued even if the current was interrupted. All the changes involved paralleled those found in the salamander limb blastemas, demonstrating that the process of regeneration was initiated by an endogenous "current of injury". Applying this knowledge to wound healing in mammals, in 1971 Beckers's team stimulated the bone marrow of rats' amputated forelegs with a 1 nanoampere current and managed to obtain partial regeneration of the limb, including new, well organized bone, cartilage, muscle, blood and nerve tissue: at least ten types of cells had differentiated from the blastema, and some specimens even demonstrated the rudiments of finger cartilage. [4 - p. 153]

What is the nature of this endogenous current which preoccupied Becker for over three decades? Far from being restricted to areas of injury, as originally believed, Becker showed in a series of ingenious experiments that the entire body of a living organism was permeated by a weak DC current, which furthermore appeared to reverse its polarity as the organism's state of consciousness changed from awake to deep sedation/anaesthesia. By demonstrating the Hall effect in the leg of a salamander as it regained consciousness [4 - p. 101], Becker showed that this DC potential was a semiconductor current - in other words, that the carriers were electrons in a semiconducting lattice. But to admit the existence of a semiconductor current permeating and regulating the brain-body continuum, one must be ready to look for an appropriate substrate. Semiconduction requires an ordered molecular structure, such as crystals, in which electrons can exist in a delocalized fashion and flow coherently across large distances with minimal dissipation of energy - a very different model from the type of conduction associated with neurons. In the wet, warm, perpetually-fluctuating environment which is the living organism, what could possibly constitute a proper matrix for this type of phenomenon?

B. INTERACTIONS BETWEEN EMFs AND DNA EVIDENCE FROM BIOELECTROMAGNETICS LABS (1990s-2003)

Before addressing the nature of semiconduction in living tissues, let us review a few more interesting studies which look at the effects of electromagnetic fields on DNA regulation.

In a 2002 study, Tofani et al.. found a statistically significant inhibition of tumor growth (40%) and increase in survival time (31%) when mice bearing a subcutaneous human colon adenocarcinoma (WiDr) were exposed to 70min/day 5.5mT magnetic fields with 50 Hz modulation for 4 weeks; a decrease in tumor cell mitotic index and proliferative activity and increase in apoptosis were also observed - with no adverse or abnormal effects [5]

In a similar study reported by Simko et al. [6], extremely-low frequency EMFs (0.1-1mT, 50Hz) applied continuously for 48-72 hrs resulted in increased micronucleus formation and apoptosis in transformed cell lines (human squamous cell carcinoma SCL II), but no adverse effects in normal, non-transformed cells. Cell death induction consistent with apoptosis was also reported in two transformed cell lines (WiDr human colon adenocarcinoma and MCF-7 human breast adenocarcinoma) that were exposed to 1mT magnetic fields modulated by 50Hz ELF's). Cells with daily exposure of 70 min. for 4 weeks showed significant tumor growth inhibition (up to 50%) by the end of treatment. No toxic morphological changes were observed in renewing, slowly proliferating or static normal cells. [7]

Zhou et al. [9] have shown that a 72 hr exposure of HL60 cells to 50Hz, 0.1-0.8 mT magnetic fields resulted in an increased transcription level for tumor necrosis factor receptor p75 and interleukin II-6Ralpha mRNA expression.

Zhao [10] examined the promotion of DNA synthesis in PDL fibroblasts under exposure to 0.14T magnetic field for 10, 40, 60, 120 min/day x 1week, comparing these to similar treatments every other day. Remarkably, he found that the cellular DNA contents increased proportionally with exposure time in the daily-treated samples, while no significant changes were found if the treatments occurred on alternate days. He concluded that the magnetic field had a cumulative, threshold-dependent and time-delayed effect on DNA synthesis.

Eichwald & Walleczek [11] found that ELF (extremely low frequency) EMFs controlled calcium uptake regulation in T lymphocytes: a bi-phasic response (stimulation / inhibition) was identified depending on the degree of cellular activation. The authors also noted that this, in turn, may affect other cellular processes that are Ca dependent – i.e. DNA synthesis.

Sontag & Dertinger [12] reported that human promyelocytes (HL-60) exposed for 5 minutes to an amplitude-modulated, 4000 kHz interferential current (25, 250 and 2500 microA/cm²) showed windows of significant stimulation and depression in intracellular cAMP within the range of frequencies studied (0-125 Hz).

In a study by Kubinyi et al., t-RNA synthetase activity isolated from the brain and liver of mice exposed to microwave radiation (2.45 GHz) during gestation showed a decrease after continuous wave exposure, and an increase in activity after amplitude-modulated irradiation [13].

It is interesting to note that many of these studies specifically report finding no adverse effects on normal cells exposed to the same EM fields.

Finally, Blank and Soo [14] reviewed evidence that EM fields interact with the activity of the cell membrane enzymes Na,K-ATPase and cytochrome oxidase in a frequency-dependent manner - but argued that, in addition, large electron flows known to exist within the stacked base pairs of DNA could interact directly with EM currents and lead to gene activation [15]. One finding that supports this contention is that DNA transcription in cell-free solutions can be activated by electromagnetic fields [16].

