

Geomagnetic, Cross-Cultural and Occupational Faces of Sleep Paralysis: An Ecological Perspective

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The case is made for a more ecological approach to understanding the cause(s) of sleep paralysis. This ecological approach includes an understanding of and sensitivity to cross-cultural similarities of sleep paralysis (SP) and tests the hypothesis that significant changes in the ambient geomagnetic field can alter normal night time dream patterns. Geomagnetic effects aside, this article argues that a bias toward clinical studies of SP, with an emphasis on dysfunctional criteria, may obscure simpler explanations for this occurrence, including the REM rebound phenomena as it pertains to occupational habits and cultural contexts. We propose a research plan, a cross-cultural and psycho-geographical approach, to understand the many geneses of SP. (*Sleep and Hypnosis* 2000;5:248-254)

Key words: *sleep paralysis, REM rebound, feeling of presence, geomagnetic flux, psycho-geographical, melatonin, pineal gland*

INTRODUCTION

Sleep paralysis (SP) is a rapid eye movement (REM) sleep disturbance and concurrent dream phenomena which usually occurs at sleep onset, upon awakening, or during the transition between REM and awakening in narcoleptics and the normal population (1-4). The dreamer wakes up during or from REM sleep and, in full awareness, recognizes and experiences the atonic condition that accompanies this sleep cycle. In addition to the atonic state, a commonly reported hallucination is the feeling of a presence (FOP) or entity in the room in which the individual sleeps. This hypnagogic hallucination may be sensed as three-

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atening, likely giving rise to the cross-cultural folklore belief of the nightmare; the Old Hag; the incubus (Europe); Pesadilla (Spain/Latin America); Tindihan (Indonesia); Night marchers (Hawaii); Doppelganger (Germany); and Kanashibari (Japan) (5-8). Other experiences associated with SP events include microsomatognosia (9); hearing voices or sounds (rumbling, hissing or crackling); odd vestibular sensations (sinking in the bed, gliding above the body or about the room, or the body twisting itself into a tight ball); abdominal or chest pain; and somatosensory events ("hands" caressing, pulling or pushing one's body) (10-12). Another typical report in SP symptomology is the continuation of dreaming into a lucid dream (10-13).

The present review updates a projected ten-year study on SP (12), and still finds evidence that SP is a normally occurring sleep disturbance reported by average individuals with no self-reported history of mental disease, who do not use anxiolytic medication, and who represent many cultures. Notwithstanding these global and mundane cases, a recent and comprehensive study by Ohayon, Zulley, Guilleminault and Smirne (14) reported that the prevalence of SP without other "easily identified and treated" factors is only about 1.7% and/or has a lifetime prevalence of SP at 6.2% in German and Italian populations (N=8,085). Their study,

although clinically useful and statistically comprehensive, did not look at or played down the role of important cross-cultural and occupational variables that may lead to a greater probability of SP. To them, it was important to ascertain the occurrence of SP in "the general population" (Germans and Italians). For example, they observed that prior to their more comprehensive study, "Most of the available figures are based on student populations or ethnic groups for which the phenomenon has a special cultural significance." Later on in this article we will argue that, in opposition to their case, there is some wisdom in looking at "ethnic groups for which the phenomenon has a special cultural significance" precisely because they report it (SP) with greater frequency. This is analogous to studying an exotic tropical disease that greatly affects the local indigenous population but only marginally affects transients. In short, by ignoring the special cases, there is a risk of diluting the incidence of SP and mislabeling it a clinical phenomenon before other factors are duly considered. Staying with the Ohayon et. al. study, such risk can be found in their overemphasis of the intake of anxiolytic medication as a predictor of SP when in the same summary they reported similar odds for another more mundane predictor of SP, legs cramps (anxiolytic medication= 4.91; nocturnal leg cramps=4.02). Additionally, their important contribution to an understanding of SP left out non-clinical aspects of sleep behavior that may contribute to the phenomenon. For example, Ohayon et. al. did not look at occupational circumstances in detail, specifically graveyard shifts and their impacts on the REM rebound phenomenon that may trigger SP. We will revisit the REM rebound phenomenon later on this article.

