THE ART OF THE BRAIN: DYNAMICS OF DREAMS

by Vlada Petric

To sleep—perchance to dream: ay, there's the rub.

Hamlet (III, i, 65)

The human brain is an arsenal of memories, generator of actions, controller of behavior, producer of dreams, and, most of all, ultimate source of the intellect. It supplies us with information about almost everything—except its own complex structure and function. Although it is the most superior product of organic matter, consciousness seems incapable of focusing on its own physical base. Social, psychological, and religious taboos have restricted scientific investigation of the human brain, retaining its association with spiritual life as an extension of divine power. Ancient philosophers found the brain to be as enigmatic as the universe; they assumed that intensive observation of the cosmos must illuminate the microcosm in the human head. Now with the aid of sophisticated technical facilities, contemporary brain science is exploring new ways of understanding the intrinsic physiological forces that activate mechanisms of the brain in both waking and sleeping states.

AN EXHIBIT ABOUT BRAIN STRUCTURE AND FUNCTION

Dreamstage, An Experimental Portrait of the Sleeping Brain, was an exhibition organized in the Carpenter Center for the Visual Arts at Harvard University, April 23 through May 22, 1977, which is now travelling around the world. Initiated by Dr. Allan Hobson, Head of the Laboratory of Neurophysiology, Department of Psychiatry, Harvard Medical School, the project also involved several artists—filmmaker Theodore Spagna, composer Paul Earls, and designers Toshi Katayama and Roger Brandenberg-Horn, who installed the show. According to Dr. Hobson, the primary intention of the exhibit was to develop "vehicles to communicate what is known about brain structure and function in ways that will be understandable to the general public." Since "there is probably no organ of the body about which the public has so vague an image," Hobson and his collaborators decided to use a live human being plus all available technology to illustrate the neurology of waking, sleeping, and particularly dreaming, so that laymen could grasp "the idea that a dream is the product of a regularly recurring brain mode, which can be utilized to lead the observer from his own experience to
his own neurobiology.” The display was supplemented by an excellent catalogue (produced by Allan Hobson, Ted Spagna, Ned Putnam, Stephen Weinstein, and Toshi Katayama), which provides basic information about brain science in a comprehensive and highly professional way and in a presentation that employs beautiful graphics.

Dreamstage could serve as a model for future scientific exhibitions, especially those dealing with the rapidly expanded field of brain science. It was actually the first public exhibition to inform large audiences about brain research, and its great success (over 10,000 visitors in 30 days) unequivocally proved the need for a permanent exhibition of this kind in a science museum. Ironically, while many important exhibitions of space explorations exist in planetaria around the world, there is still no place where people can learn how their own brains work in waking, sleeping, and dreaming states—processes that make all other human discoveries possible.

In spite of all its scientific features, Dreamstage was more a “show” than a scholarly exhibition, since its major attraction was a sleeping person isolated in a glass chamber and connected to an instrumentation center that translated the activity of his sleeping brain into a light show, accompanied by electronic music. Realizing that he risked oversimplifying the scientific facts for the sake of clarity, Hobson nevertheless chose to make his exhibit accessible and appealing to a mass audience. This choice is particularly clear when one compares the actual exhibit with Hobson’s original proposal, only 40% of which was realized due to financial and technical limitations.

The title Dreamstage was originally meant to convey four connotations: (a) the “platform” or “setting” upon which dreams are displayed; (b) the state of sleep during which dreaming occurs; (c) the infancy of brain science; and (d) the theatrical nature of the entire event. Yet, as realized, the project seemed to emphasize only the first connotation. Electronic technology was used primarily to transmit signals of the brain’s activity during sleep into audiovisual effects. The aesthetic nature of this transmission was demonstrated by the connection of prerecorded musical tapes (composed by Paul Earls) to the central brain waves. Not only did various musical segments sound according to various brain wave impulses, but also the strength of the impulses determined the dynamic intensity of the sound. Thus, it seems more accurate to name this show Sleepstage, since all the auditory and visual illustrations were related to sleeping rather than dreaming. Unfortunately, the demonstration of how dreams might influence artistic creation and contribute to post-dormant behavior was not included in the show as was initially planned.