C. ENDOGENOUS COHERENT FIELDS: BIOSYSTEMS AS DYNAMIC HOLOGRAMS EVIDENCE FROM THE INTERNATIONAL INSTITUTE OF BIOPHYSICS (1970s-2003)

All living systems emit light spontaneously: these ultra-weak emissions range from a few up to several hundred photons per second per square centimeter of surface area. The distribution spectrum ranges from infra-red to ultra-violet and is nearly flat, which indicates that the energy is emitted from a wide range of excited molecules and stored in a delocalized manner within the system. Based on the characteristics of these emissions, Popp and others [17, 18] have shown that the source of the biophotons is a coherent photon field within the organism. The dominating role of source and sink for the biophoton field is the DNA molecule [17, 24] (in fact the mammalian red blood cells, which do not have active chromatin, are the only cells which do not emit biophotons).

Photon fluxes play a remarkable number of biological roles as either carriers of information (in enzyme activation, phototropism, photomorphogenesis, phototaxis, regulation of gene expression, vision) or as a driving energy for biological processes [21]. Furthermore, it is known that both the intensity and the spectrum of the biophoton emission are strongly correlated with the physiological and developmental state of the organism: for example, [22, 23, 25] report significantly higher levels of photon emission from surgically removed tumors compared to normal tissues, a non-linear correlation between BPE and growth rate, and further correlations between the ultra-weak light from the fingertips of patients and their age and certain physiopathological states. These findings offer ample support to the thesis that biophotons are intimately related to the regulation of critical biological functions.

Noting correlations between optical properties of molecules and their carcinogenic activity, Popp has suggested that cancer induction is related to the loss of coherence of a photon field in the living tissues, originating from excited states of DNA [26, 27]. Growth regulation is based on the death rate of cells, with sudden cell death and mitosis having to balance each other perfectly. With 10^7 cells dying every second in the human body, this information has to travel a distance of at least 10^{-3} cm in 10^{-7} seconds, which is much faster than the velocity of messenger molecules, approaching the velocity of sound. If it is assumed that the message is holistic and "communicated" to the entire body, then the scale becomes 1 meter, and the speed of transmission reaches electromagnetic values. Thus cancer can be seen as an imbalance between cell growth and death due to a deterioration of intercellular and full-body communication systems [17] - and indeed, research has shown [25] that the characteristics of biophoton emission curves are different for normal versus tumor tissues.

The spatio-temporal coherence of biophoton fields means that complex electromagnetic (EM) interference patterns are created throughout the organism: the more coherent the light, the sharper the interference patterns. It has been suggested by Popp, Gariaev and others that these patterns may be the basis of morphogenesis and structural/biochemical regulation of the organism throughout its life - an EM blueprint guiding the development, repair and even social behavior of organisms. The phase information within and between cells is hypothesized to act as a biological control parameter regulating the growth and differentiation of cells, with constructive interference domains intra-cellularly and destructive interference in the extra-

cellular matrix [24]. Experimental evidence such as the phantom leaf effect [28], the delayed luminescence function of tumor cells and the distribution of *Daphnia* larvae [29, 30, 18] certainly seem to support this hypothesis.

One of the most remarkable findings to shed some light on the possible mechanism of biophoton control comes from Ho's laboratory: in 1993, she and Lawrence discovered that, under polarized light microscopy, the extraordinary level of molecular coherence makes organisms appear crystalline. This dynamic coherence is a continuum that extends from intracellular molecules to the cytoplasm, extracellular matrix and the connective tissues throughout the organism [18]. The lipids in cellular membranes, the cytoskeletal and muscle proteins, collagen and other connective tissue macromolecules, as well as the DNA in chromosomes - all these essential and ubiquitous molecules of living systems are liquid crystals [31, 32]. Consequently, the organism may be seen as a solid state possessing many of the physical characteristics of these highly interesting materials.

Liquid crystals (LCs) are mesophases - states of matter between the solid and liquid phase. While they possess long range orientational order, they are highly mobile and responsive, undergoing orientation changes (phase transitions) when exposed to a wide variety of stimuli, including electromagnetic fields, temperature and pressure changes, hydration, pH, concentrations of inorganic ions and other physico-chemical parameters [31, 32]. LC can convert information about minute changes in pressure, temperature and light into electrical currents (they are piezoelectric, pyroelectric and photoelectric). Finally, they are permanently modified (sensitized) by the passage of electrical currents so as to facilitate the future passage of such currents [4 -p. 257).

Considering these arguments, Mae-Wan Ho suggests that the LC matrix may act as a quantum holographic medium which records interference patterns between local events and the global body field - an idea which finds full agreement with Gariaev's experimental work [33].

D. EVIDENCE FROM THE RUSSIAN ACADEMY OF SCIENCES GARIAEV'S DNA-wave BIOCOMPUTER (1990s-2003)

Since the early '90s, Peter Gariaev's team has been developing a new theoretical and experimental approach to the study of genetic material encoding and expression. In a pioneering series of papers [28, 34, 35, 36, 37, 38], he and his colleagues challenge the limits of the genetic code triplet model and propose instead a dual, substantive/wave basis for the encoding and expression of genetic material. The wave-like, non-local aspect of genetic regulation is recorded at the polarization level of DNA-associated photons, and the genome is seen as a quasi-hologram of light and radio waves which creates the background necessary for the appropriate expression of genetic material.