Finally, other research has linked physiological dysfunction to a corollary of SP, FOP. For example, Brugger (15,16) reported that the FOP (the Doppelgänger), or entity, might be associated with brain damage. These researchers also report that the FOP are usually associated with epilepsy and schizophrenia, but are also associated with migraines, depression, and organic disorders. In short, both Ohayon et. al. and Brugger's observations suggest that the phenomenological experience of feeling of a presence has psychological and neurological components that cannot be ignored if the etiology of SP (and accompanying phenomenon of FOP) is to be understood.

Changes in the Geomagnetic Flux and SP

In addition to the classic and traditional literature on SP, the author of this report has provided evidence for significant associations between abrupt changes in the ambient geomagnetic field and the incidence of SP (10-12). This unorthodox approach was born out of three

robust and independent lines of research: a) the observations that ambient geomagnetic fluctuations are coincidental with so-called paranormal experiences, initially the FOP; b) the experimental manipulation of magnetic fields in order to elicit unusual mental states; and c) the reactivity of pinealocytes to the exposure of earth-strength magnetic fields. Also, later in the text, I will provide more detailed reports of these contributions and corresponding authors.

The last phase of our longitudinal study was designed to investigate the relationship between SP, geomagnetic activity and cultural variations of the same disturbance. Underlying the cross-cultural reports is that, lacking a scientific knowledge of the neurophysiology of sleep, individuals and their respective cultures may define these experiences as being paranormal given their intense imagery and emotional import (17-19).

In line with these geomagnetic studies, we have reported significant effects between the incidence of SP and abrupt changes in or low local geomagnetic activity (10-12). These analyses included a nitty-gritty evaluation of the temporal nature of SP events with respect to abrupt changes in the ambient geomagnetic field. Specifically, we found that a statistical comparison of geomagnetic activity five days before and two days after a SP event corresponds to abrupt changes (increases or decreases) of the ambient magnetic field. Furthermore, and in addition to the few case studies presented elsewhere (10,11), longitudinal data to be published at the terminus of our research decade follows a larger sample of twenty-two subjects for two years and links their self-reported SP experiences to the abrupt rise or decline of the ambient geomagnetic field and/or solar flux. Additionally, the same relationship is found in days of relative geomagnetic calm. On the other hand the probability for reporting a SP episode rarely occurs during geomagnetic field maxima. The combined probabilities of reporting SP and the FOP for all our subjects during the last eight years are: .37 for calm geomagnetic days, .26 for "abrupt" rising or declining of the geomagnetic flux, and .10 for geomagnetic flux maxima (based on 2,972 observations). Our results partially concur with Michael Persinger's hypothesis that so-called paranormal experiences occur during days of relatively low geomagnetic activity and with observations that magnetic field disturbances may give rise to hallucinations (17). Persinger deserves credit for continuing to test the complex connection between geomagnetic variables and their import on behavior and psychological states in multiple convergent studies (17,18,20-22). Interestingly, Johnson and Persinger have also linked the FOP to experimentally controlled exposures of transtemporal magnetic fields (21), further giving credence to a connection between SP and geomagnetism. In our longitudinal sample, fourteen subjects out of the twenty-

two frequently report FOP adjunct with SP.

To be fair, even the geomagnetic data seems counterintuitive at times. For example how is one to reconcile our recent data that both abrupt changes in the geomagnetic field and relatively quiet geomagnetic days coincide with increased SP reports? We believe that an orthodox neurophysiological explanation must include the ecology of individuals who may be exposed to unusually high doses of electromagnetic radiation or other temporal lobe entraining fields. These observations would include periods of time during occupational hours and the translocations from workplace to home environments. If electromagnetic radiation is usually high in the workplace, then once at home and in the absence of these fields, abrupt electromagnetic gradients can be created that give rise to cerebral liability. This would be the case if the occupational and home environments differed in electromagnetic intensities in a physiologically significant way for a particularly sensitive population. An illustration of this counterintuitive effect came from one of our contributors who works in a television station and in front of a computer monitor for many hours. She reported that her SP and FOP occur after work, when napping at home, presumably when a dramatic and artificial drop in her ambient electromagnetic environment is induced by her move to an area of lower electromagnetic intensity. In general, our studies convince us that the electromagnetic working and living environments need to be specified thoroughly, in addition to the clinical analyses, in order to assess SP.

