DIALOGUE

With this issue we are starting a new section of the Journal—Dialogue. Our investigations are proceeding to open up new areas in science, and uncertainty exists as to lines of inquiry to pursue, and as to meaning of results obtained. In this new section we invite two outstanding researchers to respond to a ground breaking paper. When we receive those comments, we send copies to the original author, who then has opportunity to respond. Then comments and the author's response are published together in this Journal. We hope that this new section of dialogue will interest you, will be thought-provoking, that it will help us to think through the hidden assumptions and issues that underlie investigations in this field. SLF

Dialogue

COMMENTS—"CARTOGRAPHY OF CONSCIOUSNESS: A FUNCTIONAL RE-EXAMINATION OF THETA, ALPHA, AND BETA." by M. A. Tansey, Ph.D., K. H. Tachiki & J. A. Tansey, *Subtle Energies* 4, 2 (1993), pp. 135-150.

COMMENTARY BY ELMER GREEN, PH.D.

This is an interesting paper for its description of a finer-toothed comb for sorting out brainwave frequencies and correlated cognitive processes. For differentiation between the following commands,

> Just Let Be
> See A Yellow Ball
> Add
> Be Aware
> Be Aware Of How Heavy Your Hands Feel
> Be Aware Of How Cool The Top Of Your Hands Feel
> Feel
> Be Aware Of How Your Hands Feel Against Your Thighs

using 1-Hz bandwidth filters, at 5, 7, 10, 12, 14, 16, 20, and 28 Hz, this research is unique. It will give graduate students a dozen ideas.

This paper makes me realize, however, that it's time to *re-unveil* the even finer-toothed EEG analysis-and-feedback machine we demonstrated (Alyce Green, Dale Walters, and I) in April 1969, to 96 researchers and clinicians at the first Council Grove Conference, attended by several of the early presidents of the Biofeedback Research Society (Brown, Kamiya, Budzynski, Stoyva, Peper). A few details of our EEG feedback system for studying states of consciousness, were subsequently described in *Beyond Biofeedback* (Elmer and Alyce Green,

1978, 1988). I'm including a description of this feedback to make two points, which I'll focus on later.

> [This machine, constructed with NIMH funds] has the interesting characteristic of being able to feed back stereo information. Brainwave data from two electrodes, left occiput and right occiput, for instance, can be separately fed back to the left ear and the right ear through earphones. In addition, the ***actual*** frequencies [emphasis added] in each EEG signal are analyzed into beta (13-25 Hz), alpha (8-13 Hz), and theta (4-8 Hz) and multiplied in each frequency band by 200 to bring brainwave frequencies up to the audible range . . . For example, because the lower limit of hearing is around 25 Hz, the average alpha frequency (10 Hz) would be inaudible without [frequency multiplication]. Multiply by 200, and the average alpha feedback tone goes to 2000 Hz, which lies in the range of the human hearing spectrum.
>
> Each wave in a series of alpha waves is of slightly different duration. Thus, even though 10 Hz is the average frequency, what is actually observed in a train of alpha waves, wave by wave, is more like 10 Hz, 9.5, 10.1, 10.7, 9.0, 9.2, 11.2, 10.8, 9.1, etc. When multiplied by 200, these alpha waves generate ***a series of musical tones*** [between 8 and 13 per second] that sound quite like flute music. The ***volume*** of the music [emphasis added] depends on the amplitude (height) of the individual waves.
>
> Beta waves have a piccololike sound in our lab machine, theta feedback sounds quite a bit like an oboe. When all three bands [are contained in] EEG signals at the same time (a common occurrence) a pleasing trio is sounded stereophonically. A standing joke in the lab is that we are going to teach someone to play "The Star-Spangled Banner" for visiting members of Congress, who might then be more inclined to provide research funds.

This stereo "music of the hemispheres" produces uncanny feedback. For instance, as the phase angle between left and right-occiput changes, cycle by cycle, the flute-like alpha tone moves back and forth inside the head. So sensitive was this motion, with ***synchrony between left and right*** electrodes causing the flute tone to stay in the center of the head, that we (and subjects) noticed that the ***slightest*** shift in focus of attention, in imagery (passive) or in visualization (intentional) caused change in the localization angle of the perceived tone, and also changed the "melody."

And when you consider that we had simultaneous independent feedback of three instruments (piccolo, flute, and oboe) in each ear, each providing delicate pitch-discrimination down to the limits of auditory JNDs, you can get an idea of the subtlety of this feedback system. Regrettably, funds were lacking for follow-up research with this "states of consciousness" feedback system.

But, and this is my first point, even though this "states of consciousness" feedback was tremendously subtle we wouldn't have felt justified in calling our research results a "Cartography of Consciousness." It would have been like early Greeks calling a sketch of Greece the "Map of Planet Earth." We would, however, have felt comfortable in using a title such as "Unique EEG Findings That Relate to a Cartography of Consciousness." To claim more than that would have been **Hasty Generalization**, an often-found error in research reports, as in the present paper.

For instance, how would our findings have related to **out-of-body travel**, to **near-death experiences** of the two different kinds (with and without a "spiritual" content). Or, how would findings be relevant to the late Dr. Edgar Wilson, who had no EEG signal at all from certain sections of his cortex, especially from CZ. And how would a presumed Cartography of Consciousness relate to the 200 hydrocephalic children reported in Britain (in a longitudinal study) who grew up and became fully-functioning adults (mathematicians, artists, lawyers, bankers, etc.) even though their total cortical areas were often less than the size of a dollar bill. A reference for the published paper on this, called "Are Brains Necessary?," can be obtained from Marco DeVries, M.D., Department of Pathology, Erasmus University, Rotterdam, Netherlands.

The point here is ***not*** that there are exceptions to a general rule, but that BRAIN and MIND are not synonymous. There is considerable evidence indicating that the MIND *per se* is in the out-of-body body, the OB BODY. If this is correct, then the interface between MIND and BRAIN is probably the "subtle energy field" that healers and yogis say is part of everyone's physical self, permeating every nerve fiber. [See my article in *Subtle Energies* 4,2 (1993), p. 151, called "Mind Over Matter: Volition and the Cosmic Connection in Yogic Theory."]

In other words, a cartography of consciousness based on EEG data would be equivalent to only a few boards in a house. I'm not implying that EEG correla-

tion with consciousness shouldn't be studied, but that we should refrain from Hasty Generalization, however enticing. Even Freud realized this, part of the time. In one place he said, "We are working in the basement of the human psyche."

