Dreams and Neuroholography: An Interdisciplinary Interpretation of Development of Homeotherm State in Evolution

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Homeotherm state can bear a relationship to development of self-cognitive consciousness in evolution. Both explicit memory and consciousness could arise from sleep and dreams. In evolution several biomolecular and biophysical mechanisms have been developed, which made possible the formation of strong coherence of the information system in the brain. This coherence can serve as a basis of explicit holograph-like information system in the brain. This article, although not going into details about neuromolecular, biophysical or biophoton processes, proposes a relationship between thermoregulation and biophysical (biophoton) informational processes in the cells of the brain. It does not claim to solve the secret of consciousness, but points out that biophotons play an important role in information processes of the brain during sleep, dreams and wakefulness, and the brain can operate by pictures during thinking. **(Sleep and Hypnosis 2005;7(2):61-76)**

Key words: homeotherm state, brain temperature, neurotransmitters, drugs, neuroholography

INTRODUCTION

According to Nobel Laureate Denes Gabor, holographic analogy of the human brain can only be functional, not structural (1). However, several features of network models derive from *holography, and there is not contradiction between network and holographic models, because many other biophysical and physical processes also work simultaneously in the brain (2). Informational processes of the brain cannot be limited just to the induction of action potentials or interaction of synapses (3).

This article points out that features of homeotherm state make the development of explicit memory possible, and the brain can operate by pictures during informational processes (dreams, thinking), which is due to the biophotons. It is also shown that exact thermoregulation is of high importance in the brain, and biophotons are originated from molecular processes. Finally, it points out that information storage of the brain can take place at subatomic levels.

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DREAM PICTURES AND THE LAWS OF PHYSICS

According to the laws of physics, electrical signals generate visible pictures if electrical signals are converted to electromagnetic waves (EMW) of the visible range (light photons of wavelengths between 350-700 nm). During dreams our eyes are closed, so the brain is isolated from visible EMWs of the surroundings, yet we can see visible dream pictures. It follows from the foregoing that electrical signals of the brain processes can generate visible pictures of dreams if and only if electrical signals are converted to weak, EMWs of the visible range (biophotons) in the brain. The permanent, ultraweak electromagnetic light photon emission from living systems is called biophoton emission. These photons have been measured in all living systems, ranging from bacteria and human tissue to the rat brain by many researchers over the world by using sensitive photomultiplier systems (4-8). However, nobody can explain origin of visible dream pictures if only the laws of physics are being taken into consideration.

According to the laws of physics, charged particles (ions, dipole molecules) moving at nonlinear speed generate EMWs. However, most biomolecules bear charges or dipoles, and are moving at nonlinear speed. The origin of coherent and incoherent biophotons is the movement of ions and dipoles, molecularly vibrations, as well as the different coherent and incoherent dynamical reactions in the cells (9-11). According to Cliento (12), biochemical reactions take place in such way, that a photon is borrowed from the surrounding electromagnetic bath, and then it excites the transition state complex, and finally returns to an equilibrium state with the surroundings. It is possible that during self-organized evolution special biostructures and molecular processes are being developed, allowing strong coherence and synchronization of biophoton processes in the brain. These processes can carry the explicit memory. Both consciousnesses (thought) and light (waves and biophotons) function as carriers of information and action, and both appear to be self-referential. Light (biophoton) can be a carrier of consciousness, as a basis for a psychophysical hypothesis of consciousness. The human memory can operate through dynamical pictures, and we link these pictures to each other in the learning process. It seems to be quite suitable that we search through information processes at weak electromagnetic levels (biophotons) in the brain.

If dream pictures are generated by biophotons in the brain, these processes also have to work during wakefulness. According to experiments in cognitive neurology and physiology, children are thinking in eidetic pictures, but they gradually lose this ability while they learn to speak, read and write (13). There are some documented cases in science claiming that humans bear perfect visual memory. For example, Aleksandr Luria, a Russian nerve specialist, published Solomon Serasevsky's story (14). Serasevsky's thinking process was like that of a child, concrete and visual. Different sounds induced visual imaginations in his brain. Serasevsky could memorize long lines of meaningless words and recall them easily and perfectly several months later. He was short of intellectual and abstract thinking. Luria's experiments unambiguously pointed out that Serasevsky's memory is visual. However, dynamical series of pictures (by biophotons) can carry unambiguous meaning (15). Moreover, acoustic signals of sounds, molecular signals of smells and tastes, and mechanic signals of touch can also be converted to electric signals then to biophotons signals in the brain. So, biophoton processes can also be a base of synesthesia (16,17). It seems that informational language of the brain is a holograph-like process by biophotons

generating visible (conscious) and invisible (unconscious, metaphor-like) pictures in the brain.

