

THE BIOLOGICAL ROLES OF HALLUCINOGENS: REM SLEEP

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ABSTRACT

In the first article, "The Biological Role of Endogenous Hallucinogens I", the LSD release of a traumatic birth memory in a 45 year-old man was followed by exact encores of the first experience appearing spontaneously over a period of a few weeks. The disappearance of these flashbacks revealed the possibility of a natural ongoing and autonomous mechanism for unburdening the individual from the chronic expenditure of energy associated with hidden traumatic memory. Here, the possibility that this mechanism might be that of the nightly REM sleep cycle is explored in terms of the role of REM dreaming and the relation between REM sleep and depression.

INTRODUCTION

The phenomenon of rapid eye movement (REM) sleep has fascinated psychologists since its first discovery fifty years ago and has stimulated lively speculations on its importance as a source of dreams. As one often guesses from observing the jerks and vocal sounds of sleeping cats and dogs, the REM state appears in several (or all) mammals, from which studies have shown that it originates at "REM-ON" and "REM-OFF" sites within the brainstem. The REM cycle usually begins after some periods of deep sleep and reappears two or three times a night for a cumulative time of 60 to 120 minutes. It produces EEG patterns similar to those of the awakened state and is accompanied by the inability to move (atonia). Another mechanism operates during REM to prevent dream recall, since REM's vivid dreams are remembered only if the subject is awakened during this cycle. Interrupting the REM period leads to irritated and agitated behavior the next day, but can relieve, though temporarily, chronic depression that accompanies sleep disturbances.

Recent publications represent considerable controversy on the role of REM sleep and on its relation to dreams. Some workers conclude that REM dreams can originate only from the forebrain and others claim that this nightly state has nothing to do with meaning or with memory consolidation. Here, another aspect is added to the fray, which introduces a special kind dream, different from other kinds, as it originates from a new definition trauma, whose storage and reactivation involves processes within the brainstem, and hippocampus, namely by the raphe 5-HT_{1a} receptor binding to its endogenous agonist, DMT or its congeners. There are two proposals: First, that the nightly onset of the REM state originates from the secretion of the endogenous hallucinogen to initiate the same spontaneous brainstem process for resolving trauma led to the occurrence and disappearance of flashbacks described in the previous report. Second, this REM-flashback proposal leads to the next hypothesis that chronic depression is the autonomic expression of subcortical attempts to complete the erasure of trauma memory that remains as a residue of interrupted trauma resolution by the same brainstem process. Depression can be a form of PTSD. The argument for this second hypothesis is derived from the partial success in alleviating depression by methods that increase “REM pressure” to produce REM rebound.

HYPOTHESIS ON THE BIOLOGICAL ROLE OF THE REM STATE

The first of two LSD experiences reported in the monograph, “The Biological Role of the Endogenous Hallucinogens I and in Part I of www.biosulime.com”, was dominated by the emergence of physical skull sensations found to be consolidated as trauma during the subjects birth. After the drug’s effect wore off, this recall continued on spontaneously for a few weeks in the form of flashbacks, exact encores of the first session’s recall. A mystifying character of these flashbacks is that a process, once begun, took on a life of its own, seemingly to complete the disappearance or erasure of the birth memory. This process continued spontaneously without any apparent input from the outside and its somatic effects diminished

little by little until their last traces were gone, never to return. The binding of a powerful hallucinogen to serotonergic (5-HT) receptors appears to be a requirement for triggering self-sustaining process that involves a much more complex chain of events broadly dispersed throughout the brain for dissolution of the memory. These facts suggest the existence of a natural, spontaneous process for healing traumatic memory, as if there were some intention within the organism to clear out the baggage of noxious memory, roughly analogous to the healing of a physical wound. Such a process within the central nervous system might be expected to follow a regular and continuing schedule and the main suspect would be REM sleep, a condition that occurs in all mammals and in humans is associated with vivid dreams. As the flesh-wound heals, so might episodic traumatic memory be erased during an extraordinary psychic state.