My second point is that the authors of this paper apparently have accepted mainstream reductionism as adequate for explaining mind and consciousness. Consider the following quotations, with my emphasis added:

> ". . . states of consciousness and its EEG **substrates. . .**" (p. 136)
> ". . . how the brain **enables** conscious experience." (p. 137)
> "These micro-state neural nets, along with stimulus refinement and associative response, **define and determine cognition.**" (p. 137)
> "An **electroencephalographic cartography** of conscious states. . ." (p. 139)
> ". . . the brain **substrate** of intentionality." (p. 140)
> "In this **state specific** activation net." (p. 141)
> "These findings provide a **coherent view of the brain-mind-body synergy.**" (p. 148)
> "**Brain, consciousness and "mind" are no longer indivisible** [divisible?] **and imponderable.**"

From my point of view, the above statements are expressions of Faith, standard religious doctrine in science, closing off open-ended systems concepts, reducing Nature to simplicities, and best of all (for many researchers) this doctrine makes it unnecessary to develop "tolerance of ambiguity." And yet, **tolerance of ambiguity** is one of the primary characteristics of Nobel Laureates!

DISCUSSION (p. 146) is a review of theorized projections of ideas, but most of the author's ideas about neural nets, etc., were exhaustively elaborated and published in the Fifties by Donald Hebb of McGill University.

Lastly, consider the electrode problem. If someone has a computer with 10 billion diodes and transistors, and a trillion interconnections (somewhat like the brain), and you put an electrode (or 20 electrodes) on it, will analysis of signals reveal what the programmer was thinking when he or she looked out the window in a moment of reverie?

If we hypothesize that **there is no programmer,** however, and that the meaning of what is printed out is an epiphenomenal correlate of the diode substrate, then the above question about what the programmer was thinking doesn't apply, and research is simpler.

I'm not saying that this paper and the research it represents are not important. On the contrary, they ***are*** important, just as the voyages and diaries of early explorers were important. But a lot happened after that.

As I see it, quoting from Hamlet, "There are more things in heaven and earth, Horatio, than are dreamt of in your philosophy."

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Commentary By Les Fehmi, Ph.D.

I enjoyed reading this paper which reports quite interesting findings. The reported results lead one to question cherished notions. The data suggest that little or no differential EEG impact is provided by individual, genetic, age, learning capacity, tension and educational factors. The following comments are given in the spirit that they may make future observations regarding these and similar findings, by these authors and others, more clear and more convincing. They are suggestions for clarifying a seminal work that could have considerable impact on our fields, in the event that it is substantiated by further research. The following observations and comments are not in any specific order of importance, they appear just as they occurred to me.

1. What I find most interesting about their reported findings is that complex cognitions, rather than single words, or images, or simple sounds, etc. elicit discrete frequency responses to commands. Even

when some of the same words are used alone in different commands, they elicit wholly unique frequency responses. Clearly, we are encouraged by this observation to look elsewhere for explanations than the more literal minded of us ordinarily would be directed (see #6 below for example). These findings suggest that specific subtle nuances of meaning rather than specific words or sounds are reflected in the sharply delineated frequency responses of brain activity.

On the other hand, in other research there is support for a narrow band of frequencies being involved in the general representation of meaning and functional verbal capacity. Giannitrapani found significant correlations between 12-14 Hz activity and performance on all WISC verbal subtests. Interestingly, there is also statistical support for a correlation between intellectual function and the amplitude of 10-12 Hz peak activity. The 12-14 correlations are strongest in the comprehension subtest, suggesting a role in facilitating general conceptual ability.

2. In the introduction, the authors state that using the standard nomenclature of delta, theta, alpha, beta is "so lacking in specificity to be scientifically *unreliable*" regarding the "domain of cognition and mental states." In light of the results reported this statement of relationship is more appropriate regarding specific cognitions (*i.e.*, the commands used by the authors) and not altogether accurate regarding more general mental states. Mental states, or as I prefer to call them mental processes, are highly correlated with peak EEG band frequencies as follows: Delta activity is correlated with sleep; theta is correlated with reverie-like processes, alpha is associated with relaxed, alert wakefulness and beta is associated with more alert higher levels of arousal associated with problem solving awareness. These correlations are widely accepted. To call these correlations unreliable is to misrepresent these relationships. I agree, however, that greater specificity might yield additional information about the relationship of mental processes.[1]

3. At the end of the method section the authors state that "following certain commands, only one epoch of EEG was collectable whereas as many as seven epochs were collected following other commands." This statement needs to be explained, particularly as to why so few were collectable after some commands and as many as seven in

response to other commands. The criteria for determination of an acceptable epoch must be clearly stated. In the results section they state that ". . . the epoch with the *highest* amplitude for the frequency band expected was used for analysis." This variability in duration of response taken together with an acknowledged "data selection bias" (using only the highest amplitude epoch) make this research outcome less convincing. I am not suggesting this procedure totally invalidates the report observations, although it could. But, I am left wondering how the data would have looked if the authors used the average values across epochs, or used only the first epochs across subjects and conditions. Would such an approach smear the frequency data which are presently shone quite sharp in frequency delineation. I am also interested in knowing if any of the seven epochs (when seven were present) were not as expected, *i.e.*, a reversal of peak energy expectations, or not in a continuous series. To truly appreciate the impact of these sharp frequency delineations, the energies in the surrounding one Hz frequency bins could also be reported

4. Figures 2 through 9 exhibit clear peak frequency differences in response to commands. While the authors state that these are conscious states and involve volitional attention, they do not provide evidence for or defend this assumption. It could be argued that the findings represent an unconscious contained response to the verbal commands. This view is supported by the exact sameness of the data across subjects. In relevant connection, it was never mentioned that these were naive subjects, and who received no feedback.

5. The command which produces 10 Hz peak energies is "add" which the authors call "engaged thought." Additional explanation of how the command "add" is related to the reported 10 Hz outcome is needed as well as the meaning of "engaged thought." More complex math, for subjects with insufficient personal mastery of the subject matter, often produces narrow focus of attention and desynchrony, *i.e.*, high frequency EEG responses above 10 Hz. In other words, commands that are "easy" for the subject, or which are over-learned may bring about highly conditioned responses, such as the way they pay attention to the subject matter, and thus leads to 10 Hz activity. I have observed that the level of mastery and type of attention are relevant parameters in relation to EEG responses. Also, whole brain

phase synchrony at 10 Hz is a very different event than local 10 Hz activity. I would be interested in the phase relarions of the activity throughout the responding cortex.

6. A rationale for why similar verbal commands cause peak energies at sharply different frequencies would increase acceptance of this data. The relationship between certain commands and their EEG responses is particularly in question. For example, "be aware" (12 Hz) compared with "*be aware* of how heavy your hands *feel*" (14 Hz) compared with "feel" (16 Hz). Why doesn't the impact upon EEG activity of "be aware" and "feel" show up on the 12 and 16 Hz skirts of the response to the command "be aware of how heavy your hands feel," which triggers 14 Hz activity? Does the EEG impact of "be aware" and "feel" show up in the 13 and 15 Hz skirts? This reviewer would benefit from assistance in the form of a neural mechanism or other explanation which would delineate how the EEG impact of words such as "be aware" and "feel" are neutralized by putting other words between them. A plausible model or explanation would help me organize these results into my experience more completely and with more understanding.

