Report

THOUGHT AND MIND AS THE PROJECTION OF MENTAHOLOMORPHIC FIELDS BY THE BRAIN: *A PROPOSED MECHANISM*

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Abstract

This paper proposes a new understanding of the relationship between brain, mind and other biofields based on the emergent properties of the brain's parallel structure, which create a brain "laser." Several thalamocortical rhythms, including a 40 cycle per second oscillation associated with event scanning and a faster EEG rhythm found in healers and others, are hypothesized to give rise to coherent electromagnetic radiation, as well as multifaceted coherent radiation in the additional dimensions posited by string theory. These rhythms cause repetitive excitation of the sugar/protein coatings of the parallel axons of the thalamocortical columns. The synchronous excitation of these glycocalyxes of the parallel columns will cause similar chemical bonds to resonate and entrain one another, giving rise to coherent radiation. This electromagnetic/multifaceted radiation forms highly complex interference patterns (termed "mentaholomorphic fields") when they interact with each other and the electromagnetic/multifaceted activity in the cortical layers. The resulting mentaholomorphic fields may be related to thought, mind and particular states of consciousness.

KEYWORDS: Morphic fields, EEG, mind, thought, consciousness, mentaholomorphic

INTRODUCTION

One of the most difficult problems faced by modern neurophysiology is to understand how the brain binds together a wide variety of simultaneous mental events, which produce very distinct and spatially separate changes in the central nervous system, into a unified representation which then gives rise to our apparently seamless conscious experience.[1]

This paper puts forward a new approach to understanding how the brain can generate a field that may correspond to some aspects of mind and consciousness. This hypothesis is derived by combining well-accepted principles of neurophysiology, physics and chemistry. It suggests that several types of rhythmic activity that travel between the thalamus and the cortex, particularly a 40 Hertz (cycles per second) event scanning thalamocortical rhythm, also create a "brain laser," projecting holographic fields related to mind and consciousness. Other EEG rhythms that can be measured from the scalp, such as the alpha rhythm, may also be involved, but are less powerful because of their lower frequencies.

This paper explores the hypothesis that the process underlying these EEG rhythms also gives rise to a brain "laser," which is more powerful at the higher EEG frequencies. This coherent electromagnetic and multidimensional multifaceted (EMMM) radiation is directed at the cerebral cortex and projects a complex holographic image of the excitation pattern of the cortex, which contains a pattern of EMMM excitation and inhibition formed by recent thoughts. Implications for understanding mind, thought and biofields follow the detailed exposition.

THE EEG RHYTHMS OF HEALERS AND OTHERS

More powerful high frequency EEG rhythms may be present in healers and other individuals with paranormal abilities. Using an advanced EEG recording system that responded up to 127 Hertz, Wilson discovered that they were able to create powerful, high frequency rhythms.[2] Hunt has recorded much higher frequencies—up to 200 Kilohertz—in the mind-field of mystics.[3]

Wilson brainmapped a number of individuals with unusual ability to heal, channel, receive psychically, or report out of body or transcendent experiences. His brainmaps (multichannel Quantitative EEGs) reveal that these experiences typically begin with an activation of theta and delta frequencies at CZ, corresponding to the crown chakra in the esoteric literature. These rhythms rapidly diffuse throughout the head and then develop overtones at higher and higher frequencies, which are particularly intense in the temporal areas, T3 and T4. These intense high frequency bursts extend forward to F7 and F8 in healers. Using a magnetometer suspended a foot above the subject's head, he was able to observe electromagnetic field changes corresponding to the high frequency bursts in a limited number of subjects.[4] He also found that the coherence between the EEGs of healers and their patients was well above chance levels in many cases.

A partial confirmation of his findings was published by Fahrion, Wirkus and Pooley, using EEGs to trace the changes in states of consciousness of healer Mietek Wirkus.[5] They found that the healer was capable of producing the same very high frequency temporal lobe pattern during meditation. They used a lower sampling rate during healing and distant healing and found high amplitude 35-60 cycle EEG output in the healer during these conditions, as well as enhanced synchrony between sites in this band in several conditions.

THE 40 HERTZ RHYTHM AND THE NEUREKA! BRAIN SYSTEM

The discovery of a 40 Hertz electromagnetic rhythm, which originates in the reticular and intralaminar nuclei of the thalamus and repeatedly sweeps the cortex from frontal to occipital sites, may point the way to a new understanding of this hypothesis in less talented individuals. Magneto-encephalographic and EEG investigations of this event scanning rhythm have established that it has several unique properties and suggest that it has a unique role in binding together the neural representations of simultaneous events (or simultaneous features of a perception) into a unified whole. One indication of the importance of the 40 Hertz rhythm is that it is the most highly correlated with the rate of brain metabolism, suggesting that there is probably a good reason for such energy expenditure.[6] Until recently, relatively few EEG studies of the

40 Hertz rhythm have been performed in comparison to its neurophysiological importance because of some methodological problems. In addition to the EMG (muscle contraction artifact) contamination issue, early researchers had to deal with another daunting methodological problem when measuring above 32 Hertz (cycles per second). The old style pen and paper strip physiological recorders couldn't easily go that fast without catching paper or spitting ink across the room. Most of the current research is recorded by computers and analyzed quantitatively or printed out by newer, faster technology. It is also well known that the higher the frequency of any EEG wave, the greater the percentage of its energy is lost coming through the scalp and meninges, so the 40 Hertz rhythm appears very small and therefore unimportant when it is measured from the scalp. On the surface of the cortex, it is much larger. I have recently developed a computational method, called the Neureka! Protocol, for clarifying the 40 Hertz rhythm and eliminating a lot of the EMG contamination, so that it can be used for neurofeedback training.[7] This lead to the hypothesis that the brain system associated with this rhythm (also termed Neureka!) is designed to process new discoveries by briefly enhancing awareness to encode more context of the thought or perception before the same system stores the event in memory.[8]

The 40 Hertz rhythm is present during waking and REM sleep, but is very attenuated in deep (delta wave) sleep.[9,10] This 35-45 Hertz rhythm occurs spontaneously during the accurate performance of a conditioned response, during focused arousal prior to performing a complex task and while an animal is immobile and focused on its prey.[11-13]

It is now becoming clear that advanced meditators have been training themselves to enhance and prolong the 40 Hertz rhythm for thousands of years. Studies of meditators have helped us identify the brain state that they intensify during meditation on kindness and compassion, and which also permeates their life.[14-16] Recent data from Davidson's talk at the Mind and Life Symposium indicates that the particular brainwave rhythm that characterizes their state of kindness and compassion is also associated with the clarity of their meditation, suggesting a relationship to awareness.[17] Preliminary data from our experience with the Neureka! Protocol indicates that it is also associated with feelings of satisfaction from accomplishment (the new discovery), gratitude, compassion, love and deep connection.