Measures of Geomagnetic and Geophysical Activity

Presently, we are collecting SP reports worldwide with a particular interest in the Pacific ring-of-fire region (more on this hypothesis later). Subjects send us information as to when (time and time zone) and where (neighborhood, city, country) the SP episode occurred. We also ask that our subjects give us an account of the activities they were engaged in twenty-four hours before the SP event took place. These activities must also be detailed and descriptive of their physical, emotional and psychological states prior to a SP event. We encourage our subjects to give us details on occupational and/or home circumstances. We hope to make these data and analyses available when the participants are of sufficient number and the geographical locations completely mapped as in the case of more traditional epidemiological studies.

Furthermore, the daily sums of the 3-hour K index for local geomagnetic activity are sent to our laboratory on a monthly basis. These daily fluctuations are in a quasi-logarithmic scale of 0 (quiet) to 9 (extremely disturbed) and are a qualitative standard indicator of geomagnetic activity (28). The K-indices are obtained from our

local geomagnetic station (observatories) in Victoria, B.C., Canada. Other American observatories provide us with an index of global solar flux activity. The daily sums are converted into modal frequency ranges in order to control for outlier effects. Geomagnetic activity is reported in Gauss (G). Moreover, we collect global geophysical data on earthquakes with a magnitude greater than 3.0 on the Richter scale on all geographical areas of interest. Finally, there is a built-in double-blind protocol in our comparison of the contributed SP occurrences and how these self-reports correlate with the geophysical data. We wait a year or more before entering both sets of data and analyzing them. This way we experimenters refrain from projecting hypothesized patterns onto data matrices. Additionally, subjects are naive with respect to the moment-to-moment changes of geomagnetic activity.

The REM Rebound Effect

In addition to the geomagnetic effects mentioned above, sleep deprivation itself, when prolonged and chronic, may create the ideal circumstances for REM rebound to occur, increasing the probability of SP in a sensitive population. REM rebounding is the physiological need of the mammalian brain to "capture" loss of REM due to alterations of normal sleep. Indeed, the REM rebound phenomenon may be seen as the consequence of several other sleep disturbances preventing regular sleep patterns. Interestingly, Ohayon et. al., without making a direct reference to REM rebounding, reported that a higher percentage of their "severe" SP sufferers (individuals who report SP at least once per week) also report high arousal situations which might lead to this deficit. For example, they reported that leg cramps, high blood pressure, and physical disorders, are all associated factors with SP. What all these complaints or situations have in common is that alone or in combinations they may become causes for sleep interruption and/or deprivation eventually leading to REM rebounding.

More importantly, four earlier surveys have already identified high percentages of reported SP (6.1%, 15.4%, 26%, and 44%) in special case populations of nursing and medical students (23-26). These studies suggest that nocturnal work and study habits increase the probability for REM rebound effects and thus, by implication, the probability of SP. Moreover, Ness (5) proposed that the phenomenon of the Old Hag in Newfoundland, Canada, might be due to the hard physical labor and lack of sleep these fishermen experience. A more recent contribution from a subject in our research, a psychiatric nurse in Ireland, adds credence to the medical occupational connection. In her ward, colleagues who work the graveyard shift (from 8 PM to 8 AM) fre-

quently report SP around 4 AM. This morning hour turns out to be their sleep onset time, coinciding with a break, after five hours of sleep postponement. This time frame is congruent with REM rebound effects possibly triggering SP. Additionally, a second nurse contributor to our study reports that she began experiencing SP about 30 years ago, coinciding with a 28-year career in nursing. These specific job-related SP experiences have long been recognized in the hospital occupational milieu and have been termed night nurses' complaint.

Once again, a move toward a causal link requires an ecological description of the SP experiencer and his/her environment. The early reports on special case populations launched a more recent and wider interest in SP and are still relevant literature for anyone who is interested in the folkloric and ecological approach to studying SP. Granted, as tantalizing as the above reports are, more controlled experiments, using normal or susceptible populations who regularly report SP episodes, need to take place. As an example of these experimental manipulations, Takeuchi, Miyasita, Sasaki, Inugami, Fukuda were able to demonstrate artificially produced SP by interrupting normal sleep (27). However, these experimental data need to match research looking at the occurrence of SP as reported by sleep-deprived individuals in different work milieus.