   If the results are reliable, then one possible explanation is that subtle "nuances of meaning" (NOMs) cause reliable changes in EEG frequency throughout a variety of specific brain areas. Certainly there are too many subtle NOMs for frequency, by itself, to account for all of them. It seems to me that there are too many subtle NOMs for even a combined frequency-locus model to account for, unless discrimination of frequency and location are extremely fine. I cannot help thinking that phase relations also play an important role in the electrophysiological correlates of attention and meaning.[2] It deserves to be reiterated that the reported results pertain to EEG recordings from only CZ, except for the one control subject (see #11 below). Also, non-dominant frequencies and their phase relations may also contribute to meaning, much as figure is given form by ground.

7. In the discussion of the results of the control subject the authors suggest that the 7 Hz dominant signature is uniquely elevated at the 3 electrode sites along the midline, CZ, F3, and PZ, with bilateral activation along the right C4 and left C3 rolandic cortex, with left temporal T3 and

left frontal F3 and F7 involvement. However, the data show that P3 is also elevated and since so many commands refer to aspects of somatic sensation, the sensory domain of the parietal lobe, it is curious that P3 was excluded from the discussion.

8. Repeated references are made to the supplementary motor cortex (SMC) and its theorized pivotal role as the site for EEG cartography of subtle behaviors and consciousness. The results of the control subject show that many other sites in the midline and left hemisphere reflect a similar cartography. Since no measurements of the placement of the single sensor purportedly at CZ was reported there is little reason to believe that activity which is specific only to SMC was recorded. The length of the sensors recording surface would, of necessity, measure activity also from the primary motor and sensory areas and perhaps also associated parietal areas. Therefore, based only upon reported results, there is little support for the proposed theory which implicates only the supplementary motor cortex. Probably many regions which are simultaneously active participate only in the processing associated with meaning.

9. I would like to know whether the one Hz filters are symmetrical around the whole integer or not. For example, is it 13 1/2 to 14 1/2 or is it 14 to 15 for a 14 Hz filter. In previous personal communication, M. Tansey reported to me that .5 Hz on either side of the whole integer was used specifically for 14 Hz training. This should be stated, if it is true, also for this study, so that replication of this research could be more precise. I also know that M. Tansey says "good" when a client or patient responds as expected during 14 Hz *training*. I would like to know whether any conscious feedback was given (or any unconscious leading was present, subtle energies or otherwise) in regard to the EEG responses reported.

10. M. A. Tansey previously presented that individuals park their mental awareness in individually specific and experientially consistent parking spots, when *not engaged* in other mental activity. The authors do claim that the reported data support this parking spot theory, of temporally stable brain activation nets. However, giving commands is *engaging* the brain in mental activity. Moreover, the use of the term "parking" suggests an event of some stability. The standardized commands

apparently engage EEG for only one to seven epochs (one epoch is one second in duration). A one to seven impact is not what one ordinarily would consider long term stable, not a long term parking lot. They failed to present data concerning a prolonged return of brain activity to a specific peak frequency bin (peaking spot) after being engaged or challenged by each command. Thus, their arguments require additional data and more detailed elucidation in order to be substantiated.

11. Again, it would be valuable to see statistics done across experimental subjects on the individual data points at each peak frequency throughout this paper and perhaps comparable to the 19 local data provided for the so-called one control client presented in this paper. (Additional statistics are provided for apparently the same results in another paper by Tansey, *et. al.*, 1994.)[3]

12. Perhaps most astonishing is that, in spite of individual differences in age, sex, level of stress, education, initial language, genetics, etc., the data by being so sharply identical in peak frequency, suggest that we all respond to the same commands in exactly the same way. I would not have expected this. I am quite surprised. We know that the same words often have different meanings to different people. This often leads to serious gaps in communication. However, this paper reports results which suggest that evetyone's EEG responds identically. However, it should be noted that the views of N. Chomsky,[4] that language represents an instinctual process, are thus supported by these findings of Tansey, *et. al.* I spoke to a number of people regarding the Tansey, *et. al.* findings. Most had hardly heard about them and had reactions, which ranged from full acceptances to deep skepticism, *e.g.*, "The data look too clean." A share of the equipment manufacturers mentioned that their equipment was programmed for the "Tansey Technique." Obviously, the authors' work is generating controversy, interest and support.

The experimental research presented by Tansey, *et. al.* adds value to the enterprise of elucidating the electrophysiology of behavior by raising many more questions than answers. But, this is the germinal impact of an original contribution. Tansey, *et. al.* offer their own views and explanations. I am sure many readers will offer other mildly to significantly conflicting views. But this arousal of interest creates a fertile environment for research and progress in arriving at satisfying and useful neurological models and associated understanding.

Again, I was very interested in this paper and look forward to independent confirmations of this work. In general, if the above comments could be addressed, it would make it easier for myself and others to climb upon a platform of work which has the potential of becoming a seminal contribution to the study of the neurophysiological correlates of subtle energies and behavior.

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BOUNDARY CONDITIONS: THE SURROUNDS OF A STATE OF MIND

MICHAEL A. TANSEY, PH.D.

In their commentaries, Dr. Elmer Green and Dr. Lester Fehmi make me think fleetingly of Columbus. We both discovered something new—with some observers maintaining that in doing so we set out in the wrong direction, while others maintain that initially, we didn't go far enough. I shall first reply to Dr. Green's commentary on my initial data which necessitates a conceptual overview, and then to Dr. Fehmi, who obliges me to address the mechanics of methodology. I need mention that I presented data on a cartography of consciousness. The very usage acknowledges the existence of other valid cartographies and mapping schema.

My understanding is that, when dealing with subtle energies and subtle energetic systems, the actual causative agencies resulting in an observed effect are more often than not, not clearly understood in quantified terms. This is, too, the ongoing case when attempting to comprehend the co-manifestation of the physicality and mentality of Man. The ongoing problem of non-existent and/or inadequate quantification leading to rejection of poorly explicated observations has radical behaviorists denying the scientific definitiveness of anything describing "mentality." For them, spiritual reality is an oxymoron. Subtle energies needs the explicative power of accurate functional quantification.

I have always sought a more exact understanding of what I refer to as the ubiquitous unity of relation that is manifested by ourselves within our personal environs of experiential potential. In this, I contend that all things that interact come into immediate functional relation. The closer the interaction the greater the relation. I contend that Man manifests via a synergistic plurality of energetic levels determined by what surrounds he/she orients with at any given moment.

