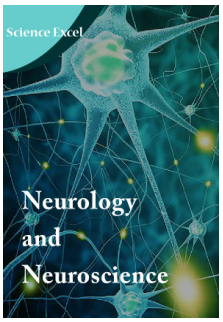
Neurology & Neuroscience

Opinion Article



Consciousness and Sleep: Quality Assurance of Rest

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Abstract

Consciousness never sleeps. During sleep consciousness is engaged in quality assurance of rest for the system psyche, nervous system, and other systems of the body through a mammoth of silent activities. Neural correlates of sleep are important but not sufficient to understand sleep. The article discusses several models of the psyche participating in the mechanism of sleep. The models also offer clues how psychic mechanisms could interact with neural mechanisms. Two psycho-maneuvering techniques have been described that help many to have quality sleep.

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- Received Date: 03 June 2025
- Accepted Date: 09 June 2025
- Publication Date: 12 June 2025

Keywords

Psyche and Sleep, Mechanism of Sleep, Mind and Sleep, Consciousness never sleeps, System Psyche, Activities during Rest

Neural Correlates of Sleep

This is an exciting phase of neuroscience of consciousness because the mainstream consciousness-researchers are moving their focus to and fro from the cerebral cortex [1] to thalamus [2-4] to brainstem [5,6] to explain the phenomenon of awakening, find out the content-source of awareness and investigate the mechanism of perception within the brain. Many researchers are plunging into dreamless sleep to look for the missing consciousness through the absence of neural activities [7]. What are the outcomes? Brainstem reticular system through its projection to the cerebral cortex initiates awakening. Clearance from thalamus gating makes us aware of the initial contents of consciousness. Posterior cortex is mainly involved (Whyte et al). Clearance of gating from the intralaminar and medial nuclei of thalamus and the thalamic loop to anterior frontal cortex is the cause of high order perception (Fang et al). Hydranencephaly patients who have little cortex but have typically preserved brainstem and a major portion of thalamus, may exhibit very basic forms of awareness but nil high order perception. Several unconscious patients who may be awake without awareness, are said to be in vegetative state, are found to have thalamic lesions and reticular system injury. Traumatic injury to the brainstem, which have all spinal incoming somatosensory, proprioceptive, and visceroceptive fibers joining the brainstem reticular system, leads to coma. The brainstem, in addition, holds all important cardiac centers, vasomotor centers and respiratory centers making the injured patient vulnerable to cardio-respiratory failure. With such incoming evidence, neural correlates of sleep, awakening and awareness are becoming clearer, without any hints whatsoever towards the source of consciousness within the brain, or its operational mechanism during sleep, or the consciousness-brain relationship during sleep. At this stage of science this paper looks at the system psyche.

Embracing Psychology

How such neuro-centric consciousness research like above could join hands with consciousness-centric investigation of neuroscience? Who is awake? Who becomes aware? Who perceives, and experiences? Consciousness and sleep research cannot avoid such questions with an ontological shift! Joining hands of two prong approaches and addressing such ontological questions is a necessity. The first step towards such a shift is accepting the psychological fundamentals! As perception cannot alter the fundamentals of different information states related to sensation, perception, concept formation and experience, similarly the experience cannot alter these psychological fundamentals. And, these fundamentals are the five faculty members of the cognitive orchestra, or the system psyche. Namely, those are operative consciousness, self, intangible parts of life, mind and information [8,9,10]. They are nonlocal, non-observable but very fundamentally influential in consciousness research [11]. We wish to bring more clarity in the area by answering four questions regarding their behavior. (i) How do we identify the psychic faculties by behavior? (ii) Is there any model of their phase position in nested nature and what, if any, is their hierarchical administrative activities in the complete organogram? (iii) How do we connect neurological phenomena such as sensation, perception, concept formation and experience with cognitive faculty and different information states? (iv) What is the Top-down chain of commands from consciousness to a signal for the 4-D world? .

Citation: Mukhopadhyay AK. Consciousness and Sleep:Quality assurance of Rest. Neurol Neurosci. 2025;6(4):020.