To begin, the hypothetical description of the REM state is as follows: The REM state begins with the 5-HT_{1a} mediated suppression of serotonergic (raphe) neurons in response to the nightly secretion of the endogenous hallucinogen (EH). This activates reticular nuclei to release stored (cerebellar) memory impulses for their ascendance into the cerebral cortex via the thalamus. This process may take place by the RaRN model previously described in concert with supporting noradrenalin action at the locus ceruleus and cholinergic and glutaminergic actions at various other brainstem sites (see table below), to release stored noxious impulses (trauma) into the cerebral cortical areas for conscious interpretation as physical sensation and dream imagery. Anatomical details of the RaRN mechanism are shown in Figures 9a,b and c for the particular case of trauma recall (McConnell, 2009; www.biosublime.com). Associated hippocampal memories are released by the same RaRN model involving suppression of 5-HT neurons of the dorsal and medial raphe nuclei. The resulting cerebral imagery creates a special kind of dream initiated by the release of the noxious components of the hidden traumatic memory. Accordingly, the hypothesis demands the additional assumption that dreams are not all alike: There are trauma

dreams (TDs) that arise from brainstem activity in the REM state and non-trauma dreams (NTDs) that could originate from both REM and non-REM states. NTDs can arise during the non-REM state, or perhaps even the REM state, but TDs arise only from the REM state.

Trauma, in this context, is defined as stored noxious impulses generated by a broad spectrum of viscerally associated incidents that occur during the opening of a sub-cortical memory substrate in response to the secretion of endogenous hallucinogens. Other similar or more intense insults not stored by this process would not qualify as trauma. Stored noxious impulses can take the form of any incident associated with pain of one kind or another. Examples could be in the form of stomach twinges or bradycardia during an incident associated with an urgent mental conflict or global physiological activation from a war injury.

The fact that the flashbacks often occurred after awakening from a night's sleep encourages the notion that they may have been initiated by the REM state. Since the REM sleep phase and its dreams often precede awakening, the possibility will be explored that REM sleep is initiated by activation of the reticular formation following (5-HT_{1a}) raphe suppression by EH. That the REM state might be hallucinogenic is supported by its attributes, which conform to the well-known earmarks of hallucinogenic states. The most obvious is a higher degree of alertness under the drug's influence resulting from reticular activation that is also seen in REM sleep, detected its similarity of EEG tracings to that of the awake state. This alertness involves contributions from the orexin system of the hypothalamus, which is subject to 5-HT_{1a}-ligand binding (Muraki et al, 2004). Muscle paralysis (REM atonia) is mediated by the caudal brainstem elements involving the 5-HT_{1a} of the medullar raphe nuclei (Hoffman et al, 2007; Brown et al, 2008). This inability to move is seen on occasion in human subjects with higher doses of some phenethylamine hallucinogens. REM saccadic eye movements aren't seen in hallucinogenic states, but also originate in the brainstem. Thus, while dream imagery certainly requires cerebral function, some

dreams are hypothesized here to originate from 5-HT_{1a} agonist action that, like the initial LSD recall and its flashbacks, opens memory substrates to send stored impulses to cortical areas for conscious interpretation, perhaps as dreams. These ascending impulses can originate from the opening of hippocampal memory substrates, as postulated in the foregoing publications on this LSD evidence (McConnell, 2008; www.biosublime.com). Conceivably, the REM state would resolve limbic as well as sub-cortical memory. The end-game of this process would be the complete neutralization of the memory as seen here in disappearing flashbacks, possibly by the destruction of synaptic junctions between associative fibers within a single, indispensable nucleus (Thompson, 2005). Thompson RF (2005) In Search of Memory Traces Annual Review of Psychology. Volume 56, Page 1-23, 2005

This conjecture of healing is not new: Carl Jung documented the gradual spontaneous disappearance of personal issues in sequential dreams long ago (Jung, 1943). Francine Shapiro and Margot Forrest among others have taken the trauma-REM connection into practice as a successful therapeutic tool (EMDR) to alleviate trauma and its stressful effects (Shapiro and Forrest, 1997). Here, the healing REM-flashback notion arrives from a different and independent direction. As a function of REM sleep, the spontaneous and weakening persistence of flashbacks (as dreams) monitors the progress of traumatic memory erasure. Intense trauma would take the altered form of repeated sequential dreaming. Testing of this REM-RaRN idea should be accessible with established neurobiological methods to provide the scientific support to answer criticisms of EMDR therapy and provide a sound basis for increasing its efficacy.