HOLOGRAPH-LIKE WORKING IN THE BRAIN

Karl Pribram's holographic theory of the brain has been forgotten, yet nowadays we have a refreshed situation, since numerous experiments and models pointed out that the holograph-like mechanism is a real possibility in the brain (18). In previous articles (19-20) I have summarized the conditions for that mechanism: (I) Living cells can originate and use electric, magnetic, electromagnetic and acoustic waves, and convert them one to another. (II) Experiments indicate that living cells are capable to produce coherent and incoherent photon waves. (III) Cells can be tuned to a permanent signal-bearing frequency. (IV) According to Shannon, the most effective coding is noise-like. In experiments, random noise helps the reaction of the neuronal system (non-linear resonance) given to a weak signal. (V) The living matrix of the brain and the body is a structural and energetic continuum. All cells contain a cytoskeleton that is connected across the cell surface, with the extracellular connective tissue matrix. Coupled oscillations, resonant transfer, and electrodynamic coupling allow energy and information to move through the network. So, electromechanical, electrochemical, electrooptical (electrobiophoton) signals can regulate the signal-amplifying processes in the brain (body). I also raised the point that special (non-calcite) piezo-biocrystals, found in the brain's cells, play a role in information processes in the brain (20). Namely, piezo-biocrystals can work as pieces of information storage units by biophotons in a holograph-like way in the brain. This idea was based on other kinds of biocrystals found in the living cells. For example, there are nonpathological piezo-calcite biocrystals in the inner ear, bearing a striking resemblance to those found in the human brain (21,22). There are billions of magnetic biocrystals in direction-sensitive cells of the hippocampus in the human brain (biomagnetites found in several creatures from bacteria to birds), which take part in space-orientation (23,24). The development of different biocrystals can be realized by interference of non-coplanar coherent biophotons in the cells. This process is similar to holographic lithography in nanotechnology (25). However, molecular processes of the living cells also operate at nano-levels. Finally, by the help of biophotons we can explain the association of different information processes in the brain. When two coherent light waves or an incoherent and a coherent wave are penetrating into a biocrystal (or into a liquid crystal, which is similar to the living cells' matrix), light waves can exchange their information in an associational way (26).

In the next sections I point out that features of homeotherm state also support the idea of a holograph-like mechanism of the brain.

HOMEOTHERM STATE AND NEUROLOGRAPHY

The development of the homeotherm state in evolution bears a relationship to the holograph-like operating mechanism of the brain. In homeotherm creatures there appear well-regulated body and brain temperatures, restricted neurogenesis, and well-structured neuronal systems (27). Moreover, both the homeotherm state (from birds to mammals) and random eye movement (REM) phases of sleep are developed simultaneously in evolution. Exact temperature regulation is important for many holographic systems, which use different electromagnetic photons, because holographic pictures can be deformed if temperature fluctuations are too large (28-30). A well-regulated temperature provides suitable optical quality and low

scatter, which insures that the signal-bearing wave front is not adversely distorted and that the noise level from scattered light is manageable. Quasi-constant structure (restricted neurogenesis) of the homeotherm's brain is also a necessity for holograph-like processes. The brain cells of poikilothermic animals are continuously dividing during their entire life. Such a phenomena is rather rare in adult homeotherm neurogenesis, but a connection network develops among neuronal cells (31). A structured neuron system is also needed to develop explicit memory, because it can guarantee a strong synchronization of different electric and biophoton signals and increase the signal/noise ratio (32). It seems that explicit memory developed first in homeotherm creatures. For example, a Gabonese grey parrot can memorize 1200 words just like a five-year old child (33). Finally, the REM phase of sleep is especially important in humans, because it guarantees a connection between implicit and explicit information of the brain.

