PSYCHOLOGY

Anatomy of Slumber

Probing beyond the simple tracings of a brain wave chart, sleep scientists are revealing the basic mechanism of dreams and opening the door to voluntary control of sleep

By PATRICIA McBROOM

➤ SINCE college students first began sleeping en masse in the laboratory in the name of science some 10 years ago, sleep research has blossomed.

At first it was a simple charting of electrical activity in the sleeping brain. Then it was a study of sleep deprivation, and scientists found confirmation for an ancient experience: that without the ease of deep slumber and the psychological refreshment of a good dream, the normally healthy person will turn into a bizarre, tormented personality.

Now scientists have located the probable source of dreams and started down the path that may give ordinary men the capacity to sleep at will.

So much research has been expended on sleep that at the moment more is known about the brain waves of sleep than of wakefulness, perhaps because they are more easily identified.

Waves Show Brain Activity

As traced by an electroencephalograph (EEG), brain waves are actually only gross manifestations of brain activity.

The EEG chart is a continuous roll of pen scratchings—the peaks and valleys representing alternating negative and positive charges or "potentials" that shift throughout the brain. Contrary to much belief, an EEG tracing does not represent batches of brain cells discharging inside the skull. More refined techniques are needed to trace the firing neurons. Rather, the brain wave seems to come from an electrical potential that courses throughout nerve endings —the dendrites—which carry information to the cell body.

In the alert mind, the EEG pattern is low, tight and irregular, indicating concentrated energy in a localized area. In the sleeping mind, brain waves assume a high voltage (energy shifts over larger areas) and a regular rhythmic pattern—as though the nerve endings were in a state of oscillation throughout the brain.

In between these two is the classic rhythm of a relaxed but wakeful mind —the "alpha" with its regular 10 cycles per second and medium voltage.

As the individual sinks into sleep, his alpha gives way to "stage one" sleep, the first of five distinct sleep stages which alternate in cycles throughout the night. In stage one the brain wave pattern is something like the alert tracing but much slower. This is the drifting off period and lasts only a few moments.

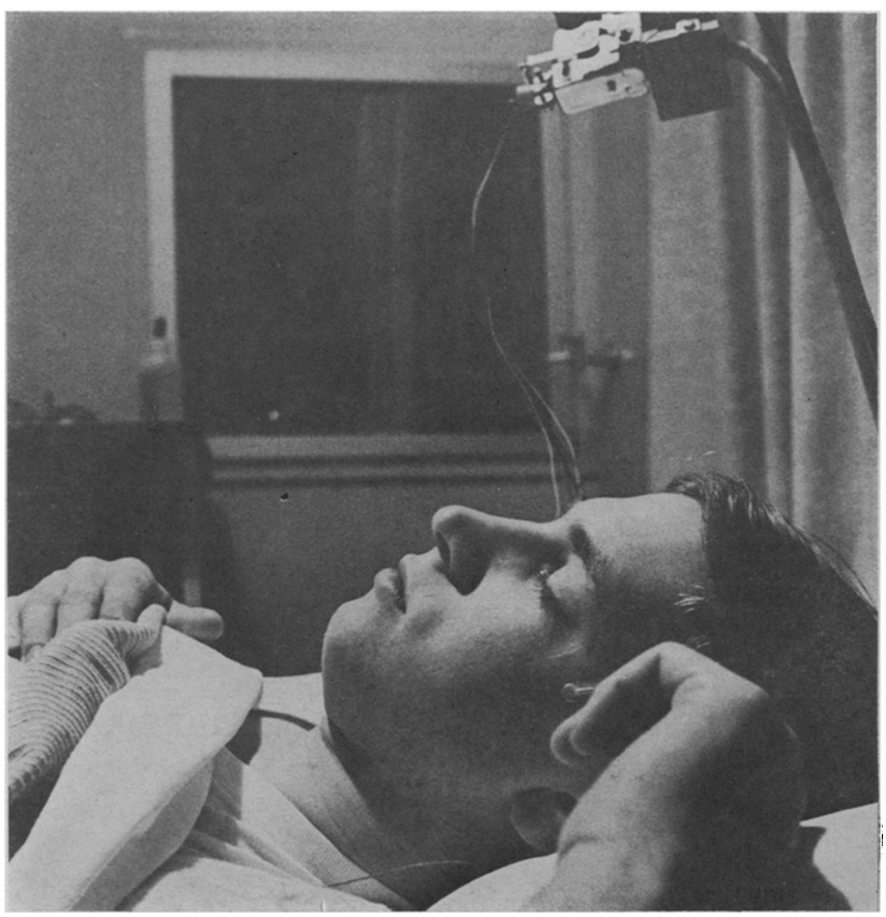
Next comes "stage two" with its bursts of spindle waves. Spindles occur only during sleep and leave high-voltage, steep up-and-down markings on the paper. If awakened from this light sleep, the individual may insist he was not sleeping at all but was engaging in reverie.