In an elegant series of experiments combining animal tissue work, implanted electrode studies and human MEG (magnetoencephalography), Llinas and his coworkers developed evidence for the hypothesis that there were actually two different brain systems that carried information at about 40 Hertz.[18] Both of these systems involved feedback loops between (different) layers of the cerebral cortex and the thalamus, the organ shaped like two flattened eggs, one in each hemisphere, with a thick bridge between them in the center of the brain. Information, in the form of somewhat repetitive patterns of nerve excitation, travels back and forth between the thalamus and the cortex at about a 40 Hertz frequency in both of these systems. One system, the specific sensory and motor relay system, relays information from the external world through the outer nuclei technically called the extralaminar nucleii, those located outside a fiber bundle or lamina dividing each egg of the thalamus to the cortex. The 40 Hertz activity in this system may not be that different than the activity in other frequency ranges, "focused arousal" as Sheer argued.[12] The other, non-specific, thalamocortical system is uniquely set up to scan all the regions of the cortex and collect information back from them, using a beam that oscillates near a constant 40 Hertz frequency. It scans the brain from front to rear 40 times a second and delivers this information back to a more central location, the intralaminar nuclei, where it can be integrated and analyzed, combining or binding the different neural aspects of the event together. Hence, the name "event binding rhythm." The scanning function can then be refined for the next pulse, modulating our awareness to emphasize the important new discoveries.

This event binding rhythm may be closely related to whether two events are experienced as either simultaneous (bound together) or separated in time. It sweeps from the frontal to the occipital lobes in 12-15 milliseconds, about half the period (25 milliseconds) of a 40 Hertz wave. If two clicks are presented at an interval greater than 12-15 milliseconds they are perceived as separate events and the magnetoencephalographic 40 Hertz rhythm is reset by the second event. At shorter intervals, the events are bound together into one experience and the 40 Hertz rhythm is not interrupted.[9] Within that time frame, the events are perceived as a common image.[19]

Llinas argues that consciousness is actually a result of the simultaneous neural firing produced by the coherence (I prefer superposition) of the inputs from

the specific and non-specific systems on the layers of dendrites in the cortex. The specific system would then provide the content that relates to the external world, and the non-specific system would give rise to the context. Together, they generate a single cognitive experience, which Llinas calls consciousness.

LOCATING THE MIND

How does this scanned, unified representation give rise to conscious experience? Where is the mind and thought? How is it affected by this pattern of excitation and inhibition? Where is the awareness of conscious experience located?

Libet summarized the mounting evidence that there is actually almost a half-second delay between the input from an experience and the conscious appreciation of it.[20] During that half second, there is a complex cognitive process, still largely uncharacterized, which decides if an event is important enough to be consciously appreciated, and then adjusts the perceived timing of the event to make it integrate seamlessly with all the other preconscious and unconscious inputs. If all that follows after scanning is that the information is returned to the various thalamic nuclei as modulated 40 Hertz patterns of excitation, would that provide a sufficient understanding of this delay and conscious experience? One difficulty with this approach is that there is abundant evidence that there is very little cross-talk among the major thalamic nuclei, pointing to very little integration.[21] Therefore, one pair of nuclei are more likely to be the center of awareness, the conscious appreciation of events. The thalamic reticular nucleus (see below) is a network of cells that intercommunicates well and projects extensively to other thalamic nuclei. The re-entrant information does continuously modulate its firing patterns, but it seems too thin and sparse to underlie the experience of conscious events. The intralaminar nuclei, particularly the centromedial nuclei, are probably the best candidate for the location of conscious integration or awareness, since the information from the cortical scan constantly returns to this central site. Lesions in this area are accompanied by major impairments of consciousness.

There is another line of thought which holds that mind and consciousness are not just local events. Rather, they exist as part of a constantly changing

fundamental field (or fields), termed the biofield, which has not yet been described in detail.[22] Biologists and philosophers have been joined by physicists, who have based their analyses on empirical evidence and quantum theory.[23] Pribram pointed out some essential similarities between Bohm's idea of the *implicate order* and his concept that thought and memory storage are holographic.[24-26] He proposed that there were holonomic (overlapping patches of holographic) structures in the cortical surface layers, which were produced by transforming inputs (from perceptions and thoughts) into slow electrical potentials according to holographic principles; Pribram sees a parallel between this and the first implicate order.[24]

THE FORMATION OF THE MENTA-HOLOMORPHIC FIELD: *AN OVERVIEW*

My perspective is that the mind is not just inherent in the brain, but rather exists in a field that is co-located with it and simultaneously external to it, a multifaceted multidimensional "mentaholomorphic" field. My recent preference for this term, rather than *electroholomorphic* field used in a previous publication will be explained in detail later.[27] Briefly, since there is clear evidence that psi phenomena are not easily blocked by electrical or magnetic shielding, I now think it is better to emphasize the probability that there are other components of field(s) involved, very possibly existing in the additional dimensions postulated by string theory.

As shown schematically in Figure 1, life events give rise to experiences and thoughts, which are reflected in the electrochemical changes in the outer layers of the cerebral cortex, perhaps as holonomic transformations. These patterns of activity are projected by radiation from the "brain laser," to form fields that are complex, rapidly shifting holograms. Recognizing the potential similarities of these fields to the implicate order in Bohm's holomovement, and to Sheldrake's (1988) *morphic fields*, as well as the holographic transformation involved here, I have termed them *mentaholomorphic* fields.