REM SLEEP

Slow-waves NREM and REM phases of sleep are different in somatic activity. During NREM, there takes place a decrease in blood pressure, heart rate and respiratory rate, while REM sleep is associated with activation and increase in the irregularity of these functions (34). Global cerebral glucose metabolism falls in slow wave spindle (SWS), but rises back to above waking levels in REM (35). During REM sleep there increased activities in extrastriate (visual) regions (as well as other sensory association sites), in the pontine reticular formation, in limbic and paralimbic regions including the lateral hypothalamus, in the amygdala and anterior cingulate and in the parahippocampal cortices. Primary sensory areas (e.g., striate cortex for the visual system) are deactivated in REM, and widespread regions of the frontal cortex including the lateral orbital and dorsolateral prefrontal cortices show marked reductions in activity in REM sleep (36). REM sleep EEG reading is similar to wakefulness (37). During wakefulness the body temperature of homeotherm organisms is well regulated, but body temperature decreases during sleep, and there appears a lack of thermoregulation. Yet, during REM sleep the brain temperature rises again (38). Both REM and NREM have been found unambiguously in mammals and in young birds, but poikilotherm creatures seem to be characterized only by NREM sleep (27). REM sleep probably has its roots in NREM sleep. This suggests a relationship between REM and advanced cortex of mammals. REM and NREM states are not unambiguously separated processes in human embryos, and typical REM appears only in 1-2 month after birth (39).

In the next sections it is shown that molecular processes of the brain and the body are dependent on thermoregulation. This thermoregulation is in connection with informational processes in the brain. Neurotransmitters, which play role in neuromolecular processes, also play a role in thermoregulation and in sleep/wake cycles. So, neurotransmitters and synapses are hardly units of information storage. Then a simple model as biophotons are generated from neuromolecular processes is described.

THERMOREGULATION

1. Certain classical neurotransmitters in thermoregulation

The hypothalamus is the primary locus for coordinating thermoregulatory information and integrating thermoregulatory responses. Thermosensitive neurons can be found throughout the hypothalamus, but the most important locus is the preoptic region, anterior hypothalamus, and nearby regions of the septum (40,41). There are two types of

thermosensitive neurons. Warm sensitive neurons that increase their firing rate when preoptic temperature rises and cold sensitive neurons that increase their firing when preoptic temperature falls. Thermoreceptors of hypothalamus send their signals via the spinal cord through the raphe nucleus of the midbrain to the thalamus and hypothalamus. The hypothalamic and thalamic pathways can result in cortical excitation, which is involved in behavioral thermoregulation.

Serotonin originates mostly in cells of the raphe nuclei in the reticular formation (42). Their projections target the same areas as histamine (the thalamus, hypothalamus, hippocampus, basal ganglia and the neocortex). Serotonin neurons play a complex part in sleep-wake cycles and thermoregulation. Serotonin increases the firing rate of warm-sensitive neurons and decreases of cold-sensitive neurons (43). Serotonin takes part in the hypothermic and the hyperthermic regulation by different 5-HT receptors (44). Serotonergic cells are activated when we are awake and get aroused. During slow wave NREM sleep the firing of serotonin cells decreases, in REM sleep their activity stops, and right after REM sleep, their activity slowly increased until the next REM phase (45).

Histaminergic neurons in the posterior hypothalamus play an important role in cortical arousal, sleep-wake cycles and thermoregulation (46,47). Neurons in this area may directly influence REM sleep. Hypothalamic histaminergic neurons have the high firing rate in waking, decreased in SWS and the lowest in REM sleep (48).

Acetylcholine is usually an excitatory neurotransmitter, and is synthesized to the greatest rate in the striatum, nucleus accumbens and the interpeduncular nucleus. It plays a role in sleep-wake cycles, cortical EEG desynchronization and thermoregulation (49,50). Cholinergic input, into the medial preoptic area, is spontaneously active in the regulation process of the sleep-wake cycle and body temperature (51). This regulation is mediated through muscarinic receptors. Cholinergic activity decreases significantly during SWS, but cholinergic REM-on neurons have the higher level of activity during REM than during waking (52).