Some of the experimental evidence cited in support of this new model is listed below:

1. The existence of homonymous-synonymous ambiguities of genetic texts;
2. The virus-like strain specificity of prions in the absence of nucleic acid material;
3. The role of introns: statistical analysis using the Zipf-Mandelbrot law reveals that DNA non-coding sequences, which account for 95-98% of the genome, have more in common with natural languages and demonstrate more long-distance correlations than coding sequences; this, according to the authors, is a strong indication that non-coding areas are the basis for one or more biological languages and represent "a strategic informational content of chromosomes";
4. The ability of DNA and chromatin in vitro to be pumped as a laser-active medium for subsequent laser light generation;
5. Dzang Kangeng's experiments: successful wave transmission of genetic information from donor biosystem to an accepting one via split laser beams fed repeatedly through the optically-active donor biosystem, then delivered to the receiving biosystem in early developmental stages. Mixed characteristics of these non-molecular hybrids (seeds and chicks) were transferred to the next generation without need for further irradiation. (Although Kangeng provides no theoretical interpretation of the operational device, the authors' previous work with laser mirrors closely parallels his protocol, leading them to conclude that the polarized laser beam split into orthogonal waves which, by repeated passing through the optically active donor DNA and multiple interference with itself, lead to the phenomenon of photon field localization and information recording);
6. The authors' similar experiments with polarization-laser-radio-wave (PLRW) spectroscopy, whereby they used orthogonally polarized EM beams to repair the genetic information of old radioactively-damaged seeds from the Chernobyl area (1987).

The authors argue that the genome emits light and radio-waves whose delocalized interference patterns create calibration fields (blueprints) for a system's space-time organization. This holographic-type information is being constantly and simultaneously read in billions of cells, accounting for the quick coordinated response typical of living systems. Gariaev and his team suggest that the genome operates like a "complex multi-wave laser with adjustable frequencies", able to produce light and radio waves which regulate the biosystem's space and time organization. This complex background is the basis for the correct expression of genetic material (peptide codes) during embryogenesis and adult life, accounting for the elusive self-regulation and specificity of DNA function in various tissues and under various conditions. Various solitons (optical, acoustic, conformational, rotatable-oscillating, etc) excited in polynucleotide areas, and transmitted over large distances significantly exceeding the hydrogen-bond length, "become the apparatus for continual (non-local) reading of context RNA sequences on a whole".

On the basis of this model, the authors suggest that the activation of oncogenes and xenobiotic HIV sequences is dependent on genome holographic processes and therefore that future research in these high-profile areas should focus on the factors modulating such EM field characteristics (such as external artificial modified fields) in addition to local, molecular biology approaches.

Given that the expression (onset) of oncogenes and retroviruses such as HIV is known to vary widely among individuals and be largely context-specific, the authors suggest that external artificial modified fields may, in the future, help us modulate this apparent cellular context (environment) and thus keep such noxious genetic material dormant for indefinite periods of time. Another interesting suggestion made by Gariaev is that phenomena such as cellular apoptosis might be connected with an abnormal compression of photons by cell nuclei, which are accumulated to a maximal value and then destroy the nuclei.

Since apoptosis has been frequently demonstrated in healer-treated cancer cultures, and unusual electromagnetic signals are also commonly observed during spiritual healing sessions, we would like at this point to re-direct our attention and discuss some of the major experimental evidence and current conclusions with respect to this phenomenon.

II. THE EFFECTS OF HEALERS' INTENT ON LIVING TISSUES

In an earlier paper [1] we have described a series of experiments which demonstrate that human intentionality can produce a statistically significant effect on the following genetic programs:

1. Cell division, reflecting DNA synthesis and mitotic rates
2. Transcription rates and DNA conformation
3. Gene specific translation rates
4. Cell differentiation
5. Mutagenesis
6. Apoptosis, or programmed cell death.

Furthermore, conscious intent has been shown capable (at statistically significant levels) of producing the following structural and physiological effects:

1. Conformational changes in cell membrane, chromatin, proteins [1, 78]
2. Distant influence on a target's EEG, heart rate, galvanic skin response, finger blood volume, blood pressure, as well as fish orientation and algae motility [40, 41, 42 - p. 336]

These controlled, randomized and typically (but not always) blind studies have been extensively discussed in our previous paper – however we shall briefly summarize these results in order to highlight certain parallels with the effect of weak EMFs on living tissues, as described earlier.

Accelerating or Decelerating the Growth of Biological Subjects

This is one of the most commonly documented effects of conscious intent on living organisms in both the Eastern and Western literature. The studies reported under this category include the acceleration of seed germination and plant growth rate [79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89]; a directional increase/decrease in the growth rate of in-vitro cancer cell cultures like human nasopharyngeal carcinoma cell line (CNE-2), human breast cancer cell lines, lung cancer cells (SPC-A1), liver cancer cell line (BEL-7402), erythroleukemia (K562), promyelocytic leukemia, CNE-2, SGC-7901 gastric adenocarcinoma, spleen cells of mice and lung tumor cell line (LA-795), etc. [90, 91, 92, 93, 94, 1]; bi-directional effects on the growth of bacterial cultures such as E-coli [95,96] and Salmonella typhimurium [97]; and inhibition of in-vivo tumor growth in mice [94, 98, 99].

The typical in-vitro study involved randomly dividing laboratory-prepared cancer cells or other cultures into groups with at least one group being treated with intention or external bio-energy (like external qi), plus one or two control groups. Sometimes, one group was treated by a sham healer (person without training in bioenergy healing).

In vivo-models most commonly used mice inoculated with cancerous cells, which were then randomly divided into various groups with one group being treated by external qi or other spiritual healing method for a set period of time. The control group could be either non-treatment or sham treatment. Then tumor size and the survival time were measured as the outcomes.