Identification of the cognitive faculty by behavior

Consciousness is identified by its ability to make a "will"/"won't". Consciousness could be a non-discrete (e.g., John Huglings Jackson, Daniel Dennett etc.) phenomenon as well as a discrete (e.g., Francis Crick, Gerald Edelman, Antonio Damasio etc.) phenomenon. Author subscribes that the will-making property belongs to this non-discrete or ground consciousness which has no background. Discrete consciousness is a system-confined consciousness, such as universal consciousness, brain-confined consciousness, cellular consciousness etc. The 'unity' property of consciousness is in its non-discrete ground part, whereas two other properties like 'subjectivity' and 'intentionality' are expressed in consciousness's operational part. Whereas the ability of consciousness to make a 'will' or 'won't', belongs to its ground part, cognition and feeling are properties of its operational part. The feeling is expressed as an emotional behavior in the 4-D world.

'Self', which is identical with consciousness in substance, is the CEO appointed for a discrete conscious system. It is identified by its ability/inability to implement the "will"/"won't" of consciousness within the system with understandable logic.

Intangible parts of 'life' within the psyche is identified by its homeostatic (the term Walter Canon used for a property of any live-system) property. At the psyche level, homeostasis is also subtle; uncertainty-certainty homeostasis, symmetry breaking-symmetry making homeostasis, and homeostasis of tangible and intangible energy [12]. Intangible parts of 'life' in the psyche are also responsible to build up the logistics for implementation of the "will" of consciousness. The 'life' is also responsible for the production of qualia, memory, and helps consciousness to generate feeling. Feeling is conveyed to the mind to generate emotional expression in the 4-D world of the brain. Feeling is the conscious experiential counterpart of emotional reactions which are mostly unconscious. In the absence of 'life', no memory and no qualia is formed! It is understood now why the AI built up on the basis of ANN technology, which has no 'life' has no memory, qualia and feeling.

From unity, following creation of duality, the boundary between the two systems matures as the faculty of "mind". The mind is the organ of communication between two conscious systems. The mind makes the boundary for duality that remains till its final dissolution into unity, in nonduality. It is this mind which converts a signal into a piece of information. No machine in this world can do it. It is the mind which takes us from the signal world to the world of information and vice versa. However, in this transformation, there is involvement of nature at ZPE state/fluctuation. Since the mind divides consciousness into two, the mind also cannot be localized. It is everywhere in the brain in between communicating cells, or in between their communicating organelles, and may also be in between two conscious biophotons.

No information is an island. Information is everywhere, every time. Information connects (Figure 1) the nonlocal world of consciousness, self, life and mind of the individual with the local world of space, time, matter, and energy. This is possible because of its having a specific geometric structure of a trifoliate leaf [13].

The proposed model of the Psyche: Phase position in nested nature and Administrative hierarchy

The phase positions of the psychic faculty in nested nature are shown in the figure 2.

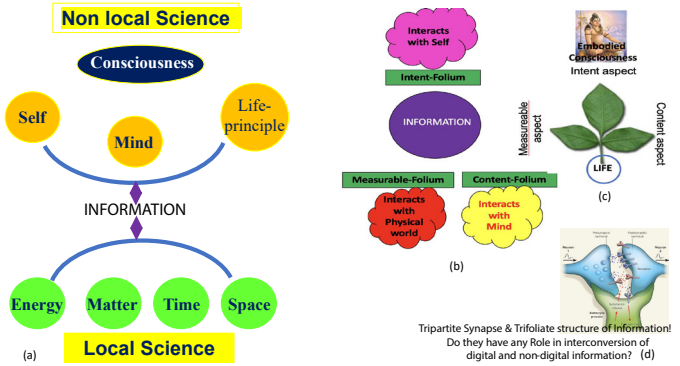

Figure 1: *a) Information connects the local science of space time, matter and energy with nonlocal science of consciousness, self, life and mind. b) Information is like a trifoliate leaf, having a measurable-folium that interacts with the physical world, a content-folium that interacts with mind, and an intent-folium that interacts with self. c) The petiole of the leaf is immersed in life. The intent-folium is towards consciousness (Lord Shiva is considered the embodiment of consciousness). d) The question is raised, whether the tripartite synapse in the cerebral cortex have anything to do with trifoliate structure of information in conversion of digitized information to non-digitized information.*