Cross-cultural Issues of SP: A Special Psycho-Geographical Case for The Pacific Ring-of-Fire

The above theoretical and experimental considerations, viewed from the perspective of an historical and traditional widespread phenomenon of SP around the world, argue for the possibility of several causal tracks all giving rise to a collection of REM related symptomatology. One causal track we are pursuing argues for Pacific ring-of-fire cultural SP dream phenomenology that may be induced by above-the-norm changes in the ambient geomagnetic field due to volcanic and/or earthquake activity (these cultures may even refer to themselves as "the general population.") This hypothesis is a corollary of Persinger's argument for an association between so-called paranormal experiences and geophysical instability (29,30). After Persinger then, our hypothesis is that geophysical instability, such as earthquakes produced by volcanism or tectonic movement affecting local variations of the geomagnetic field, may give rise to unique cultural SP occurrences and produce rich and pervasive dream experiences that give rise to traditional dream folklore. This hypothesis also owes much to Ness and Firestones (5,6) descriptions of the socio-cultural context of the phenomenon of the Old Hag in the population of Newfoundland. Furthermore, this kind of psycho-geographical approach could also elucidate genetic bottlenecks, situational, and behavioral

contributors to SP. (Five of our long-term contributors report bloodline, familial incidences of SP.) Human sensitivity to infrasounds that occurs with or anticipates significant geological instability, when these sounds are pervasive in such regions, may itself disrupt normal nighttime REM periods.

In addition to the larger effects of an ever-fluctuating ambient geomagnetic field, and its interaction with other geophysical variables, these Pacific ring-of-fire cultural SP phenomena may be enhanced by local anomalies in the geomagnetic field such as the position of the sleeper or the arrangement of the furniture in a room. A case reported to me by one of our contributors (Mr. Blasius Winang Asmara) in Indonesia illustrates the point. People who report *tindihan* when they sleep in a particular room of their house may never experience it when they sleep in a different room. The warning they hear of "No, don't sleep in there, you'll get *tindihan*," alludes to the preciseness of these effects and their relation to specific locations. Even in our own studies, we have to be vigilant and sweep entire rooms with a sensitive magneto-flux meter in order to locate and control potential sources of ferromagnetic nuisance. Furthermore, on the Hawaiian island of Oahu, another Pacific ring-of-fire location, the locals tell stories of "night marchers" when they sleep on the eastern side of this island (in Kualoa). These night marchers are said to press upon the sleepers as if a burden. The SP sufferers report being unable to lift their heads off their pillows. These experiences are not reported in other locations with the same frequency of the same magnitude on the island. Common to both cultural experiences are: 1) atonia of the body; 2) the presence of entities (usually malicious) about the room; 3) a history of both active volcanic geology and earthquake activity; and 4) folklore linking the SP phenomena to a geophysically unstable geographical area and/or micro location. We must also include Japan's version of SP, *kanashibari*, and point out that Japan too is located in the geologically active region of the Pacific ring-of-fire. As one explanation among many, our hypothesis may turn out to be incorrect. Still, the cross-cultural approach is a valid process for discounting invalid hypotheses or when trying to relate several variables together.

Melatonin Synthesis: A possible Psychobiological Model of SP

Our search for a causal psychobiological mechanism that might explain the clinical, cross-cultural and the geomagnetic data first rests on several reports that pineal systems may be sensitive to rapid fluctuations in the strength of the earth's magnetic fields and that temporal-limbic systems are liable tissue predisposed to this external activation (31-37). A specific case has been

made between these liable tissues and the role of melatonin (38). Furthermore, Sandyk (39) provided evidence for the curtailing of sleep paralysis using weak electromagnetic fields. In the case of Sandyk's report, these fields may have acted as an enhancement of melatonin production and contributed to the normalization of circadian rhythms diminishing the probability for further SP occurrence. As in the case of any neuropsychological data, dream phenomena such as SP, reported by sensitive individuals, may provide models that test similar neurophysiological mechanisms in humans.