In Hobson’s original proposal, he planned to divide the exhibition locale into four areas, each furnished with specific data generated from a sleeping person and presented in a coordinated multimedia display. The material in these four subsets was to be arranged and classified by the subject’s biological clock, as shown in Table 1.

In the actual exhibit, the space was divided into only two separate areas: a light space with predominantly verbal explanations displayed on the walls and supported by schema and diagrams; and a dark space containing nonverbal data and a sleeping man in the isolated chamber visible through a one-way mirror (see Figure 1). As one might have guessed, the dark space attracted the most visitors who spent a great deal of time observing the sleeping man and watching the projected images on the wall. However, once having been intrigued by the output of the sleeping man whose scalp was connected by electrodes through an electroencephalograph to a laser projector, their eyes were drawn to the rotating slide projections of microscopically photographed brain cells, and to the projected stills showing the various body positions of the dormant model at 15-minute intervals. Ultimately, the visitors could discover the structural relationship between the rhythm of the music and the oscillations of the multi-colored laser electro-
Table 1: Four Areas of Data Display

Physiological Data
The electrically recordable brain, muscle, and eye events of the sleep cycle are demonstrated on-line from the sleeping subject and from tape-recording samples. Comparable data from the cat are displayed together with single neuron signals. Responses to visual stimuli and motor events are shown. The displays consist of laboratory recorders (paper and oscillographic) and of laser mediated amplification on walls or phosphorescent panels. Excitation and inhibition are demonstrated through change in rate, color, sound intensity of the action potential data.

Psychological Data
The sequence of mental emotional states accompanying the cycle are demonstrated by tracings of tape-recorded reports, some of which are also broadcast by audioamplification.

The contrast between waking and dreaming perception is illustrated by art material and photography.

Movement in waking is contrasted with the paralysis of the dream.

Anatomy
The location of the brain in the subject's head is indicated by X-Ray.

The brain regions involved in control of the sleep cycle are illustrated by slides of the surface features and cellular detail.

The single neuron is shown to be the structural unit of the system. The axon and types of processes are illustrated.

The synapse is shown to be the site of neurotransmission and/or neuromodulation in relation to the changes in the sleep cycle.

Behavioral Data
Time Lapse Photography shows the sequence of postural changes in sleep through still collages and lap-dissolve sleep reanimation.

Video shows details of the sleeping subject on-line. Aspects of his daily waking activity are interspersed from tape for contrast.

Film shows particular aspects of the cycle in slow-motion for emphasis of particular sensor-motor events. The relationship of human sleep to that of other mammals is established.

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encephalograms projected on the dark walls; on the other hand, the audiovisual materialization of the brain activity also enhanced, perhaps unnecessarily, the mystery of human sleep.

It was both exciting and instructive to see electrical impulses, projected via optical laser scanners, originate from the heart, central brain, posterior brain, muscles, left eye and right eye, of an ostensibly motionless sleeper. (During sleep, muscles produce electro waves in a nonmotoric way.) The multicolored visual manifestation, like a symphony of vibrating light patterns combined with music "synthesized" by the sleeper's brain, revealed a continual inner movement in the sleeper's brain. However, it was not clear which of the projected laser waves corresponded to the eye movement (EOG), which to the muscle tone (EMG), and which to the various cardiac activities (EKG). Also, the relationship between the visual and auditory sensations produced by the sleeper's brain was not sufficiently developed and documented in *Dreamstage*. It would be instructive to see how two or more scintillating patterns powered by the sleeper's inner activities relate to each other in their ever-changing intensity and oscillation during the various stages of sleeping and dreaming.