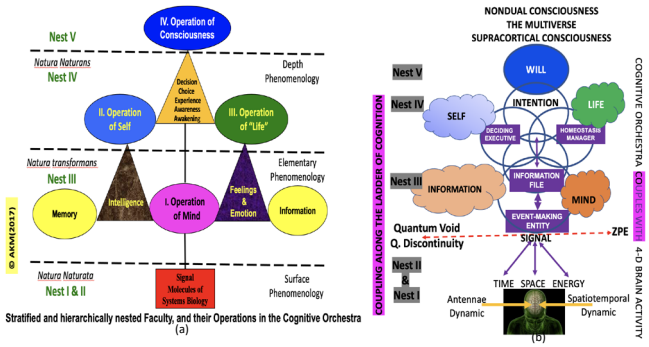

Figure 2: *(a) On the left side, the nature-consciousness spectrum is shown to have five nests where consciousness's residence is deep in nest V. Self and Life operate from the nest IV (natura naturans), and the mind from the Nest III (natura transformans), whereas the signal world is the domain of classical (nest I) and quantum physics (nest II) (natura naturata). Information, memory, intelligence, feeling/emotion originate in the nest III. Operations of the self and the mind working with memory creates intelligence whereas operations of 'life' and mind along with information create feeling. Phenomenology has its strategic depths; surface phenomenology in the nests II and I, elementary phenomenology in the nest III, and depth phenomenology in the nest IV of nature. (b) On the right side of the figure are shown the members of the cognitive orchestra interloping their operations with each other spread over the respective nests of nature. We know even in the nervous system the control from the higher levels occurs by more and more complex neural loops. In this cognitive orchestra, consciousness is the will-making entity. Self is the chief system executive to implement the decision. Life is the homeostatic manager, and the mind is the event-making entity. At the lower part of the figure is shown how for the inter-phasing of extracerebral and cerebral consciousness, the cortical Antennae dynamics and Spatiotemporal dynamics could play the role at the top of the cerebrum. .*

The administrative model of the Psychic system

The mind is the final common contact of the psyche with the 4-D world through ZPE state/fluctuations. The mind reports to 'self'. The self and 'life' maintain a tangled hierarchy between them, and independently report to operative consciousness. At the cellular level, a similar hierarchical relationship is proposed between neurons and astrocytes [14]. The operative consciousness manages the whole system.

The gross and intangible parts of life have intrinsic contact communication between them. The petiole of trifoliate information is connected with the 'life'. Similar intrinsic communication exists between the mind and consciousness. Infidel character of the mind is because of its contact with the 4-D signal world. Fertility of the mind is because of its contact with consciousness. Without consciousness, the mind is sterile..

Neurological phenomena are connected with their Psychological counterparts through Information States

Figure 3 below explains the complete process of cognition, different information-states involved, and the four operations of the mind, the self, the life and consciousness consecutively.