Moreover, Semm, Schneider and Vollrath (31) were the first team to report the effects of controlled earth strength magnetic fields on the activity of pineal gland functioning. Additionally, Wilson (32) has shown that exposing rats to modulated earth-strength magnetic fields reduced the production of melatonin. In connection with our observations that abrupt changes in the ambient geomagnetic field may induce SP, it is important to note that pinealocytes are also reactive to changes in the electromagnetic field rather than to passive fields (33,37). These findings are important because they implicate the direct action of ambient changes of weak electromagnetic fields in the reduction of the levels of a major chemical sleep agent. If changes in the ambient magnetic field produce observable changes in physiological functioning, then these neurochemical events may be significant enough to induce psychological phenomena. These are not trivial connections considering the perceived role of melatonin in the maintenance and duration of normal sleep as reflected by the health trends of the American public. Coveting normal sleep in fast-paced western societies has given rise to the profitable marketing and sale of melatonin. As far as I know, no one is taking stock of the possible impact of this popular intake of melatonin on the occurrence of SP. But taking all the melatonin experiments together to bear on this nutritional trend, one would argue for a reduction of the normal incidence of SP in the general population.

In the future, a more complete understanding of the role that pineal systems play in the etiology of SP needs to be clarified. A number of non-invasive experimental protocols can be designed and variables can be manipulated, from alterations of

L-tryptophan in the diet to following up on Sandyk's findings and manipulating electromagnetic fields to produce diverse melatonin metabolism outcomes. In general, and in addition to the aforementioned pineal / melatonin mechanisms, the researcher of SP has to consider other psychobiological pathways that might lead to a maintenance of self-awareness in the presence of inhibition of motor neurons during REM sleep: bound lucidity. As the clinical literature suggests, psychological anxiety itself can produce high arousal during beta REM activity and/or correlates with melatonin-mediated tem-

poral microseizures (14,38). There might be several etiologies leading to SP and some of these may have a common psychobiological origin. If the sleeping agent preserves a high degree of environmental monitoring (external and internal), however this monitoring translates into neurochemical events, an awareness of body events, including atonic states, might be noticed and reported as SP.