Noradrenaline cells arise from the locus coeruleus in the brain stem, and project their axons to the neocortex, cerebral cortex, areas involved in memory, hormonal regulation, temperature and sleep regulation, etc. (53). It increases our heart beat, respiratory rate and it makes us alert (54). The rate of firing of noradrenaline REM-off neurons in the locus coeruleus almost stops during REM sleep, and increases radically when awoken. Sleep can be mediated by α_1, wakefulness by ß and body temperature by α_2 noradrenergic receptors (55). Mallick and Alam suggested that similar phenomena of noradrenergic receptors may exist in other systems of other neurotransmitters (55).

Most dopaminergic functions take place in the limbic system of the brain (56). It plays an important role in dreaming and central thermoregulation in mammals. Dopamine can decrease Tco by its facilitatory actions on warm-sensitive neurons and inhibitory actions on cold-sensitive neurons in the POAH (57). It is supposed that the effects of dopamine on normal sleep can be mediated by its interactions with other neurotransmitter systems. It seems POAH in the basal forebrain regulates sleep-wakefulness and body temperature, but these two functions can be modulated independently (58). One of the functions of the sleep-wake cycle is to maintain body and brain temperature within physiological limits. However, brain thermoregulation is quasi-independent from body thermoregulation.

GABA is the principal inhibitory neurotransmitter. It is an important homeostatic factor, which plays substantial role in thermoregulation. GABA can

modulate spontaneous activity of thermosensitive neurons in POAH (59). GABA release decreases in basal forebrain during wakefulness, an increase during REM sleep and it has an intermediate level during NREM (60). GABA can mediate the REM-on cholinergic action by slow down noradrenergic REM-off neurons (61).

Glutamate is the principal excitatory neurotransmitter in the central nervous system. It is distributed widely throughout the neuroaxis. L-glutamate has important functions in thermoregulation by acting via NMDA ionotropic receptors (62,63). Glutamate level increases during wakefulness and REM sleep, but during SWS it is suppressed and/or eliminated (64).

Besides the above-mentioned examples, there are several known neurotransmitters and modulator factors, which also take part in sleep-wake cycle and thermoregulation processes. I call an attention to the observation that neurotransmitters take part in thermoregulation processes and many other important physiological functions, but not in information storage. For example, if depressed patients take antidepressant or sedative drugs they can calm down. However, drugs change neurotransmitters levels and many physiological functions (thermoregulation) in the brain, but long-term information does not change in their brain. This should be taken into consideration, when memory of the brain is studied at synaptic, molecular or network levels.

2. Melatonin and the pineal gland in thermoregulation

The pineal gland (and the pituitary gland) has the next highest level of blood circulation after the kidneys. It is not protected by the blood-brain barrier. Thrombocytes can carry the highest amounts of serotonin, so the pineal gland is a very important site of serotonergic activity in connection with the blood system and thermoregulation. The pineal gland takes several roles in psychological and thermoregulation mechanisms (65,66). Since, melatonin in the pineal gland is transformed from serotonin, a slight level of serotonin can cause a slight level of melatonin. Melatonin sends signals to the POAH, where it adjusts the set point of body temperature. Melatonin is an important component of sleep regulation with hyphogenic and hypothermic effects, and with many effects on mental and physiological states (67,68).

3. Neuroleptics and antidepressants in thermoregulation

Neuroleptics have a known strong poikilothermic effect. These have anticholinergic properties, which block sweating and heat dissipation, and antidopaminergic properties, which interferes with hypothalamic thermoregulation (69,70). These drugs are not specifically active in febrile states, but act to disable thermoregulatory mechanisms. Since neuroleptic drugs suppress the release of dopamine, the pituitary is free to secrete abnormal hormones except for prolactin, because the secretion of prolactin is inhibited by dopamine. Prolactin, also known as a stress hormone, can increase the proportion of REM (71) in sleep phases. There is a positive correlation between serum prolactin levels and the REM latency in-patients with non-affective psychosis. The dopaminergic system can be suppressed by inhibitors of serotonin. So, antidepressant drugs, which modify serotonin levels, also influence the level of dopamine.