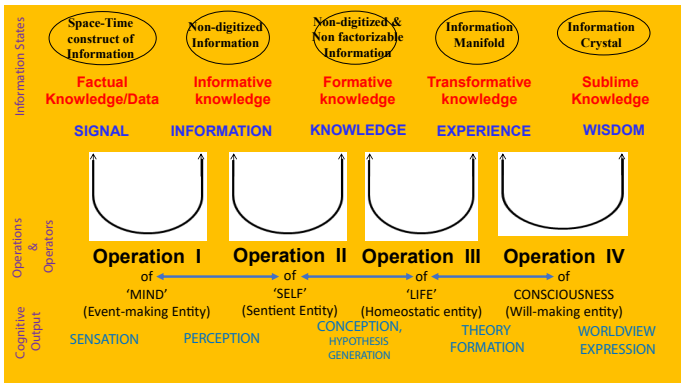

Figure 3: *Begin your observation with the central horizontal axis of the figure, with the words in blue in capital letters. On the left side, it begins with the signal, followed by Information, Knowledge, Experience, and at the extreme right side ends with Wisdom. In terms of knowledge, these milestones have been represented respectively by data/factual knowledge, informative knowledge, formative knowledge, transformative knowledge, and sublime knowledge. On the topmost line, the figure describes the same milestones in the language of information-science, starting with space-time construct of information, followed by non-digitized information, non-factorizable information (where three folia of information, namely content, intent and the ability to reduce uncertainty, could not be separately identified, and several related information are in a combinatorial symmetry), information manifold, and information crystal. In the combined perspective of Neuroscience and Informatics, signals lead to sensation, information to perception, knowledge to concept formation and hypothesis generation, and experience to theory, and wisdom to Worldview formation. Stretched over the five landmarks/ milestones, there are four operations expressed numerically from the left to right, as Operations I, II, III, and IV conducted by the non-observable but influential operators. In popular language of the formative world, Operator I of the natural world is known as 'Mind', Operator II of the natural world has been mystically labelled as 'Self' in the formal world, Operator III of the natural world is called 'Life' in the formal world, and the Operator IV in both scientific and spiritual terms of natural and formal worlds are labelled as Consciousness. .*

Top-down chain of commands from conscious will to signals for the 4-D world

Figure 4 below shows the structural framework and the organogram of how the 'will' is translated into a signal.

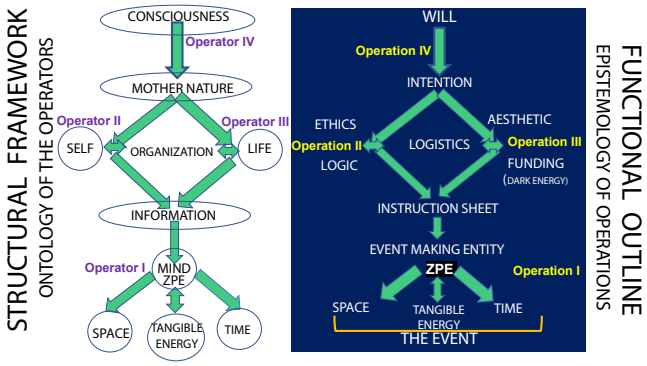

Figure 4. *The left side of the figure describes the structural framework of the ontological operators with their phase position. The right side shows the organogram; the operations from the 'will' to the event. Consciousness does not operate with any known force, field or visible energy. Consciousness operates with only 'will', that originates from the ground consciousness and is converted into intention by its operative facet (also called Mother Nature). Self's operation examines the logic and ethical part of the intention while the 'life'-operations take care of the aesthetic parts of its execution along with the logistics of energy-homeostasis. Instruction sheet, thus formed, is handed over to the event-making entity, the 'mind', for occurrence of events in the 4-D world. The result is creation of new space, new time, and new tangible energy within the neural substrate of cognition. This last operation happens across ZPE state/fluctuation in the natural world. For behavioral expression the new signal captures the neural network and Wi-fi, operative in the ZPE state/fluctuation of the brain.*

Sleep Research in the Context of Consciousness Study

Sleep is not a planetary, stellar, galactic, universal or multiversal phenomenon, each one of them, although, influences sleep. Sleep is a consciousness-phenomenon. Here, we are discussing human sleep. The planets are observable from the satellite, the stars from the spaceflights, the galaxies through long distance telescopes. The universe and the multiverse are our cortical intellectual constructs. A system cannot sleep keeping its observables online and constructions alive!

Consciousness never disappears nor remains inactive in any stage of sleep of human beings. Ground consciousness, operative consciousness, the self, and the intangible parts of life never sleep. The great four are awake forever. Neural correlates of various stages of sleep are known. Some functions of sleep are understandable but require proper scientific articulation. The role of cognitive faculty in the whole process of sleep is little known. We will go step by step.

