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Health Bulletin *for* Teachers

Sleep

IN CONFORMING to the 24-hour cycle of day and night into which time on earth is astronomically divided, healthy human adults spend about one third of their lives in sleep and about two thirds in wakefulness. Since they are awake longer than they are asleep and think and act only when they are awake, many people have come to the conclusion that their waking hours are the only hours that count. Those who are impatient of the interruption of sleep can find plenty of philosophers and poets, from Aristotle on, who have backed the conception of sleep and wakefulness as opponents, each with its second or "twin brother"—sleep and death against wakefulness and life.

Actually, sleep is no more the opponent of wakefulness than is the trough of a wave the antagonist of its crest, or a valley the foe of the mountain rising from it. One is the complement of the other, and neither can be conceived of apart. Without the periodic temporary interruption of sleep, wakefulness is impossible, and the ability to wake up is a vital part of the definition of sleep.

Sleep may be defined as a state of relative unconsciousness in which the complex sensory-motor activities that bring the individual into relation with his environment are temporarily suspended. It is distinguished from pathological sleeplike states, such as coma and trance, by its recuperative character, its reversibility, and its natural alternation with periods of wakefulness.

The Concomitants of Sleep. Observations show that all portions of the central nervous system are affected by sleep, but to relatively different degrees. The ability to react to sensory stimuli such as those of sound and touch is reduced, but the stimuli required to wake up a sleeper vary in strength and type according to the individual and according to the depth of sleep. It may take a loud thunderclap to waken one sleeper, and only the rustle of a mouse in the wastebasket to waken another. On the other hand, a mother may sleep through a thunderstorm but waken at the least stir of her child. A person who is fast asleep may fail to react to a noise which serves to waken him when he is sleeping lightly.

There is a great difference of opinion as to the effect of sleep on reflex excitability. In general it may be said that reflexes are retained, diminished, or abolished according to the type of reflex, the depth of sleep, and the species studied. On the whole, conditioned or learned

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reflexes disappear. Equilibrium reflexes ordinarily are abolished, and that is why we lie down ~~normally~~ while asleep ~~instinctively~~ as a preparation for sleep.

The skeletal muscles are almost completely relaxed, and this relaxation is an important accompaniment of sleep, since it lessens metabolic activity and permits recovery from muscular fatigue. However, *complete* relaxation of all skeletal muscles does not occur except perhaps in very deep sleep. No one "sleeps like a log" the whole night through. Studies show that normal sleepers change position many times without waking, or at least without suspecting that they are doing so. ~~Each individual has his own range of motility, and usually his "own repertoire of favorite positions."~~

From the first, sleep has been one of the favorite conditions to be studied by electro-encephalography—that is, the graphic recording of the electrical currents developed in the cerebral cortex by brain action. The records show that the brain-wave pattern passes from the typical rhythm of wakefulness through various changes in rhythm according to gradations in the depth of sleep. Thus electro-encephalography offers concrete proof that the rhythmic activity of the brain is altered by the change from wakefulness to sleep, and by the stages of sleep from initial drowsiness to final awakening.

It is scarcely necessary to mention that the purely vegetative functions of the organism—the functions that are manifestations of life, such as the circulation of the blood, respiration, and metabolism—continue during sleep. Recent findings indicate that the changes they undergo are in general due not to sleep itself, but rather to the change in posture or the quiet physical state accompanying it.

Going to Sleep. Going to sleep is characterized by several gradations of consciousness. At the approach of sleep, a person feels tired; he has no wish to move; he desires sleep. Observers may notice that he is less alert than usual, that he yawns, and that his eyelids droop. But at this stage a brisk walk, an interesting topic of conversation—in fact, anything stimulating—will banish drowsiness. The accessory factors ordinarily required before the state of sleepiness passes into sleep include the damming off or slackening of the steady stream of incoming impulses moving toward the cerebral cortex. This is the part of the brain that is in constant operation during wakefulness, and is responsible for the critical analysis of impulses coming in from the outer world and for the elaboration of adequate responses in the light of the individual's previous training and experience.

The cells of the cortex take what comes and handle what they can up to the point of complete exhaustion. Thus, as we might encourage someone to rest by reducing his work load, it is usually necessary to encourage the onset of brain sleep after the inital stage of drowsiness by diminishing the external stimuli which reach the cortex, more especially via the eyes, ears, and skin, and by reducing the impulses coming from the body itself. Choosing a dark, quiet room as a place to sleep and closing the eyelids minimizes auditory and visual stimuli. Changing to night apparel and

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the use of comfortable beds helps to reduce tactile stimuli. The assumption of a flexed horizontal position is relaxing and thus reduces the number of impulses coming into the cortex from ~~nerve endings in~~ the muscles.

The Sleep-Center Question. Even if the functional cutting off of the cerebral cor..x from incoming impulses should prove to be the immediate cause of sleep, as several investigators have proposed, there still remains the question: What finally closes the lid on consciousness? Attempts to evolve a theory of sleep which satisfies all requirements have not yet succeeded. The search still goes on for the definite localization of a sleep center in the nervous system, the functions of which would depend on the theory of sleep finally accepted. Perhaps, as some investigators suggest, the center is really a center of wakefulness, and its function that of bombarding a naturally sleeping cerebral cortex with impulses to keep it in a state of wakefulness.