Surrounds is my term for the bounded envelope of stimuli/energy/information that one as a relational entity orients to at any given moment. This is why the exact explication of all experimental conditions is necessary to replicate one's

observations. Nothing is a singular isolate. All is embedded in something and in relation to it; *i.e.*, the surround. The constituents of a surround mutually self-inform themselves as to the resultant plurality of relations extant therein and their manifestation. These functionally orienting relations define the cohesive whole whose characteristics transcend and then orchestrate the qualities of any of its constituents. Explicate and quantify some part of the relation and the rest becomes more amenable to systematic examination and fuller comprehension.

Physicality and mentality co-manifest and are in relation. Because I attempted to quantify some aspect of the mind-brain-cognizance relation via spectral analysis, in no way does it necessarily follow that I am a single minded exponent of the Cartesian view wherein cognizance is limited to the somatic boundaries of the head. The brain, its structural and functional manifestation, play a well documented role in the quality of our lives. The energetic mechanisms enjoining this process should be explicated as fully as possible. It is commonly accepted in neuropsychology that the brain appears to manifest what we are through various mechanisms of genetic unfolding of ability from a reservoir of potential. As a species, our behavioral repertories are thought to be selected and inventoried by the attrition of nature, and further refined by the demands of ongoing experience. It appears that neuropsychology affirms quite strongly that we cannot manifest behaviorally, or experience as phenomenal reality, what the brain cannot integrate into its functionally responsive networks. Functional investigation into the role of brain tissue, or as in the case of Luria and those following in his footsteps, shows clearly that loss-impairment-trauma of brain tissue equals loss and/or impairment of pre-injury levels of functional manifestation of self in everyday life.

It is widely accepted that natally, we all come into the world sharing inherited developmental blueprints for the future unfolding of the mind-brain-body relation which manifests to the world as "us." Most often, the blueprints activate on time and we manifest age-normal expected behavior. Sometimes, the expected blueprint doesn't actualize as expected—or the substrates necessary for its actualization are disrupted due to loss- impairment- trauma of brain tissue. Such scenarios are well documented. Examples of individual variations in perception of phenomena, as they appear to our senses and realized in our consciousness through the synergistic instrumentality of the brain, exist in abundance.

The brain tissue of the hydrocephalic, although limited in the volume of space allowed for it to physically expand within the skull, seems to co-manifest with a varied and broad range of function. Explicating if there were any "normal" functional manifestation without the presence of the usually associated cerebral tissue would seem to be a cogent beginning to an answer to Dr. Green's question. To further his argument we need find, explicate, and replicate data showing that there is or that there is not an identity-specific transcendental schema or transcendent cognizance that can manifest irrespective of relative intactness of one's physiology. Is what colors and gives depth to our personal phenomenal reality solely the range of possibilities that our brains make available to us? Is there something likened to what I refer to as a "background cognizance" that informs and choreographs both conscious mind and enabling brain? Adding to the mystery are the varying levels of personal awareness of this pervading surround of background cognizance.

Cognizance transcends and affects the corporeal and the physical. Physics and years of solid experimentation agree on this. The observation of such transcendence has been done in a variety of ways. The difficulty is that operational descriptions of the mechanisms enabling such demonstrations are not readily explicable in terms acceptable to many scientists. The presence background cognizance seems to have been revealed via the examination of the electrical activity of the brain.

Libet replicated the results of Deeke, Grotzinger and Kornhuber.[1-3] They attempted to quantify and temporally isolate any EEG change relating to an act of individual volition—flexing a finger. While the people in these studies thought that they were spontaneously flexing their finger, their brains' were observed to be building up the electrical potentials leading to the finger flex for from one to one-and-a-half seconds prior to their conscious execution of the avowed spontaneous and unanticipated finger flex. The choice of time and allocation of the necessary neural substrates were made by what part of "them"? Surely, according to them, not their conscious minds. Accordingly, it is a plausible explanation that there was a background cognizance which transcended and choreographed the resultant behavior for both conscious mind and brain.

Spectral footprints of brain activity are a good place to start when tracking things that transcend or transduce the material. As Pribram noted, much of

the human sensory apparatus in its reception and transduction of surround stimuli, for subsequent brain processing, storage and retrieval of information, utilize a specific dynamic modality—spectral analysis.[4] Notably, our visuo-spatial receptors and associated brain relations depend on Fourier Transforms. Since Fourier Transforms are a primary vehicle for sensory and neural information transduction, it may partially explain their utility in my initial application of same to obtain a limited cartography of consciousness. Spectral analysis and Fourier Transforms have been noted to encode our experience of our surrounds. I find that its usage of the same Fourier transforms allow us to in a small way "listen in" on the process—to test the boundary conditions which inform our conscious states of mind.

Since Dr. Fehmi's commentary are in his words not "in any specific order of importance," I chose an concise overview of how the methodology for the target paper was arrived at as the most efficient manner in which to address Dr. Fehmi's commentary. The target paper itself, was a re-examination of data obtained from a previous paper published by the authors' in the *International Journal of Neuroscience.*[5]

As a private-practice EEG neurofeedback clinician, efficacious protocols and repeatable results were paramount. From the onset, I had found the vague and nebulous "states of mind" commonly attributed to Alpha, Theta, and Beta to be very frequently not the only mental things to make these large aggregate bands of EEG activity respond when monitored with an EEG neurofeedback instrument. I found that Alpha training resulted in reinforcement for things other than calm states of personal well being. The correlational studies defended by Dr. Fehmi were flawed in their attributions. They were measuring groups of individuals who were well practiced in meditation and they thereby attributed the change in monitored EEG energy (Alpha) to the powerfully specific meditative state of mind entered into by these practiced meditators. So far so good. The problem is that these correlational studies were averaging all of EEG energy across all of five or six EEG electrical frequencies; these were averaged together to get their index of change. Obviously, their electrical index went up—and no one to date knows (until someone reexamines the data) the functional makeup of the specific waveforms co-manifesting with the onset of meditation. What actually made their wide band Alpha indicator go up? Figure 1A clearly shows that when you obtain wide-band averages for aggregate

measures of EEG activity, you cannot know which of its constituents is really producing your change and by how much. This becomes very problematic when your wide-band contains within it several pure EEG signals which reflect functionally opposite states of mind.

In my clinical practice, I found that practicing meditators always increased Alpha in accord with their meditative posture, but if I tried to train someone who had no acquaintance with a meditative state by instrumental neurofeedback training for Alpha production, frustratingly opposite results frequently obtained. This is why we find some individuals claiming to be training their clients to produce Alpha via EEG neurofeedback; while the actual training session is predominated by the playing during the feedback of Alpha a relaxation tape whose contents the person is instructed to intently listen to *so as to be shifted by the tape to the elusive brain activation signature manifesting the Alpha state.* A more accurate service description is EEG Neurofeedback Assisted Relaxation Training. As a practicing clinician who wanted to do efficacious EEG work, this was unacceptable. I wanted to help people with EEG neurofeedback directly related to improved function, not to be in the business of selling audio cassettes of relaxation exercises.