Related to this type of study are experiments in which human intent was applied to revitalize fully denatured seeds and accelerate sprouting, producing measurable plants within minutes. One particularly gifted subject, Ms. Chulin Sun, has worked with dozens of scientists world-wide and been involved in hundreds of successful replications of this phenomenon over the past 16 years. Some of these studies involve revitalization of fried peas or cooked peanuts [100, 101, 102] while others report a statistically significant acceleration in the sprouting of peas [103], wheat [104], corn, watermelon seed, bean, flower seed and peanuts [101, 105].

Transcription/Translation and Differential Gene Expression

Chien et al. [106] looked at the bi-directional effects of external qi on FS-4 human fibroblasts and found that "facilitating" qi produced a 1.8% increase in cell growth rate in 24 hrs, 10-15% increase in DNA synthesis and 3-5% increase in cell protein synthesis in a 2 hr period. With "inhibiting" qi, cell growth decreased by 6% in 24 hours, while DNA and protein synthesis decreased respectively by 20-23%, 35-48%.

Zhang et al. [107] studied the effect of emitted qi on the nucleic acids of chick red blood cells and found a two-fold increase in DNA and 12-fold increase in RNA content.

Related results include the ability of emitted qi to increase NK cell and K cell activities [108] and to enhance the number of active osteoclasts and the quality and quantity of both fibrous and bony callus tissue in laboratory rabbits [109].

These studies suggest that conscious intent may act by increasing the rate of cell-specific transcription/translation responsible for specialized functions, as well as possibly stimulating cell differentiation and/or recruitment.

Structural Changes Caused by Intent or Mental Power

D. Y. Chu of Peking University tested more than 20 qigong healers in controlled studies to explore the effects of EQT on the conformation of bio-molecules [110]. In her study, a circular dichroism (CD) spectrum was used to monitor the conformation of various bio-molecules, such as poly-glutamic acid, poly-lysine, metallothionein, and some RNAs. After more than a hundred trials were repeated with different healers and controls, she found that the CD spectra of bio-molecular samples were changed significantly after exposure to EQT in comparison with both controls and the baseline. In general, the changes of the CD characteristic ellipticity were over $1 \cdot 10 \times 10^3 \text{ dgr} \times \text{cm}^2 \times \text{dmol}^{-1}$, and the maximum was $93.9 \times 10^4 \text{ dgr} \times \text{cm}^2 \times \text{dmol}^{-1}$. The change of ellipticity could be positive or negative depending on the intent of the qigong healer. These findings were successfully replicated when she visited the US in 2000 [111].

Rein and McCraty [112] reported a 250% change in DNA conformation, directly correlating with the intent of a healer from a distance. The directional winding/unwinding of DNA under specific intent has been repeatedly demonstrated by Rein and his team over a number of years and experimental set-ups, with some samples showing more denaturation than could be obtained via normal heating or mechanical means [113]. Similar changes in the conformation of DNA and RNA samples have been found under the effect of conscious intent (external qi) by Lu Zuyin [114] and Sun et al. [115] as indicated by changes in the samples' ultraviolet absorption curve.

In addition, statistically significant effects on erythrocyte cell membranes were documented by Braud et al. [116, 117] and Sun et al. [118]. These include the ability of healers and/or ordinary persons to decrease the rate of RBC hemolysis; to increase fluidity of the erythrocytic membrane; and to suppress activity of Na^+ , K^+ of RBC membrane.

Changes in cell colony architecture were also documented by Chen X. et al [119] and by Chen [120,121], correlating with a change in the types of glycoproteins expressed on the cell membrane surface - so this effect may also be a result of alterations in the specific genes expressed under the effect of external qi.

Intent-Induced Mutation

Nash [122] randomly assigned 60 ordinary subjects (not known to be psychically gifted) into three groups: one group mentally promoted mutation of lac-negative strains of e-coli to lac-

positive strains in three test tubes, one group mentally inhibited mutation in three test tubes, and the rest 20 subjects worked as control. All tube conditions were carefully blinded to the lab technicians. He found that the mutation ratio of lac-positive to total bacteria was greater in the promoted tubes than that in the inhibited tubes ($p < .005$); and less in the inhibited tubes than in the control ($p < .02$).

There are many more studies in this area that we will not discuss in detail here. For example, Liu et al [123] applied EQT as mutagenesis for micromonospora echinosporid, and found that EQ has the ability to kill micro-organisms and change strains properties. Pei et al [124] reported that mutation of E-coli C311 occurred after exposure to EQT. Shan et al [125] also used the intent of the qigong healer as mutagenesis to select various antibiotic-producing strains in the pharmaceutical production, and had some success. Bai et al. [103] reported that the seeds mentally induced to germinate rapidly were apparently genetically altered with significant differences in DNA extraction and Polymerase chain reaction.