4. Street drugs in thermoregulation

3,4-Methylenedioxymethamphetamine (MDMA, street name Ecstasy) is a phenylisopropylamine amphetamine analog, which influences the dopamine and

serotonin system (72). MDMA has the capabilities to severely alter our mood, memory and personality (73). In animal tests, where MDMA was blocked from entering the 5-HT neuron, rats still showed signs of hyperthermia, although neurotoxic effects were not seen. According to Dafters and Lynch, MDMA's thermogenic effects are more sensitive to ambient temperatures than it was previously demonstrated, and the serotonergic neurotoxicity of the drug can produce long-lasting changes in the thermoregulatory mechanism (74).

Street drugs can also serve as important examples (besides visible dream pictures) that the brain use pictures during informational processes, which is in directed connection with brain thermoregulation. If humans take street drugs, they often can see madness-like, visible pictures, which are independent of visible pictures of the surroundings. So these visible pictures are generated inside the brain if and only if weak EMWs of visible range (biophotons) are generated in the brain.

5. Temperature dependence of EEG

Changes in body or brain temperature can modulate synchronization and desynchronization processes of EEG, influence EEG power density spectra, and induce a shift in frequencies (75). Moderate temperature changes in humans and mammalians during circadian or menstrual cycle, or induced by drugs, have simultaneously effect on EEG frequencies and the corresponding power spectrum. There is a relationship between the EEG frequency and the cortical temperature, which is similar to the temperature dependence of the Na+-K+-pump (76). The simultaneous change in sleep-wake/EEG probably maintains the brain temperature within the physiological limit, because heating produces a non-specific increment of the nervous activity, which is due to an increase of EEG randomness instead of an increase in alertness in poikilotherm organisms (77). The physiology of poikilotherm animals is strongly dependent on temperature. Reptiles appear to show mixed features between waking and NREM sleep. Reptilians' EEG exhibited SWS and high-voltage spikes that could appear both spontaneously and after sensory stimulation, which is similar to those found in mammals during SWS. It supports the hypothesis that reptilian waking could evolve into mammalian SWS. In mammalians influence on sleep-wakefulness is unlikely to be associated with simultaneously changing body temperature (58). So, thermoregulation of the mammalian brain is quasi-independent from body temperature.

6. Circadian rhythm, brain temperature and memory

Memory achievement of the brain is in direct connection with the circadian rhythm. The circadian rhythm has important roles in metabolic, thermoregulation and sleep/wakefulness processes (78). Both short-term and long-term memories are dependent on the circadian rhythm. Strong stress can eliminate interactions, which promoted synchronization of the circadian rhythm (79). Melatonin production is coordinated not only by light but also by the circadian rhythm. It is possible that the decrease of core temperature during night is caused by an increase in melatonin level. The circadian rhythm can modulate sleep and brain temperature (80).

7. Psychogenic stress induced by temperature

Infections and inflammations can cause fever, but psychological stress also can rise core temperature in animals or humans. The symptom is called psychogenic fever (81). Psychogenic fever is in connection with

conscious experiences or emotion. For example, core temperature can be higher after watching exciting films or suppression of negative emotions. The magnitude of the psychogenic fever is independent of the temperature of the environment and is not due to the increased locomotory activity during stress (82). So, it is a centrally regulated rise in temperature due to an elevated set point of thermoregulation. Neuroleptic, antidepressant and anxiolytic drugs can suppress psychogenic fever (83). Blood levels of cytokines in psychogenic fever do not differ between the raised temperature state and the normal temperature state after psychotherapy in patients with psychogenic fever. Animal studies suggest that the principal mediators of psychogenic fever are classical neurotransmitters.

BRAIN TEMPERATURE AND NEURONS IN DUAL ROLE

In the previous part it was pointed out that most of biochemical processes are connected with thermoregulation (energy) in the somatic or brain cells. Neural activity sensitizes to small variations in the temperature (84). There are differently directed changes in metabolic activity in the neurons of the anterior hypothalamus in hyperthermia, hypothermia and fever (85). The cortical temperature has a strong influence on REM sleep propensity, which indicates the possibility of an optimum cortical temperature for recovery sleep after sleep deprivation (86). Neurons seem to be involved in both temperature regulation and sleep. There are two mechanisms in connection with the hypothalamus and the limbic system. One can promote the excited state and the other the sedative state. The emotional state is determined by afferent impulses, which can regulate the balance between these two mechanisms. This is similar to the systems of nutrition and thermoregulation.