Sleep Cycle and its Neural waves

Sleep happens in a cycle of 90 minutes duration repeated 3-5 times in the night. For every cycle, stage I ushers the gradual slowing of high frequency waves in EEG. Stage II is characterized by the appearance of sleep spindles (7-15 Hz oscillations over a period of 1-2 seconds) and K complex (detected in EEG record by LS-SVM classifier). Stage III is characterized by gradual appearance of delta-waves with increasing numbers. Sleep

enters stage IV when the delta waves cross the 50% threshold. This takes about 30 minutes. Next 30 minutes are for staying in stage IV. This is NREM sleep. Following a total one hour, there is a backtrack towards early stages, not meant for waking up but for a sudden switch over to Stage V sleep characterized by rapid eye movements due to activities through the Ponto-Geniculate-Occipital (PGO) pathway. REM sleep begins and continues for the next 30 minutes. The first cycle is completed, and there is a back and forth movement with repetition of the five stages of the cycle 3-5 times in the night. When REM is on, the brainstem cholinergic fibers activate the forebrain. For REM-off, serotonergic, noradrenergic and histaminergic (from hypothalamus) fibers discharge into the cerebral cortex. During the early hours of sleep, NREM dominates the cycles. During the early hours of morning, or wake up time, REM sleep dominates. Generally, REM sleep occupies about 25% of total sleep hours [15].

Functions of Sleep

Consciousness as a ground does not remain confined to our brain. It extends extra-cerebrally over planetary, stellar, galactic, universal and the multiversal consciousness [16]. The aim of sleep is periodic calibration of a conscious system in tune with the universal or multiversal consciousness with the following objectives.

The objective of sleep is periodic facilitation of an effortless communication between system-bound and system-independent consciousness to refresh the conscious system for a better awakening, awareness, perception and experience, and their memories. What assured are quality rest, quality calibrations of the organogram of the system psyche, and of cellular neural assemblies regarding their wi-fi, electromagnetic and other forms of connectivity. The objective percolates down the nervous system to the other systems of the body namely endocrine, visceral, somatosensory, and musculoskeletal systems for an overall quality integration of all systems of the body.

Two horizontally confronting and equally strong questions, why do we sleep and why do we wake up, are simultaneously answered from the top in the articulated aim and objectives of sleep.

When we sleep, the intangible parts of life are engaged in homeostasis within the psyche and the tangible life-processes are engaged in homeostasis of the gross body. Should this quality assurance of sleep by operative consciousness not go well, the quantity of sleep cannot compensate for it. This has given rise to phenomena like the Scandinavian pattern of sleep, and sleep-divorce of the married couple. When the quality of sleep falls, three subtle management of homeostasis fail giving rise to three most common psychiatric disorders namely anxiety (failure of uncertainty-certainty homeostasis), stress (failure of asymmetry-symmetry homeostasis) and depression (failure of intangible and tangible energy homeostasis). Major depression due to lack of quality sleep may precipitate suicidal event. Besides, sleep has a direct effect on the immune cells of the body, and on the epigenetic activities mediated by consciousness-sourced subtle energy which is supposed to operate during sleep.

Another purpose of sleep is to keep the brain cells and other cells of the body systems active with their ultradian rhythms in the absence of external stimuli.

Activities during sleep at the cellular level:

When we sleep and the neurons are not receiving any external signals, the astrocytes are awake and do the housekeeping, and fill the neurons with ATPs and other glial transmitters, repair the tripartite synapses, and help in plasticity [17]. Modulating the blood brain barrier by their foot processes, astrocytes help in glymphatic clearance helped by other active factors [18]. There is evidence of driving away tau and amyloid-beta through glymphatics during sleep. The great brain clearance and dementia debate between Maiken Nedergaard and Nick Franck has been recently highlighted [19]. Restoration of optimal cortical network [20] and intrinsic hippocampal reactivation for memory consolidation [21] have also been reported.

Sleep is for psychic, neural, and the whole body homeostasis. In lack of quality sleep weight gain, increased tendency of developing type II diabetes have also been reported [22].

Mechanism of Sleep. The role of Psychic Faculty

Non-stop activities go on during sleep

1. Activities during Falling asleep

What are the signals for falling asleep? The period of sleep deficit (time gap from awakening from the last sleep), and the cue from the intrinsic circadian rhythms of the body as a whole along with reduction of high frequency alertness waves in the cerebral cortex are signals for falling asleep.