Morphological Alterations and Cell Differentiation

Electron microscopy studies of malignant tissue extracted from laboratory animals treated with external qi have repeatedly shown clear histological signs of apoptosis and/or reversal of cancer features, when compared to controls. For example, in their study of the inhibitory effect of EQT on human hepatocarcinoma in mice, Chen et al [126] found morphological alterations including nuclear condensation, nuclear fragmentation, decreased ratio of nucleus and cytoplasm, swollen mitochondria with poorly organized mitochondrial cristae (some vacuolated) and many apoptotic bodies in the extracellular space. Shao et al. [127] looked at qigong-treated mice with implanted S180 sarcoma and reported that the averaged diameters of cells and nuclei, the ratio of nucleus to cytoplasm and the number of tumor cells division phase and Ag-NOR counts in nuclei in the sarcoma of EQT treated mice were all much less than those in the controls ($p < 0.001$). They also found that in the EQT treated mice a great number of sarcoma cells showed atrophy, degeneration, and pyknosis or karyolysis, while some membrane structures such as mitochondria appeared to be injured. Finally, Li et al. [128] studied the effects of emitted qi on G422 neurogliomas implanted in mice, finding that mitotic rates were reduced and the differentiation of the glioma cells tended to be reversed and the activity of NK and K cells was increased significantly compared to the tumor control.

These several hundred studies, conducted over the past 3 decades by a large number of university and independent laboratories in countries like the US, England, China, Japan, Russia, Germany and others, represent a pioneering body of work whose importance cannot be overstated. Although not all of them have been conducted under ideal methodological conditions of blindness and control, and the reporting style is far from consistent across the field (see [42] for an outstanding synopsis and analysis of experimental quality in these different categories), the overall evidence is much too compelling and significant to ignore. Replicating these studies under proper, uniform academic standards is of course a necessary first step. However, many of the results obtained by independent laboratories appear to reinforce each other, to a degree that

certain general observations about the effect of mental intent on biological targets can already be drawn.

A. SPECIFICITY OF INTENT

The effect of intentionality appears to be directional and target specific. For example, Achterberg and Rider showed that training patients in cell-specific visualization of either T lymphocytes or neutrophils resulted in statistical increase in cell blood levels correlating with the type of imagery employed [43].

Becker used hypnotized subjects to demonstrate that they could decrease or increase the DC potential of specific areas of the body depending on the suggestion given (a suggestion of numbness in the left arm resulted in no response to a pinprick stimulus and a drop to zero in the DC potential, while the pinprick response/DC potential remained almost unchanged for the right arm; the change in voltage was "exactly the same as that seen in standard chemical nerve block" [45 - p 90-91].

Many of the studies described above also reflect such a directional effect (see, for example, 129, 41, 113, 47).

B. ELECTROMAGNETIC WINDOWS OF HEALING AND INTENT

Studies by Zimmerman and Beck show that healers' hand and brain frequencies measured during active "healing states" sweep a 0.3-30 Hz range, with most activity in the 7-8 Hz area. These frequencies, which show an uncanny consistency across a remarkable number of cultures and healing traditions, appear to closely overlap the electromagnetic specificity windows used in clinical and laboratory applications to enhance neural regeneration (2 Hz); bone growth (7 Hz); ligament healing (10 Hz) and capillary and fibroblast proliferation (15, 20 and 72 Hz) [48].

Both local and distant mental interactions have been shown to produce unusual EM signatures. Magnetic signals up to 105nT were found by Wu et al. during Qi emission by qigong practitioners [49]. Unusually high static charges (up to 221 volts) from the bodies of healers and psi-gifted people were reported by Watkins, Hochenegg, Shallis and Green [42 p157]. Nakamura measured an increase in biophoton emission intensity from the hands of practitioners in the qigong state [50]. Wallace found that human biophoton emissions could be increased by subjects at will and measured up to 100 times stronger emissions from the hands of gifted subjects compared to controls [51]. High surges in the magnetic field surrounding healers, or significant effects on distant magnetic sensors, have been published by Ullman, Watkins, Puthoff and Targ, Zimmerman and Ostrander and Schroeder, Sergeyev, (52; 42 p 168; 39). Photographic film exposure in association with healing or clairvoyance experiments has been demonstrated in independent studies by Watkins, Turner and Zhao Yong-Jie [42 p 157, 169]. Radin reports that the background ionizing radiation could be decreased in accordance to task instructions ($p < 0.05$), only to suddenly increase above control levels 20 seconds after the

treatment period [53]. In a series of experiments involving therapeutic touch practitioners and their subjects, gamma radiation levels significantly decreased in 100% of the subjects and at every body site tested [54, 55].

Finally, we should also ask ourselves what such capabilities tell us about the healer's metabolic status. We know, for example, that advanced practitioners of Qigong can enter a special state (Bigu) in which they can subsist for weeks, sometimes months, on only 2-300 calories per day, while carrying on with normal activities. [56, 57] This "super-efficient state", as Prof. Roy has described it, has been shown to be metabolically different from that of normal fasting - which suggests that the body somehow switches over to a different way to process and conserve energy. Is there a link between Bigu and the energetic phenomena described above?

C. DISTANT MENTAL INTERACTIONS WITH LIVING SYSTEMS (DMILS)

DMILS include a wide range of variables, from physiological parameters like EEG and galvanic skin response [40, 58, 59, 60] to the denaturation of DNA in solution [42, 61] to affecting the morbidity and mortality rates of HIV/AIDS patients by remote prayer groups [62]. Typically in these experiments the sender is isolated from the experimental group by distances ranging from a few meters (an adjacent room) up to thousands of kilometers and the subjects are blind to the sending period, so that a comparison can be made with the "non-influence" windows.

The statistical significance of these remote effects across dozens of independent studies is highly consistent despite the subjects' inability to consciously "guess" the sending window. Some studies have shown a lag time to onset of effect in the order of seconds [59,60], while in others, paradoxically, an anticipatory effect has been demonstrated [58] - consistent with decades of parapsychological retro-pk evidence, but a clear challenge to our current concept of information flow and causality.

