



Spring 1982

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Recommended Citation

(1982) "Sleep Studies, A Diagnostic Tool," *Bellwether Magazine*: Vol. 1 : No. 3 , Article 4.
Available at: <https://repository.upenn.edu/bellwether/vol1/iss3/4>

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A Diagnostic Tool

"Sleep well and sweet dreams" is the blessing of many parents when children scamper off to bed. Sleeping well, however, is no simple matter for many individuals and the dream phase can be troublesome, even fatal, to some people.

Sleeping and dreaming have been viewed, simply, as a stage differing in behavior and brainwave pattern from wakefulness. In the early fifties, through EEG measurements, researchers discovered that normal sleep is a cycle comprised of several distinct, repeated phases, one of which shows brainwave patterns similar to those during wakefulness. In this phase of the sleep cycle, which lasts about ten minutes and is called rapid eye movement (REM), people and other mammals have rapid eye movements and minor twitching of toes and fingers. The head and the neck, however, remain still and the muscles in that area are in an atonic state. It has now been recognized that abnormalities in the sleep cycle and brainwave patterns may indicate medical and neurological disorders.

It is on this aspect of sleep that researchers at the School of Veterinary Medicine are concentrating their efforts to find clues through the use of animal models to the causes of sleep disorders and the underlying medical and neurological problems. Joan C. Hendricks, V.M.D., Ph.D., resident in medicine, is studying sleep disorders, and Adrian Morrison, D.V.M., Ph.D., professor of anatomy, is studying the physiology of sleep.

Dr. Hendricks, who has pursued this area of study since 1974, treats dogs, cats, and some other animals suffering from sleep disorders at the hospital. She explained that this is the only facility where such treatment for animals is available. Most of her patients are referred by the neurology department at the Veterinary School. In her research she also works closely with the sleep clinic and the cardio-vascular-pulmonary group at the Hospital of the University of Pennsylvania (HUP). Medicine is beginning to recognize the implications of sleep disorders, and Dr. Hendricks views this study as an important diagnostic tool. "We should be paying attention to what is going on during sleep. Abnormalities may manifest themselves first in sleep while they may still be subclinical in waking."

As an example, Dr. Hendricks cited sleep apnea (hypersomnia with periodic apnea, HPA), a disorder found primarily in middle-aged men. These individuals breathe normally during waking, but in slow-wave sleep they begin to have pauses in breathing. In REM sleep they cease to breathe for long periods, sometimes up to eighty-percent of the REM phase. The oxygen level in their blood sinks to very low levels, and the body attempts to compensate by increasing circulation and diaphragmatic efforts. Often these people begin to snort and gasp, some sit up, others get up in an attempt to catch their breath. Snoring and low blood oxygen levels during sleep are symptoms common to all HPA sufferers. They are

not aware of their breathing problems during the night and complain only of daytime sleepiness.

While most people experience brief periods of apnea during sleep, it does not damage their systems as it does in HPA sufferers. Here the pulmonary and circulatory systems are stressed and get progressively weaker. Some of these individuals may eventually die of heart failure. Some HPA sufferers have obstructions in their upper airways which interfere with breathing while lying down. Others may be overweight, although many afflicted individuals are normal in weight or only slightly overweight. In others, the upper airway becomes obstructed during REM sleep, making it impossible to breathe properly and causing apnea and snorting. It is this phenomenon, which has unknown causes, that Dr. Hendricks

infant death syndrome which is fatal to many human babies.

To study animals in their sleep, the veterinary school has a special soundproof cage which is lighted, heated, and ventilated. The animal is observed through a one-way mirror, and the cage is spacious enough to house a large dog. Dr. Hendricks said that dogs and cats adjust quickly to the cage. "We play with them, then we put food and water in the cage, and a litterpan for a cat. The animals eat and then fall asleep in the quiet, warm environment." Then they are observed. Often a video camera is positioned in front of the mirror to record the entire sleep cycle. Brain (EEG) and muscle (EMG) activity may also be recorded at the same time.

One animal studied in this manner was Checkers, a cat that is now Dr. Hendrick's pet.



hopes to study in animals. She suspects that dogs may suffer from sleep apnea and could be used as models to study the disorder, since many owners have reported loud snoring, gasping, and shifting of the head to an elevated position by their dogs. "It is easier to get animals to sleep than humans, and we can easily observe them. Their sleep cycles are shorter and one person can handle the observation. It is also easier to follow an animal from puppyhood to old age as the disorder progresses." She hopes to have available soon the sensitive instruments needed to measure blood gases and breathing rates of animals while they are soundly asleep. Only in this way will she be able to confirm her suspicion that dogs do suffer from apnea. Dr. Hendricks also hopes to find a reason for the unexplained deaths of very young puppies, and explains that apnea has been implicated in sudden

Checkers was brought to the hospital by her owners because, while sleeping, she moved around so violently that she destroyed furniture and often landed on the floor across the room. The cat was tested and checked and no neurological disorders were found. Dr. Hendricks then studied her sleep cycle and the cerebral activity in conjunction with muscular activity in the neck muscles was recorded by EEG and EMG. It was found that the cat went through the normal slow-wave sleep and then entered REM sleep. In this phase normal behavior never occurred. Instead, the cat exhibited violent movements although her neck muscles were in an atonic state. When comparing the cat's movements to sleepwalking in man, Dr. Hendricks explained that sleepwalking occurs during slow-wave sleep and not during the REM phase. The disorder of Checkers is a different one and its causes remain a mystery. A second cat with identical signs has recently been studied.