The same can be said about brain structures and neurotransmitters, which are involved in the control of sleep, also include in the control of body and brain temperature. Since neurotransmitters take part in thermoregulation processes they are hardly units of information in the brain. It is probable that informational processes are connected to biophysical (biophoton or quantum) processes in the brain. Biophoton processes arise from molecular (thermoregulation) processes in a co-operative way, and they influence each other. The homeothermic regulation is in connection with awakeness, but poikilothermic regulation can be mixed features between waking and SWS. In homeothermic organisms the well-regulated thermoregulation, restricted cell division and the structured cells of the cortex allowed a strong, synchronized electrical and biophoton mechanism, which can be a base of the implicit and explicit visual information system in the brain. Experiments of Kobayashi et al. support my theory (87). They proved by in vivo imaging that spontaneous ultra weak biophoton emission from a rat's brain correlated with cerebral energy metabolism (thermoregulation), EEG activity and oxidative stress. So, we can come to the conclusion: temperature, neurotransmitters, metabolism, oxidation, molecular processes and biophoton emission are in functional connection in the brain. Here I suggest that in evolution explicit memory could arise from dreams, which is due to the strong, synchronized electrical (gamma oscillation at electrical level) and coherent biophoton information processes in the brain.

However, as it was pointed out in the introduction, it is not possible to perceive visible pictures without visible EMW/biophotons during dreams. Dreams are not dependent on the presence of contemporaneous visual-perceptual experience. So, there must exist an informational system of biophotons in the

brain. It is known that the brain temperature, which stays fairly constant in NREM sleep, increases significantly during REM. In REM some regions of the brain reach the temperature of waking level, which allows a similar performance of the brain as during wakefulness, but REM is unconscious-like. Dream pictures make a connection possible between the explicit and implicit memory systems in the brain, which allows us to remember our unprocessed emotional information. But visible or invisible dreams are metaphor-like, because dreams are nonlinear holographic informational processes, and several visible/invisible pictures are assembled together. However, this process meets some thoughts of Freud. The possible origin of dream emotionality is REM-associated limbic activation, because all input information, which goes into the brain also goes trough the limbic system.

BRAIN TEMPERATURE, NEURONAL ACTIVITY, EEG AND BIOPHOTONS: MOLECULAR AND BIOPHYSICAL ASPECTS

Several experiments pointed out that the molecular mechanism of sleep-wake/EEG cycle is connected to changes in body temperature (59,76,88). Alternation of synchronization processes of EEG and the shift of EEG frequencies not only due to changes in body temperature, but also change of brain temperature (75). It seems that during sleep-wake cycle body and brain temperatures modulate each other simultaneously and quasi-independently. So, brain thermoregulation works quasi-independently from body thermoregulation.
In the following section a simple model is described how biophotons are generated from the above mentioned molecular processes and connected to temperature and EGG processes. Biological molecules bear extraordinary dielectric properties (89). Changes of dielectric constant, conductivity, ion mobility, molecular conformations, etc. are due to the change of temperature (90). Neurotransmitters modulate ion currents and induce many different molecularly processes and conformational changes. According to laws of physics these nonlinear processes always generate weak EMW/biophoton. Generated biophoton signals are dependent on the change of temperature, because molecular reactions, from which biophotons are generated, also have temperature dependence. For example, the motor protein kinesin, a molecular motor working in association with microtubules, has essential dependence on temperature (91). Emitted biophotons excite the transition state complex of molecules and finally return to equilibrium states of the surroundings. The electric signals of neurons, which carry information through frequency and amplitude fluctuations, are converted to biophoton signals and vice versa. But weak biophotons can be absorbed in a short-range in the cells, these also take part in long-range information processes. All cells contain an interconnected cytoskeleton system, across the cell surface, with the extracellular connective tissue matrix. So, molecular configuration waves can propagate along microtubules (92). Biophotons, as optical signals, can be stored by surface acoustic waves of biomolecules (acousto-optic signal processing) and can be reassembled into light after very long delay times and at a remote locations of the sample (93). These waves are called as conformons, which are mechanical vibrations of biomolecules like phonons in a solid crystal (94). Propagation of conformational changes can mediate long-range interaction and signal amplifying in the network of the cells. This informational process is more rapid than an electric one. In summary: electromechanical, electrochemical or electrooptical (biophoton) resonant transfer can regulate the signal-amplifying processes in the brain. One manifestation of these complex processes at electric level is the

synchronization-desynchronization processes of temperature dependence of EEG signals.