Electrical energy is expressed in exact units of measurement. This is usually noted in terms of a specific cycles-per-second characteristic of the specific electrical energy band. The cycles-per-second reference was changed. Electrical energy is now referenced as so many Hertz (Hz). Figure 1 shows how a 7 Hz (or as they used to say, a 7 cycles-per-second waveform) is a single energy measurement that describes the energy flow which manifest in peaks and troughs. Figure 1 shows a 7 Hz or as they used to say, a 7 cycles-per-second waveform.

Alpha and Theta and Beta are bandied about by their proponents as if they were naturally occurring single entity waveforms. Wide band EEG proponents even proclaimed that instrumental EEG neurofeedback training for Sensorimotor Rhythm (SMR), a large aggregate brainwave band averaging EEG energy across 12 through 15 Hz, is the same as EEG training of a 1 Hz wide band at 14 Hz. Figure 1A dramatically illustrates the non-reality of that assertion. In Figure 1A the person was being trained for the production of a 1 Hz wide 14 Hz EEG signal. Obviously adjacent bands of EEG activity and

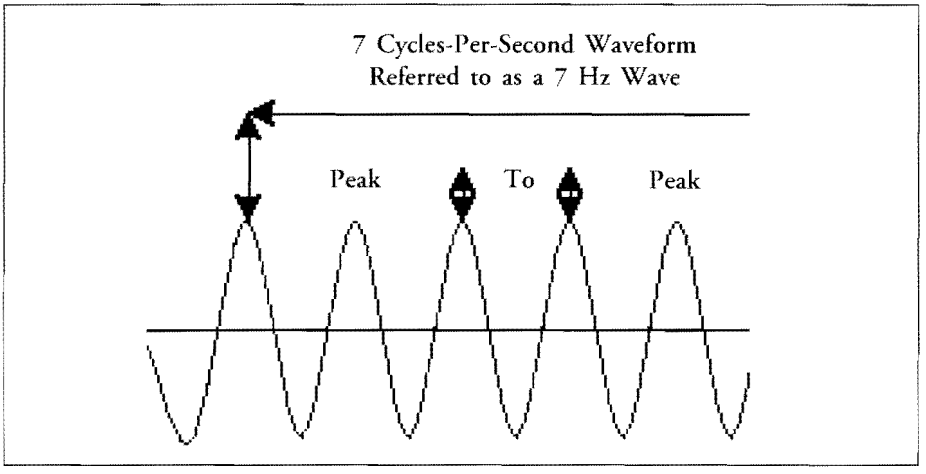

Figure 1. *Figure 1 shows a 7 cycles-per-second waveform referred to as a 7 Hz wave.*

their cognitive referents are not in lock step. There is altogether too much treating these wide aggregate bands of EEG activity as naturally occurring single energy entities—and then applying them as if they had a unitary and specific effect.

Alpha (8 - 13 Hz) is all of the electrical energy that occurs in the 8, 9, 10, 11, 12, and 13 cycles-per-second waveforms of available energy—averaged together as a single sample. Theta (4 - 8 Hz) does the same thing. It is all of the electrical energy that occurs in the 4, 5, 6, 7, and 8 cycles-per-second waveforms of available energy. When someone like Dr. Fehmi strongly defends the accuracy of the old correlational studies and how they really did find specific and reproducible states of consciousness for the wide aggregate bands of Alpha and Theta, I remember how in 1992, a past-president of the Association for Applied Psychophysiology and Biofeedback—J. Peter Rosenfeld to be specific, said in writing what many of us practitioners already knew:

> What does Alpha mean? What does Theta mean? That is, what psychological state is indexed by Alpha, by Theta, or both? . . . I hope no one seriously attempts to provide these answers in terms of what is presently known about the functional significance of Alpha and Theta; *i.e.* very little.[6]

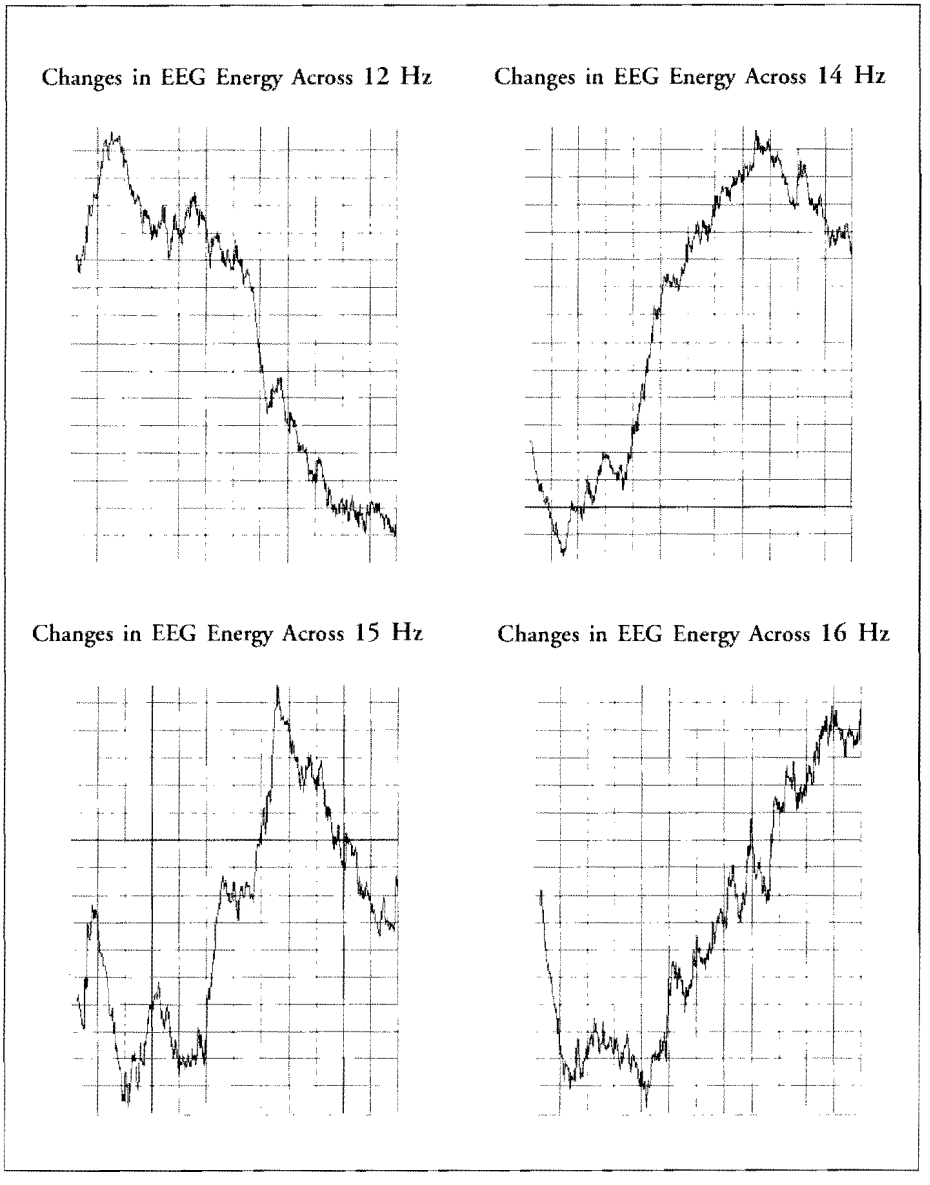

Figure 1A. *Some of what's happening in the wide aggregate band of SMR during 15 minutes of EEG Neurofeedback at 14 Hz.*