Such evidence of space and time non-locality is probably the single greatest reason for which spiritual healing continues to encounter major resistance as a legitimate research subject from the scientific establishment. And yet at a physics theoretical level there is nothing that prohibits such effects from taking place: indeed, if there is one salient observation to be made on the basis of our foregoing discussion, it is that modern medicine seems to have almost entirely disassociated itself from the biophysical bases of life: current thinking appears to stop mysteriously at the biomolecular level, completely oblivious to the physics that lie beneath. Our challenge is to take this next step and place the current, biomolecular understanding of genetic regulation into a broader context - hoping that some of the answers which have eluded us so far, such as the onset criticality and reversal of malignant programs, will become more obvious at this level of the control hierarchy.

III. A NEW PERSPECTIVE ON THE GENETIC CODE

A. A HIERARCHY OF GENETIC REGULATORY MECHANISMS:

Even a brief survey of the literature, such as we have undertaken, suggests that there are at least three main levels of control mechanisms dictating the unfolding of genetic programs:

1. **THE BIOCHEMICAL LEVEL:** this includes, but is not limited to, the triplet genetic code and the newly discovered histone code; mechanisms such as the availability of cellular chemical messengers, molecular feedback loops and cis-/ trans-regulation work on this level, controlling to at least some degree the sequence of different genes' expression.

2. **THE BIOPHYSICAL LEVEL:** this can further be divided into local and non-local effects.

2A. **LOCAL** control refers to the conformational effects of electromagnetic fields on chromatin, enzymes and cell membranes - which in turn affect the exposure of given genes and the rate of transcription/translation, plus possibly the rate of DNA synthesis and cell mitosis.

2B. **NON-LOCAL** effects include endogenous field coherence, electromagnetic interference grids, superconduction, photon localization phenomena and the possibility of non-material, wave-based genetic hybridization and regeneration, as demonstrated by the experiments of Gariaev and Kangeng.

3. **THE CONSCIOUS LEVEL.** As we suggested before, it is difficult to tell at this point whether consciousness and mental intent act both locally and non-locally, although the existence of DMILS and anticipatory effects is a strong indication that we need to look beyond simple electromagnetic entrainment between healer and patient.

Once we recognize that genetic programs are continuously modulated by all these different parameters, we need to ask ourselves a new set of questions. For example:

1. What is the correct order of these elements in the hierarchy?
2. How do level 1 and 2 mechanisms interface with conscious intent? (EM or other physical substrate?)
3. How do coherent biophoton fields interact with environmental EMFs?
4. How does conscious intent modulate endogenous EMFs?
5. What is the power/frequency/polarization profile of biophoton emissions under different states of consciousness and how does it vary with various intentions or forms of visualization?

6. What is the basis of target specificity and bi-directional effects in controlled healing/pk studies?

7. How is information transmitted non-locally?

B. PRELIMINARY FRAMEWORK

To begin addressing these questions, it is important to re-emphasize the biophysical perspective on living tissues emerging from the works cited above. According to this view, the coherence of endogenous EM fields and liquid crystal properties of biomolecules account for:

- NONLOCAL COMMUNICATION THROUGHOUT THE ORGANISM/ TISSUE/POPULATION
 - -SYNCHRONIZED BEHAVIOR OF BILLIONS OF CELLS
 - EXQUISITE SENSITIVITY AND SPECIFICITY TO WEAK STIMULI
 - HIGHLY EFFICIENT ENERGY UTILIZATION
- POSSIBLE BRAIN-BODY ELECTROMAGNETIC CONTINUUM AND TUNING REGULATORY MECHANISM FOR TISSUE-LEVEL INTERFERENCE EFFECTS

C. WORKING HYPOTHESES

1. INTENT-DRIVEN CHROMATIN DECONDENSATION AS A FACTOR IN TRANSCRIPTION?

It is generally accepted that the conformation of the chromatin fiber must change reversibly in processes that require the access of regulatory proteins and enzymes to the DNA template (such as in transcription, replication and repair). Van Holde and Zlatanova have suggested [63, 64] that one of the major conformational changes that occurs during DNA compaction is a collapse of the angle made between three consecutive nucleosomes (internucleosomal angle), probably mediated by electrostatic changes in histone interactions with linker DNA.

Could such a change in angle be partly controlled by the electromagnetic hologram grid nodes postulated by Gariaev, Popp and others? If electrostatic interactions are responsible for chromatin folding/unfolding, it would be easy to see how changes in the frequency or polarization angle of DNA-associated biophotons could alter the locus of action of such pre-transcriptional decondensation. The demonstrated ability of conscious intent to produce winding/unwinding of in-vitro chromatin and to directionally influence transcription becomes highly significant in this context. One other supporting piece of evidence is the published experiments of Yan Xin [65] in which he repeatedly demonstrated the ability of external qi to

alter the polarization of targeted He-Ne laser beams from distances ranging between 7-2000 km. The change in polarization occurred within an hour of the external qi emission, as repeated sharp fluctuations averaging 6-7 degrees and 10-12% change in intensity of the normal beam, compared to baseline. No difference was recorded in the controls.