During the above mentioned processes generated biophotons provide development of visible and invisible (not conscious) holograph-like pictures of dreams in the brain. During wakefulness biophoton informational processes also work, but are switched over to an another working mode in the brain, which allows us to take information of the surroundings. Dreams of born blind people can also work by invisible pictures, which are not concrete but metaphor-like (95). They perceive information on the surroundings by touch, sounds, tastes and smells, which information are transmitted to electric, and then to biophotons signals in the brain, but this information is invisible and metaphor-like in their brain.

DREAMS IN THE FOREBRAIN

In the base of brainstem mechanisms, Hobson suggested the activation-synthesis model (96). Dreams are actively generated by the brainstem and passively synthesized by the forebrain. This model was revised as Activation-Input-Mode, where REM and NREM dreams are attributed to reciprocal interactions between aminergic and cholinergic brainstem neurons (97). Later, these models have been questioned, because beyond the originally proposed cholinergic and aminergic neuronal populations some additional neurotransmitter systems can participate in the control of REM sleep (98). Solms raised that REM and dreaming are controlled by different brain mechanisms (99). The REM state is a cholinergic mechanism that is motivationally neutral, but the dream states are of dopaminergic mechanisms. L-dopa causes an increase in the frequency and intensity of dreaming without any effect on the frequency or intensity of REM sleep. Solms also pointed out that dream imagery is not generated by chaotic activation of the forebrain, but rather by a specific forebrain mechanisms with dreams and complex cognitive processes. A REM dream is a cognitive-like process that is supported by phenomena (100). If during REM we use those stimuli, which were conditioned previously during wakefulness, it can increase remembrance. This method is called cuing (101). If during REM a classical conditioned answer is generated, it can be developed after sleep (104). We can see our dreams from first-person perspective, which is a feature of consciousness. Lucid dreams also exist, mainly during REM dreams (105). Dreams are not random processes, because they bear a high rate of narrative.

Implicit informational processes seem to work continuously in mammalian brains, but the development of explicit memory is due to the strong and coherent electric and biophoton information. Finally, the appearance of self-consciousness in humans is due to the very well structured neocortex and the language.

Dream is an energetic process at molecular and thermoregulation levels, but also an information process at coherent electromagnetic (biophoton) and submolecular levels in a co-operation way. REM dreams are especially important, because they allow a connection between the explicit and implicit informational systems of the brain. However, we remember our dreams if information of dream pictures can go into our consciousness. It can occur mainly, if harmfully associated information persist (strong emotions are linked to implicit information in the brain). According to Crick and Mitchison, there is an active process of reverse learning, where associations are weakened, rather than strengthened, by their occurrence in the dream (104). In depression states there is persistence of harmful associations. In schizophrenia the structure of the brain is disintegrated, so dream pictures break into the waking consciousness, which is similar to madness (105). Antidepressant drugs

decrease or eliminate REM, nevertheless, the patient can recover, but long time REM deprivation has harmful effect (106). In addition, antidepressants also can increase REM sleep (107). It is not a contradiction, because drugs can change thermoregulation of the brain then disturbed biophoton processes are not strong enough, so dream pictures, which are generated by biophotons, cannot break into consciousness and we cannot remember consciously our dream pictures. Drugs can inhibit the replay of associative visible pictures in the forebrain. But dreams, as informational processes, work continuously in spite of we cannot remember them or there is a lack of paradoxical eye movement during sleep.