This launches a series of speculations based on M's flashbacks and the RaRN model. Are some dreams really a milder form of flashbacks and, by association, a release of traumatic memory? Clearly, some dreams are re-enactments of hidden memory, since some produce symbols that are accurately recognized as part of the dreamer's unique history within the play of otherwise distorted dream

imagery (Jung, 1943). In M's experience the disappearance and non-retrieval of these flashbacks with further LSD trials strongly implies the complete erasure of the memory. It would follow from these two observations that REM sleep might be a natural (hallucinogenic) state of the sleep cycle that heals by inducing reticular activation to erase the burden of traumatic memory. Since REM occurs in all known mammals, it would represent the natural biological process that evolved for conserving energy, the coin of natural selection, by eliminating the energy needed for the constant firing of raphe neurons that keeps the memory hidden. Energy would be conserved, as well, by obviating trauma's strenuous unconscious effects on behavior and on PTSD. The awakening of a subject during REM sleep results in more erratic, irritating, hypersexual behavior and decreased cognitive ability the next day, as if a process sorely needing completion has been interrupted. (Notably, this same kind of "hangover" resulted from the interruption of fetal activity in the adult on LSD (see "The Biological Role of Endogenous Hallucinogens, II" of this series and Part 2 of www.biosublime.com).

On the whole, the functions of the raphe activity appear to be inhibitory and protective to the organism's homeostasis by preventing sensory overload and untoward activation of specialized brain areas. The suppression of their 5-HT neurons provides a selective disinhibition of these specialized areas needed at a particular time. Three properties of REM dreaming associated with protection are: 1) Atonia during the REM state to avoid harm by violent movement, which testifies to the high intensity possible in REM dreams, 2) After dreaming, there is a mechanism that militates against recall of the dream that is consistent with the re-closing of the memory substrate as the raphe 5-HT neurons restore normal activity and 3) Recurring dreams of noxious events imply that, like the flashbacks, the release of traumatic material is metered in a sequential, stepwise manner each REM cycle to avoid the release of stored impulses too noxious to bear all at once. This stepwise activation of trauma as recurring (REM) dreams of a particular noxious insult would prevent the

reconsolidation of the total insult and provide for sequential erasure of the memory as seen in M's flashbacks.

In approaching the question of whether REM sleep might be involved in spontaneous healing, some of its voluminous and confusing history will be confronted, much of which is contrary to this notion.

Accordingly, three points will be referenced: 1) REM, though not the only sleep state for dreaming, is postulated to be associated with the kind of dreams that are related to trauma, 2) Earmarks of a REM traumatic dream are the diffuse presence of noxious body sensations arising from sub-cortical storage and the recognition of a specific symbol from the past of the dreamer and 3) REM dreams of the traumatic kind originate from the same brainstem condition of raphe inhibition by the bi-directional RaRN model introduced previously for opening and closing memory substrates.

The second point above has been discussed at some length under the section on Twilight Sleep birth (McConnell, 2009; www.biosublime.com) and in the description of Jung's dream progressions in the same web page, "Afterwords". Briefly, the popular clinical therapeutic description of PTSD as "psychological trauma" with its semantic implication of cerebral exclusivity tends to draw attention away from the importance of visceral and somatic pain stored sub-cortically. Yet, brainstem-generated memory may be the primary association for this therapeutic and empirical approach. The pristine physicality of the referred LSD memory recall is from a sub-cortical domain and likely represents a key stimulation for dreams of this kind. Perhaps a better name for "psychological trauma" would be "CNS trauma".

REM sleep or not, it is generally agreed that dreams do not include recapitulation of physical discomforts or intense emotional states that one would expect from released trauma; the actual re-living of sensory insults would be attenuated. Apparently, the associations

expressed in dreams are exclusive to or minimize visceral somatic sensations and form imagery mainly from cerebral cortical areas. Yet, their bizarre imagery serving as theatre set to distorted plots are much more than the mere recall of the incident as declarative or cognitive memory. Within this fantasyland certain objects and symbols appear that were players in the real incident leading to the memory and are recognizable by the dreamer soon after awakening (Jung, 1943). At this time, some visceral sensations will be felt as details of the real incident are remembered. It is generally known that “unpleasant” dreams occur when a person retires for the night with physical discomfort caused during the day by flu symptoms, bad food, etc. This physical discomfort is largely obscured in the dream, but returns after awakening. It’s not surprising that visceral sensations are involved in dreaming initiated by the release of noxious memory from brainstem memory substrates. These TDs are manifestations of accumulated hidden memories, whose consolidation and release require an endogenous agonist that binds to the 5-HT_{1a} receptors within the brainstem.

THE BRAINSTEM AND REM SLEEP.