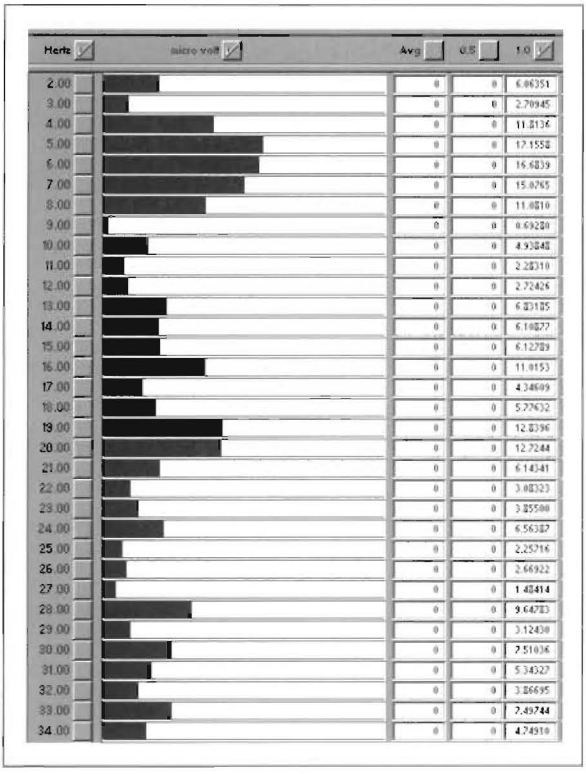

Figure 2a. *1-Second Epoch at End of Instruction*

Figure 2 shows how charting EEG energy across 1-second epochs, in pure, specific, cycles-per-second energy samples, can functionally index one's cognitive state. In Figure 2 we see the EEG energy sampled and charted in one-second epochs, in 1 Hz windows stacked vertically for all the EEG energy from 2 Hz through 34 Hz. In this, Figure 2 depicts three consecutive 1-second samples of EEG energy, and a one-second sample taken five seconds later to see what EEG changes manifested with the individual "recalling" the image "manufactured" five seconds earlier.

The first chart in Figure 2 depicts the last one-second epoch of EEG energy manifesting at the end of the instruction: "In your mind's eye, see a red ball." The second charting shows the next immediate 1-second epoch of EEG response immediately following the instruction. The third chart shows the next 1-second epoch of EEG response (2 seconds post instruction) wherein this person spontaneously ceased creating the image. The fourth chart shows the 1-second epoch of EEG response, obtained five seconds later, immediately following the instruction: "Let that image go." This last chart of data indicating EEG change co-manifesting with a volitional recapitulation of a previously manufactured internal visual image was not in the target article. In fact, neither is the comprehensive charting found in the computer screens reproduced in Figure 2. These are reproduced here to respond definitively to

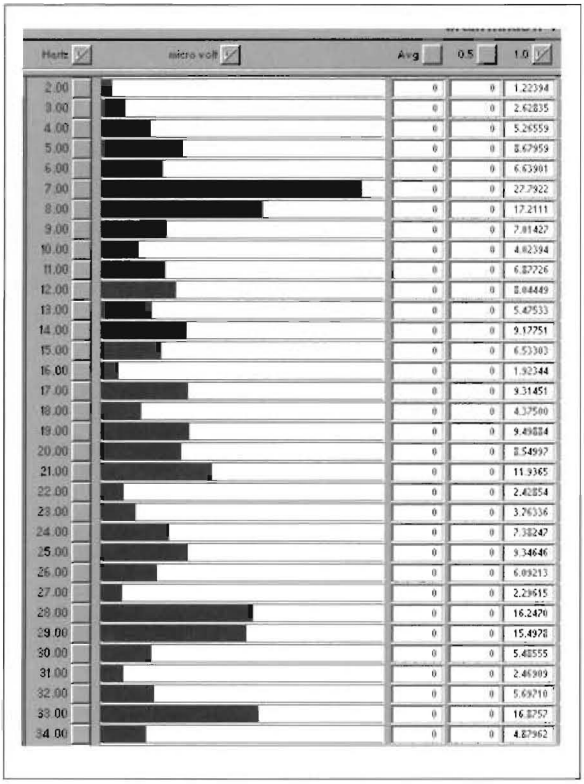

Figure 2b. *1-Second Epoch 1-Sec. After Instruction*

the commentaries requesting clarification on changes in EEG data that was not present in the target article.

It is dramatically obvious, that during the exact one-second epoch of EEG energy following the computer delivered instruction: "In your mind's eye, see a red ball"—there was a 7 Hz dominant EEG signature obtained. The 1 Hz wide 7 Hz band surged to 27.79 microvolts peak-to-peak. It is also notable that one sees that there are only three other EEG bands whose energy exceeds ten microvolts and that these notables start at 28 Hz. These energy bands are 28 Hz at 16.24 microvolts, 29 Hz at 15.49 microvolts, and 33 Hz at 16.87 microvolts. Figure 2 addressees three major points: First, the "Telepathy" software 1 delivers very precise and cleanly demarcated indexes of EEG energy for each of the 1 Hz wavebands. Also, if the EEG energy were sampled in 2 Hz wide units of measurement or more the true impact would have been lost. Second, the instruction for the imaginal production differed from that in the target article only in the color of the ball. Here, we had the person "see" a red ball while in the target article the people were instructed to "see" yellow balls. This may allay some concern as to the influence of nuances of meaning (NOM). NOM's to date are essentially non-quantified nebulous consttucts when it comes to EEG charting—with as much predictive utility as Alpha in uncovering specific information about the influence of different words on one's brain-cognitive state. As stated in the target article, all of the