On the basis of information in the mind received from proprioception, visceroception or physical sensory signals in the tune that the 'manifestation machine', the organ brain, requires rest, or on the basis of consciousness's own 'will' to shut down the machine for a while, consciousness's permissive 'will' for sleep is converted into 'intention' to sleep by operative consciousness. Following scrutiny of this intention by the system's CEO, the 'self', and the intangible parts of 'life' the said intent is handed over to the mind for its implementation. The mind dissociates its operations completely from neural operations. The sleep changes begin to be observed in EEG ranging from stage I to stage IV over approximately half of an hour.

The problem in Falling asleep and how psychological maneuverings can solve it?

Restless mind precipitates sleepless nights. The remedy lies in appropriate use of our psychic faculties. When the mind is restless let us use our intelligence to quieten it, and then use this property of mind for a better purpose.

Mind's load is organized in four stacks. Information is from the external world. Thoughts are the mind's own creation as a product of informational memory without or with emotional content. Imagined products are acquired from interstellar space (e.g., looking at the stars followed by leading imagination to become like them). The strength of the latent intentions is because of the mind's territory in the intergalactic space.

Information load is minimum when the mind is cut off from the external world. Using our intelligence, let us now take an intelligible space voyage. Mind creates the boundary problem. Let us willfully push this boundary as much as we can. We can throw the thought-piles of mind out into interplanetary space, imagined inventory into the bay of interstellar space joining the intergalactic space, and the intents inside the chest of the mind into the deep intergalactic space. The 'self' also unloads much of its burden of episodic memory and many of its impressions of karma during this voyage. At the end the 'self' is free to enter the inter-universal space breaking the last boundary of the mind at the edge of the universe. Duality melts into unity, nonduality in the inter-universal space, in the *Essence* of the Multiversity.

By this method, our self reaches the Multiversal consciousness, which is unconditional, contentless and pure consciousness that accommodates multiple operating systems of the individual universe with ease, without malice, encouraging pluralism without compromise on individualism. Back to the universe and our psyche, let us use the property of restlessness of the mind in its new weightless state, to our benefit. The method I am describing is from our Akhanda spiritual tradition established in India (by the author's spiritual Master) about one hundred years back and is practiced by millions of His followers. Engage this freshened mind, carrying the sense of the *Essence* of the system Multiversity, in roaming our body from the perineum to the cranium several times following a particular order; let the mind, whose natural tendency in bed is towards perineum, ascend from the perineum to the cranium via the left lower limb, the spine, and the left upper limb. Rotate the mind clockwise (anticlockwise for the women) a few times over the cranium. Next, let the mind descend to the perineum via the right upper limb, the spine and the right lower limb. Let this roaming of mind continue till it gets tired, or you fall asleep. Sure, you will have a satisfying sleep.

2. Activities during Dreamless sleep:

A lot of activities go on during the dreamless phase of both NREM and REM sleep. About 50% of NREM sleep and 5-20% of REM sleep is dreamless. The brain is at a state equivalent to physical zero-point energy-state or fluctuations (ZPE) [23]. There are supposed to be information exchange and intent-exchange between the psyche bound to the brain and the brain-independent consciousness occupying the voids across the stars, the galaxies and the universe overarched by the multiverse. We do not have any method or device to objectively detect such an exchange at this stage. At the time when the brain and mind sleep, silent intra-system or extra-system communication between the ever-awake great four takes place of which we know nothing. *Mandukya Upanishad*, most likely, describes this silent communication as '*yoganidra*', a pathway to experience and understand the Turiya state of consciousness, the unconditional nondual consciousness that could probably in science be described as the *Essence* of the Multiversity.

Neural activities during dreamless sleep

Dreamless sleep is an opportune moment for the brain for long term potentiation of synapses, neural regeneration, dendritic sprouting, and healing of injured neurons and glial cells.