Earlier studies on REM neurophysiology pointed to its origin in the rostral or pons area of the brainstem (Jouvet 1962, McCarley & Hobson 1975). As already mentioned, application of agonists and antagonists to the dorsal raphe 5-HT_{1a} receptor seems to be well established in initiating and stopping REM sleep (see below). The dorsal raphe nucleus is itself comprised of six to eight sub-nuclei and is the source of the great majority (ca. 90%) of serotonergic projections throughout the brain. Many attributes of REM sleep, e.g., decreased heart rate, blood pressure and body temperature are reproduced during non-REM sleep (NRM) with the application of raphe 5-HT_{1a} agonist and reversed by 1a antagonists (Brown et al, 2007; Hoffman et al, 2008). NREM + 1a agonist = REM. Other neurotransmitter systems within the brainstem affect REM sleep by

interacting with “REM-on” and REM-off neurons acting in reciprocal fashion. REM-on neurons are those that fire during REM sleep and REM-off neurons, e.g., the raphe 5-HT1a neurons, must remain inactive at the same time. The primary requirement for activating REM sleep is the cessation of firing of REM-OFF neurons (Pal and Mallick, 2007). The different locations of REM-on and REM-off neurons are shown in the table below:

Neurotransmitter	BRAINSTEM SITE	
	REM-ON	REM-OFF
5-HT1a Agonist	Medullar Raphe ??	Raphe dorsalis
GABA	Med-RN SLD* RPO, RPG	Vipag dPpMe Pons- Oralis
Noradrenaline		Locus ceruleus
Acetylcholine	Ld/pp/t	

TABLE LEGEND:

ovIPAG ventrolateral
periaqueductal gray (Sapin
et al, 2009)

dDpMe dorsal part of the
deep mesencephalic

reticular nucleus immediately ventral to vIPAG (Sapin et al, 2009)

Med-RN medullary reticular nuclei known to generate muscle atonia during REM (Hoffman et al, 2007; Brown et al, 2008)

SLD is non-GABA

Pons Oralis A reticular nucleus in the pons region of the brainstem (Ming-Chu et al, 1999).

RPO nucleus reticularis pontis oralis (Sanford, et al, 2003)

RPC nucleus reticularis pontis caudalis (Sanford, et al, 2003)

Ld/pp/t Laterodorsal/pedunculopontine tegmentum (Pal and Mallick 2007)

Locus ceruleus (Pal and Mallick 2007)

Comment on the table: The insertion of "Medllar raphe" as a REM-ON site was made by this author and is probably incorrect. It refers to the stopping of REM sleep in piglets with the application of the 5-HT1a agonist, 8-OH DPAT to the medullar raphe (Brown et al, 2008). This result is questionable, since it is contradictory to similar experiment of agonist action on this same medullar nucleus that produced muscular relaxation or atonia, a classic sign of REM sleep.

THE OPPOSITION: NERUOPHYSIOLOGY

- 1) Some studies have eliminated the raphe nuclei altogether as mediating the REM state on the basis of retrograde dye transfer to trace the origins of 5-HT neurons in the brainstem (Rodrigo-Argulo, 2000). These serotonergic fibers originate from a different source in a location other than the brainstem.
- 2) In possible consistency with the Rodrigo-Argulo results, attention is called to the fact that 5-HT1a receptors that do not originate from 5-HT neurons share space within raphe nuclei and are found elsewhere (Hoffman et al, 2007; Brown et al, 2008 see above table legend).
- 3) Shutting off 5-HT neurons in the medullar raphe of the piglets by the 5-HT1a agonist eliminates REM sleep. The specific binding of agonists and antagonists even in the presence of high 5-HT levels expected in the cooling stress for the animal would support this observation. However, this observation is questionable, as explained in Notes, 2002; Brown et al, 2008).

Thus, the opening of brainstem memory substrates by a powerful 5-HT1a receptor agonist is a fact, but the involvement of raphe nuclei per se is weakened by the discovery of this receptor elsewhere in the brainstem. The relevance of this question to the processes postulated here for initiating REM sleep is moot.

1.4.4.3 THE OPPOSITION: MEDICINE AND PSYCHOLOGY

The canons about REM sleep published in 2000 by Solms and those of Vertes and Eastman are found together as fully accessible texts in (<http://bbsontime.org/Preprints/OldArchives/bbs.htm>). These works provide valuable insights into the origins and functions of the REM state and dreaming, while rejecting the brainstem (the source of REM cycles) as a source of dreams (Solms) that have nothing to do with memory (Vertes and Eastman). These claims are placed into serious question rather neatly by parsing each from the perspective of REM state definitions presented here in the preceding text.