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The choice of pattern and color for each specific graph also suggested that the show was conceived primarily as a theatrical or aesthetic event. No matter how arbitrary each decision may have been, it would have been useful to know why a certain color was associated with a specific brain wave. Since this aspect of presentation seemed to be quite random, it did not illuminate the relationship between the changing impulses and the psychological content of the sleeping man's dreams. Equally ambiguous was the use of the brain as a "synthesizer" of prerecorded musical motifs. There are some indications that, by means of a computer, it is possible to explain how a musical segment becomes activated by brain energy, especially if the segments are linked with specific wave lengths during dreaming. But how it functions on both the biological and psychosomatic levels is still an enigma. Do certain rhythmic patterns repeat themselves during a single dream, and under what circumstances do they replace each other? Does the "melody" of such a musical collage, "conducted" by a sleeping brain, have any structural unity, or is it only mechanically related to the electrical impulses? How does it all relate to the basic emotional excitement stimulated by the dream? Could the scientists explain how the actual selection of musical segments is made by the electrical activity of the sleeping brain? What principles, if any, are followed in transforming electrical impulses into specific rhythm beats, which, ineluctably, affect the composition of music as finally performed? Most importantly, how does the overall structure of such synthesized music relate to the content of dreams—a relationship that could be expanded upon by an examination of the dreamer's recollections of the dreamed event and its comparison to the electroencephalographic patterns?

Dreamstage implicitly suggests that the sleeping brain is only partially responsible for the visual and auditory display in the sense that the brain provided the energy through its electrical wave-lengths which activated the visual and auditory patterns. The composer of the musical segments connected to the impulses, as well as the designer who assigned colors to brain waves are, of course, responsible for such activation. Yet, a more remote contribution comes from the stage of sleep and the emotional content and type of dream. In other words, the composer and designer provided the ingredients, and the brain, the energy; but the architecture of the display came from the mood created by the content of the dream, which, through the sleeping brain, "synthesizes" inchoate sensorimotor signals sent up to the forebrain from the brain stem. What the actual connection is between all these phenomena remains to be revealed by further research. If the imagination is permitted to anticipate the evolution of brain science, perhaps in the future there will be "brain music," "brain video," and "brain cinema," as new forms of "brain art." But even at this stage of research, we can see the human brain from a new perspective: as painter, composer and filmmaker.

As already stated, Dreamstage at Harvard presented only the anatomical and physiological data with a small portion of behavioral information supported by time lapse photographs illustrating the physical connection between the four stages of sleep and the positions of a sleeper's body (see Figure 2). Unfortunately, the live TV image of the sleeping person appeared blurred on the screen and the stage of sleep transmitted was not announced, making it difficult for the audience to correlate the stages of sleep with the physical position of the model. The improvement of shooting technology will permit the observers to witness a correlation between the position of the sleeper's body and the content of his dream. (For example, had the model been dreaming of flying or running, would his arms and legs in any way tend to change position?) Is there any physical manifestation of the interior drama occurring in the mind of the sleeper that is visible to the audience?

What electronic technology failed to capture in the brain structure, the microscopic photo-camera did with fascinating results. The three-slide multicolor projections of the microscopic organization of brain cell structure (which irresistibly
Figure 2: Three frames from a 15-Minute Interval Time-Lapse Study of a Sleeping Couple. Photo Credit: Theodore Spagna
reminds the viewer of the most sophisticated abstract painting) formed a unique “neuronal landscape.” This was probably the most “artistic” realization of brain science demonstrated in Dreamstage. Ragnar Karlstrom, who conceived the three-slide projections, stated that his photographs showed how “through scientific exploration, perceiving the essence of life can be an elemental conceptual experience.”