3. Activities during Dream sleep:

About 80-95% of REM sleep and 50% of NREM sleep is occupied by dreams. During dream sleep the brain as a machine is grossly under rest but the mind continues to operate alone, dissociated from the brain. Dreams are in the mind. The mind dreams and the dreamful mind is restless. REM sleep-like patterns are observed (developing Pontine-Geniculate body-Occipital lobe connections) in the formative stage of the developing brain in fetus and REM sleep patterns with dream during developing mind in neonates and infants. Fetal memory of absent respiration should by chance be awakened in neonate, the neonate may stop respiration and this is one of the hypotheses of sudden infant death syndrome [24]. Dreams happen in both REM and NREM sleep. Major dreams happen during REM sleep. The REM-dreams are long, primarily visual or audiovisual, somewhat emotional, not connected to immediate events of life while the NREM dreams are short, less visual, more conceptual than emotional, and related to current life events (McCormic and Westbrook).

Dreams have been said to consolidate memory probably by increasing the signal-to-noise ratio [25], enhancing salient emotional experiences and forgetting less relevant information [26]. Therefore, we dream to remember, we dream to forget. Dreams could be a rehearsal of handling threats. Dreams occasionally open a new door of discovery. We are aware of Friedrich August Kekulé getting hexagonal Benzene structure from a dream of a snake, and Otto Loewi getting in a dream the chemical transmitter, acetylcholine, in neuronal synapses. Niels Bohr, in a dream, envisaged electrons moving around the nucleus. It all means a dream can piece together several pieces of information in a meaningful or useless way. This remains a mystery. The mystery is also that most of the dreams are not remembered. The dreams happening near the awakening phase of sleep are only remembered. Memory cannot happen without involving 'life', intangibly. Interestingly this intangible part of life is actively involved during awakening.

Silent Neural activities during dream sleep

Silent neural activities such as memory consolidation at the synapses, synaptic plasticity etc. continue to happen in the brain.

Noisy Dream-effects on neural infrastructure

Mind has the habit of connecting with neural infrastructure through antennae dynamics (dendritic mat at the top layer of the cerebral cortex and non-synaptic spines at the apical dendrites of cerebral cortex) and spatiotemporal dynamics (Fig. 3b). As a result we get sleep terror while the patient is transitioning out of slow wave delta-sleep, obstructive sleep apnea and behavioral sleep disorders like sleep-walking, sleep paralysis etc. during REM sleep. Bad dreams are common during NREM sleep while nightmares are common in REM sleep.

4. Activities during Awakening from sleep

Once the sleep deficit starts waning out towards zero and the awakening drives start, may be from the cue of intrinsic circadian and ultradian rhythms of the body, awakening begins. There is supposed to be a clear message from the grosser 'life' to the intangible parts of 'life', on the completion of the body's rest. 'Life' awakens the system. If 'life' falls silent during sleep, the being encounters the death phenomenon during sleep. The message of 'life' for awakening, in turn, is sent to the self and also to the mind that begins acting on the vital respiratory, cardiac and vasomotor centres in the reticular system of the brainstem. Then, neurology takes over.

Neurologically, the awakening starts at the brainstem with a cholinergic reticular system spreading through the thalamus to the cerebral cortex. Noradrenergic and then serotonergic (chemoreceptors trigger zone) fibres join, added by histaminergic fibres from the hypothalamus.

The person yawns (unconscious brain stem activity), and becomes awake with brainstem activation. With clearance of message from the thalamus to the cerebral cortex, the awakened 'self' of the person rubs his eyes, sensitizes the sense organs and becomes aware of the surrounding environment. Following this supportive act, consciousness gradually takes over the role of participating, intervening, or creative consciousness from the phase of sensation to perception, concept formation and experience. Consciousness intervenes only to assert its choice, that may be creative by execution of the 'will' from the ground.

Concluding Remarks

Conceptually a new horizon has been opened up joining psychology and neurology with different information-states.

The organogram of the system psyche appears to be most fascinating, which could not be found in any other literature except of author's. Mind-problem has been considered as the boundary problem. Willfully pushing the envelope of the mind up until the multiverse and coming back to the psyche and the body is considered an excellent mind-maneuvering technique when, along with the mind the 'self' also loses its burden of episodic memory and many of its karmic impressions. The article has tried to address many of the questions on sleep like its purpose and mechanism, and the quality assurance of rest. However, this conceptual contribution requires several well-designed case study, and objective experimental verification.

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