Solms:

Solms' argument that the basal forebrain in the cerebellum is not a passive actor as previously thought, but an active area for the generation of dreams may be an important piece in the puzzle for understanding of dreams, together with his finding of the parietal-occipital-temporal nexus as the area for dream interpretation. Just as Jouvett (Jouvett, 1962) rejects the forebrain in favor of the brainstem, Solms rejects the brainstem in favor of the forebrain as the source of dreams. The problem is the position that dreams, all being of the same kind, can't originate in one area if they originate in another. Both Jouvett and Solms are correct, but it depends on the kind of dream they are referring to. As hypothesized here, not all dreams are alike. The facts of M's recall and flashbacks establish the existence and modality of cerebral interpretation of impulses originating in the brainstem, even without the need to invoke the RaRN mechanism. Of course, the images within some sort of distorted plot of an original memory would all require exercise of the cortical areas in the cerebrum, but some dreams would carry associations that must originate from brainstem processes that specialize in the opening of memory substrates. These would be traumatic dreams (TDs), as opposed to non-traumatic dreams (NTDs), whose existence is not in

question. NTDs could be unrelated to brainstem or hippocampal storage opening and, as Solms postulates, may well originate in the basal forebrain and even occur during the REM state. However, only the REM state established by brainstem processes shown here can give rise to TDs, whose imagery, again, is manifested in the cerebral cortical areas. Without the suggestion presented here that TDs exist, the conflation of all dreams under the same rubric becomes the central mistake in rejecting the brainstem or basal forebrain as a source in all cases. The possibility of dreams, both originating and not originating in the brainstem, continues as a problem for the following reports.

Verdes and Marshall:

Verdes and Marshall (V&M) may be quite correct in cutting the connection between REM (or NREM) dreaming and memory consolidation, but the evaluation of memory consolidation used in the cited references is incomplete. The survival of learning ability and memory in humans belongs to the category of declarative memory, which is willfully accessed and (apparently) independent of the brainstem (Kandel et al, 2001). Declarative or cognitive memory retrieval exercises cerebral functions and is accessed voluntarily by recalling associations stored in cortical areas under the control of the hippocampus. The maintenance of this kind of learning ability after absorbing different sorts of brainstem injury or living in the absence of REM sleep, even in someone without brainstem function, is not too surprising, since this is only a question of declarative memory that may operate independently of brainstem processes. The brainstem consolidates a different kind of memory defined in this monograph as trauma. Unlike declarative memory, trauma recall is not accessible voluntarily or by any means used in those experiments cited by V&M. What is needed for access to this hidden memory is the subcortical opening of a memory substrate by the interaction between a brainstem 5-HT_{1a} receptor having a high affinity for an endogenous,

highly specific agonist. This process would be immune to tricyclic antidepressives or to SSRIs that only encourage moderate increases in 5-HT. Also, the use of SSRIs, as opposed to adding 5-HT, is done in recognition that the sites at issue are highly localized and less accessible to systemic factors. For this same reason, their citation of experiments showing that monoamine oxidase inhibitors (MAOIs) completely abolish REM sleep does not jibe with the kind of parameter measured, i.e., evidence that the subject is unaffected in (declarative) memory or learning.

V&W's reference to MAOI studies (Vogel et al, 1990; Wyatt et al, 1969 – See Thornton et al, 2004.) may be the most serious evidence questioning the REM-flashback mechanism proposed here for the nightly onset of the REM state and, indeed, the raphe mechanism itself. Unless this author is missing something, the prevention of MAO destruction of monoamine neurotransmitters by MAOI is contradictory to expectations. Referring to the table above, inhibition of MAO would produce an increase in the monoamines, catecholamine and the tertiary amine, acetylcholine that would drive, not inhibit REM sleep at each of the REM-ON and REM-OFF sites. This masterpiece of paradox would apply to the endogenous hallucinogens, DMT and its amine congeners as well, to induce a chronic REM or hallucinogenic state for months, since tolerance is not seen with these drugs (Section 1.9, "What is the endogenous hallucinogen"). Resolution of this koan by invoking the necessity for sequestering these REM-ON and REM-OFF activators away from access to a blood agent is a lame argument, since other blood components, e.g., LSD do have access. The way out of this is to adopt the present view that the action of MAOI is very unbalanced with respect to the resulting ratios of psychoactive amines. REM sleep is reported to be attributed to noradrenergic and serotonergic blockade to produce this imbalance (Sharpley & Cowen, 1995). In either case, the assumption made in the V&M citations, that MAOI action involves the brainstem, is questionable. As a protein, it is expected that MAOI within the bloodstream has severely limited and

asymmetric access to the storage sites for the powerful endogenous hallucinogens, which, in any case, are secreted only in timely fashion for control over brainstem areas. Otherwise, their open access to MAOI would certainly upset homeostasis in the brain.