I was disappointed that the proposed dream-film was not included in the exhibition because it would demonstrate that cinema is the medium that can revive the dream experience in the most kinesthetic manner. Numerous specific cinematic devices could be used for the sensorial visualization of dream processes. The idea of using film in presenting visual and sensorimotor activation during dreaming should be further explored through the close cooperation of scientists and filmmakers. More than in any other art form, cinema reflects, in a parallel way to dreams, a four-dimensional experience of time and space, both in a narrative and a physiological sense. The unconscious reaction of the sleeping body, that is, its behavioral activity during sleep, is, in many respects, similar to the response of the body during film viewing. This activity proves to be more physiological than in any other art, including television. Hence, there are three points of striking similarity between dreams and cinema. First, film is capable of visualizing the bizarre imagery and illogical combinations of objects-events, presenting them on the screen as an extraordinary but credible world. The second similarity is that cinema, like dreams, can subvert the notion of time and space in the most dynamic and revealing ways. Finally, and most significantly, cinema has the power to stimulate a unique sensorimotor experience that is akin to what the dreamer experiences in his most exciting dreams. It would be interesting to know what responses would be registered if electrodes were connected to the film viewers’ neural centers? What type of EKG would be obtained? Would it differ for various films and, especially, film genres? How would a specific film stimulate the brain activity and the corresponding neurocenters in different audiences, adults and children, intellectuals and general moviegoers? How would the electroencephalographs registered during film viewing relate to those of a specific dream content as compared with a film content?

The psychological data were also insufficiently presented in Dreamstage, in spite of the fact that the initial project emphasized emotional states of the dreamer. The idea was to use all sorts of artistic “documents” of the dream experience, not only in music but also in painting, theater, and poetry, to demonstrate “the contrast between waking and dreaming perception.” This seems to be an essential aspect of a show like Dreamstage. Combined with film, video, photography, music, kinetic art, and even dance, the “art material” could be presented as the materialization of specific psychic visions and dream imageries conveyed in an artistic form and shaped according to subconscious patterns. If one speaks of what dreams can contribute to a waking existence, then it is certainly not fortune-telling—not even a resolution of psychic crises but a stimulation of creative activity. This is why Hobsb's initial proposal for the exhibition is important: it includes psychological and behavioral sections consisting of various artistic presentations of the brain as human organ, children’s drawings of the brain, dream statements made in literary and psychiatric sources, taped reports and symbolic interpretations of dreams, poetry readings, surrealist prints, photographs, films, and electronic music. In the given circumstances, however, Hobsb was forced to decide either to pin down dreams, at all costs, or to demonstrate scientifically the dynamism of the sleeping brain. He opted for the latter and, to no one's surprise, the dreams got away.

My desire to see Hobson's original Dreamstage proposal realized was strengthened by my reading of his paper, "The Brain as a Dream State Generator: An Activation-Synthesis Hypothesis of the Dream Process" (delivered at the University of Edinburgh on April 23, 1975 and published in 1977), which was
derived from research done in collaboration with Robert W. McCarley at the Laboratory of Neurophysiology, Harvard Medical School, and which has tremendously important implications for dream aesthetics.\textsuperscript{3} The most important conclusion in this paper is one that considerably expands the activation-synthesis concept according to which the activated brain generates its own information during dreaming by a pontine brainstem mechanism, which is most likely responsible for the generation of REM sleep. Hobson and McCarley hypothesize that this internally generated sensorimotor information, which is partially random and partially specific, is related to stored sensorimotor data in the synthesis of dream content.

This hypothesis suggests that some situations in our dreams draw from our daily experiences, while some are "induced" by neural information. Such a combination creates many "illogical" and "unreal" dream images. Hobson-McCarley's hypothesis opens a new possibility of explaining the surreal aspect of our dreams, especially their spatiotemporal shifts, and directly challenges the Freudian explanation of the dream process. Hobson and McCarley define the dreaming sleep state as primarily a synthetic constructive process.