2. MEDITATION AS PSYCHO-PHYSIOLOGICAL REMODELING

We propose that qigong and other meditative techniques work by progressively increasing the overall coherence ("qi flow"?) of the body's liquid crystal matrix via conscious mental driving, in a way not dissimilar to laser pumping or the gradual orientation of ferromagnetic particles in an EM field. Meditation frequencies could engage the thalamic silent periods (as Oschman has suggested) and possibly other frequency-window pacemakers, and thus drive the configurational states that the body naturally cycles through, to sensitize its LC matrix to particular frequencies. Moreover, the semiconductor nature of living tissues suggests that, with repeated passage of an EM current through them, their sensitivity to subsequent signals should increase - a property which, we believe, is critical to the understanding of long-term physiological changes seen in meditators [66, 67]. The maintenance of a mentally-driven, permanent tighter-than-average molecular coherence would, in our model, lead to a gradual increase in tissue liquid crystallinity, more efficient signal detection/transmission and hence greater perceptual sensitivity, energy efficiency (Bigu) and ability to correct local EM "contextual errors".

3. DO SPECIFIC INTENTS TRANSLATE INTO CHARACTERISTIC BRAIN-BODY WAVE FORMS?

As we have seen earlier, Becker has shown that an organism's somatic DC field correlates in very specific ways with its state of consciousness: using salamanders for test subjects, Becker found that under anesthesia, their peripheral voltages dropped to zero, and even reversed in very deep stages [4 p. 111]. Similar instances of reversal in body polarity are reported as occurring in human subjects monitored during deep trances induced in preparation for remote viewing. In *Spiritual Healing*, Benor reports on a study by Rein and Laskow which found that four different intentions by the same healer produced different body magnetic emissions which correlated with different biological effects on tumor cell cultures [42 p. 159].

As we have seen earlier, the bi-directional effect of intent on living targets is also mirrored, remarkably, by the bi-phasic response of tissues to specific EM frequency windows (section I-B).

Furthermore, it is highly interesting to note the close parallel between the genetic-level effects of healing intent as described in [1] and those of weak electromagnetic fields as discussed earlier in this paper (i.e. altered levels of mRNAs and proteins, increased enzyme activities, decrease in tumor growth and cell mitotic index, tumor cell alterations in shape and membrane discontinuity, increased apoptosis, accelerated differentiation - as well as seed revitalization and hybridization

with the Gariaev/Kangeng techniques). The fact that many of these bioelectromagnetic studies found no adverse EMF effects on normal cells also seems to parallel the regulatory influence of healing intent [42, 78].

Is there a link between effective mental healing intent, or the altered state of consciousness required to produce it, and these unusual EM emissions? Are characteristic frequencies/spectra required for particular healing effects? And do these unusual EM signals play an active role in healing (perhaps by entrainment and frequency synchronization with the patient, as Oschman suggests) - or are they merely by-products of a deeper interpersonal communication mechanism we have yet to discover?

Based on the evidence presented in this paper, we tend to agree with suggestions by Beck, Oschman and Becker that healers produce characteristic electromagnetic frequencies which can exert specific biological effects on their target. However, we would like to qualify this statement by adding the following observations:

1. Frequency may not be the only parameter involved in modulating the EM signal. In view of Popp's and Gariaev's data, we have reason to believe that the phase and polarization of endogenous fields are also under the effect of conscious intent, which may be self-generated or transmitted non-locally by a healer.

Thus the specificity of guided imagery may be the result of unique windows of frequency/polarization excited at the level of the cerebral cortex, then spreading globally along neural and perineural pathways. It is also possible that concentration on complex sensory modalities (i.e. the vividness of imagery) synchronizes larger areas of the cortex, resulting in a more powerful signal. Gariaev's contextual holographic paradigm further suggests that a pathologic EM environment may be less stable than that of healthy tissue, and thus more easily modified. Finally, we could also make an argument that stress, or other chronic emotional disturbances, represent a possible source of de-synchronization with partial loss of endogenous field coherence.

2. Another point that cannot be overemphasized is that the presence of electromagnetic signatures associated with intent does not necessarily imply an EM transmission mechanism (i.e. via proximal frequency, entrainment or coupling to the Schumann resonance, as previously discussed by Oschman, Becker and Sidorov) - but simply that these ubiquitous EM signals may be produced as a secondary, local effect of the primary interaction. While EM coupling cannot be excluded in some situations, we need to realize that the nonlocal characteristics of mental healing (target specificity, distance and time independence) require more than a classical communication framework (see below).

4. DISTANT INFORMATION TRANSFER

One of the most remarkable features of distant mental interactions with living and inert systems is that they affect only the target samples, leaving other (control) samples which are within the

same radius, statistically unchanged [49]. This strongly suggests that we are dealing with some form of entanglement between healer and target, rather than a classical, isotropic field-mediated process. However, it has been repeatedly pointed out by Dossey, Walach, Pitkanen and others that in such cases the definition and exact mechanism of quantum entanglement would have to be expanded to account for the insertion/extraction of intelligent information and for the notorious problem of decoherence in complex quantum systems.

