

## METHOD AND APPARATUS TO MONITOR SLEEP BEHAVIOUR

### FIELD OF INVENTION

This invention relates to a method and apparatus to monitor sleep and wakefulness in a human subject. More particularly this invention relates to a vibratory stimulus-response device to monitor sleep behaviour.

### BACKGROUND OF INVENTION

Sleep can be assessed subjectively, behaviourally or physiologically. Of these three approaches, electrophysiological recordings have over the last thirty-five years become the standard approach. This approach—polysomnography—requires that electrodes be attached to the subject, using standard positions, for the continuous monitoring of electroencephalographic (EEG), electroculographic (EOG) and electromyographic (EMG) activity. The resulting record is scored into various sleep stages according to internationally accepted criteria (Rechtschaffen & Kales, 1968. "A manual of standardized terminology, techniques and scoring system for sleep stages of human subjects." Brain Information Service/Brain Research Institute, Los Angeles, Calif.)

While electrophysiological techniques have the advantage of being non-invasive, relatively unobtrusive, and being well tolerated, they have a number of practical disadvantages. Their application usually requires the subject or patient to come to a sleep clinic or laboratory for an overnight stay under the constant supervision of a trained technician, who will spend up to an hour and a half connecting and disconnecting the patient to the polygraph, and several hours monitoring the sleeping patient. Such a study will generate an enormous paper record—of the order of one third of a mile long, which must be scored and evaluated by trained personnel. The mathematical reduction of the data is not trivial. Thus the electrophysiological testing methods are cumbersome, expensive and not readily adaptable to ambulatory or home based monitoring.

In addition, there are a number of substantive issues which bear on the efficacy of the physiological assessment of sleep. While electrophysiological techniques assess certain important aspects of sleep, they ignore others. Specifically, they do not assess behaviour directly. The presence of a particular type of brain activity is not an infallible guarantee that an individual will be able to make a specific response such as identifying a warning signal on a nuclear reactor or navigating a vehicle on a motorway. This issue is also pertinent to the assessment of individuals complaining of sleep disorder. At any given time about one third of the general population over the age of eighteen is likely to complain of having insomnia while a small proportion complain of being excessively sleepy. The number of individuals being referred for sleep-related complaints has increased markedly over the last two decades and continues to increase as do the number of specialist centres devoted to their assessment and treatment. While polysomnography has an important role in this, its application is limited by its availability and by its appropriateness. Even a large sleep disorders centre can only see about twelve patients nightly or about 4000 patients a year while most facilities can only handle 300-1000 patients per year. Also, polysomnography does not address all relevant aspects of a disorder. Many insom-

nia patients complain of excessive sensitivity to environmental stimulation while many excessively sleepy patients complain of failing to respond adequately to environmental stimulation.

There is, therefore, a considerable need for a simple method and apparatus for sleep monitoring which would measure relevant aspects of behaviour, would be suitable for home use, could be used to provide a preliminary screen to quickly and efficiently identify patients in need of a more intensive evaluation. A wider spectrum of relevant behaviour could be assessed, the costs of the polysomnographic examination may be avoided and the frustration of long patient waiting lists may be reduced.

### OBJECT OF INVENTION

Thus, it is one object of the present invention to provide a simple vibratory stimulus response device to monitor sleep and wakefulness in a human subject.

Another object is to provide a method for assessing sleep behaviour in a human subject.

### BRIEF STATEMENT OF INVENTION

Thus by one aspect of this invention there is provided an apparatus for monitoring sleep behaviour in a human subject comprising:

a housing; vibratory means and subject response means contained within said housing; timing means to activate said vibratory means at selected time intervals; means to record and store each activation event of said vibratory means, and subject positive and negative response thereto; and means to retrieve and analyze said records.

By another aspect of this invention there is provided a method for assessing sleep behaviour in a human subject, comprising:

(a) subjecting the subject to a vibratory stimulus at selected spaced intervals of time;  
 (b) recording the time of each said stimulus and the subject's response or lack thereof to each said stimulus;  
 (c) recovering stored information; and  
 (d) assessing the subject by comparison of said recovered stored information with known standards of sleep behaviour.

### BRIEF DESCRIPTION OF DRAWINGS

FIG. 1 is a sketch of a hand-held unit incorporating the invention;

FIG. 2 is a schematic block diagram of one embodiment of the invention;

FIG. 3 is a graph illustrating mean sleep onset latencies corresponding to five physiological and two behavioural definitions; and

FIG. 4 is a diagram illustrating behavioural response in each stage of sleep.

### DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

As shown in FIG. 1, a preferred embodiment of the invention comprises a self-contained vibrator and data storage unit 1 which is about 4 inches long, 3.5 inches wide, and 0.5 inches thick, which may be hand-held. For convenience, and to prevent loss during sleep, the unit 1 is provided with a strap loop 2 through which the hand 3 is slipped so as to hold the unit firmly in the palm of the hand. A response button 4, such as a spring loaded micro switch, is conveniently located at one end