There is, therefore, no need to postulate either a censor or an information degrading process working at the censor's behest [i.e., the sleeper's subconscious]. The dream content elaborated by the forebrain may include contradictually charged memories, but even this aspect of dream construction is seen as synthetic and transparent, rather than degradative and opaque. ("The Brain as a Dream-State Generator")

The grammar of the brain, after all, is a grammar of coded electrical signals. In waking, such codes copy the external world and determine our record of the outside world in the memory. If, as appears to be the case in dreaming sleep, similar codes are generated by auto-activation of brain structures, they will be read with inference to memory. As the result of this interaction, completely new codes can and probably do continually arise from the depth of our brains in dreaming sleep.

The brain structures concerned with coordinating head, eye, and body positions during waking become active during dreaming sleep, indicating that the information generated during the waking by those structures might contribute, in a direct and specific way, to the spatial aspects of dream sensations, which have the greatest impact on the dreamer. For example, our common "flying dreams may be a logical, direct and unsymbolic (my italics) way of synthesizing information generated endogenously by the vestibular system." In view of this explanation, "it seems gratuitous to 'interpret' the sensual flying dreams as sexual." Following this scientific path of reasoning about the "illogical" and "bizarre" formation of dreams, Hobson and McCarley state that "symbol formation and the often bizarre juxtaposition of sensations in the dream may be a reflection of the heightened degree of simultaneous activation of multiple sensory channels in dreaming as compared with waking." Conversely, the lack of the rational filtering of the number of sensations (which we automatically do in our waking state) is the real source of the surreal formation of our dreams. Hence, Hobson and McCarley conclude that some of the "bizarre" formal features of the dream may directly reflect the properties of the brain stem neuronal generator mechanism; they seriously question the symbolic transformation of the supposed ideational basis of many dreams and their significance in our waking life. If we recall how odd and fantastic dreams are often "read," and if we now take into consideration the possibility that their structure is not generated (to a great extent) from our subconscious and repressed desires, but from the physiological mechanisms, it becomes clear what effect this hypothesis can have on dream theory and the relationship between dreaming and artistic creation.

Although their new concept cannot yet account for the emotional aspects of the dream experience, "it assumes that these are produced by the activation of brain
regions subserving effects in parallel with activation of the better known sensorimotor pathways.” It should be emphasized that this concept of dreams does not exclude the interpretative meaning of dreams. It only encourages (a) a more direct route to their acquisition than anamnesis via free association; (b) a less complex approach to their interpretation than conversion from manifest to latent content; and (c) a broader view of their use in therapy than that provided by the transference form of reference. Studying the quantitative correlation between eye movement (REM) intensity and dream experience, Hobson and McCarley defined the dream process “as having a sleep maintenance mechanism built into its physiological substrate rather than a sleep guardian function operating at the psychological level.”

The results of Hobson’s and McCarley’s experiments and research led them to conclude that “the primary motivating force for dreaming is not essentially psychological but physiological, since the time of occurrence and duration of dreaming are quite constant, suggesting a preprogrammed, neurally determined genesis.” Hobson and McCarley assert that specific stimuli for dream imagery appear to arise intracerebrally, though initially, in the pontine stem and, secondarily, in the cognitive areas of the cerebrum. This discovery challenges psychoanalytically motivated “theories” of dreams, providing at the same time a completely new understanding of the dream experience, its hallucinoid character, visual vividness, and its “bizarre” formation due to such spatiotemporal distortions as condensation, discontinuity, blocking, acceleration, deceleration, and, especially, delusional acceptance of the phenomena as “real” at the time of their occurrence.

This discovery, of course, does not mean that a retroactive analysis of dreams cannot be used as a strategy for reducing our psychic tension and as a means of gaining some knowledge about ourselves. The interrelationship between dreams and post-dreaming human behavior remains to be examined on the psychological level. Only then can answers be found to such important questions as: Why does the dreamer have specific emotional responses? Why do dreams have such a profound influence on our waking emotional state? How does a set of dreams illuminate their personal interpretation? The “unnaturalness” of our dreams, which from time immemorial has been the source of human frustration, can now be scientifically explored through the combined efforts of advanced psychoanalysis and neurobiology, which promise to rid us of our primitive attitudes toward dreams.