This paper will focus on the example in which the object to be projected as a mentaholomorphic field is the chemical activity in a small area of cerebral cortex, although there are probably many other physiological systems in which

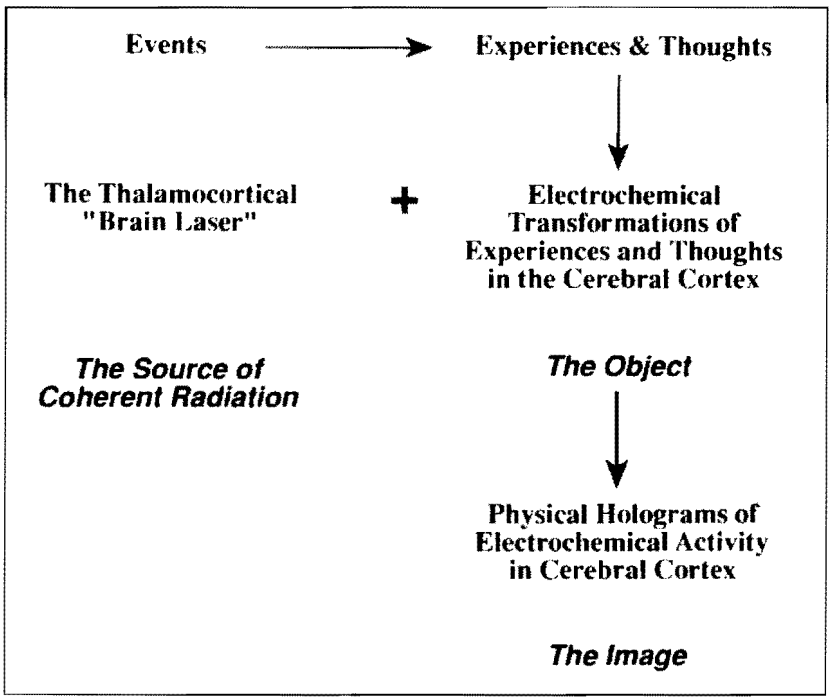

Figure 1. *Mentaholomorphic Field Formation: The boldface phrases are described in this model. The italicized phrases indicate the corresponding components in the process of forming a traditional holographic image.*

this proposed mechanism can take place. For purposes of exposition, the constant motion of the neurochemicals in this small area will be temporarily set aside in order to first understand the formation of a static hologram.

To create a hologram, it is necessary to have a coherent energy source as well as the object to be projected. A photographic plate would only be necessary if the hologram were to be recorded. The holographic image exists as an interference pattern in space whether or not a picture is made.

The source of coherent energy is the vibration of parts of the membranes of the axons that connect the neurons in the thalamus to the cerebral cortex. These axons run parallel to each other, forming columns that are essentially perpendicular to the cortical surface, with excitation flowing from the deeper

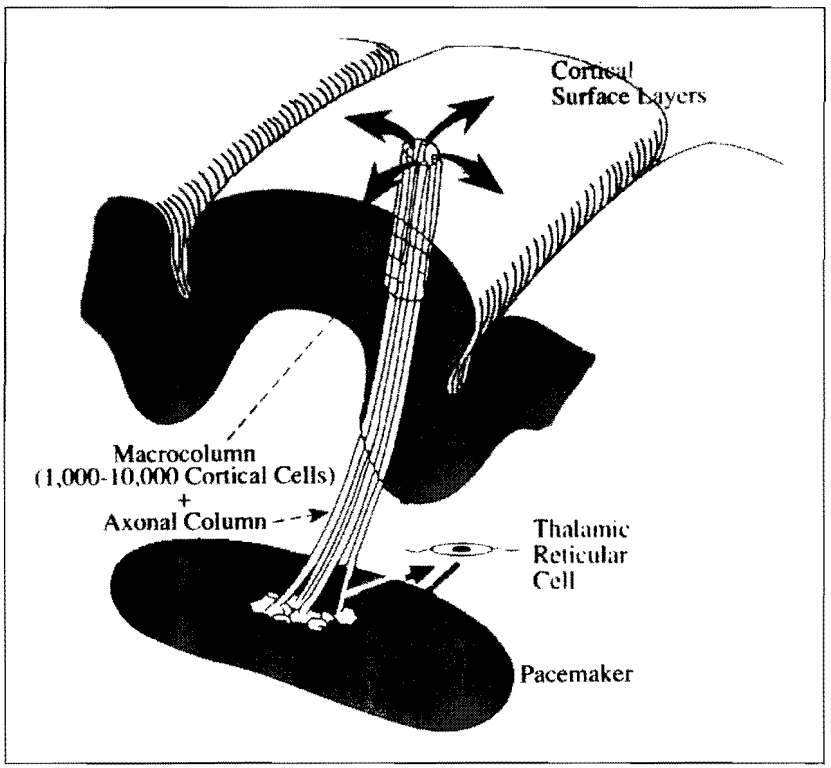

Figure 2. *The "Brain Laser:" The column of axons transmits impulses synchronously from thalamus to cortex, providing the energy to produce coherent radiation.*

structures (the thalamic nuclei) to the surface, as shown schematically in Figure 2. The patterned activity of these columns, in combination with the reciprocating messages from cortex to thalamus, is thought to be responsible for the formation of the synchronized activity of the EEG at 40 Hertz and below. Experiments have led an international committee of scientists to conclude that the reticular nucleus of the thalamus, a thin grid of neurons surrounding the egg-shell shaped thalamus, is responsible for originating and organizing the slower brain rhythms, including the 7-14 Hertz spindles present at sleep onset and some alpha and theta rhythms.[21] Input from this surrounding sheet of cell can cause a group of neurons in the sensory-specific nuclei of the thalamus (located outside the lamina, thus "*extra*laminar") to beat in complete synchrony, forming the pacemakers that drive each column of several thousand parallel

axons, and excite the slightly larger macrocolumn of 1,000 to 10,000 cortical cells. More recent studies have extended this generating mechanism to the 40 Hertz event scanning rhythm, which is thought to be produced by the *intra*laminar nucleus of the thalamus.[29] Axons from these cells project to layer I of all areas of the cerebral cortex; the thalamocortical circuit that generates these rhythms is completed by layer V pyramidal cell axons which return the excitation pattern to the reticular and intralaminar nuclei of the thalamus. Another 40 Hertz rhythm is generated by the reticular and the extralaminar sensory specific thalamic nuclei in response to particular stimulating events (auditory clicks, etc). It is thought to co-resonate with the event scanning rhythm, resetting the scanning rhythm and increasing its amplitude.[9,10,30]