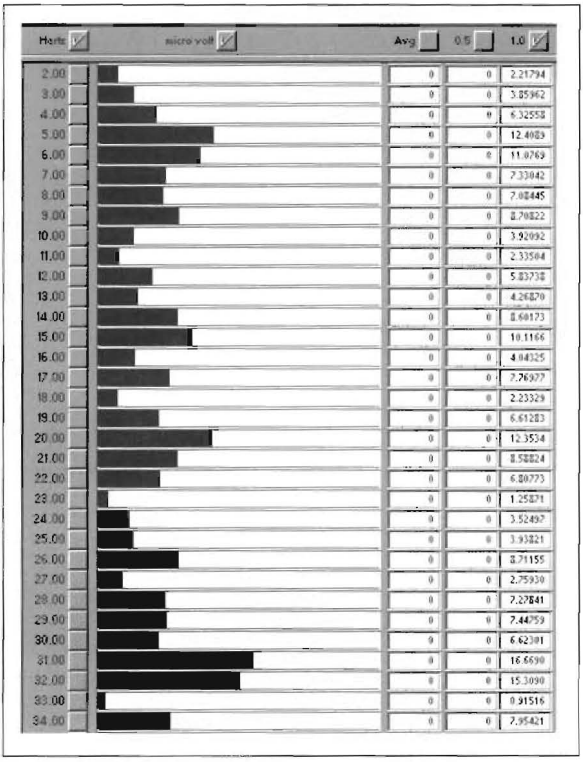

Figure 2c. *1-Second Epoch 2-Sec. After Instruction*

instructions in this ongoing research have their delivery via computer controlled protocols, so all stimuli are standardized, all data collection is automated, and thus no investigator bias or involvement is allowed to intrude. As is abundantly clear, feedback of any kind was operationally precluded and impossible. In the same vein, yes, the subjects were experimentally naive. Thus, there is a continuous, consecutive, automated stimulus ptesentation without verbal interaction with anyone or anything once the sequence is initiated. Thitd, if we had sampled the EEG enetgy in Figure 2 in terms of Theta we would have been blind to this highly significant EEG reflection of internal image production. In fact we find that: At the end of the instructions, the mean energy of Theta was 14.35 microvolts. Immediately following the instructions, the mean energy of Theta was 13.10 microvolts. The second one-second epoch of EEG energy following the instructions showed the mean energy of Theta to be 8.84 microvolts. The recapitulation of the internal image showed the mean energy of Theta to be 9.26 microvolts. So, across the three consecutive seconds of EEG charting wherein the person afterwards confirmed having produced a vivid internal image of a red ball immediately after the computerized instructions—Theta was 14.35 microvolts. At the end of the instructions, Theta dropped 8.7% during the actual image production. Theta further dropped another 38% in the second one-second epoch following the instructions, and was 35% less than at the pre-image state when the image was recapit-

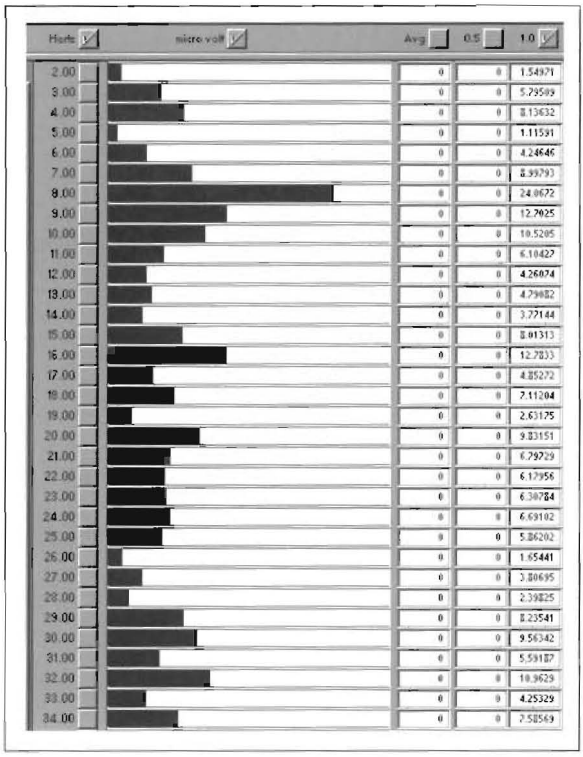

Figure 2d. "Let that Image Go"

ulated with an even more clean and striking 1 Hz EEG index for the production of an internally generated image.

The data are clear and unambiguous, if we were charting the EEG energies obtained using the operational specificity of the Theta band—we would have seen Theta actually decrease across time with no indication at all of what was going on in that person's mind. If we had also had been charting the changes in Alpha at the same time, we would have had even less of an indication as to what was going on in that person's mind. In fact, using the Theta and Alpha bands we would have seen Theta decrease and Alpha increase in energy before, during, and after the internal production of the image of a red ball—which occurrence was signaled by neither. It is noteworthy that in this instance the initial production of the internal image had a 7 Hz dominant brainwave signature standing out light a lighthouse against the shoreline, and the recapitulation signature had an even more clean 8Hz dominant signature. This paper is too short to go into our ongoing research on this and other matters.

The target paper showed data obtained on our EEG neurofeedback training screen. This screen depicts ten bars of 1Hz wide EEG energy that I have identified, using the type of analysis found in Figure 2, as consistently reflecting specific volitional mental and somatosensory awareness. As the target article

states, this verification procedure was performed with many hundreds of people over many years. In the target paper, the number of epochs available for sampling following each computer delivered instruction in the target article came about in a very simple way. I made a stimulus sound file to be delivered by computer to the test subjects. In recording it, I would give one instruction and pause and give another and pause, not thinking that the length of the pause varied all that much and later finding out how it varied the amount of data recordable after the various instructions. Thus, I had uneven intervals following the varied instructions. As part of my ongoing research, I am replicating all of the original commands with exact five second intervals separating all commands and am examining the EEG data obtained using the same screen as in Figure 2.

In the text of the target article, due to editorial fatigue I omitted the notation that P3 was one of the sites for observing a 7 Hz dominant pattern of brainwave signature reflecting a subject's response to standardized imaginal cue.[7] I am glad that most readers who have contacted me did realize that I drew a line to P3 in Figure 10 of the target article, that I was pointing it out to the readers as such. Also, most of the same readers readily saw how the active sensor clearly centers about CZ and the Supplementary Motor Cortex. One only has to look to the data presented in the charting of Figure 10 to know that I am well aware and am strongly bringing to the awareness of the reader the fact that there is a synergistic network of cortical sites involved in these phenomena—but the data is also clear that the characteristic signature so obtained is indeed strongest from over the midline, centering about CZ.