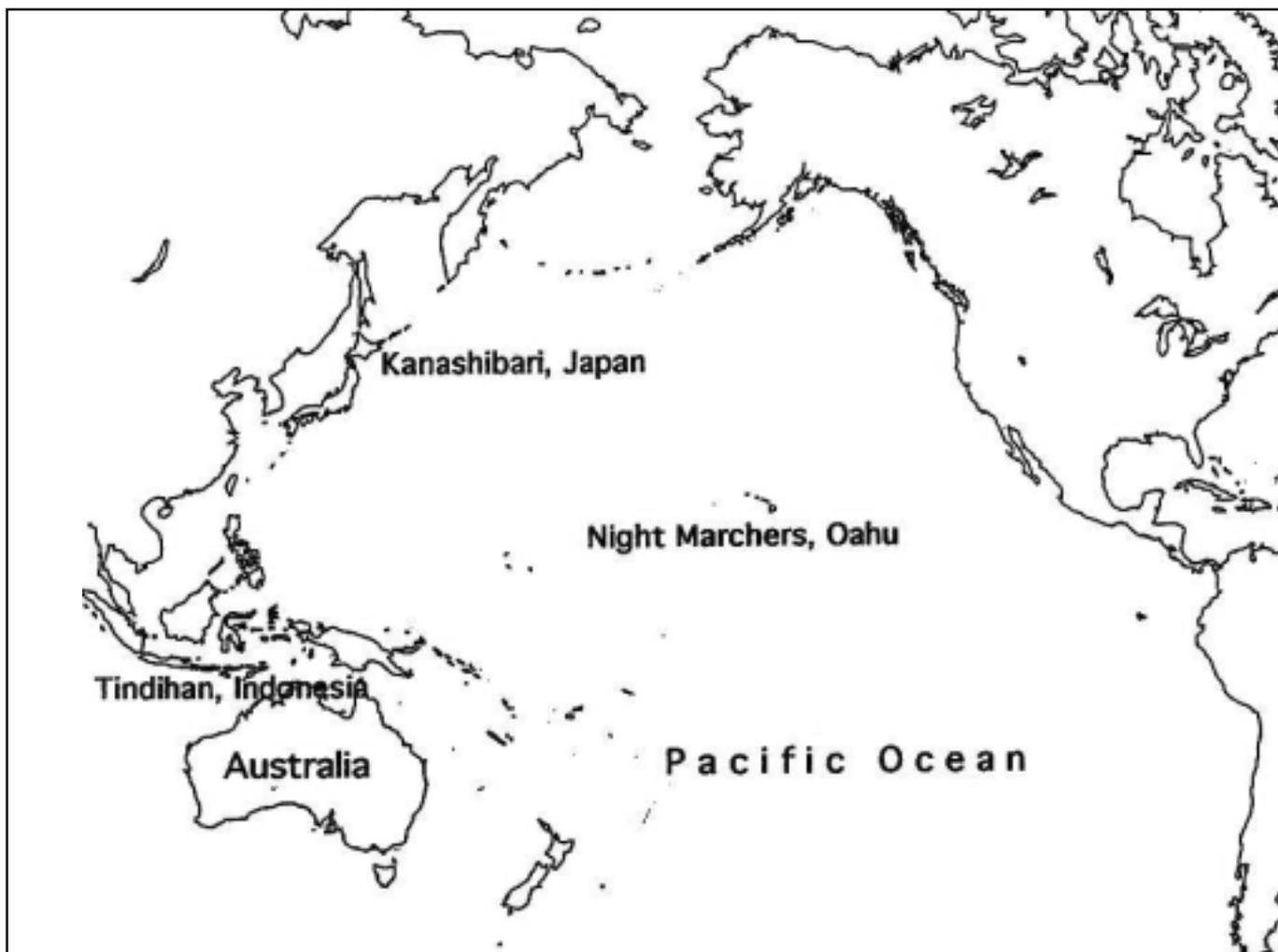
CONCLUSION

Figure 1 shows the known cross-cultural prevalence of SP phenomena in the Pacific ring-of-fire region as identified by folklore terminology. Given the aforementioned connection between geophysically unstable regions and the incidence of SP, there is reason to anticipate similar patterns in other regions of the world. In other words, our case for the Pacific ring-of-fire region may be one of several such psycho-geographical maps. Previous research has already identified the possible connection between geophysical activity and biological systems (40), the role of geomagnetic disturbances in myocardial infarction and strokes (41), and, more generally, the effects of the geomagnetic ambient field on the human brain (42). So our research focus is neither new nor unreasonable given the probable interplay between a complex electrochemical system that itself produces a magnetic field, the human brain, and ambient sources of electromagnetism. This psycho-geographical map also hints at the logistical challenge of recruiting the collaboration of other research teams in trying to collect and evaluate SP reports according to some consistent SP criteria. Nevertheless, this challenge includes the achievable comparison of random samples within these populations to control samples from different geographical regions (e.g., Europe). Perhaps Ohayon et. als. reported incidence of SP in European normals of 1.7%, if it can be replicated, can be used as a standard to compare against other more sensitive distributions. Once identified, these other samples can provide us with a clearer understanding of the multivariate geneses of SP.

Indeed we anticipate possible converging effects and intervening variables when trying to identify the environmental triggers of SP: psychological, geomagnetic, occupational, and cultural. That is, even when diversity of folklore identifies the SP phenomenon precisely (as described by traditional symptomology), the researcher would still have to ascertain when and where the occurrence of SP is due to physical or psychological stress, traditional work habits, periodic geomagnetic effects and/or geophysical events. All these variables must be considered.

To conclude, the problem of understanding SP is the problem of understanding the neurophysiological mechanism(s) of self-awareness emerging in the midst of

Figure 1. Three Pacific ring-of fire traditional cultures with dream folklore accounts of Isolated Sleep Paralysis: Javanese Tindihan, Hawaiian Hight Marchers, and Japans Kanashibari. (Other Occounts of sleep paralysis in this region include Fijian, tarda vakarerevaki, Mayan Quiches, white sleep or sak waram, and Alaskas Eskimo.)



atonia or when transitioning from REM sleep to awakening. This understanding begins with a hard look at the role of metabolism of melatonin and its implication in psychological anxiety (the psychiatric model) as well as geomagnetic and cultural effects and their role in SP.

Finally, this state of bound lucidity and cortical beta coherence does more than agonize in paralysis. Self-awareness can adapt in the creative state of hypnagogic

hallucinatory states and give rise to multigenerational and cross-cultural dream stories. The "ghosts", the "incubi" and the "hags" in turn invent culture. In the old Gestalt view of perceptual coherence, unproven "brain fields" pieced reality into a whole. It would be their vindication if these brain fields turn out to be real geomagnetic ones explaining at least why some of us enter this peculiar state of bound lucidity.

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