The constant, synchronous excitation of the axons from the neurons in the thalamus to the cortex provides the energy for the brain "laser" formed by each macrocolumn. Each time that a nerve impulse-a wave of depolarization—flows down the axon, metabolic energy is consumed at each point that it passes. With each impulse, the axonal membrane and its constituent molecules move and vibrate in an organized fashion.

After the impulse passes, many of the molecules and atoms, as well as their constituent charged particles will continue to vibrate at their characteristic resonant frequencies—well above typical EEG frequencies—for some time. Charged particles in motion create electromagnetic waves and may also create other types of multifaceted multidimensional waves (EMMM radiation). Coherent and synchronous waves result when these moving charged particles vibrate in phase with one another—that is, when their peak motions in the same direction are at precisely the same time. The molecular structure of each axonal membrane undoubtedly has many repeating units—the same pattern of constituents, embedded in very similar chemical environments. The presence of 1,000 to 10,000 axons in a synchronously-excited column multiplies the number of repeating units.

Following a basic law of physics, these repeating units, vibrating at the same frequencies, should entrain each other and tend to resonate together—to vibrate coherently in phase. This synchronous motion should produce coherent EMMM radiation; it constitutes a brain "laser," emitting energy at a number of different frequencies. These coherent EMMM waves impinge upon the

chemical and EMMM activity in the surface layers of the cortex, as well as upon the meninges and the skull, forming an interference pattern—the mentaholomorphic field.

THE COHERENT VIBRATIONS OF THE AXONS' GLYCOCALYXES

Each of these axons has a repeating structure, the nodes of Ranvier, spaced at fixed intervals, and specifically designed to amplify the signal from the thalamus by activating the gate-channel complex, embedded in the axon's membrane. One particular membrane structure that should give rise to coherent energy waves is the glycocalyx, or sugar coating, which is composed largely of glycoproteins, or proteoglycans. These include a number of derivatives of chondroitin sulfate and heparan sulfate.[31] Figure 3 is a schematic diagram of the membrane of a single axon in the column, with the outside on the right. All of these structures are inside the myelin sheath of each axon. Glycoproteins have an uncharged protein end, which dissolves in the fatty membrane, and a very negatively charged sugar end, which sticks out into the external fluid, somewhat like a ball on a rubber stick.[32] Together, these sugars form the bulk of the glycocalyx. The diagram (modified from Lipton, 1986) also shows the gate/channel complex, which changes conformation to allow ions into the axon briefly during a nerve impulse, thus causing the nerve cell to depolarize.[33] It then returns to its original shape when the impulse has passed.

When this gate/channel complex in the membrane moves rapidly in response to a nerve impulse, the charged sugar ends that line the axonal membrane should all vibrate back and forth. These glycoproteins are either directly or indirectly (through the linking peptide shown as a dark ball) connected to the channel protein. As the channel opens and then closes in response to each impulse, its kinetic energy is transferred to the glycoprotein and to other surrounding structures, which vibrate and emit an electromagnetic wave until this motion is damped out. Other vibrational modes and frequencies and the related electromagnetic waves result from the movements of charged atoms within the membranes. This is roughly analogous to what happens every time that we open and then slam a door shut: some

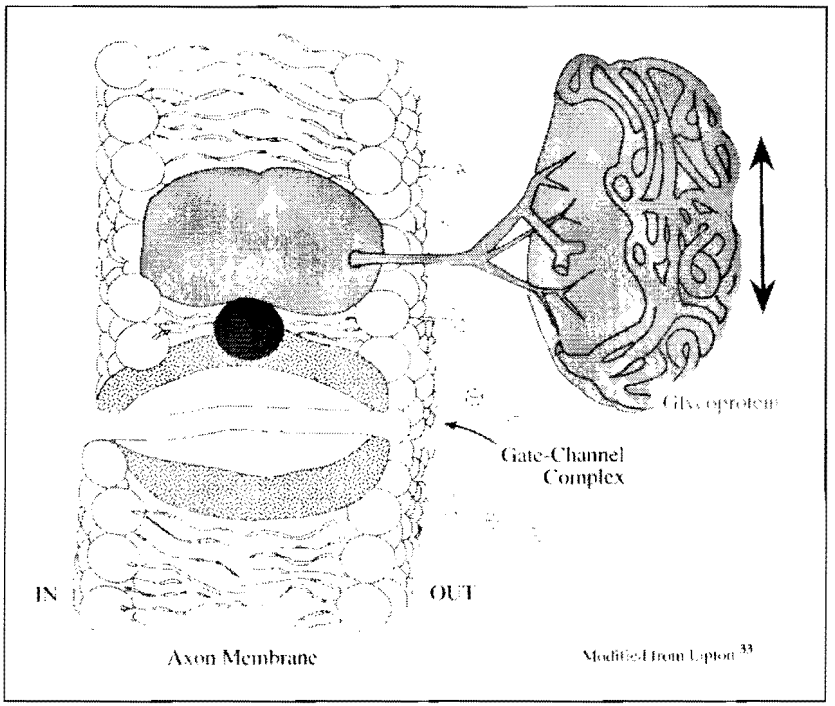

Figure 3. *The Glycoprotein Attached to the Gate/Channel Complex: Molecular constituents of the glycocalyx vibrate in response to the transferred energy from opening and closing the gate-channel complex.*

of the kinetic energy is transferred to the surrounding walls, where it vibrates their internal layers and the surface structures.