Demonstrating proof in experimental environs are one thing and real life demonstration in front of your peers is quite another. I avidly pursue both. At the first meeting of those EEG neurofeedback practitioners who subsequently formed the EEG Section of the AAPB, I broached the concept of specific combinations of 1 Hz bands of brainwave energy being reflective of specific cognition. The next day, many of them came to me to experientially find out for themselves. Many were practiced in meditation. I was 100% accurate in relating to them the type of internal meditative posture they were assuming during their meditation and during other mental tasks. I also diagnosed a functional deficit in the ability to do mental math in a very well known EEG neurofeedback practitioner (Yes, using 10 Hz) during this real life

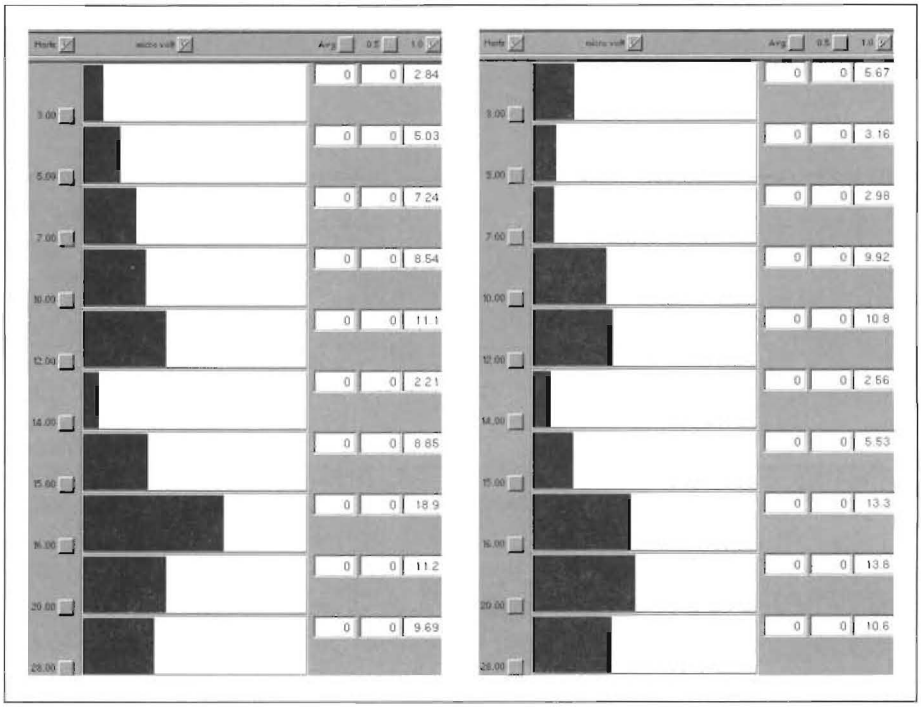

Figure 3a. *First epoch 1-Sec. after instruction.*

Figure 3b. *Second epoch 2-Sec. after instruction.*

field test of my protocol in front of my peers. In fact, during that period of field verification by my colleagues, two psychiatric interns from Menninger asked to be subjects so that they could first hand ascertain the validity of the designated 1 Hz wave-bands. Everything went very well until we tried to track their ability to construct internal mental images. In order to demonstrate 7 Hz as being responsive to internal imagery, I would usually ask the individual to see in their mind's eye a red ball or a dog or something familiar—sometimes a green frog. Both psychiatric interns had no 7 Hz response to balls or dogs or ice cream cones. But, when I asked them to image a green frog, we obtained a signature like in Figure 2—a very large 7 Hz response. I asked them, why. They said that neither had dogs, and the other images were impossible to conjure, but they had just seen a large green frog in a previous booth in the

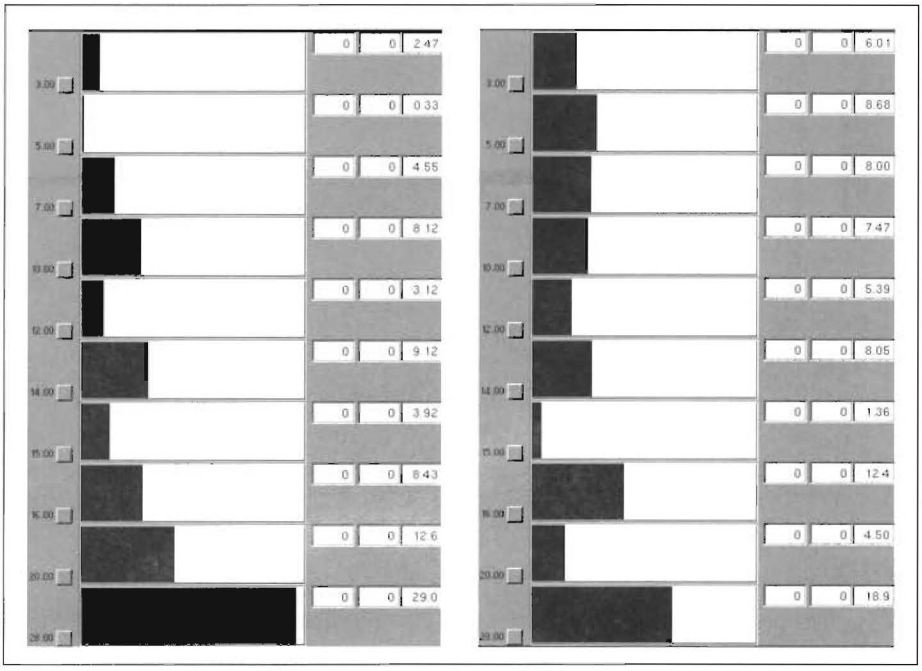

Figure 3c. *Third epoch 3 Sec. after instruction.*

Figure 3b. *Keep the feeling of warmth.*

exhibit area and that image was clear and fresh in their minds. My initial research data—as found in the ten-band treatment screens was next presented as part of a program at The Menninger Clinic wherein both Dr. Dale Walters and Thomas Allen confirmed these accounts of the above "real Life" field-test and demonstration of my protocol.

Yes, the various identified waveforms, when used in the ten band training screen, do co-surge in recognizable combinations reflecting changes in cognition and attention. I found them to be experientially reflective and additive. As shown as part of over 4 hours of video at the SSNR's meeting in Las Vegas on the utility of our ten band training screen; instructions like "Be aware of your hands becoming heavy and warm" resulted in the immediate dominance of 12 Hz, then the next one-second epoch showed the 12 Hz

subsiding and being replaced by a dominant 14 Hz and in the next epoch the 14 Hz and the 28 Hz both peaking together reflecting the dual attention. To give you a better picture as to how such things are seen to manifest, Figure 3 shows three seconds of our training screen data covering the three consecutive one-second epochs of EEG energy monitored immediately following the computer generated instruction: "Feel the warmth on your palms," followed by the one-second epoch immediately following the instruction "Keep the feeling of the warmth."

It would take a whole other paper to try to depict the various concurrence of 1Hz band markers and the kinds of cognitive material they seem to track and/or reflect. That is for several other papers, not this one. This approach is obviously new and more data resulting from refinement of the experimental protocol is constantly being analyzed. I am trying to draw the first few lines of a map of unknown territory whose boundary conditions need explicating. There are other ways to interpret the same topography of this unknown terrain. I look forward to the discovery of a unity of relation wherein all of our cartographies reflect a synergistic picture of how we orient to all of our surrounds.

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