Now deep sleep begins with the appearance of delta waves among the spindles—"stage three." Here the brain gives off its highest voltage in mountainous, slow waves. Where the alpha had 10 cycles per second, the delta has one.

All the time, respiration, heart rate and blood pressure are falling. Muscles are becoming more relaxed. Finally a base is reached in "stage four" with its exclusively delta pattern.

Stage four is the sweet oblivion of sound sleep. This seems to be the most important stage physiologically, since the individual, deprived of all but a few hours of sleep will still spend the full amount in stage four, even at the expense of dream time.

Very depressed people, among others



National Institutes of Health

ELECTRICITY OF SLEEP—Identification of brain waves in the sleeping mind prompted an outpouring of scientific effort in this field some 10 years ago. Since then, increasingly sophisticated study of the waves has led investigators to frontiers of the mind unsuspected in the '50s.

with brain disorders, may have trouble reaching this deep sleep. Thus their complaint of "not being able to sleep all night" has some basis in fact. They were probably in light sleep all night.

The last distinctive sleep pattern is REM (Rapid Eye Movement) or dream sleep. After the sleeper has progressed through all four stages, he will start back up again toward stage one. But, instead of coming to wakefulness, he enters a unique state: his brain waves are low, fast and irregular (like those of wakefulness), his breathing is uneven, his heart rate and blood pressure are acting up, and his eyes are darting around in their sockets. He seems as though he could be awake, yet nothing short of a blast on a horn will bring him to consciousness. He is dreaming.

Where do dreams come from? If the question is: why the bizarre images and what do they mean, there are no solid answers. But if the question reads: what provokes dreaming, a good answer is now available.

Dreams Originate in Pons

Dreams appear to originate in a most primitive part of the brain—the pons—located in the brainstem. Unlike other regions, the pons is quite independent of influences outside the nervous system.

From the pons, impulses seem to follow a path through the sensory channels and on up to the cortex—that part of the brain accounting for man's superior mentality.

When this routing of dreams is coupled with the recent discovery that newborn infants spend a good part of the day in REM dream sleep, the implications are enormous.

Three leaders in sleep research, Drs. Howard P. Roffwarg of Columbia University, Joseph N. Muzio of the New York State Psychiatric Institute, and William C. Dement of Stanford University, have found that newborns will spend half their sleeping time in the REM stage. Very premature infants may spend up to 100% in REM sleep.

The scientists suggest that this very active sleep is a central means by which the brain develops and matures.

Clearly, the day-old infant does not yet have a rich base of visual memories from which to draw dreams, but the researchers believe that some kind of rudimentary hallucinations are possible, even in the womb. Thus, "dreams" may prepare the tiny, immature nervous system for the onslaught of experience coming with birth. Soon after birth, the infant rapidly loses much of this REM sleep, presumably turning over the field to his newfound senses.

Extending their theory further, the scientists have risked an answer to the strangeness of dreams. If the primitive brainstem plays such a role in developing the cortex, perhaps the cortex thereafter fits normal visual images into the "unreal" structure of pre-birth imaginings.