One comprehensive model that happens to contain such an extended concept of entanglement (together with numerous testable predictions which are supported by Gariaev's spectra and the presence of EM signatures at the target) is Pitkanen's Topological Geometro-dynamics - an 8-dimensional cosmology which is the product of 4-D Minkowskian space-time and the $SU(3)/U(2)$ projective space of two complex dimensions [68, 69, 70, 71]. The geometrization of all basic interactions in TGD means that classical fields and matter form a pseudo-Feynman diagram in which the lines representing matter are replaced by spacetime sheets and virtual bosons are replaced by topological light rays ("massless extremals", MEs). MEs generate geometrical supracurrents which serve as a source of coherent photons and act as geometrical correlates of entanglement between distant material space/time sheets (the vertices of the pseudo-Feynman diagram). One of the predictions of TGD is that focused mental intent produces topological field quanta - form-specific MEs which act as non-dissipative entanglement bridges between sender and target and which create characteristic ionic and electromagnetic signatures at both ends by their interaction with local magnetic flux tubes.

Thus the solution proposed by Pitkanen appears to elegantly connect all the major observations we have discussed in our paper up to this point: a distant healer's conscious intent can be seen as generating form-specific geometrical currents which "propagate" non-dissipatively across arbitrarily large distances and which interact with the intended target by producing characteristic, coherent photon signatures. In turn these photons interact with the organism's endogenous electromagnetic field to modulate specific frequency or polarization parameters as described by Popp and Gariaev, thus altering interference patterns, regulating inter-cellular communication and the contextual environment of DNA/RNA expression inside cells.

Of course, at this point it is difficult to fill in all the details, or indeed feel confident of the absolute validity of such a model. On the other hand, TGD opens experimental possibilities that have generally not been available with other theories of nonlocal healing. In [70] we have made a number of proposals regarding the types of tests that could be conducted as a preliminary verification of TGD predictions. Together with additional replications of the Gariaev experiments and of the major histo-molecular healing studies reviewed in this paper, we believe these ideas are well-worth pursuing as part of a future research program in complementary and alternative medicine. As opposed to previous mind-body research proposals, all these suggested protocols are remarkably concrete, objective, quantifiable and compatible with our need to construct a consistent physical theory. Since only innovative experimentation will be able to select the most promising theoretical models, and since in the absence of such models we cannot begin to incorporate this valuable body of evidence into our overall therapeutic strategy, we feel it is imperative that the NIH and other potential sponsors treat these proposals with the attention they deserve.

CONCLUSIONS

Where do we go from here? The first step, of course, should be a well-coordinated experimental program replicating the major classes of mental interactions described in these two papers. Protocols could be set up to study the biophysical basis of differential response in normal and abnormal cell populations (target specificity/normalization); to compare the effect size, replicability, side effects and long-term response for biophysical and mind-body therapeutic approaches in specific pathological models; to study the ability of normal human populations to learn and effectively implement such mental techniques (clinical studies); and to investigate the interactions between external EM fields and endogenous currents with respect to genetic regulation. Finally, given the common challenge that nonlocal communication presents to researchers in physics, parapsychology and mind-body medicine, we strongly advocate the establishment of interdisciplinary teams to collaborate on innovative new protocols capable of extracting meaningful conclusions about this fundamental aspect of reality.

From an applications point of view, we should start identifying the most effective meditation protocols for specific effects - i.e. enhancement of immune function, expression of specific genes, and suppression of pathogens or reversal of malignant cell behavior/induction of apoptosis. It is also important to start designing and standardizing teaching programs, perhaps through the use of biofeedback methods to evaluate the effectiveness of teachers' and students' meditation on specific biological parameters. Understanding the interactions between mind-body interventions and conventional treatment modalities (such as the demonstrated increase in drug uptake and reduction in chemotherapy side effects with concurrent qigong practice) is another long-term goal, which should allow us to eventually integrate such multi-modality therapies for optimal results with minimal iatrogenic trauma to the organism.

Finally, we would like to take a step back and end this presentation with a philosophical observation. For more than a century, the common assumption in parapsychology research has been that the brain is the primary detection organ for subconscious/ anomalous cognition. However, in spite of this experimental focus, there is a remarkable lack of evidence supporting this contention - in fact we now know that certain peripheral responses to anomalous stimuli, such as the galvanic skin response, are highly consistent in the absence of any conscious awareness of these stimuli. Is the brain the only conceivable transducer of nonlocal information?

Indeed, the literature shows that psi function manifests across the full taxonomic continuum, from humans to animals [41, 58, 73, 74, 77] to plants and individual cells [72, 42]. Since such consistent features are generally attributed to a very successful adaptive mechanism, and Pitkanen's TGD predicts a fractal hierarchy of biological emitters/receivers for nonlocal communication, could it be that the exquisite sensitivity of genetic material (DNA, RNA, protein) to mental intent may in fact reflect a deep evolutionary principle? For these first forms of life, devoid of what we would call a sensory system, chemical and electromagnetic interactions with the environment would have been one, albeit purely random, type of "orientation" response. However, the complex behavior of organisms starting from the very bottom of the taxonomic tree (see virus and prion dynamics, DNA repair and transcription, etc) strongly suggest that behavioral adaptations were set in place, which clearly reflect a directional,

self-serving interaction with the environment and that we are at a loss to explain on purely biomolecular grounds. Could the survival instinct of primitive organisms qualify as consciousness - suggesting that the genetic material in our bodies might in fact be the oldest and primary "antenna" for nonlocal communication? While this may at first look like a rhetorical question, the sobering realization that we are still in the dark about the higher-level programs regulating the spatial and temporal expression of DNA [2,3,77], together with the evidence presented in this paper, suggest a positive answer. And if conscious intent has the ability to shape our organism's response to environmental challenges by acting all the way down to DNA, RNA and protein levels, then it is indeed the most versatile and potent therapeutic intervention we could ever conceive.

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