Aside from the question of its proper name and function, the existence of a center affecting sleep is with few exceptions admitted by most investigators. The choice of the general site lies between the thalamus and the hypothalamus, both of which are located at the base of the brain. An exact site may not exist in the sense of being a very limited area. For critical analyses of the various theories of sleep the reader is referred to the books listed at the end of this article.

The Effect of Sleep Loss. In an attempt to explain the "why" of sleep, many investigators have studied the effects of sleep loss on volunteer subjects who have been kept awake for continuous periods of varying lengths, during which they were given a variety of physiological and psychological tests. In his book *Sleep and Wakefulness*, Nathaniel Kleitman, of the Department of Physiology, University of Chicago, describes the effects of experimental deprivation of sleep on human beings and animal subjects as observed by numerous investigators, including himself and his collaborators.

In general, subjects deprived of sleep for varying lengths of time exhibit no important deviations from the normal range in the body functions presided over by the autonomic nervous system. Heart rate, blood pressure, body temperature, basal metabolism, appetite, and the composition of the blood and urine, all more or less conform to what may be expected of them under normal conditions.

With one exception, tests to determine the effect of loss of sleep on the nervous system showed no consistent variation for the group as a whole when the test involved no effort on the part of the subject. The exception was sensitivity to pain which showed a progressive increase during the period of enforced wakefulness. Tests requiring mental and muscular effort on the part of the subject showed, in general, a decrease in performance ability. Although it was possible to maintain normal performance if the tests were short, sustained effort was impossible.

The outstanding result of lack of sleep indicated in the evidence presented by Kleitman is fatigue of the cerebral cortex. After going without sleep for relatively long periods of time, animals and human beings can keep awake only by engaging in practically uninterrupted muscular activity. There must be "forcible feeding" of sensory stimuli to keep the jaded cortical centers in a state of excitation. The subject yearns to relax, but this he cannot do without instantly falling asleep. Even if he is ordinarily good-natured he becomes very irascible, resembling in his behavior "well-trained children who often become quite unmanageable if they stay up past their usual bedtime."

The observations summarized here were made on adults during a single long period of wakefulness. They indicate that the body has a large factor of safety as regards sleep requirements. The consequences

of the occasional nights during which one "wasn't able to sleep a wink" are probably not of great importance in the long run. However, the irritability and emotional instability, the lowered threshold of pain, and the failure to perform work with normal accuracy and speed for any length of time conjure up a vivid picture of the individual who has been constantly denied adequate hours of sleep. Especially is this true of children and young people, who require more sleep than adults do and who have not yet been faced with the necessity for acquiring the technique of hiding the effects of sleep loss.

The Sleep-Wakefulness Rhythm. Human beings are not born with a sleep-wakefulness rhythm adapted to a 24-hour cycle of day and night. The consolidation of the relatively short periods of sleep and the still shorter periods of wakefulness, characteristic of babyhood, into one long period of nighttime sleep and one still longer period of daytime wakefulness, is the result of a learning process and depends for its establishment and maintenance upon the cooperation of the cerebral cortex. Thus one's sleep-wakefulness rhythm is more or less an individual affair. In general, however, adaptation to the day-night cycle is about as follows. Beginning with the time of getting up, when according to the results of performance tests one is not at one's best, a gradual ascent is made to a plateau of highest efficiency usually in the afternoon. Thence a gradual descent begins into a valley of lowest activity, the bottom of which is reached in the early hours of sleep. To complete the cycle, the depth of sleep gradually decreases until the point of awakening is reached, when one may be fully as drowsy as when one went to bed the night before.

In many interesting experiments conducted by Kleitman and his collaborators it is shown that speed and efficiency of performance increase with the rise and decrease with the fall of body temperature within its normal limits. Possibly individual variations in body temperature curves have some bearing on individual variations in the sleep-wakefulness pattern. From observation it is known that there are two types of sleepers, designated as the "morning type" and the "evening type." "Evening" people feel at their best in the evening and like to stay up late and sleep late in the morning. "Morning" people feel tired in the evening and like to go to bed early and get up early in the morning.

Improving the Quality of Sleep. Each individual seems to be a law unto himself so far as his sleep requirements in each 24-hour cycle are concerned. ~~Studies show that, in evaluating a good night's sleep, different individuals attach different degrees of importance to various characteristics such as duration, ease of getting to sleep, incidence and vividness of dreaming, and motility during sleep.~~ If a tendency to be irritable or markedly drowsy during the day leads a normal person to feel that the quality of his sleep should be improved, he may need to work first on duration. This in turn may mean concentrating on ease of going to sleep. On the average, it takes about 20 minutes for healthy persons to fall asleep. Aside from providing good conditions for sleep ~~by eliminating so far as possible known sleep disturbers, such as nervous tension and physical discomfort~~, the establishment of regular habits of existence is probably the best method of promoting the quality of one's sleep as well as one's efficiency during waking hours. Since the sleep-wakefulness rhythm is a learned process, it is conditioned by repeated performance and thus can be fortified by regularity in one's activities—work, play, meals, and hours of going to bed and getting up.

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