Hobson’s approach to dreams is important because it is based on scientific laboratory procedures that were unavailable to Freud who, instead, developed a more inward approach of interpretive introspection. New studies of dreams will correct the mistakes Freud made, although they will in no way invalidate his teaching about the influence of dreams on the sleeper’s waking psychology. But the new discoveries will undoubtedly show that the experimental dimension of dreams has to be reconsidered and reinterpreted in line with the new scientific facts. Only a collaborative psychological and physiological approach to dreams will advance the search for a link between dreams and reality.

**FILMIC ART AND THE NEW DREAM THEORY**

One suspects that the new hypothesis about dreams will become very significant in the study of surrealist art, particularly in the analysis of the “absurd” combinations of objects and the juxtaposition of incompatible elements. This is not to say that Freudian explanations of dreams can no longer be useful in the analysis of
surrealistic works and their relationship to dreaming. It seems inevitable, however, that the older but still dominant ideas about surrealism will be modified in light of the new discoveries in brain science. This is particularly true with respect to cinema.

Filmmakers and video artists, more than anyone else, will be inspired by the new dream theory and the advancement of shooting technology, which will allow visual and acoustic materialization of human dreams. There is a striking similarity between the nature of the dream experience and cinema which is capable of producing the most “bizarre” imagery with maximum spatiotemporal distortions, allowing at the same time the movie viewer to perceive the “surreal” events as “real” at the time of watching them on the screen. This similarity needs to be further explored on both scientific and aesthetic levels. The new dream research already provides enough material to compare the relationship between the structure of dreams and filmmaking, not only in terms of the cinema’s potential to illustrate the strangest dreams, but also to achieve a dream-like (i.e., sensorial experience by the use of specific cinematic devices. The movie screen seems to be the best “dreamstage” on which the imaginative directors have created imagery that can equal the imagery we see in our dreams. Buñuel, Maya Deren, Bergman, Fellini, Resnais, and Brakhage come to mind, not only because they succeed in presenting oniric events on the screen, but because they stimulate in the viewer a unique sensorimotor experience.

What seems most revealing to me in Dreamstage is the striking similarity between the technical properties inherent in cinema and the image-generating and image-interpreting capacities of the dreaming brain. The synthesis of inchoate data performed by the dreaming brain is reminiscent of the play of chance so common in the artistic process—that unpredictable combination of elements which sometimes create a new and indicative arrangement of biological information. As Hobson emphasizes, this recognition of the play of chance in the dreaming process does not rob dreams of their symbolic meaning, as is so often feared by the opponents of the new dream theory, i.e., those who continue to uphold the “disguise-censorship” hypothesis of dreams.

As Hobson recognized during the Bergman and Dreams conference (Harvard, January 27–29, 1978), it is quite legitimate to compare the function of the dreaming brain with the multifaceted cinematic process. It seems to me that the dreaming brain works, in a sense, as an instant camera (by transforming the stimuli immediately into an image), an editing table (by juxtaposing the images without following the narrative continuity and spatiotemporal logic), and a projector (by activating the dreamer’s sensorimotor centers with a kinesthetic intensity). This is where film and dreams meet in creating a surreal landscape and a bizarre course of events.

REFERENCE NOTES

1. Unfortunately, the new Dreamstage catalogue, made for the touring exhibition in 1978, contains less scientific information and is designed primarily to entertain, rather than to inform potential visitors.
2. Professor M. F. Malik, from the Department of Communication Studies, Concordia University Montreal, is conducting such tests in his Communication Research Laboratory. Some of his results obtained via biometrical measurements of sample audiences prove that valuable information can be contributed to this area of cinema studies.

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