In summary, cited works within the claims of Vertes and Marshall showing that insults to the brainstem or loss of REM sleep don't affect memory consolidation is dealt with by two arguments: 1) The criteria used for assessing the effects of REM or brainstem perturbations is not appropriate by themselves and 2) The results of the preceding monograph reveal the consolidation of hidden memory that can reach the cerebral cortex to manifest conscious sensation that might initiate a certain kind of (trauma) dream. There can be no question that a brainstem process is inaugurated spontaneously to erase the memory. In addition, evidence for healing a hidden memory is seen in the successful use of a 5-HT_{1a} agonist in PTSD therapy (MAPS.com). This and the similarities between the REM and hallucinogenic states, together with the cerebral awareness of the flashbacks would have to be a consideration in the rejection of memory consolidation by Vertes and Marshall as a component of all dreams. These authors may be correct if their reference is restricted to non-trauma related dreams in their respective positions about basal forebrain sources and memory consolidation. These authors have additional critics on similar issues (Bednar, 2003).

Therefore, the extension of these experimental results of spontaneous flashbacks as signs of trauma erasure to the mechanism of REM sleep remains as a hypothesis worthy of testing. The appearance of the agonist in the blood as the REM state begins and ends could be managed (see "Testing the Hypothesis"). Just as brainstem events documented here lead to conscious awareness of released memory impulses, the release of stored impulses by the same brainstem events in the REM state reach their conscious manifestation as dreams from cerebral processes. The confirmation

or falsification of these predictions is possible by testing based on neurobiological methods with the 5-HT_{1a} receptor as target and the use of functional imaging (fMRI) and PET, as outlined in the same section on testing. The anticipation is that REM dreams are evidence of a healing function repeated nightly to rid the dreamer of noxious impulses stored according to the RaRN model. Whether or not the 5-HT_{1a} receptor really belongs to the raphe nuclei or to another thus far unknown source is a valid question, but irrelevant to the fact that cerebral transformation into conscious sensation or dream imagery can originate from 1a-ligand binding within the brainstem.

A PROPOSED ETIOLOGY OF DEPRESSION

A major finding of this monograph is the evidence of a memory substrate controlled by a 5-HT_{1a} agonist for consolidation or release of traumatic impulses. The model generated from this evidence has been exemplified by known anatomical and neural interactions and accounts for a number of general observations in the areas of hallucinogen research and, notably, in the area of posttraumatic stress disorder (PTSD). The RaRN model accounts for the frequent persistence of noxious flashbacks and PTSD in the clinical setting.

Thus, a natural outcome of combining the REM-flashback hypothesis with clinical studies on REM sleep is the proposal that chronic depression is an external manifestation of autonomic attempts to complete the resolution of a trauma memory whose resolution was not completed during REM sleep. In other words, the daytime condition of certain depressive individuals is a chronic form of posttraumatic stress disorder (PTSD). The basis for this hypothesis is the documented success of treating depression by methods that increase REM pressure to induce “REM rebound” (Bednar, 2003). In these cases, the patient is awakened each time the REM state is detected, either by EEG theta waves or by rapid eye movement. This awakening is repeated for one or two nights. If the patient is undisturbed the third night, his REM latency will be normal and dreams may be intense as the patient “catches up” on REM time.

The next day the depression is gone. Although this approach does not produce lasting relief from depression, the observation is fairly reliable and was suggested by earlier observations that loss of sleep often produces an improvement in depression, while napping does the opposite. The rationale for using these clinical observations is as follows: In some depressives the brainstem mechanism of opening memory substrates containing noxious impulses is insufficient, owing to insufficient REM pressure to reach a threshold for agonist secretion or for the activation of second messengers as described in later sections to hyperpolarize functional target areas. Increasing REM pressure is required to reach this threshold and release the hidden memory into cortical dream interpretation. The question as to what neural processes give rise to REM pressure is an intriguing one. The autonomic system could be keeping track of jobs unfinished. As mentioned in "Afterword," a "reference" is must be monitored continually and, as in M's flashbacks, personal issues in dreams diminish with time to reach a reference state, which is monitored by the character of dreams in this progression (Jung 1943). Interference with this progression would represent incompleteness of trauma resolution by one (among many) reason: Reconsolidation of the noxious memory.

References REM Sleep

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