During dreaming, when the brain is no longer ruled by day-time reality, the strange patterns re-emerge.

As with most fertile research, the sleep studies have implications for other areas of investigation, principally in mental disorders.

Brain scientists are currently pursuing the notion of "feedback control." For instance, sensory impulses spreading into the cortex leave their mark on cortical cells, which in turn act back upon the sensory centers and influence cellular development there.

If the sensory areas should be somehow abnormal, the entire cycle gets off to a bad start, with each exchange reinforcing the abnormality.

Canada's Dr. Herbert Jasper, a leading brain scientist at the University of Montreal, believes the concept of feedback control will do much to illuminate the mysterious diseases of childhood schizophrenia and autism. The main stumbling block here has been that the pathology shows up so early in life. It seems implausible that the cause could be "poor parents" or a "bad home."

Combining Dr. Jasper's ideas with those of the sleep scientists leads to the thought that perhaps the kinds of hallucinations the fetus has in the womb set the stage for mental health or illness, before the brain's sensory centers ever get a chance.

What about the returns for normal people, so often ignored in the search for an explanation to disease?

Control Over Sleep Possible

At this moment, it seems entirely possible that man will be able to gain a measure of control over sleep. Evidence to support the assertion comes from a provocative piece of work done by Dr. Neal Miller at Yale University. Dr. Miller trained cats to enter a state of mind which would produce spindle patterns in the brain waves. Spindles occur only in the second and third stages of sleep.

Only the cat knows whether he was actually sleeping, but Dr. Miller said that while the EEG was tracing out spindles, the animal stood like a sphinx and stared glassily off into space.

That the control was voluntary is quite certain. Training began with an electric shock to the cat's pleasure center (in the brain) whenever he showed the spindles. Soon the cat was coming up with spindles spontaneously and regularly. It seems he had learned to sleep at will.

Conversely, when Dr. Miller rewarded an arousal pattern, the cat made an equally distinct change in that direction.

Other suggestive work has come from control of the alpha rhythm. The alpha is primarily a rhythm of relaxed visual centers. It disappears when the eyes are open and focused to attention. However, other things also block the alpha—sudden happiness, anger or mental concentration. LSD knocks it out altogether.

To Dr. Joe Kamiya of the Langley Porter Institute in San Francisco, control of the alpha may be a way to train people to greater serenity. There have been reports that Buddhists show the alpha during their periods of meditation.

Alpha Rhythm State Serene

College students whom he educated to voluntarily induce or suppress the rhythm said that the mental state corresponding to alphas was serene, pleasant and devoid of imagery.

Dr. Kamiya thinks it may be possible to train people in controlling other waves and states of mind once they are defined and correlated.

Not everyone would agree with this hope, however. Beyond a general state of anxiety which will show distinctively on the EEG chart, the emotional counterpart of a brain wave cannot be identified, said Dr. Jasper. Further, the value of the alpha is highly questionable. Perhaps it is nothing more exotic than simple relaxation. "It may be like twiddling your fingers," he said. "What good is it?"

But even twiddling the fingers may be of some use to people if it brings momentary surcease from a pressure-cooker world.

SURGERY

England Plans 'Codes of Practice' for Livestock

➤ THE BRITISH Government has announced plans to set up animal care standards for farmers aimed at preventing unnecessary suffering of livestock.

Existing legislation does not sufficiently safeguard the welfare of livestock, according to the Minister of Agriculture, who said new legislation will be introduced giving the Government the power to prescribe "codes of practice" and to inspect animal farms.

No penalties will be included in the legislation, but non-compliance with the codes could be used in evidence against any farmer accused of causing unnecessary suffering.

The codes are directed at halting the practice of debeaking poultry, setting up minimum floor space standards for birds, pigs and calves; controlling the docking of pigs' tails; and reviewing feed-stuffs and husbandry practices in the raising of sheep and rabbits.

More research, however, is needed before regulations governing housing and husbandry can be firmly established, the announcement said.