THE VIBRATION OF PARALLEL STRUCTURES PRODUCES COHERENT RADIATION

One type of movement is shown schematically in Figure 4, which depicts small portions of three axons in a macrocolumn. The balls represent charged portions of the glycoproteins in a simplified fashion. When they move in a parallel fashion, they give rise to the symmetric mode of vibration which is responsible for part of the emission spectrum—the unique electromagnetic pattern

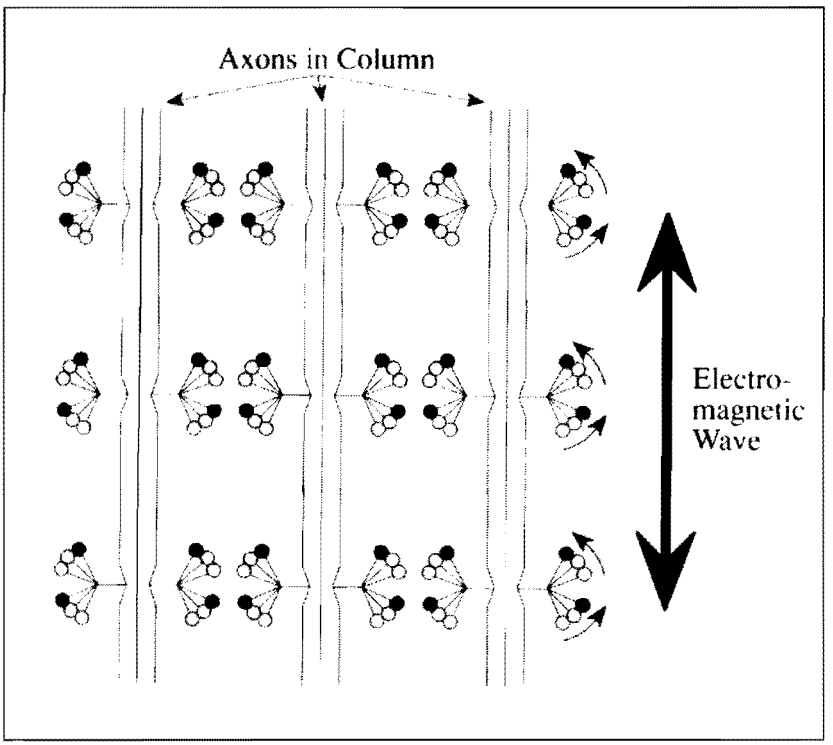

Figure 4. *Parallel Resonant Vibration of Charged Particles in the Glycoproteins: All of the balls (glycoproteins) are vibrating in similar fashion to the arrows in the last column. These give rise to coherent electromagnetic radiation. The myelin sheaths surrounding the axon are omitted for clarity.*

produced by the glycoprotein. The molecular structure of each axonal membrane has many of these repeating units, and there are many axons in a macrocolumn. When they all vibrate simultaneously in response to the depolarizations caused by the synchronous nerve impulses from the thalamus, they should follow a basic law of the physics of resonance and entrain each other so that they vibrate more closely in phase with each other. This should produce some synchrony and coherence in the energy radiations resulting from these characteristic vibrations. Of course, there will be a lot of more random activity in the glycoprotein molecules here and in the rest of the brain. The remaining non-coherent energy is not important to this hypothesis, since it is random

noise. From basic spectrochemistry, we know that each chemical has its own emission spectrum, resulting from the excitation and subsequent decay of vibrations of charged chemical bonds. Each characteristic vibration resulting from a different type of moving charge (from a different chemical structure) will emit waves as it decays at its own frequency. Since the chemical structure is attached to a fixed membrane, it will also have a characteristic direction (with respect to the membrane), in which the coherence is maximum. Therefore, several different brain "lasers" may result from the same thalamocortical source. If the macrocolumn has some curves, or if there are several repeating units oriented differently with respect to the membrane, there will be several directions in which the coherence is maximum, resulting in several "laser" beams with the same frequency but different spatial orientations.

An analogous phenomenon was demonstrated experimentally many years ago. The emission of coherent microwave (5 to 10 micron) radiation from the surface of stimulated axons was first demonstrated by Fraser and Frey in sensory nerves taken from the legs of the blue crab.[34] Further work by Frey and others established the coherence of this radiation.[35] It may be technically more accurate to add the term "maser" to refer to coherent radiation at microwave frequencies, or to generally discuss "brain coherent electromagnetic radiation," but neither of these terms are as familiar to readers as "laser," so I have decided to use "laser" in quotes throughout the paper.

The coherent EMMM waves formed by each pacemaker in the thalamus and its associated column of axons will, to a greater or lesser degree, reach the nearby cortical surface layers, as shown in Figure 5. Wavefronts from nearby columns may be coherent with one another, since the repeating units in these columns are very similar. If there is widespread phase synchrony between electrode sites in the EEG, this indicates greater breadth of the coherent wavefronts. These coherent wavefronts will be partly reflected from neurochemical structures in the cortical layers, including those chemicals which are (holonomically) modulated by the dendritic slow potentials. Some of these wavefronts should also be partly reflected from other structures, such as the dura shown in Figure 5, as well as pia, arachnoid and skull. The multiple reflections at the same wavelength will interfere with each other, forming holograms at each frequency produced by a brain "laser."