SUBMOLCULAR INFORMATION STORAGE

Jouvet suggested that during sleep there is an iteration process at DNA level, which maintains and programs the hereditary behavior (108). In my model, during sleep, holographic, fixed explicit information of surroundings is transferred from biocrystals and quasi-liquid-crystal system of the cells' matrix to submolecular and subatom levels in an iteration way by biophotons (20). Hereditary iteration processes can work simultaneously with consciously and unconsciously fixed information of the brain by biophoton, because of the nonlinear optical law of (bio)photon waves allows it. Many scientists suggest that information content of our entire life can be stored at sub-molecular or sub-atom levels in the brain, because information capacity of DNA triplet code or neural network cannot realize it. It can be a basis of long-term memory when short-term memory (information of biocrystals and cells' matrix) is transferred to sub-molecular DNA and sub-atom levels. Then unnecessary biocrystals are solved or biophoton processes cancel information content of biocrystals and quasi-crystal-matrix of the brain cells. If unnecessary biocrystals are unsolved (at low hydration level in the brain) in the different brain's cells, it can cause disorganized thinking. For example, calcification of the pineal gland can be related to disorganized thinking in schizophrenia (109,110)! Cells' matrix can also be a system of short-term information storage, because the living matrix is like a liquid crystal, which is similar to electrooptical and holographic applications of liquid crystals in nanotechnology (111,112). Pribram postulated a neural hologram made by the interaction of waves in the cortex, which in turn is based on a hologram of much shorter wavelengths formed by the wave interactions on the sub-atomic level (113). Different types of holography (laser holography, X-ray holography, electron holography, etc.) bear a common feature. Information content of different types of holography can be copied from one into the other. However, consciousness might be a result of neuro-quantum interactions, interactions of classical and quantum or sub-quantum world. In 1999, a quantum process has been demonstrated to take place in certain bacterial enzymes that allowed a particle to pass through a barrier even if it had insufficient activation energy (114). In 2003 Biro et al. reported that butterflies' larvae contained natural quantum photonic crystals, which had a dramatic impact on the thermal management of the butterfly (115). As seen, living cells are quantum “devices” rather than simple molecularly, mechanical machines. Quantum and nanotechnology seem to help us to understand the living world, but classical neurology must incorporate biophysics and quantum physics of the living brain.

SHORT SUMMARY

We have seen a new explanation of the development of homeotherm state by holograph-like model, in which the exact

thermoregulation, REM state, restricted cell division and the structured cortex are involved. Antidepressants, neuroleptics, street drugs and several molecularly processes have important effect on thermoregulation and biophoton (holographic) information processes simultaneously. We can remember consciously our dreams, so dreams must work in the same areas of the brain where the consciousness and cognitive processes also work, namely in the fore brain. Since the brain can use dynamical pictures by the help of biophotons, the hypnotic state allows a direct connection with implicit information of the brain, which works by pictures. So, hypnosis is a very effective therapy for different mental and behavioral syndromes, etc., but unfortunately it is hardly utilized. Finally, although the presented model is not claimed to solve the secret of consciousness, yet biophotons may play a fundamental role in informational processes in the brain. Should the brain not use pictures during thinking, how could a painter-artist make a picture from memory.

FOOTNOTE

*In holography there is an interference between the light reflected and scattered by the object, called the object (signal) beam, and a reference beam is created and recorded on a photographic emulsion. Fixed pictures of objects in photographic emulsion can be developed by the help of a reference beam as a 3D picture. If a hologram breaks into pieces, each piece can reproduce the entire image. Holography has an ability to store one record on top of another and to be independently recalled by an associative memory. It has distributed memory and parallel computation. There are two main types of holograms as phase and amplitude modulated. The phase type hologram produces phase changes in the reconstruction beam due to a variation in the refractive index or thickness of the medium. Phase holograms have the advantage over amplitude holograms of no energy dissipation within the hologram medium and a higher diffraction efficiency. Recently, there are many other types of holography from optical, electron, X-ray to atom holography and new procedures have been investigated, which can work by low coherent (the coherent light has the same wavelength and the phase light) and incoherent waves as well. According to Denes Gabor, the holographic analogy of the human brain can be only functional, not structural. He raised the idea that the living brain might work as diffuse-like holography, since these bear a turbidmedia, and diffuse holograms have distributed memory similarly to the brain. If we use autocorrelational light waves in holography (for example, sphere waves coming from a single point), object beam and reference beam can be the same wave. The living cells are quasi-liquid crystals, and liquid crystals are among most available substances for dynamical holography in nanotechnology.

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