

jects factor. A significant effect of definition was found ($F(6,66)=8.62$; $p<0.0013$). As can be seen in FIG. 3, this was due mainly to differences between the mean latency defined by the physiological criterion of the first appearance of Stage 1 and the two consolidated sleep onset latency definitions and both of the behavioural definitions of sleep onset latency.

Statistical analysis indicates that the estimates of sleep onset latency provided by the vibratory stimulus device do not differ significantly from those provided by the consolidated physiological definitions of sleep onset.

This suggests that the behavioural criteria define consolidated sleep and can serve as accurate indicators of the onset of polygraphically defined consolidated sleep.

Relationship of Behavioural Response to Polysomnographically Defined Sleep Stages

The mean percent of stimuli responded to in each sleep stage is illustrated in FIG. 4. As anticipated, the highest level of responding was seen in wakefulness (AW). During sleep a higher level of responding occurred in the 'lighter' stages of sleep (Stage 1 and Stage 2), while little or no responding was seen in the 'deeper' stages (Stages 3 and 4). An intermediate level of responding was found during REM sleep.

Effects of Stimulation on Sleep Architecture

The relationship between the behavioural measure and polysomnographic recording was also examined by correlating the total percent responding of the subjects with various polygraphic measures of sleep. These correlations are presented in Table 3.

Over the whole night, a significant correlation was found between behavioural responding and both total sleep time ($r(10)=-0.777$; $p<0.003$) and sleep efficiency ($r(10)=-0.819$; $p<0.001$). Thus, those subjects who responded more frequently during the night slept significantly less than subjects who responded less frequently, and their sleep efficiency (calculated by dividing the total sleep time by the total recording time and multiplying by 100) was also significantly reduced.

TABLE 3

Table of Pearson Product Moment Correlation between Mean Percent Responding and Sleep Variables		
Sleep Variable	r	P
Total Time Recorded (TTR)	0.298	n.s.
Total Sleep Time (TST)	-0.777	<0.003
Sleep Efficiency (SE)	-0.819	<0.002
Sleep Onset Latency (SOL)	0.568	n.s.
% Awake (PERAW)	0.838	<0.001
% Stage 1 (PER1)	0.727	<0.01
% Stage 2 (PER2)	-0.747	<0.006
% Stage 3 (PER3)	-0.371	n.s.
% Stage 4 (PER4)	-0.250	n.s.
% REM (PERREM)	-0.682	<0.05
% MT (PERMT)	0.117	n.s.
REM Latency (REML)	0.614	<0.05
No of REM Periods (NREMP)	-0.463	n.s.
Shifts to Awake (SHAW)	-0.672	<0.02
Shifts to Stage 1 (SH1)	0.501	n.s.
Shifts to MT (SHMT)	0.146	n.s.
% SWS (PERSWS)	-0.593	<0.05
Shifts to Aw + 1 + MT (SHAW1MT)	0.664	<0.02

Mean percent responding over the night was also correlated with the different stages of sleep. It was found that, in general, wakefulness ($r(10)=0.838$; $p<0.0007$) and Stage I ($r(10)=0.727$; $p<0.008$) correlated positively with behavioural responding, while 'deeper' stages of sleep (Stages 3 and 4) correlated nega-

tively. This suggests that the more frequently subjects responded, the more time they spent awake and in Stage 1, and the less time they tended to spend in SWS ($r(10)=0.592$; $p<0.05$). The amount of time spent in Stage 2 sleep was also found to be significantly correlated with percent responding ($r(10)=-0.746$; $p<0.005$). Subjects who responded with greater frequency to the stimulus spent significantly less time in Stage 2 sleep. A significant correlation was also found between mean percent responding and shifts to awake ($r(10)=0.672$; $p<0.02$), indicating that more frequent responding was associated with more shifts to awake.

A significant negative correlation was also found between mean percent responding and percentage of REM sleep ($r(10)=-0.682$; $p<0.01$). Subjects who responded more often to the vibratory stimulus had significantly less REM sleep than those subjects who responded less frequently. Finally, percent responding was found to be significantly correlated with REM latency ($r(10)=0.614$; $p<0.03$), which is defined as the interval of time between sleep onset and the beginning of the first REM period. Thus, REM latency was significantly longer for those subjects who responded more frequently to the vibratory stimulus.

It is evident that a substantial relationship exists between sleep assessed behaviourally and polygraphically.

Sleep Disturbance Produced by the Vibratory Stimulus

Although the parameters of the stimulus presentation were chosen so as to minimize the possibility of disturbing the subjects' sleep, the extent to which sleep might differ from that usually experienced was assessed in two ways: by examining the subjects' subjective appraisal of their experience and their polysomnographically defined sleep. It is generally known that sleeping in a new environment produces a 'first night effect', that is sleep may be more disturbed than that which occurs in an environment which is familiar.

In the morning subjects were asked a number of questions to obtain information on their own experience during the study. On average subjects estimated that they experienced 8 vibrations a night while, in fact, they received an average of about 50 per night. Half the subjects indicated that their sleep was the same as a 'normal' night's sleep at home and half indicated that it was worse, a finding that it is typically obtained after the first night in a sleep laboratory.

A number of polygraphic parameters were compared with a sample of approximately the same age who were also spending their first night in the laboratory but who were allowed to sleep undisturbed. The results indicated differences in Stage 1, Stage 2, Slow Wave Sleep (Stages 3 and 4) and Movement Time. Overall the degree of disturbance averaged slightly over 4 percent of the total night's sleep.

Overall, by both subjective and polygraphic criteria, the sleep of the subjects was disturbed to some degree by the vibratory units. However, the amount of disturbance appears to be quite small and insufficient to invalidate the general conclusions regarding the efficacy of this device.

We claim:

1. An apparatus for monitoring sleep behaviour in a human subject, comprising:
 - a housing;