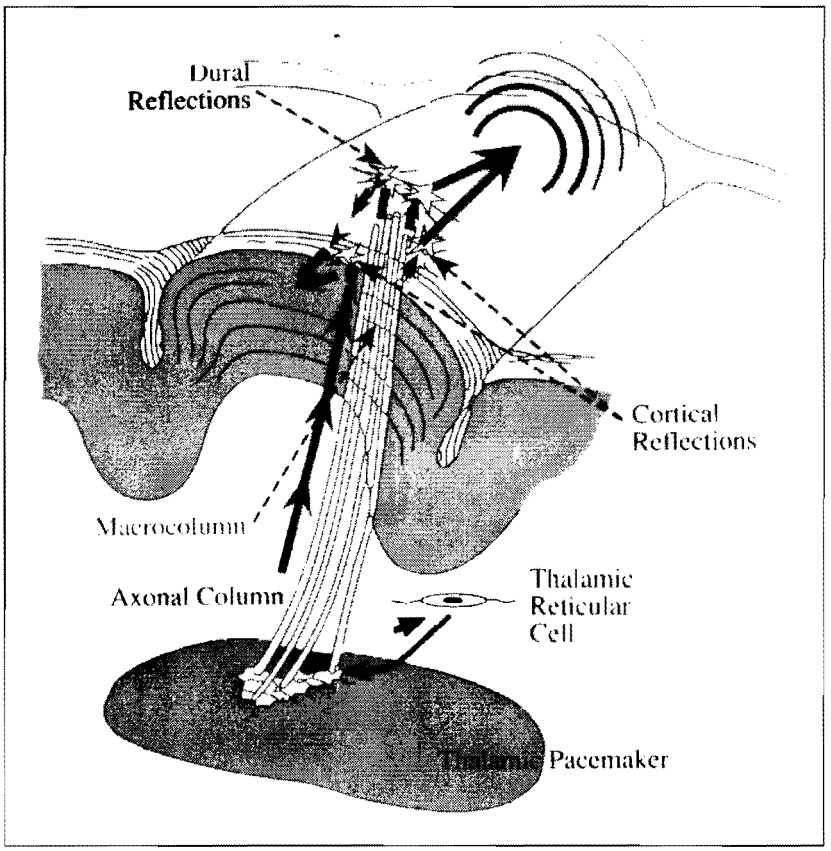

Figure 5. *The Brain "Laser" Produces a Mentaholomorphic Field: The coherent radiation produced by the axonal column interacts with the electrochemical (EMMM) activity in the cortical layers, the dura, pia (not shown), arachnoid (not shown), and skull (not shown), as well as from other axonal columns to form a holographic field.*

THE PROJECTION AND RECEPTION OF THE MENTAHOLOMORPHIC FIELD

The activity in the cerebral cortex shifts quickly, often faster than 40 Hertz, and the radiation from the thalamic pacemakers is at an even higher frequency. An extremely complex mentaholomorphic field will be generated by their interaction. It will extend throughout the brain and into the space outside the

brain. The partial transmission of this field through the skull will be aided by the fact that it is being pulsed or modulated at the extremely low frequencies typical of the EEG—the rate at which the thalamocortical axons actually fire. Although they are weak, magnetic fields produced by the brain are not typically impeded by the skull.[32,36]

According to this model, the higher the wave energy and the more synchronous the phases of the waves from various cortical locations are, the stronger the output from the brain "laser" and the resulting hologram should be. More powerful EEG output at higher frequencies should also increase the efficiency of the brain "laser" because the energy of the rhythmic discharges of the thalamocortical tracts, which is reflected by the EEG recordings, drives the brain "laser" by vibrating the parts of the glycoproteins. The higher the frequency of the thalamocortical rhythms, the more frequently that these glycoproteins are re-energized and the more constantly they will vibrate (see Figure 4). The more energetic and consistent this vibration is, the greater that the resonance between the vibrating parts of neighboring glycoproteins, and the stronger the brain "laser's" coherent output. All of these factors, acting together, should enhance the strength of the mentaholomorphic field emitted by the 40 Hertz scanning rhythm, relative to lower frequencies such as delta, theta, alpha, and beta. All of these rhythms may play a role in the formation of the mentaholomorphic fields, as will the even higher frequency fields of those talented individuals who can generate them.

The proposed mechanism for the reception of mentaholomorphic fields by the brain must assume that such fields exist and can persist through time, as Sheldrake does for his morphic fields. Holograms actually exist in the frequency domain, and time should not diminish them, since it is not a factor in their calculation. Recently, Tiller has proposed the idea that there are actually 10 or 11 dimensions, as superstring theory posits, but without its limitation that many dimensions are too small to observe.[37,38] Tiller suggests that four of these dimensions (called R-space) are actually formed by the same type of Fourier transform process that creates a hologram. This book contains intriguing evidence for this general conception. The idea that there are additional dimensions that we cannot (routinely) sense, first put forth in the classic book, ***Flatland: A Romance of Many Dimensions***, and more recently animated in the film ***What the Bleep: Down the Rabbit Hole***, is very attrac-

tive as addition to the present hypothesis. Recently, physicist John Hagelin has pointed out that:

> In addition to the particles and forces that we know and love—gravity, electromagnetism, and so forth—there are additional forces and particles that we don't see, but they fill the room. It was once thought that these were irrelevant to human life because they only interacted with us gravitationally, which is too weak to be of any interest. But if you do the calculations properly in the context of the superstring, you find that they also interact with us electromagnetically, even if rather weakly. . . .[39(p.19)]

The strength of this interaction should be amplified by the coherence under discussion here.

As Bohm also suggested, several different types of fields, each operating at many spatial and temporal frequencies, may well be involved.[23] The characteristics of the particular type of radiation will partially determine the range and resolution of the potential information transfer; this has yet to be understood. Quantum fields do not diminish as quickly over distance as electromagnetic fields do. This uncertainty is why I now prefer the more encompassing term *mentaholomorphic.*

All that is required to read a hologram is a coherent reference beam of the same energy type, identical frequency and proper orientation. The portions of the coherent waves produced by the macrocolumns that are not reflected from cortical structures will serve as reference beams. The hologram will be received by the brain as a reconstruction of the same electrochemical pattern that was in the cortex at the time it was originally projected. This reconstructed image will influence the probabilities of occurrence of the ongoing patterns of electrochemical cortical activity, making them more similar to the pattern that originally gave rise to the image. I suspect that the activity pattern in the cortical surface layers quiets down during reception in order to eliminate interference with this process. These altered probabilities of neurochemical activity could then influence brain function by affecting the release of vesicles containing neurotransmitters into the synapse, by changing slow potentials, or by altering the function of the neuronal membrane, as well as through several other methods.[40] The resulting activity pattern in the cortical layers is then scanned by the 40 Hertz (Neureka!) system and the information is returned to the intralaminar nuclei of the thalamus for integration and action.

One issue with this approach is that it would seem to require that the head be in somewhat the same spatial orientation during transmission and reception, so that the reference beams are projected in the same directions at both times, if reception of mentaholomorphic fields generated by matter outside the head, and transmitted solely by ordinary physical means, is considered. However, anyone who has ever looked at a hologram knows that you can still see it fairly well from considerably off axis, so the orientation doesn't have to be perfect.

This new mechanism may also generate coherent scalar subtle energy waves and holograms. These waves should be formed by any antisymmetric-directly out of phase-modes of vibration of charged particles. These modes are well known and accepted in the field of spectrochemistry and should occur at many sites within membrane proteins. These vibrations may also entrain each other into coherence in the same way that the symmetric modes shown in Figure 4 do. These antisymmetric modes of vibration are the molecular counterparts of the two opposing electrical coils that Bearden showed were capable of producing scalars.[41] These scalar waves and holograms may be particularly important as information transfer agents because they do not diminish in intensity with distance and they are not as easily shielded as conventional electromagnetic waves.

THE IMPLICATE ORDER, MENTA-HOLOMORPHIC FIELDS AND THE MIND

These fields appear to have some characteristics which have also been proposed for the properties of the mind. They are holistic, far reaching transformations of brain activity, which may also involve interaction with a larger, more encompassing field. Bohm has suggested that there is a relationship between the *implicate order*, his term for the true ground of being, and the *explicate order*, which roughly corresponds to the ordinary way in which we view reality.[23] The implicate order transforms, by a process he calls unfolding, to form the explicate order. By a constant process of folding and unfolding into each other, the implicate and explicate orders continuously form the totality of *what is*, which he terms the *holomovement*. He states that "This enfoldment and unfold-

ment takes place not only in the movement of the electromagnetic field, but also in that of other fields, such as the electronic, protonic, sound waves, etc. There is already a whole host of such fields that are known and any number of additional ones, as yet unknown, that may be discovered later."[23(pp.177-178)] If, as Bohm suggests, the actual content, structure, function, and activity of thought is in the implicate order, then perhaps this mechanism, or one very much like it, can begin to explain how the explicate order of everyday experience is transformed into several implicate orders (or levels) of thought and mind.[23(pg. 204)] It may also help us to understand how, after this information interacts with the larger field, it is unfolded back into the explicate order.

It may actually be more accurate to suggest that there are at least two layers of implicate order. The present model enlarges on Pribram's seminal idea that thought and components of memory storage are holonomic.[25] He proposed that there were "patchy" holographic (or holonomic) structures, consisting of dendritic slow electrical potentials in the cortical surface layers, which were produced by transforming input into slow electrical potentials according to holographic principles; this is the first implicate order.[24] Pribram did not suggest the formation of actual electromagnetic holograms or mentaholomorphic fields projecting beyond the cerebral cortex, as I have here. Both hypotheses are actually possible simultaneously: the brain may form multiple physical holograms of the patchy holographic transformations of the input to the cortex. This mentaholomorphic field would then be a second implicate order, or a "superimplicate" order.

A quantum mechanical approach to understanding the formation and retrieval of memory from the mentaholomorphic field can also be fashioned following Stapp's ideas.[42] Rather than pursue this digression here, I will simply note that the Zeno effect may be particularly important in understanding memory retrieval.

MENTAHOLOMORPHIC FIELDS, 40 HERTZ RHYTHM & MEMORY

There are several lines of evidence that indicate that the 40 Hertz rhythm profoundly enhances learning and memory. The clearest experimental

evidence for the specific role of the 40 Hertz rhythm in learning was published by Miltner et al. in ***Nature***.[43] They measured the EEGs of a group of young women who were learning the association between a colored light and a shock to one hand, examining those regions of the cortex that were known to be stimulated by the light and the shock to the hand. They found that there was more 40 Hertz activity in those regions of the cortex, as well as some surrounding regions, during the trials than at other times. Furthermore, they examined the coherences between the 40 Hertz outputs of the specific areas involved and compared them with other regions and other times when the specific color and shock were not paired as controls. They found clear evidence that associative learning involved increased connectivity (coherence) between these brain regions in the 40 Hertz band, and that this coherence dropped off very quickly as they examined higher or lower frequencies. In a study of epileptic patients with electrodes implanted right on their cortical surfaces, Sederberg et al. found that their short-term memory for words was related to the gamma output of electrode sites in their frontal and temporal areas, particularly near the 40 Hertz band.[44] There are now many other studies demonstrating a relationship between memory and EEG rhythms above 30 Hertz. Our preliminary observations with Neureka! indicates that it increases when individuals try to remember something from long ago.

It is possible that memory storage and retrieval may be partly mediated by the mentaholomorphic fields produced by the Neureka! system, acting in combination with neuronal mechanisms. There is no reason why both processes—local synaptic and mentaholomorphic field—can't be working simultaneously. In fact, if reception of the mentaholomorphic signals is frequently of poor quality—as the small magnitudes of most psi effects would suggest—leading to a lot of uncertainty of thought, it would make good design sense to have a local backup system in the cerebral cortex. This system could act as an additional tuning mechanism to improve reception, by introducing additional information into the projected reference beams to refine the search. If the signal could not be discerned, it would substitute locally stored information from previous experiences. At other times, the information from both sources could be combined. Although using a backup could have disadvantages, it is probably better than waiting patiently for good reception if survival is at stake. One of the costs of adapting to the fast pace of decision making

in our modern world may be that we often lack the patience to wait for the reception processes to complete.

There are studies which show that stimulating cortical cells at more than 7 Hertz enhances long term potentiation of their ability to transmit information across synapses.[45] This process is triggered by calcium entering the cell every time the synapse is stimulated by two inputs at the same time.[46] It would seem reasonable that faster stimulation speeds, such as from a 40 Hertz scanning rhythm, would increase the amount of calcium entering the cells per second and speed up this process. Classical neurophysiology posits that long term potentiation of a group of cells connected together (a "cell assembly") forms a long term memory.

Several factors may increase the probability of accurate memory retrieval via both of these mechanisms acting together. If the individual is in the same state of consciousness as he was during the projection of the field during memory storage, the coherent waves from the various axonal columns should be more similar than if he is not. If the context during memory retrieval (reception) is similar to that at storage (projection), then an experience should be easier to retrieve. This gives rise to state/context dependent learning and retrieval. If salient events, such as new discoveries and others related to survival increase the amplitude of the 40 Hertz rhythm, as discussed previously, this may aid both information storage and retrieval. Other factors that increase the amplitude and/or synchrony of these wave fronts should also aid retrieval, all else being equal.

This new mechanism may also help to account for "how long range synchronization across feature-specific neuronal modules emerges" quickly enough to be consistent with the observed speed of processing.[47]

PROPOSED VALIDATION

There are many opportunities for both experimental testing and mathematical modeling of this proposed mechanism. For example, it should be possible to enlarge on Fraser and Frey's work by scanning for coherent radiation over a

wide range of electromagnetic frequencies at varying distances from animal and human brains.[34] In an animal preparation, the skull and meninges could be partially removed to eliminate their interference. In addition, fiberoptic probes could be inserted to sample the coherent radiation at various layers.

EXTENSIONS OF THE THEORY

Other neuroanatomical structures may also contain synchronously-excited parallel axons that can project and receive mentaholomorphic fields. The coherent radiation from the thalamocortical system also radiates in the other direction, towards the thalamus, hypothalamus and brain stem, and may produce interference patterns with their activity. Within the brain, there are other bundles of parallel axons, some driven by pacemakers. The septal-hippocampal system is one example. A 10 Hertz scanning rhythm has been discovered in the olivocerebellar tract; it may be related to the awareness and coordination of movement.[19] Nerve fibers that respond to pressure, temperature, muscle stretch and position in the periphery—for example, from the hands and feet running through the spinal cord to the brain—are regularly and repeatedly excited, as are the pacemaker fibers in the heart. Each of these parallel fiber bundles may emit coherent radiation.

In fact, all that is necessary for this type of holographic generation and reception mechanism is a number of aligned repeating units in any tissue, crystal, or other material and a method of exciting them into resonant modes of vibration. This type of parallel structure is frequently found in the membranes of cells that are arranged in a regularly repeating pattern. Subunits such as receptors, glycoproteins and other integrated membrane proteins which act as antennae can shift their conformation in response to events inside and outside the cell.[48] They can serve as energy transducers in both directions—creating and receiving energy fields at their resonant frequencies—like the radio tuner analogy that Sheldrake frequently discusses. The possibilities suggested by resonances that also vibrate in additional dimensions are very intriguing.

Hameroff suggested the idea that microtubules within axons are responsible for receiving and demodulating quantum fields containing information from the quantum field, which he hypothesizes to be the mind.[49] However, his proposal has a rather serious shortcoming: it lacks a method for transmitting informa-

tion from the brain to the mind. These microtubules are arranged in parallel with the axon's membrane. Therefore, the chemical groups that line the microtubules would have the parallel structure to resonate with each other from axon to axon. In his model they cannot upload information because they appear to lack a direct source of energy for exciting them into resonance. However, Hameroff states that "cytoskeletal structures (fodrin, actin filaments, etc.) connect membrane receptors to microtubules."[49] Adding this to Figure 3, a depolarization of the gate-channel complex could also set off modes of resonance in chemical groups within the axon—on the inside of the membrane, within the protein and actin filament connectors and (indirectly and more weakly) inside or outside the microtubules themselves. In other words, the repeated stimulation of the axon could drive a series of modes of resonance that encompass the membrane glycoproteins, the linking proteins and actin filaments and the cytoskeleton of the axon, acting together. This may be an even stronger projector of the mentaholomorphic fields than my previous proposal. Mentaholomorphic fields are, of course, also describable in quantum mechanical terms. The reception of these fields could take place by Penrose and Hameroff's objective reduction (within the microtubules), the present model's methods, or both simultaneously.

IMPLICATIONS AND APPLICATIONS

Perhaps the most intriguing question in this area is the relationship of this model to transmitting intention and related information across time and space. It is clear from the massive amount of data summarized in McTaggart, Sheldrake, Tiller et al. and Radin that effects such as clairvoyance, telepathy and telekinesis do take place.[37,50-52] The magnitudes of these effects are relatively weak, although highly statistically significant. Can the insights from this hypothesis help dedicated intenders to amplify these effects? For example, would learning to enhance the amplitude of 40 Hertz waveforms by using Neureka! neurofeedback also improve the effect size and/or increase the success rate? It is intriguing that one of the key procedural details about projecting intent specified in many texts and the movie ***The Secret*** is to imagine that the intended outcome is already here and to create the associated feeling of satisfaction. Our preliminary observations strongly support the idea that feelings of satisfaction from accomplishment increase the amplitude of Neureka!

The combination of neurofeedback for single pointed Focus on the intention, and Neureka!, both available on the Peak Achievement Trainer, may be even more helpful in intensifying the broadcast of intention.

The recent books by Mc Taggart and Sheldrake can be used as catalogs of the potential implications and applications of this model.[50,51] These include improving our understanding and potentially enhancing the effectiveness of telepathy and other paranormal links between people, clairvoyance, psychokinesis and prayer. The implications for studying energy healing, distant healing, channeling, and transcendent experiences are particularly profound if Wilson's groundbreaking finding of high frequency EEGs can be confirmed and extended. All of these can be studied by comparing successful vs. unsuccessful trials while simultaneously measuring the high frequency EEG and/or emitted coherent waves.

This type of projection and reception mechanism may also help us to understand the soul, the spirit, and the collective unconscious, as well as to explore the relationships among the brain, the mind, thoughts and states of consciousness.

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